


51st Annual Meeting

San Diego, California

January 24-28, 2015

Abstract Book

The Society of Thoracic Surgeons

The Society of Thoracic Surgeons gratefully acknowledges the following companies for providing educational grants for the STS 51st Annual Meeting.

This list is accurate as of December 11, 2014.

STS Platinum Benefactor

Provided $50,000 or above

Abbott Vascular

STS Gold Benefactor

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Provided $10,000–$24,999

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MISSION STATEMENT

The mission of The Society of Thoracic Surgeons is to enhance the ability of cardiothoracic surgeons to provide the highest quality patient care through education, research, and advocacy.

OVERALL MEETING OBJECTIVE

The overall objective of this meeting is to provide a forum for all cardiothoracic surgeons and their teams to learn the most up-to-date information on research, surgical techniques, patient management, and social, ethical, and political issues in order to maintain the highest level of care for the cardiothoracic patient.

STS CONTINUING MEDICAL EDUCATION (CME) MISSION STATEMENT

The continuing medical education mission of The Society of Thoracic Surgeons is to provide a forum for reporting results of scientific research and for updating information in the disciplines of cardiovascular, general thoracic and congenital heart surgery. The principal continuing education programs conducted by the Society include an annual scientific meeting, self-study programs, and other stand-alone meetings. The Annual Meeting is composed of peer-reviewed scientific abstracts, invited overview presentations, small group presentations, presentations on new technologies and video programs. The broad scope of topics related to cardiothoracic surgery is covered during each Annual Meeting. In addition to and separate from the national meeting, topical meetings are held that focus on relevant information needs of cardiothoracic surgeons. These educational sessions frequently highlight a multidisciplinary approach and include content relevant to cardiothoracic surgeons as well as other physicians and health care providers in related disciplines. STS programs are developed and provided with the intent of confirming existing knowledge base, imparting new knowledge, and promoting competence in the content areas covered for cardiothoracic surgeons, residents, and their allied health care providers.

Amended by the STS Board of Directors: January 25, 2009

FUTURE MEETINGS OF THE SOCIETY OF THORACIC SURGEONS

STS 52nd Annual Meeting
January 23–27, 2016
Phoenix, Arizona

The information in this Abstract Book is accurate as of December 11, 2014.

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Friday, January 23, 2015

3:00 PM – 6:00 PM	Registration: STS/AATS Tech-Con 2015 and STS 51st Annual Meeting

Saturday, January 24, 2015

7:00 AM – 6:00 PM	Registration: STS/AATS Tech-Con 2015 and STS 51st Annual Meeting
8:00 AM – 12:30 PM	STS/SCA: The Utility of Perioperative Echocardiography for Surgical Decision Making
8:00 AM – 3:00 PM	STS/CHEST: Primer on Advanced and Therapeutic Bronchoscopy—Theory and Hands-on Session
12:00 PM – 6:30 PM	STS/AATS Tech-Con 2015 Exhibits Open
1:00 PM – 2:30 PM	Cardiopulmonary Bypass Simulation Course
1:00 PM – 5:00 PM	STS/AATS Tech-Con 2015
5:00 PM – 6:30 PM	STS/AATS Tech-Con 2015 Reception

Sunday, January 25, 2015

7:00 AM – 6:30 PM	Registration: STS/AATS Tech-Con 2015 and STS 51st Annual Meeting
7:00 AM – 3:00 PM	STS/AATS Tech-Con 2015 Exhibits Open
7:50 AM – 12:00 PM	Acquired and Congenital Heart Surgery Symposium: Challenges and Management of the Aorta in Adults With Congenital Heart Disease
	Practice Management Summit
	STS/AATS Critical Care Symposium: Essential Cardiac Critical Care Topics
8:00 AM – 11:45 AM	STS/AATS Tech-Con 2015
1:00 PM – 4:00 PM	Residents Symposium: Transitioning From Residency to a Successful Practice
1:15 PM – 4:30 PM	Parallel Surgical Symposium: Congenital
	Parallel Surgical Symposium: General Thoracic
	STS/AATS Tech-Con 2015
2:00 PM – 6:30 PM	Scientific Posters Open
2:30 PM – 4:30 PM	CT Surgery Interprofessional Education Symposium: Multidisciplinary Team Approach to ECMO
4:30 PM – 6:30 PM	Opening Reception in STS Exhibit Hall

Monday, January 26, 2015

6:30 AM – 5:00 PM	Registration: STS 51st Annual Meeting
7:00 AM – 7:15 AM	Opening Remarks
7:15 AM – 8:15 AM	J. Maxwell Chamberlain Memorial Papers
8:15 AM – 9:00 AM	Richard E. Clark Papers
9:00 AM – 4:30 PM	Exhibits Open
	Scientific Posters Open
9:00 AM – 9:30 AM	BREAK—Visit Exhibits and Scientific Posters
9:30 AM – 9:40 AM	*The Annals of Thoracic Surgery* 50th Anniversary Presentation
9:40 AM – 9:50 AM	Introduction of the President: Mark S. Allen
9:50 AM – 10:50 AM	Presidential Address: David A. Fullerton
10:50 AM – 11:30 AM	BREAK—Visit Exhibits and Scientific Posters
11:30 AM – 12:30 PM	Adult Cardiac Session: Arrhythmia
(8 parallel sessions)	Adult Cardiac Session: Heart Failure
	Basic Science Research: Adult Cardiac
	Basic Science Research: General Thoracic
	Congenital Session: Adult Congenital
	Critical Care
	General Thoracic Session: New Techniques
	STS/CATS/CSCS: Current and Future Workforce Issues in Cardiothoracic Surgery—Staff and Resident Perspectives From Canada and the US
12:30 PM – 1:15 PM	BREAK—Visit Exhibits and Scientific Posters
1:15 PM – 5:15 PM	ACC @ STS
	Evidence and Quality Reshaping Practice
1:30 PM – 3:30 PM	Adult Cardiac Session: Aortic
(7 parallel sessions)	Adult Cardiac Session: Ischemic

New Non-CME Session

		Congenital Session: Pediatric Congenital I
		General Thoracic Session: Lung Cancer I
		General Thoracic Session: Lung Transplantation
		Managing Cardiogenic Shock or Pulmonary Failure: Short-Term Mechanical Circulatory Support
		STS/SCA: Considerations in Perioperative Resuscitation of Cardiothoracic Patients
3:30 PM – 4:15 PM		BREAK—Visit Exhibits and Scientific Posters
4:15 PM – 5:15 PM		Surgical Motion Picture Matinees: Adult Cardiac, Congenital, and General Thoracic
		Late-Breaking Abstract Sessions
5:00 PM – 6:30 PM		Scientific Posters and Wine
5:30 PM – 6:30 PM		Business Meeting (STS Members Only)
6:45 PM – 7:45 PM		STS-PAC Reception
7:00 PM – 10:00 PM		STS Social Event: USS Midway Aircraft Carrier Museum

Tuesday, January 27, 2015

6:30 AM – 4:30 PM		Registration: STS 51st Annual Meeting
7:30 AM – 8:30 AM		Early Riser Sessions
7:30 AM – 8:30 AM		Early Riser Health Policy Forum: The End of Global Surgical Payments Under Medicare?
9:00 AM – 10:00 AM		Thomas B. Ferguson Lecture: Pedro J. del Nido
9:00 AM – 3:00 PM		Exhibits Open
9:00 AM – 5:00 PM		Scientific Posters Open
10:00 AM – 10:45 AM		BREAK—Visit Exhibits and Scientific Posters
10:45 AM – 11:00 AM		Award Presentations
11:00 AM – 12:00 PM		C. Walton Lillehei Lecture: Patrick T. O'Gara
12:00 PM – 1:00 PM		BREAK—Visit Exhibits and Scientific Posters
		Ethics Debate: Must Surgeons in Training Programs Allow Residents to Operate on Their Patients to Satisfy Board Requirements?
	CME	Residents Luncheon
1:00 PM – 3:00 PM		Adult Cardiac Session: General I
(8 parallel sessions)		Adult Cardiac Session: Mitral Valve
		Congenital Session: Pediatric Congenital II
		General Thoracic Session: Esophageal
		General Thoracic Session: Lung Cancer II
		Patient Safety Symposium: Building a High-Performance Team for Patient Safety
		STS/EACTS: Management of the Aortic Arch in Aortic Dissection
		Strategies to Improve Outcomes With Long-Term Mechanical Circulatory Support Devices
1:00 PM – 5:00 PM		JCTSE/STS Workforce on International Relationships: Globalization of Graduate Surgical Education in Cardiothoracic Surgery
3:00 PM – 3:30 PM		BREAK—Visit Scientific Posters
3:30 PM – 5:30 PM		Adult Cardiac Session: Aortic Valve
(8 parallel sessions)		Adult Cardiac Session: General II
		Cardiothoracic Surgical Education
		Congenital Session: Pediatric Congenital III
		ESTS @ STS: Controversial Issues in General Thoracic Surgery—Perspectives From Europe and North America
		General Thoracic Session: Mediastinal/Pulmonary
		Role of SBRT in Lung Cancer Treatment
		SVS @ STS

Wednesday, January 28, 2015

6:30 AM – 9:30 AM		Registration: STS University
7:00 AM – 9:00 AM		STS University
9:30 AM – 11:30 AM		STS University (courses repeated)

CONTINUING MEDICAL EDUCATION CREDIT

STS 51st Annual Meeting

The Society of Thoracic Surgeons is accredited by the Accreditation Council for Continuing Medical Education to provide continuing medical education for physicians.

The Society of Thoracic Surgeons designates this live activity for a maximum of 34.25 *AMA PRA Category 1 Credits*™. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

The American Board of Cardiovascular Perfusion designates this activity for 39.8 Category I CEUs.

Learning Objectives for the STS 51st Annual Meeting

Upon completion of this activity, participants should be able to:

- Review the results of clinical and laboratory investigations designed to reveal new knowledge of cardiothoracic disease or to develop new technology applicable to the management of cardiothoracic disease
- Evaluate the impact of new knowledge and the application of new technology on the treatment of cardiothoracic disease
- Discuss the importance of patient safety issues and how current strategies can be introduced into one's practice or institution
- Discuss surgical techniques in order to improve the standard of care within the specialty
- Examine how public policy can impact the treatment of one's patients
- Share and summarize information provided through small group discussions facilitated by leaders in cardiothoracic surgery

STS/AATS Tech-Con 2015

The Society of Thoracic Surgeons is accredited by the Accreditation Council for Continuing Medical Education to provide continuing medical education for physicians.

The Society of Thoracic Surgeons designates this live activity for a maximum of 9.25 *AMA PRA Category 1 Credits*™. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

The American Board of Cardiovascular Perfusion designates this activity for 11.2 Category I CEUs.

Learning Objectives for STS/AATS Tech-Con 2015

Upon completion of this activity, participants should be able to:

- Introduce the newest therapies in both adult cardiac and general thoracic surgery and evaluate how these therapies will impact current and future practice
- Evaluate the barriers and/or pathways for adoption of new technology
- Discuss the latest innovations, outcomes data, and controversies in coronary artery disease
- Critically assess the latest esophageal technologies and their impact on cardiothoracic surgery
- Present new developments in the management of lung tumors
- Discuss new strategies and technologies for atrial fibrillation, mitral valve, and left atrial appendage

STS EDUCATION DISCLOSURE POLICY

As a sponsor of continuing medical education accredited by the Accreditation Council for Continuing Medical Education (ACCME), The Society of Thoracic Surgeons requires that any individual who is in a position to control the content of an educational activity must disclose all relationships with commercial interests (including known relationships of his or her immediate family, department, and partners). The ACCME defines a commercial interest as "any entity producing, marketing, reselling, or distributing health care goods or services consumed by, or used on, patients. The ACCME does not consider providers of clinical service directly to patients to be commercial interests." The question of whether a disclosed conflict situation could represent undue influence on the educational activity by a commercial interest or whether the disclosed information is sufficient to consider an abstract, presentation, or other educational enduring material to represent potentially biased information must be resolved prior to an individual's involvement in STS educational programming.

Required disclosures include (1) a financial interest of any amount (e.g., through ownership of stock, stock options, or bonds) (2) the receipt of any amount of cash, goods or services within the current 12-month period (e.g., through research grants, employment, consulting fees, royalties, travel, or gifts) or (3) a nonremunerative position of influence (e.g., as officer, director, trustee or public spokesperson). EXCLUDED from this disclosure requirement are blind trusts or other passive investments such as mutual funds. In the case of a financial or other relationship disclosure, the company, product/service, and specific nature of the relationship must be noted. Disclosure is mandatory for any person involved in the planning, management, presentation, and/or evaluation of STS educational activities.

Failure to disclose all relationships with commercial interests disqualifies the individual from being a planning committee member, a teacher, or an author of educational materials, and this individual cannot have any responsibility for the development, management, presentation, or evaluation of STS educational activities. This requirement is intended neither to imply any impropriety of such relationships nor to prejudice any individual planner, presenter or author. It is merely to identify such relationships through full disclosure, and to allow STS to assess and resolve potential influences on the educational activity prior to the planning and implementation of an educational activity. If no relationships with commercial interests exist, the individual must indicate this on the disclosure form.

Additionally, the fact that the presentation, paper, or other educational product describes (a) the use of a device, product, or drug that is not FDA approved or (b) an off-label use of an approved device, product, or drug must also be disclosed. This requirement has been adopted in response to FDA policy and case law involving medical societies, and is not intended to prohibit or inhibit independent presentation or discussion regarding the uses of devices, products, and drugs as described in (a) or (b) above.

For live presentations, all disclosures must be stated orally and on a slide at the beginning of the presentation and will be noted in published material related to the activity. Slides, handouts, and other materials utilized as part of an educational activity cannot contain any advertising, trade names or a product group message. Speakers are required to disclose that they have nothing to disclose if this is the case.

Amended by the STS Executive Committee: April 11, 2012

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

ELECTRONIC CME/CEU EVALUATION

The STS 51st Annual Meeting utilizes an entirely electronic evaluation and CME/Perfusion CEU credit claim process. Both physicians and perfusionists can use this system to claim credit, complete evaluations, and print CME/Perfusion CEU certificates. Certificates of Attendance are also available for other attendees and international physicians not wishing to claim CME credit. Attendees will not be able to evaluate and claim CME/Perfusion CEU credit for ticketed sessions unless they have registered for those sessions. Please note that CME credit is not available for the Cardiopulmonary Bypass Simulation Course, Residents Symposium, or Residents Luncheon.

Attendees can complete the overall meeting evaluations and all individual session evaluations onsite at CME Stations located in Lobby E and the Ballroom 20D Foyer. Certificate printing is available.

Attendees can also access evaluations and CME/Perfusion CEU credit by visiting the online evaluation site through personal computers or handheld devices at www.sts.org/2015evaluation. You can also access the site through the STS Mobile App. In order to make this process more convenient for attendees, the meeting evaluations will be available online through Wednesday, February 11, 2015.

Attendees can log in to the website with the following information:

- **Username:** 6-digit member ID number located at the lower left-hand side of the meeting badge
- **Password:** First initial and last name

PHYSICIAN COMPETENCIES

As an accredited provider of continuing medical education, STS strives to provide the best, most relevant educational experience for those who take part in the Society's educational activities. The Accreditation Council for Continuing Medical Education (ACCME) has stressed the importance of CME program planning and implementation that is focused on quality with the aim of improving health care. In an effort to help clarify how STS programming focuses on the Accreditation Council for Graduate Medical Education (ACGME) / American Board of Medical Specialties (ABMS) competencies, physician competencies are listed prior to STS/AATS Tech-Con 2015 and STS 51st Annual Meeting information. Sessions may touch upon other competencies in addition to those identified below.

Practice-based Learning and Improvement: Show an ability to investigate and evaluate patient care practices, appraise and assimilate scientific evidence, and improve the practice of medicine.

Patient Care and Procedural Skills: Provide care that is compassionate, appropriate, and effective treatment for health problems and to promote health.

Systems-based Practice: Demonstrate awareness of and responsibility to the larger context and systems of health care. Be able to call on system resources to provide optimal care (eg, coordinating care across sites or serving as the primary case manager when care involves multiple specialties, professions, or sites).

Medical Knowledge: Demonstrate knowledge about established and evolving biomedical, clinical, and cognate sciences and their application in patient care.

Interpersonal and Communication Skills: Demonstrate skills that result in effective information exchange and teaming with patients, their families, and professional associates (eg, fostering a therapeutic relationship that is ethically sound, uses effective listening skills with non-verbal and verbal communication; working as both a team member and at times as a leader).

Professionalism: Demonstrate a commitment to carrying out professional responsibilities, adherence to ethical principles, and sensitivity to diverse patient populations.

RULES REGARDING ORAL PRESENTATIONS

1. Each abstract that is presented orally or as a poster during the STS 51st Annual Meeting **must be submitted before or at the time of the meeting to *The Annals of Thoracic Surgery*** for publication consideration. Manuscripts must be submitted via *The Annals* online editorial office (www.atseditorialoffice.org). Editorial office staff will be on hand at the meeting to assist you in submitting your paper if you need help. Manuscripts will not be considered for publication if submitted after Wednesday, January 28, 2015, 11:59 PM, Pacific Standard Time. All manuscripts shall become the property of the Society. Publication of manuscripts in *The Annals of Thoracic Surgery* is not assured. If manuscripts are not submitted to *The Annals* prior to or at the time of the STS 51st Annual Meeting, a 2-year period of ineligibility for participation in the STS Annual Meeting will be imposed upon all authors of the manuscript. The same 2-year sanction applies to all abstracts returned to authors for revisions that are not resubmitted within 1 calendar year of the request for revision.
2. Presenters for scientific sessions are provided with time limits for their presentations and must comply with these limits. Please refer to your confirmation notification for your specific time limit.
3. All visuals accompanying scientific oral presentations must be produced in Microsoft Office PowerPoint. Presenters must report to the Speaker Ready Room (Room 22) at least 24 hours prior to their scheduled presentation time to download their PowerPoint into the presentation system.
4. Reserved seating is available for presenters and invited discussants at the front of the room for the General Sessions. In the interest of time, presenters and discussants should sit in this reserved seating.
5. Presenters will remain with discussants on the dais during the oral presentations to respond directly to the discussants' queries.
6. Commercial and regulatory disclosures as defined in the STS Education Disclosure Policy (see page 7) must be disclosed orally to the audience at the beginning of each presentation. This requirement is for moderators, presenters, and invited discussants. The first slide of a presentation must be used to reveal the nature of the disclosure. Disclosure information will also be provided in the text of this *Abstract Book*.

NOTE: The Society of Thoracic Surgeons does not necessarily endorse the opinions expressed by any moderator, presenter, or discussant.

RULES REGARDING SCIENTIFIC POSTERS

1. Each abstract that is presented orally or as a poster during the STS 51st Annual Meeting **must be submitted before or at the time of the meeting to *The Annals of Thoracic Surgery*** for publication consideration. Manuscripts must be submitted via *The Annals* online editorial office (www.atseditorialoffice.org). Editorial office staff will be on hand at the meeting to assist you in submitting your paper if you need help. Manuscripts will not be considered for publication if submitted after Wednesday, January 28, 2015, 11:59 PM, Pacific Standard Time. All manuscripts shall become the property of the Society. Publication of manuscripts in *The Annals of Thoracic Surgery* is not assured. If manuscripts are not submitted to *The Annals* prior to or at the time of the STS 51st Annual Meeting, a 2-year period of ineligibility for participation in the STS Annual Meeting will be imposed upon all authors of the manuscript. The same 2-year sanction applies to all abstracts returned to authors for revisions that are not resubmitted within 1 calendar year of the request for revision.

2. Scientific posters have been assigned designated poster boards. Each scientific poster must correspond with the assigned poster board number. Scientific poster numbers begin with "P" followed by the corresponding poster board, eg, P12.
3. Scientific posters must be designed to fit the poster board, which is 4 feet high by 8 feet wide. The poster title and author block must be displayed across the top of the poster. This will allow meeting participants to easily find posters. Poster material should be readable from a distance of at least 6 feet.
4. Commercial and regulatory disclosures as defined in the STS Education Disclosure Policy (see page 7) must be included on the poster in the lower right-hand corner. Posters not containing commercial and regulatory disclosures may be removed from the scientific poster area. If you do not have anything to disclose, please print "Nothing to Disclose" in the lower right-hand corner. This requirement is not intended to imply any impropriety of such relationships or to prejudice any individual presenter, author, or discussant. It is merely to identify such relationships through full disclosure and to allow audience members to form their own judgments regarding the poster presentation.
5. Scientific posters may be set up on Saturday, January 24, 2015, from 8:00 AM to 5:00 PM and Sunday, January 25, 2015, from 8:00 AM to 2:00 PM in the Foyer outside of Rooms 29-32 at the San Diego Convention Center. Posters must be hung by a poster representative during these times. STS staff will then be moving the posters chosen for the Scientific Posters and Wine event (see below) to the Foyer outside of Ballroom 20D. You are only responsible for hanging your poster in the Foyer outside of Rooms 29-32 by 2:00 PM on Sunday, January 25, 2015. STS will move selected posters to the Foyer outside of Ballroom 20D between 2:00 PM and 4:00 PM on Monday, January 26, 2015. You will be notified via e-mail by 7:00 PM on Sunday, January 25, 2015, if your poster was selected for the Scientific Posters and Wine event.
6. Scientific posters accepted for the STS 51st Annual Meeting must be displayed at the meeting for the entire time assigned and in the assigned location. Authors who do not display their posters will be subjected to a 2-year period of ineligibility for participation in the STS Annual Meeting. This sanction applies to all poster authors.
7. The STS 51st Annual Meeting will feature a unique Scientific Posters and Wine event, to be held from 5:00 PM to 6:30 PM on Monday, January 26, 2015, in the Foyer outside of Ballroom 20D. Moderators for each of the subspecialties will guide participants through a discussion of the selected poster abstracts. If your poster is selected for this event, please arrive at the Foyer outside of Ballroom 20D no later than 4:45 PM on Monday, January 26, 2015, to prepare.
8. All posters will be graded on the evening of Sunday, January 25, 2015. Therefore, in order to be considered as a poster winner, you will need to have your poster set up by 2:00 PM on Sunday, January 25, 2015. Authors of the top graded posters will present their poster during the Scientific Posters and Wine event and will have their presentations graded by selected reviewers. A winner for each category will be announced shortly thereafter.
9. Scientific poster teardown will occur Tuesday evening, January 27, 2015. If your poster was presented at the Scientific Posters and Wine event, your poster will be moved back to the Foyer outside of Rooms 29-32 after the event ends. Scientific posters must remain on display until 5:00 PM on Tuesday, January 27, 2015. STS is not responsible for any scientific posters remaining after 10:00 AM on Wednesday, January 28, 2015. STS will not ship posters back to authors.

Commercial Relationships of the Program Planning Members

The Society would like to thank the following STS leaders for planning the educational content of STS/AATS Tech-Con 2015. Unless otherwise noted, the program planning members have no commercial relationships to disclose:

K. Robert Shen, Co-Chair, Workforce on Annual Meeting (Tech-Con Task Force)

Vinod H. Thourani, Co-Chair, Workforce on Annual Meeting (Tech-Con Task Force)
COMMERCIAL RELATIONSHIPS Research Grant, Edwards Lifesciences Corporation, Medtronic, Inc, SORIN GROUP; Consultant/Advisory Board, Boston Scientific, St Jude Medical, Inc; Ownership Interest, Apica Cardiovascular

Gorav Ailawadi, Workforce on Annual Meeting (Tech-Con Task Force)
COMMERCIAL RELATIONSHIPS Consultant/Advisory Board, Abbott Vascular, Edwards Lifesciences Corporation, Mitralign, Inc; Speakers Bureau/Honoraria, St Jude Medical, Inc

Mark F. Berry, Workforce on Annual Meeting (Tech-Con Task Force)

Shanda H. Blackmon, Workforce on Annual Meeting (Tech-Con Task Force)

Robert W. Emery Jr, Workforce on Annual Meeting (Tech-Con Task Force)
COMMERCIAL RELATIONSHIPS Consultant/Advisory Board, Kips Bay Medical, Inc

Robert C. Hagberg, Workforce on Annual Meeting (Tech-Con Task Force)
COMMERCIAL RELATIONSHIPS Other, Edwards Lifesciences Corporation, Data Safety Monitoring Board Member

Richard Lee, Workforce on Annual Meeting (Tech-Con Task Force)

Himanshu J. Patel, Workforce on Annual Meeting (Tech-Con Task Force)
COMMERCIAL RELATIONSHIPS Consultant/Advisory Board, W. L. Gore & Associates, Inc, Medtronic, Inc, Terumo Medical Corporation

Joseph D. Schmoker, Workforce on Annual Meeting (Tech-Con Task Force)
COMMERCIAL RELATIONSHIPS Other, Medtronic, Inc, Serve as a Trainer and Proctor

The Society would like to thank the following STS leaders for planning the educational content of the STS 51st Annual Meeting. Unless otherwise noted, the program planning members have no commercial relationships to disclose:

Kevin D. Accola, Workforce on Health Policy, Reform, and Advocacy
COMMERCIAL RELATIONSHIPS Speakers Bureau/Honoraria, Edwards Lifesciences Corporation, CryoLife, Inc; Consultant/Advisory Board, Edwards Lifesciences Corporation, CorMatrix

David H. Adams, Workforce on New Technology
COMMERCIAL RELATIONSHIPS Ownership Interest, Medtronic, Inc, Edwards Lifesciences Corporation

Arvind K. Agnihotri, Workforce on Health Policy, Reform, and Advocacy
COMMERCIAL RELATIONSHIPS Consultant/Advisory Board, Edwards Lifesciences Corporation; Speakers Bureau/Honoraria, Terumo Medical Corporation

Gorav Ailawadi, Worforce on Annual Meeting (Program Task Force)
COMMERCIAL RELATIONSHIPS Consultant/Advisory Board, Abbott Vascular, Edwards Lifesciences Corporation, Mitralign, Inc; Speakers Bureau/Honoraria, St Jude Medical, Inc

Gabriel S. Aldea, Workforce on National Databases

Diane E. Alejo, Workforce on Associate Membership

Mark S. Allen, First Vice President, Board of Directors
COMMERCIAL RELATIONSHIPS Ownership Interest, Medtronic, Inc; Nonremunerative Position of Influence, Joint Council on Thoracic Surgical Education

Giorgio M. Aru, Workforce on Patient Safety

Emile A. Bacha, Director-at-Large, Board of Directors; Workforce on Surgical Treatment of Adults With Congenital Heart Disease
COMMERCIAL RELATIONSHIPS Consultant/Advisory Board, CorMatrix

Leah M. Backhus, Workforce on Annual Meeting (Surgical Symposia Task Force)

Vinay Badhwar, Workforce on Annual Meeting (Program Task Force)

Craig J. Baker, Workforce on Thoracic Surgery Resident Issues

Faisal G. Bakaeen, Workforce on Clinical Education
COMMERCIAL RELATIONSHIPS Consultant/Advisory Board, Jace Medical; Speakers Bureau/Honoraria, AstraZeneca; Research Grant, VA Cooperative Studies Program, CTSN/NHLBI

Michael K. Banbury, Workforce on Health Policy, Reform, and Advocacy
COMMERCIAL RELATIONSHIPS Consultant/Advisory Board, ValveXchange, Inc

Joseph E. Bavaria, Second Vice President, Board of Directors
COMMERCIAL RELATIONSHIPS Research Grant, Edwards Lifesciences Corporation, Medtronic, Inc, St Jude Medical, Inc

Thomas M. Beaver, Workforce on Thoracic Surgery Resident Issues
COMMERCIAL RELATIONSHIPS Consultant/Advisory Board, AtriCure, Inc, AbbVie Inc; Research Grant, AtriCure, Inc, Medtronic, Inc

Edward M. Bender, Workforce on Clinical Education
COMMERCIAL RELATIONSHIPS Other, SORIN GROUP, sponsors two iOS apps Dr. Bender developed

Shanda H. Blackmon, Director-at-Large, Board of Directors; Workforce on Annual Meeting (Tech-Con Task Force); Workforce on General Thoracic Surgery

Matthew G. Blum, Workforce on Practice Management

Robert S. Boova, Workforce on Health Policy, Reform, and Advocacy

Greg A. Bowman, Workforce on Practice Management

Christopher A. Caldarone, Co-Chair, Workforce on Annual Meeting (Surgical Symposia Task Force); Workforce on National Databases; Workforce on Surgical Treatment of Adults With Congenital Heart Disease
COMMERCIAL RELATIONSHIPS Other, CellAegis Devices Inc, Founder

John H. Calhoon, Director-at-Large, Board of Directors; Council on Education and Member Services Operating Board; Workforce on Critical Care
COMMERCIAL RELATIONSHIPS Other, JCTSE Director, TSFRE President, STSA President

Andrea J. Carpenter, Workforce on Clinical Education
COMMERCIAL RELATIONSHIPS Consultant/Advisory Board, Edwards Lifesciences Corporation

Yvonne M. Carter, Workforce on Health Policy, Reform, and Advocacy

Alfred S. Casale, Workforce on Practice Management

Stephen D. Cassivi, Chair, Workforce on Patient Safety

Graciano Castillo-Ortega, Workforce on International Relationships

Robert J. Cerfolio, Workforce on General Thoracic Surgery
COMMERCIAL RELATIONSHIPS Speakers Bureau/Honoraria, Intuitive Surgical, Inc

Andrew C. Chang, Workforce on National Databases
COMMERCIAL RELATIONSHIPS Speakers Bureau/Honoraria, Michigan Society of Thoracic and Cardiovascular Surgery

Faisal H. Cheema, Workforce on Associate Membership

Haiquan Chen, Workforce on International Relationships

Edward P. Chen, Workforce on Thoracic Surgery Resident Issues

Jonathan M. Chen, Workforce on Annual Meeting (Surgical Symposia Task Force)

Aaron M. Cheng, Workforce on Annual Meeting (STS University Task Force); Workforce on Critical Care

Stephen C. Clark, Workforce on Patient Safety

Joseph C. Cleveland Jr, Council on Education and Member Services Operating Board; Chair, Workforce on Annual Meeting; Chair, Workforce on Annual Meeting (Program Task Force); Workforce on National Databases

Adnan Cobanoglu, Workforce on Health Policy, Reform, and Advocacy

Tony Coelho, Public Director, Board of Directors
COMMERCIAL RELATIONSHIPS Other, Partnership to Improve Patient Care, Chairman for a coalition of health care stakeholders that promote patient-centeredness in health policy

David T. Cooke, Workforce on Clinical Education

Juan A. Crestanello, Workforce on Annual Meeting (STS University Task Force)
COMMERCIAL RELATIONSHIPS Research Grant, Medtronic, Inc, Abbott Vascular

Richard S. D'Agostino, Workforce on National Databases
COMMERCIAL RELATIONSHIPS Ownership Interest, Saphena Medical Inc, Tengion, EntreMed, Inc

Michael J. Davidson, Workforce on Health Policy, Reform, and Advocacy
COMMERCIAL RELATIONSHIPS Consultant/Advisory Board, Edwards Lifesciences Corporation, Medtronic, Inc, Harvard Clinical Research Institute

Elizabeth A. David, Workforce on Thoracic Surgery Resident Issues
COMMERCIAL RELATIONSHIPS Other, Intuitive Surgical, Inc, Training Fellowship, Travel supported

Joseph A. Dearani, Council on Education and Member Services Operating Board; Chair, Workforce on Surgical Treatment of Adults With Congenital Heart Disease

Jose Ribas De Campos, Workforce on International Relationships
COMMERCIAL RELATIONSHIPS Consultant/Advisory Board, DePuy Synthes, Inc

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COMMERCIAL RELATIONSHIPS Consultant/Advisory Board, Spiration, Inc

Harold G. Roberts Jr
COMMERCIAL RELATIONSHIPS Research Grant, Medtronic, Inc

Gaetano Rocco
COMMERCIAL RELATIONSHIPS Speakers Bureau/Honoraria, Covidien Ltd, Synthes, Inc, Baxter

Evelio Rodriguez
COMMERCIAL RELATIONSHIPS Consultant/Advisory Board, Edwards Lifesciences Corporation; Research Grant, Medtronic, Inc; Speakers Bureau/Honoraria, Medtronic, Inc, SORIN GROUP

Eric E. Roselli
COMMERCIAL RELATIONSHIPS Speakers Bureau/Honoraria, Medtronic, Inc, Terumo Medical Corporation; Consultant/Advisory Board, Edwards Lifesciences Corporation; Nonremunerative Position of Influence, SORIN GROUP

Todd K. Rosengart

Marc Ruel

Valerie W. Rusch

William H. Ryan
COMMERCIAL RELATIONSHIPS Consultant/Advisory Board, Edwards Lifesciences Corporation, Medtronic, Inc

Joseph F. Sabik
COMMERCIAL RELATIONSHIPS Research Grant, Abbott Vascular, Edwards Lifesciences Corporation; Cosultant/Advisory Board, Medtronic, Inc, SORIN GROUP

Jorge D. Salazar

Christopher T. Salerno
COMMERCIAL RELATIONSHIPS Consultant/Advisory Board, Thoratec Corporation

Juan A. Sanchez

Edward B. Savage

Matthew J. Schuchert

Frank W. Sellke
COMMERCIAL RELATIONSHIPS Consultant/Advisory Board, CLS Behring, The Medicines Company

Craig H. Selzman

Jay G. Shake

K. Robert Shen

Ramesh Singh
COMMERCIAL RELATIONSHIPS Consultant/Advisory Board, Baxter

Nicholas G. Smedira
COMMERCIAL RELATIONSHIPS Consultant/Advisory Board, Medtronic, Inc

Michael A. Smith

Joshua R. Sonett

Howard Song

Alan M. Speir
COMMERCIAL RELATIONSHIPS Consultant/Advisory Board, Medtronic, Inc

Thomas L. Spray

Sandra L. Starnes

Robert W. Stewart

Jack C. Sun

Lars G. Svensson
COMMERCIAL RELATIONSHIPS Ownership Interest, Cardiosolutions, Inc

Wilson Y. Szeto
COMMERCIAL RELATIONSHIPS Consultant/Advisory Board, Micro Interventional Devices, Inc; Research Grant, Edwards Lifesciences Corporation, Medtronic, Inc, SORIN GROUP

Roy T. Temes

Michael F. Teodori

Hassan A. Tetteh

Ajit K. Tharakan

Patricia A. Thistlethwaite

Vinod H. Thourani
COMMERCIAL RELATIONSHIPS Research Grant, Edwards Lifesciences Corporation, Medtronic, Inc, SORIN GROUP; Consultant/Advisory Board, Boston Scientific, St Jude Medical, Inc; Ownership Interest, Apica Cardiovascular

Betty C. Tong
COMMERCIAL RELATIONSHIPS Consultant/Advisory Board, W. L. Gore & Associates, Inc

Robert F. Tranbaugh

Curt Tribble

Elaine E. Tseng
COMMERCIAL RELATIONSHIPS Research Grant, University of California, Wallace H. Coulter Foundation

Joseph W. Turek

Mark W. Turrentine

James S. Tweddell
COMMERCIAL RELATIONSHIPS Consultant/Advisory Board, CorMatrix

Akif Undar
COMMERCIAL RELATIONSHIPS Research Grant, XENIOS AG

Glen S. Van Arsdell
COMMERCIAL RELATIONSHIPS Ownership Interest, CellAegis Devices, Inc, Medtronic, Inc

Thomas K. Varghese Jr
COMMERCIAL RELATIONSHIPS Research Grant, Nestlé Health Science S.A., Pacira Pharmaceuticals

Edward D. Verrier

John C. Wain

Jennifer D. Wakler

Africa F. Wallace

Todd S. Weiser

Benny Weksler

Michael J. Weyant

Glenn J. R. Whitman

Richard I. Whyte

Jason A. Williams

Mathew R. Williams
COMMERCIAL RELATIONSHIPS Consultant/Advisory Board, Medtronic, Inc, Edwards Lifesciences Corporation; Research Grant, Medtronic, Inc, Direct Flow Medical, Inc

Douglas E. Wood
COMMERCIAL RELATIONSHIPS Consultant/Advisory Board, Spiration, Inc; Research Grant, Spiration, Inc

Cameron D. Wright

Stephen C. Yang

Leora T. Yarboro

Saikrishna S. Yendamuri

J. Nilas Young

Marco A. Zenati

Friday, January 23, 2015

3:00 PM – 6:00 PM *Lobby D*

Registration: STS/AATS Tech-Con 2015 and STS 51st Annual Meeting

Saturday, January 24, 2015

7:00 AM – 6:00 PM *Lobby D*

Registration: STS/AATS Tech-Con 2015 and STS 51st Annual Meeting

12:00 PM – 6:30 PM *Ballroom 20 Foyer*

STS/AATS Tech-Con 2015 Exhibits

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

The physician competencies addressed in STS/AATS Tech-Con 2015 are medical knowledge, practice-based learning and improvement, and systems-based practice. These physician competencies will be addressed through individual lectures, debates, panel discussions, and questions and answers from the audience.

1:00 PM – 2:45 PM *Ballroom 20D*

Joint Session: Barriers and/or Pathways for Adoption of New Technology—Perspectives From Surgeons, FDA, CMS, Industry, and Hospital Administration

Moderators: *K. Robert Shen, Rochester, MN, and Vinod H. Thourani, Atlanta, GA*

COMMERCIAL RELATIONSHIPS V. H. Thourani: Research Grant, Edwards Lifesciences Corporation, Medtronic, Inc, SORIN GROUP; Consultant/Advisory Board, Boston Scientific, St Jude Medical, Inc; Ownership Interest, Apica Cardiovascular

1:00 PM

Welcome and Introduction

K. Robert Shen, Rochester, MN, and Vinod H. Thourani, Atlanta, GA

COMMERCIAL RELATIONSHIPS V. H. Thourani: Research Grant, Edwards Lifesciences Corporation, Medtronic, Inc, SORIN GROUP; Consultant/Advisory Board, Boston Scientific, St Jude Medical, Inc; Ownership Interest, Apica Cardiovascular

1:02 PM

Pathways for Getting New Medical Devices Into Humans

Thomas J. Fogarty, Portola Valley, CA

1:10 PM

Barriers for Getting New Medical Devices Into Humans

Todd L. Demmy, Buffalo, NY

1:18 PM

Balancing the Evaluation of New Innovations and Keeping the Patient Safe

John C. Laschinger, Silver Spring, MD

1:26 PM

Perspective From Research and Development: Adult Cardiac Surgery

Richard Olson, Plymouth, MN

COMMERCIAL RELATIONSHIPS Employment, St Jude Medical

1:34 PM

Perspective From Research and Development: General Thoracic Surgery

TBA

1:42 PM

Discussion

2:00 PM

We Have the Technology, But Will Physicians Be Able to Use It?

Michael J. Mack, Dallas, TX

COMMERCIAL RELATIONSHIPS M. J. Mack: Nonremunerative Position of Influence, Abbott Vascular, Edwards Lifesciences Corporation

REGULATORY DISCLOSURE This presentation will discuss numerous adult cardiac surgical products/devices that are not FDA approved.

2:08 PM

Decision Making for Pathway of Reimbursement: Hospital and Physician

TBA

2:16 PM

"We Love New Technology, But Help Us Not Go Under": Perspective From a Hospital CEO

Dane C. Peterson, Atlanta, GA

2:24 PM

Discussion

2:40 PM

Closing Remarks

2:45 PM – 3:15 PM ***Ballroom 20 Foyer***

BREAK—Visit STS/AATS Tech-Con 2015 Exhibits

3:15 PM – 5:00 PM ***Ballroom 20D***

Adult Cardiac Track I: Mitral Valve, Atrial Fibrillation, and the Left Atrial Appendage

Moderators: *Gorav Ailawadi, Charlottesville, VA, and Richard Lee, St Louis, MO*

COMMERCIAL RELATIONSHIPS G. Ailawadi: Consultant/Advisory Board, Abbott, Edwards Lifesciences Corporation, Mitralign Inc; Speakers Bureau/Honoraria, St Jude Medical, Inc

3:15 PM

Welcome and Introduction

Gorav Ailawadi, Charlottesville, VA, and Richard Lee, St Louis, MO

COMMERCIAL RELATIONSHIPS G. Ailawadi: Consultant/Advisory Board, Abbott, Edwards Lifesciences Corporation, Mitralign Inc; Speakers Bureau/Honoraria, St Jude Medical, Inc

3:17 PM

New Left Atrial Appendage (LAA) Closure Devices for Open or Closed Chest Techniques

David R. Holmes Jr, Rochester, MN

3:25 PM

The LAA Should Always Be Eliminated During Open Cardiac Surgery

PRO: *Richard Lee, St Louis, MO*

CON: *Vinay Badhwar, Pittsburgh, PA*

3:41 PM

How I Do It: Robotic Mitral Valve Repair—Making It Simple and Reproducible

Douglas A. Murphy, Atlanta, GA

COMMERCIAL RELATIONSHIPS D. A. Murphy: Speakers Bureau/Honoraria, Edwards Lifesciences Corporation, Intuitive Surgical, Inc

3:49 PM

Discussion

4:06 PM

MitraClip: The Only FDA-Approved Transcatheter Mitral Valve Repair Technology in the US

Gorav Ailawadi, Charlottesville, VA

COMMERCIAL RELATIONSHIPS G. Ailawadi: Consultant/Advisory Board, Abbott, Edwards Lifesciences Corporation, Mitralign Inc; Speakers Bureau/Honoraria, St Jude Medical, Inc

4:14 PM

Transcatheter Mitral Valve Replacement Techniques

Vinod H. Thourani, Atlanta, GA

COMMERCIAL RELATIONSHIPS V. H. Thourani: Research Grant, Edwards Lifesciences Corporation, Medtronic, Inc, SORIN GROUP; Consultant/Advisory Board, Boston Scientific, St Jude Medical, Inc; Ownership Interest, Apica Cardiovascular

REGULATORY DISCLOSURE This presentation will address CardiacAQ, Tendyne, and the Edwards Fortis valve, which have FDA statuses of investigational.

4:22 PM

Transcatheter Mitral Valve Repair Techniques

Michael J. Mack, Dallas, TX

COMMERCIAL RELATIONSHIPS M. J. Mack: Nonremunerative Position of Influence, Abbott Vascular, Edwards Lifesciences Corporation

REGULATORY DISCLOSURE This presentation will discuss various transcatheter mitral valve repair devices that are not FDA approved.

4:30 PM

Surgical Management of Atrial Fibrillation in Patients Undergoing Coronary Artery Bypass Grafting (CABG) Surgery or Aortic Valve Replacement: Pulmonary Vein Isolation or Biatrial Maze Operation

Patrick M. McCarthy, Chicago, IL

4:38 PM

Discussion

4:55 PM

Closing Remarks

3:15 PM – 5:00 PM ***Room 33ABC***

General Thoracic Track I: Novel Thoracoscopic Techniques & Tools, New Developments in Management of Lung Tumors

Moderators: *Mark F. Berry, Durham, NC, and Sunil Singhal, Philadelphia, PA*

3:15 PM

Welcome and Introduction

Mark F. Berry, Durham, NC, and Sunil Singhal, Philadelphia, PA

3:20 PM

Setting Up a Lung Cancer Screening Program
Daniel J. Boffa, New Haven, CT

3:35 PM

Uniportal VATS Lobectomy in Non-Intubated Patients
TBA

3:50 PM

New Thoracoscopic Tools
Mark F. Berry, Durham, NC

4:05 PM

Novel Agents for Induction Treatment of Non-Small Cell Lung Cancer
Mark Onaitis, Durham, NC

4:20 PM

Intraoperative Local Cancer Therapies
Shaf H. Keshavjee, Toronto, Canada

4:35 PM

Multimodality Treatment of Pulmonary Metastatic Disease
Jessica S. Donington, New York, NY

4:50 PM

Discussion

5:00 PM – 6:30 PM ***Ballroom 20 Foyer***

STS/AATS Tech-Con 2015 Reception

Sunday, January 25, 2015

7:00 AM – 6:30 PM ***Lobby D***

Registration: STS/AATS Tech-Con 2015 and STS 51st Annual Meeting

7:00 AM – 3:00 PM ***Ballroom 20 Foyer***

STS/AATS Tech-Con 2015 Exhibits

8:00 AM – 9:30 AM ***Ballroom 20D***

Adult Cardiac Track II: Coronary Artery Disease
Moderators: *Robert C. Hagberg, Hartford, CT, and Michael E. Halkos, Atlanta, GA*
COMMERCIAL RELATIONSHIPS M. E. Halkos: Consultant/Advisory Board, Intuitive Surgical, Inc, Medtronic, Inc

8:00 AM

Welcome and Introduction
Robert C. Hagberg, Hartford, CT, and Michael E. Halkos, Atlanta, GA
COMMERCIAL RELATIONSHIPS M. E. Halkos: Consultant/Advisory Board, Intuitive Surgical, Inc, Medtronic, Inc

8:02 AM

How I Do It: Robot-Assisted Coronary Artery Bypass Grafting (CABG), Left Internal Mammary Artery (LIMA)-Left Anterior Descending Grafting

Francis P. Sutter, Wynnewood, PA

COMMERCIAL RELATIONSHIPS F. P. Sutter: Speakers Bureau/Honoraria, Intuitive Surgical, Inc, Medtronic, Inc

8:12 AM

How I Do It: Totally Endoscopic Coronary Artery Bypass—Getting Past Robotic LIMA Harvest to Robotic Anastomosis

Johannes Bonatti, Baltimore, MD

8:22 AM

How I Do It: Non-Robotic Minimally Invasive CABG Approaches for Multivessel Coronary Artery Disease

Marc Ruel, Ottawa, Canada

COMMERCIAL RELATIONSHIPS M. Ruel: Research Grant, Medtronic, Inc

8:32 AM

Can We Afford Anastomotic Connectors for CABG?

Husam H. Balkhy, Chicago, IL

COMMERCIAL RELATIONSHIPS H. H. Balkhy: Speakers Bureau/Honoraria, Intuitive Surgical, Inc

8:42 AM

Robotic CABG Disasters

Bob S. Kiaii, London, Canada

COMMERCIAL RELATIONSHIPS B. S. Kiaii: Research Grant, Medtronic, Inc

8:52 AM

Hybrid Coronary Revascularization: Who's Eligible?

Michael E. Halkos, Atlanta, GA

COMMERCIAL RELATIONSHIPS H. H. Balkhy: Speakers Bureau/Honoraria, Intuitive Surgical, Inc

9:02 AM

Cost of Robotic Technology and Financial Implications for Hospital Administration

Robert S. Poston, Tucson, AZ

9:12 AM

Panel Discussion

9:25 AM

Closing Remarks

8:00 AM – 9:30 AM ***Room 33ABC***

General Thoracic Track II: Integrated Medical Records, 3D Printers for Surgical Planning, Chest Wall Techniques, Artificial Organs, and Simulation

Moderators: *K. Robert Shen, Rochester, MN, and Michael F. Reed, Hershey, PA*

COMMERCIAL RELATIONSHIPS M. F. Reed: Consultant/Advisory Board, Spiration, Inc

8:00 AM

Welcome and Introduction

K. Robert Shen, Rochester, MN, and Michael F. Reed, Hershey, PA

COMMERCIAL RELATIONSHIPS M. F. Reed: Consultant/Advisory Board, Spiration, Inc

8:05 AM

Expanded Use of Electronic Medical Records

Cameron D. Wright, Boston, MA

8:17 AM

3D Printers for Surgical Planning

Jane S. Matsumoto, Rochester, MN, and Jonathan M. Morris, Rochester, MN

8:29 AM

Pectus Repair in Adults

Dawn E. Jaroszewski, Phoenix, AZ

COMMERCIAL RELATIONSHIPS D. E. Jaroszewski: Consultant/Advisory Board, BioMet, Inc; Research Grant, I-Flow, LLC, a Kimberly-Clark Health Care Company

8:41 AM

Rib Plating for Thoracic Trauma

Jane Yanagawa, New York, NY

8:53 AM

Decellularization of Whole Organs as a Platform for Bioengineered Organs

Harald C. Ott, Boston, MA

9:05 AM

How to Acquire New Skills Using Simulation

Shari L. Meyerson, Chicago, IL

9:17 AM

Discussion

9:30 AM – 10:15 AM ***Ballroom 20 Foyer***

BREAK—Visit STS/AATS Tech-Con 2015 Exhibits

10:15 AM – 11:45 AM ***Ballroom 20D***

Adult Cardiac Track III: Aortic Valve

Moderators: *Michael A. Borger, New York, NY, and Robert W. Emery Jr, Minneapolis, MN*

COMMERCIAL RELATIONSHIPS M. A. Borger: Speakers Bureau/Honoraria, Edwards Lifesciences Corporation, St Jude Medical, Inc, SORIN GROUP

10:15 AM

Welcome and Introduction

Michael A. Borger, New York, NY, and Robert W. Emery Jr, Minneapolis, MN

COMMERCIAL RELATIONSHIPS M. A. Borger: Speakers Bureau/Honoraria, Edwards Lifesciences Corporation, St Jude Medical, Inc, SORIN GROUP

10:16 AM

How I Do It: A Self-Expanding Sutureless Valve

Martin Misfeld, New York, NY

10:23 AM

Will Sutureless Valves Replace Commercially Available Stented Valves?

Michael A. Borger, New York, NY

COMMERCIAL RELATIONSHIPS M. A. Borger: Speakers Bureau/Honoraria, Edwards Lifesciences Corporation, St Jude Medical, Inc, SORIN GROUP

REGULATORY DISCLOSURE This presentation will address the Edwards Intuity Valve and the Sorin Perceval Valve, which have FDA statuses of investigational. This presentation will also discuss the Medtronic Enable Valve, which is not FDA approved.

10:30 AM

Discussion

10:37 AM

Pitfalls of Aortic Valve Repair

Laurent De Kerchove, Brussels, Belgium

REGULATORY DISCLOSURE This presentation will address the off-label use of Medtronic's Simplici-T annuloplasty system as external annuloplasty system in aortic valve repair.

10:44 AM

Most Patients Should Have a Biologic Aortic Valve Since Transcatheter Aortic Valve Replacement (TAVR) Valve-in-Valve Is Available

PRO: *G. Michael Deeb, Ann Arbor, MI*

CON: *John S. Ikonomidis, Charleston, SC*

COMMERCIAL RELATIONSHIPS G. Deeb: Consultant/Advisory Board, Edwards Lifesciences Corporation, Medtronic, Inc; Research Grant, Boston Scientific, Edwards Lifesciences Corporation, Medtronic, Inc

REGULATORY DISCLOSURE This presentation will address the Medtronic CoreValve and the Edwards Lifesciences Sapien Valve, which have FDA statuses of investigational.

10:58 AM

Discussion

11:05 AM

A Self-Expanding Valve for All Annular Sizes: CoreValve Evolut

Michael J. Reardon, Houston, TX

COMMERCIAL RELATIONSHIPS M. J. Reardon: Consultant/Advisory Board, Medtronic, Inc; Nonremunerative Position of Influence, Medtronic, Inc, National PI for Medtronic SurTAVI Trial Steering Committee for Medtronic CoreValve IDE trial

REGULATORY DISCLOSURE This presentation will address the Medtronic Evolut R valve, which has an FDA status of investigational.

11:11 AM

A New Balloon Expandable Valve With an Anti-Leak Cuff: SAPIEN 3

Vinod H. Thourani, Atlanta, GA

COMMERCIAL RELATIONSHIPS V. H. Thourani: Research Grant, Edwards Lifesciences Corporation, Medtronic, Inc, SORIN GROUP; Consultant/Advisory Board, Boston Scientific, St Jude Medical, Inc; Ownership Interest, Apica Cardiovascular

REGULATORY DISCLOSURE This presentation will address the Edwards Lifesciences' SAPIEN 3 valve, which has an FDA status of investigational.

11:18 AM

Other Upcoming Technologies for TAVR: Lotus, Portico, and Symetis

Gregory P. Fontana, New York, NY

COMMERCIAL RELATIONSHIPS G. P. Fontana: Research Grant, Medtronic, Inc, St Jude Medical, Inc; Speakers Bureau/Honoraria, SORIN GROUP; Consultant/Advisory Board, Edwards Lifesciences Corporation

REGULATORY DISCLOSURE This presentation will address St Jude Medical's device Portico, Boston Scientific's device Sadra, and JenaValve Technology's device. These devices have FDA statuses of investigational.

11:24 AM

A Transapical Valve for Aortic Insufficiency: JenaValve

Hendrik Treede, Hamburg, Germany

COMMERCIAL RELATIONSHIPS H. Treede: Consultant/Advisory Board, JenaValve Technology

REGULATORY DISCLOSURE This presentation will address the JenaValve transapical TAVR system, which is not FDA approved.

11:31 AM

Transcaval TAVR: Are You Serious?

Adam B. Greenbaum, Detroit, MI

COMMERCIAL RELATIONSHIPS A. B. Greenbaum: Ownership Interest, inventor on patent applications for devices for caval-aortic access that have been assigned to my employer, Henry Ford Hospital

REGULATORY DISCLOSURE This presentation describes the off-label use of the St Jude Medical muscular VSD occluder (MVSDO) during closure of the aorto-caval tract after transcaval TAVR.

11:38 AM

Discussion

11:44 AM

Closing Remarks

10:15 AM – 11:45 AM ***Room 33ABC***

General Thoracic Track III: New Techniques for Esophageal Disease, Diaphragm Disorders, and Nanotechnology

Moderator: *Shanda H. Blackmon, Rochester, MN*

10:15 AM

Welcome and Introduction

Shanda H. Blackmon, Rochester, MN

10:20 AM

Endoluminal Suturing Devices

Shanda H. Blackmon, Rochester, MN

10:35 AM

Integrating Peroral Endoscopic Myotomy Into Clinical Practice

Shanda H. Blackmon, Rochester, MN

10:50 AM

Reoperative Foregut Surgery for Failed Novel Technology

Steven R. Demeester, Los Angeles, CA

11:05 AM

Diaphragm Pacing

Raymond P. Onders, Cleveland, OH

COMMERCIAL RELATIONSHIPS R. P. Onders: Ownership Interest, Synapse Biomedical, Case Western Reserve University, University Hospitals Case Medical Center, and myself, intellectual property rights of diaphragm pacing and part founder of company

REGULATORY DISCLOSURE This presentation will discuss the off-label use of the Synapse Biomedical diaphragm pacing system in children, after a phrenic nerve injury, and temporary use to help in weaning of the ventilator in intensive care units.

11:20 AM

Nanotechnology Applications in General Thoracic Surgery

Yolonda L. Colson, Boston, MA

COMMERCIAL RELATIONSHIPS Y. L. Colson: Other, Novadaq Corp, Paid for coach travel to present our non-sponsored data at educational meeting about NIR imaging

11:35 AM

Discussion

11:45 AM – 12:00 PM *Ballroom 20 Foyer*

BREAK—Visit STS/AATS Tech-Con 2015 Exhibits

12:00 PM – 1:00 PM *Sails Pavilion*

Lunch

1:00 PM – 1:15 PM *Ballroom 20 Foyer*

BREAK—Visit STS/AATS Tech-Con 2015 Exhibits

1:15 PM – 2:45 PM *Ballroom 20D*

Adult Cardiac Track IV: Aortic Surgery and Endovascular Interventions

Moderators: *Himanshu J. Patel, Ann Arbor, MI, and Joseph D. Schmoker, Burlington, VT*

COMMERCIAL RELATIONSHIPS H. J. Patel: Research Grant, Edwards Lifesciences Corporation, Medtronic, Inc, W. L. Gore & Associates, Inc; J. D. Schmoker: Speakers Bureau/Honoraria, Medtronic, Inc

1:15 PM

Welcome and Introduction

Himanshu J. Patel, Ann Arbor, MI, and Joseph D. Schmoker, Burlington, VT

COMMERCIAL RELATIONSHIPS H. J. Patel: Research Grant, Edwards Lifesciences Corporation, Medtronic, Inc, W. L. Gore & Associates, Inc; J. D. Schmoker: Speakers Bureau/Honoraria, Medtronic, Inc

1:16 PM

Valve-Sparing Root Replacement Using the Expandable Aortic Ring

Emmanuel Lansac, Paris, France

COMMERCIAL RELATIONSHIPS E. Lansac: Consultant/Advisory Board, CORONEO, Inc

REGULATORY DISCLOSURE This presentation will address the CORONEO device, EXTRA AORTIC annuloplasty ring, which has an FDA status of investigational.

1:24 PM

How I Do It: Valve-Sparing Aortic Root Replacement in a Bicuspid Aortic Valve

Joseph E. Bavaria, Philadelphia, PA

COMMERCIAL RELATIONSHIPS J. E. Bavaria: Research Grant, W. L. Gore & Associates, Inc

1:32 PM

Discussion

1:39 PM

Utilization of Hybrid Stent Grafts for the Aortic Arch

Robin Heijmen, Nieuwegein, Netherlands

1:47 PM

Cerebral Protection for Aortic Arch Surgery: Retrograde Cerebral Perfusion Is Optimal

Leonard N. Girardi, New York, NY

1:55 PM

Cerebral Protection for Aortic Arch Surgery: Antegrade Cerebral Perfusion Is Optimal

Joseph S. Coselli, Houston, TX

COMMERCIAL RELATIONSHIPS J. S. Coselli: Consultant/Advisory Board, Medtronic, Inc, Vascutek Terumo; Research Grant, Edwards Lifesciences Corporation, GlaxoSmithKline, Medtronic, Inc, W. L. Gore & Associates, Inc

2:03 PM

Discussion

2:10 PM

Single Limb and Multibranch Grafts in the Descending Aorta

Himanshu J. Patel, Ann Arbor, MI

COMMERCIAL RELATIONSHIPS H. J. Patel: Research Grant, Edwards Lifesciences Corporation, Medtronic, Inc, W. L. Gore & Associates, Inc

REGULATORY DISCLOSURE This presentation will address the W. L. Gore Thoracic Single Side Branch Device, which has an FDA status of investigational.

2:18 PM

How I Do It: Thoracic Endovascular Aortic Repair (TEVAR) for Type B Aortic Dissection

Bradley G. Leshnower, Atlanta, GA

COMMERICAL RELATIONSHIPS B. G. Leshnower: Speakers Bureau/Honoraria, Medtronic, Inc

2:25 PM

Type B Dissection: Open vs Endovascular Repair

Michael P. Fischbein, Stanford, CA

COMMERCIAL RELATIONSHIPS M. P. Fischbein: Speakers Bureau/Honoraria, St Jude Medical, Inc

2:33 PM

Transapical TEVAR for the Ascending Aorta

Wilson Y. Szeto, Philadelphia, PA

COMMERCIAL RELATIONSHIPS W. Y. Szeto: Research Grant, Edwards Lifesciences Corporation, Medtronic, Inc, SORIN GROUP; Consultant/Advisory Board, Micro Interventional Devices, Inc

REGULATORY DISCLOSURE This presentation will address the off-label use of thoracic stent grafts in the treatment of ascending aortic pathology using endovascular stent grafts.

2:40 PM

Discussion

2:44 PM

Closing Remarks

2:45 PM – 3:10 PM *Ballroom 20 Foyer*

BREAK—Visit STS/AATS Tech-Con 2015 Exhibits

3:10 PM – 4:30 PM *Ballroom 20D*

Adult Cardiac Track V: Ventricular Heart Devices

Moderators: *Nicholas G. Smedira, Cleveland, OH, and Y. Joseph Woo, Stanford, CA*

COMMERCIAL RELATIONSHIPS N. G. Smedira: Consultant/Advisory Board, Edwards Lifesciences Corporation

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3:10 PM

Welcome and Introduction

Nicholas G. Smedira, Cleveland, OH, and Y. Joseph Woo, Stanford, CA

COMMERCIAL RELATIONSHIPS N. G. Smedira: Consultant/Advisory Board, Edwards Lifesciences Corporation

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3:12 PM

Left Ventricular Assist Device (LVAD) for Class 3b Patients

Francis D. Pagani, Ann Arbor, MI

3:20 PM

LVAD Plus Stem Cells

Deborah Ascheim, New York, NY

COMMERCIAL RELATIONSHIPS D. Ascheim: Other, BackBeat Medical, Inc, Data & Safety Monitoring Board

REGULATORY DISCLOSURE This presentation will address the Mesoblast Revascor and the Celladon MYDICAR, which have FDA statuses of investigational.

3:28 PM

Transcutaneous Energy Transfer Technologies

Hari R. Mallidi, Houston, TX

3:36 PM

Lower Threshold for BiVAD Implantation

Evgenij P. Potapov, Berlin, Germany

REGULATORY DISCLOSURE This presentation will address the off-label use of HeartWare HVAD.

3:44 PM

Miniaturized Implantable Intracardiac LVAD

Mark S. Slaughter, Louisville, KY

3:52 PM

ReinHeart

Sotirios Spiliopoulos, Duisburg, Germany

REGULATORY DISCLOSURE This presentation will address the ReinHeart Total Artificial Heart, which is not FDA approved.

4:00 PM

Carmat Total Artificial Heart

Mark S. Slaughter, Louisville, KY

COMMERCIAL RELATIONSHIPS M. S. Slaughter: Consultant/Advisory Board, HeartWare, Inc; Research Grant, CARMAT

REGULATORY DISCLOSURE This presentation will address the CARMAT Total Artificial Heart, which is not FDA approved.

4:08 PM

How I Do It: LVAD Implantation

Nicholas G. Smedira, Cleveland, OH

COMMERCIAL RELATIONSHIPS N. G. Smedira: Consultant/Advisory Board, Edwards Lifesciences Corporation

4:16 PM

Discussion

4:26 PM

Closing Remarks

NOTES

6AM
7AM
8AM
9AM
10AM
11AM
12PM
1PM
2PM
3PM
4PM
5PM
6PM
7PM
8PM
9PM

7:00 AM – 6:00 PM
Registration: STS/AATS Tech-Con 2015 and STS 51st Annual Meeting

8:00 AM – 12:30 PM
STS/SCA: The Utility of Perioperative Echocardiography for Surgical Decision Making

8:00 AM – 3:00 PM
STS/CHEST: Primer on Advanced and Therapeutic Bronchoscopy—Theory and Hands-on Session

1:00 PM – 2:30 PM
Cardiopulmonary Bypass Simulation Course

New

Non-CME Session

7:00 AM – 6:00 PM **Registration: STS/AATS Tech-Con 2015 and STS 51st Annual Meeting**

8:00 AM – 12:30 PM **STS/SCA: The Utility of Perioperative Echocardiography for Surgical Decision Making**

8:00 AM – 3:00 PM **STS/CHEST: Primer on Advanced and Therapeutic Bronchoscopy—Theory and Hands-on Session**

1:00 PM – 2:30 PM **Cardiopulmonary Bypass Simulation Course**

7:00 AM – 6:00 PM *Lobby D*

Registration: STS/AATS Tech-Con 2015 and STS 51st Annual Meeting

8:00 AM – 12:30 PM *Room 32AB*

STS/SCA: The Utility of Perioperative Echocardiography for Surgical Decision Making

Anesthesiologist and cardiac surgeon teams will present cases that demonstrate the utility of perioperative echocardiography for facilitating perioperative surgical decision making. This course is presented by STS and the Society of Cardiovascular Anesthesiologists.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Recognize the utility of intraoperative echocardiography in diagnosing previously undiagnosed findings and guiding surgical decision making
- Explain how intraoperative echocardiography can be used to identify persistent or iatrogenic causes of valvular heart disease in the immediate post cardiopulmonary period and to guide clinical decision making
- Recognize the utility of echocardiography for refining the preoperative plan based upon intraoperative analysis of the primary indication for surgery

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The physician competencies addressed in this session are patient care and procedural skills, medical knowledge, and interpersonal and communication skills. These physician competencies will be addressed through a series of collaborative lectures by members of The Society of Thoracic Surgeons and the Society of Cardiovascular Anesthesiologists.

***Moderators**: Alina Nicoara, Durham, NC, and Stanton K. Shernan, Boston, MA*

COMMERCIAL RELATIONSHIPS S. K. Shernan: Other, e-echocardiography.com, Editor; Other, Philips Healthcare, Inc, Educator

***Faculty**: Vinay Badhwar, Pittsburgh, PA, Georges Desjardins, Salt Lake City, UT, and G. Burkhard Mackensen, Seattle, WA*

Session I

8:00 AM **Persistent Mitral Regurgitation After Mitral Valve Repair**
Stanton K. Shernan, Boston, MA
COMMERCIAL RELATIONSHIPS S. K. Shernan: Other, e-echocardiography.com, Editor; Other, Philips Healthcare, Inc, Educator

8:30 AM **Mitral Regurgitation in Patients Undergoing Aortic Valve Surgery**
G. Burkhard Mackensen, Seattle, WA

9:00 AM **New Mitral Stenosis After Mitral Valve Repair**
Stanton K. Shernan, Boston, MA
COMMERCIAL RELATIONSHIPS S. K. Shernan: Other, e-echocardiography.com, Editor; Other, Philips Healthcare, Inc, Educator

9:30 AM **Clinical Utility of Echocardiography in the ICU After Cardiac Surgery**
Georges Desjardins, Salt Lake City, UT

10:00 AM **Break**

Session II

10:30 AM **Aortic Valve—Repair or Replace?**
Georges Desjardins, Salt Lake City, UT

11:00 AM **Unsuspected Aortic Stenosis During Scheduled Coronary Artery Bypass Grafting Surgery**
Alina Nicoara, Durham, NC

11:30 AM **Mitral Valve Surgery or Myectomy Alone for Hypertrophic Obstructive Cardiomyopathy**
G. Burkhard Mackensen, Seattle, WA

12:00 PM **Systolic Anterior Motion After Aortic Valve Replacement**
Alina Nicoara, Durham, NC

8:00 AM – 3:00 PM ***Room 30E***

STS/CHEST: Primer on Advanced and Therapeutic Bronchoscopy—Theory and Hands-on Session

This course, offered in conjunction with the American College of Chest Physicians, will introduce participants to the theory and practice of endobronchial ultrasound (EBUS) and interventional bronchoscopy as relevant to the practicing thoracic surgeon. The target is the practicing surgeon who wishes to expand his or her scope of practice and become familiar with the increasing array of technological solutions for lung cancer staging and management of airway obstruction. A combination of lectures, case presentations, and simulation will be used to teach the basics of EBUS, EBUS-guided biopsy, and the management of airway obstruction by stenting and several modalities of tumor ablation. Hands-on workstations will be available for participants to gain exposure and familiarity with EBUS endoscopes, cryoablative technology, rigid bronchoscopes, and airway stent deployment.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Identify indications, yield, and complications of EBUS
- Recognize benefits and limitations of airway ablative modalities
- State the benefits and limitations of various airway stents

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The physician competencies addressed in this session are patient care and procedural skills, medical knowledge, and interpersonal and communication skills. These physician competencies will be addressed through a series of collaborative lectures and hands-on demonstrations led by members of The Society of Thoracic Surgeons and The American College of Chest Physicians.

***Moderators**: Momen M. Wahidi, Durham, NC, and Richard I. Whyte, Boston, MA*

COMMERCIAL RELATIONSHIPS M. M. Wahidi: Consultant/Advisory Board, Olympus America, Inc

8:00 AM **Welcome and Introduction**
Momen M. Wahidi, Durham, NC, and Richard I. Whyte, Boston, MA
COMMERCIAL RELATIONSHIPS M. M. Wahidi: Consultant/Advisory Board, Olympus America, Inc

8:10 AM **EBUS Mediastinal Anatomy**
Kazuhiro Yasufuku, Toronto, Canada
COMMERCIAL RELATIONSHIPS K. Yasufuku: Research Grant, Olympus America, Inc, Intuitive Surgical, Inc, Veran Medical Technologies, Inc, Siemens AG; Other Research Support, Novadaq Corp; Consultant/Advisory Board, Olympus America, Inc, Covidien Ltd, Ethicon, Inc

8:30 AM **EBUS/Transbronchial Needle Aspiration (TBNA)**
Momen M. Wahidi, Durham, NC
COMMERCIAL RELATIONSHIPS M. M. Wahidi: Consultant/Advisory Board, Olympus America, Inc

8:50 AM **Navigational Bronchoscopy and Radial EBUS**
Alexander C. Chen, St Louis, MO

9:20 AM **Panel Discussion**

9:40 AM **Break**

10:00 AM **Rigid Bronchoscopy**
Stephen R. Hazelrigg, Springfield, IL

10:20 AM **Therapeutic Endoscopy: Laser, Cryotherapy, Electrocautery, and Argon Plasma Coagulation (APC)**
Moishe A. Liberman, Montreal, Canada
COMMERCIAL RELATIONSHIPS M. A. Liberman: Research Grant, Ethicon Endo-Surgery, Inc

10:40 AM **Airway Stents**
Michael S. Mulligan, Seattle, WA
COMMERCIAL RELATIONSHIPS M. S. Mulligan: Consultant/Advisory Board, Covidien Ltd

11:00 AM **Foreign Body Removal**
David E. Ost, Houston, TX

11:20 AM **Endobronchial Valves for Air Leak**
Christine Argento, Atlanta, GA

11:40 AM **Panel Discussion**

12:00 PM **Lunch**

12:30 PM ***Room 30CD***

Hands-on Breakout Sessions

Station 1: EBUS/TBNA Airway Models
Kazuhiro Yasufuku, Toronto, Canada, and Robert E. Merritt, Columbus, OH
COMMERCIAL RELATIONSHIPS K. Yasufuku: Research Grant, Olympus America, Inc, Intuitive Surgical, Inc, Veran Medical Technologies, Inc, Siemens AG; Other Research Support, Novadaq Corp; Consultant/Advisory Board, Olympus America, Inc, Covidien Ltd, Ethicon, Inc

Station 2: Case Discussion
Momen M. Wahidi, Durham, NC, and Richard I. Whyte, Boston, MA
COMMERCIAL RELATIONSHIPS M. M. Wahidi: Consultant/Advisory Board, Olympus America, Inc

Station 3: Endobronchial Valves
Christine Argento, Atlanta, GA, and David E. Ost, Houston, TX

Station 4: Rigid Bronchoscopy and Stents
Michael S. Mulligan, Seattle, WA
COMMERCIAL RELATIONSHIPS M. S. Mulligan: Consultant/Advisory Board, Covidien Ltd

Station 5: Electrocautery, APC, and Cryotherapy
Alexander C. Chen, St Louis, MO, and Moishe A. Liberman, Montreal, Canada
COMMERCIAL RELATIONSHIPS M. A. Liberman: Research Grant, Ethicon Endo-Surgery, Inc

1:00 PM – 2:30 PM ***Room 31ABC***

Cardiopulmonary Bypass Simulation Course

Despite the extensive education of a cardiothoracic surgeon, only a small portion of that time is spent studying perfusion. And while there may always be a professional perfusionist in the operating room, it is important for the cardiothoracic surgeon, as team leader in the OR, to understand the role and implications of perfusion related to each procedure. To gain a behind-the-pump perspective, attendees will work together on a simulator to put a virtual patient on and off bypass. During the program, taught by a nationally recognized cardiothoracic surgeon and a perfusionist, a simulator will allow the attendees to experience common problems, as well as uncommon events, and learn how the perfusionist, surgeon, and anesthesiologist should interact effectively to solve problems.

This activity is open to residents, medical students, and any other participants who are part of an interprofessional team within the operating room.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Develop a systematic approach to initiating, maintaining, and separating from cardiopulmonary bypass
- Discuss how to diagnose and manage various crises and catastrophes that can occur while on cardiopulmonary bypass

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Course Director: *Thomas E. MacGillivray, Boston, MA*

NOTES

6AM
7AM
8AM
9AM
10AM
11AM
12PM
1PM
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9PM

7:00 AM – 6:30 PM
Registration: STS/AATS Tech-Con 2015 and STS 51st Annual Meeting

7:50 AM – 12:00 PM
Acquired and Congenital Heart Surgery Symposium: Challenges and Management of the Aorta in Adults With Congenital Heart Disease

7:50 AM – 12:00 PM
Practice Management Summit

7:50 AM – 12:00 PM
STS/AATS Critical Care Symposium: Essential Cardiac Critical Care Topics

1:00 PM – 4:00 PM
Residents Symposium: Transitioning From Residency to a Successful Practice

1:15 PM – 4:30 PM
Parallel Surgical Symposium: Congenital

1:15 PM – 4:30 PM
Parallel Surgical Symposium: General Thoracic

2:30 PM – 4:30 PM
CT Surgery Interprofessional Education Symposium: Multidisciplinary Team Approach to ECMO

2:00 PM – 6:30 PM
Scientific Posters Open

4:30 PM – 6:30 PM
Opening Reception in the STS Exhibit Hall

New

Non-CME Session

7:00 AM – 6:30 PM Registration: STS/AATS Tech-Con 2015 and STS 51st Annual Meeting

7:50 AM – 12:00 PM
- Acquired and Congenital Heart Surgery Symposium: Challenges and Management of the Aorta in Adults With Congenital Heart Disease
- Practice Management Summit
- STS/AATS Critical Care Symposium: Essential Cardiac Critical Care Topics

1:00 PM – 4:00 PM Residents Symposium: Transitioning From Residency to a Successful Practice

1:15 PM – 4:30 PM
- Parallel Surgical Symposium: Congenital
- Parallel Surgical Symposium: General Thoracic

2:00 PM – 6:30 PM Scientific Posters Open

2:30 PM – 4:30 PM CT Surgery Interprofessional Education Symposium: Multidisciplinary Team Approach to ECMO

4:30 PM – 6:30 PM Opening Reception in the STS Exhibit Hall

7:00 AM – 6:30 PM *Lobby D*

Registration: STS/AATS Tech-Con 2015 and STS 51st Annual Meeting

7:50 AM – 12:00 PM *Room 30CD*

Acquired and Congenital Heart Surgery Symposium: Challenges and Management of the Aorta in Adults With Congenital Heart Disease

The Symposium will encompass two sessions. The first session will focus on the thoracic aorta, specifically the dilated ascending aorta or the hypoplastic aortic arch and aortic isthmus with coarctation. Speakers who represent the adult cardiac and congenital heart surgery communities will discuss indications for surgery versus percutaneous approaches, a controversial topic that continues to evolve.

The second session will focus on the numerous clinical challenges to treating failing Fontan circulation in a growing patient population. An experienced congenital cardiologist will talk about the noncardiac evaluation, which contributes to selection for conventional surgery versus multiple organ transplant, and congenital heart surgeons will discuss unconventional surgical options, options for mechanical circulatory support, and multiple organ transplantation.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Identify the surgical indications and approaches for a dilated ascending aorta and bicuspid aortic valve disease
- Identify the surgical indications and techniques for a dilated ascending aorta in conotruncal anomalies
- Describe the percutaneous and surgical approaches to hypoplasia of the aortic arch or primary coarctation
- Explain a noncardiac evaluation in the preop evaluation for Fontan revision versus transplantation
- Discuss unconventional surgical options for failing Fontan circulation
- List current and future mechanical circulatory support strategies for single ventricle circulation
- State the indications and outcomes of multiorgan transplantation for failing Fontan circulation

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The physician competencies addressed in this session are patient care and procedural skills, medical knowledge, professionalism, and interpersonal and communication skills. These physician competencies will be addressed through a series of lectures that will focus on the dilated ascending aorta and the second session will focus on the clinical challenges to treating failing Fontan circulation.

***Moderators**: Emile A. Bacha, New York, NY, Christopher A. Caldarone, Toronto, Canada, Joshua L. Hermsen, Seattle, WA, and Thomas E. MacGillivray, Boston, MA*

COMMERCIAL RELATIONSHIPS E. A. Bacha: Consultant/Advisory Board, CorMatrix

7:50 AM **Welcome**
Joseph A. Dearani, Rochester, MN

8:00 AM **Ascending Aorta With Bicuspid Aortic Valve**
Joseph E. Bavaria, Philadelphia, PA
COMMERCIAL RELATIONSHIPS J. E. Bavaria: Research Grant, W. L. Gore & Associates, Inc

8:25 AM **Ascending Aorta With Conotruncal Anomalies**
Joseph A. Dearani, Rochester, MN

8:50 AM **Percutaneous Approaches to the Arch and Isthmus**
Grayson H. Wheatley, Philadelphia, PA
COMMERCIAL RELATIONSHIPS G. H. Wheatley: Consultant/Advisory Board, Bolton Medical, Inc, Medtronic, Inc

9:15 AM **Surgical Approaches to the Arch and Isthmus**
Hazim J. Safi, Houston, TX

9:40 AM **Break**

10:00 AM **Noncardiac Evaluation**
Michael Landzberg, Boston, MA

10:25 AM **Unconventional Surgery**
Brian E. Kogon, Atlanta, GA

10:50 AM **Ventricular Assist Devices—What's Now, What's Next**
Mark D. Rodefeld, Indianapolis, IN
COMMERCIAL RELATIONSHIPS M. D. Rodefeld: Ownership Interest, Vortronix Medical LLP

11:15 AM **Multiorgan Transplantation**
Stephanie M. Fuller, Philadelphia, PA

11:40 AM **Discussion**

7:50 AM – 12:00 PM ***Room 32AB***

Practice Management Summit

This session will help participants understand the changing health care practice landscape as it impacts cardiothoracic surgery. Participants will obtain a working knowledge of the Affordable Care Act, principles of leadership, contracting with health systems, health policy, and the productive management of health delivery units.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Describe the basic components of the Affordable Care Act
- Illustrate a working knowledge of surgeon health system contracts and restrictive covenants
- Explain principles of effective organizational leadership
- Describe the impact of health care reform on the cardiothoracic surgery practice
- Express the value of the cardiothoracic surgeon in an integrated health care delivery system
- Better approach the renegotiation of a second-term contract with a health care organization

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The physician competencies addressed in this session are professionalism and systems-based practice. These physician competencies will be addressed through a series of individual lectures that are meant to discuss concerns over the changes in health care that have impacted providers and hospitals. The program will have an open discussion forum at the end to encourage questions and participant discussion.

Moderators*: Greg A. Bowman, Pueblo, CO, Frank L. Fazzalari, Rochester, MI, Paul S. Levy, Jonesboro, AR, Drew Rector, Rockledge, FL, and V. Seenu Reddy, Nashville, TN*

COMMERCIAL RELATIONSHIPS G. A. Bowman: Employment, Parkview Medical Center; V. S. Reddy: Speakers Bureau/Honoraria, AstraZeneca, CryoLife, Inc

7:50 AM **Introduction**
Frank L. Fazzalari, Rochester, MI

8:00 AM **Basics of the Affordable Care Act/Free Market**
Chris McBride, Denver, CO

8:20 AM **Contracts and Restrictive Covenants**
Mike Heaton, Indianapolis, IN

8:40 AM **Work Relative Value Unit Employment Models: A Bad Choice for Cardiothoracic Surgeons**
Michael G. Moront, Toledo, OH

9:00 AM **The Value of the CT Surgeon Leader in an Integrated Delivery System**
Drew Rector, Rockledge, FL

9:20 AM **One Surgeon's Observations on Leadership From Public, Private, and Nonprofit Perspectives**
James B. Peake, Washington, DC

9:40 AM **Panel Discussion**

10:10 AM **Break**

10:20 AM **Washington Perspective: Health Policy in the Final Years of the Obama Presidency and Longer-Term Outlook**
Joseph Antos, Washington, DC

10:40 AM **The Real Economics of Care Delivery**
Paul Taheri, New Haven, CT

11:00 AM **A Realistic, Practical Assessment of Health Care Reform on Cardiothoracic Surgery**
Nathan Kaufman, San Diego, CA

11:20 AM **Transitions From Practice: Pathway Opportunities Outside of the OR**
Stephen C. Yang, Baltimore, MD

11:40 AM **Panel Discussion**

7:50 AM – 12:00 PM ***Room 30E***

STS/AATS Critical Care Symposium: Essential Cardiac Critical Care Topics

This symposium will focus on how to develop a successful cardiothoracic Intensive Care Unit (CT ICU). Topics include endocarditis, glycemic control, nutritional therapy, and delirium in the postoperative cardiothoracic patient. This symposium will be relevant for university- and non-university-based practices. Special attention will be given to providing practical information germane to the entire interdisciplinary team that cares for patients in the CT ICU.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Interpret key echocardiographic imaging findings, medical therapy indications and limitations, and the utility of surgical procedures in patients with native and prosthetic valve endocarditis
- Discuss the importance of appropriate glycemic control in CT ICU patients and gain knowledge of the practical implementation of glycemic protocol relevant to their clinical context
- Describe the importance of appropriate timely nutritional therapy in CT ICU patients and gain knowledge of the practical implementation of nutrition protocols relevant to their clinical context
- Explain the impact of postoperative delirium in the postoperative cardiothoracic patient and gain knowledge of the practical implementation of early mobilization protocols and clinical pathways to identify patients at high risk of developing postoperative delirium

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The physician competencies addressed in this session are patient care and procedural skills, medical knowledge, practice-based learning and improvement, professionalism, and systems-based practice. These physician competencies will be addressed through a series of collaborative lectures by members of The Society of Thoracic Surgeons and the American Association for Thoracic Surgery. These lectures are meant to advance knowledge and expertise in the complex field of cardiothoracic critical care. A moderated poster session, panel discussions, and questions from the audience will augment these competencies.

***Moderators**: Rakesh Arora, Winnipeg, Canada, Kevin W. Lobdell, Charlotte, NC, and Vassyl A. Lonchyna, Chicago, IL*

COMMERCIAL RELATIONSHIPS R. Arora: Research Grant, Manitoba Health Research Council (MHRC), Manitoba Medical Service Foundation (MMSF), Research Salary Award (MHRC/MMSF), Pfizer Canada Inc, TECHVALUENET; V. A. Lonchyna: Ownership Interest, Abbott Laboratories, Hospira

7:50 AM **Welcome and Introduction**
Kevin W. Lobdell, Charlotte, NC

8:00 AM **Diagnosis and Medical Therapy for the Treatment of Endocarditis**
Emily Langdon, Chicago, IL

8:15 AM **Echocardiography Assessment of Endocarditis**
John Symanski, Charlotte, NC

8:30 AM **Why Is Endocarditis a Surgical Problem? Aggressive Surgical Approach to Endocarditis**
Gosta Pettersson, Cleveland, OH

8:50 AM **Question and Answer Session**

9:00 AM **The "Correct" Way of Nutritional Support in the CT ICU**
Krishnan Sriram, Chicago, IL

9:20 AM **Current Practice of Nutritional Therapy in the Johns Hopkins CT ICU**
Emily Stewart, Baltimore, MD

9:30 AM **Question and Answer Session**

9:45 AM **The New Era of Glycemic Control in the CT ICU**
Kevin W. Lobdell, Charlotte, NC

9:50 AM **Current "State of the Art" Strategies for Glycemic Control in the CT ICU**
Harold L. Lazar, Boston, MA
COMMERCIAL RELATIONSHIPS H. L. Lazar: Research Grant, Eli Lilly and Company

10:10 AM **The Way We Do It**
Natasha Brooks, Charlotte, NC, and Elizabeth Martin, Chicago, IL

10:20 AM **Question and Answer Session**

10:30 AM **Break**

10:45 AM **Delirium 101**
Jose Maldonado, Stanford, CA
REGULATORY DISCLOSURE This presentation will address the off-label use of various antipsychotic agents, various alpha-2 agonist agents, and various anticonvulsant agents in the prevention and management of delirium. Of note, to date, the FDA has not approved any pharmacological agent for the management of delirium.

11:00 AM **ABCDE Bundle: Mobilization in the ICU**
Biren Kamdar, Los Angeles, CA

11:15 AM **Developing a Delirium Strategy in Your CT ICU**
Rakesh Arora, Winnipeg, Canada
COMMERCIAL RELATIONSHIPS R. Arora: Research Grant, Manitoba Health Research Council (MHRC), Manitoba Medical Service Foundation (MMSF), Research Salary Award (MHRC/MMSF), Pfizer Canada Inc, TECHVALUENET

11:25 AM **Question and Answer Session**

11:45 AM **Moderated Critical Care Poster Session**
Vassyl A. Lonchyna, Chicago, IL, and Nevin M. Katz, Baltimore, MD
COMMERCIAL RELATIONSHIPS V. A. Lonchyna: Ownership Interest, Abbott Laboratories, Hospira

1:00 PM – 4:00 PM ***Room 28CD***

Residents Symposium: Transitioning From Residency to a Successful Practice

This symposium will provide cardiothoracic surgery residents with practical information regarding the transition from residency to practice. The first session will include talks related to the job search: how to find the right position, interviewing tips, and negotiating a contract. The second session will include talks related to transitioning into practice: how to bring new technologies to a practice, team building, and early career development. Each session will be followed by small group table discussions led by experienced surgeons and a larger group discussion with the speakers.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Plan a successful job search
- Understand the important elements of a contract
- Discuss the necessary aspects of bringing new technologies into a practice
- Identify the important aspects of early career development

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The physician competencies addressed in this session are medical knowledge and professionalism. These physician competencies will be addressed through a series of individual lectures that will address practical early career information.

***Moderators**: Sidharta P. Gangadharan, Boston, MA, Sandra L. Starnes, Cincinnati, OH, and Ara A. Vaporciyan, Houston, TX*

1:00 PM **Introduction**
Sidharta P. Gangadharan, Boston, MA, Sandra L. Starnes, Cincinnati, OH, and Ara A. Vaporciyan, Houston, TX

1:05 PM **How to Find a Position**
Danny Chu, Pittsburgh, PA, and Raja R. Gopaldas, Columbia, MO

1:25 PM **Keys to a Successful Interview**
TBA

1:45 PM **What You Need to Know About Contracts**
Faiz Y. Bhora, New York, NY

2:05 PM **Breakout Sessions**

2:25 PM **Group Discussion**

2:40 PM **Evaluation Completion/Break**

2:50 PM **Team Building and Adding New Technologies**
Edward P. Chen, Atlanta, GA

3:10 PM **Early Career Development**
Elizabeth A. David, Sacramento, CA

3:30 PM **Breakout Sessions**

3:45 PM **Group Discussion**

3:55 PM **Evaluation Completion**

1:15 PM – 4:30 PM ***Room 32AB***

Parallel Surgical Symposium: Congenital

Congenital Heart Surgery Rounds: Problems, Choices, Action

The symposium will simulate "Monday Morning Rounds," where problems are complex, choices must be made, and action undertaken. The agenda will alternate between the presentation of "Tough Problems" and "Clinical Scenarios." Tough Problems will feature presentations from experts on how they've treated difficult clinical problems. For the Clinical Scenarios, volunteers will present a real clinical scenario and at least three reasonable courses of action. Ad hoc panelists, who will not have advance knowledge of the case, will be called upon to select a course of action. Audience members will then be able to share their opinion via electronic polling. Finally, the staff surgeon involved in the clinical scenario will describe the actual course of action taken.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Identify options for managing interrupted aortic arch with ventricular septal defect and left ventricular outflow tract obstruction
- Describe options for managing neonatal pulmonary atresia with intact ventricular septum, coronary anomalies, and diminished ventricular function
- Explain options for managing hypoplastic left heart syndrome after stage I palliation with diminished ventricular function, ventilator dependence, and tricuspid insufficiency
- Discuss options for managing borderline hypoplastic left ventricle after two-ventricle repair with residual left-sided lesions
- Identify options after failed repair of obstructed pulmonary veins

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The physician competencies addressed in this session are patient care and procedural skills, medical knowledge, and systems-based practice. These physician competencies will be addressed through a series of clinical scenarios and tough problems that will focus on pertinent and controversial topics in congenital heart disease, pediatric heart surgery, postoperative management, and decision-making. Panel discussions and questions from the audience will augment these competencies.

***Moderators**: Christopher A. Caldarone, Toronto, Canada, Jonathan M. Chen, Seattle, WA, and Andrew C. Fiore, St Louis, MO*

1:15 PM **Introductory Remarks**
Christopher A. Caldarone, Toronto, Canada, Jonathan M. Chen, Seattle, WA, and Andrew C. Fiore, St Louis, MO

1:20 PM **Tough Problem 1: Infant with interrupted aortic arch and ventricular septal defect with left ventricular outflow tract obstruction**
Ralph S. Mosca, New York, NY

1:40 PM **Clinical Scenario 1**

1:55 PM **Tough Problem 2: Neonate with pulmonary atresia-intact ventricular septum with right ventricular dependent coronary circulation and diminished left ventricular function**
James S. Tweddell, Milwaukee, WI
COMMERCIAL RELATIONSHIPS J. S. Tweddell: Consultant/Advisory Board, CorMatrix

2:15 PM **Clinical Scenario 2**

2:25 PM **Tough Problem 3: Infant on a ventilator, blood type O, with hypoplastic left heart syndrome after Norwood stage I with diminished ventricular function and severe tricuspid regurgitation**
Glen S. Van Arsdell, Toronto, Canada
COMMERCIAL RELATIONSHIPS G. S. Van Arsdell: Ownership Interest, CellAegis Devices, Inc, Medtronic, Inc

2:45 PM **Clinical Scenario 3**

3:00 PM **Break**

3:15 PM **Tough Problem 4: Infant with borderline left ventricle by size converted to a two-ventricle repair, now with left atrial hypertension, moderate aortic stenosis and regurgitation, and moderate mitral stenosis**
Pedro J. del Nido, Boston, MA
COMMERCIAL RELATIONSHIPS P. J. del Nido: Consultant/Advisory Board, CorAux Technologies

3:35 PM **Clinical Scenario 4**

3:50 PM **Tough Problem 5: Infant with recurrent pulmonary vein stenosis after a sutureless repair of post-repair pulmonary vein stenosis**
Christopher A. Caldarone, Toronto, Canada

4:10 PM **Clinical Scenario 5**

4:25 PM **Concluding Remarks**
Christopher A. Caldarone, Toronto, Canada, Jonathan M. Chen, Seattle, WA, and Andrew C. Fiore, St Louis, MO

1:15 PM – 4:30 PM ***Room 33ABC***

Parallel Surgical Symposium: General Thoracic

This symposium will focus on issues that are pertinent to today's practicing thoracic surgeon and will help attendees address gaps in knowledge on the current treatment of esophageal cancer, the approach to complex resections for lung cancer, and the management of challenging situations in thoracic surgery.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Describe the treatment of early stage esophageal cancer, as well as alternative conduits for esophageal replacement, the effect of the new staging system on treatment decisions, and pitfalls to avoid during minimally invasive esophagectomy
- Outline the management of ground glass pulmonary lesions and the indications and best approaches for segmentectomy, en bloc resection of locally advanced lung cancer, and bronchial sleeve resection
- Describe the repair of a pulmonary artery injury during thoracoscopic lobectomy, airway injury during esophagectomy, and the management of esophageal perforations and intraoperative positive margins

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The physician competencies addressed in this session are patient care and procedural skills, medical knowledge, and systems-based practice. These physician competencies will be addressed through a series of individual lectures that will address issues in thoracic surgery that are commonly encountered in daily practice. Questions from the audience will augment these competencies.

Moderators: *Leah M. Backhus, Seattle, WA, Jules Lin, Ann Arbor, MI, and Joseph B. Shrager, Stanford, CA*

1:15 PM **How the New Staging System Changes Treatment: Update on Esophageal Cancer**
Rishindra M. Reddy, Ann Arbor, MI
COMMERCIAL RELATIONSHIPS R. M. Reddy: Research Grant, GlaxoSmithKline; Speakers Bureau/Honoraria, Covidien Ltd

1:30 PM **Treatment of Early Stage Disease: Update on Esophageal Cancer**
Steven R. Demeester, Los Angeles, CA

1:45 PM **When the Stomach Is Not Available: Update on Esophageal Cancer**
Shanda H. Blackmon, Rochester, MN

2:00 PM **Minimally Invasive Esophagectomy Tips and Tricks: Update on Esophageal Cancer**
TBA

2:15 PM **Segmentectomy Tips and Tricks: Pearls in Lung Cancer Resection**
Robert J. McKenna, Los Angeles, CA

2:30 PM **Pulmonary Artery Injury During VATS Lobectomy: Complicated Scenarios in Thoracic Surgery**
Michael S. Mulligan, Seattle, WA
COMMERCIAL RELATIONSHIPS M. S. Mulligan: Consultant/Advisory Board, Covidien Ltd

2:45 PM **Resecting Locally Invasive Lung Cancer: Pearls in Lung Cancer Resection**
Garrett L. Walsh, Houston, TX

3:00 PM **Management of Ground Glass Lesions: Pearls in Lung Cancer Resection**
Nasser K. Altorki, New York, NY

3:15 PM **Break**

3:30 PM **Bronchial and Pulmonary Arterial Sleeve Resections: Pearls in Lung Cancer Resection**
G. Alexander Patterson, St Louis, MO

3:45 PM **Airway Injury During Esophagectomy: Complicated Scenarios in Thoracic Surgery**
Jules Lin, Ann Arbor, MI
REGULATORY DISCLOSURE This presentation will discuss the off-label use of LifeCell Alloderm tissue matrix to repair the membranous trachea after the development of a large tracheogastic fistula after a transhiatal esophagectomy.

4:00 PM **How to Manage Positive Margins During Thoracic Surgery: Complicated Scenarios in Thoracic Surgery**
Mark K. Ferguson, Chicago, IL
COMMERCIAL RELATIONSHIPS M. K. Ferguson: Nonremunerative Position of Influence, CTSNet.org, Officer and editor; Other, Elsevier, Springer, I receive royalties and a stipend for editorial services

4:15 PM **Management of Esophageal Perforations: Complicated Scenarios in Thoracic Surgery**
Thomas K. Varghese Jr, Seattle, WA

2:00 PM – 6:30 PM ***Rooms 29-32 Foyer***

Scientific Posters Open

2:30 PM – 4:30 PM ***Room 30E***

CT Surgery Interprofessional Education Symposium: Multidisciplinary Team Approach to ECMO

The 4th annual CT Surgery Interprofessional Education Symposium will take an in-depth look at the world of extracorporeal membrane oxygenation (ECMO) from different angles of the multidisciplinary heart team. The Symposium will offer lectures, as well as scenario-based virtual simulation and ECMO basics.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Recognize ECMO candidates as well as types of ECMO to use
- Discuss ECMO basics, such as the role of the oxygenator, the need for anticoagulation, and cannulation techniques
- Identify parameters required to wean patients
- Identify and troubleshoot ECMO complications
- Recognize the requirements and constraints for development of an ECMO program

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

The physician competencies addressed in this session are patient care and procedural skills, medical knowledge, professionalism, and interpersonal and communication skills. These physician competencies will be addressed through a series of lectures and a simulation session that is meant to enhance the understanding of the evolving roles within the interprofessional team.

***Moderators**: Diane E. Alejo, Baltimore, MD, Nicole M. Michaud, Franklin, TN, and Harmik J. Soukiasian, Los Angeles, CA*

2:30 PM **Who Is a Candidate for ECMO and What Type of ECMO?**
Daphne Hardison, Franklin, TN

2:45 PM **The ABCs of an ECMO Circuit**
Britt McIlwain, Trussville, AL

3:00 PM **The Window of Opportunity: When to Wean and When Not to Wean**
William T. Costello, Nashville, TN

3:15 PM **Establishing an ECMO Program**
Kenton J. Zehr, Baltimore, MD

3:30 PM **Simulation Session**
Jeffrey Riley, Rochester, MN
REGULATORY DISCLOSURE This presentation will discuss the off-label use of pumps and oxygenators for longer than 6 hours in ECMO.

4:10 PM **Panel Discussion**

4:30 PM – 6:30 PM ***Exhibit Hall***

Opening Reception in the STS Exhibit Hall

NOTES

MONDAY AT A GLANCE

6AM

6:30 AM – 5:00 PM
Registration: STS 51st Annual Meeting

7AM

7:00 AM – 7:15 AM
Opening Remarks

7:15 AM – 8:15 AM
J. Maxwell Chamberlain Memorial Papers

8AM

8:15 AM – 9:00 AM
Richard E. Clark Papers

9:30 AM – 9:40 AM
The Annals of Thoracic Surgery 50th Anniversary Presentation

9AM

9:00 AM – 4:30 PM
Exhibits Open

9:40 AM – 9:50 AM
Introduction of the President: Mark S. Allen

10AM

9:50 AM – 10:50 AM
Presidential Address: David A. Fullerton

Scientific Posters Open

11AM

11:30 AM – 12:30 PM

Adult Cardiac Session: Arrhythmia	Adult Cardiac Session: Heart Failure	Basic Science Research: Adult Cardiac	Basic Science Research: General Thoracic	Congenital Session: Adult Congenital	Critical Care	General Thoracic Session: New Techniques	STS/CATS/CSCS

12PM

1PM

1:30 PM – 3:30 PM

Adult Cardiac Session: Aortic	Adult Cardiac Session: Ischemic	Congenital Session: Pediatric Congenital I	General Thoracic Session: Lung Cancer I	General Thoracic Session: Lung Transplantation	Managing Cardiogenic Shock or Pulmonary Failure	STS/SCA: Considerations in Perioperative Resuscitation of Cardiothoracic Patients

1:15 PM – 5:15 PM
ACC @ STS

1:15 PM – 5:15 PM
Evidence and Quality Reshaping Practice

2PM

3PM

4PM

4:15 PM – 5:15 PM
Surgical Motion Picture Matinees: Adult Cardiac, Congenital, and General Thoracic

4:15 PM – 5:15 PM
Late-Breaking Abstract Session

5PM

5:00 PM – 6:30 PM
Scientific Posters and Wine

5:30 PM – 6:30 PM
Business Meeting (STS Members Only)

6PM

6:45 PM – 7:45 PM
STS-PAC Reception

7PM

7:00 PM – 10:00 PM
STS Social Event: USS Midway Aircraft Carrier Museum

8PM

9PM

New Non-CME Session

6:30 AM – 5:00 PM	Registration: STS 51st Annual Meeting
7:00 AM – 7:15 AM	Opening Remarks
7:15 AM – 8:15 AM	J. Maxwell Chamberlain Memorial Papers
8:15 AM – 9:00 AM	Richard E. Clark Papers
9:00 AM – 4:30 PM	Exhibits Open Scientific Posters Open
9:30 AM – 9:40 AM	*The Annals of Thoracic Surgery* 50th Anniversary Presentation
9:40 AM – 9:50 AM	Introduction of the President: Mark S. Allen
9:50 AM – 10:50 AM	Presidential Address: David A. Fullerton
11:30 AM – 12:30 PM	Adult Cardiac Session: Arrhythmia Adult Cardiac Session: Heart Failure Basic Science Research: Adult Cardiac Basic Science Research: General Thoracic Congenital Session: Adult Congenital Critical Care General Thoracic Session: New Techniques STS/CATS/CSCS: Current and Future Workforce Issues in Cardiothoracic Surgery—Staff and Resident Perspectives From Canada and the US
1:15 PM – 5:15 PM	ACC @ STS Evidence and Quality Reshaping Practice
1:30 PM – 3:30 PM	Adult Cardiac Session: Aortic Adult Cardiac Session: Ischemic Congenital Session: Pediatric Congenital I General Thoracic Session: Lung Cancer I General Thoracic Session: Lung Transplantation Managing Cardiogenic Shock or Pulmonary Failure: Short-Term Mechanical Circulatory Support STS/SCA: Considerations in Perioperative Resuscitation of Cardiothoracic Patients
4:15 PM – 5:15 PM	Surgical Motion Picture Matinees: Adult Cardiac, Congenital, and General Thoracic Late-Breaking Abstract Session
5:00 PM – 6:30 PM	Scientific Posters and Wine
5:30 PM – 6:30 PM	Business Meeting (STS Members Only)
6:45 PM – 7:45 PM	STS-PAC Reception
7:00 PM – 10:00 PM	STS Social Event: USS Midway Aircraft Carrier Museum

6:30 AM – 5:00 PM *Lobby D*

Registration: STS 51st Annual Meeting

9:00 AM – 4:30 PM *Exhibit Hall*

Exhibits Open

9:00 AM – 4:30 PM *Rooms 29-32 Foyer*

Scientific Posters Open

7:00 AM – 10:50 AM *Ballroom 20ABC*

General Session I

Moderators: *David A. Fullerton, Aurora, CO, and Keith S. Naunheim, St Louis, MO*

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

Presenting authors are listed in **bold** on each abstract.

The physician competencies addressed in this session are patient care and procedural skills, medical knowledge, and professionalism. These physician competencies will be addressed through a series of individual lectures and focused discussion on key points of presentations.

7:00 AM *Ballroom 20ABC*

Opening Remarks

7:15 AM *Ballroom 20ABC*

J. Maxwell Chamberlain Memorial Paper for General Thoracic Surgery

Comparison of The Society of Thoracic Surgeons General Thoracic Surgery Database and the American College of Surgeons National Surgical Quality Improvement Program in a General Thoracic Surgical Practice

M. S. Allen*, F. C. Nichols, S. D. Cassivi, K. Shen, D. A. Wigle*

Mayo Clinic, Rochester, MN

Discussant: *Joe B. Putnam Jr, Nashville, TN*

COMMERCIAL RELATIONSHIPS J. B. Putnam: Consultant/Advisory Board, GlaxoSmithKlein; Employment, Various parties, Legal review/expert witness

Purpose: Improving the quality of surgical care is an important endeavor. The purpose of this study was to compare data from the American College of Surgeons National Surgical Quality Improvement Program (NSQIP) and The Society of Thoracic Surgeons General Thoracic Surgery Database (STS-GTSD) to determine if the measurements and conclusions are similar.

Methods: A common data abstractor collected and recorded 2012 data from NSQIP and the STS-GTSD for our institution. The data were de-identified and analyzed for demographics, preoperative risk factors, mortality, and morbidity.

Results: The STS-GTSD recorded 1,595 (100%) operations for the year 2012, whereas NSQIP recorded 308 (19.3%). Postoperative events were recorded in 17.2% of NSQIP patients and 30.1% in STS-GTSD patients. For the data regarding specific operations, NSQIP introduced significant error in the reporting of both morbidity and mortality. For example, NSQIP underestimated the pneumonia rate for lobectomy (5.9% vs 10.9%) and overestimated the pneumonia rate for an Ivor Lewis esophagogastrectomy (23.8% vs

18.8%). When our institution's NSQIP data were compared to NSQIP national norms, our institution was ranked in the lowest 8th decile for 30-day operative mortality; however, when all of our operations were used and compared to the STS-GTSD national norms, we were better than average (1.2% [2/162] vs 1.4% [538/37,324] for pulmonary resections and 3.0% [3/100] vs 3.6% [138/3,865] for esophagectomy).

Conclusions: Partial databases, such as NSQIP, may be useful for general data analysis; however, for specific operations, complete databases, such as the STS-GTSD, are necessary for meaningful quality improvement initiatives. National comparisons should be used with caution when using partial databases.

All Patients	NSQIP (n=309)		STS (n=1595)	
	#	%	#	%
Operative mortality	5	1.6%	26	1.6%
UTI	5	1.6%	59	3.7%
SSI (Deep or Organ space)	4	1.3%	15	0.9%
Pneumonia	13	4.2%	80	5.0%
> 48 Hrs on Vent*	11	3.6%	22	1.4%

Lobectomy (32480)	NSQIP (n=34)		STS (n=128)	
	#	%	#	%
Operative mortality	0	0.0%	1	0.8%
UTI	1	2.9%	7	5.5%
SSI (Deep or Organ space)	0	0.0%	0	0.0%
Pneumonia	2	5.9%	14	10.9%
> 48 Hrs on Vent	1	2.9%	1	0.8%

All Pulmonary Resections	NSQIP (n=162)		STS (n=619)	
	#	%	#	%
Operative mortality	2	1.2%	6	1.0%
UTI	4	2.5%	29	4.9%
SSI (Deep or Organ space)	2	1.2%	4	0.7%
Pneumonia	5	3.1%	34	5.8%
> 48 Hrs on Vent	5	3.1%	6	1.0%

VATS Wedge (32663)	NSQIP (n=21)		STS (n=74)	
	#	%	#	%
Operative mortality	0	0.0%	0	0.0%
UTI	0	0.0%	4	5.4%
SSI (Deep or Organ space)	0	0.0%	2	2.7%
Pneumonia	1	4.8%	5	6.8%
> 48 Hrs on Vent	1	4.8%	1	1.4%

All Esophageal Resections	NSQIP (n=29)		STS (n=100)	
	#	%	#	%
Operative mortality	3	10.3%	3	3.0%
UTI	1	3.4%	6	6.0%
SSI (Deep or Organ space)	1	3.4%	6	6.0%
Pneumonia*	7	24.1%	7	7.0%
> 48 Hrs on Vent	3	10.3%	3	3.0%

*p<0.05

Ivor Lewis (43117)	NSQIP (n=21)		STS (n=69)	
	#	%	#	%
Operative mortality	2	9.5%	2	2.9%
UTI	0	0.0%	3	4.3%
SSI (Deep or Organ space)	1	4.8%	3	4.3%
Pneumonia	5	23.8%	13	18.8%
> 48 Hrs on Vent	2	9.5%	2	2.9%

Laparoscopic Nissen (43281)	NSQIP (n=23)		STS (n=84)	
	#	%	#	%
Operative mortality	0	0.0%	1	1.2%
UTI	0	0.0%	3	3.6%
SSI (Deep or Organ space)	1	4.3%	1	1.2%
Pneumonia	0	0.0%	1	1.2%
> 48 Hrs on Vent	1	4.3%	1	1.2%

7:35 AM ***Ballroom 20ABC***

J. Maxwell Chamberlain Memorial Paper for Adult Cardiac Surgery

Over 3 Decades of Follow-Up Demonstrates Improved Survival With Bilateral vs Single Internal Mammary Artery Grafting in Elderly Patients

P.A. Kurlansky[1], *E. Traad*[1], *M. J. Dorman*[2], *D. Galbut*[1], *G. Ebra*[1]

[1]*Florida Heart Research Institute, Miami,* [2]*Palm Beach Gardens Hospital, Boynton Beach, FL*

Discussant: *Robert A. Guyton, Atlanta, GA*

COMMERCIAL RELATIONSHIPS R. Guyton: Consultant/Advisory Board, Medtronic, Inc

Purpose: Extensive evidence documents a survival benefit for bilateral internal mammary artery (BIMA) grafting compared to single IMA (SIMA) grafting for patients with advanced coronary artery disease. However, controversy continues to exist regarding the incremental benefit of BIMA grafting in elderly patients.

Methods: A retrospective analysis was conducted of 4,503 consecutive isolated coronary artery bypass grafting (CABG) operations (SIMA n=2,340 and BIMA n=2,163) performed from 1972 to 1994. Multivariate analysis was used to created propensity score-matched groups of SIMA (n=1,063) and BIMA (n=1,063) patients 65 years of age and over, and 70 years of age and over (n=612, SIMA and BIMA), with similar baseline characteristics. Survival status was obtained by periodic follow-up, query of the U.S. National Death Index and other internet searches, and was 99.6% complete. The influence of age on late mortality was assessed by Cox proportional hazards regression analysis, and Kaplan-Meier survival curves between matched groups were compared.

Results: The propensity score-matched groups experienced similar perioperative mortality and morbidity. Survival benefits were found for BIMA vs SIMA grafting across both age categories. Actuarial curves after 23,593 patient-years of follow-up (mean BIMA=11.7 years; 6 weeks-33.1 years; SIMA=10.5 years; 6 weeks-30.7 years) demonstrated improved long-term survival for BIMA vs SIMA patients (10-year survival 60.1% ± 1.5% vs 50.2% ± 1.5%; 20-year survival 12.0% ± 1.0% vs 10.3% ± 1.0%; $p < 0.001$; Figure A). Similarly, in matched groups of patients age 70 and over, overall survival was also enhanced with BIMA grafting ($p = 0.005$; Figure B).

Conclusions: Advanced age should not be considered a contraindication for BIMA grafting. Long-term follow-up clearly demonstrates that BIMA grafting, when broadly applied in elderly patients, results in improved long-term survival.

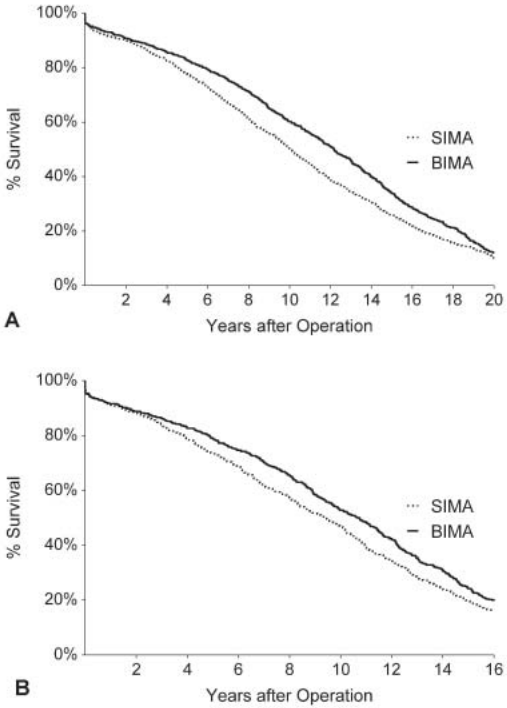


FIGURE 1. A. Actuarial survival of SIMA versus BIMA patients 65 years of age and older. B. Actuarial survival of SIMA versus BIMA patients 70 years of age and older.

7:55 AM **Ballroom 20ABC**

J. Maxwell Chamberlain Memorial Paper for Congenital Heart Surgery

Improving Cardiac Surgical Site Infection Diagnosis, Adjudication, and Reporting by Using Registry Data for Case Ascertainment

***V. Nayar**, A. T. Kennedy, J. Pappas, K. D. Atchley, C. Field, S. Smathers, E. Teszner, J. Sammons, S. Coffin, J. Gerber, T. L. Spray, J. Steven, L. Bell, J. Forrer, F. Gonzalez, A. Chi, W. J. Nieczpiel, J. Martin, J. Gaynor*

The Children's Hospital of Philadelphia, PA

***Discussant:** Donald S. Likosky, Ann Arbor, MI*

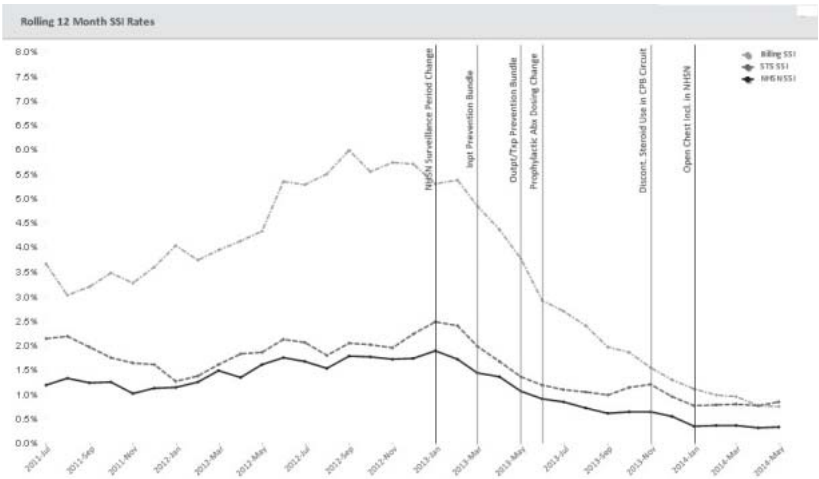
COMMERCIAL RELATIONSHIPS D. S. Likosky: Research Grant, Agency for Healthcare Research and Quality (AHRQ); Speakers Bureau/Honoraria, SpecialtyCare; Consultant/Advisory Board, American Society of Extracorporeal Technology

Purpose: We have shown that use of administrative data in isolation for surgical site infection (SSI) surveillance leads to inaccurate reporting of SSI rates. A quality improvement (QI) initiative was conducted to link clinical registry and administrative databases to facilitate SSI surveillance and improve the identification and adjudication of SSIs.

Methods: The Society of Thoracic Surgeons Congenital Heart Surgery Database (STS-CHSD) and our infection surveillance database for National Healthcare Safety Network (NHSN) reporting were linked to electronic health record (EHR) billing data. A data visualization tool was created to: 1) use the STS-CHSD for case ascertainment; 2) resolve discrepancies among STS-CHSD, infection surveillance, and billing SSI cases; and 3) accurately assess the impact of QI initiatives. QI interventions included wound alert reports from the EHR, bedside reviews for SSI adjudication, inpatient and outpatient SSI prevention bundles, prophylactic antibiotic dosing changes, removal of steroids from bypass circuit, and biller education on SSIs.

Results: Over the 47-month study period, 156 SSIs were identified via the STS-CHSD, 79 via the infection surveillance database, and 433 via billing. The rolling 12-month SSI rate based on the STS-CHSD decreased from 2.48% (21/848, Jan 2013) to 0.76% (11/1,442, Jan 2014) (Figure). Control charts in the data visualization tool allowed for statistical monitoring of SSI rate changes. SSI case discrepancies across the databases were reviewed to ensure that differences were due to variations in SSI reporting criteria for each database, not inaccurate surveillance population ascertainment or inaccurate SSI identification. Workflow changes, including the wound alert report and bedside reviews, facilitated communication among providers and improved adjudication of suspected SSIs. Education of hospital billing coders on SSI chart documentation led to more accurate coding and narrowed variation among the three SSI rates. The data visualization tool demonstrated clear temporal relationships between QI initiatives and changes in SSI rates.

Conclusions: Linkage of registry and infection control surveillance data with the EHR improves SSI surveillance. The visualization tool along with workflow changes improved communication, facilitated adjudication of SSIs, and allowed assessment of the impact of QI initiatives to prevent SSIs. Implementation of these QI initiatives was associated with decreased SSI rates.


Rolling 12 Month SSI Rates
8.0%
7.5%
7.0%
6.5%
6.0%
5.5%
5.0%
4.5%
4.0%
3.5%
3.0%
2.5%
2.0%
1.5%
1.0%
0.5%
0.0%
NpSN Surveillance Period Change
Inpt Prevention Bundle
Outpt/Tep Prevention Bundle
Prophylactic Abx Dosing Change
Discont. Steroid Use in CPB Circuit
Open Chest incl. in NHSN
Billing SSI
STS SSI
NHSN SSI
2011-Jul
2011-Sep
2011-Nov
2012-Jan
2012-Mar
2012-May
2012-Jul
2012-Sep
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2013-Jan
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2013-Jul
2013-Sep
2013-Nov
2014-Jan
2014-Mar
2014-May

8:15 AM **Ballroom 20ABC**

Richard E. Clark Paper for General Thoracic Surgery

The Society of Thoracic Surgeons Composite Score for Lobectomy for Lung Cancer: The First Thoracic Quality Measure for Public Reporting

B. D. Kozower[1], *M. J. Magee*[2], *S. O'Brien*[3], *A. Kosinski*[3], *R. Dokholyan*[3], *J. P. Jacobs*[4], *D. M. Shahian*[5], *C. D. Wright*[5], *F. G. Fernandez*[6]

[1]*University of Virginia Health System, Charlottesville,* [2]*HCA North Texas Division, Dallas,* [3]*Duke Clinical Research Institute, Durham, NC,* [4]*Johns Hopkins All Children's Heart Institute, St Petersburg, FL,* [5]*Massachusetts General Hospital, Boston,* [6]*Emory University, Atlanta, GA*

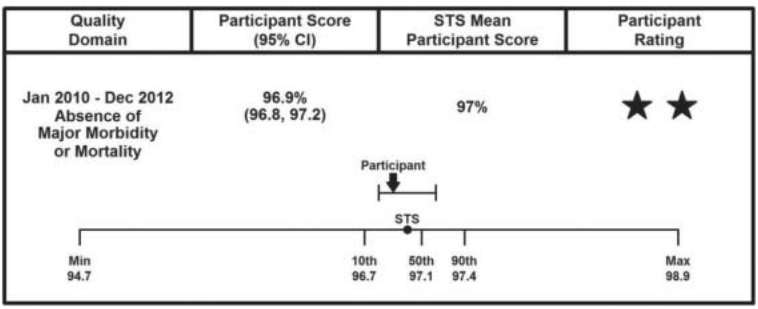
Discussant: *Farhood Farjah, Seattle, WA*

Purpose: The Society of Thoracic Surgeons (STS) has developed multidimensional composite quality measures for common cardiac surgery procedures. This is the first composite measure for general thoracic surgery evaluating participant performance for lobectomy performed for lung cancer.

Methods: The STS lobectomy composite score is comprised of two outcome measures: risk-adjusted mortality and any-or-none risk-adjusted major morbidity. General Thoracic Surgery Database (GTSD) data were included from 2010 to 2012 to provide adequate sample size for hospital profiling. 95% Bayesian credible intervals determined "star ratings." STS GTSD participants were also compared to national benchmarks using the Nationwide Inpatient Sample. Comparisons of discharge mortality, postoperative length of stay, and the percentage of stage I lung cancers resected using a minimally invasive approach are not included in the "star rating," but will be displayed on the STS public reporting website.

Results: The study population included 19,312 lobectomy patients from 207 participants. In-hospital or 30-day mortality was 1.4%, major morbidity was 10.0%, and median postoperative length of stay was 5 days. Using 3 years of rolling data and 95% credible intervals, adjusted mortality and morbidity rates varied threefold from highest performing (3 star) to lowest performing (1 star) programs. Approximately 2% of participants were 1-star, 4% were 3-star, and 94% were 2-star programs. The concordance probability, an estimation of the reliability of the composite measure, was 0.72 (95% CI, 0.69-0.75). Figure 1 illustrates a program's composite report.

Conclusions: STS has developed the first general thoracic surgery quality composite measure to reliably compare programs performing lobectomy for lung cancer. This measure adds considerable value to the GTSD, as it will be used for quality assessment, provider feedback, public reporting, and performance improvement.



8:30 AM ***Ballroom 20ABC***

Richard E. Clark Paper for Adult Cardiac Surgery

Comparison of Alternative Access Transcatheter Aortic Valve Replacement Techniques in the US for 6,341 Patients Considered High-Risk or Inoperative for Aortic Valve Replacement and With Severe Aortic Stenosis: An Analysis From the STS/ACC TVT Registry™

V. H. Thourani[1], V. Babaliaros[1], R. M. Suri[2], D. Dai[3], J. Brennan[3], E. L. Sarin[1], J. Rumsfeld[4], F. H. Edwards[5], E. Tuzcu[6], W. Y. Szeto[7], A. Kirtane[8], S. Lerakis[1], C. Devireddy[1], S. A. Iturra[1], J. D. Carroll[4], D. R. Holmes[2], F. L. Grover[4], M. R. Williams[8], D. M. Shahian[10], M. J. Mack[9]

[1]Emory University, Atlanta, GA, [2]Mayo Clinic, Rochester, MN, [3]Duke University Medical Center, Durham, NC, [4]University of Colorado, Denver, [5]University of Florida, Jacksonville, [6]Cleveland Clinic, OH, [7]University of Pennsylvania, Philadelphia, [8]Columbia University Medical Center, New York, NY, [9]Baylor University, Plano, TX, [10]Massachusetts General Hospital, Boston

COMMERCIAL RELATIONSHIPS V. Babaliaros: Speakers Bureau/Honoraria, InterValve Inc; Consultant/Advisory Board, BARD Medical, Direct Flow Medical, Inc; C. Devireddy: Consultant/Advisory Board, Medtronic, Inc; F. L. Grover: Consultant/Advisory Board, Somahlution Inc; R. M. Suri: Research Grant, Abbott, Edwards Lifesciences Corporation, Medtronic, Inc, SORIN GROUP, St Jude Medical, Inc; Other, Abbott, Member of the Clinical Steering Committee, St Jude Medical, Inc, Member of the Steering Committee; W. Y. Szeto: Research Grant, Edwards Lifesciences Corporation, Medtronic, Inc, SORIN GROUP; Consultant/Advisory Board, Micro Interventional Devices, Inc; V. H. Thourani: Research Grant, Edwards Lifesciences Corporation, Medtronic, Inc, SORIN GROUP; Consultant/Advisory Board, Boston Scientific, St Jude Medical, Inc; Ownership Interest, Apica Cardiovascular; M. R. Williams: Research Grant, Direct Flow Medical, Inc, Medtronic, Inc; Consultant/Advisory Board, Edwards Lifesciences Corporation, Medtronic, Inc; M. J. Mack: Nonremunerative Position of Influence, Abbott Vascular, Edwards Lifesciences Corporation; J. Rumsfeld: Other, American College of Cardiology National Cardiovascular Data Registry (NCDR), Chief Science Officer; A. Kirtane: Research Grant, Abbott Vascular, Abiomed, Boston Scientific, Eli Lilly & Company, Medtronic, Inc, St Jude Medical, Inc, Vascular Dynamics, Inc

Discussant: *A. Pieter Kappetein, Rotterdam, The Netherlands*

Purpose: Among patients with severe aortic stenosis and at high/inoperative risk for surgical aortic valve replacement and undergoing transcatheter aortic valve replacement (TAVR) utilizing non-transfemoral (TF) access, the outcomes of patients with alternative access (AA) TAVR from the commercially available balloon-expandable valve in the US have not been reported. The purpose of this study was to compare the US experience with transapical (TA) and transaortic (TAo) TAVR.

Methods: A retrospective analysis of patients undergoing TAVR in the STS/ACC Transcatheter Valve Therapy Registry from November 2011 to April 2014 was performed. AA TAVR represented 45% (7,042/15,621) of all procedures during the study period. Of the AA TAVR: 5,373 (34.4%) underwent TA, 968 (6.2%) TAo, and the rest were categorized as "other." For this abstract, only TA and TAo outcomes are described.

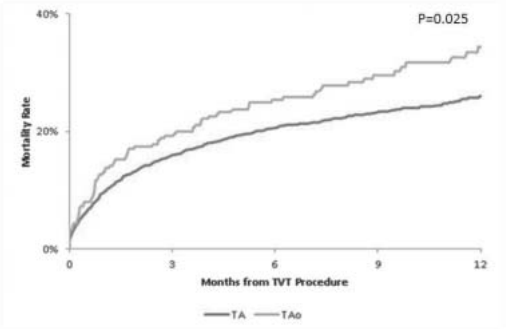
Results: Mean age for all patients was 81.7 years ± 8.3 years (TA: 82.5 years ± 8.2 years and TAo: 82.3 years ± 8.4 years) and 57.2% were female (TA: 55.6% and TAo: 66.3%). Postoperative stroke was 1.8% in all patients (TA: 1.7% vs TAo: 2.8%, $p = 0.02$, Table). Overall operative mortality was 7.1% (TA: 6.9% vs TAo: 8.1%, $p = 0.2$), corresponding to an O:E mortality of 0.77 in all patients (TA: 0.78 vs TAo: 0.77, $p = 0.2$). In high-risk patients, there was a significantly higher stroke rate in the TAo group (3.0% vs 1.6%, $p = 0.004$), but this was not apparent in the inoperative group (TA: 2.1% vs TAo: 0.9%, $p = 0.38$). STS PROM O:E mortality in the high-risk patients was similar for TA (0.78) and TAo (0.77). In the STS PROM O:E mortality for the inoperative patients, the TAo patients had a trend toward a higher mortality (O:E 0.91 vs 0.72, $p = 0.055$). One-year all-cause mortality was higher in TAo patients (34.4% vs 26.0%, $p = 0.03$, Figure).

Continued on next page

General Session I – Continued

Abstract continued from previous page

Conclusions: The current series is the largest to date on AA TAVR. In high-risk patients, there was a lower stroke rate in TA patients, but similar mortality to TAo. In inoperative patients, there was a similar stroke rate between groups, but there was a trend to improved mortality in TA patients. Studies are required to better tailor the appropriate AA algorithm for non-TF TAVR candidates.



All Patients	Overall (N=6,341)	Transapical (N=5,373)	Transaortic (N=968)	p Value
Postop Stroke, n (%)	117 (1.8)	90 (1.7)	27 (2.8)	0.018
New postop dialysis, n (%)	174 (2.7)	144 (2.7)	30 (3.1)	0.463
Postop LOS (days), mean ± SD	8.7 ± 8.2	8.6 ± 8.5	9.1 ± 6.7	<0.001
Operative mortality, n (%)	448 (7.1)	370 (6.9)	78 (8.1)	0.190
STS PROM Score, mean ± SD	9.1 ± 6.5	8.9 ± 6.3	10.5 ± 7.7	<0.001
O/E mortality	0.773	0.775	0.765	0.189
High Risk Patients	**Overall (N=5,657)**	**TA (N=4,804)**	**TAo (N=853)**	**p Value**
Postop Stroke, n (%)	104 (1.8)	78 (1.6)	26 (3.0)	0.004
New postop dialysis, n (%)	159 (2.8)	134 (2.8)	25 (2.9)	0.818
Postop LOS (days), mean ± SD	8.6 ± 6.8	8.5 ± 6.8	9.1 ± 6.7	<0.001
Operative mortality, n (%)	404 (7.1)	338 (7.0)	66 (7.7)	0.463
STS PROM Score, mean ± SD	9.2 ± 6.5	9.0 ± 6.3	10.4 ± 7.3	<0.001
O/E mortality	0.775	0.781	0.744	0.462
Inoperative Patients	**Overall (N=684)**	**Transapical (N=569)**	**Transaortic (N=115)**	**p Value**
Postop Stroke, n (%)	13 (1.9)	12 (2.1)	1 (0.9)	0.375
New postop dialysis, n (%)	15 (2.2)	10 (1.8)	5 (4.3)	0.084
Postop LOS (days), mean ± SD	8.9 ± 15.8	8.9 ± 17.0	9.2 ± 7.2	0.150
Operative mortality, n (%)	44 (6.4)	32 (5.6)	12 (10.4)	0.055
STS PROM Score, mean ± SD	8.5 ± 6.9	7.9 ± 5.9	11.5 ± 9.9	<0.001
O/E mortality	0.760	0.716	0.907	0.055

8:45 AM ***Ballroom 20ABC***

Richard E. Clark Paper for Congenital Heart Surgery

Characteristics of Patients Undergoing Congenital Heart Surgery Vary Across US Children's Hospitals and Impact Assessment of Hospital Performance: An Analysis of The Society of Thoracic Surgeons Congenital Heart Surgery Database

S. K. Pasquali[4], *M. L. Jacobs*[1], *J. Gaynor*[2], *X. He*[3], *M. Gaies*[4], *E. Peterson*[3], *J. C. Hirsch-Romano*[5], *J. E. Mayer*[6], *J. P. Jacobs*[7]

[1]*The Johns Hopkins School of Medicine, Baltimore, MD,* [2]*The Children's Hospital of Philadelphia, PA,* [3]*Duke Clinical Research Institute, Durham, NC,* [4]*University of Michigan, Ann Arbor,* [5]*Michigan Congenital Heart Center, Ann Arbor,* [6]*Boston Children's Hospital, MA,* [7]*Johns Hopkins All Children's Heart Institute, St Petersburg, FL*

COMMERCIAL RELATIONSHIPS J. E. Mayer: Consultant/Advisory Board, Medtronic, Inc; E. Peterson: Research Grant, Eli Lilly & Company, Janssen Pharmaceutical, Inc; Consultant/Advisory Board, Boehringer Ingelheim GmbH, Janssen Pharmaceutical, Inc, Merck & Co, Inc, sanofi-aventis

Discussant: *David M. Shahian, Boston, MA*

Purpose: Accurate hospital performance measures in congenital heart surgery are important to multiple stakeholders. Current metrics primarily account for procedural case-mix, but not important patient characteristics that may vary across hospitals and influence outcome. We evaluated the impact of these patient characteristics on performance assessment in a large cohort.

Methods: Children (0-18 years) undergoing cardiac surgery at centers participating in the STS Congenital Heart Surgery Database (2010-2013) with adequate data quality were included (premature neonates undergoing ductus arteriosus ligation were excluded). Patient characteristics (listed in the Table) known from previous analyses to significantly impact outcome were examined, and variation across hospitals described. Hospital performance, as assessed by discharge mortality rate and mortality ranking within the cohort, was evaluated and compared using data generated from standard models that adjusted for differences across hospitals in procedural case-mix only (using the STAT method), vs models which adjusted for both procedural case-mix and patient characteristics.

Results: Overall, 49,374 patients from 86 centers were included. There was significant variation across hospitals for all patient characteristics examined (Table). For example, the proportion of neonates with weight <2.5 kg at surgery ranged from 5.8% to 19.4% across centers ($p < 0.0001$). When hospital mortality rankings were evaluated based on standard methods which adjusted for differences across hospitals in procedural case-mix alone vs the full model which adjusted for both differences in procedural case-mix and patient characteristics, 58% of centers changed their ranking for mortality by five or more positions (35% with change of 10 or more positions), 28% of centers changed which mortality quartile they were classified in, and 8% of centers changed their classification as a statistical outlier (Figure).

Conclusions: Characteristics of patients undergoing congenital heart surgery vary across hospitals. Methods that do not take these characteristics into account can lead to inaccurate assessment of outcomes and performance.

Continued on next page

Abstract continued from previous page

Figure. Change in hospital mortality ranking with full vs. standard model

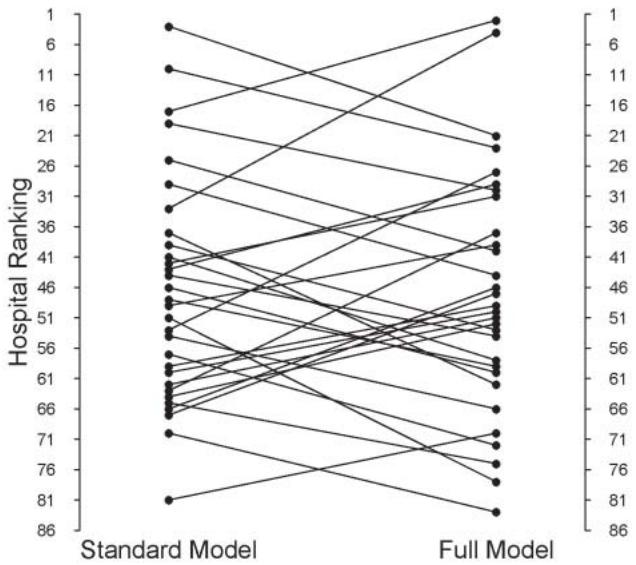


Figure displays change in hospital mortality ranking depending on whether the standard model (adjustment for differences across hospitals in procedural case–mix only) vs. full model (adjustment for both procedural case–mix and patient characteristics) is used. Only hospitals changing 10 or more rank positions are displayed.

Table. Variation in patient characteristics across hospitals*

Characteristic	Median	10th percentile	90th percentile
Mean age (yrs)	3.0	2.5	3.9
% Neonates	20.1%	12.9%	26.0%
Mean weight (kg)	14.1	12.2	17.4
Weight <2.5 kg**	12.3%	5.8%	19.4%
Prematurity **	19.2%	14.2%	24.9%
Previous cardiac operation	15.3%	11.5%	18.8%
Non-cardiac/genetic anomaly	24.5%	18.5%	32.0%
STS pre-operative factors			
Any	27.3%	10.8%	45.3%
Mechanical ventilation	7.7%	3.0%	16.2%
Renal failure requiring dialysis	0.7%	0%	2.4%
Shock persisting at surgery	0.5%	0%	2.0%
Mechanical circulatory support	0.4%	0%	1.2%

Data are displayed on a hospital-level
*p<0.0001 for all characteristics comparing values of 10th and 90th percentiles
**in neonates

9:00 AM

BREAK—Visit Exhibits and Scientific Posters
Complimentary coffee available in Exhibit Hall

9:30 AM ***Ballroom 20ABC***

***The Annals of Thoracic Surgery* 50th Anniversary Presentation**
G. Alexander Patterson, St Louis, MO

9:40 AM ***Ballroom 20ABC***

Introduction of the President
Mark S. Allen, Rochester, MN

9:50 AM ***Ballroom 20ABC***

Presidential Address
David A. Fullerton, Aurora, CO

11:30 AM – 12:30 PM ***Room 31ABC***

Adult Cardiac Session: Arrhythmia

Moderators: *Vinay Badhwar, Pittsburgh, PA, and J. Scott Rankin, Nashville, TN*

COMMERCIAL RELATIONSHIPS J. S. Rankin: Ownership Interest, BioStable Science and Engineering, Inc

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

Presenting authors are listed in **bold** on each abstract.

The physician competencies addressed in this session are patient care and procedural skills and medical knowledge. These physician competencies will be addressed through a series of individual lectures and a brief question-and-answer session after each topic.

11:30 AM ***Room 31ABC***

Should Patients With Over 5 Years' Duration of Atrial Fibrillation Expect Reasonable Outcomes Following Concomitant Cox Maze Procedure?

N. Ad*, H. Je, G. Pritchard, S. Holmes*

Inova Heart and Vascular Institute, Falls Church, VA

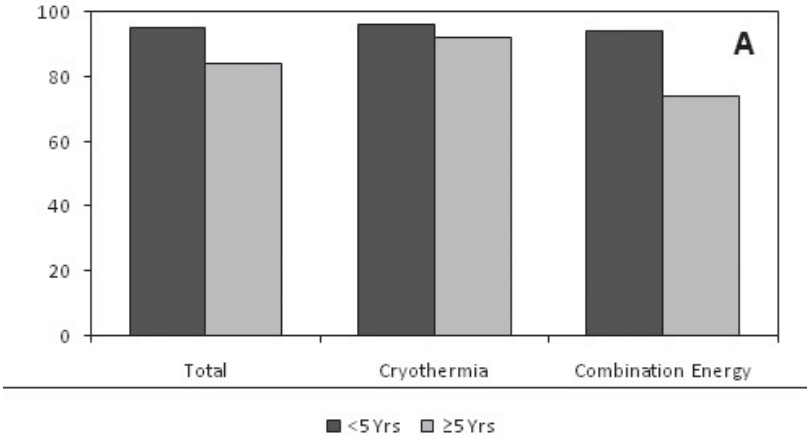
COMMERCIAL RELATIONSHIPS N. Ad: Speakers Bureau/Honoraria, AtriCure, Inc, Medtronic, Inc; Consultant/Advisory Board, AtriCure, Inc, Medtronic, Inc

Purpose: One of the most consistent predictors for failure of the Cox Maze (CM) procedure for atrial fibrillation (AF) is longer duration of AF. The purpose of this study was to examine the impact of AF duration on results of CM and whether this effect can be attenuated.

Methods: There were 473 patients who underwent a first-time concomitant CM. Freedom from atrial arrhythmia (AA; HRS guidelines) and antiarrhythmic drug (AAD) status data were collected prospectively following CM. Median [IQR] duration of AF was 14.2 [2.7-51.9] months. Patients were categorized into longer AF duration (≥5 years; n=101) and shorter AF duration (<5 years; n=372). AF duration as a continuous variable was used in regression analyses.

Results: Longer AF duration patients were older (68.9 vs 65.1 years, $p < 0.001$) and in long-standing persistent AF (84% vs 35%, $p < 0.001$). Freedom from AA and AA off AAD was lower in AF duration ≥5 years group at 1 year (84% vs 95%, $p = 0.003$; 78% vs 93%, $p = 0.003$) and 2 years (72% vs 93%, $p < 0.001$; 68% vs 91%, $p < 0.001$). The AA burden (<1 hour during 24 hours) was similar between longer and shorter AF duration at 1 year (45% vs 61%, $p = 0.43$) and 2 years (54% vs 58%, $p = 0.82$). Freedom from stroke/TIA was similar by AF duration (95.1% vs 96.0%, $p = 0.73$). Adjusting for clinical and AF-associated factors, each 1-year increase in AF duration had 12% greater odds for failure at 1 year (OR=1.12, $p = 0.03$) and 31% greater odds at 2 years (OR=1.31, $p < 0.001$). Use of cryothermia attenuated the negative impact of AF duration on success (Figure A) and success off AAD (Figure B) at 1 year vs bipolar radiofrequency plus cryothermia.

Conclusions: Patients with longer AF duration can expect reasonable success after the CM procedure. The association between longer AF duration and failure is clearly a product of severe tissue remodeling. This information should be accounted for when it comes to choice of ablation device and lesion set.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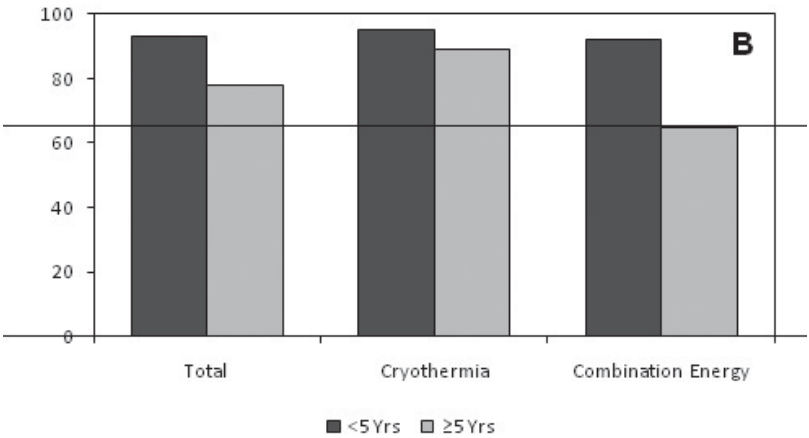
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11:45 AM **Room 31ABC**

Electrophysiological Results After Totally Thoracoscopic Ablation for the Treatment of Lone Persistent Atrial Fibrillation

D. Jeong[1], *M. Kim*[1], *H. Chang*[2], *Y. Lee*[1], *P. Park*[1]

[1]*Samsung Medical Center, Seoul, Republic of Korea,* [2]*Seoul National University Hospital, Seoul, Republic of Korea*

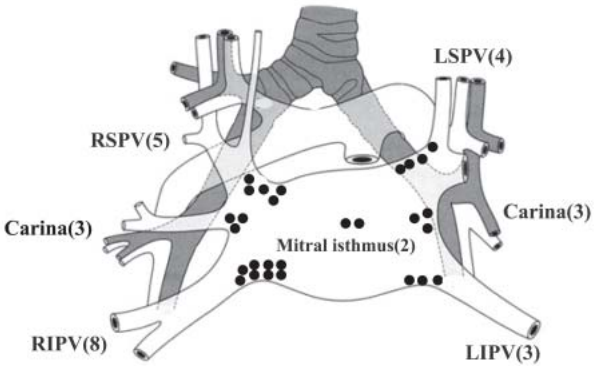
Purpose: Thoracoscopic ablation strategies for the treatment of lone persistent atrial fibrillation (AF) have rapidly evolved during the past decade. However, the durability and electrophysiological results are still questionable. We investigated the electrophysiological results and mid-term durability of totally thoracoscopic ablation in patients with lone persistent AF.

Methods: Seventy-nine consecutive patients with paroxysmal (eight patients, 10.1%), persistent (17 patients, 21.5%), and long-standing persistent AF (54 patients, 68.3%) were prospectively enrolled. The mean age was 54 years, the mean left atrial volume index was 46 ml/m2, and the mean AF duration was 51 ± 55 (maximum, 240) months. Thoracoscopic ablation consisted of a bilateral closed-chest approach to perform pulmonary isolation (a box lesion), ganglionated plexus ablation, division of the Marshall ligament, and left atrial auricle resection. Electrophysiological study was performed 5 days after surgery in 61 patients (77%). Freedom of AF was assessed with electrocardiograms or Holter monitoring every 3 months.

Results: No death or conversion to cardiopulmonary bypass occurred. During electrophysiological study, residual pulmonary vein potentials were observed in 15 patients (19%). Figure illustrates the geographical distribution of residual potentials in the left atrium. Among total 28 gaps, 20 gaps (71%) were located in the superior and inferior ridges of pulmonary veins. Six gaps (21%) were detected in the carina of pulmonary veins. The mitral isthmus was ablated in two patients (7%). At a mean follow-up of 12.1 (maximum, 28) months, 93.7% (74 of 79 patients) are in normal sinus rhythm. Freedom from AF at 2 years was 92.6% ± 3.3%. Late cardiac events included atrioesophageal fistula (one patient), permanent pacemaker insertion (two patients), and atrial arrhythmias (11 patients) requiring cardioversion or additional ablations. Freedom from cardiac events at 2 years was 74.7% ± 6.0%. Cox regression analysis demonstrated that the predictors of atrial arrhythmias were old age, hypertension, and the left atrial volume index (Table).

Conclusions: Totally thoracoscopic ablation followed by electrophysiological confirmation is a safe method, providing excellent mid-term durability in patients with lone persistent AF. However, the incidence of residual potentials around the pulmonary veins is not negligible.

Figure. Distribution of residual potentials in the left atrium



RSPV, right superior pulmonary vein
RIPV, right inferior pulmonary vein
LSPV, left superior pulmonary vein
LIPV, left inferior pulmonary vein

Table. Predictors of atrial arrhythmia during follow up

Variables	P value	Hazard ratio	95% CI
Age, *year*	0.029	1.096	1.01 ~ 1.19
Hypertension	0.032	3.569	1.11 ~ 11.45
Left atrial volume index, ml/m^2	0.016	1.045	1.01 ~ 1.08
Presence of residual PV potentials	0.531		

PV, *pulmonary vein;* CI, *confidence interval.*

12:00 PM **Room 31ABC**

The Effectiveness of Surgical Ablation in Patients With Atrial Fibrillation and Aortic Valve Disease

***M. Henn**, C. Lawrance, L. Sinn, J. Miller, R. Schuessler, H. S. Maniar, R. J. Damiano*

Washington University School of Medicine, Barnes Jewish Hospital, St Louis, MO

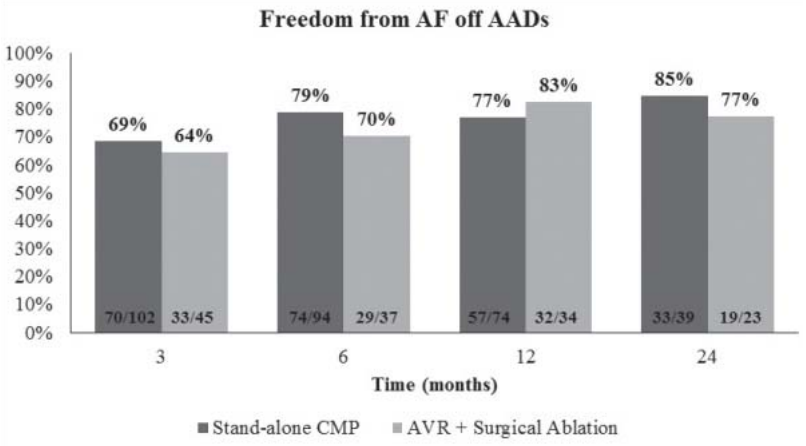
COMMERCIAL RELATIONSHIPS R. J. Damiano: Consultant/Advisory Board, AtriCure, Inc; Speakers Bureau/Honoraria, Edwards Lifesciences Corporation

Purpose: For patients with atrial fibrillation (AF), adding surgical ablation to an aortic valve replacement (AVR) has been shown not to increase procedural morbidity. However, outcomes in this population have not been carefully evaluated. This study compared outcomes between patients undergoing standalone Cox Maze procedure (CMP) to those undergoing surgical ablation and concomitant AVR.

Methods: From January 2002 to May 2014, 188 patients received a standalone CMP (n=113) or surgical ablation with concomitant AVR (n=75). In the concomitant AVR group, patients underwent a CMP (n=58), left-sided CMP (n=3), or pulmonary vein isolation (PVI) (n=14). Thirty-one preoperative and perioperative variables were compared. Freedoms from AF on and off antiarrhythmic drugs (AADs) were evaluated at 3, 6, 12, 24, and 48 months.

Results: Follow-up was 97% at 2 years. The concomitant AVR group had more comorbidities, more paroxysmal AF, and was older. Demographic data are presented in the Table. Freedom from AF on and off AADs in patients receiving a standalone CMP vs concomitant AVR was not significantly different at 3, 6, 12, or 24 months (Figure). In the concomitant AVR group, there were more postoperative pacemaker implantations (25% vs 5%, $p = 0.001$) and major complications (25% vs 5%, $p < 0.001$). The median ICU stay was longer in the concomitant AVR group (3 days [1-32 days] vs 2 days [range 1-35 days], $p < 0.001$) as was hospital stay (9 days [range 4-52 days] vs 8 days [range 4-53 days], $p < 0.001$). In a subgroup analysis, freedoms from AF on and off AADs for patients receiving an AVR and PVI alone at 1 year were 64% (7/11) and 45% (5/11) and at 2 years were 63% (5/8) and 50% (4/8), respectively.

Conclusions: A CMP when performed with an AVR is as effective as a standalone CMP in treating AF, even in an older population with more comorbidities. PVI was not as effective and is not recommended. A CMP should be considered in all patients undergoing AVR with a history of AF.



Demographics	Stand-alone CMP n=113	Concomitant AVR n=58	*p*-value
Age (years)	56.5 ± 10.6	70.5 ± 8.1	$p < 0.001$
Male	86/113 (76%)	50/75 (67%)	$p = 0.157$
Paroxysmal AF	28/113 (25%)	45/75 (60%)	$p < 0.001$
Persistent AF	7/113 (6%)	10/75 (13%)	$p = 0.001$
Long-Term Persistent AF	78/113 (69%)	20/75 (27%)	$p < 0.001$
Length of Time in AF (months)	89 ± 77	84 ± 113	$p = 0.746$
LA Size (cm)	4.9 ± 1.1	4.9 ± 0.8	$p = 0.984$
Failed Catheter Ablation	53/113 (47%)	4/75 (5%)	$p < 0.001$
Preoperative Pacemaker	13/113 (12%)	12/75 (16%)	$p = 0.374$
NYHA 3/4	32/113 (28%)	55/75 (73%)	$p < 0.001$
LVEF (%)	50 ± 13	55 ± 13	$p = 0.035$
PVD	6/113 (5%)	12/75 (16%)	$p = 0.015$
Hypertension	68/113 (60%)	56/75 (73%)	$p = 0.040$
Dyslipidemia	58/113 (51%)	44/58 (76%)	$p = 0.003$
Chronic Lung Disease (Moderate - Severe)	3/113 (3%)	6/75 (8%)	$p = 0.093$
Diabetes	12/113 (11%)	30/75 (40%)	$p < 0.001$
Renal Failure	0/113 (0%)	3/75 (4%)	$p = 0.032$

12:15 PM ***Room 31ABC***

Update on STS Clinical Practice Guidelines on Surgical Ablation

Vinay Badhwar, Pittsburgh, PA

11:30 AM – 12:30 PM ***Room 33ABC***

Adult Cardiac Session: Heart Failure

Moderators: *Robert L. Kormos, Pittsburgh, PA, and Matthew A. Romano, Ann Arbor, MI*

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

Presenting authors are listed in **bold** on each abstract.

The physician competencies addressed in this session are patient care and procedural skills and medical knowledge. These physician competencies will be addressed through a series of individual lectures and a brief question-and-answer session after each topic.

11:30 AM ***Room 33ABC***

Debate: Axial vs Centrifugal Flow Left Ventricular Assist Devices

Axial: *James W. Long, Salt Lake City, UT*

Centrifugal: *Edwin C. McGee Jr, Chicago, IL*

COMMERCIAL RELATIONSHIPS E. C. McGee: Consultant/Advisory Board, HeartWare International Inc; J. W. Long: Other, Thoratec, Educational program support

REGULATORY DISCLOSURE This presentation will address the HeartWare MVAD and Thoratec HeartMate III, which have FDA statuses of investigational. This presentation will also discuss the off-label use of the Thoratec HeartMate II for destination therapy.

12:00 PM ***Room 33ABC***

Preoperative Predictors of Right Ventricular Failure Requiring Mechanical Support Following Continuous-Flow Left Ventricular Assist Device Implantation as a Bridge to Transplantation

N. P. Patil*, A. Sabashnikov, P. Mohite, A. Weymann, D. Dhar, D. Garcia Saez, B. Zych, C. Bowles, R. Hards, A. Moza, F. De Robertis, T. Bahrami, M. Amrani, S. Rahman-Haley, N. Banner, A. Popov, A. Simon*

Royal Brompton and Harefield NHS Foundation Trust, London, United Kingdom

COMMERCIAL RELATIONSHIPS R. Hards: Consultant/Advisory Board, HeartWare International Inc; A. Simon: Consultant/Advisory Board, HeartWare International Inc, Thoratec Corporation

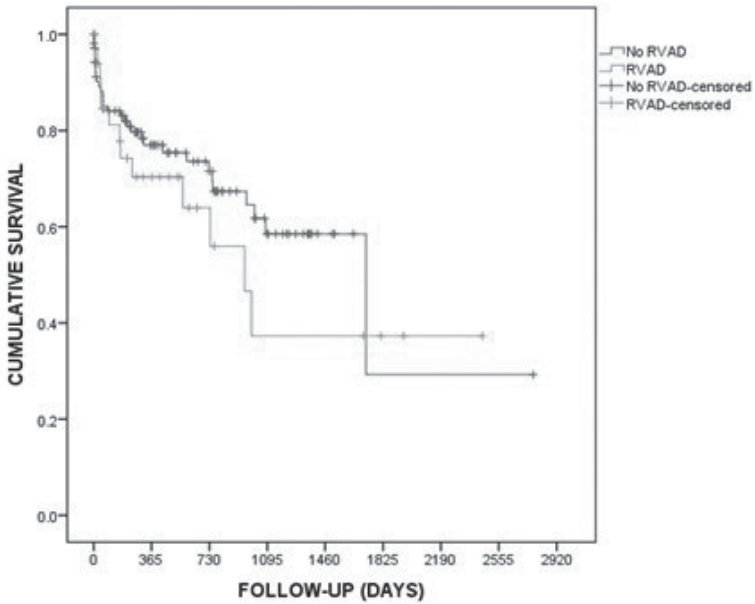
Purpose: Outcomes of ventricular assist device (VAD) therapy remain limited by right ventricular failure (RVF). We sought to define predictors of RVF requiring mechanical support following continuous-flow left VAD (CF-LVAD) implantation and evaluate its impact on longer-term outcomes.

Methods: Perioperative clinical, echocardiographic, hemodynamic, and laboratory data of CF-LVAD recipients for last 10 years were analyzed, comparing patients who developed severe RVF requiring right VAD (RVAD) to the rest of the patient cohort. April 1, 2014, was chosen as the cut-off date for observations. Multivariate logistic regression analysis was performed on univariate predictors for severe RVF with an entry criterion of $p < 0.05$.

Results: Between July 2003 and June 2013, 164 CF-LVADs were implanted as bridge to transplantation in 151 patients: 73 (44.5%) HeartMate II, 68 (41.5%) HeartWare, and 23 (14.0%) Jarvik 2000. The overall postoperative incidence of severe RVF requiring RVAD support was 23.2% (n=38). RVAD implantation did not significantly affect eventual transplantation ($p = 0.336$) or longer-term survival ($p = 0.318$). Multivariate analysis revealed female gender ($p = 0.013$, 95% CI 2.034-433.671, OR 29.698), lesser tricuspid annular

plane systolic excursion (TAPSE) (p = 0.008, 95% CI 0.387-0.865, OR 0.579), and smaller left atrial diameter (p = 0.027, 95% CI 0.739-0.982, OR 0.852) as independent predictors of RVAD implantation postoperatively. Preoperative right ventricular diameter (RVD), pulmonary regurgitation (PR), and alanine transaminase levels were univariate predictors (p < 0.001, p = 0.012 and p = 0.048 respectively), while RVD and PR trended toward (but did not meet criteria for) significance (p = 0.060 and p = 0.063, respectively) as independent predictors for RVAD implantation in multivariate analysis.

Conclusions: Female gender, lesser TAPSE, and smaller left atrial diameter are independent predictors of severe RVF requiring mechanical support following CF-LVAD implantation. RVAD implantation does not adversely affect eventual transplantation or survival following CF-LVAD implantation.



	30 days	6 month	1 year	2 years	3 years	4 years	5 years
No RVAD							
Survival (%)	90.2	83.0	77.0	71.6	58.5	58.5	29.3
Patients at risk	89	78	55	35	17	5	1
RVAD							
Survival (%)	93.9	74.2	70.3	63.9	37.3	37.3	37.3
Patients at risk	30	21	16	8	4	4	1

12:15 PM **Room 33ABC**

Do Concomitant Procedures at the Time of Left Ventricular Assist Device Implantation Impact Long-Term Outcomes? Implications by Device Type and Indication

S. Maltais[1], *F. D. Pagani*[2], *N. Haglund*[1], *M. E. Davis*[1], *J. Schirger*[3], *J. M. Stulak*[3]

[1]*Vanderbilt Heart and Vascular Institute, Nashville, TN,* [2]*University of Michigan Hospital, Ann Arbor,* [3]*Mayo Clinic, Rochester, MN*

COMMERCIAL RELATIONSHIPS S. Maltais: Consultant/Advisory Board, HeartWare International Inc

Purpose: Guidelines for performing concomitant procedures (CPs) in patients undergoing continuous-flow left ventricular assist device (CF-LVAD) implantation are unclear. Studies have not analyzed the impact of increased surgical intervention complexity on long-term outcomes in a contemporary CF-LVAD cohort.

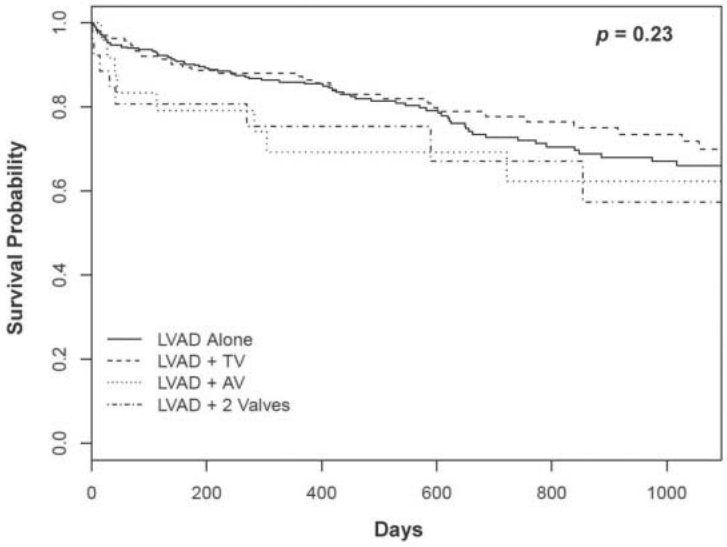
Methods: From May 2004 to December 2013, 614 patients (499 male, 81%) underwent CF-LVAD implant at our institutions (HeartMate II=492, 80%; HeartWare=122, 20%). Median age was 57 years ± 13 years and 364 (59%) were bridge to transplantation (BTT). Survival and device-related complications were analyzed and stratified based on the complexity of the surgical intervention.

Results: Follow-up was available in all patients (median, 13 months) for a total of 984 patient-years of support. Overall survival was 76%, and 398 patients (65%) underwent CF-LVAD implantation without CPs. The remaining patients (35%, n=216, Table 1) were grouped according to the complexity of the CPs, including: 1) LVAD + TV procedure (n=166, 27%), 2) LVAD + AV procedure (n=24, 4%), and 3) LVAD + two valve procedures (n=26, 4%). Survival (Figure 1) and time to any device-related adverse event or death were comparable between groups and not influenced by the complexity of the intervention ($p = 0.67$; $p = 0.27$, respectively), indication for implant (BTT, $p = 0.75$), or device type ($p = 0.90$). Regression analysis revealed increased age ($p = 0.03$), preoperative renal dysfunction (RD) ($p = 0.002$), cardiopulmonary bypass time ($p = 0.03$), and decreased body mass index ($p = 0.03$) were predictors of mortality, while only age ($p = 0.006$) and a prior sternotomy ($p = 0.02$) were related to adverse device-related events.

Conclusions: Performing CPs is common and leads to comparable survival and device-related outcomes after implant. The decision to perform CPs should be similar between device types and indications for implant, but balanced with age, RD, and projected complexity of surgery. Further collaborative efforts are needed to refine CPs indications.

Surgical Intervention Group					
Surgical Procedure	**LVAD Alone** (n=398)	**LVAD + TV Procedure** (n=166)	**LVAD + AV Procedure** (n=24)	**LVAD + Double Valve Procedure** (n=26)	***p*-Value**
TVr		90%, n=149		92%, n=24	all <0.001
TVR		10%, n=17		8%, n=2	
AVr			79%, n=19	77%, n=20	
AVR			21%, n=5	23%, n=6	
MV				12%, n=3	

TVr=tricuspid valve repair; TVR=tricuspid valve replacement; AVr=aortic valve repair; AVR=aortic valve replacement; MV=mitral valve



11:30 AM – 12:30 PM ***Room 30E***

Basic Science Research: Adult Cardiac

Moderators: *Afshin Ehsan, Newton, MA, and Thomas G. Gleason, Pittsburgh, PA*

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

Presenting authors are listed in **bold** on each abstract.

The physician competencies addressed in this session are patient care and procedural skills and medical knowledge. These physician competencies will be addressed through a series of individual lectures and a brief question-and-answer session after each topic.

11:30 AM ***Room 30E***

The Z-score Normalization of Regional Contractile Function in Dilated Cardiomyopathy Confirms Heterogeneous Contractile Injury

M. Henn*, C. Lawrance, J. Kar, B. Cupps, S. Joseph, H. Craddock, K. Wallace, G. Ewald, M. K. Pasque*

Barnes Jewish Hospital/Washington University, St Louis, MO

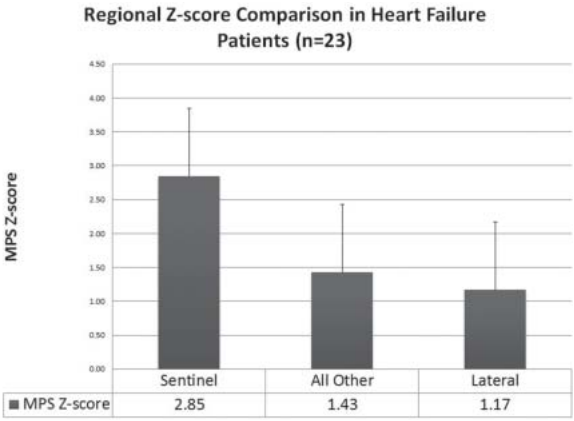
COMMERCIAL RELATIONSHIPS M. K. Pasque: Ownership Interest, CardioWise, LLC; B. Cupps: Ownership Interest, CardioWise, LLC; G. Ewald: Consultant/Advisory Board, HeartWare International Inc, Thoratec Corporation

Purpose: In dilated cardiomyopathy, symmetrical geometric changes suggest a homogeneous distribution of injury. The objective of this study was to evaluate the distribution of subregional myocardial contractile function in patients with dilated cardiomyopathy utilizing high-resolution cardiac magnetic resonance imaging (MRI).

Methods: One hundred normal test subjects underwent cardiac MRI with multiple 3D strain parameters calculated from tissue tag-plane displacement data. 15,300 LV grid points contributed to a normal human strain database. Twenty-three patients with dilated cardiomyopathy underwent cardiac MRI. Normalized z-scores for three strain parameters at each of the LV grid-points were calculated by comparing raw strain values to the normal database. The multiparametric strain z-scores were averaged over six LV regions at basilar, mid, and apical levels (18 subregions).

Results: Average multiparametric strain z-scores were calculated for each of the 18 subregions. The anteroseptal and posteroseptal subregions in the mid and basil levels (n=4 subregions) composed the most consistently and heavily injured subregions and were combined as "sentinel" regions. The average multiparametric strain z-score from these four subregions in the 23 dilated cardiomyopathy patients was compared to the average z-score for the rest of the LV (14 subregions) and the average of the lateral wall (six subregions). Sentinel z-scores were significantly larger (worse) than those for the rest of the ventricle (2.85 ± 1.65 vs 1.43 ± 0.59; $p < 0.001$) and for those in the lateral wall (2.85 ± 1.65 vs 1.17 ± 0.60; $p < 0.001$) (Figure).

Conclusions: Despite homogeneous LV geometrical changes in dilated cardiomyopathy, contractile injury occurs in a heterogeneous distribution with basal- and mid-septal regions being affected the most. Targeting this region using MRI-based metrics of microregional contractile function may supply a more accurate method to track response to surgical therapy in dilated cardiomyopathy.


Regional Z-score Comparison in Heart Failure Patients (n=23)
MPS Z-score
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Sentinel
All Other
Lateral
MPS Z-score
2.85
1.43
1.17

11:40 AM **Room 30E**

The Impact of Prolonged Atrial Fibrillation on Atrial and Ventricular Function in a Porcine Model

T. Kazui[1], *M. Henn*[1], *C. Lawrance*[1], *Y. Watanabe*[2], *S. Okada*[2], *J. Greenberg*[2], *R. Schuessler*[2], *R. Damiano*[2]

[1]*Barnes Jewish Hospital/Washington University, St Louis, MO,* [2]*Washington University School of Medicine, St Louis, MO*

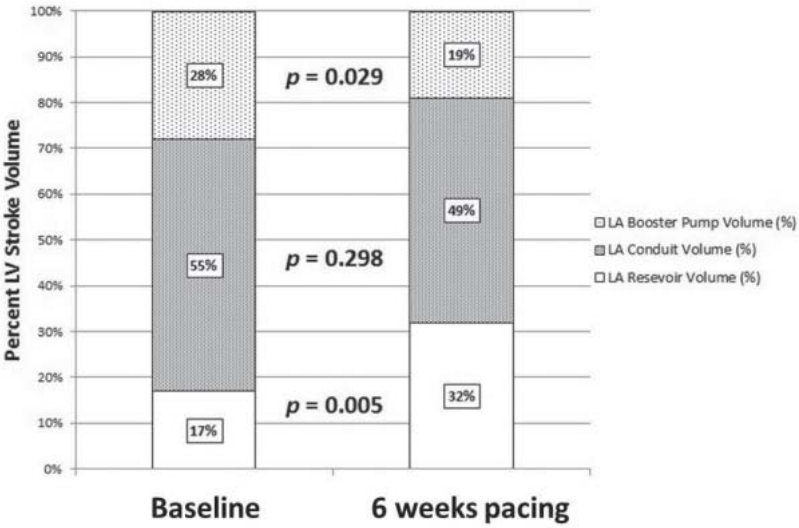
COMMERCIAL RELATIONSHIPS R. Damiano: Consultant/Advisory Board, AtriCure, Inc; Speakers Bureau/Honoraria, Edwards Lifesciences Corporation

Purpose: The impact of prolonged episodes of atrial fibrillation (AF) on atrial and ventricular function has been poorly characterized. The purpose of this study was to investigate the influence of AF on left atrial (LA) and ventricular (LV) function in a 6-week rapid pacing porcine model of AF.

Methods: A control group of pigs (group 1, n=8) underwent LA and LV conductance catheter studies and fibrosis analysis. A second group (group 2, n=8) received a baseline cardiac magnetic resonance imaging (cMRI) scan to characterize LA function as determined by the fractional contributions of reservoir, booster, and conduit volume to total LV stroke volume. Pacemakers were then implanted, and the animals' right atria were rapidly paced into AF for 6 weeks. The animals then received a second cMRI followed by conductance catheter studies and fibrosis analysis.

Results: In group 2, 6 weeks of AF resulted in a significantly higher LA reservoir volume and lower LA booster pump volume compared to baseline (Figure). After the chronic pacing, the cMRI demonstrated a decreased LV ejection fraction (LVEF) (58 ± 8 vs 29 ± 9; $p < 0.001$). Contractility in the LA as measured by the end systolic pressure-volume relationship (ESPVR) was significantly lower in group 2 compared to group 1 (1.1 ± 0.5 vs 1.7 ± 1.0; $p = 0.041$), while compliance measured by the end diastolic pressure volume relationship (EDPVR) was unchanged (1.5 ± 0.9 vs 1.6 ± 1.3; $p = 0.733$). However, LV ESPVR and LV EDPVR in both groups showed no significant differences (1.9 ± 1.9 vs 1.4 ± 1.0; $p = 0.339$, 1.9 ± 2.0, 1.6 ± 1.5; $p = 0.968$). The LA in group 2 showed a significantly higher percentage of fibrosis throughout the LA compared to group 1 (Table).

Conclusions: In a chronic pacing model of AF, the LA demonstrated significant structural remodeling and decreased contractility. LV functional impairment was less than the observed LA functional impairment, although there was a significant drop in LVEF. These data suggest that early intervention in patients with persistent AF would be beneficial.



Table

	Control group (n=8)	Pacing group (n=8)	p-value
Left Atrial Fibrosis			
LA Appendage (%)	14 ± 5	21 ± 4	0.017
LA Free Wall (%)	15 ± 6	21 ± 2	0.02
LA Posterior Wall (%)	17 ± 6	26 ± 2	0.013
LA Roof (%)	19 ± 7	26 ± 2	0.024
Left Lower PV (%)	16 ± 5	30 ± 5	<0.001
Left Upper PV (%)	16 ± 4	29 ± 5	<0.001
Right Lower PV (%)	14 ± 5	26 ± 4	0.005
Right Upper PV (%)	16 ± 5	26 ± 4	0.001
Right Atrial Fibrosis			
RA Appendage (%)	12 ± 2	24 ± 5	<0.001
RA Free Wall (%)	12 ± 5	23 ± 5	0.001
Left Ventricle Fibrosis (%)	9 ± 5	9 ± 3	0.799

All values listed as mean ± standard deviation, LA = left atrial, RA = right atrial, PV = pulmonary vein

11:50 AM **Room 30E**

AKT2 Regulates Bone Marrow Cell–Mediated Aortic Protection in Mice

***S. A. LeMaire**, S. Zou, P. Ren, L. Zhang, J. S. Coselli, Y. Shen*

Baylor College of Medicine, Houston, TX

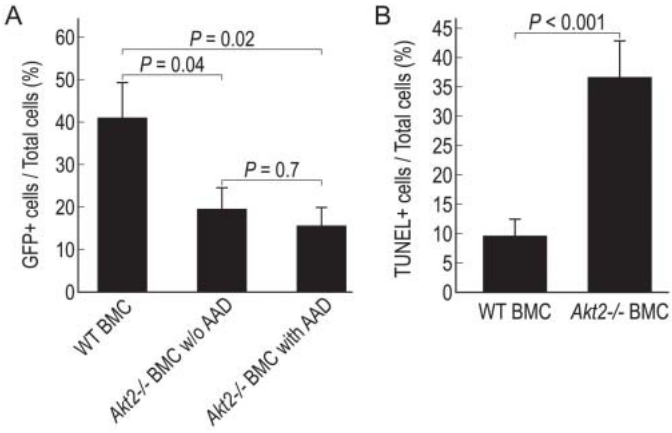
COMMERCIAL RELATIONSHIPS J. S. Coselli: Consultant/Advisory Board, Medtronic, Inc, Vascutek a Terumo Company; Research Grant, Edwards Lifesciences Corporation, GlaxoSmithKline, Medtronic, Inc, W. L. Gore & Associates, Inc; S. A. LeMaire: Consultant/Advisory Board, Baxter International, Inc, Medtronic, Inc

Purpose: Insufficient aortic protection and repair contribute to the development of aortic aneurysms and dissections (AAD). AKT2 is a multifunctional kinase that plays an important role in protecting the aortic wall. We tested the hypothesis that AKT2 regulates bone marrow cell (BMC)–mediated aortic repair and, thus, protects against AAD.

Methods: Irradiated wild-type (WT) mice received transplanted GFP+ BMCs from WT mice (WT BMCs) or from *Akt2*-/- mice (Akt2-/- BMCs) and were later challenged with continuous angiotensin II (Ang II) infusion for 4 weeks. We compared the incidence of AAD, bone marrow-derived cell recruitment and proliferation, and apoptosis within the aortic wall in WT BMC recipients (n=14) vs *Akt2*-/- BMC recipients (n=14). We performed cell co-culture experiments to assess the effects of WT BMCs and *Akt2*-/- BMCs on the survival of SMCs subjected to oxidative stress.

Results: After Ang II infusion, none (0/14) of the mice that received WT BMCs developed AAD; in contrast, 64% (9/14) of the mice that received *Akt2*-/- BMCs developed AAD ($p = 0.002$). Compared to aortas from WT BMC recipients, aortas from *Akt2*-/- BMC recipients had significantly reduced BMC recruitment (Figure 1A) and impaired BMC proliferation. Aortas from *Akt2*-/- BMC recipients had significantly fewer bone marrow-derived NG2+ progenitor cells and FSP-1+ fibroblasts and significantly more TUNEL+ apoptotic cells (Figure 1B) than did aortas from WT BMC recipients. In co-culture, WT BMCs promoted SMC survival; this protective effect was significantly diminished with *Akt2*-/- BMCs.

Conclusions: In mice subjected to Ang II infusion, AKT2 regulates BMC–mediated aortic protection and repair by promoting recruitment of bone marrow-derived progenitor cells and preventing apoptosis. Defects in this pathway may impair aortic repair mechanisms and allow progressive degeneration during AAD development.


A
GFP+ cells / Total cells (%)
60
50
40
30
20
10
0
P = 0.02
P = 0.04
P = 0.7
WT BMC
Akt2-/- BMC w/o AAD
Akt2-/- BMC with AAD
B
TUNEL+ cells / Total cells (%)
45
40
35
30
25
20
15
10
5
0
P < 0.001
WT BMC
Akt2-/- BMC

12:00 PM **Room 30E**

Enoximone Protects Myocardial Mitochondrial ATP-Production by Limitation of H+-leak-dependent Improvement of ΔΨm-Stability in Ischemia Reperfusion Injury

S. Sommer, M. Leistner, I. Aleksic, C. Schimmer, C. Scheler, R. Leyh, ***S. Sommer***

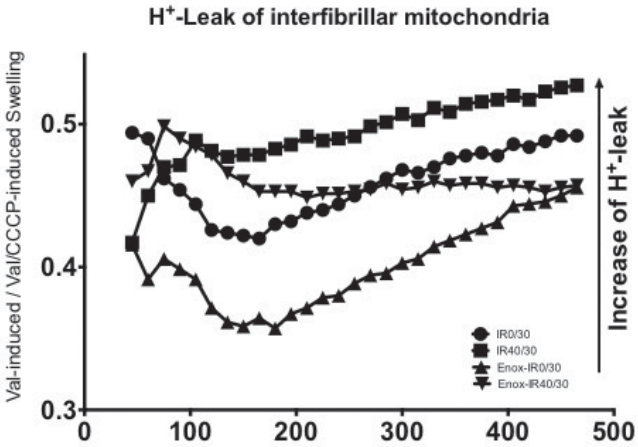
University Hospital Würzburg, Germany

Purpose: We previously demonstrated the impact of Enoximone (Enox) on mitochondrial respiratory chain function (RCF), membrane potential (ΔΨm), and mPTP-function. Suspecting further impact of Enox on ATP-content, we analyzed mitochondrial ATP-production combined with comprehensive analysis of ΔΨm-stability in rat hearts undergoing ischemia reperfusion injury (IR).

Methods: Hearts were divided into four groups and subjected to 30 minutes of reperfusion without (IR0/30) or with Enox application (Enox-IR0/30). Groups were mirrored with 40 minutes of stop-flow induced warm global ischemia (IR40/30; Enox-IR40/30). Myocardial function was determined by left ventricular pressure (mean, max, dp/dt max) and coronary flow. Interfibrillar/subsarcolemmal mitochondria (IFM/SSM) were analyzed regarding electron transport chain (ETC) coupling to complex V, ATP-production (chemiluminescence), ADP-challenged ΔΨm repolarization (Fluorescence, Rho123), and H+-leak (swelling assay).

Results: IR depressed myocardial function. As demonstrated earlier, IR reduced activities of respiratory chain complexes with concomitant uncoupling from complex V (Resp. Q) of SSM at complex I-V respiration (SSM: $p = 0.07$; IFM: $p = 0.13$). Regarding IR-dependent I-V function, Enoximone promoted uncoupling (SSM: $p = 0.045$; IFM: $p = 0.099$). Non-IR mitochondria demonstrated loss of coupling at complex I-V (SSM: $p = 0.099$; IFM: $p > 0.1$), too. ADP-challenge after energizing mitochondria consumed ΔΨm; Enox improved repolarization determined by Rhodamin123 demonstrated in SSM at I-V respiration and IFM at I- and II-V respiration. Enox significantly reduced IFM/SSM H+-leak. Consequently, Enox stabilized ATP-content/production, predominately during IR, in SSM (II-V: $p = 0.06$) and IFM (I-V: $p < 0.05$, II-V: $p = 0.06$).

Conclusions: Enoximone stabilizes myocardial mitochondrial ATP-content due to limitation of H+ leak in combination with improved respiratory chain activity. However, impaired coupling of the respiratory chain to complex V after Enox is evident and needs further investigation.


H+-Leak of interfibrillar mitochondria
Val-induced / Val/CCCP-induced Swelling
0.5
0.4
0.3
0
100
200
300
400
500
IR0/30
IR40/30
Enox-IR0/30
Enox-IR40/30
Increase of H+-leak

12:10 PM **Room 30E**

Cardioplegia and Cardiopulmonary Bypass Decrease Activation of Signal Transducer and Activator of Transcription 3 Pathway in Diabetic Human Myocardial Tissue

A. Wang, S. Sakamuri, ***K. Owais****, T. Huang, A. Pal, J. Hubbard, K. R. Khabbaz, F. Mahmood, R. Matyal*

Beth Israel Deaconess Medical Center, Boston, MA

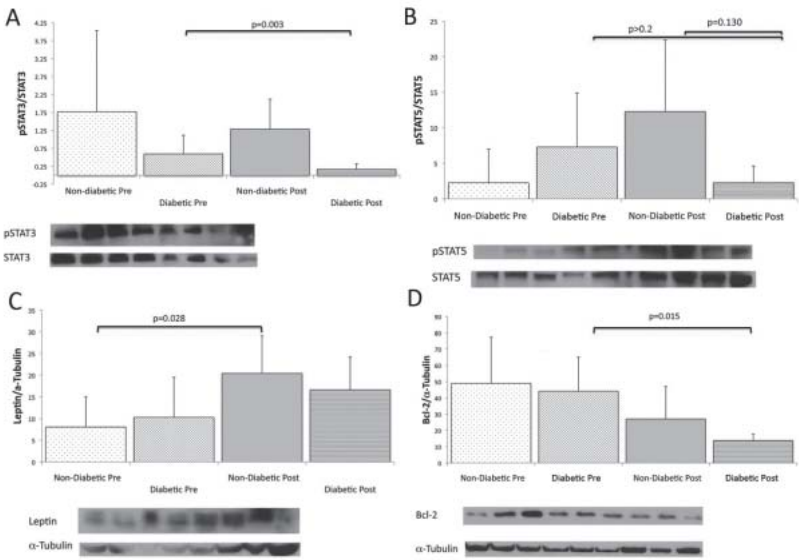
COMMERCIAL RELATIONSHIPS K. R. Khabbaz: Speakers Bureau/Honoraria, Medtronic, Inc

Purpose: Signal Transducer and Activator of Transcription 3 (STAT3) pathway has been shown to be of critical importance for cardioprotection in animal studies. We assessed the magnitude of activation of STAT3 and its effects on cell survival in the diabetic myocardium undergoing cardioplegia and cardiopulmonary bypass (CP/CPB) in comparison with non-diabetic.

Methods: Right atrial tissue was collected from type II diabetics with HbA1c >6.5 (25) and non-diabetic (25) male patients undergoing non-valvular cardiac surgery before and after CP/CPB. The tissue was evaluated for phosphorylation of STAT3, STAT5, pro-apoptotic markers, anti-apoptotic markers, and leptin with Western blotting and immunohistochemistry. Serum was also collected before and after CP/CPB for microarray analysis.

Results: No significant differences in demographics, comorbidities, or cross-clamp and bypass times were observed between the two groups. Despite equal levels of STAT3 in both groups, diabetics had significantly less phosphorylated STAT3 compared to non-diabetic patients ($p = 0.003$) on Western blot and staining post-CP/CPB. Level of leptin, a pSTAT3 stimulator, was significantly increased in non-diabetics ($p = 0.028$) post-CP/CPB compared to pre-CP/CPB value. Inflammatory marker NF-κβ was significantly higher ($p < 0.001$) in diabetics post-CP/CPB compared to pre-CP/CPB value. The levels of pro-survival Bcl-2 and Mcl-1 were significantly decreased in diabetic patients ($p = 0.015$ and 0.003 simultaneously) while Caspase3, a pro-apoptotic marker, was significantly higher in diabetic patients ($p = 0.003$). There was no difference in the levels of pSTAT5 in both groups. The microarray data also showed significantly decreased levels of Bcl-2 in diabetic patients ($p = 0.042$) and increased levels of pro-apoptotic pSTAT1 ($p = 0.001$) and caspase 9 ($p = 0.001$).

Conclusions: As compared to non-diabetics, reduced phosphorylation of STAT3 and increased activation of pSTAT1 in diabetics possibly results in attenuation of cardioprotective effects and increased apoptosis. The possibility of modulating STAT3 pathway to improve outcomes in this patient population merits further investigation.


A
p=0.003
pSTAT3/STAT3
Non-diabetic Pre
Diabetic Pre
Non-diabetic Post
Diabetic Post
pSTAT3
STAT3
B
p>0.2
p=0.130
pSTAT5/STAT5
Non-Diabetic Pre
Diabetic Pre
Non-Diabetic Post
Diabetic Post
pSTAT5
STAT5
C
p=0.028
Leptin/a-Tubulin
Non-Diabetic Pre
Diabetic Pre
Non-Diabetic Post
Diabetic Post
Leptin
α-Tubulin
D
p=0.015
Bcl-2/α-Tubulin
Non-Diabetic Pre
Diabetic Pre
Non-Diabetic Post
Diabetic Post
Bcl-2
α-Tubulin

12:20 PM **Room 30E**

Alcohol and the Heart: A Proteomics Analysis of Pericardium and Myocardium in a Swine Model of Chronic Myocardial Ischemia

N. Y. Elmadhun[1], *A. Sadek*[2], *A. Sabe*[1], *A. D. Lassaletta*[1], *F. W. Sellke*[3]

[1]*Beth Israel Deaconess Medical Center, Boston, MA,* [2]*Cardiovascular Research Center, Warren Alpert Medical School of Brown University, Providence, RI,* [3]*Brown Medical School/Rhode Island Hospital, Providence*

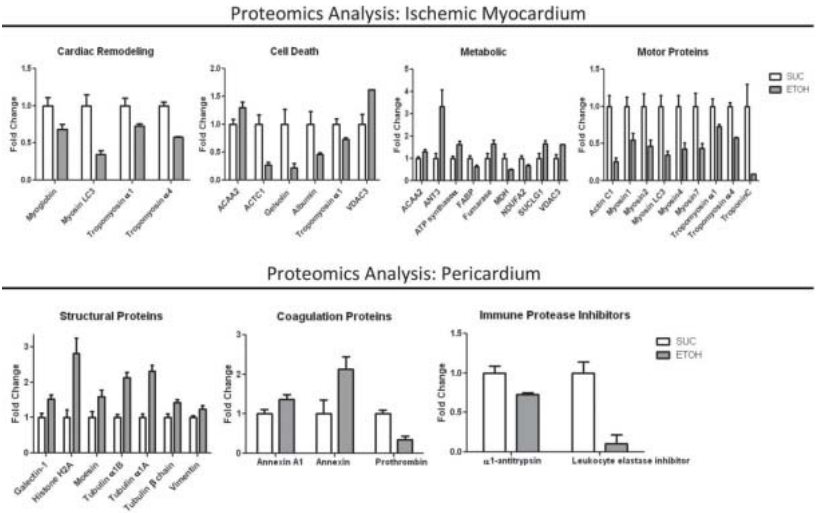
COMMERCIAL RELATIONSHIPS F. W. Sellke: Consultant/Advisory Board, The Medicines Company, CLS Behring

Purpose: Although epidemiologic studies have demonstrated that low to moderate alcohol consumption is cardioprotective, the mechanism is not fully understood. Using proteomic analysis, we sought to objectively investigate the effects of daily moderate alcohol consumption in the pericardium and myocardium in a swine model of chronic myocardial ischemia.

Methods: Fourteen male swine underwent placement of an ameroid constrictor to induce chronic myocardial ischemia. Animals were supplemented with 90 mL of ethanol daily (ETOH) or 80 g of sucrose of equal caloric value (SUC). After 7 weeks, the ischemic myocardium and pericardium were harvested for proteomics analysis.

Results: Pericardial proteomics analysis yielded 397 proteins, of which 23 were unique to SUC and 52 were unique to ETOH. Of the 322 common proteins, 71 were statistically significant and 23 were characterized ($p < 0.05$). Alcohol supplementation increased proteins related to chaperones, structural proteins, and decreased immune protease inhibitors in the pericardium (Figure, $p < 0.01$). Myocardial proteomics analysis yielded 589 proteins, of which 32 were unique to SUC and 21 were unique to ETOH. Of the 523 common proteins, 85 were significant and 32 were characterized ($p < 0.05$). Alcohol supplementation decreased cardiac remodeling proteins, cell death proteins, and motor proteins, and increased metabolic proteins (Figure, $p < 0.05$).

Conclusions: The results suggest that daily moderate alcohol consumption affects numerous pathways that contribute to cardioprotection, including cardiac remodeling, metabolism, and cell death. Our findings reveal the biosignature of myocardial and pericardial protein expression in the setting of chronic myocardial ischemia and daily moderate alcohol consumption. This comprehensive protein expression profile may clarify the mechanisms by which alcohol is cardioprotective and facilitate future biomarker research.



Protein expression listed as fold change± standard error of the mean compared to SUC. All proteins have $p<0.05$.

11:30 AM – 12:30 PM ***Room 29D***

Basic Science Research: General Thoracic

Moderators: *Andrew C. Chang, Ann Arbor, MI, and Michael J. Weyant, Aurora, CO*

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Presenting authors are listed in **bold** on each abstract.

The physician competencies addressed in this session are patient care and procedural skills and medical knowledge. These physician competencies will be addressed through a series of individual lectures and a brief question-and-answer session after each topic.

11:30 AM ***Room 29D***

Using 3D Printing Technology as a Tool for Tracheal Tissue Engineering

T. Goldstein[1], *J. Schwartz*[2], *D. Grande*[2], *S. J. Kwon*[3], *L. Smith*[4], *D. Zeltsman*[3]

[1]*North Shore-LIJ Health System, Manhasset, NY,* [2]*Feinstein Institute for Medical Research, Manhasset, NY,* [3]*North Shore-LIJ Health System, Great Neck, NY,* [4]*North Shore-LIJ Health System, New Hyde Park, NY*

REGULATORY DISCLOSURE This presentation will address 3D printed tissue that is not FDA approved.

Purpose: The fabrication of a tissue-engineered, 3D–printed, biodegradable tracheal segment, containing the patient's own cells, will be used as an avenue for complex tracheal reconstruction. This proof of concept study seeks to address reconstructive techniques that require donor tissues from secondary surgery sites.

Methods: A 3D-CAD template was created from human CT images. The 3D rendering was modified to generate a printable scaffold containing a chondrocyte specific bio-ink. The tracheal segments were printed on a modified MakerBot® Replicator® 2X Experimental 3D Printer in a biological safety cabinet out of polylactic acid (PLA) and the chondrocyte specific bio-ink. Each segment contains ~10,000 cells per mm3 that were suspended in the bio-ink prior to printing. The segments were incubated in a bio-incubator at 37oC for 2, 7, 14, 21, and 28 days. The samples were analyzed for viable cell-numbers/proliferation assay, histological staining, and mechanical testing.

Results: Thirty scaffolds were divided into three groups: two empty scaffolds, two non-cellular controls, and two cell seeded segments. The bio-printed cells were tested for viability, proliferation, and gene expression. The cells survived the printing process, were able to continue dividing, and produced the extracellular matrix expected of tracheal chondrocytes. There was no significant difference between the proliferation rates of the experimental group compared to the controls grown in T150 cell culture flasks. The segments retained their strength, contour, and rigidity/flexibility compared to the non-cellular controls. In addition, quantities of extracellular matrix increased as time progressed. Histological staining with Fast Green / Safranin O expressed formation of cartilage components within the segment.

Conclusions: The fabrication of a tissue-engineered, 3D–printed, biodegradable tracheal segment can address an unmet clinical need in tracheal reconstruction. Although further development is necessary for a viable clinical treatment, this proof-of-concept model indicates that this technology is a feasible alternative to traditional treatments.

11:45 AM ***Room 29D***

Triptolide Inhibits Lung Cancer Cell Migration, Invasion, and Metastasis

T. Reno, *Y. Li, J. Y. Kim, D. J. Raz*

City of Hope National Medical Center, Duarte, CA

COMMERCIAL RELATIONSHIPS D. J. Raz: Consultant/Advisory Board, Circea Theranostics, LLC

Purpose: Triptolide is an extract from Tripterygium wilfordii, which has been used in traditional Chinese medicine to treat autoimmune disorders. Triptolide has anticancer effects in vitro and has been reported to impair cancer cell migration through modulation of chemokine expression. We studied whether triptolide inhibits lung cancer cell migration and metastasis.

Methods: We tested the effects of triptolide on migration and invasion of H460 and A549 human lung cancer cells using Transwell filters coated with fibronectin and Matrigel, respectively. Imaging was used to quantify migrated cells. Western blots were used to compare expression of cell migration genes before and after 10 nM triptolide treatment. Tail vein injections using H460 and A549 cells were performed in groups of five NSG mice, which were treated with 1 mg/kg triptolide or vehicle by IP injection daily. The number of lung and liver metastases was compared at 5 weeks. Means of groups were compared using a t-test.

Results: Triptolide significantly decreased both the migration and invasion of human lung cancer cells from approximately 10 cells to two cells per 20X field ($p < 0.01$). In H460 and A549 cells, we found that triptolide decreases Focal Adhesion Kinase (FAK) protein expression. Downregulation of FAK caused a decrease in phosphorylated paxillin, which leads to impairment of the migration machinery. Finally, triptolide treatment of mice injected with human lung cancer cells significantly decreased metastatic colony formation in the lungs and liver ($p < 0.01$) (Figure).

Conclusions: Triptolide significantly decreases lung cancer cell migration and invasion in vitro and inhibits metastatic tumor formation in mice. Triptolide suppresses FAK, which causes deregulation of the migration machinery. These results suggest that triptolide inhibits lung cancer metastasis and should be investigated as a novel lung cancer therapy.

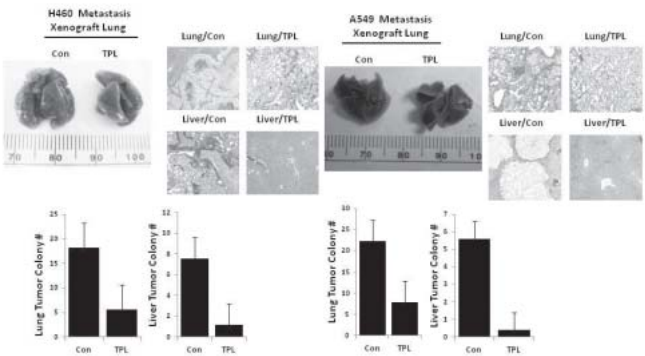


Figure. Triptolide decreases metastatic colony formation in mice. H460 (left) and A549 (right) human lung cancer cells were injected into the mouse tail vein. After 2 weeks, the mice were treated daily with either vehicle (Con) or 1 mg/kg triptolide (TPL). Five weeks later, the mice were sacrificed and tumor colony formation in the lungs and liver was analyzed. n = 5; p-value < .01.

MONDAY MORNING

12:00 PM **Room 29D**

Pulmonary Metastases Exhibit Epigenetic Clonality: Implications for Precision Therapy

E. Reardon[1], *D. Straughan*[2], *J. Hong*[2], *M. Zhang*[2], *M. Rao*[2], *D. Schrump*[2]

[1]*National Cancer Institute, Bethesda, MD,* [2]*National Institutes of Health, Bethesda, MD*

Purpose: Development of efficacious therapies for cancer may be limited by intratumoral epigenetic heterogeneity as a manifestation of therapeutic resistance and clonal evolution during tumor dissemination. Limited information is available regarding epigenetic landscapes of pulmonary metastases. This study sought to characterize epigenetic signatures of pulmonary metastases and identify novel therapeutic targets.

Methods: RNA and DNA were extracted from 80 pulmonary metastases resected from 16 patients (seven with sarcomas, nine with epithelial malignancies). qRT-PCR techniques were used to evaluate expression levels of cancer-testis genes (NY-ESO-1, BORIS, MAGE-3, MAGE-9, MAGE-12, SSX-1, SSX-2), tumor suppressors (RASSF1A, p16, DKK1, DAPK, p53), and epigenetic enzymes (DNMT1, DNMT3b, EZH2 and EED) aberrantly expressed in malignancies. Pyrosequencing techniques were used to quantitate DNA methylation levels in LINE1 and NBL2 repetitive elements, and confirm promoter methylation status of differentially regulated genes. Results of these analyses were compared to a standardized pool of RNA and DNA from normal human respiratory epithelia.

Results: Pulmonary metastases exhibited global DNA demethylation evidenced by hypomethylation of LINE-1 and NBL2. Epigenetic signatures were remarkably consistent among metastases from the same patient irrespective of time of resection (synchronous/metachronous) or anatomic location. Although histology-specific gene alterations (ie, activation of NY-ESO-1 in synovial sarcomas) were occasionally detected, significant inter-patient variability was observed even among patients with similar histologies. EZH2 and/or EED (core components of polycomb repressive complex-2 [PRC-2]) were upregulated in the majority of metastases.

Conclusions: Pulmonary metastases exhibit patient-specific epigenetic clonality, which may be exploited for precision therapies targeting aberrant cancer-testis or tumor suppressor gene expression. PRC-2 may be a shared target for epigenetic therapy of pulmonary metastases.

12:15 PM ***Room 29D***

Human Lung Fibroblast Inhibits Metastatic Lesion Formation in 4D Lung Cancer Model Seeded With Human Lung Cancer Cell Line

*S. Compean[1], D. Mishra[1], M. Thrall[1], X. Liu[2], E. Massarelli[2], J. Kurie[2], **M. P. Kim**[3]*

[1]Houston Methodist Hospital Research Institute, TX, [2]The University of Texas, MD Anderson Cancer Center, Houston [3]The Methodist Hospital – Weill Cornell Medical College, Houston, TX

COMMERCIAL RELATIONSHIPS M. P. Kim: Speakers Bureau/Honoraria, Ethicon, Inc; Other, Applied for a patent for 4D model

Purpose: We have shown that a 4D lung cancer model allows isolation of tumor cells at different phases of tumor progression: primary tumor, circulating tumor cells, and metastatic lesion formation. We plan to determine the impact of human fibroblasts in metastatic lesion formation in a 4D lung cancer model.

Methods: Human fibroblasts were isolated from the primary tumor (cancer-associated fibroblast, CAF) and the normal lung far away from the tumor (normal lung fibroblast, LF) from a lobectomy specimen using fluorescence-activated cell sorting of patients. The ex vivo 4D metastatic lung cancer model was seeded with the human lung cancer cell line (H460) alone, with CAF, or with LF. We measured the primary tumor's size and the number of circulating tumor cells (CTC) during the study period. We performed immunohistochemistry (IHC) on the primary tumor with the fibroblast marker α-SMA. We counted the number of tumor cells per high-power field to analyze the metastatic lesion and compared the groups using a student's t-test.

Results: Primary tumor nodules formed in the lung of the 4D model with H460 alone, H460 with LF, or H460 with CAF and the nodules grew over time. CTC were present starting on day 3 and they increased over time. Gross metastatic lesions were seen in all three conditions on day 12 and day 15. The H&E showed no significant difference in the growth of the tumor cells in the primary tumor among the three conditions. The IHC of the primary tumor showed the presence of α-SMA positive cells for H460 with LF and H460 with CAF but no positive cells with H460 alone. There were metastatic lesions seen on the H&E of the lobectomy specimen for all three time points and all three conditions. H460 with LF had significantly fewer metastatic lesions per high power field than H460 alone or H460 with CAF for day 12 and day 15 ($p < 0.002$).

Conclusions: The normal human lung fibroblasts obtained from lobectomy specimens from lung cancer patients formed significantly fewer metastatic lesions when grown in the 4D model with the human lung cancer cell line than the lung cancer cell line alone or when grown with the cancer-associated fibroblast. This model may be used to determine the role of different components of the tumor's microenvironment in metastatic lesion formation.

11:30 AM – 12:30 PM ***Room 30AB***

Congenital Session: Adult Congenital

Moderators: *Andrew C. Fiore, St Louis, MO, and Brian E. Kogon, Atlanta, GA*

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

Presenting authors are listed in **bold** on each abstract.

The physician competencies addressed in this session are patient care and procedural skills and medical knowledge. These physician competencies will be addressed through a series of individual lectures and a brief question-and-answer session after each topic.

11:30 AM ***Room 30AB***

Anomalous Aortic Origin of the Coronary Artery With Inter-arterial Course: Selection for Surgical Repair With Anatomic- and Function-Based Follow-Up

E. N. Feins*, D. Defaria Yeh, A. Bhatt, B. Ghoshhajra, I. Inglessis-Azuaje, R. Liberthson, T. E. MacGillivray*

Massachusetts General Hospital, Boston

Purpose: Anomalous aortic origin of the coronary artery (AAOCA) is a rare congenital anomaly. Indications for surgery are debated, and repair techniques have evolved. We have managed 269 adult patients with AAOCA over 40 years. Our multidisciplinary treatment algorithm includes anatomic- and functional-based surveillance for selection of surgical candidates. We reviewed the subset of adults who underwent surgical repair and analyzed anatomic and functional outcomes.

Methods: We queried our heart center database to obtain the names of all patients with AAOCA managed at our institution between 1974 and 2014. We performed a retrospective chart review.

Results: Two hundred sixty-nine adult patients were managed for AAOCA. Fifty-one patients underwent surgery. Twenty-two with associated coronary atherosclerosis were excluded. Four were excluded due to incomplete follow-up. Twenty-five patients with a "malignant" inter-arterial course of their anomalous coronary artery underwent surgical repair. Mean age was 43.3 years ± 15.3 years. Nineteen patients (76%) had right AAOCA. Five (20%) had left AAOCA. One (4%) had anomalies of both coronary arteries. Repair techniques included: 17 unroofings (68%), four reimplantations (16%), four coronary artery bypass grafts (CABG) (16%). Median follow-up was 15 months (2 to 164 months). There was no early or late mortality. Follow-up anatomic testing with CT angiography was performed on 12 patients. All 12 had widely patent coronary arteries. Functional testing was performed on 17 patients. Sixteen had no evidence of ischemia. One, who underwent CABG, had reversible ischemia; angiogram revealed an atretic internal mammary arterial graft.

Conclusions: We use a treatment algorithm to select which adults with AAOCA should undergo surgical repair. Based on this, only a small subset of patients require surgery, and we favor unroofing and reimplantation techniques. With this paradigm, outcomes are excellent, as validated with anatomic- and functional-based testing.

11:45 AM **Room 30AB**

An Empirically Based Tool for Analyzing Mortality Associated With Adult Congenital Heart Surgery

S. M. Fuller[1], *J. P. Jacobs*[2], *M. L. Jacobs*[3], *S. K. Pasquali*[7], *J. Gaynor*[4], *C. E. Mascio*[4], *K. Hill*[5], *X. He*[5], *Y. Kim*[6]

[1]*Children's Hospital of Philadelphia/University of Pennsylvania School of Medicine,* [2]*Johns Hopkins All Children's Heart Institute, St Petersburg, FL,* [3]*The Johns Hopkins School of Medicine, Baltimore, MD,* [4]*The Children's Hospital of Philadelphia, PA,* [5]*Duke Clinical Research Institute at Duke University, Durham, NC,* [6]*University of Pennsylvania, Philadelphia,* [7]*University of Michigan, Ann Arbor*

Purpose: Adjustment for differences in case-mix is critical to accurate outcomes analysis. While empirically based tools for case-mix adjustment exist in pediatric/congenital heart surgery, they are lacking for the rapidly expanding field of adult congenital heart surgery. We developed such a tool for this population.

Methods: Mortality risk was estimated for 52 types of operative procedures or groups of closely related procedures using data from 12,842 operations in The Society of Thoracic Surgeons Congenital Heart Surgery Database (STS-CHSD) on adults ≥18 years of age between January 2000 and June 2013. Procedure groups with n<30 were excluded. Procedure-specific mortality risk estimates were calculated using a Bayesian model that adjusted for small denominators. Each procedure or group of similar procedures was assigned a numeric score ranging from 0.1 to 5.0 based on the estimated mortality risk (STS Adult Congenital Heart Surgery Mortality Score).

Results: An increasing number of procedures on adult patients were reported to the STS-CHSD from 2000 (n=85) to 2012 (n=1,961). Overall unadjusted mortality across all procedures analyzed was 1.8%. The model-based estimate of mortality for procedures or groups of closely related procedures was lowest for repair of atrial septal defect (0.2%) and partial anomalous pulmonary venous return (0.4%) and highest for coronary artery intervention (5.5%), Fontan procedures (6.0%), and Fontan revision (7.3%). Also accounting for significantly high mortality were heart (7.2%) and lung (6.6%) transplant. When compared to previously established pediatric/congenital mortality risk stratification, some procedures common to both cohorts have widely disparate mortality risk (eg, adult mitral valve replacement 3.6% vs all ages congenital 7.3%). The most prevalent adult congenital procedures are listed in Table 1 together with their mortality scores.

Conclusions: These derived mortality scores for adult congenital cardiac surgery are exclusively based on adult congenital data, as pediatric risk scores cannot be accurately extrapolated to adults. Risk models incorporating these unique measures for adult congenital heart surgery may be used to compare mortality outcomes across institutions with differing case mixes.

Continued on next page

Congenital Session: Adult Congenital – Continued

Abstract continued from previous page

Table 1. Most commonly performed adult congenital heart surgeries

	N	*Unadjusted Estimate (95% CI^1)*	*Model- Based Estimate (95% CI^2)*	*Mortality Score*
Pulmonary valve replacement	1605	0.4% (0.1%, 0.8%)	0.4% (0.2%, 0.8%)	0.3
Pacemaker procedure	986	0.3% (0.1%, 0.9%)	0.4% (0.1%, 0.9%)	0.2
Atrial septal defect repair	780	0.0% (0.0%, 0.5%)	0.2% (0.0%, 0.6%)	0.1
Atrial arrhythmia ablation	604	2.3% (1.3%, 3.9%)	2.3% (1.3%, 3.6%)	1.5
Aortic valve replacement	491	1.6% (0.7%, 3.2%)	1.7% (0.8%, 2.9%)	1.0
Pacemaker implantation	401	1.0% (0.3%, 2.5%)	1.1% (0.4%, 2.2%)	0.7
Conduit reoperation	398	1.3% (0.4%, 2.9%)	1.3% (0.5%, 2.6%)	0.8
Non-valve sparing aortic root replacement	341	3.5% (1.8%, 6.1%)	3.4% (1.8%, 5.5%)	2.2
PAPVC repair	325	0.0% (0.0%, 1.1%)	0.4% (0.0%, 1.1%)	0.2
Aortic aneurysm repair	325	1.5% (0.5%, 3.6%)	1.6% (0.6%, 3.1%)	1.0
Mitral valvuloplasty	313	0.6% (0.1%, 2.3%)	0.8% (0.2%, 2.0%)	0.5

CI^1=Exact Binomial Confidence Interval for Unadjusted Estimate

CI^2 =Bayesian Credible Interval for Model-Based Estimate

PAPVC = Partial Anomalous Pulmonary Venous Connection

12:00 PM ***Room 30AB***

Durability of Bioprostheses in Tricuspid Position in Patients With Congenital Heart Disease

M. Burri, J. Hoerer, M. Vogt, J. Cleuziou, J. Kasnar-Samprec, R. Lange, C. Schreiber

German Heart Centre Munich

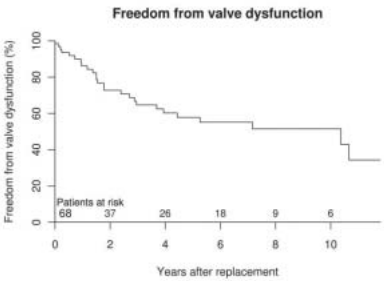
COMMERCIAL RELATIONSHIPS R. Lange: Consultant/Advisory Board, Medtronic, Inc

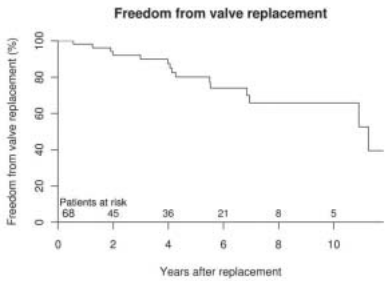
Purpose: The aim of the study was to determine valve function and need for reoperation in patients with congenital heart disease (CHD) following tricuspid valve replacement (TVR) with a bioprosthesis.

Methods: Between 1990 and 2013, 54 patients with CHD underwent 68 TVR using a bioprosthesis. Median age at operation was 29 years. Underlying pathology was Ebstein's anomaly in 34 (63%) patients. Implanted valves included 46 pericardial, 15 porcine, and seven transcatheter pericardial valves. All available echocardiographic examinations (n=725) were reviewed. Dysfunction was defined with ≥ moderate regurgitation or a mean diastolic gradient ≥ 8 mm Hg. Freedom from death, reoperation, and prosthetic valve dysfunction were estimated using the Kaplan-Meier method.

Results: Early mortality (30 day) was 6%. Estimated survival at 1 and 10 years was 85% and 79%, respectively. Freedom from prosthetic valve dysfunction at 1, 5, and 10 years was 86%, 58%, and 52%, respectively. Main reason for dysfunction was insufficiency (73%). A lower indexed Effective Orifice Area was not a risk factor for valve dysfunction. 5-year freedom from dysfunction was 54% for pericardial valves and 75% for porcine valves ($p = 0.087$). Freedom from reoperation at the tricuspid valve at 1, 5, and 10 years was 98%, 80%, and 66%, respectively.

Conclusions: In patients with CHD undergoing TVR with a bioprosthesis, valve dysfunction may occur only a few years after implantation. In our cohort, nearly half of the implanted valves exhibited a significant dysfunction within 5 years. Porcine bioprostheses seem to perform better than pericardial bioprostheses.





12:15 PM **Room 30AB**

Patterns of Aortopathy and Valve Pathology Differ in Children and Young Adults With Bicuspid Aortic Valve and Marfan's Syndrome

M. Ruzmetov

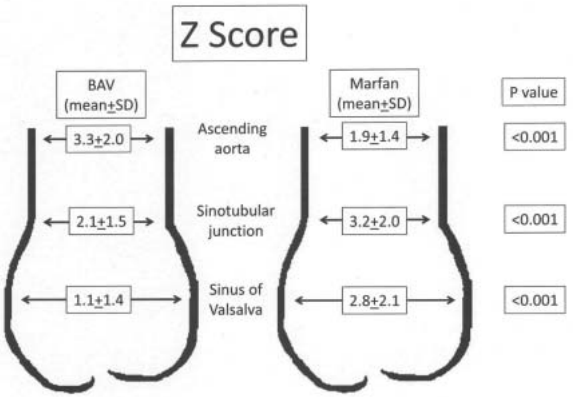
Children's Hospital of Illinois, Peoria

Purpose: Patients with bicuspid aortic valve (BAV) and patients with Marfan syndrome (MFS) are both at increased risk for aortic dilation and dissection. The purpose of this study is to compare patterns of aortopathy, aortic valve pathologies, and rates of aortic surgical intervention in patients with either BAV or MFS.

Methods: We performed a retrospective review of all patients older than 10 years of age who presented to our center with either BAV or MFS from 1990 to 2014. Moderate or greater aortic stenosis (AS) was defined as a valve gradient >3.5 m/s; aortic insufficiency (AI) was quantified using standard criteria. Aortic diameter was measured at three levels, and Z-scores were computed. Freedom from aortic root repair or replacement was determined using long-rank calculations.

Results: Four hundred thirty-two patients were identified: BAV n=358, MFS n=74. Median age was 17 years (10-40), with patients with BAV being younger (Table). Moderate or greater AS and moderate or greater AI were observed most often in patients with BAV. Conversely, dilation of the aortic root or ascending aorta was more common in patients with MFS. The two patient populations had different patterns of aortic dilatation. Patients with MFS had greater dilatation, as measured by Z-scores, of the sinus of Valsalva and sinotubular junction while patients with BAV had greater enlargement of the ascending aorta (Figure). Valve-sparing aortic root replacement (David, Yacoub) was performed in 12 patients (BAV, n=7; MFS, n=5) and aortic root replacement (Bentall, Ross) was performed in 45 patients (BAV, n=34; MFS, n=11). Freedom from surgical intervention on the aortic root at 30 years of age was significantly better in the BAV group (BAV, 92% vs MFS, 80%; $p = 0.003$).

Conclusions: Patients with BAV and MFS have different patterns of aortopathy and aortic valve pathology. Dilation of the ascending aorta and aortic valve pathology is more common in patients with BAV while dilation of the aortic root is seen more frequently in patients with MFS. Our data may help inform disease-specific patient counseling and follow-up.



	BAV(n=358)	MFS(n=74)	P Value
Age (years)	18±7.3	21±8.6	<0.001
Gender (male/female)	65%/35%	54%/46%	0.11
AS	113 (32%)	0	<0.001
AI	88 (25%)	10 (14%)	0.05
Dilated aorta (Z score >3)	135 (38%)	42 (57%)	0.003
Surgical intervention on aortic root	41 (12%)	16 (22%)	0.02
Mean age at surgical repair on aortic root (yrs)	25±11	21±9	0.15
Freedom from intervention on aortic root	92%	80%	0.003

11:30 AM – 12:30 PM ***Room 30CD***

Critical Care

Moderators: *James M. Isbell, Charlottesville, VA, and Glenn J. R. Whitman, Baltimore, MD*

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Presenting authors are listed in **bold** on each abstract.

The physician competencies addressed in this session are patient care and procedural skills and medical knowledge. These physician competencies will be addressed through a series of individual lectures and a brief question-and-answer session after each topic.

11:30 AM ***Room 30CD***

Feasibility, Effectiveness, and Safety of Activated Recombinant Factor VII Use for Intractable Bleeding During Extracorporeal Life Support in Adults

H. A. Welp*, A. Rukosujew, H. Deschka, M. Scherer, S. Martens*

University Hospital Muenster, Germany

COMMERCIAL RELATIONSHIPS M. Scherer: Consultant/Advisory Board, Thoratec Corporation

Purpose: Some reports describe an "off-label" use of activated recombinant factor VII (rFVIIa) to control excessive hemorrhage in cardiac surgery patients. Especially in patients requiring extracorporeal membrane oxygenation (ECMO) support, concerns about the safety of rFVIIa have been raised since circuit thromboses were described.

Methods: We retrospectively reviewed our database and identified all patients receiving rFVIIa for life-threatening intractable bleeding while on ECMO support. The following parameters were analyzed: demographic data, preexisting medical history, surgical parameters, anticoagulation therapy before, during, and after ECMO therapy, surgical interventions while on ECMO, length of stay on ICU, patient outcome, and incidence of thrombotic complications.

Results: From June 2001 until July 2013, a total of 330 patients were treated with ECMO in our ICU. In 10 of those, a successful rescue attempt to stop bleeding with rFVIIa was conducted. In none of the patients who received rFVIIa was an oxygenator thrombosis detected. Furthermore, no thromboembolic events, such as cardiac thrombosis, peripheral venous/arterial thrombosis, mesenterial ischemia, infarction of the liver, spleen, or kidney, or pulmonary embolism were detected. Two patients suffered from a stroke, which cannot uncritically be attributed to rFVIIa.

Conclusions: The use of rFVIIa to control excessive bleeding during ECMO support appears effective to reduce blood loss and transfusion requirements. In accordance with our results, concerns about clotting of the circuit and thromboembolic complications cannot be supported.

11:45 AM *Room 30CD*

Rotational Thromboelastometry Decreases Blood Product Transfusion in High-Risk Patients Undergoing Cardiac Surgery

***K. Yount**, L. T. Yarboro, R. Thiele, R. K. Ghanta, I. L. Kron, G. Ailawadi, J. A. Kern, C. L. Lau*

University of Virginia Health System, Charlottesville

COMMERCIAL RELATIONSHIPS G. Ailawadi: Consultant/Advisory Board, Abbott, Edwards Lifesciences Corporation, Mitralign; Speakers Bureau/Honoraria, St Jude Medical, Inc; J. A. Kern: Consultant/Advisory Board, SORIN GROUP; Speakers Bureau/Honoraria, CorMatrix, Edwards Lifesciences Corporation

Purpose: Most transfusion algorithms rely on tests hampered by long turnaround times and interference with heparin and protamine, and the additional value of thromboelastography (TEG) to such algorithms has long been debated. Our objective was to assess a recently introduced point-of-care coagulation test, rotational thromboelastometry (ROTEM®), in patients undergoing cardiac surgery.

Methods: Between January 1 and July 1, 2013, 213 patients undergoing cardiac surgery at a single institution were prospectively screened to be at high-risk for bleeding and selected for ROTEM® to guide transfusions. Screening criteria included anticoagulation, renal failure, redo sternotomy, bleeding disorder, combined procedure, emergent procedure, bypass time >120 minutes, circulatory arrest, or assist device implantation. This cohort was then procedure-matched to the most recent 213 patients meeting high-risk criteria who underwent cardiac surgery prior to the introduction of ROTEM® at our institution. The two cohorts were compared on differences in transfusion patterns, transfusion-related costs, major complications, and mortality.

Results: Although the proportion of patients receiving a transfusion with any blood product was not significantly reduced with ROTEM® ($p = 0.230$), transfusion volumes were significantly reduced (6.22 vs 4.96 units per patient, $p = 0.046$). There were no significant differences in the proportion or volumes of intraoperative transfusion; however, postoperative transfusions (< 24 hours following surgery) were significantly decreased with specific reductions in postoperative red blood cell, plasma, and platelet transfusions ($p < 0.001$). Transfusion-related costs were reduced by $484 per patient. Across all operation types, there was a lower incidence of stroke ($p = 0.028$), but an increased incidence of renal failure ($p = 0.049$). There were no significant differences in hospital length of stay or operative mortality.

Conclusions: Selective use of ROTEM® in high-risk patients undergoing cardiac surgery is associated with decreased transfusions, an altered transfusion pattern, and reduced costs.

12:00 PM **Room 30CD**

Race Is Associated With Mortality in Patients Undergoing Extracorporeal Cardiac Support

***T. Chan**, J. Di Gennaro, R. Farris, M. Radman, D. McMullan*

Seattle Children's Hospital, Washington

Purpose: Previous studies have demonstrated an association between non-Caucasian race and poor outcomes following cardiac surgery. This study aims to examine the association of race/ethnicity in patients undergoing extracorporeal membrane oxygenation (ECMO) for cardiac support using the Extracorporeal Life Support Organization (ELSO) registry.

Methods: All patients in the ELSO registry who received ECMO for cardiac support between 1989 and 2012 were included and categorized as postoperative, myocarditis/cardiomyopathy, structural heart disease without a procedure, other cardiac disease (including pulmonary embolism and myocardial infarct), and no identifiable heart disease. Logistic regression models examining race/ethnicity and hospital mortality, adjusting for diagnosis, cannulation site, pre-ECMO acidosis, type of ECMO support, age group, and year, were constructed.

Results: Of 14,951 patients utilizing cardiac ECMO, Caucasians composed the largest racial group (48%), while Asian (11%), Black (10%), and Hispanic ethnicity (9%) composed the other identifiable races/ethnicities. After adjusting for covariates, multivariate analysis identified Black race (Odds Ratio [OR]: 1.25, 95% Confidence Interval [CI]: 1.11-1.42) and Hispanic ethnicity (OR: 1.22; 95% CI: 1.07-1.40) as independent risk factors for mortality. Black race (OR: 1.26, 95% CI 1.08-1.47) and Hispanic ethnicity (OR: 1.36, 95% CI: 1.16-1.60) were associated with increased odds of experiencing a neurologic complication, the complication type most strongly associated with mortality. However, Black race and Hispanic ethnicity remained independently associated with hospital mortality, despite adjustment for complications.

Conclusions: Black race and Hispanic ethnicity are independently associated with mortality in patients who require cardiac ECMO. Racial variation in rates of neurological injury may be an important determinant of increased mortality in Black and Hispanic patients.

Table: Multivariate Logistic Regression Models for Hospital Mortality, Adjusting for Cannulation Site, Type of ECMO, Age, Pre-ECMO Acidosis, Year

Characteristic	Odds Ratio	95% Confidence Interval
Pre-ECMO Model		
Race/Ethnicity		
Caucasian	Reference	
Hispanic	1.22	1.07-1.40
Asian	1.13	0.99-1.29
Other	1.00	0.84-1.20
Missing	1.22	0.99-1.49
Diagnostic Category		
STAT 1-3	Reference	
STAT 4	0.89	0.79-1.00
STAT 5	1.12	0.96-1.31
Unknown Procedure	1.19	1.00-1.42
Muscle Disease	0.69	0.59-0.81
Structural Heart Disease, No Procedures	0.99	0.84-1.17
Other Cardiac Disease	1.18	1.01-1.38
No Structural Heart Disease	1.02	0.86-1.21
ECMO Complications Model		
Race/Ethnicity		
Caucasian	Reference	
Black	1.23	1.09-1.39
Hispanic	1.23	1.08-1.39
Asian	0.89	0.79-1.01
Other	0.99	0.83-1.17
Missing	1.35	1.16-1.58
Complications		
Any Cardiac Complication	1.15	1.07-1.25
Any Hematologic Complication	1.24	1.15-1.33
Any Infectious Complication	1.22	1.08-1.38
Any Metabolic Complication	1.29	1.18-1.41
Any Neurologic Complication	3.07	2.76-3.40
Any Pulmonary Complication	1.56	1.35-1.81
Any Renal Complication	1.98	1.83-2.13
Hours on ECMO	1.00	1.00-1.00

*STAT: Society of Thoracic Surgeons-European Association for Cardio-Thoracic Surgery Mortality Categories

12:15 PM **Room 30CD**

Long-Term Survival and Predictors of Mortality in Patients Needing Prolonged Intensive Care Unit Stay Post-Cardiac Surgery

R. Manji[1], *B. Hiebert*[2], *R. Arora*[3], *M. Moon*[3], *D. Freed*[4], *A. H. Menkis*[3]

[1]I.H. Asper Clinical Research Institute, Winnipeg, Canada, [2]Winnipeg Regional Health Authority Canada, [3]St Boniface General Hospital, Winnipeg, Canada, [4]University of Alberta, Edmonton, Canada

COMMERCIAL RELATIONSHIPS R. Arora: Research Grant, Manitoba Health Research Council (MHRC), Manitoba Medical Service Foundation (MMSF), Research Salary Award (MHRC/MMSF), Pfizer Canada Inc, TECHVALUENET

Purpose: Long-term survival and predictors of mortality for patients needing prolonged length of stay in the ICU (prLOSICU)—defined as staying ≥5 days post-cardiac surgery (CS)—are not well defined.

Methods: Data of patients with prLOSICU from January 1, 2000, to September 30, 2011, were extracted from clinical and provincial databases. Cox proportional regression analysis was done to determine predictors of mortality post-discharge home.

Results: There were 862 out of a total 9,711 CS patients (8.9%) who had prLOSICU and 790/862 patients (91.6%) survived to ICU discharge. The patients had many comorbidities (including mental illness), were acutely ill (high-risk score), came from lower income quintile neighborhoods within the province, and primarily had CABG or CABG + Valve procedures done. Post-ICU hospital survival rate was 88.5%, and 1, 3, and 5 year post-discharge home survival rates were 88.6%, 78.7%, and 72.6%, respectively. Cox proportional hazard regression analysis revealed factors associated with mortality post-discharge home were (n=699): preoperative cardiac arrest (OR=2.52, 95% CI [1.53-4.16], $p < 0.001$), preoperative social assistance requirement (OR=2.22, 95% CI [1.13-4.34], $p = 0.021$), preoperative infection (OR=1.80, 95% CI [1.18-2.76], $p = 0.007$), diabetes mellitus (OR=1.49, 95% CI [1.12-1.99], $p = 0.006$), chronic obstructive pulmonary disease (OR=1.47, 95% CI [1.03-2.11], $p = 0.036$), congestive heart failure (OR=1.41, 95% CI [1.02-1.94], $p = 0.036$), and age (OR=1.02, 95% CI [1.01-1.04], $p = 0.005$ for each year of age since surgery).

Conclusions: Following cardiac surgery, 8.9% of patients have prLOSICU with reasonable long-term survival rates. Long-term mortality is related more to comorbidities, initial presentation (eg, preoperative cardiac arrest), and socioeconomic status rather than having a complex cardiac operation. This information may prove useful in determining goals of care in "sick" cardiac surgery patients "struggling" in the ICU.

NOTES

11:30 AM – 12:30 PM ***Ballroom 20D***

General Thoracic Session: New Techniques

Moderators: *Melanie A. Edwards, St Louis, MO, and K. Robert Shen, Rochester, MN*

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Presenting authors are listed in **bold** on each abstract.

The physician competencies addressed in this session are patient care and procedural skills and medical knowledge. These physician competencies will be addressed through a series of individual lectures and a brief question-and-answer session after each topic.

11:30 AM ***Ballroom 20D***

Angiopoietin II in Donor Lungs Is an Indicator of Graft Quality and Is Associated With Primary Graft Dysfunction After Lung Transplantation

G. Singh[1], *J. Costa*[2], *M. Biscotti III*[1], *J. Van Hassel*[1], *J. R. Sonett*[2], *M. Bacchetta*[1]

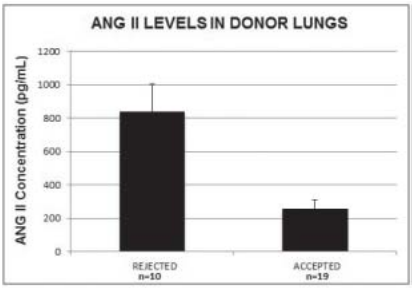
[1]*New York Columbia Presbyterian, NY,* [2]*Columbia University Medical Center, New York, NY*

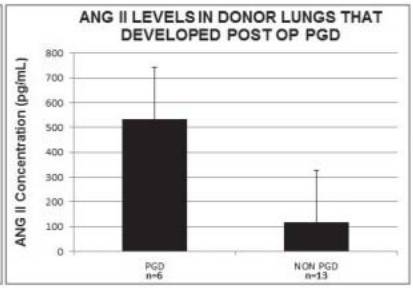
Purpose: Primary graft dysfunction (PGD) is associated with poor outcomes after lung transplantation (LTx). Studies have shown high levels of Angiopoietin II (ANG II) in acute lung injury and acute respiratory distress syndrome. Elevated levels in donor lung grafts could be associated with poor graft quality and the development of PGD.

Methods: At the time of organ evaluation, bronchoalveolar lavage was performed following general inspection of the tracheobronchial tree and installation of 20-30 mL of room temperature normal saline. The recovered volume of fluid (15-20 mL) was placed on ice and transported back to our institution. Upon arrival, the samples were then placed in storage at -80˚C until subsequent analyses. The BAL was thawed and centrifuged to remove alveolar macrophages and any particulate matter. ANG II was measured using a commercially available ELISA kit following the manufacturer's instructions. The clinical parameters for 19 recipients were collected retrospectively.

Results: ANG II levels were markedly higher in 10 lungs that were rejected for transplantation based on well-established criteria for evaluation of grafts. Of the 19 recipients that were implanted, 10 were double lung implants and nine were single lung implants. The mean age of these patients was 56.8 years ± 3.09 years; nine were male and 10 were female. The mean ischemic time for the double lung implants was first lung: 288.7 minutes ± 22.7 minutes and second lung: 393.2 minutes ± 27.9 minutes. The mean ischemic time for single lung implants was 233.3 minutes ± 16.7 minutes. ANG II levels were higher in the grafts implanted into patients who developed postoperative PGD. Out of 19 recipients, six developed PGD grade 2 and 3 at 24 hours and 72 hours. In this study, 17 out of 19 patients survived to discharge, one patient is hospitalized, and one patient died.

Conclusions: Recipients may be at higher risk for developing PGD if they receive donor lungs that have higher levels of ANG II. Further investigation is needed in the role of ANG II as a biomarker of endothelial injury in donor lungs prior to LTx and in patients with PGD after LTx.





PARAMETERS	PGD n=6	NON PGD n=13
Age	52.8±7.1	58.5±3.2
Ischemic time	282.3±33.0	252.2±17.5
Days of Intubation	13±6.3	5.71±2.7
ICU Length of Stay	15.16±3.9	10.9±3.1

11:45 AM ***Ballroom 20D***

Ex Vivo Evaluation of the Effectiveness of Pulmonary Artery Sealing Using the HARMONIC ACE®+ Shears (HS) for Video-Assisted Thoracoscopic Surgical (VATS) Lobectomy

M. A. Liberman[1], *M. Khereba*[1], *B. S. Nasir*[1], *E. Goudie*[1], *A. Danino*[2], *J. Giot*[2], *N. Nizard*[2], *R. Hadjeres*[2], *V. Thiffault*[1], *N. Farrenq*[1], *P. Ferraro*[1]

[1]*CHUM Endoscopic Tracheobronchial and Oesophageal Center (CETOC), University of Montreal, Canada,* [2]*University of Montreal, Canada*

COMMERCIAL RELATIONSHIPS M. A. Liberman: Research Grant, Ethicon Endo-Surgery, Inc

REGULATORY DISCLOSURE This presentation describes the off-label use of the Ethicon Harmonic Ace+, which is not indicated for sealing vessels greater than 5 mm in diameter.

Purpose: The standard technique for pulmonary arterial (PA) branch sealing in VATS lobectomy consists of vascular endostaplers. We aimed to evaluate the immediate efficacy of an ultrasonic energy vessel sealing device for sealing PA branches and compare it to the gold standard (endostapler) in an ex vivo pulmonary artery sealing model.

Methods: Prospective cohort study. Patients undergoing anatomical lung resection or lung transplantation were recruited. Immediately following anatomical lung resection, PA vessel sealing was achieved using either the HARMONIC ACE®+ Shears (ACE) sealing device or a vascular endostapler (VES) in a 3:1 ratio based on vessel diameter. The vessel was slowly pressurized and the bursting pressure (BP) was recorded. The unburst side of each sealed vessel was examined histologically by electron microscopy and was tested for collagen:elastin ratio.

Results: One hundred thirty-seven PA branches were sealed in specimens from 44 patients. There were 90 vessels sealed with ACE and 47 sealed with VES. The mean PA branch diameter was 6.0 mm (range: 1.7 mm – 24.0 mm, SD=3.1). The mean BP in the ACE group was 333.0 mm Hg (84.0 mm Hg – 1415.1 mm Hg, SD=231.4). The mean BP in the VES group was 114.2 mm Hg (0 mm Hg – 840.0 mm Hg, SD=124.7) ($p < 0.001$). There were no complete sealing failures in the ACE group. Electron microscopy of ACE sealed PA vessels demonstrated adventitial sealing with partial preservation of the collagen bundles (Figure 1A) and media with a sealed matrix of melted collagen (Figure 1B).

Conclusions: PA branches sealed using the HARMONIC ACE®+ in a simulated ex vivo model were able to sustain high intraluminal pressures. ACE sealed vessels burst at mean bursting pressures equal to or greater than endostapled vessels. Further research is needed to determine the in vivo and long-term safety of PA branch ultrasonic energy sealing.

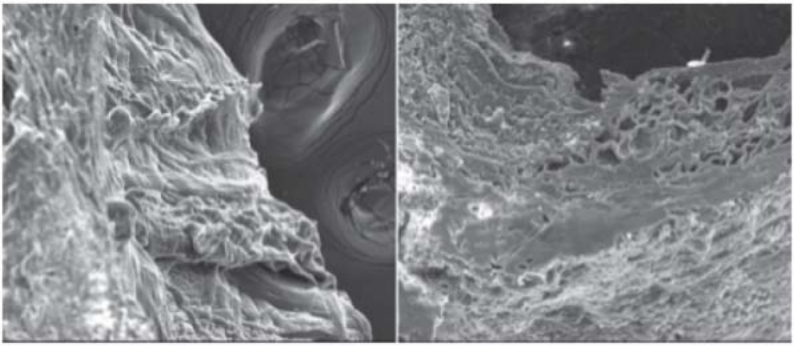


Figure 1A **Figure 1B**

Table 1 – Mean Burst Pressure by Size of Vessel

Vessel Diameter (mm)	Number of Vessels	Mean (SD) Burst Pressure (mmHg) - ACE	Mean +(SD) Burst Pressure (mmHg) - VES	p-value
1.1 – 2.0	2	205.0	198.2	-
2.1 – 3.0	12	474.8 (240.3)	246.9 (396.4)	0.342
3.1 – 4.0	13	291.0 (136.4)	139.5 (75.9)	0.019
4.1 – 5.0	20	303.4 (195.8)	120.0 (87.6)	0.002
5.1 – 6.0	21	288.6 (313.4)	64.0 (30.4)	0.012
6.1 – 7.0	19	407.0 (278.0)	96.0 (32.1)	0.001
7.1 – 8.0	9	268.1 (89.6)	97.9 (7.4)	0.002
8.1 – 9.0	7	260.5 (75.0)	108.3 (75.5)	0.051
>9.0	18	278.3 (220.1)	88.6 (56.4)	0.273

SD = Standard Deviation, ACE = HARMONIC ACE®+ Shears, VES = Vascular Endostapler

12:00 PM ***Ballroom 20D***

Initial Experience and Outcome With Peroral Endoscopic Myotomy (POEM) by a Thoracic Surgeon

S. G. Worrell[1], *E. Alicuben*[2], *S. DeMeester*[2]

[1]*University of Southern California, Los Angeles,* [2]*Keck School of Medicine of USC, Los Angeles, CA*

Purpose: Peroral endoscopic myotomy (POEM) is a new option in the treatment of achalasia. Our objective was to assess our initial experience and outcomes with POEM.

Methods: A retrospective chart review was performed of all patients who underwent POEM. The procedure was performed using the ERBE hybrid knife. Patients were assessed postoperatively with endoscopy and timed barium swallow.

Results: Since October 2012, 25 patients underwent POEM—12 male and 13 female (Table). The median age was 53 years (range 25-83). Prior endoscopic therapy (Botox or balloon dilatation) had been performed prior to POEM in 12 patients (48%). One patient had a previous laparoscopic myotomy. Follow-up was available for 14 patients at a median of 20 weeks. Heartburn symptoms were present in six patients and were relieved with proton pump inhibitor medication. Dysphagia was improved or resolved in all patients.

Conclusions: POEM provides excellent relief of dysphagia for all manometric types of achalasia and after failed prior procedures. POEM is associated with a short hospital stay and few complications. Minor erosive esophagitis is common on follow-up endoscopy and resolves with acid suppression therapy. Long-term follow-up will be important to confirm the role of POEM in patients with achalasia.

12:15 PM ***Ballroom 20D***

Clinical Utility of Endobronchial Ultrasound-Guided Transbronchial Needle Aspiration (EBUS-TBNA) for the Evaluation of Mediastinal Lymphadenopathy Concerning for Lymphoma

K. S. Nason*, M. J. Schuchert, J. D. Luketich, N. A. Christie, L. Pantanowitz, A. Karunamurthy, S. Monaco*

University of Pittsburgh Medical Center, PA

COMMERCIAL RELATIONSHIPS J. D. Luketich: Research Grant, Accuray Incorporated; Ownership Interest, Intuitive Surgical, Inc; Express Scripts, Inc

Purpose: Endobronchial ultrasound-guided transbronchial needle aspiration (EBUS-TBNA) is increasingly used as the initial diagnostic modality to evaluate mediastinal lymphadenopathy. While the role for EBUS-TBNA for metastatic carcinoma is well described, the utility of EBUS-TBNA in lymphomas is not as well defined. Our aim was to study the utility of EBUS-TBNA in the diagnosis and management of mediastinal lymphadenopathy concerning for lymphoproliferative disorders.

Methods: We reviewed all EBUS-TBNAs procured at our institution over a 6-year period (n=462 patients with 766 specimens; 2007 to 2013). Cases were reviewed for the indication for the procedure, cytological diagnosis, histological follow-up, and available ancillary studies. Intraoperative rapid onsite evaluation was performed for all cases.

Results: Of the 766 specimens from 462 patients, 102 (22%) underwent mediastinal tissue sampling to evaluate mediastinal lymphadenopathy without a history of lung cancer, and the final diagnoses are listed in Table 1 for these cases. Of the 17 cases where a final diagnosis of lymphoma was confirmed by histology and/or ancillary studies (11 Non-Hodgkin lymphomas, five Hodgkin lymphoma, and one posttransplant lymphoproliferative disorder), EBUS-TBNA was diagnostic in 10 cases (58%) and indeterminate in three (18%), unsatisfactory in three (18%), and negative in one (false-negative rate=6%). Histological follow-up was available in eight cases (47%). When rapid onsite evaluation deemed the specimen adequate for diagnosis, sensitivity for lymphoma was 91%.

Conclusions: EBUS-TBNA has high sensitivity and a low false-negative rate for lymphoproliferative disorders when specimens are adequate for analysis and provides alternative diagnoses in most cases, thus reducing the need for mediastinoscopy. Ideally, EBUS-TBNA is performed in the operating room, facilitating conversion to mediastinoscopy when needed based on onsite cytopathologic evaluation.

Table 1: Follow-up of EBUS-TBNA cases performed for mediastinal lymphadenopathy without definitive lung mass or history of lung cancer

		N (%)
Total cases		462 (100%)
EBUS-TBNA for mediastinal lymphadenopathy		102 (22%)
Final Diagnosis	Negative or NonDx	40 (39%)
	Granulomatous inflammation	19 (19%)
	Lymphoma	17 (17%)
	Non-small cell carcinoma	17 (17%)
	Small cell carcinoma	9 (9%)

11:30 AM – 12:30 PM ***Room 32AB***

STS/CATS/CSCS: Current and Future Workforce Issues in Cardiothoracic Surgery—Staff and Resident Perspectives From Canada and the US

The objective of this session, offered by STS, the Canadian Association of Thoracic Surgeons, and the Canadian Society of Cardiac Surgeons, is to discuss workforce issues pertinent to Canadian and American cardiothoracic (CT) surgeons. Experiences and differences in training and certification of CT surgeons in North America will also be reviewed. Leaders in workforce planning research, as well as resident leaders, will provide in-depth perspectives on issues that may impact future workforce planning.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Discuss current issues affecting CT surgery workforce planning in North America
- Describe the difference in training between Canadian and American CT training programs
- Review future issues affecting CT surgery workforce planning in North America
- Recognize models for predicting whether there will be sufficient jobs in North America for CT trainees in the future

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

The physician competencies addressed in this session are professionalism and patient care and procedural skills. These physician competencies will be addressed through a series of lectures and a panel discussion that is meant to enhance the understanding of the different workforce issues in cardiothoracic surgery.

Moderators: *Sean C. Grondin, Calgary, Canada, and John S. Ikonomidis, Charleston, SC*

11:30 AM **Introduction**

11:35 AM **General Thoracic Surgery in Canada: Staff Perspective**
Sean C. Grondin, Calgary, Canada

11:45 AM **General Thoracic Surgery in Canada: Resident Perspective**
Janet P. Edwards, Calgary, Canada

11:50 AM **Cardiac Surgery in Canada: Staff Perspective**
Christopher M. Feindel, Toronto, Canada

12:00 PM **Cardiac Surgery in Canada: Resident Perspective**
Maral Ouzounian, Halifax, Canada

12:05 PM **CT Surgery in the United States: Staff Perspective**
Richard J. Shemin, Los Angeles, CA

12:15 PM **CT Surgery in the United States: Resident Perspective**
David D. Odell, Pittsburgh, PA

12:20 PM **Panel Discussion**

12:30 PM – 1:15 PM

BREAK—Visit Exhibits and Scientific Posters

Complimentary coffee available in Exhibit Hall

1:15 PM – 5:15 PM ***Room 33ABC***

ACC @ STS

This session, presented by STS and the American College of Cardiology, will concentrate on a truly collaborative "Heart Team" approach to treating complex issues facing the practicing physician or affiliate provider. Using a unique and innovative format that highlights the spectrum of adult cardiac diseases, this year's session will concentrate on the multidisciplinary approach to coronary artery disease (CAD), mitral regurgitation (MR), and atrial fibrillation. Course components include invited technical videos featuring procedural expertise in these disease processes, a critical review of the literature, and an invited lecture regarding research from the STS/ACC TVT Registry™, as well as original scientific abstracts. This session also will utilize patient presentations describing difficult clinical scenarios, followed by an invited commentary.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Discuss the controversies surrounding the management of CAD
- Review and describe the indications and contraindications for the treatment of ischemic MR
- Describe the construction and makeup of the multidisciplinary "Heart Team" and its influence in improving patient outcomes and fostering communication among specialties
- Identify and explain the optimal management in those patients with specific case scenarios who are evaluated for coronary artery bypass grafting, MR, and atrial fibrillation

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

Presenting authors are listed in **bold** on each abstract.

The physician competencies addressed in this session are patient care and procedural skills, medical knowledge, and interpersonal and communication skills. These physician competencies will be addressed through a series of collaborative lectures by members of The Society of Thoracic Surgeons and the American College of Cardiology.

Moderators: *Hersh S. Maniar, St Louis, MO, Patrick T. O'Gara, Boston, MA, Richard W. Smalling, Houston, TX, and Vinod H. Thourani, Atlanta, GA*

COMMERCIAL RELATIONSHIPS R. W. Smalling: Research Grant, Abbott Vascular; V. H. Thourani: Research Grant, Edwards Lifesciences Corporation, Medtronic, Inc, SORIN GROUP; Consultant/Advisory Board, Boston Scientific, St Jude Medical, Inc; Ownership Interest, Apica Cardiovascular

1:15 PM **Introduction**

Patrick T. O'Gara, Boston, MA, and Vinod H. Thourani, Atlanta, GA

COMMERCIAL RELATIONSHIPS V. H. Thourani: Research Grant, Edwards Lifesciences Corporation, Medtronic, Inc, SORIN GROUP; Consultant/Advisory Board, Boston Scientific, St Jude Medical, Inc; Ownership Interest, Apica Cardiovascular

Multidisciplinary Management of Coronary Artery Disease (CAD)

1:17 PM **Current Status of Percutaneous CAD Treatment: What to Expect in the Next 5 Years**

Patrick T. O'Gara, Boston, MA

1:25 PM **Technical Video for Multiple Arterial Coronary Bypass Grafting (CABG) Surgery**
Joseph F. Sabik III, Cleveland, OH
COMMERCIAL RELATIONSHIPS J. F. Sabik: Research Grant, Abbott, Edwards Lifesciences Corporation; Consultant/Advisory Board, Medtronic, Inc, SORIN GROUP

1:33 PM **Putting Together the Long-Term Results of the Randomized SYNTAX Trial**
Michael J. Mack, Dallas, TX
COMMERCIAL RELATIONSHIPS M. J. Mack: Nonremunerative Position of Influence, Abbott Vascular, Edwards Lifesciences Corporation

1:41 PM **Discussion**

1:46 PM **Putting Together the Results of Large National Registry Databases Comparing Percutaneous Coronary Intervention (PCI) and CABG Surgery**
TBA

1:54 PM **Case Presentation of CAD and Poor Ejection Fraction**
Jeffrey S. Miller, Atlanta, GA

2:02 PM **Optimal Evaluation and Intervention for Patients With CAD and Low Ejection Fraction**
David R. Holmes Jr, Rochester, MN

2:10 PM **Discussion**

2:15 PM **Room 33ABC**

Comparison of Hybrid Coronary Revascularization vs Coronary Artery Bypass Grafting With Bilateral or Single Internal Mammary Artery Use

J. Rosenblum[1], *R. Harskamp*[2], *N. Hoedemaker*[2], *H. Liberman*[1], *R. de Winter*[3], *T. A. Vassiliades*[5], *J. Puskas*[4], *M. E. Halkos*[1]

[1]*Emory University, Atlanta, GA,* [2]*Duke University, Durham, NC,* [3]*Academic Medical Center, Amsterdam, The Netherlands,* [4]*Mount Sinai Beth Israel, New York, NY,* [5]*Medtronic, Inc, Mounds View, MN*

COMMERCIAL RELATIONSHIPS M. E. Halkos: Consultant/Advisory Board, Intuitive Surgical, Inc, Medtronic, Inc; T. A. Vassiliades: Employment, Medtronic, Inc

Purpose: Hybrid coronary revascularization (HCR) combines a minimally invasive left internal mammary artery to left anterior descending artery (LIMA-LAD) bypass with percutaneous intervention of non-LAD vessels. The purpose of this study was to compare short- and long-term outcomes of HCR to conventional CABG using either single (SIMA) or bilateral internal mammary artery grafting (BIMA) for patients with multivessel coronary disease.

Methods: From October 2003 to September 2013, 303 consecutive patients who underwent HCR were compared to 8,411 patients who underwent CABG with either SIMA (7,542, 86% of total) or BIMA (869, 10%) at a US academic center. The primary outcome was a composite of 30-day death, myocardial infarction, and stroke (MACCE). Secondary outcomes included 5-year all-cause mortality, in-hospital complications, and recovery parameters. Logistic regression and Cox-regression models were used to determine short- and long-term outcomes, respectively.

Results: Compared to BIMA and HCR, patients undergoing SIMA had a higher STS predicted risk of mortality score (SIMA=1.1%, BIMA=0.7%, HCR=0.9%, $p < 0.001$). Thirty-day MACCE events were equivalent in all three groups (HCR=9, 3.0%; BIMA=19, 2.2%; SIMA=256, 3.4%), whereas in-hospital complications were significantly higher in SIMA and BIMA groups compared to HCR, adjusted for STS morbidity score (Table). A significantly higher percentage of HCR patients had length of stay less than 5 days, compared to BIMA and SIMA patients (HCR=159, 52.5%; BIMA=370, 42.6%; SIMA=2,655, 35.2%, $p < 0.05$) when adjusted for STS predicted risk of prolonged length of stay score. Cox-proportional modeling showed no difference between HCR and SIMA for all-cause mortality at 5 years (HR=0.87, $p = 0.57$). BIMA patients had a trend toward lower probability of mortality compared to HCR (HR=1.46, p = 0.15) (Figure).

Conclusions: HCR is a safe minimally invasive alternative to traditional CABG and has an equivalent mortality and morbidity profile. Long-term outcomes may be improved with BIMA compared to HCR or CABG with SIMA, but only a randomized trial could address this possibility.

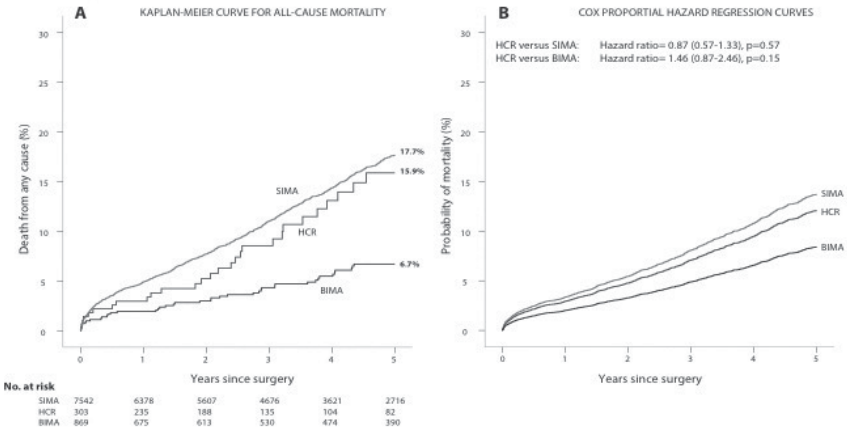


Table: Short-term outcomes and recovery parameters

	HCR vs BIMA		HCR vs SIMA	
	OR (95% CI)	P-value	OR (95% CI)	P-value
MACCE (30 days), %	1.21 (0.53-2.75)	0.65	0.98 (0.50-1.93)	0.96
All-cause mortality	1.75 (0.44-6.93)	0.43	1.06 (0.39-2.92)	0.90
Myocardial infarction	0.79 (0.17-3.76)	0.77	0.97 (0.24-4.02)	0.97
Permanent stroke	1.39 (0.34-5.61)	0.65	0.62 (0.20-1.98)	0.42
In-hospital complications, %	0.42 (0.26-0.67)	<0.001	0.53 (0.34-0.80)	0.003
Renal failure	0.53 (0.18-1.59)	0.26	0.54 (0.22-1.32)	0.18
Prolonged ventilation (>24h)	0.34 (0.19-0.61)	<0.001	0.42 (0.25-0.71)	0.001
Reoperation	1.35 (0.66-2.76)	0.41	0.93 (0.51-1.68)	0.80
Bleeding events				
CABG-related bleeding	1.07 (0.60-1.91)	0.82	0.73 (0.46-1.16)	0.18
Need for >5 units blood	0.77 (0.36-1.67)	0.51	0.53 (0.29-0.97)	0.038
Recovery parameters				
Post-op Length of Stay < 5 days	1.96 (1.47-2.60)	<0.001	1.85 (1.44-2.38)	<0.001
Post-op Length of Stay > 10 days	0.53 (0.22-1.24)	0.14	0.47 (0.22-1.01)	0.052

Mitral Regurgitation (MR)

2:30 PM **Therapy for Functional MR Guidelines: Appropriate Evaluation and Who We Should Be Treating**
Robert O. Bonow, Chicago, IL
REGULATORY DISCLOSURE This presentation will discuss the off-label use of Abbott's MitraClip for management of secondary (functional) mitral regurgitation.

2:38 PM **Discussion**

2:43 PM **Technical Video for the Treatment of Severe Ischemic MR**
Steven F. Bolling, Ann Arbor, MI

2:51 PM **Decision Making for Repair vs Replacement in Severe Ischemic MR: Update From the NIH CTSN Severe IMR Trial**
Michael A. Acker, Philadelphia, PA
COMMERCIAL RELATIONSHIPS M. A. Acker: Consultant/Advisory Board, Thoratec Corporation, HeartWare International Inc

2:59 PM **Discussion**

3:04 PM **Case Presentation of Moderate Ischemic MR With Concomitant CAD**
Jacob DeLaRosa, Pocatello, ID

3:09 PM **Current Management of Moderate Ischemic MR: Update From the NIH CTSN Moderate IMR Trial**
Vinod H. Thourani, Atlanta, GA
COMMERCIAL RELATIONSHIPS V. H. Thourani: Research Grant, Edwards Lifesciences Corporation, Medtronic, Inc, SORIN GROUP; Consultant/Advisory Board, Boston Scientific, St Jude Medical, Inc; Ownership Interest, Apica Cardiovascular

3:17 PM **Discussion**

3:22 PM **The Optimal Patient for the Percutaneous MitraClip Technique for Degenerative MR**
Saibal Kar, Los Angeles, CA
COMMERCIAL RELATIONSHIPS S. Kar: Research Grant, Abbott Vascular; Consultant/Advisory Board, Abbott Vascular

3:30 PM **The Percutaneous MitraClip Technique for Functional MR: Update From the European Registries and the COAPT Trial**
Francesco Maisano, Milan, Italy
COMMERCIAL RELATIONSHIPS F. Maisano: Research Grant, Abbott Vascular, Valtech Cardio Ltd
REGULATORY DISCLOSURE This presentation will discuss the off-label use of the Abbott Vascular MitraClip for FMR patients.

3:38 PM **Discussion**

3:43 PM *Room 33ABC*

Determinants of Late Outcomes in Women Undergoing Repair of Myxomatous Degeneration

V. Chan, *E. Elmistekawy, M. Ruel, T. G. Mesana*

University of Ottawa Heart Institute, Canada

COMMERCIAL RELATIONSHIPS M. Ruel: Research Grant, Medtronic, Inc

Purpose: Studies have consistently shown that women have worse perioperative outcomes following cardiac surgery compared to men. Few data are available that explain these divergent gender outcomes, especially in patients undergoing mitral surgery. This study was conducted to determine if women with degenerative mitral valve disease present to surgery with more advanced disease than men and if these differences influence long-term clinical outcomes.

Methods: Seven hundred forty-three patients underwent repair of mitral regurgitation (MR) due to myxomatous degeneration between 2001 and 2014. Of these, 325 (44%) were female, and concomitant coronary bypass grafting was performed in 103 (14%). Mean clinical follow-up was 2.8 years and extended to 11.1 years. A total of 1,729 postoperative echocardiograms were available for these 743 patients at a mean of 2.9 years following surgery.

Results: Perioperative mortality was 0.1%. Preoperatively, women had a larger indexed left atrial diameter (27.4 ± 5.7 mm/m2 vs 25.3 ± 4.8 mm/m2, $p < 0.001$), larger indexed left ventricle end-systolic dimension (20.5 ± 5.5 mm/m2 vs 19.5 ± 4.9 mm/m2, $p = 0.01$), and higher right ventricular systolic pressure (44.4 ± 14.4 mm Hg vs 41.7 ± 13.3 mm Hg, $p = 0.03$) compared to men. Five-year survival and freedom from recurrent MR ≥2+ was 88.7% ± 1.8% and 90.7% ± 1.6%, respectively. Although gender was not associated with survival (hazard ratio 1.6 ± 0.5, $p = 0.2$), women were more likely to develop recurrent MR ≥2+ at follow-up compared to men (hazard ratio 1.9 ± 0.5, $p = 0.01$).

Conclusions: In this large series, female patients with degenerative mitral valve disease presented with echocardiographic markers suggestive of more advanced disease at the time of surgery. Although there was no difference in early or late survival between groups, female patients were more likely to develop recurrent MR ≥2+ over the course of follow-up. Earlier surgical referral of female patients may therefore be advised.

3:58 PM **Break**

Management of Atrial Fibrillation

4:14 PM **Technique for Biatrial Cox-MAZE IV**
Vinay Badhwar, Pittsburgh, PA

4:22 PM **Guidelines for Medical or Surgical Management of Atrial Fibrillation: Who, When, and Techniques Used**
Patrick T. O'Gara, Boston, MA

4:30 PM **Discussion**

4:35 PM **Room 33ABC**

Detection of Atrial Fibrillation Following Surgical Ablation: Conventional vs Continuous Monitoring

R. J. Damiano[1], *C. Lawrance*[1], *L. Saint*[1], *M. Henn*[1], *L. Sinn*[1], *J. Kruse*[2], *M. Gleva*[3], *H. S. Maniar*[3], *P. M. McCarthy*[2], *R. Lee*[4]

[1]Barnes Jewish Hospital/Washington University, St Louis, MO, [2]Northwestern Memorial Hospital, Chicago, IL, [3]Washington University School of Medicine, St Louis, MO, [4]St Louis University, MO

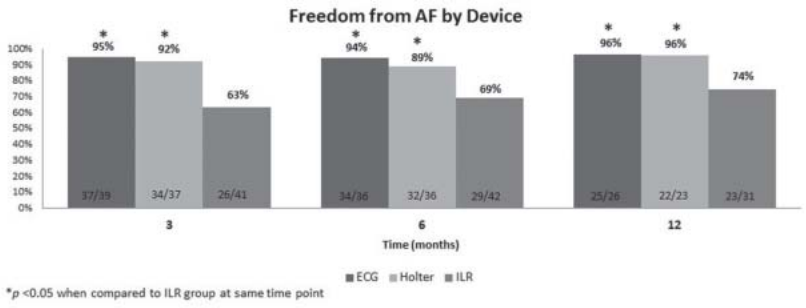
COMMERCIAL RELATIONSHIPS R. J. Damiano: Consultant/Advisory Board, AtriCure, Inc; Speakers Bureau/Honoraria, Edwards Lifesciences Corporation; M. Gleva: Research Grant, BIOTRONIK, Medtronic, Inc, St Jude Medical, Inc; Speakers Bureau/Honoraria, BIOTRONIK

Purpose: Current guidelines recommend 24-hour Holter monitoring at 6-month intervals to evaluate the recurrence of atrial fibrillation (AF) following surgical ablation. In this prospective multicenter study, conventional intermittent methods of AF monitoring were compared to continuous monitoring using an implantable loop recorder (ILR).

Methods: From August 2011 to August 2013, 47 patients receiving surgical treatment for AF at two institutions had an ILR placed at the time of surgery. Each atrial tachyarrhythmia (ATA) of 2 or more minutes was saved. Patients transmitted ILR recordings bimonthly or at any symptomatic event. Up to 27 minutes of data were stored before files were overwritten. Patients also received ECG and Holter monitoring at 3, 6, and 12 months. ILR compliance was defined as any transmission between 0-3 months, 3-6 months, or 6-12 months. Freedom from AF was calculated for each detection method and compared.

Results: ILR compliance at 3, 6, and 12-month time points was 91% (41/45), 93% (42/45), and 91% (31/34) compared to a 12-month ECG and Holter compliance of 84% (26/31) and 74% (23/31) respectively. ILR devices reported a total of 20,538 ATAs. Of these, 2,128 episodes (10%) were available for review and 949 (45%) were confirmed as AF. Reported freedom from AF was lowest among the ILR group (Figure). Symptomatic events were triggered in 32% (15/47) of patients, consisting of 138 episodes. However, only 16% (22/138) were confirmed as AF. In patients whose AF was detected by ILR monitoring, the mean calculated AF burden at 12 months was 0.61% (range 0.37%-0.85%). The longest episode of recorded AF in this subgroup was 24 minutes.

Conclusions: ILRs increased compliance and detected more episodes of AF when compared to Holter or ECG. However, the high rate of false positives and limited number of events available for review present barriers to broad implementation for this form of monitoring. Interestingly, very few symptomatic events were actually AF upon review.



Clinical Case Scenarios: My Worst Recent Scenario and What I Would Have Done Differently

4:50 PM **Two Cases I Wish I Had Sent to Surgery**
E. Murat Tuzcu, Cleveland, OH

5:03 PM **Two Cases I Wish I Had Sent for a Percutaneous Procedure**
Gorav Ailawadi, Charlottesville, VA

COMMERCIAL RELATIONSHIPS G. Ailawadi: Consultant/Advisory Board, Abbott, Edwards Lifesciences Corporation, Mitralign; Speakers Bureau/Honoraria, St Jude Medical, Inc

5:11 PM **Discussion**

1:15 PM – 5:15 PM ***Room 29AB***

Evidence and Quality Reshaping Practice

The STS National Database has been a valuable tool for outcomes assessment in cardiothoracic surgery since 1989. The Database continues evolving to meet the changing needs of physicians in a complex health care delivery system. This program will address new science and evidence that impacts clinical cardiac and thoracic surgery, data-driven public reporting, quality measurement, and clinical practice guideline development. In addition, this important program will describe ways in which the robust data from the Database can be used to implement quality improvement initiatives and drive reimbursement.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Discuss implications and strategies for physician-level reporting
- Discuss the importance of cost and resource utilization in care delivery
- Define data transparency and describe its importance in improving quality
- Apply strategies for using the feedback report for quality improvement
- Explain the rationale for a multidisciplinary approach in quality improvement
- Create a plan to establish a regional quality improvement collaborative
- Describe how STS utilizes data from its National Database to support thoracic surgery relative value recommendations to CMS
- Identify the evidence recommendations in current and future clinical practice guidelines, such as "Arterial Conduits for Coronary Artery Bypass Grafting" and "The Role of Multimodality Treatment for Cancer of the Esophagus and Gastroesophageal Junction"

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

Presenting authors are listed in **bold** on each abstract.

The physician competencies addressed in this session are patient care and procedural skills and medical knowledge. These physician competencies will be addressed through a series of individual lectures that will focus on the STS National Database and how it is evolving to meet the changing needs of physicians in a complex health care delivery system. Panel discussions and questions from the audience will augment these competencies.

Moderators: *Vinay Badhwar, Pittsburgh, PA, and Jeffrey P. Jacobs, St Petersburg, FL*

1:15 PM **Introduction**

1:20 PM ***Room 29AB***

The STS Composite Performance Measure for Surgeons: A Report of the STS Quality Measurement Taskforce

D. M. Shahian[12], *X. He*[1], *S. O'Brien*[1], *P. A. Kurlansky*[2], *V. Badhwar*[3], *J. C. Cleveland Jr*[4], *F. L. Fazzalari*[5], *G. Filardo*[6], *A. P. Furnary*[7], *M. J. Magee*[8], *J. S. Rankin*[9], *K. F. Welke*[10], *J. P. Jacobs*[11]

[1]*Duke Clinical Research Institute, Durham, NC,* [2]*Florida Heart Research Institute, Miami,* [3]*University of Pittsburgh, PA,* [4]*University of Colorado, Aurora,* [5]*University of Michigan Medical School, Rochester,* [6]*Institute for Health Care Research and Improvement, Dallas, TX,* [7]*Starr-Wood Cardiac Group of Portland, PC, OR,* [8]*HCA North Texas Division, Dallas,* [9]*Vanderbilt University, Nashville, TN,* [10]*Children's Hospital of Illinois, Peoria,* [11]*Johns Hopkins All Children's Heart Institute, St Petersburg, FL,* [12]*Massachusetts General Hospital, Boston*

COMMERCIAL RELATIONSHIPS A. P. Furnary: Consultant/Advisory Board, Edwards Lifesciences Corporation, Glumetrics Inc, GlySure, OptiScan; Speakers Bureau/Honoraria, Edwards Lifesciences Corporation; J. S. Rankin: Ownership Interest, BioStable Science and Engineering, Inc

Purpose: Because of sample size concerns and the team nature of cardiac surgery, STS currently analyzes performance only at the hospital or practice level. In response to increasing national interest in physician-level performance, STS has now developed a valid, reliable composite metric for surgeons.

Methods: The development cohort included 2,607 STS National Database participating surgeons who performed isolated CABG (n=441,669), isolated AVR (n=82,651) and AVR + CABG procedures (n=54,224) between July 1, 2010, and June 30, 2013. An overall composite measure was developed for these three procedures using four domains: (1) risk-adjusted mortality; (2) risk-adjusted major morbidity (stroke, renal failure, reoperation, deep sternal infection, or prolonged ventilation); (3) IMA use in isolated CABG; and (4) medication bundle use in isolated CABG. Performance categories were determined using 98% Bayesian credible intervals.

Results: Overall observed median mortality and occurrence of major morbidity were 2.1% and 14.3%; in isolated CABG patients, median failure to use an IMA was 1.8% and median medication bundle failure was 9.9%. Performance was classified below average (1 star) for 8.3% (217/2,607) of surgeons, average (2 star) for 78.8% (2,055/2,607), and above average (3 star) for 12.9% (335/2,607). The higher the surgeon performance category, the lower the observed adverse event rates in every quality domain (mortality [4.0%, 2.4%, 1.1%]; morbidity [22.7%, 14.7%, 9.4%]; failure to use an IMA [7.1%, 2.6%, 1.6%]; and medication bundle failure [23.1%, 11.8%, 6.5%]). Measure reliability was 0.73.

Conclusions: STS has developed a four-domain, three-procedure, multiyear composite measure that reliably discriminates surgeon-level performance. This new metric mitigates sample size issues encountered when estimating surgeon performance using single metrics (eg, risk-adjusted mortality) or procedures (eg, isolated CABG).

Continued on next page

Evidence and Quality Reshaping Practice – Continued

Abstract continued from previous page

Table: Distribution of model-based estimates of surgeon performance

	Composite	Mortality	Morbidity	IMA	Medications
0%	0.865	0.907	0.434	0.623	0.290
10%	0.941	0.961	0.784	0.938	0.735
25%	0.952	0.970	0.821	0.964	0.829
50%	0.962	0.977	0.857	0.981	0.903
75%	0.970	0.983	0.886	0.990	0.951
90%	0.976	0.987	0.908	0.994	0.974
100%	0.989	0.995	0.961	0.999	0.998
mean	0.960	0.975	0.850	0.971	0.875

1:28 PM **Discussant**

Joseph E. Bavaria, Philadelphia, PA

COMMERCIAL RELATIONSHIPS J. E. Bavaria: Research Grant, W. L. Gore & Associates, Inc

1:35 PM ***Room 29AB***

Successful Linking of STS and CMS Medicare Data to Examine the Penetration, Completeness, and Representativeness of the STS Adult Cardiac Surgery Database

J. P. Jacobs[1], *D. M. Shahian*[15], *X. He*[2], *S. O'Brien*[2], *R. Dokholyan*[2], *E. Peterson*[2], *V. Badhwar*[3], *J. C. Cleveland Jr*[4], *A. P. Furnary*[5], *P. A. Kurlansky*[6], *J. S. Rankin*[7], *K. F. Welke*[8], *M. J. Magee*[9], *G. Filardo*[10], *J. Han*[11], *D. McDonald*[11], *D. Schmitz*[11], *F. H. Edwards*[12], *R. L. Prager*[13], *F. L. Grover*[14]

[1]*Johns Hopkins All Children's Heart Institute, St Petersburg, FL,* [2]*Duke Clinical Research Institute, Durham, NC,* [3]*University of Pittsburgh, PA,* [4]*University of Colorado, Aurora,* [5]*Starr-Wood Cardiac Group of Portland, PC, OR,* [6]*Florida Heart Research Institute, Miami,* [7]*Vanderbilt University, Nashville, TN,* [8]*Children's Hospital of Illinois, Peoria,* [9]*HCA North Texas Division, Dallas,* [10]*Institute for Health Care Research and Improvement, Dallas, TX,* [11]*The Society of Thoracic Surgeons, Chicago, IL,* [12]*University of Florida, Jacksonville,* [13]*University of Michigan Hospitals, Ann Arbor,* [14]*University of Colorado, Aurora,* [15]*Massachusetts General Hospital, Boston*

COMMERCIAL RELATIONSHIPS A. P. Furnary: Consultant/Advisory Board, Edwards Lifesciences Corporation, Glumetrics Inc, GlySure, OptiScan; Speakers Bureau/Honoraria, Edwards Lifesciences Corporation; F. L. Grover: Consultant/Advisory Board, Somahlution Inc; J. S. Rankin: Ownership Interest, BioStable Science and Engineering, Inc; E. Peterson: Research Grant, Eli Lilly & Company, Janssen Pharmaceutical, Inc; Consultant/Advisory Board, Boehringer Ingelheim GmbH, Janssen Pharmaceutical, Inc, Merck & Co, Inc, sanofi-aventis

Purpose: The CMS Medicare Database has been successfully linked to the STS National Database. This linkage complements the STS National Database by facilitating comparative effectiveness research and providing information about long-term follow-up and cost. The present study uses this link to determine the completeness, penetration, and representativeness of the STS National Database.

Methods: The Duke Clinical Research Institute used variables common to both the STS and CMS databases to link STS operations to CMS inpatient claims data for all coronary artery bypass grafting (CABG) discharges (isolated or combined) between 2000 and 2011, inclusive, for patients >65 years enrolled in traditional fee-for-service Medicare. For each CMS CABG hospitalization, it was determined whether or not a matching STS record existed.

Results: ***Patient-level penetrance*** (number of CMS-CABG cases linked to STS records divided by total number of CMS-CABG cases) increased from 51% to 94% from 2000 to 2011. In 2011, 77,988 of 82,890 CMS-CABG admissions (94%) were at an STS site. ***Center-level penetrance*** (number of CMS sites with at least one matched STS record divided by total number of CMS-CABG sites) increased from 45% to 89% from 2000 to 2011. In 2011, 974 of 1,091 CMS-CABG sites (89%) were linked to an STS site. ***Completeness*** of case inclusion at STS sites (number of CMS-CABG cases at STS sites linked to STS records divided by total number of CMS-CABG cases at STS sites) increased from 86% to 98% from 2000 to 2011. In 2011, 75,035 of 76,946 CMS-CABG hospitalizations at STS sites (98%) were linked to an STS record. Table 1 compares linked and unlinked CABG operations in 2011 at STS sites.

Conclusions: Linkage of the STS and CMS databases demonstrates high and increasing penetrance and completeness of the STS National Database. Slightly higher mortality was observed for unmatched cases at STS sites; the reasons for this are unclear and bear further investigation. Linking STS and CMS data will facilitate the study of long-term cardiothoracic surgery outcomes.

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Evidence and Quality Reshaping Practice – Continued

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Figure 1.

Center-level penetration of The Society of Thoracic Surgeons Adult Cardiac Surgery Database stratified by state, for the year 2011.

Table 1. Representativeness of STS Data in 2011[a]

	Not matched to STS (n = 1,911)	Matched to STS (n = 75,035)	*p* Value
Age, years, mean (1st, 3rd quartile)	73.0 (68.0, 78.0)	73.0 (69.0, 79.0)	0.0218
Sex, male	1,285 (67.2%)	51,902 (69.2%)	0.0716
Race			<0.001
White	1,668 (87.3%)	68,095 (90.8%)	
Black	150 (7.8%)	3,615 (4.8%)	
Other/unknown	93 (4.9%)	3,325 (4.4%)	
Admission type			0.0057
Emergent	467 (24.4%)	17,500 (23.3%)	
Urgent	378 (19.8%)	17,366 (23.1%)	
Elective	1,053 (55.1%)	39,778 (53.0%)	
Other/unknown	13 (0.7%)	391 (0.5%)	
Mortality[b]			
In-hospital	105 (5.5%)	2,480 (3.3%)	<.0001
30-day (Kaplan-Meier)	7.8% (6.6%, 9.0%)	5.0% (4.8%, 5.1%)	<0.001

SD = standard deviation; STS = The Society of Thoracic Surgeons

a = Only includes admissions during months of STS participation. Sample size (n = 76,946)

b = Mortality is for all coronary artery bypass graft surgery (CABG) cases: isolated CABG and CABG combined with other operations

1:43 PM **Discussant**

Sara K. Pasquali, Ann Arbor, MI

1:50 PM **Room 29AB**

The Impact of Modifiable Clinical Variables on Length of Stay Following First-Time Cardiac Surgery

N. Ad[1], S. Holmes[1], G. Pritchard[1], A. M. Speir[2], L. Halpin[1]

[1]Inova Heart and Vascular Institute, Falls Church, VA, [2]Cardiac, Vascular & Thoracic Surgery Associates, Falls Church, VA

COMMERCIAL RELATIONSHIPS N. Ad: Speakers Bureau/Honoraria, AtriCure, Inc, Medtronic, Inc; Consultant/Advisory Board, AtriCure, Inc, Medtronic, Inc; A. M. Speir: Consultant/Advisory Board, Medtronic, Inc

Purpose: Recent financial challenges highlight the importance for accurate prediction of length of hospital stay (LOS). Our aims were to assess reliability of STS risk prediction for extended and shorter LOS and examine whether modifiable clinical variables are associated with LOS in first-time cardiac surgery patients.

Methods: Aortic valve, mitral valve, and coronary artery bypass grafting surgery patients since 2008 were included in analyses (n=3,503). Multivariate linear regression evaluated modifiable and non-modifiable predictors of LOS in days. Variables were chosen a priori based on clinical experience and relevant literature.

Results: Mean age was 63.8 years ± 11.3 years, EF was 54.6% ± 11.7%, emergent status in 3%, male (76%), and Caucasian (75%). Median [IQR] LOS was 4 [3-6] days. Predicted STS risk for long LOS (>14 days) was 6.1% ± 7.1% and 48.1% ± 20.4% for short LOS (<6 days). STS mortality risk was 1.9% ± 3.3%. Observed long LOS in 5.2% of patients (O/E=0.85). Observed short LOS was better than predicted (67.8%; O/E=1.40). Inclusion of potentially modifiable clinical variables to the model was significant ($p < 0.001$) with modifiable predictors including lower preoperative Hct, higher HgbA1c, major perioperative morbidity, and blood transfusion (Table). When applying the model to an average patient, predicted LOS was 5.0 days. Holding all other factors constant, addition of blood transfusion increased predicted LOS to 7.7 days, an increase in preoperative Hct from 27 to 39 predicted LOS reduced by 1 day, and decrease in HgbA1c from 8% to 6% predicted LOS reduced by a half day.

Conclusions: This study demonstrated that STS predictions for LOS are accurate. However, it is lacking the important ability to predict exact LOS in days. Accounting for potentially modifiable clinical variables, such as low Hct and its association with blood transfusion, especially in elective patients, should lead to shorter LOS, higher satisfaction, and reduce financial burden.

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Evidence and Quality Reshaping Practice – Continued

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Non-modifiable Factors	B	*p*-value
Age (yrs)	0.03	0.001
Female	-0.24	0.241
Caucasian	-0.02	0.907
Married	-0.26	0.128
Ejection Fraction	0.004	0.463
Emergent	1.88	0.001
Chronic Pulmonary Disease	0.43	0.048
IABP	1.56	0.001
CPB Time (mins)	0.001	0.622
STS Risk for Long LOS	0.15	<0.001
Modifiable Factors	**B**	***p*-value**
Preoperative Hematocrit	-0.06	0.002
HgbA1c	0.15	0.017
Body Mass Index	0.0002	0.987
Major Morbidity	7.46	<0.001
Blood Transfusion	2.68	<0.001
Active Smoker	0.04	0.870

1:58 PM **Discussant**

Thomas E. MacGillivray, Boston, MA

2:05 PM ***Room 29AB***

Late Operating Room Start Times Impact Mortality and Cost for Nonemergent Cardiac Surgery

K. Yount*, C. L. Lau, L. T. Yarboro, R. K. Ghanta, I. L. Kron, J. A. Kern, G. Ailawadi*

University of Virginia Health System, Charlottesville, VA,

COMMERCIAL RELATIONSHIPS G. Ailawadi: Consultant/Advisory Board, Abbott, Edwards Lifesciences Corporation, Mitralign; Speakers Bureau/Honoraria, St Jude Medical, Inc; J. A. Kern: Consultant/Advisory Board, SORIN GROUP; Speakers Bureau/Honoraria, CorMatrix, Edwards Lifesciences Corporation

Purpose: Given the increased focus on improving systems-based practices, there is growing concern over the effect of starting elective cases later in the day on patient outcomes and efficient resource utilization. Our objective was to determine the differences in patient outcomes for patients undergoing non-emergent cardiac surgery after 3:00 PM.

Methods: All non-emergent cardiac operations performed at a single institution from July 2008 to 2013 were reviewed. Cases were stratified based on "early start" or "late start," defined by incision time before or after 3:00 PM. Operations were further categorized by attending, case type, and year. Data were also collected on case order and the number of consecutive hours the surgeon had been operating. Rates of observed and risk-adjusted mortality, major complications, and costs were compared on a univariate basis for all patients and via multivariable linear and logistic regression for patients with a valid STS Predicted Risk of Mortality (PROM).

Results: A total of 3,395 non-emergent cardiac operations were reviewed, including 418 late start cases. Compared to cases starting earlier, mortality was significantly higher for patients undergoing late operations (3.2% vs 5.2%, $p = 0.046$), despite similar preoperative risk (STS PROM 3.3% vs 3.8%) and major complication rates (18.2% vs 18.3%). Importantly, total hospitalization costs were 8% higher with late start cases ($47,641 vs $51,576, $p < 0.001$). After controlling for case type, surgeon, year, and STS PROM, starting after 3:00 PM resulted in higher mortality (odds ratio 2.04, $p = 0.041$) despite slightly shorter operative duration (16 min, $p < 0.001$). The number of consecutive hours the surgeon had been operating was not a significant predictor of outcomes.

Conclusions: Absolute and risk-adjusted mortality is higher in patients undergoing non-emergent cardiac surgery later in the day. Operative factors alone do not appear to explain these differences. Consequently, systems must focus not only to ensure on-time starts but also to strengthen care delivery for late starts and arrivals to intensive care.

2:13 PM **Discussant**

V. Seenu Reddy, Nashville, TN

COMMERCIAL RELATIONSHIPS V. S. Reddy: Speakers Bureau/Honoraria, AstraZeneca, CryoLife, Inc

2:20 PM **Room 29AB**

Development, Implementation, and Feasibility of Surgeon-Specific Outcome Reports and of a Surgeon-Led, Continuous Quality Improvement Program in Thoracic Surgery

J. Ivanovic[1], *C. Anstee*[2], *T. Ramsay*[3], *P. J. Villeneuve*[2], *S. Gilbert*[2], *D. Maziak*[2], *F. Shamji*[2], *R. Sundaresan*[2], *A. J. Seely*[1]

[1]*University of Ottawa, Canada,* [2]*The Ottawa Hospital, Canada,* [3]*Ottawa Hospital Research Institute, Canada*

COMMERCIAL RELATIONSHIPS S. Gilbert: Ownership Interest, Bristol-Myers Squibb Company, Eli Lilly & Company, Merck & Co, Inc, Pfizer Inc, Sanofi Sponsored ADR

Purpose: Using the Thoracic Morbidity & Mortality (TM&M) classification of adverse events, we created surgeon-specific outcome reports (SSORs) to enable self-assessment and implemented a divisional, surgeon-led, continuous quality improvement (CQI) program as a means to assess and improve clinical performance.

Methods: Mixed-methods study within a division of six thoracic surgeons involving: development of real-time, web-based, risk-adjusted SSORs built upon the TM&M platform; implementation of CQI seminars (n=6; 09/13-06/14) to review results, select quality indicators, discuss quality improvement strategies based on identification of positive outliers along with best practice measures, and select topics for subsequent discussion; and in-person interviews to identify facilitators/barriers of using SSORs and CQI. Interview transcripts were analyzed using thematic analysis.

Results: Through iterative development, anonymous, dynamic SSORs were created. Interviews revealed that all surgeons believed SSORs can lead to improvements in care through knowledge of personal outcomes with divisional comparison and can be used for continuous professional development and maintenance of certification. Perceived limitations of SSORs included limited understanding of risk adjustment, resistance to change, and belief that knowledge of sensitive data could lead to punitive actions. All surgeons believed a program of CQI led to collegial interactions and discussions. Perceived limitations of a CQI program included quorum participation and failing to circle back on actionable items.

Conclusions: Real-time performance feedback using SSORs can motivate surgeons to improve their practice, while a CQI program offers the opportunity to review and interpret results, and address issues in a collegial and supportive environment. Whether SSORs and CQI can lead to improvements in postoperative M&M rates is a matter of ongoing research.

All Diseases All Priorities All Incisions Lobectomy with All Systems Prolonged Air Leak: Oct-2012 to Jan-2014

	Surgeon A	Surgeon B	Surgeon C	Surgeon D	Surgeon E	Surgeon F	Divisional Avg [Divisional Total]	p value (Yates' p value)
Pts w Complications	27%	23%	43%	12%	12%	25%	6 in 25 (23%) [34 in 152 (22%)]	0.10 (0.24)
Pts w Minor Complications	27%	23%	38%	12%	12%	25%	6 in 25 (24%) [33 in 152 (22%)]	0.20 (0.43)
Pts w Major Complications	0%	0%	5%	0%	3%	4%	1 in 25 (4%) [3 in 152 (2%)]	0.69 (1.00)
Pts w Grade V Complications	0%	0%	0%	0%	0%	0%	0 in 25 (0%) [0 in 152 (0%)]	1.00 (1.00)

All Diseases All Priorities All Incisions Lobectomy with All Systems Prolonged Air Leak: Oct-2012 to Jan-2014

NSQIP	Surgeon A	Surgeon B	Surgeon C	Surgeon D	Surgeon E	Surgeon F	Divisional Avg
Maker-Wasserman (Occurence) 95% CI	0.49 0.30 - 0.68	0.49 0.29 - 0.69	0.22 0.13 - 0.31	0.27 0.18 - 0.36	0.55 0.32 - 0.78	0.87 0.50 - 1.24	0.48
Maker-Wasserman (Severity) 95% CI	0.49 0.30 - 0.68	0.77 0.46 - 1.08	0.22 0.13 - 0.31	0.34 0.23 - 0.45	0.55 0.32 - 0.78	1.06 0.61 - 1.51	0.57
EVAD (Age, DLCO, FEV1)	Surgeon A	Surgeon B	Surgeon C	Surgeon D	Surgeon E	Surgeon F	Divisional Avg
O/E 95% CI	0.41 0.38 - 1.07	0.32 0.94 - 1.39	0.22 0.29 - 1.01	0.19 0.43 - 1.01	0.45 0.37 - 1.10	0.69 0.64 - 1.33	0.38
Dynamic Risk Picker (Age,Sex,ASAClass)	Surgeon A	Surgeon B	Surgeon C	Surgeon D	Surgeon E	Surgeon F	Divisional Avg
Complications - O/E 95% CI	0.5 0.49 - 1.35	0.44 1.32 - 1.94	0.26 0.35 - 1.21	0.24 0.53 - 1.23	0.55 0.46 - 1.36	0.9 0.84 - 1.76	0.48

2:28 PM **Discussant**

Daniel L. Miller, Marietta, GA

COMMERCIAL RELATIONSHIPS D. L. Miller: Consultant/Advisory Board, Ethicon Endo-Surgery, Inc, Bard Medical

2:35 PM **Moderated Panel Discussion: New Perspectives on STS Clinical Practice Guidelines**

Gabriel S. Aldea, Seattle, WA, Alex G. Little, Tucson, AZ, and John D. Mitchell, Aurora, CO

COMMERCIAL RELATIONSHIPS J. D. Mitchell: Speakers Bureau/Honoraria, Covidien Ltd; Consultant/Advisory Board, MAQUET, Varian Medical Systems Inc

3:00 PM **Break**

3:15 PM **Moderated Panel Discussion: New Perspectives of the STS National Database**

Marshall L. Jacobs, Newtown Square, PA, Benjamin D. Kozower, Charlottesville, VA, and Richard L. Prager, Ann Arbor, MI

Evidence and Quality Reshaping Practice – Continued

3:45 PM **Quality Measurement—Past, Present, and Future**
David M. Shahian, Boston, MA

3:55 PM **Transparency and Public Reporting**
Jeffrey P. Jacobs, St Petersburg, FL

4:05 PM **Room 29AB**

Risk-Adjusted Bundled Care in Cardiac Surgery: Is It Feasible?

***K. Yount**, J. M. Isbell, Z. Dietch, G. Ailawadi, I. L. Kron, J. A. Kern, C. L. Lau*

University of Virginia Health System, Charlottesville

COMMERCIAL RELATIONSHIPS G. Ailawadi: Consultant/Advisory Board, Abbott, Edwards Lifesciences Corporation, Mitralign; Speakers Bureau/Honoraria, St Jude Medical, Inc; J. A. Kern: Consultant/Advisory Board, SORIN GROUP; Speakers Bureau/Honoraria, CorMatrix, Edwards Lifesciences Corporation

Purpose: Policy experts have proposed risk-adjusted bundled care to enable reimbursement tied to value rather than to quantity of services. The purpose of our study was to assess the relationship between risk and cost to develop a model for forecasting our institution's cardiac surgery costs under a bundled care payment scheme.

Methods: All patients undergoing adult cardiac operations for which there was a Society of Thoracic Surgeons (STS) Predicted Risk of Mortality (PROM) score over a 5-year period (2007-2012) at a tertiary care, university hospital were retrospectively reviewed for clinical and cost data. A multivariable regression model was developed to analyze the relationship between preoperative risk and log-transformed costs after controlling for surgeon, year, and case type. After grouping patients according to preoperative risk as a basis for negotiating risk-adjusted bundles, Monte Carlo simulation of this model was performed to forecast year 2013 costs and then compared to actual costs.

Results: Among the 2,514 patients included in our analysis, preoperative risk was strongly correlated with perioperative hospital costs ($p < 0.001$) after controlling for surgeon, year, and case type. However, forecasting models using individual STS PROM scores were able to explain only 28% (RR=0.28) of the variation in costs among individual patients. Using bundling to diffuse and adjust for risk improved prediction to only 33% (RR=0.35). Actual costs in 2013 were $21.6M compared to predicted costs of $19.3M ± $350K, which is well outside the 95% confidence interval of the forecast.

Conclusions: Even among the most common cardiac operations, much of the variation in costs cannot be explained by risk, and risk-adjusted bundling only moderately improved forecasting models. Consequently, surgeons should re-examine whether individual practices or insurance agencies are best suited to manage this financial risk before widespread adoption of bundled care.

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Evidence and Quality Reshaping Practice – Continued

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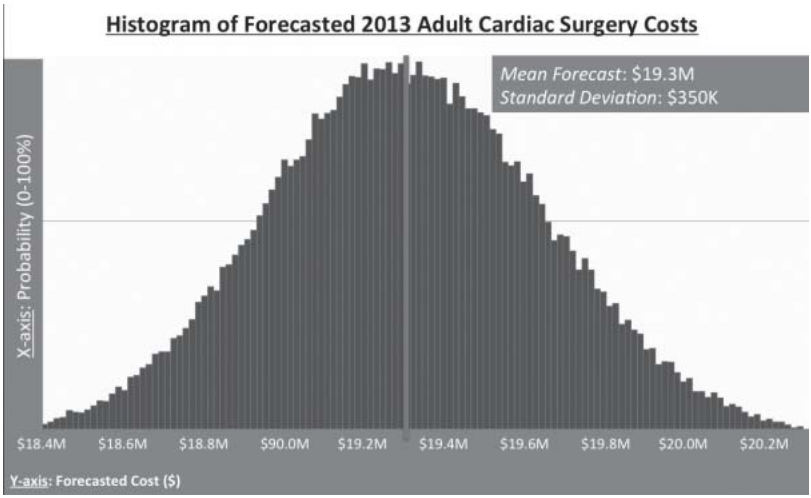


4:13 PM **Discussant**
Frank L. Fazzalari, Rochester, MI

4:20 PM **Supporting Cardiothoracic Surgery Reimbursement With STS Data: The Relative Value Scale Update Committee (RUC)**
Peter K. Smith, Durham, NC

4:30 PM **Moderated Panel Discussion: The STS Adult Cardiac Surgery Database and the Genesis, Evolution, and Sustainability of Local and Regional Quality Collaboratives**
Baron L. Hamman, Dallas, TX, William C. Nugent, Lebanon, NH, and Alan M. Speir, Falls Church, VA
COMMERCIAL RELATIONSHIPS A. M. Speir: Consultant/Advisory Board, Medtronic, Inc

NOTES

1:30 PM – 3:30 PM ***Room 31ABC***

Adult Cardiac Session: Aortic

Moderators: *Michael P. Fischbein, Stanford, CA, and Wilson Y. Szeto, Philadelphia, PA*

COMMERCIAL RELATIONSHIPS W. Y. Szeto: Research Grant, Edwards Lifesciences Corporation, Medtronic, Inc, SORIN GROUP; Consultant/Advisory Board, Micro Interventional Devices, Inc

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

Presenting authors are listed in **bold** on each abstract.

The physician competencies addressed in this session are patient care and procedural skills and medical knowledge. These physician competencies will be addressed through a series of individual lectures and a brief question-and-answer session after each topic.

1:30 PM **Management of Aortic Arch Aneurysms: How Should It Be Done in ER Patients? Total Open**
Thomas E. MacGillivray, Boston, MA

1:45 PM **Management of Aortic Arch Aneurysms: How Should It Be Done in ER Patients? Total Endovascular**
Francois Dagenais, Quebec City, Canada

REGULATORY DISCLOSURE This presentation will address the off-label use of custom-made arch grafts, including branch arch grafts, fenestrated arch grafts, and tunnel and periscope use of approved Cook devices.

2:00 PM **Management of Aortic Arch Aneurysms: How Should It Be Done in ER Patients? Hybrid**
G. Chad Hughes, Durham, NC

COMMERCIAL RELATIONSHIPS G. Hughes: Consultant/Advisory Board, W. L. Gore & Associates, Inc; Speakers Bureau/Honoraria, Medtronic, Inc

REGULATORY DISCLOSURE This presentation will address the off-label use of Bolton, Cook Medical, Medtronic, and W. L. Gore thoracic endografts for repair of aortic arch pathology.

2:15 PM ***Room 31ABC***

Stent Grafting Acute Aortic Dissection: Comparison of DeBakey Extent IIIA vs IIIB

A. A. Arafat*, E. E. Roselli, V. Menon, M. Eagleton*

Cleveland Clinic Foundation, OH

COMMERCIAL RELATIONSHIPS M. Eagleton: Consultant/Advisory Board, Bolton Medical, Inc, Cook; E. E. Roselli: Speakers Bureau/Honoraria, Medtronic, Inc, Terumo Medical Corporation; Consultant/Advisory Board, Edwards LifeSciences Corporation; Nonremunerative Position of Influence, SORIN GROUP

REGULATORY DISCLOSURE This presentation will address the use of Medtronic, Cook, and W. L. Gore thoracic stentgrafts in aortic dissection. Some of these are now approved for use in dissection; however, they were off-label at the time of use in these patients.

Purpose: Thoracic stent grafting is effective for acute dissection in select patients, but most remain at risk for reintervention. Influence of the extent of dissection on outcome is unclear. Objectives are to describe patients with DeBakey extent IIIA and IIIB dissection and compare outcomes after TEVAR.

Methods: From 2005 to 2013, 520 patients presented with acute aortic syndrome. One hundred eight (41 IIIA, 67 IIIB) underwent thoracic endovascular aortic repair (TEVAR). Data were collected from a prospective registry and chart review, and 3D imaging analysis was performed. Patients with IIIB dissection were younger (59.5 ± 13 years vs 69.9 ± 10 years), more often male (67% vs 46%), and larger (BMI 30 ± 6.9 vs 25.5 ± 4.8) than IIIA. Dissection length was 447 mm ± 83 mm (IIIB) vs 202 mm ± 88 mm (IIIA), and 46 IIIB (69%) had dissected abdominal branches. Most common indication for TEVAR was ischemia in IIIB (65.7%) and pain in IIIA (34.1%).

Results: Rupture was more common in IIIA (24.3% vs 1.5%). IIIB patients had smaller true/false lumen ratio (0.58 vs 1.33) and wider proximal tear (9.5 mm ± 7.1 mm vs 5.9 mm ± 3.1 mm), and it occurred closer to subclavian (41 mm ± 40 mm vs 62 mm ± 55 mm). Interval to intervention was 9.5 days ± 9.8 days for IIIA vs 4.4 days ± 6 days for IIIB. Stent graft coverage was 152 mm ± 42 mm for IIIA vs 212 mm ± 85 mm for IIIB. Five (12%) IIIA and 20 (30%) IIIB received additional branch stents, and seven had infrarenal stenting. Early mortality and complications were more common for IIIB vs IIIA patients: mortality 13.4% vs 4.8%, permanent paralysis 1.5% vs 0.0%, renal failure 4.4% vs 0.0%, respectively, except for stroke, which was more common in IIIA (4.8%) than IIIB (2.9%). Mean follow-up was 30 months ± 28 months. Fifteen percent of IIIA (6/39) required reintervention for aneurysm (n=2), ascending dissection (n=2), and endoleak (n=1), and 24% of IIIB patients (14/58) required 17 interventions for endoleak (n=5), endoleak (n=2), aneurysm (n= 7), rupture (n=1), and ascending dissection (n=3). Survival at 1, 3, and 5 years was 84%, 65%, and 38% for IIIA, and 70%, 66%, and 59% for IIIB, respectively.

Conclusions: In patients undergoing TEVAR for acute dissection, both patient factors and detailed aortic morphology differ by extent of dissection. Those with DeBakey IIIB dissection are at higher early risk from the intervention, probably related to morphologic features. Survival curves cross at about 3 years, which may be explained by differences in patient characteristics.

2:30 PM **Room 31ABC**

Decision Making for the Management of Type A Dissection Repair in Octogenarians

***N. Desai**, R. Menon, W. Y. Szeto, J. Gottret, P. Moeller, P. Vallabhajosyula, J. E. Bavaria*

Hospital of the University of Pennsylvania, Philadelphia

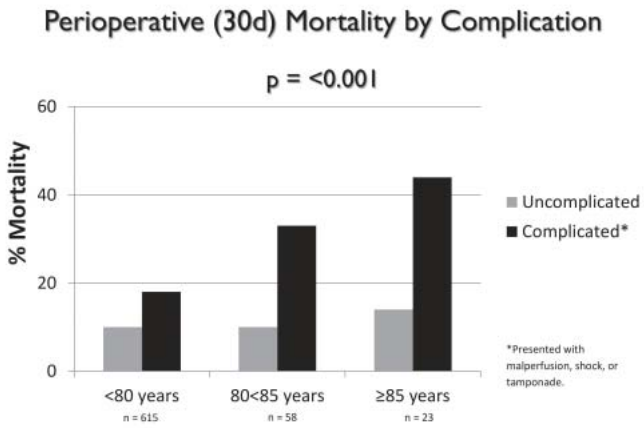
COMMERCIAL RELATIONSHIPS N. Desai: Consultant/Advisory Board, St Jude Medical, Inc; Speakers Bureau/Honoraria, Medtronic, Inc, W. L. Gore & Associates, Inc; W. Y. Szeto: Research Grant, Edwards Lifesciences Corporation, Medtronic, Inc, SORIN GROUP; Consultant/Advisory Board, Micro Interventional Devices, Inc; J. E. Bavaria: Research Grant, W. L. Gore & Associates, Inc

Purpose: Octogenarians are frequently denied surgery for type A aortic dissections due to concerns about very high mortality rates and morbidity. We sought to determine a clinical threshold where the risks posed by surgery may become excessive.

Methods: From 1988 to 2013, 696 consecutive type A dissection repairs at our institution were reviewed. Of these, 81 (12%) were performed on patients >80 years of age, with 58 (8%) being 80 to 85 years and 23 (4%) being ≥85 years. All patients typically underwent sternotomy, aortic valve resuspension, and open distal hemiarch under circulatory arrest with cerebral perfusion. Standard univariate, survival, logistic regression, and Cox proportional hazards modeling methods were employed. This is, to our knowledge, the largest review of type A dissections in the octogenarian population to date.

Results: Thirty-day mortality among patients >80 and <80 years was 22% and 9% ($p = 0.003$), respectively. Among octogenarians, perioperative mortality was similar for patients aged 80 to 85 (21%) and ≥85 (26%), $p = 0.4$. The incidence of complicated dissections (defined as presenting with malperfusion, shock, and/or hemopericardium/tamponade) at presentation were similar among the <80, 80 to 85, and ≥85 groups (46%, 47%, and 40%, respectively). Early (30-day) mortality within these groups, however, was 18%, 33%, and 44%, respectively ($p < 0.001$). Five-year mortality among all octogenarians was 59%: 80 to 85 years (55%) and ≥85 years (70%).

Conclusions: Overall, octogenarians have acceptable outcomes following open repair for type A aortic dissection. Patients ≥85 years with complicated presentation have substantially poorer outcomes and open aortic surgery may not be superior to medical therapy. These patients may benefit from emerging endovascular therapies.



2:45 PM **Room 31ABC**

Effects of Dual Arterial Perfusion on Outcome of Patients With Acute DeBakey Type I Aortic Dissection

S. Song, *T. Kim, K. Yoo*

Gangnam Severance Hospital/Yonsei University College of Medicine, Seoul, Republic of Korea

Purpose: Few issues remain when performing emergency repair of acute DeBakey type I aortic dissection (AIAD). The arterial perfusion strategies in which all the philosophies, such as optimal temperature, brain protection, and visceral protection, are included will determine the outcome of AIAD.

Methods: We reviewed 218 consecutive patients (mean age, 57 years) with AIAD who underwent surgical repair using different arterial cannulation (1997-2010). Arterial perfusion was either by single (axillary or femoral, n=136, 62%) or dual (axillary and femoral at the same time, n=82, 38%) cannulation. The outcomes were compared between the two groups.

Results: Dual perfusion significantly reduced cooling time, circulatory arrest time, cardiopulmonary bypass time, and total operation time ($p < 0.001$). The in-hospital mortality was 20% (27 of 136) in the single and 7% (6 of 82) in the dual group ($p < 0.05$). All-cause postoperative morbidities were significantly lower in the dual group ($p = 0.003$). Permanent neurologic complications occurred in 16 patients (7.3%), with statistically significant difference between the groups (10% in the single and 2% in the dual group; $p < 0.05$). Also, the peak level of postoperative serum creatinine was significantly lower in the dual group (2.74 mg/dL vs 1.98 mg/dL; $p = 0.015$). Dual perfusion also enabled aortic repair under progressively warmer systemic hypothermia (from 13°C to 30°C).

Conclusions: Dual arterial perfusion confers better neurologic and visceral outcomes in patients with AIAD, if used with antegrade selective cerebral perfusion and retrograde intermittent lower body perfusion.

3:00 PM **Room 31ABC**

Thoracic Endovascular Aortic Repair Promotes False Lumen Thrombosis and Remodeling of the Thoracic Aorta in Acute Complicated Type B Aortic Dissection

J. Gottret, *W. Y. Szeto, P. Vallabhajosyula, R. Menon, P. Moeller, G. Wang, B. Jackson, R. M. Fairman, J. E. Bavaria, N. Desai*

Hospital of the University of Pennsylvania, Philadelphia

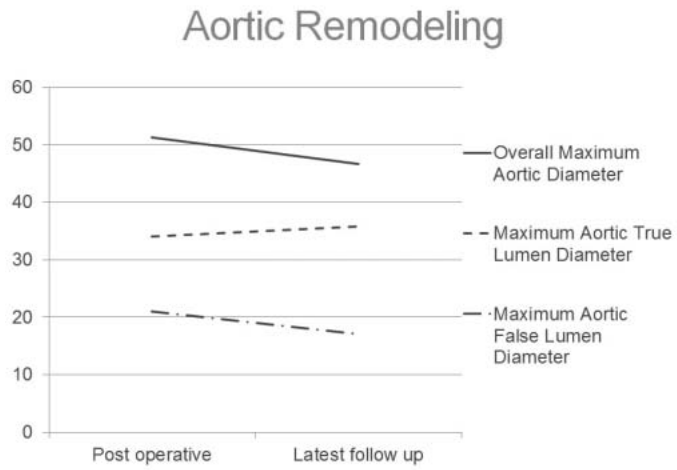
COMMERCIAL RELATIONSHIPS J. E. Bavaria: Research Grant, W. L. Gore & Associates, Inc; N. Desai: Consultant/Advisory Board, St Jude Medical, Inc; Speakers Bureau/Honoraria, Medtronic, Inc, W. L. Gore & Associates, Inc; W. Y. Szeto: Research Grant, Edwards Lifesciences Corporation, Medtronic, Inc, SORIN GROUP; Consultant/Advisory Board, Micro Interventional Devices, Inc

Purpose: Endovascular stent grafting for the treatment of complicated acute type B aortic dissections has emerged as an effective therapy and has gained rapid clinical adoption. This study presents the efficacy of thoracic endovascular aortic repair (TEVAR) in promoting thrombosis of the false lumen and remodeling of the acutely dissected thoracoabdominal aorta.

Methods: From 2005 to 2014, 143 patients underwent TEVAR for the treatment of acute complicated type B dissection. Thoracic and abdominal false lumen patency was assessed and total aortic, true, and false lumen diameters were measured at different anatomic locations. True and false lumen indices were calculated to evaluate the impact of TEVAR on aortic remodeling. Early postop (<1 month postop) and most recent follow-up (>1 year postop) CTA scans were considered.

Results: In-hospital and 30-day mortality was 5.6% and 8.3%, respectively. Endovascular therapy stabilized the descending aorta size and remodeled the thoracic aorta in 72% of patients. TEVAR significantly expanded the true lumen (average increase 3 mm, $p = 0.024$) and reduced the false lumen (average decrease 3.9 mm, $p = 0.014$). Total false lumen thrombosis, thoracic false lumen thrombosis, and stented portion false lumen thrombosis was achieved in 30.7%, 61.5%, and 69.2% of patients, respectively. Of the 77 patients that presented initially with thoracoabdominal dissections, abdominal false lumen remained patent in 61% and 86.4% on early postop and follow-up CT, respectively.

Conclusions: TEVAR is effective in stabilizing and remodeling the acutely dissected thoracic aorta. Abdominal false lumen patency is maintained in patients with DeBakey 3b dissections.



Aortic Remodeling

False Lumen Thrombosis	Early Postoperative	Latest follow up	p value
Total False lumen Thrombosis	35.3%	30.07%	0.243
Thoracic False Lumen Thrombosis	50%	61.5%	0.044
Stented False Lumen Thrombosis	60.9%	69.2%	0.042
Persistent Flow in the Abdominal False Lumen (for DeBakey 3b Dissections)	61%	86.4%	0.12
Type 1# Endoleaks	14.6%	11.3%	0.79

3:15 PM **Room 31ABC**

Complex Cusp Repair in Patients Undergoing David's Procedure—Is It Worth It?

H. Baumbach[2], *K. Wachter*[2], *R. Nagib*[2], *R.Yadav*[1], *U. Franke*[2]

[1]*Royal Brompton Hospital, London, United Kingdom,* [2]*Robert Bosch Hospital, Stuttgart, Germany*

COMMERCIAL RELATIONSHIPS H. Baumbach: Research Grant, Edwards Lifesciences Corporation; Consultant/Advisory Board, Edwards Lifesciences Corporation

Purpose: Even though valve-sparing aortic root replacement has already proven its excellent long-term results with low valve-related complications, the question of whether an additional expanded cusp repair is an alternative still needs to be discussed.

Methods: Data of 192 elective patients who underwent valve-sparing aortic root replacement were prospectively recorded. Patients with systemic disorders or aortic dissection were excluded. Fifty-eight patients (30.2%) received an isolated aortic root replacement (group I); 134 patients (69.8%) received additional complex cusp repair (group II), such as plication of the free margin (n=96), decalcification (n=45), and/or pericardial patch (n=39). Cumulative follow-up was 480 patient years, with a mean of 2.5 years ± 1.5 years.

Results: Mean age was 60 years (range 22–85 years) and 76.6% were men. In-hospital mortality was 3.4% (2/58) in group I compared to 0.0% in group II. Freedom from cardiac death at 5 years was 83% vs 98% (p = 0.058). Freedom from moderate or severe aortic insufficiency at 5 years (Kaplan-Meier estimation) was 100.0% in group I vs 93% in group II (CI 95%: 86–97%), respectively. Seven patients required reoperation for aortic insufficiency or stenosis: re-repair (n=3), Ross procedures (n=2), and biological aortic valve replacement (n=2). Freedom from reoperation at 5 years (Kaplan-Meier estimation) was 96% in group I vs 89% in group II (p = 0.305).

Conclusions: Overall survival and freedom from reoperation after valve-sparing aortic root replacement, even with additional complex cusp repair, provides excellent mid-term results. The low risk of valve-related complications and the absence of anticoagulation therapy should provide encouragement for this complex procedure.

NOTES

1:30 PM – 3:30 PM ***Room 32AB***

Adult Cardiac Session: Ischemic

Moderators: *James R. Edgerton, Dallas, TX, and Frank W. Sellke, Providence, RI*

COMMERCIAL RELATIONSHIPS F. W. Sellke: Consultant/Advisory Board, The Medicines Company, CLS Behring

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

Presenting authors are listed in **bold** on each abstract.

The physician competencies addressed in this session are patient care and procedural skills and medical knowledge. These physician competencies will be addressed through a series of individual lectures and a brief question-and-answer session after each topic.

1:30 PM ***Room 32AB***

Total Arterial Coronary Revascularization Is Achievable and Prognostically Effective: A Multi-institutional Analysis

J. Tatoulis[1], *B. Buxton*[2], *R. Wynne*[2], *P. Skillington*[3]

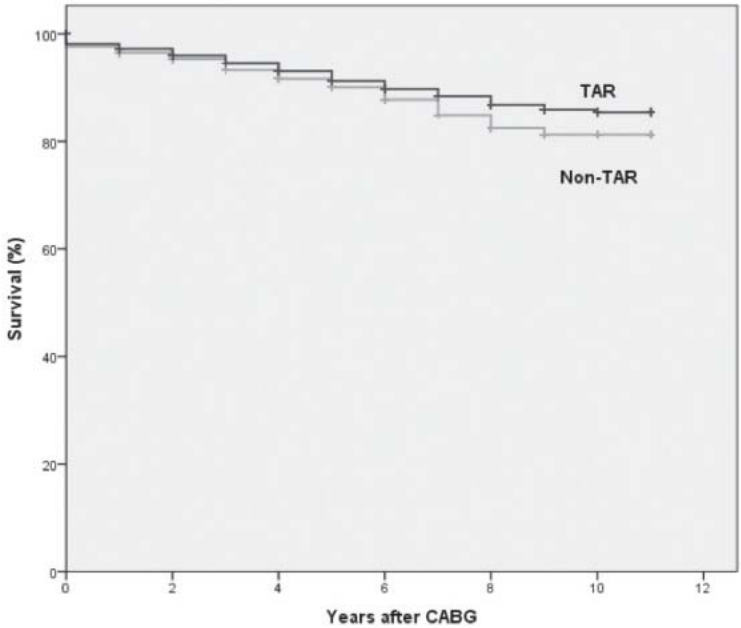
[1]*Private Medical Centre, Victoria, Australia,* [2]*The University of Melbourne, Australia,* [3]*Royal Melbourne Hospital, Australia*

Purpose: Total arterial revascularization (TAR) is a strategy adopted to overcome late vein graft atherosclerosis, occlusion, and the need for reoperation. The uptake of TAR, however, remains generally low, despite several reports suggesting superior freedom from reoperation and recurrent angina. Previous studies primarily involve single site samples and short-term follow-up. We report the influence of TAR on long-term survival in a large Australian patient cohort.

Methods: We reviewed 63,592 cases from an audited, collaborative Australian cardiac surgical database. A total of 34,181 patients undergoing first-time isolated coronary artery bypass grafting (CABG) surgery from 2001 to 2012 in 24 Australian hospitals were identified. Data were linked to the National Death Index. We compared outcomes in patients who underwent TAR (n=12,271) with those who did not (n=21,910). The influence of TAR on all-cause mortality was assessed using propensity score analyses in 6,232 matched pairs.

Results: Crude 30-day mortality was 0.8% for TAR (96/12,271) and 1.8% for non-TAR (398/21,910) ($p < 0.001$), and late mortality was 7.5% for TAR (918/12,271) and 8.9% for non-TAR (1,952/21,910) ($p < 0.001$). Mean follow-up was 4.9 years. In the propensity-matched cohort, perioperative mortality was 0.9% in the TAR group (53/6,232) vs 1.2% (76/6,232). Kaplan-Meier survival in the matched cohort at 1, 5, and 10 years was 97.2%, 91.3%, and 85.4% for the TAR group and 96.5%, 90.1%, and 81.2% for non-TAR, respectively (log rank, $p < 0.001$). Late mortality was 8.0% for TAR (n=500) and 10.0% for non-TAR (n=622) ($p < 0.001$). Cox proportional hazards models showed lower all-cause mortality in the TAR group (hazard ratio 1.25, 95% CI: 1.10-1.41, $p < 0.001$).

Conclusions: TAR is achievable in a high proportion of CABG patients, is associated with lower perioperative mortality, and, importantly, improved long-term survival. More liberal use of TAR may result in further prognostic benefit.



Patients at risk:

TAR	6232	4865	3380	2184	1253	532
Non-TAR	6232	5008	3429	2021	1132	764

Figure 1: Comparison of Kaplan-Meier survival for propensity-matched patients (log rank, $p < 0.001$). CABG = coronary artery bypass grafts; TAR = total arterial revascularization.

1:45 PM **Room 32AB**

Multi vs Single Arterial Coronary Artery Bypass Surgery Across the Left Ventricular Ejection Fraction Spectrum: A Multi-institutional Analysis

T. A. Schwann[1], *L. Al-Shaar*[2], *R. F. Tranbaugh*[3], *K. R. Dimitrova*[3], *D. M. Hoffman*[3], *C. Geller*[5], *M. Engoren*[6], *M. R. Bonnell*[1], *R. H. Habib*[2]

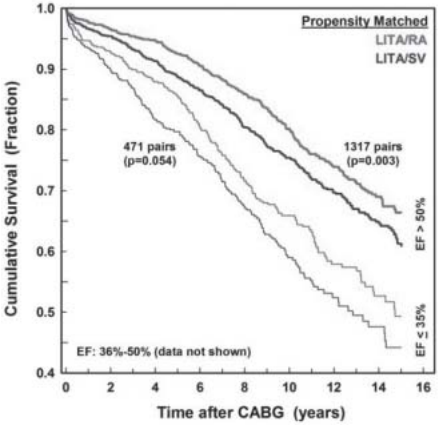
[1]*University of Toledo Medical Center, OH,* [2]*American University of Beirut, Lebanon,* [3]*Beth Israel Medical Center, New York, NY,* [5]*Mount Sinai Beth Israel, New York, NY,* [6]*University of Michigan, Ann Arbor*

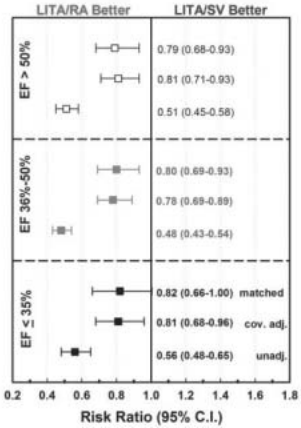
Purpose: Multiarterial coronary artery bypass grafting (CABG) surgery, based on left internal thoracic artery with radial artery (LITA/RA), is associated with improved long-term survival compared to the traditional single arterial plus saphenous vein (LITA/SV) approach. We assessed the hypothesis that this multiarterial advantage is true irrespective of left ventricular ejection fraction (LVEF) status.

Methods: We retrospectively analyzed the primary, nonemergent, nonsalvage, multigraft CABG experience (n=11,621; 64.4 years ± 9.4 years, 70.4% men) from two institutions (1995-2011). Risk-adjusted 15-year survival was pairwise compared for the LITA/RA vs LITA/SV grafting approaches within three LVEF subcohorts [>50%: n=4,833 (44% RA); 36%-50%: n=4,465 (39% RA); and ≤35%: n=1,963 (34% RA)] using covariate adjusted Cox regression (all patients) and Kaplan-Meier analysis in propensity-matched comparisons

Results: Propensity matching yielded 1,317 (>50%), 1,179 (36%-50%), and 471 (≤35%) well-matched grafting method pairs. LITA/RA was uniformly associated with better 15-year survival compared to LITA/SV for all EF categories [Figure-Left]. The associated matched adjusted risk ratios (95% confidence intervals) were consistent across EF groups at 0.79 (0.68-0.93), 0.80 (0.69-0.93), and 0.82 (0.66-1.0), respectively [Figure-Right]. Covariate-adjusted RR in all patients concurred with matched results.

Conclusions: Multiarterial grafting with LITA/RA enhanced long-term survival compared to single arterial (LITA/SV) CABG, regardless of the degree of left ventricular (LV) dysfunction. These results support adopting multiarterial CABG as the therapy of choice by the heart team, even in patients with a limited prognosis due to LV dysfunction.


Propensity Matched
LITA/RA
LITA/SV
471 pairs
(p=0.054)
1317 pairs
(p=0.003)
EF > 50%
EF ≤ 35%
EF: 36%-50% (data not shown)
Cumulative Survival (Fraction)
Time after CABG (years)


LITA/RA Better
LITA/SV Better
EF > 50%
0.79 (0.68-0.93)
0.81 (0.71-0.93)
0.51 (0.45-0.58)
EF 36%-50%
0.80 (0.69-0.93)
0.78 (0.69-0.89)
0.48 (0.43-0.54)
EF ≤ 35%
0.82 (0.66-1.00) matched
0.81 (0.68-0.96) cov. adj.
0.56 (0.48-0.65) unadj.
Risk Ratio (95% C.I.)

2:00 PM **Room 32AB**

Hospital-Level Variation in Infection Rates After Coronary Artery Bypass Grafting Surgery: An Analysis From The Society of Thoracic Surgeons Adult Cardiac Surgery Database

D. S. Likosky[1], *A. Wallace*[5], *R. L. Prager*[1], *J. P. Jacobs*[2], *S. D. Harrington*[3], *P. Saha-Chaudhuri*[6], *P. F. Theurer*[1], *A. Fishstrom*[1], *R. Dokholyan*[7], *J. S. Rankin*[4], *D. M. Shahian*[8]

[1]*University of Michigan Health System, Ann Arbor,* [2]*Johns Hopkins All Children's Heart Institute, St Petersburg, FL,* [3]*Advanced Cardiothoracic Surgeons, Clinton Township, MI,* [4]*Vanderbilt University, Nashville, TN,* [5]*University of Pittsburgh Medical Center, PA,* [6]*Duke University Medical Center, Durham, NC,* [7]*Duke Clinical Research Institute, Durham, NC,* [8]*Massachusetts General Hospital, Boston*

COMMERCIAL RELATIONSHIPS D. S. Likosky: Research Grant, Agency for Healthcare Research and Quality (AHRQ); Speakers Bureau/Honoraria, SpecialtyCare; Consultant/Advisory Board, American Society of Extracorporeal Technology; J. S. Rankin: Ownership Interest, BioStable Science and Engineering, Inc

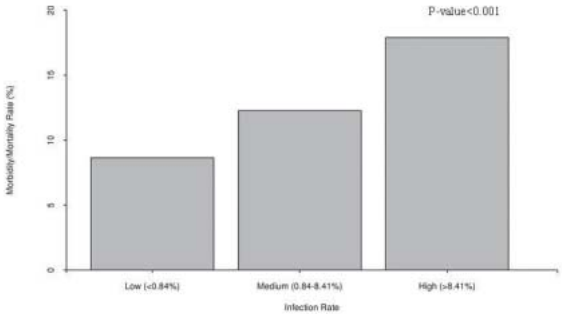
Purpose: Patients undergoing coronary artery bypass grafting (CABG) surgery are at risk for developing a spectrum of infections. While investigators have focused on predictors of these adverse sequelae, less work has been paid to characterizing hospital-level variability in these outcomes.

Methods: A total of 365,686 patients in the STS Adult Cardiac Surgery Database underwent isolated CABG across 1,084 hospitals between 2011 and 2013. Hospital-acquired infections (HAIs) were defined as: pneumonia, sepsis/septicemia, deep sternal wound infection/mediastinitis, vein harvest/cannulation, or thoracotomy. Hospitals were ranked based on their HAI rate: Low (≤10th percentile) vs Medium (10th-90th percentile) and High (>90th percentile). Differences in perioperative factors and composite morbidity/mortality endpoints were made across these groups using Wilcoxon-Rank sum and chi-square tests.

Results: HAIs occurred among 4.27% of patients, although rates varied across hospital groups (Low: <0.84%, Medium: 0.84%-8.41%, High: >8.41%). Pneumonia (3.25%) was the most common HAI, followed by sepsis/septicemia (0.88%), Table. Patients at high-rate hospitals were more often smokers, had diabetes, chronic lung disease, were NYHA Class III-IV, received blood products, and had appropriate timing of antibiotic prescribing/discontinuation, $p < 0.001$. However, patients at high-rate hospitals had fewer appropriate antibiotic prescriptions, $p < 0.001$. Differences in these characteristics were small relative to the base rate of HAIs. Patients at high HAI rate hospitals had higher composite endpoint rates, $p < 0.001$ (Figure).

Conclusions: Substantial hospital-level variation exists in postoperative HAIs among patients undergoing CABG, driven predominantly by pneumonia. Given the relatively small absolute differences in comorbidities across hospital groups, our findings suggest that factors other than case mix may explain the observed variation in HAI rates.

Figure: Risk of Composite Endpoint by Strata of Hospital-Acquired Infections Among 1084 Participating Hospitals



Morbidity/Mortality defined as any of the following: operative mortality, reoperation for cardiac reasons, renal failure (in patients without preoperative dialysis or preoperative creatinine >4mg/dl) or prolonged ventilation.

Table 1: Distribution and Types of Hospital-Acquired Infections Across 1084 Participating Hospitals

		Hospital Groups Based on HAI Rate		
	Mean	**Low**	**Medium**	**High**
Pneumonia	3.25%	<0.38%	0.38-6.67%	>6.67%
Sepsis/Septicemia	0.88%	0.00%	0.00-2.04%	>2.04%
Vein Harvest/Cannulation	0.37%	0.00%	0.00-1.06%	>1.06%
DSWI/Mediastinitis	0.31%	0.00%	0.00-0.89%	>0.89%
Thoracotomy	0.02%	0.00%	0.00-0.00%	>0.00% (max 1.61%)
Overall HAI Rate	**4.27%**	**<0.84%**	**0.84-8.41%**	**>8.41%**

Hospital-acquired infections (HAIs) were defined as: pneumonia, sepsis/septicemia, deep sternal wound infection/mediastinitis, vein harvest/cannulation, or thoracotomy. **Thoracotomy**: incisional infection involving thoracotomy or parasternal site; **Vein Harvest/Cannulation**: infection involving a conduit harvest or cannulation site.

2:15 PM **Room 32AB**

Greater Volume of Acute Normovolemic Hemodilution May Aid in Reducing Blood Transfusions After Cardiac Surgery

J. Goldberg[1], *T. Paugh*[2], *T. A. Dickinson*[3], *J. Fuller*[4], *G. Paone*[5], *P. F. Theurer*[2], *K. Shann*[6], *T. M. Sundt*[6], *R. L. Prager*[2], *D. S. Likosky*[2]

[1]*Massachusetts General Hospital/Harvard Medical School, Boston,* [2]*University of Michigan Health System, Ann Arbor,* [3]*SpecialtyCare, Nashville, TN,* [4]*St John Providence Health System, Detroit, MI,* [5]*Henry Ford Hospital, Detroit, MI,* [6]*Massachusetts General Hospital, Boston*

COMMERCIAL RELATIONSHIPS D. S. Likosky: Research Grant, Agency for Healthcare Research and Quality (AHRQ); Speakers Bureau/Honoraria, SpecialtyCare; Consultant/Advisory Board, American Society of Extracorporeal Technology; T. M. Sundt: Consultant/Advisory Board, Thrasos Therapeutics

Purpose: Perioperative red blood cell (RBC) transfusions are associated with increased morbidity and mortality after cardiac surgery. Acute normovolemic hemodilution (ANH) is recommended for reducing perioperative transfusions; however, supporting data are limited and conflicting. We describe the relationship between ANH and RBC transfusions after cardiac surgery using a multicenter database.

Methods: A total of 6,515 patients underwent coronary artery bypass grafting (CABG) surgery between 2010 and 2013 at 21 hospitals in the state of Michigan participating in a prospective cardiovascular perfusion database. The volume of ANH (no ANH, <400 mL, 400-799 mL, ≥800 mL) was recorded and linked to each center's surgical data. We report adjusted odds ratios (ORadj) reflecting the association between the use and amount of ANH and odds of perioperative RBC transfusion. Results were adjusted for baseline risk and additionally accounted for factors that may impact the use and volume of ANH (ie, body surface area and preoperative hematocrit), Table.

Results: ANH was used in 8.4% of patients (545/6,515). Volume of ANH was inversely related to transfusion rate ($p$trend=0.01), Table and Figure. Transfusion rates were not impacted by those with ANH volume <800 mL. However, patients with ≥800 mL of ANH had a 62% reduced odds of transfusion relative to patients not receiving ANH (ORadj 0.38, $p < 0.001$), Figure.

Conclusions: There is a significant association between increased volume of ANH and reduced RBC transfusions, even after adjustment. Our findings suggest the use and volume of ANH should be considered as a part of a center's overall blood conservation strategy.

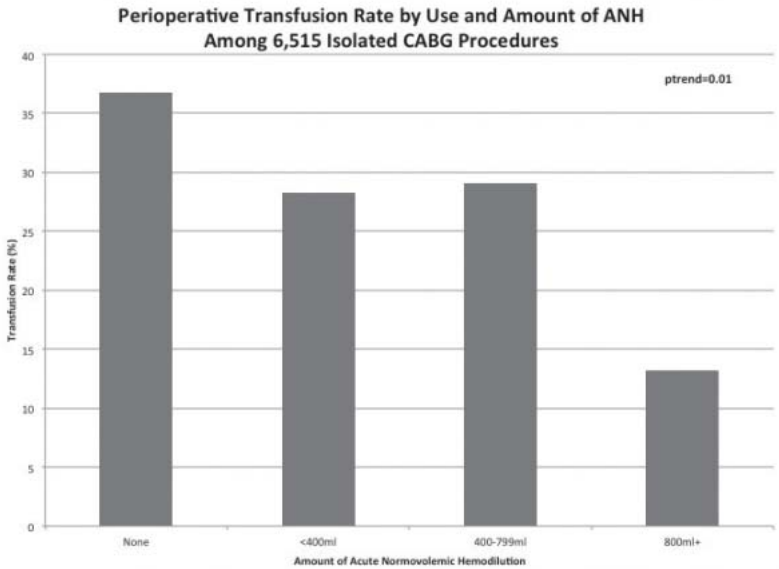


Table. Association between ANH use and RBC Transfusion

ANH Use	Patients (#)	Transfusion (%)	Odds Ratio$_{adj}$	p-value
None	5970	36.6	Ref	
<400ml	113	28.3	1.0	0.88
400-799ml	265	29.1	1.1	0.65
800ml+	167	13.2	0.38	<0.001
Overall	**6,515**	**35.6**	**0.87**	**ptrend=0.01**

Adjusted for: patient demographics, comorbid conditions (including body surface area, severity of cardiac disease), previous interventions, medication use, hemodynamics or findings from cardiac catheterization, acuity, use of mechanical cardiac assist devices, pre-operative hematocrit and medical center

2:30 PM **Room 32AB**

Red Blood Cell Transfusions Impact Pneumonia Rates After Coronary Artery Bypass Grafting Surgery

D. S. Likosky[1], *G. Paone*[2], *S. D. Harrington*[3], *P. F. Theurer*[1], *A. Delucia III*[4], *A. Fishstrom*[1], *R. L. Prager*[1]

[1]*University of Michigan Health System, Ann Arbor,* [2]*Henry Ford Hospital, Detroit, MI,* [3]*Advanced Cardiothoracic Surgeons, Clinton Township, MI,* [4]*Bronson Methodist Hospital, Kalamazoo, MI*

COMMERCIAL RELATIONSHIPS D. S. Likosky: Research Grant, Agency for Healthcare Research and Quality (AHRQ); Speakers Bureau/Honoraria, SpecialtyCare; Consultant/Advisory Board, American Society of Extracorporeal Technology

Purpose: Pneumonia, a known sequelae of coronary artery bypass grafting (CABG) surgery, significantly increases a patient's risk of morbidity and mortality. While not well characterized, red blood cell (RBC) transfusions may increase a patient's risk of pneumonia. We describe the relationship between RBC transfusion and postoperative pneumonia after CABG surgery.

Methods: A total of 16,182 consecutive patients underwent isolated CABG surgery between 2011 and 2013 at any of 33 hospitals in the state of Michigan. We used propensity scoring to match (based on age, sex, body mass index, history of smoking, congestive heart failure, chronic obstructive pulmonary disease, diabetes, prior cardiac surgery, vascular disease, ejection fraction, preoperative hematocrit, and preoperative pneumonia) 4,585 patients receiving RBCs to 9,612 not receiving RBCs (ntotal=14,197). We report adjusted odds ratios (ORadj), estimated from logistic regression, reflecting the association between the number of RBC units (none, 1, 2 3, 4, 5, 6+) transfused and postoperative pneumonia.

Results: After propensity matching, 450 (3.2%) patients developed pneumonia and 4,585 (32.3%) received RBC transfusion. There was a significant association between any RBC transfusion and pneumonia (ORadj 4.0, $p < 0.001$). There was a dose-response between number of units and odds of pneumonia, Figure and Table. Patients receiving only one or two units of RBCs had a nearly twofold (ORadj 1.8, $p < 0.001$) increased odds of pneumonia.

Conclusions: We found a significant, volume-dependent association between an increasing number of RBCs and odds of pneumonia, which persisted after adjusting for preoperative patient characteristics. One strategy to reduce pneumonia following CABG surgery may be through the utilization of restrictive RBC transfusion practices.

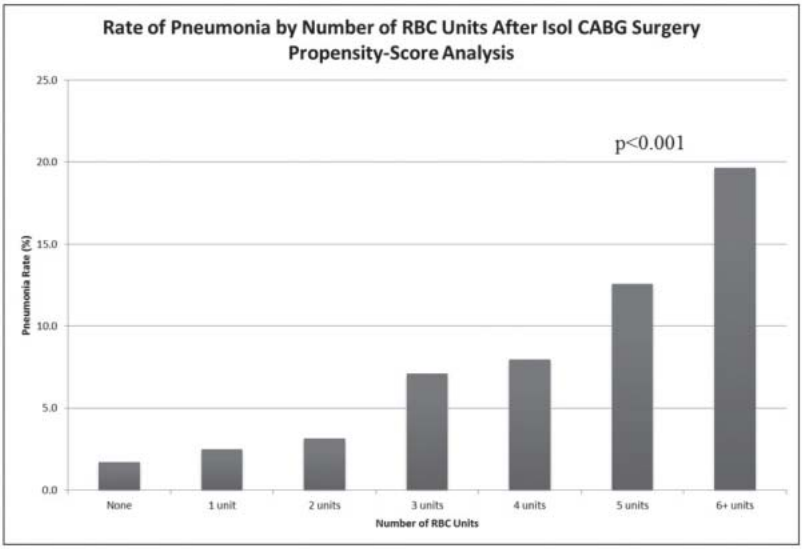


Table. Association between Number of RBC units and Pneumonia

Number of RBCs	Patients (#)	Pneumonia (%)	Odds Ratio$_{adj}$	p-value
None	9,612	1.7	Ref	
1 unit	1,202	2.5	1.6	0.02
2 units	1,614	3.2	2.1	<0.001
3 units	606	7.1	4.9	<0.001
4 units	452	8.0	5.5	<0.001
5 units	207	12.6	8.9	<0.001
6+ units	504	19.6	14.4	<0.001
Overall	**14,197**	**3.2**	**4.0**	**ptrend<0.001**

2:45 PM **Room 32AB**

Impact of Comprehensive STS Quality Improvement on Outcomes and Failure to Rescue

***D. Chu**, P. Chan, L. M. Wei, C. C. Cook, T. G. Gleason, V. Morell, V. Badhwar*

University of Pittsburgh Medical Center, PA

Purpose: The Society of Thoracic Surgeons (STS) quality benchmarks guide operative and perioperative outcome improvement in cardiac surgery. Failure to rescue (FTR) from major postoperative morbidity is a proposed metric of program quality. We examined the impact of a programmatic quality improvement initiative guided by STS quality measures on clinical outcomes and FTR.

Methods: After excluding cases of shock, endocarditis, and transplantation, prospectively collected STS data on 3,065 consecutive patients who underwent nonemergent cardiac operations at a quaternary US institution from January 1, 2010, to January 31, 2014, were retrospectively analyzed. On January 1, 2012, a program guided by evidence-based STS measures on preoperative optimization and protocolized postoperative management was implemented. Clinical outcomes and FTR rates were compared between operations performed before (Group A) and after (Group B) implementation.

Results: STS predicted preoperative mortality (PROM) and composite of mortality+morbidity (PROMM) were similar in both Group A and Group B (2.9% ± 3.7% vs 3.1% ± 4.0%, $p = 0.21$; 17.8% ± 12.1% vs 18.3% ± 12.4%, $p = 0.24$, respectively). However, the observed mortality and composite mortality+morbidity was lower in Group B vs Group A (31/1,576 [2.0%] vs 46/1,489 [3.1%], $p = 0.05$; 168/1,576 [10.7%] vs 301/1,489 [20.2%], $p = 0.0001$, respectively). Despite clinical outcome improvement, no differences in FTR rates were observed across all seven major morbidity indicators (Table 1). These findings remained consistent during procedural subgroup analysis for isolated coronary artery bypass grafting (CABG) surgery (Figure 1).

Conclusions: Implementation of evidence-based improvement initiatives derived from STS quality measures significantly improves cardiac surgical outcomes without impacting FTR rates. Future studies involving national data would be needed to determine if FTR proves to be a useful quality instrument over existing adult STS metrics.

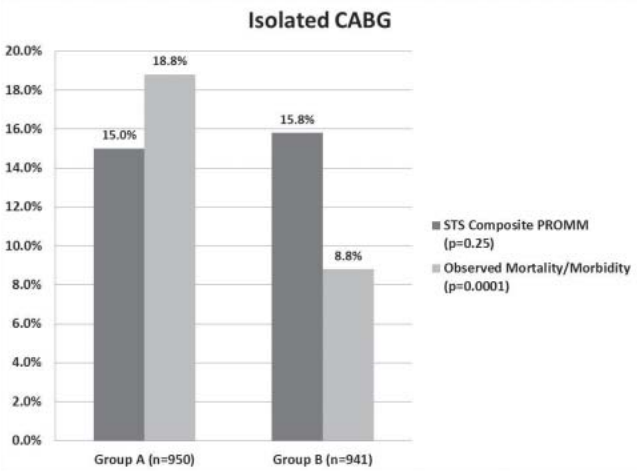


Table 1			
	Study Period (all cases)		
	Group A (n=1,489)	**Group B (n=1,576)**	
Outcome Measure	**Incidence**		***p* value**
STS PROM	2.9% ± 3.7%	3.1% ± 4.0%	0.21
Observed Mortality	46/1,489 (3.1%)	31/1,576 (2.0%)	0.05
STS Composite PROMM	17.8% ± 12.1%	18.3% ± 12.4%	0.24
Observed Mortality/ Morbidity	301/1,489 (20.2%)	168/1,576 (10.7%)	0.0001
Complication	**Failure to Rescue Rates**		***p* value**
Reoperation for bleeding	5/44 (11.4%)	1/33 (3.0%)	0.23
Deep Sternal Wound Infection	0/2 (0.0%)	0/3 (0.0%)	1
Cerebral Vascular Accident	5/29 (17.2%)	1/24 (4.2%)	0.2
Prolonged Ventilation	29/202 (14.4%)	17/97 (17.5%)	0.5
Pneumonia	13/80 (16.3%)	10/45 (22.2%)	0.47
Renal Failure	21/82 (25.6%)	7/32 (21.9%)	0.81
Dialysis	13/38 (34.2%)	5/21 (23.8%)	0.56
Any Complication	35/290 (12.1%)	19/156 (12.2%)	1

3:00 PM ***Room 32AB***

Debate: 65-Year-Old Diabetic Female With Triple Vessel Disease and BMI of 35

Bilateral IMA: *TBA*

LIMA and Veins: *Robert A. Guyton, Atlanta, GA*

COMMERCIAL RELATIONSHIPS R. A. Guyton: Consultant/Advisory Board, Medtronic, Inc

1:30 PM – 3:30 PM ***Room 30CD***

Congenital Session: Pediatric Congenital I

Moderators: *Christopher A. Caldarone, Toronto, Canada, and Sitaram M. Emani, Boston, MA*

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

Presenting authors are listed in **bold** on each abstract.

The physician competencies addressed in this session are patient care and procedural skills and medical knowledge. These physician competencies will be addressed through a series of individual lectures and a brief question-and-answer session after each topic.

1:30 PM ***Room 30CD***

Over 2 Decades of a Single-Institution Experience With the Ross Procedure: Lessons Learned

Z. Y. Al Halees*, B. Fadel, M. Al Shahid, M. Al Amri, Z. Al Bulbul, A. Alomrani, M. Al Ahmadi, J. Alburaiki*

King Faisal Specialist Hospital and Research Center, Riyadh, Saudi Arabia

Purpose: The Ross procedure is an attractive option for aortic valve replacement (AVR), particularly in the young. Controversy exists on long-term outcomes in this age group, particularly in reference to aortic root dilatation and subsequent need for reoperation.

Methods: From January 1990 to December 2012, 532 patients underwent the Ross procedure at our institution for various aortic valve pathologies (67% rheumatic). Mean age was 18 years ± 13 years with 46 patients less than 2 years of age and the rest 2-52 years. Neonates and infants who required complex concomitant procedures like arch reconstruction and/or mitral valve repair were not included. The autograft was implanted as a full standing aortic root with coronary transfer. Seventy-four patients had mini-Ross–Konno procedures. Mean follow-up was 9.6 years ± 9 years.

Results: Hospital mortality was 1.2%. Freedom from all events excluding reoperation was 97% ± 2%. Eighty-six patients required 91 reoperations and these were mostly in rheumatic patients with aortic regurgitation and dilated aortic roots (>27 mm) from our early experience. The risk of autograft failure increased in the presence of concomitant rheumatic mitral valve disease requiring concomitant repair. Patients with aortic stenosis (AS) and congenital aortic valve disease, with AS being the main hemodynamic manifestation, had almost no autograft-related reoperations. Infants and children who required a mini-Ross–Konno procedure showed no AR, no recurrence of left ventricular outflow obstruction, and a growth that paralleled somatic growth with no significant neoaortic root dilatation. Survival in all groups was excellent.

Conclusions: Autograft failure is higher in patients with preoperative AR and dilated aortic roots, particularly with rheumatic etiology. Patients with AS and congenital aortic valve disease showed excellent outcomes and are probably the best candidates for the procedure. Currently, they constitute our main indication for the procedure.

1:45 PM ***Room 30CD***

Transcatheter Pulmonary Valve Replacement With the Melody Valve in Children and Adults With Right Ventricular Outflow Tract Conduit Dysfunction After the Ross Procedure

*M. Gillespie[3], **D. McElhinney**[1], J. Kreutzer[3], W. Hellenbrand[4], H. El-Said[5], P. Ewert[2], L. Bergersen[6], J. Rhodes[7], L. Sondergaard[8], T. Jones[9]*

[1]NYU Medical Center, New York, [2]German Heart Centre Munich, [3]The Children's Hospital of Philadelphia, PA, [4]Yale New Haven Hospital, CT, [5]Children's Hospital San Diego, CA, [6]Children's Hospital Boston, MA, [7]Miami Children's Hospital, FL, [8]Rigshospitalet–Copenhagen University Hospital, Denmark, [9]Seattle Children's Hospital, WA

COMMERCIAL RELATIONSHIPS T. Jones: Research Grant, Medtronic, Inc; Consultant/Advisory Board, Medtronic, Inc; D. McElhinney: Consultant/Advisory Board, Medtronic, Inc; M. Gillespie: Research Grant, Medtronic, Inc; Consultant/Advisory Board, Medtronic, Inc; J. Kreutzer: Consultant/Advisory Board, Medtronic, Inc; Research Grant, Medtronic, Inc; W. Hellenbrand: Consultant/Advisory Board, Medtronic, Inc; L. Sondergaard: Consultant/Advisory Board, Medtronic, Inc

Purpose: In reported series, the most common reasons for reoperation of the Ross procedure (RP) were right ventricular outflow tract (RVOT) conduit dysfunction and autograft regurgitation. Transcatheter pulmonary valve replacement (TPVR) could alter the impact of conduit dysfunction and the risk-benefit balance for the RP in general.

Methods: The inception cohort for this study included all 358 patients who underwent catheterization with the intent to implant a Melody TPV as part of three prospective studies that included 21 international sites. The 67 patients (19%; median age 17 years) who had a prior RP comprised the study cohort for this analysis.

Results: TPVR was performed in 56 patients for RVOT obstruction (22), pulmonary regurgitation (PR) (21), or both (13). In 11 patients, a valve was not implanted due to risk of coronary artery (CA) compression (5), favorable hemodynamics (4), and other (2). One patient underwent emergent surgery for CA compression after TPV implant. The RVOT gradient decreased after TPVR, from 38 mm Hg to 13 mm Hg (median; $p < 0.001$), and there was no/trivial PR in all but three patients with mild PR. At a median follow-up (FU) of 4 years, there was one death from sepsis. Twelve patients underwent RVOT reintervention: in six, the TPV was explanted (three for endocarditis with conduit obstruction, one for stent fracture and conduit stenosis, two at reoperation for other reasons); eight patients had transcatheter reintervention for stent fracture and stenosis (two later underwent explant). Freedom from explant was 87% ± 5% at 4 years. Overall, there was no significant change in RVOT gradient or right ventricular pressure from early to later FU, and only one patient was found to have >mild PR.

Conclusions: TPVR with the Melody valve provides good acute outcomes and durable valve function in the majority of RP patients. Recurrent RVOT obstruction associated with TPV stent fracture was the main reason for reintervention. CA compression is an important potential complication.

2:00 PM **Room 30CD**

The Valved Polytetrafluoroethylene Conduits for Right Ventricular Outflow Tract Reconstruction: Clinical Experience and Mechanical Properties of Bulging Sinuses

T. Shinkawa[1], *F. Watanabe*[2], *T. Miyazaki*[3], *M. Yamagishi*[3], *M. Imamura*[1]

[1]*Arkansas Children's Hospital, Little Rock,* [2]*University of Arkansas, Little Rock,* [3]*Kyoto Prefectural University of Medicine, Japan*

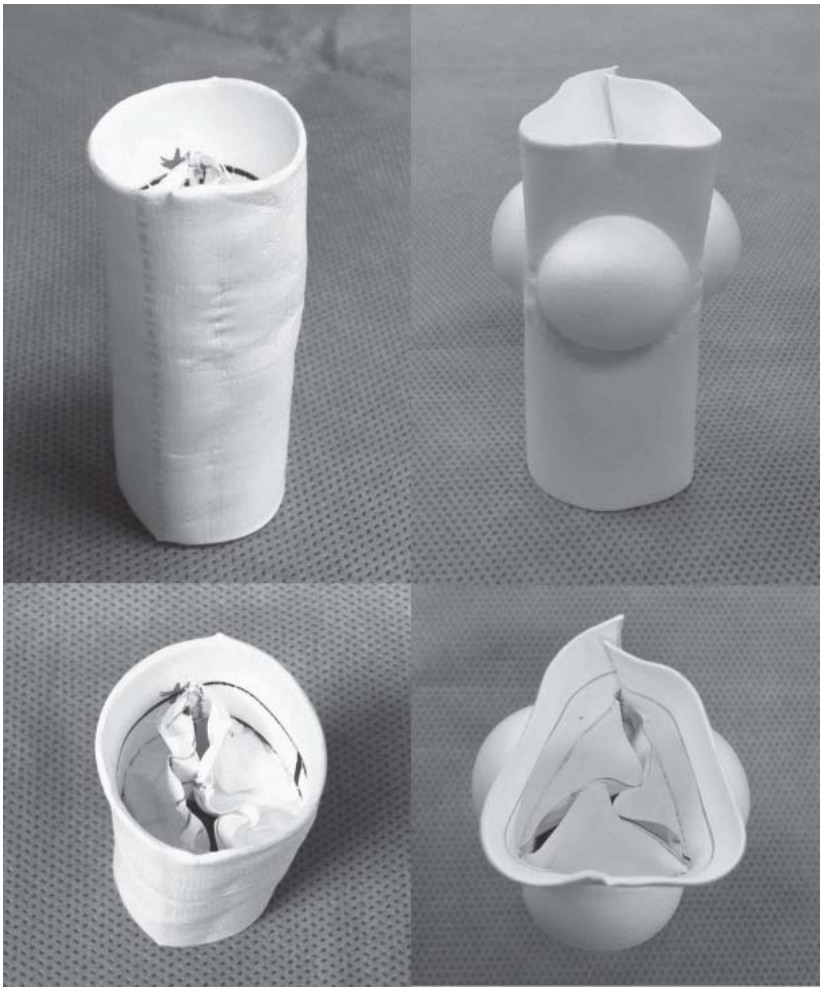
REGULATORY DISCLOSURE This presentation describes the off-label use of the W. L. Gore PRECLUDE Pericardial Membrane, which was used for heart valve leaflet in this study.

Purpose: The purposes of this study were to review our early outcomes of the expanded polytetrafluoroethylene (ePTFE) valved conduit with or without bulging sinuses as right ventricle to pulmonary artery conduit for congenital heart disease, and to examine mechanical strength and surface appearance of the ePTFE material after creating bulging sinuses.

Methods: This is a retrospective review of all patients receiving the ePTFE valved conduit between January 2008 and March 2014 at a single institution. Major outcomes studied included conduit survival and function. The mechanical wall strength and the surface appearance after creating bulging sinuses were investigated by unidirectional pull test and by scanning electron microscopy.

Results: There were 108 right ventricle to pulmonary artery conduit operations with ePTFE valved conduit with or without bulging sinuses. The median age and weight at the operation was 6.3 years (0.0–36.5 years) and 21.7 kg (2.6–96.5 kg). Eighty-three operations were reoperation for right ventricular outflow tract. Conduit size varied from 12 mm to 24 mm. There were two early deaths and one late death, two orthotopic heart transplantations, and four conduit reoperations during the median follow-up of 2.7 years (0.2 to 6.1 years). Freedom from conduit reoperation at 5 years was 92.9%. Among the patients followed more than a year, the conduit insufficiency was less than mild in 78% of patients (51/65) with mean pressure gradient of 26 mm Hg. The pull tests and the scanning electron microscopy images showed no obvious difference in mechanical strength for radial and longitudinal direction and in surface appearance between the ePTFE grafts with or without bulging.

Conclusions: The ePTFE valved conduit with or without bulging sinuses showed excellent early outcomes. The unidirectional pull test and scanning electron microscopy examination showed no obvious difference in mechanical property after creating bulging sinuses on ePTFE graft.



2:15 PM **Room 30CD**

Hybrid Procedure as an Alternative to Surgical Palliation of High-Risk Infants With Hypoplastic Left Heart Syndrome and Its Variants: Mid-Term Outcomes

M. O. Murphy, *H. Bellsham-Revell, G. Morgan, T. Krasemann, E. Rosenthal, S. Qureshi, C. Salih, C. Austin, D. Anderson*

Guy's & St Thomas'/Evelina London Children's Hospital, United Kingdom

Purpose: Hybrid procedures (HP) offer patients with severe congenital heart disease an alternative initial procedure to conventional surgical reconstruction. We report the mid-term outcomes of a cohort of neonates who had HP for variants of hypoplastic left heart syndrome (HLHS).

Methods: Between December 2005 and January 2013, 41 neonates at high-risk for Norwood procedure (NP) underwent bilateral pulmonary artery banding followed by ductal stenting via sternotomy. Thirty-five patients had HLHS, while six had aortic stenosis (AS) with severe left ventricular (LV) hypoplasia. Primary indications for HP was low birth weight in 18, borderline LV for biventricular repair (BVR) in six, intact atrial septum in five, and poor preoperative condition in 13. Echocardiographic, angiographic, operative, and clinical data were reviewed. Outcomes were summarized with descriptive statistics and risk factors for mortality identified.

Results: At a median of 6 days and 2.6 kg, 25 males and 16 females underwent HP. All but six patients had an antenatal diagnosis and 24 patients were from other congenital cardiac centers. Nine patients had perioperative balloon aortic valvuloplasty (BAV), one patient had fetal BAV, and 17 patients had intervention to their atrial septum (41.4%). There were nine inpatient deaths (21.9%) and four inter-stage deaths (9.8%). Twenty-eight patients survived to undergo either NP (11), comprehensive stage II (CS2) (14), or BVR (3). No patients had heart transplantation. There were two early deaths, two late deaths prior to Fontan, and one late death after Fontan completion after CS2. All patients who had subsequent NP or BVR were mid-term survivors. Overall survival was 56.1% at a median follow-up of 32.0 months. By univariate analysis, patient factors, diagnosis of HLHS, and CS2 as the first procedure after HP were associated with non-survival.

Conclusions: HP as an alternative to NP offers good mid-term survival in patients deemed high-risk for neonatal reconstruction.

2:30 PM ***Room 30CD***

Distal Transverse Arch to Left Carotid Artery Ratio Helps Identify Neonates With Aortic Arch Hypoplasia

M. F. Swartz*, B. Simon, J. Cholette, N. Atallah-Yunes, G. M. Alfieris*

University of Rochester-Strong Memorial Hospital, NY

Purpose: The differentiation between coarctation (Co) with or without aortic arch hypoplasia (AAH) is critical to delineate the surgical approach. We defined Co+AAH when the transverse aortic arch was less than or equal to the diameter of the left carotid artery. Based upon our definition, we hypothesized that infants with Co+AAH would demonstrate distinct genetic expression patterns.

Methods: In 13 infants (7 Co+AAH, 6 Co), we analyzed mRNA from the area of Co+AAH, as well as the distal aorta. An Affymetrix 1.0 genome array identified significant genes that were expressed between infants with Co+AAH vs Co alone. RT-PCR quantified the fold difference in expression between the Co+AAH or Co region relative to the distal aorta. To further validate that infants with a distal transverse arch less than or equal to the left carotid artery represents the diagnosis of Co+AAH, we retrospectively compared the clinical outcomes from 2000-2010.

Results: The microarray data demonstrated 407 distinct genes that were significantly overexpressed in infants with Co+AAH, predominantly in vascular smooth muscle cell regulation, cell division, and development. RT-PCR confirmed Co+AAH was associated with an increased expression of genes involved in vascular development (Figure 1). Of 79 infants requiring surgical repair, 28 had Co+AAH and were repaired using a sternotomy and 51 Co approached using a thoracotomy (Table 1). At most recent follow-up, there was a negative mean arm:leg blood pressure within both groups (-11.8 ± 21.9 mm Hg vs -12.1 ± 23 mm Hg, $p = 0.9$). Further, only two patients were currently treated with anti-hypertensive therapy and only one patient from the thoracotomy group required reintervention.

Conclusions: This study provides genetic evidence that the diameter of distal transverse arch:left carotid artery can be used to identify Co+AAH. Furthermore, preoperatively delineating infants with Co+AAH results in limited hypertension at a mid-term follow-up.

Continued on next page

Abstract continued from previous page

Figure 1.

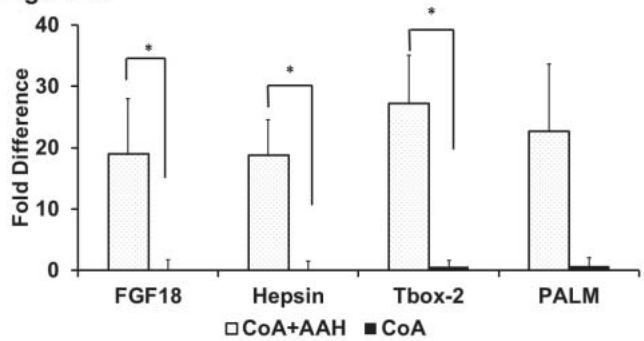


Figure 1. Fold difference in gene expression of Fibroblast Growth Factor 18 (FGF18), Hepsin, Tbox-2, and Parlamin (PALM) from infants with Coarctation of the aorta (CoA) + aortic arch hypoplasia(AAH) and coarctation alone.
* Denotes p value < 0.05

Table 1. Clinical Variables from Infants Requiring Surgery

	Aortic Arch Hypoplasia (26)	Coarctation of the Aorta (53)	p value
Age (Days)	16.5±14.5	21.9±19.3	0.2
Weight (Kg)	3.2±0.8	3.26±1.1	0.7
Distal Transverse Arch (mm)	2.9±0.8	3.53±0.8	0.005
Left Carotid Artery (mm)	3.2±0.6	3.26±0.74	0.7
Distal Transverse Arch:Left Carotid Artery	0.9±0.2	1.1±0.2	0.004
Follow-up (Years)	7.6±3.2	7.8±3.1	0.8
Arm:Leg Blood Pressure Gradient (mmHg)	-11.8±21.9	-12.1±23.0	0.9

2:45 PM **Room 30CD**

Evolving Technical Approach and Results in Hypoplastic Left Heart Syndrome With Intact or Highly Restrictive Atrial Septum

F. De Rita[1], *A. Hermuzi*[1], *A. McBrien*[2], *M. Chaudhari*[1], *D. Crossland*[1], *J. O'Sullivan*[1], *M. Griselli*[1], *A. Hasan*[1]

[1]*Newcastle Upon Tyne, United Kingdom,* [2]*Freeman Hospital, Newcastle Upon Tyne, United Kingdom*

Purpose: Variants of hypoplastic left heart syndrome (HLHS) with intact atrial septum (IAS) or highly restrictive interatrial communication (HRIC) still represent a challenging management and have long been recognized as predictors of poor survival. The purpose of this study is to describe our current approach from fetal assessment to Norwood palliation and report interstage results.

Methods: A retrospective review, since the institutional HLHS program started in 2005 to date, was conducted to identify neonates with HLHS associated to IAS/HRIC, requiring emergent/urgent left atrial decompression. All the babies had fetal assessment demonstrating absence of atrial communication or prominent flow reversal in the pulmonary veins. Our technical approach evolved during the time so that nowadays, delivery is accommodated in hybrid theater: via median sternotomy, attempt of interventional defect creation/enlargement is performed; otherwise, surgical septectomy with inflow occlusion technique is quickly viable as backup plan.

Results: Nine neonates required left atrial decompression within the first 48 hours of life (five immediately after birth). Four and five had IAS and HRIC, respectively. Three neonates with HRIC had immediate clinical deterioration post failed septostomy, two required extracorporeal membrane oxygenation (ECMO), and all three died before Norwood operation. Of the other six, three had successful inflow occlusion septectomy, two transatrial stent placement, and one transatrial balloon septostomy. Five out of six underwent concomitant bilateral pulmonary artery banding. All six patients reached Norwood procedure after 27 days ± 21 days and 50% required ECMO postoperatively. There was no hospital mortality after Norwood and current inter-stage survival is 100%: five patients successfully underwent second-stage palliation; one of them had heart transplantation after Fontan completion.

Conclusions: Our experience suggests that effective postnatal left atrial decompression can improve the outcome of HLHS patients with IAS and HRIC. A systematic multidisciplinary approach and mechanical cardiac support facility are mandatory and effective to cut down hospital mortality after Norwood palliation and guarantee excellent interstage survival.

3:00 PM **Room 30CD**

Potential Molecular Mechanism of Retrograde Aortic Arch Stenosis in the Hybrid Approach to Hypoplastic Left Heart Syndrome

***N. Hibino**, M. Cismowski, B. Lilly, P. MaConnell, T. Shinoka, J. Cheatham, P. Lucchesi, M. E. Galantowicz, A. Trask*

Nationwide Children's Hospital, Columbus, OH

COMMERCIAL RELATIONSHIPS T. Shinoka: Research Grant, GUNZE LIMITED

Purpose: Hybrid palliation for hypoplastic left heart syndrome (HLHS) has emerged as an alternative approach to the Norwood procedure. The development of patent ductus arteriosus (PDA) in-stent stenosis can cause retrograde aortic arch stenosis (RAAS) leading to significant morbidity. This study aimed to identify the mechanism of RAAS development from patients undergoing hybrid palliation.

Methods: After IRB approval, tissues from stented PDA were collected from 19 patients undergoing timely or premature comprehensive stage 2 repair from 2009 to 2014. RNA extracted from these samples was examined by qPCR analysis for smooth muscle cell (SMC) differentiation, SMC proliferation, and inflammation markers. A retrospective chart review of these patients was also performed. Patients requiring RAAS intervention based on cardiology-surgery consensus were defined as Group I (n=12), whereas patients without any RAAS intervention formed Group II (n=7).

Results: Patient characteristics are HLHS with aortic atresia: 8, HLHS with aortic stenosis: 3, unbalanced atrioventricular canal (AVC): 1 in Group I; double inlet left ventricle/transposition of the great arteries: 3, double outlet right ventricle: 2, and unbalanced AVC: 2 in Group II. Smooth muscle cell differentiation markers, such as SM22 and calponin, were significantly higher in Group I than in Group II (SM22: $p = 0.01$, calponin: $p = 0.04$). In an initial study investigating potential signaling pathways known to be involved in smooth muscle cell modulation, the expression of TGF-beta, Notch receptors, and PDGF were significantly higher in Group I compared with Group II (TGF-beta: $p = 0.03$, Notch1: $p = 0.01$, Notch2: $p = 0.04$, Notch3: $p < 0.01$, PDGF-B: $p < 0.01$).

Conclusions: Increased SMC differentiation and expression of proliferation signaling markers suggest a mechanism for inward neointimal formation in the peri-stent region; therefore, these markers could be therapeutic targets to prevent RAAS.

3:15 PM ***Room 30CD***

Complex Aortic Arch Reconstruction Using Moderate Hypothermia and Antegrade Cerebral Perfusion in Newborns and Children

B. Gupta[1], A. Dodge-Khatami[3], M. Taylor[2], D. Maposa[1], J. Knudson[1], ***J. D. Salazar[1]***

[1]University of Mississippi Medical Center, Jackson, [2]Children's Heart Center, Jackson, MS, [3]Batson Children's Hospital/The University of Mississippi Medical Center, Jackson

Purpose: Antegrade cerebral perfusion (ACP) is used with deep to moderate hypothermia for cerebral protection during aortic arch surgery. Little data exist on the use of tepid temperatures in a pediatric population. We report the clinical outcomes of newborns and children who underwent arch reconstruction using moderate hypothermia with ACP.

Methods: Between 2010 and 2014, 56 newborns and children underwent complex aortic arch surgery using moderate hypothermia (25.1°C ± 0.2°C) with ACP and pH stat strategy. These included 45% Norwood operations, 43% isolated arch reconstructions, 7% arch reconstructions with other procedures, 4% comprehensive stage I+II, and 2% arch aneurysm repairs. Median patient age at surgery was 9 days (range 3 days-16 years). Operative and postoperative outcomes included cross-clamp time, cardiopulmonary bypass time, discharge mortality, length of hospital stay, need for extracorporeal membrane oxygenation (ECMO), serum peak creatinine level, need for peritoneal dialysis, seizures, and stroke.

Results: The mean cardiopulmonary bypass and cross clamp times were 211 min ± 112 min and 98 min ± 70 min, respectively. ACP was performed at a flow rate of 46 mL/min/kg ± 6 mL/min/kg for 54 min ± 20 min. No patient required hemodialysis. None of the patients had liver dysfunction. The postoperative outcomes are detailed in the Table below.

Conclusions: Moderate hypothermia with antegrade cerebral perfusion resulted in encouraging early outcomes in newborns and children undergoing complex aortic arch surgery. Further follow-up on the late clinical outcomes is needed.

Table 1. Postoperative outcomes on N = 56 newborns and children

Postoperative outcome	Value
Discharge mortality, N	4 (7%)
Need for ECMO, N	6 (11%)
Length of hospital/ICU stay, days	20±17/14±13
Peak postop serum creatinine level, mean (mg/dL)	0.7±0.3 (age at surgery: less than 1 year) 0.8±0.3 (age at surgery: 1 – 16 years)
Need for temporary peritoneal dialysis, N	2 (4%)
Seizures, N	3 (5%)
Neurologic deficit or Stroke, %	0

1:30 PM – 3:30 PM ***Ballroom 20D***

General Thoracic Session: Lung Cancer I

Moderators: *Jules Lin, Ann Arbor, MI, and Sandra L. Starnes, Cincinnati, OH*

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Presenting authors are listed in **bold** on each abstract.

The physician competencies addressed in this session are patient care and procedural skills and medical knowledge. These physician competencies will be addressed through a series of individual lectures and a brief question-and-answer session after each topic.

1:30 PM ***Ballroom 20D***

Free Margin Distance Does Not Influence Recurrence and Survival Rate After R0 Wedge Resection for Stage I Non-Small Cell Lung Cancer

G. Maurizi[1], *A. D'Andrilli*[2], *A. Ciccone*[2], *M. Ibrahim*[1], *C. Andreetti*[2], *S. Tierno*[2], *C. Poggi*[2], *F. Venuta*[2], *E. A. Rendina*[2]

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Purpose: The relationship between free margin distance and recurrence rate and overall survival after R0 wedge resection (WR) for non-small cell lung cancer (NSCLC) is still not clear. We retrospectively evaluated long-term oncological outcome of patients who had undergone WR for NSCLC to assess the prognostic impact of margin distance in this setting.

Methods: Between 2003 and 2013, 243 consecutive patients with functional contraindication to major lung resection underwent WR with systematic lymph node dissection for clinical stage I NSCLC. Only patients with pathological stage I and R0 resection (182) were enrolled in the study and divided into three subgroups according to margin distance (<1 cm, 1-2 cm, >2 cm).

Results: Histology was adenocarcinoma in 112 patients, squamous cell in 30, and other in 40. Postoperative morbidity rate was 18.7%. Postoperative mortality was 1.1%. The median follow-up was 31 months (range 2-133 months). Locoregional (lung parenchyma, hilum, mediastinum) recurrence rate was 26.4% (n=48). Distant recurrence rate was 11% (n=20). Overall 5-year survival was 70.4%. Disease-free 5-year survival was 51.7%. No statistical difference in locoregional (p = 0.92) and distant (p = 0.28) recurrence rate was found if comparing the three patient groups. No difference was found in overall survival between the three groups (p = 0.73).

Conclusions: WR is a viable option for surgical treatment of stage I NSCLC when lobectomy is contraindicated. Distance between the tumor and the parenchymal suture margin does not influence recurrence and survival rate when R0 resection is achieved.

1:45 PM ***Ballroom 20D***

Outcomes Following Surgery in High-Risk Patients With Early Stage Lung Cancer

M. S. Sancheti*, J. Melvan, R. Medbery, F. G. Fernandez, T. Gillespie, Q. Li, J. Binongo, A. Pickens, S. D. Force*

Emory University, Atlanta, GA

COMMERCIAL RELATIONSHIPS A. Pickens: Speakers Bureau/Honoraria, Ethicon Endo-Surgery, Inc

Purpose: Patients with early stage lung cancer considered high risk for surgery are increasingly being treated with non-surgical therapies, including stereotactic body radiation therapy. However, consensus on high-risk classification does not exist. We compared clinical outcomes following lung cancer surgery in patients considered to be high risk to those of standard risk patients.

Methods: Four hundred ninety patients from our institutional STS data from 2009 to 2013 underwent resection for clinical stage I lung cancer. High-risk patients were identified by ACOSOG z4032/z4099 criteria: major: forced expiratory volume (FEV1) ≤50% or diffusing capacity (DLCO) ≤50%; minor (two of the following): age ≥75 years, FEV1 51-60%, or DLCO 51-60%. Demographics, perioperative outcomes, and survival between high and standard risk patients undergoing lobectomy and sublobar resection were compared. Univariate analysis was performed using the chi-square test/Fisher's exact test and the t-test/Mann-Whitney test. Survival analysis was performed with a Cox regression model to calculate hazard ratios and Kaplan-Meier survival curves were drawn.

Results: One hundred eighty (37%) of patients were classified as high risk. Compared to standard risk patients, high-risk patients were older (70 years vs 65 years, $p < 0.0001$), had worse FEV1 (57% vs 80%, $p < 0.0001$), and DLCO (47% vs 77%, $p < 0.0001$). High-risk patients also had greater smoking pack years (46 vs 30, $p < 0.0001$) and greater incidence of COPD (72% vs 32%, $p < 0.0001$). High-risk patients were more likely to undergo sublobar resection (32% vs 20%, $p = 0.001$). Length of stay was longer in the high-risk group (5 days vs 4 days, $p < 0.0001$). There was no difference in postoperative mortality (2% vs 1%, $p = 0.53$). Nodal upstaging occurred in 20% of high-risk patients and 21% of standard-risk patients ($p = 0.79$). Three-year survival was 59% for high-risk patients and 76% for standard-risk patients ($p < 0.0001$) (Figure).

Conclusions: Good clinical outcomes following surgery for early stage lung cancer can be achieved in patients classified as high risk. In our study, surgery led to upstaging in 20% of patients and reasonable 1-, 2-, and 3-year survival. This study suggests that empiric selection criteria may deny patients optimal oncologic therapy.

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General Thoracic Session: Lung Cancer I – Continued

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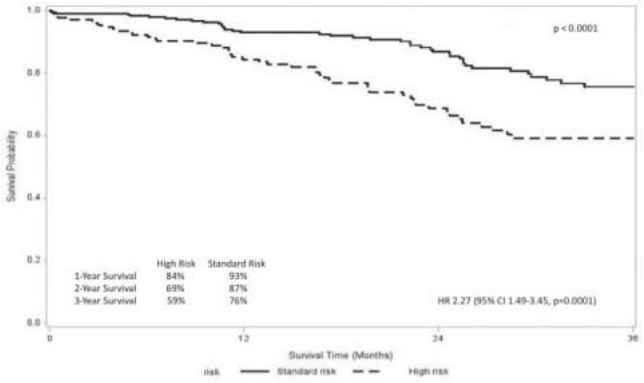

2:00 PM ***Ballroom 20D***

Video-Assisted Thoracoscopic Surgery Is a Safe and Effective Alternative to Open Approach in Anatomical Segmentectomy for Treatment of Non-Small Cell Lung Cancer Patients

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New York Presbyterian Hospital/Weill Cornell Medical Center, New York

Purpose: A video-assisted thoracoscopic surgical (VATS) approach for segmentectomy is technically challenging and differs from the conventional open approach. This is a comparative study between VATS and thoracotomy for anatomical segmentectomy to explore the feasibility and safety of VATS in the treatment of non-small cell lung cancer (NSCLC).

Methods: We retrospectively analyzed patients undergoing anatomical segmentectomy performed for NSCLC between 2000 and 2014. We evaluated primary outcome variables, including perioperative course, pathology, recurrence, and survival. The probability of overall and disease-free survival was estimated with the Kaplan-Meier method and significance was estimated by the Log-rank test.

Results: We performed 193 segmentectomies: 91 VATS (47%) and 102 open (53%). VATS patients were older (72 vs 68, $p = 0.016$) and had similar gender (63% vs 61% female, $p = 0.792$), comorbidity index (1.2 vs 1.6, $p = 0.505$), and T-classification (90% vs 82% T1, $p = 0.228$) vs thoracotomy patients. There were no significant differences for VATS vs thoracotomy regarding median number of lymph nodes (7 vs 8, $p = 0.112$) or of mediastinal lymph node stations sampled (2 vs 2, $p = 0.2$). VATS patients had more N1 stations sampled (mean: 1.2 vs 0.9, $p = 0.033$). VATS was associated with decreased length of stay (4 days vs 5 days, $p = 0.001$) and pulmonary complications (8% vs 20%, $p = 0.033$) compared to thoracotomy (Table 1). There was no difference in final pathologic stages between groups ($p = 0.331$), although patients undergoing thoracotomy had larger median tumor size (1.7 cm vs 1.5 cm, $p = 0.034$). No significant difference was apparent in 3-year overall survival for stage IA NSCLC, although the trend favored VATS (90% vs 75%, $p = 0.212$). Similarly, 3-year overall survival for the entire cohort favored VATS over thoracotomy (90% vs 71%, $p = 0.018$).

Conclusions: VATS anatomic segmentectomy is a feasible and oncologically safe technique, particularly for the treatment of stage IA NSCLC patients. VATS patients have shorter hospital stays and fewer pulmonary complications compared to those undergoing thoracotomy. VATS patients received equivalent lymphadenectomy to thoracotomy patients. VATS patients had improved overall survival, although this may have been due to differences in patient selection.

Continued on next page

General Thoracic Session: Lung Cancer I – Continued

Abstract continued from previous page

		VATS Segmentectomy (n= 91)	Thoracotomy Segmentectomy (n=102)	P value
Pathological stage	0 (Tis)	1 (1.1%)	0	P=0.331
	IA	71 (78%)	69 (67.6%)	
	IB	13 (14.35)	17 (16.7%)	
	IIA	3 (3.3%)	6 (5.9%)	
	IIB	1 (1.1%)	4 (3.9%)	
	IIIA	2 (2.2%)	6 (5.9%)	
Complications:	All	9 (10%)	23 (23%)	P=0.033
	Pulmonary	8 (9%)	20 (19.6%)	
	Others	1 (1%)	2 (2%)	

2:15 PM ***Ballroom 20D***

Robotic Lobectomy Does Not Increase Nodal Upstaging Compared to Video-Assisted Thoracoscopic Surgical (VATS) Lobectomy in Clinically Node-Negative Patients With Lung Cancer

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The Valley Hospital, Ridgewood, NJ

Purpose: Recent multi-institutional published data demonstrated increased pathologic nodal upstaging by robotic lobectomy compared to historical VATS lobectomy data. To eliminate potential variability from having multiple surgical and/or pathological techniques, we compared the rate of nodal upstaging at a single institution where both robotic and VATS lobectomy are performed.

Methods: This was a retrospective, single institution review of clinically node negative patients with lung cancer undergoing VATS or robotic lobectomy by two thoracic surgeons from 2009 to 2014. Patients with in-situ adenocarcinoma (formerly bronchioloalveolar carcinoma) were excluded. All patients underwent preoperative CT/PET imaging. Additional staging procedures were performed when clinically indicated. One surgeon solely performed VATS lobectomy while the other performed both VATS and robotic lobectomy. Clinical data were recorded in concordance with The Society of Thoracic Surgeons National Database elements. The rates of pathological nodal upstaging, as well as disease-free and overall survival, were calculated.

Results: A total of 211 patients met inclusion and exclusion criteria and underwent anatomic lobectomy by VATS (n=158) or robotics (n=53). The two groups were statistically similar in their clinical stage, tumor size, location, and histology. Within the VATS group, 24 patients experienced nodal upstaging (15.2%) with 13 patients having pN1 disease, seven patients having pN2 disease, and four patients having pN1+N2 disease. The robotics group contained seven patients (13.2%) with nodal upstaging with five patients exhibiting pN1 disease and two patients with pN1+N2 disease. There was no difference in pathological upstaging between VATS and robotics (p = 0.72). When comparing VATS vs robotics, there were no significant differences in 2-year overall survival (89% vs 95%, respectively, p = 0.56) and 2-year disease-free survival (83% vs 95%, respectively, p = 0.41).

Conclusions: In this comparison of robotic and VATS lobectomy for clinically node negative lung cancer that was managed with consistent surgical technique and pathologic evaluation, the rate of nodal upstaging achieved by robotics appears similar to VATS. In addition, there were no appreciable differences in disease-free survival or overall survival.

2:30 PM ***Ballroom 20D***

Diameter of Solid Tumor Component Alone Should Be Used to Establish T-Stage in Lung Adenocarcinoma

B. M. Burt[1], *A. Leung*[1], *M. Yanagawa*[2], *W. Chen*[1], *C. D. Hoang*[1], *V. Nair*[1], *J. B. Shrager*[1]

[1]*Stanford University School of Medicine, CA,* [2]*Osaka University Graduate School of Medicine, Japan*

Purpose: The CT appearance of "ground glass" components within lung adenocarcinomas closely correlate with non-invasive tumor histology, and solid radiographic components closely correlate with invasive histology. We therefore hypothesized that T-stage might be more accurately applied by considering only the solid component nodule diameter, rather than total nodule diameter.

Methods: We identified 74 patients with a solitary lung adenocarcinoma who underwent surgical resection without receiving neoadjuvant therapy and who had a thin-section chest CT within 3 months prior to surgery. CT scans were re-reviewed by a thoracic radiologist, and maximum total diameter and solid diameter of the resected nodules were measured. T-tests, ANOVA, univariate and multivariate Cox proportional hazards models, and Kaplan-Meier analyses with log-rank tests were performed to determine whether total nodule diameter, or solid component diameter, was more predictive of overall survival (OS).

Results: Thirty-three patients (45%) had a solid nodule, 39 (53%) had a part-solid nodule, and two (3%) had a pure ground glass lesion. The majority of patients were white (59%) and female (69%); 42% were never-smokers. Mean age was 65.2 years ± 12.4 years. Seventy-four percent underwent lobectomy and 23% sublobar resection. Sixty-six percent had pathologic stage I disease, 22% stage II, and 12% stage IIIA. Mean total and solid nodule diameters were 32.1 mm ± 17.5 mm and 24.8 mm ± 18.0 mm, respectively ($p = 0.01$). Among the 39 patients with part-solid nodules, multivariate models incorporating significant univariate predictors of OS (age, procedure, n descriptor) revealed that maximum solid diameter was associated with OS (HR 1.17, $p = 0.005$) and maximum total diameter was not. Multivariate analyses of the entire cohort (42% with pure solid nodules) constructed with significant univariate predictors of OS (age, procedure, n descriptor, histology) revealed that maximum solid diameter was an independent predictor of OS (HR 1.04, $p = 0.015$) while maximum total diameter was not ($p = 0.13$).

Conclusions: In a largely non-Asian cohort undergoing resection for adenocarcinoma, radiographic diameter of the solid component of a part-solid lesion is a better predictor of OS than entire lesion diameter. These data suggest alteration of the T-descriptor for lung adenocarcinoma such that the ground glass contribution to nodule diameter be ignored.

2:45 PM ***Ballroom 20D***

Angiogenesis Biomarkers May Be Useful in the Management of Patients With Indeterminate Pulmonary Nodules

C. W. Seder[1], *J. Kubasiak*[1], *E. Davila*[2], *R. Medairos*[1], *R. Pithadia*[1], *I. Tarhoni*[1], *C. Fhied*[1], *H. Alnajjar*[1], *G. W. Chmielewski*[1], *W. Warren*[1], *S. Basu*[1], *J. Borgia*[1], *M. Liptay*[1]

[1]*Rush University Medical Center, Chicago, IL,* [2]*University of Illinois at Chicago*

Purpose: Low-dose CT screening offers a means to detect lung cancer at an early stage. However, the high false-positive rate associated with screening often creates patient management dilemmas, introduces risk from diagnostic follow-up, and negatively impacts cost-effectiveness. This study aims to survey angiogenesis biomarkers for those capable of assigning clinical significance to indeterminate pulmonary nodules detected through CT imaging studies.

Methods: An institutional database and specimen repository were used to identify 186 patients with stage I non-small cell lung cancer (NSCLC) (T1-2N0M0) and 68 patients with benign solitary pulmonary nodules detected by CT imaging studies. Patients with nodules of 3 cm or less and a high-risk profile were included in this study. All specimens were evaluated in a blinded manner for 17 angiogenesis biomarkers using multiplex immunoassays. Biomarker performance was calculated through the Mann-Whitney Rank Sum U test and a receiver operator characteristic analysis. A multivariate analysis of age, gender, and smoking history was also conducted via ANOVA.

Results: A total of 254 patients were screened for 17 angiogenesis biomarkers. Median nodule size was 1.4 cm for benign cases and 1.7 cm for NSCLC; median smoking histories were 20 and 35 pack-years, respectively. Differences in serum concentrations of G-CSF, endoglin, endothelin, FGF-1, HB-EGF, VEGF-C and VEGF-D were strongly significant ($p \leq 0.001$) and EGF, follistatin, PLGF, FGF-2, VEGF-A, and BMP-9 were significant ($p \leq 0.05$) between the benign and malignant nodule cohorts. Performance characteristics for these biomarkers were excellent (area under the curve greater than 0.650).

Conclusions: Angiogenesis biomarkers may be capable of discriminating stage I NSCLC from benign pulmonary nodules. These findings will be used to improve the performance of our multi-analyte algorithm for this purpose.

3:00 PM **Ballroom 20D**

Long-Term Effect of an Interdisciplinary Supportive Care Intervention for Lung Cancer Survivors Following Surgery

***D. J. Raz**, V. Sun, J. Y. Kim, A. Williams, M. Koczywas, M. Cristea, K. Reckamp, J. Hayter, B. Tiep, B. Ferrell*

City of Hope National Medical Center, Duarte, CA

COMMERCIAL RELATIONSHIPS D. J. Raz: Consultant/Advisory Board, Circea Theranostics, LLC

Purpose: Surgery provides the best chance for cure and long-term survival in non-small cell lung cancer (NSCLC). Persistent symptoms following surgery are common, and they can negatively impact health-related quality of life (HRQOL) for survivors. The purpose of this study was to examine the long-term effect of an interdisciplinary supportive care intervention to improve HRQOL and symptoms in lung cancer survivors who were treated surgically.

Methods: Patients undergoing curative intent resection for NSCLC were enrolled in a prospective sequential design whereby the control group was accrued first, followed by the intervention group. Patients in the intervention group were presented by nurses at weekly interdisciplinary care meetings prior to surgery and received four educational sessions (physical, psychological, social, and spiritual wellbeing) following surgery. Appropriate symptom management, social work, rehabilitation, and spiritual support interventions were coordinated by the study nurse. In both groups, HRQOL, psychological distress, and symptom severity were assessed at baseline and at 6-week intervals for 12 months using surveys, which included the validated LCS, FACT-L, and MSAS questionnaires. Mean survey scores were analyzed using 2x2 Factorial ANOVAs at 12 months.

Results: A total of 66 survivors (33=control, 33=intervention) were accrued. There was no difference in age, baseline performance status, stage of disease, or proportion of patients who underwent minimally invasive surgery between groups. Patients in the intervention group had significantly less distress (mean 1.3 vs 4.0, $p < 0.001$, range 0-10) and more favorable mean FACT-L scores (125.4 vs 99.3, $p < 0.001$, range 0-140), LCS scores (29.2 vs 23.9, $p < 0.001$, range 0-32), and MSAS scores (0.22 vs 0.41, $p < 0.001$, range 0-4) at 12 months. The mean scores of all categories of questions in FACT-L (physical, social/family, emotional, and functional wellbeing) were significantly more favorable in the intervention group at 12 months. There was an interaction present with minimally invasive surgery for functional wellbeing. The intervention was associated with improved individual physical symptom scores, including dyspnea, lack of energy, and difficulty sleeping.

Conclusions: An interdisciplinary supportive care intervention improves psychological distress, HRQOL, and symptom severity at 12 months after lung cancer surgery. This study has important implications in improving quality of life for lung cancer survivors after surgery. Further study is warranted on incorporating the interdisciplinary personalized interventions used in this study into clinical practice in lung cancer survivors.

3:15 PM **Ballroom 20D**

The Impact of Zero-Day Global Reimbursement on Lung Cancer Care

Keith S. Naunheim, St Louis, MO

NOTES

1:30 PM – 3:30 PM ***Room 29D***

General Thoracic Session: Lung Transplantation

Moderators: *Seth D. Force, Atlanta, GA, and Eric L. Grogan, Nashville, TN*

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

Presenting authors are listed in **bold** on each abstract.

The physician competencies addressed in this session are patient care and procedural skills and medical knowledge. These physician competencies will be addressed through a series of individual lectures and a brief question-and-answer session after each topic.

1:30 PM ***Room 29D***

Spontaneously Breathing Extracorporeal Membrane Oxygenation Support Provides the Optimal Bridge to Lung Transplantation

M. Schechter*, A. M. Ganapathi, B. R. Englum, P. Speicher, B. Gulack, S. Hirji, R. Davis, M. G. Hartwig*

Duke University Medical Center, Durham, NC

Purpose: Extracorporeal membrane oxygenation (ECMO) is increasingly being utilized as a bridge to lung transplantation. Small, single-institution series have described increased success using ECMO in spontaneously breathing patients compared to patients on ECMO with mechanical ventilation, but this strategy has not been evaluated on a large scale.

Methods: Using the United Network for Organ Sharing database, all adult patients undergoing isolated lung transplantation from January 2000 through September 2013 were identified. Patients were categorized by their type of pre-transplant support: ECMO + mechanical ventilation; ECMO only; vent only; no support. Kaplan-Meier survival analysis with log-rank testing was performed to compare survival based upon type of preoperative support. A Cox regression model was used to determine whether type of preoperative support was independently associated with mortality, using previously established predictors of survival as covariates.

Results: A total of 18,392 pulmonary transplantations were included in this analysis. One hundred fifty-five patients (0.84%) were on ECMO + vent, 93 (0.51%) were on ECMO only, 813 (4.42%) required only mechanical ventilation, while the remaining 17,331 (94.23%) required no invasive support prior to transplantation. Survival was significantly worse with patients requiring ECMO + vent or vent only ($p < 0.0001$ for both), but similar between patients on ECMO alone and those not on support ($p = 0.12$; Figure 1). In multivariable analysis, ECMO + vent and vent only were independently associated with decreased survival compared to non-support patients (ECMO + vent: hazard ratios (HR) = 1.96, 95% confidence interval (CI) = 1.36–2.84; vent only: HR = 1.52, CI = 1.31–1.78; $p < 0.0001$ for both), while ECMO alone was not significant (HR = 1.07, CI = 0.57–2.01, $p = 0.843$).

Conclusions: In patients with rapidly advancing pulmonary disease awaiting lung transplantation, ECMO with spontaneous breathing affords improved survival compared to other bridging strategies.

Figure 1.

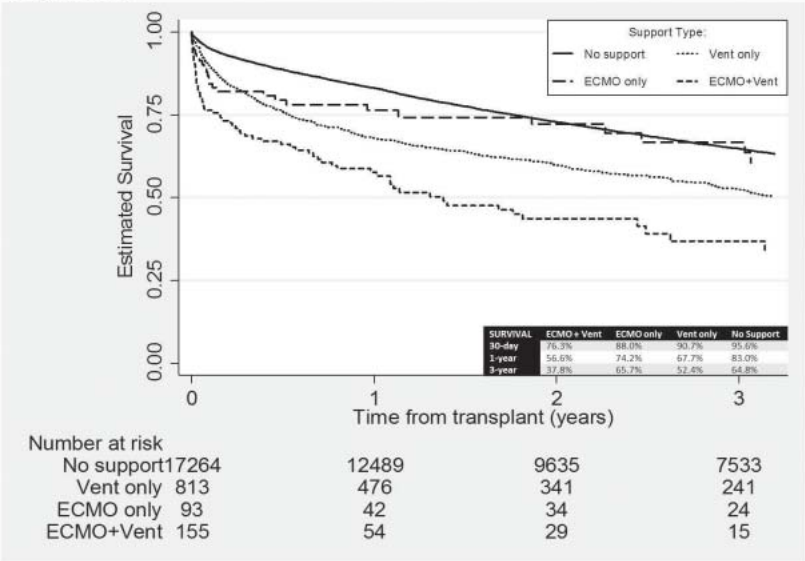

Table 1. Influence of Pre-Transplant Support on Mortality After Lung Transplantation from January 2000 to September 2013, multivariate analysis (n=18,392)

	Hazard Ratio	[95% Conf. Interval]		*p* value
Preoperative Support				
No Support	1 (Reference)			
Vent only	1.53	1.31	1.78	<0.0001
ECMO only	1.07	0.57	2.01	0.83
ECMO + Vent	1.96	1.36	2.84	<0.0001

Variables also included in Cox regression model: patient age; diagnosis; force vital capacity (%); end oxygen requirement (LPM); need for dialysis prior to transplant; total serum bilirubin; serum creatinine; partial pressure of carbon dioxide; diabetic donor; era of transplant (pre/post-2008)

1:45 PM **Room 29D**

Venous Thromboembolic Complications of Lung Transplantation in the Era of the Lung Allocation Score

***C. F. Evans**, F. Cheema, J. Kim, I. Timofte, S. Pham, B. P. Griffith, A. Iacono, K. Rajagopal*
University of Maryland, Baltimore

COMMERCIAL RELATIONSHIPS S. Pham: Consultant/Advisory Board, TransMedics, Inc

Purpose: The lung allocation score (LAS) shifts organ allocation preferentially to high acuity recipients, who may be more susceptible to postoperative complications. Venous thromboembolic (VTE) complications following lung transplantation may adversely affect recipient survival and allograft function. We sought to understand VTE complications in lung transplant recipients in the LAS era.

Methods: The records of lung transplant recipients from July 1, 2008, to June 30, 2013, were reviewed. The start and end dates of data collection were chosen to ensure that recipients fit into the LAS era and adequacy of follow-up. No patients were censored from data analysis. Deep venous thrombosis (DVT) was diagnosed using duplex ultrasonography. Pulmonary embolism (PE) was identified based upon one or more of the following: computed tomography angiography (CTA), ventilation-perfusion (V/Q) scanning demonstrating high probability for PE, or V/Q scanning with intermediate probability of PE plus evidence of a concomitant DVT.

Results: One hundred twenty-three transplants were performed on 117 patients. Median recipient age was 64 years; men comprised 64% (75/117), while women comprised 36% (42/117). Primary transplants accounted for 93% of cases (115/123), while reoperative transplants accounted for 7% of cases (8/123). In the overall recipient group, 46% (57/115) underwent bilateral transplantation, while 54% (66/123) underwent unilateral transplantation. Extracorporeal circulation was utilized in 34% of operations (42/123). Venous duplex ultrasonography was performed in 86% of patients (101/117); 66% (67/101) had evidence of DVT, inclusive of isolated upper extremity DVT attributable to central venous catheters. Pulmonary imaging was performed in 88% of patients (103/117); 15% (15/103) had evidence of PE. Median interval from transplant to diagnosis of DVT was 15 days, while median interval from transplant to diagnosis of PE was 245 days. Survival in patients with VTE complications was not statistically significantly different from survival in patients without VTE complications.

Conclusions: The incidence of VTE complications in lung transplant recipients is high in the modern era and is higher than reported in the pre-LAS era literature. Longer-term postoperative chemoprophylaxis may be appropriate, given the time course of postoperative VTE occurrences. Additional studies are required to determine effects on allograft function.

2:00 PM ***Room 29D***

Risky Business: Taking the Stigma Out of High-Risk Donation in Lung Transplantation

S. Bansal[1], *J. A. Hayanga*[2], *D. D. Odell*[1], *K. Jeong*[1], *A. Fabio*[1], *J. D. Luketich*[1], *J. D'Cunha*[1]

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COMMERCIAL RELATIONSHIPS J. D. Luketich: Research Grant, Accuray Incorporated; Ownership Interest, Intuitive Surgical, Inc, Express Scripts, Inc

Purpose: With the number of lung donors limited, many centers have utilized high-risk donors for transplantation into recipients willing to receive them. To date, there has been limited information regarding outcomes of recipients receiving these organs. We sought to fully elucidate the outcomes of those lung transplant (LTx) recipients who received organs from high-risk donors that have this designation secondary to social behavior using a national database.

Methods: We retrospectively reviewed the United Network for Organ Sharing registry from 1987 to June 2013 to identify those patients undergoing LTx and receiving organs from designated high-risk donors. Student t-test and chi-square test was used to identify differences in outcomes. A Cox proportional hazard model was developed to identify independent predictors of outcomes in recipients receiving high-risk allografts.

Results: We identified 14,923 patients who underwent LTx. A total of 1,149 (8.3%) recipients received allografts from donors identified as high risk. A higher rate of double lung transplants was noted in high-risk recipients, 69.3% vs 65.6% ($p = 0.011$). The mean recipient age in non-high-risk recipients was 52.7 ± 15.1 and high-risk group was 53.9 ± 14.0 ($p = 0.015$). There were no significant differences in time on waitlist ($p = 0.64$) or acute rejection episodes ($p = 0.70$). Survival analysis demonstrated no survival benefit for patients receiving allografts from non-high-risk donors ($p = 0.57$). Interestingly, high-risk donors did not have significantly higher rates of viral loads, including HCV abs, HBc abs, and HBs antigen. Cox proportional hazard controlling for age, gender, and LAS score of recipient demonstrated that negative social behaviors in the donor, such as alcohol abuse, drug and cocaine use, and tattoos, were not a significant detriment to survival.

Conclusions: Recipients receiving allografts from high-risk donors had at least equivalent survival to non-high risk donors. Despite the concerning nomenclature, our study supports the use of high-risk donation given the limited allograft resource. Centers interested in using these donors may better educate prospective recipients and potentially safely transplant recipients who are willing to consider this option.

2:15 PM **Room 29D**

Extracorporeal Membrane Oxygenation as a Bridge to Lung Transplantation: Is There a Volume Threshold for Optimized Survival?

J. A. Hayanga[1], *A. Woodwyk*[1], *C. McGraw*[1], *A. Lira*[2], *H. Kaiser*[3], *R. Girgis*[4], *J. D'Cunha*[2], *A. Khaghani*[5]

[1]*Spectrum Health/Michigan State University, Grand Rapids,* [2]*University of Pittsburgh Medical Center, PA,* [3]*The Johns Hopkins Medical Institutions, Baltimore, MD* [4]*Spectrum Health - Richard DeVos Heart & Lung Transplant Program, Grand Rapids, MI*

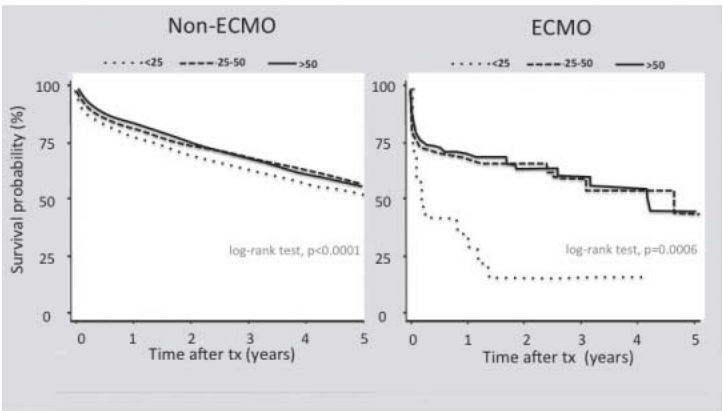
Purpose: We sought to evaluate the effect of center volume on survival when extracorporeal membrane oxygenation (ECMO) was used as a bridge to lung transplantation (LTx).

Methods: We performed a retrospective analysis of International Registry for Heart and Lung Transplantation (ISHLT) data on adult lung transplantations performed between 2005 and 2010. Centers were categorized based on annual volume of transplants into low, medium, and high (<25, 25-50, and >50, respectively). Baseline characteristics were assessed, and Kaplan-Meier analysis estimated survival with log-rank test, pair-wise comparisons, and Bonferroni correction to allow for multiple comparisons.

Results: Of the 16,603 adult recipients, 85 were bridged using ECMO. Twenty (23.5%) of these were bridged in low, 30 (35.3%) in medium, and 35 (41.2%) in high-volume centers. High-volume centers were more likely to use ECMO to bridge patients with idiopathic pulmonary fibrosis (IPF) and less commonly for COPD or cystic fibrosis ($p = 0.0039$). Overall distribution of pulmonary diagnoses varied between centers ($p < 0.0001$). High-volume centers more commonly used older donors ($p < 0.0338$) with heavy smoking history. There were significant differences between the two cohorts in both 1-year ($p = 0.0038$, $p < 0.0001$) and 5-year ($p = 0.0006$, $p < 0.0001$) survival. In the ECMO cohort, the lowest 5-year survival rate (13.61%) was observed at low-volume centers. No differences were noted between medium and high-volume centers.

Conclusions: The lung transplantation volume-outcome relationship is non-linear with an inflection point. Overall, lowest-volume centers have poorest survival, but there exists a volume threshold at which better outcomes are achieved.

Volume Effect on Survival in the use of ECMO as a Bridge to Transplantation



2:30 PM ***Room 29D***

Warm, Ex Vivo Lung Preservation and Transport

Abbas Ardehali, Los Angeles, CA

REGULATORY DISCLOSURE This presentation will address the TransMedics OCS, which is not FDA approved.

3:00 PM ***Room 29D***

Lung Donor Offer Score: How Can We Use This?

Gabriel Loor, Minneapolis, MN

1:30 PM – 3:30 PM ***Room 30E***

Managing Cardiogenic Shock or Pulmonary Failure: Short-Term Mechanical Circulatory Support

Advanced mechanical device technologies for cardiac and pulmonary support are providing new opportunities for both temporary and long-term patient treatment options. Two sessions, one on Monday and the other on Tuesday, will cover the complexities of patient management and new mechanical circulatory support (MCS) device technologies associated with initiating and maintaining an advanced technologies program.

This session offers a series of lectures, followed by abstract presentations on short-term MCS, including extracorporeal membrane oxygenation (ECMO), and will address patient selection, new technologies and devices, and how to tailor devices to patients.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Identify a comprehensive selection of short-term devices
- Explain the importance of proper patient selection and timing of intervention
- Demonstrate and describe how to tailor a specific device to the patient
- Describe the complex infrastructure necessary to support a mechanical circulatory assist program
- Identify pitfalls in peri- and postoperative management
- Recognize the steps to develop and manage an ECMO program
- Describe regulatory oversight of MCS therapy

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

Presenting authors are listed in **bold** on each abstract.

The physician competencies addressed in this session are patient care and procedural skills, medical knowledge, professionalism, and interpersonal and communication skills. These physician competencies will be addressed through a series of lectures meant to enhance the understanding of patient selection, new technologies and devices, and how to tailor devices to patients.

Moderators: *Shaf H. Keshavjee, Toronto, Canada, and Francis D. Pagani, Ann Arbor, MI*

1:30 PM **Short-Term Circulatory Support Options for Acute Cardiogenic Shock: New Technologies and Approaches for Success**
Charles W. Hoopes, Lexington, KY

1:45 PM **Defining a Destination for the Patient on Short-Term Circulatory Support: Steps to Increase Options**
Christian Bermudez, Pittsburgh, PA
REGULATORY DISCLOSURE This presentation will discuss the off-label use of Maquet, Sorin, and Thoratec extracorporeal membrane oxygenation devices.

2:00 PM **Strategies for Pulmonary Failure**
Matthew D. Bacchetta, New York, NY

2:15 PM **Networking to Improve Short-Term Mechanical Circulatory Support Outcomes**
Michael F. McGrath, Norfolk, VA

2:30 PM ***Room 30E***

Subclavian Intra-aortic Balloon Pump—Use as an Intermediate Duration Bridge to Decision Device

S. Tuladhar, D. Onsager, V. A. Lonchyna, S. Fedson, G. Sayer, G. Kim, N. Uriel, ***V. Jeevanandam***

The University of Chicago Medical Center, IL

COMMERCIAL RELATIONSHIPS V. A. Lonchyna: Other, Abbott Laboratories, Hospira Inc, Own a small number of stock in each company; V. Jeevanandam: Consultant/Advisory Board, HeartWare International Inc, ReliantHeart, Inc, Thoratec Corporation; N. Uriel: Consultant/Advisory Board, HeartWare International Inc, Thoratec Corporation, XDx, Inc

Purpose: Subclavian intra-aortic balloon pump (IABP) via an infraclavicular incision in advanced congestive heart failure (aCHF) with cardiogenic shock (CS) helps to optimize patients as a bridge to decision prior to definitive treatment. We reviewed our experience and assessed the feasibility, tolerability, and safety of this technique.

Methods: Clinical and demographic data for subclavian IABP placement for patients with aCHF with CS (BP mean <70 and CI <2.0 with PA mean >25) between January 2011 to April 2014 were retrospectively reviewed. Subclavian anastomosis was done using a polytetrafluoroethylene (PTFE) graft through an infraclavicular incision with an introducer sheath stub tied to the distal part of the graft acting as a one-way valve. Patients were followed from the date of insertion until discharge or mortality. Primary outcome measured was survival until definitive treatment. Secondary outcomes measured were complications with the need for replacement, reexploration, or repositioning.

Results: Sixty-six patients with aCHF and CS underwent subclavian IABP support from 4 days to 74 days (median 19 days). Forty-six patients (69.7%) underwent successful heart transplant. Sixteen patients (24.2%) underwent long-term mechanical circulatory support. One patient declined treatment. CS resolved in 62 patients, with four patients needing escalation of inotrope treatment (three of whom died prior to definitive treatment). All patients were exercised at least three times per day with maximum distance ranging from 0.25 to 6 miles daily. Eleven patients (16.6%) needed replacement of the IABP due to kinking, balloon rupture, or displacement. Nine patients (13.6%) needed wound reexploration. Three patients (4.5%) needed repositioning of the IABP. No patients died as a complication of subclavian balloon pump placement. There was one CVA, no subclavian artery malperfusion, no thromboembolic events, one distal IABP migrating into the SMA, and two transient brachial plexus neurolagia.

Conclusions: Subclavian IABP is a feasible, safe, and well-tolerated bridging technique for aCHF patients with CS. Mobility helps patients to undergo active rehabilitation prior to definitive treatment. IABP can also be easily removed post-treatment without opening the wound.

2:45 PM **Room 30E**

Perioperative Risk Factors for Mid-Term Mortality in Patients Bridged to Transplant With a Continuous-Flow Left Ventricular Assist Device

A. H. Healy[1], *J. Stehlik*[1], *L. Edwards*[2], *S. H. McKellar*[1], *S. Drakos*[1], *C. H. Selzman*[1]

[1]*University of Utah, Salt Lake City,* [2]*International Society for Heart and Lung Transplantation, Addison, TX*

REGULATORY DISCLOSURE This presentation will address the off-label use of the Jarvik 2000 Left Ventricular Assist Device as one of many LVAD types used to bridge patients to transplant as reported in the International Society for Heart and Lung Transplantation Transplant Registry.

Purpose: Continuous-flow left ventricular assist devices (CF-LVADs) are standard of care for bridging patients to cardiac transplantation. However, existing data about perioperative factors influencing post-transplant survival in this population are limited. The purpose of this study was to determine risk factors for mortality using a large, international database.

Methods: All patients in the International Society for Heart and Lung Transplantation Transplant Registry who were bridged to transplantation with a CF-LVAD between June 2008 and June 2012 were included. Risk factors for mortality within 3 years of transplant, conditional on 30-day post-transplant survival, were identified. Statistical approach included multivariable analysis and Kaplan-Meier survival analysis.

Results: During the study period, 2,142 CF-LVAD patients underwent heart transplantation, of which 2,041 (95.3%) survived the first 30 days. Overall 3-year survival was 81.8% and conditional 3-year survival was 85.7%. Risk factors for mortality during this window included pre-discharge dialysis (HR 3.58, 95% CI 2.55-5.01), azathioprine vs tacrolimus/mycophenolate mofetil for maintenance (HR 3.05, 95% CI 1.53-6.07), pre-transplant left ventricular remodeling (HR 2.50, 95% CI 1.01-6.17), Jarvik vs HeartMate II LVAD (HR 2.43, 95% CI 1.26-4.69), pre-transplant coronary bypass grafting (HR 1.70, 95% CI 1.26-2.28), and pre-discharge drug-treated infection (HR 1.50, 95% CI 1.07-2.10). Increasing donor age ($p = 0.032$) and recipient body mass index ($p = 0.008$) were also associated with an increased mortality risk.

Conclusions: In patients bridged with CF-LVADs, several risk factors for subsequent mortality can be identified in the perioperative period. Despite the inherent complexities of reoperative surgery and the physiologic alterations from continuous- to pulsatile-flow, patients bridged to transplant with CF-LVADs have excellent mid-term survival.

3:00 PM ***Room 30E***

Should Marginal Donors Be Utilized in Patients Undergoing Heart Transplantation With Left Ventricular Assist Device Explantation?

S. Maltais[1], *M. E. Davis*[1], *J. M. Stulak*[2], *N. Haglund*[1]

[1]*Vanderbilt Heart and Vascular Institute, Nashville, TN,* [2]*Mayo Clinic, Rochester, MN*

COMMERCIAL RELATIONSHIPS S. Maltais: Consultant/Advisory Board, HeartWare International Inc

Purpose: Utilization of continuous-flow left ventricular assist devices (CF-LVAD) as a bridge to orthotopic heart transplantation (OHT) has increased. This study examined survival outcomes after CF-LVAD explantation-OHT utilizing marginal donors.

Methods: Adults undergoing OHT with or without CF-LVAD explant using marginal donors between 2007 and 2014 were identified in the Scientific Registry for Transplant Recipients database. A previously validated donor risk score (range, 1 to 15) was used to define marginal donors (score ≥7). Patients were stratified into four groups based on the utilization of a marginal donor with or without CF-LVAD explantation at OHT and analyzed according to graft survival at 1 and 5 years.

Results: Overall, 8,334 patients with OHT were analyzed. While 2,064 patients (25%) underwent OHT utilizing marginal donors, only 626 patients (30%) (group A) underwent OHT with CF-LVAD explant (HeartMate II = 581, 93%; HeartWare = 45, 7%), and 1,438 (70%) underwent direct OHT utilizing marginal donors (group B). Standard donors were utilized in 2,336 patients with CF-LVAD explant (group C), whereas 3,934 patients underwent direct OHT (group D) using standard donors. Compared to other groups, Kaplan-Meier analysis revealed that utilization of marginal donors in patients undergoing CF-LVAD explantation was associated with decreased post-transplant graft survival (Figure; $p < 0.001$). After adjusting for covariates (recipient age, gender, listing status at OHT, BMI, and creatinine), Cox regression analysis found that patients bridged with CF-LVADs, recipients transplanted with marginal donors, recipients with the highest BMI and highest creatinine were at increased risk of graft failure (all $p < 0.01$).

Conclusions: Utilization of marginal donors in patients undergoing CF-LVAD explantation-OHT is associated with reduced early and late graft survival. These findings support cautionary use of marginal donors in patients bridged with CF-LVAD.

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Managing Cardiogenic Shock or Pulmonary Failure – Continued

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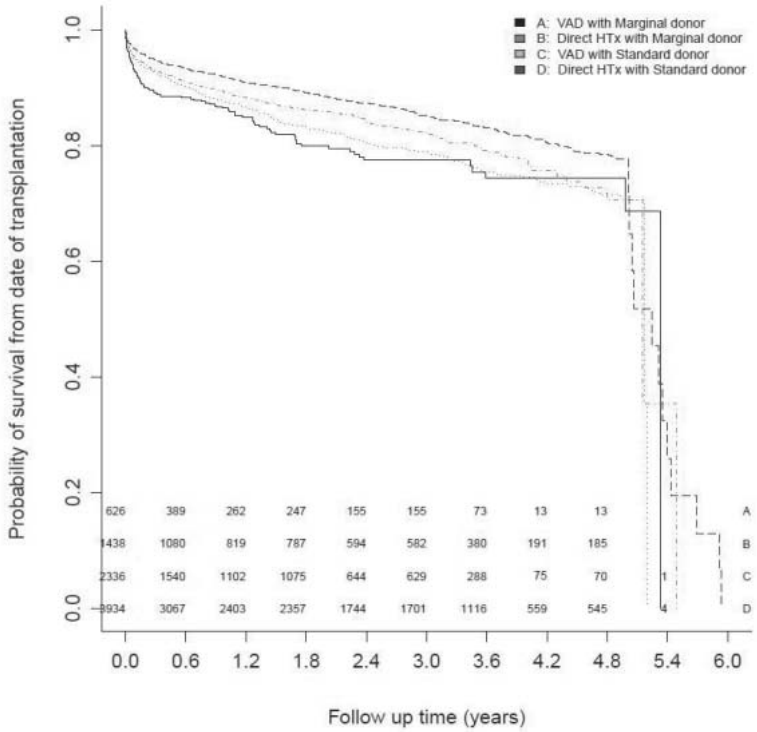

3:15 PM ***Room 30E***

Does Postoperative Blood Pressure Control Influence Development of Aortic Regurgitation Following Continuous-Flow Left Ventricular Assist Device Implantation?

N. P. Patil, *P. Mohite, A. Sabashnikov, A. Weymann, D. Dhar, D. Garcia Saez, B. Zych, C. Bowles, R. Hards, A. Popov, F. De Robertis, A. Moza, T. Bahrami, M. Amrani, S. Rahman-Haley, N. Banner, A. Simon*

Royal Brompton & Harefield NHS Foundation Trust, London, United Kingdom

COMMERCIAL RELATIONSHIPS R. Hards: Consultant/Advisory Board, HeartWare International Inc; A. Simon: Consultant/Advisory Board, HeartWare International Inc, Thoratec Corporation

Purpose: True impact of postoperative blood pressure (BP) control on development of aortic regurgitation (AR) following continuous-flow left ventricular assist device (CF-LVAD) implantation remains uncertain. This study examines the influence of BP in patients with de novo AR following CF-LVAD implantation.

Methods: All patients with no or less than mild AR who underwent CF-LVAD implantation from July 2006 to July 2012 at our institute and with subsequent device support of ≥3 months (n=90) were studied. Serial echocardiograms and BP readings were obtained preoperatively, postoperatively at 1, 3, and 6 months, and then at a minimum of 4-month intervals. BP readings were compared between patients who developed mild AR (AR group) vs those who did not (Non-AR group). Logistic regression analysis was used to define independent predictors of ≥mild AR following CF-LVAD implantation.

Results: Median duration of CF-LVAD support was 575 days (range: 98-2,433). Forty-eight patients (53.3%) developed mild AR over a median duration of 126 days. BP readings (median values, mm Hg) between AR vs Non-AR groups showed significant difference: at 3 months: systolic 99.5 vs 92.5 ($p = 0.038$), diastolic 81.5 vs 66 ($p < 0.001$), mean 86.5 vs 74 ($p < 0.001$), and at 6 months: diastolic 73 vs 62 ($p = 0.044$), mean 83 vs 74.5 ($p = 0.049$), respectively. Systolic BP at 3 months ($p = 0.047$, 95% CI 0.453-0.994, OR 0.671), aortic valve closure ($p = 0.01$, 95% CI 0.002-0.429, OR 0.029) and duration of support ($p = 0.04$, 95% CI 1.000-1.009, OR 1.004) were found to be independent predictors of AR following CF-LVAD implantation.

Conclusions: Suboptimal postoperative BP control was identified as a significant determinant of AR following CF-LVAD implantation, along with aortic valve closure and longer support duration. Aggressive control of BP may help protect against development of AR in CF-LVAD patients.

Continued on next page

Managing Cardiogenic Shock or Pulmonary Failure – Continued

Abstract continued from previous page

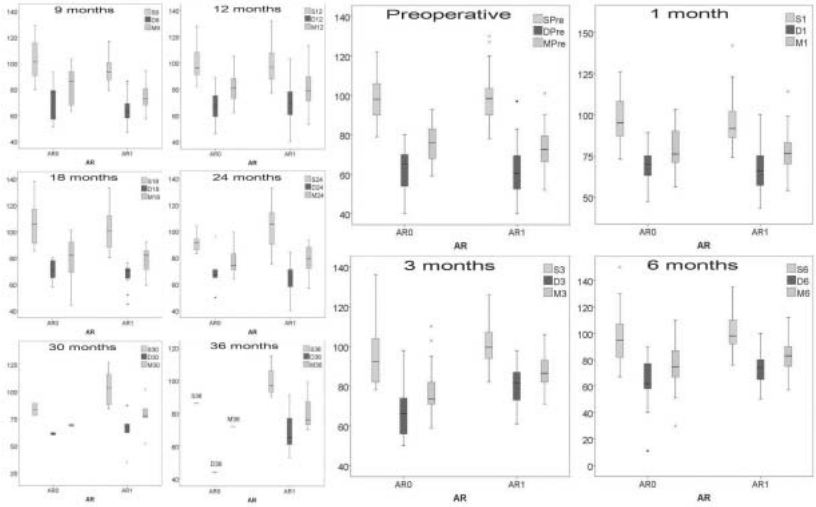

Table 4. Comparison of BP readings (mm Hg) between AR and Non-AR groups

Blood Pressure	Non-AR Goup	AR-Group	*p*-value
S-Pre	98 (89.5;107)	98.5 (90;104)	0.924
D-Pre	65 (53;70.5)	60.5 (52;69.7)	0.422
M-Pre	75.5 (68;83)	73 (66.5;80.5)	0.291
S1	88 (-;100.5)	89 (78.5;100)	0.588
D1	63 (-;74)	60 (50;71.5)	0.826
M1	74.5 (67;85.2)	74 (64.2;81.5)	0.805
S3	92.5 (82;104)	99.5 (94;107)	0.038
D3	66 (56;74.5)	81.5 (72.7;87.2)	<0.001
M3	74 (71;85)	86.5 (82;93)	<0.001
S6	95 (82;106)	98 (92;110)	0.091
D6	62 (57.7;77.2)	73 (64;80)	0.044
M6	74.5 (67;86.7)	83 (74.7;89.2)	0.049
S9	100 (86.2;118)	94 (87.5;104)	0.341
D9	78 (55;80)	63 (56;71)	0.299
M9	86.5 (68;92.2)	74 (68;87)	0.240
S12	96 (90;108)	95 (87.5;107)	0.632
D12	67 (59;76.5)	69 (60.2;78.5)	0.752
M12	81.5 (72.7;89)	79 (72;88.5)	0.836
S18	104 (91;117)	100 (88;110)	0.337
D18	71 (63.2;78.5)	70 (63.7;72)	0.427
M18	82 (69;92)	80 (68.5;84.5)	0.565
S24	93 (86;94)	101 (88.5;112)	0.158
D24	67 (61.2;77.2)	65 (57.5;72)	0.483
M24	75 (71;83)	81 (72;88)	0.728
S30	89 (78;-)	100 (90;114)	0.102
D30	61 (60;-)	67 (55.2;74.2)	0.238
M30	70 (68;-)	77.5 (70;88.5)	0.606
S36	86 (86;86)	97 (90.5;106)	0.223
D36	44 (44;44)	65 (59;81)	0.127
M36	72 (72;72)	80.5 (70.5;92.7)	0.331
S48	-	81 (78;100)	-
D48	-	59 (51.2;72.7)	-
M48	65 (65;65)	66 (63;81)	0.667
S60	-	96.5 (94;-)	-
D60	-	78 (72;-)	-
M60	-	85 (83;-)	-
S72	-	94.5 (78;-)	-
D72	-	60 (55;-)	-
M72	-	72 (63;-)	-
S84	-	92 (92;92)	-
D84	-	71 (71;71)	-
M84	-	78 (78;78)	-

S- Systolic; D- Diastolic; M- Mean; Pre- Preoperative. Values expressed as Median (Q1;Q3). Numerals after S, D, and M indicate the time in months of follow-up, eg, S3 = Systolic BP at 3 months of follow-up.

1:30 PM – 3:30 PM ***Room 30AB***

STS/SCA: Considerations in Perioperative Resuscitation of Cardiothoracic Patients

This session, presented by STS and the Society of Cardiovascular Anesthesiologists, will focus on considerations in perioperative resuscitation and coagulopathy management of cardiac surgery patients. Discussion topics will include choosing the appropriate fluid for perioperative administration, optimizing resuscitation of the bleeding patient, and understanding the role of pharmacological adjuncts and rational endpoints of blood component therapy in managing coagulopathy. The panel will consist of cardiac surgeons, cardiac anesthesiologists, and intensivists.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Recognize the evidence, strengths, and drawbacks in the choices of colloid and crystalloid for fluid resuscitation
- Assess the practical roles of massive transfusion protocols and point-of-care goal-directed strategies in resuscitation of cardiac patients
- Discuss rational triggers and endpoints for transfusing blood components in the perioperative period
- Describe the role and the risk-benefit ratio for use of available pharmacological adjuncts in treating perioperative coagulopathy

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The physician competencies addressed in this session are patient care and procedural skills and medical knowledge. These physician competencies will be addressed through a series of collaborative lectures by members of The Society of Thoracic Surgeons and the Society of Cardiovascular Anesthesiologists.

Moderators: *Aaron M. Cheng, Seattle, WA, Jay G. Shake, Temple, TX, Andrew Shaw, Nashville, TN, and Linda Shore-Lesserson, Hempstead, NY*

COMMERCIAL RELATIONSHIPS A. Shaw: Consultant/Advisory Board, Baxter International, Grifols; L. Shore-Lesserson: Consultant/Advisory Board, Elcam, Grifols

1:30 PM **Colloid, Crystalloid, and the Appeal for Balanced Solutions: What's the Evidence and Does It Really Matter?**
Andrew Shaw, Nashville, TN
COMMERCIAL RELATIONSHIPS A. Shaw: Consultant/Advisory Board, Baxter International, Grifols

1:50 PM **Discussion**

2:00 PM **Massive Transfusion Protocols and Point of Care Directed Bleeding Management: Are They Worth Following in Our Patients?**
Victor A. Ferraris, Lexington, KY

2:20 PM **Discussion**

2:30 PM **Beyond Packed Red Blood Cell Transfusion—Plasma, Cryo, Platelets: Deciding Rational Triggers and Endpoints in the Perioperative Period**
Bruce Spiess, Richmond, VA
COMMERCIAL RELATIONSHIPS B. Spiess: Research Grant, US Department of Defense - Army Combat Casualty Materiel Command; Consultant/Advisory Board, Grifols, Hemosonics Inc; Speakers Bureau/Honoraria, Hemonetics Inc

2:50 PM **Discussion**

3:00 PM **Can We Do Better? Pharmacological Adjuncts in Treating Perioperative Coagulopathy—What Are They, Who Gets Them, and Are They Safe?**

Linda Shore-Lesserson, Hempstead, NY

COMMERCIAL RELATIONSHIPS L. Shore-Lesserson: Consultant/Advisory Board, Elcam Medical Inc, Grifols

REGULATORY DISCLOSURE This presentation will address the off-label use of Kcentra, other prothrombin complex concentrates, and Novoseven for use in bleeding during cardiac surgery.

3:20 PM **Discussion**

3:30 PM – 4:15 PM

BREAK—Visit Exhibits and Scientific Posters

Complimentary coffee available in Exhibit Hall

4:15 PM – 5:15 PM ***Ballroom 20D***

Surgical Motion Picture Matinee: Adult Cardiac

Moderators: *TBA*

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Presenting authors are listed in **bold** on each abstract.

The physician competencies addressed in this session are patient care and procedural skills and medical knowledge. These physician competencies will be addressed through a series of surgical videos followed by discussion and questions from the audience.

4:15 PM ***Ballroom 20D***

Advanced Measured Tube Technique for Ensuring the Correct Length of Artificial Chordae in Mitral Valvuloplasty

Y. Matsui*, Y. Naito, Y. Shingu, S. Wakasa, T. Ooka, T. Tachibana*

Hokkaido University Graduate School of Medicine, Sapporo, Japan

Purpose: Mitral valvuloplasty using slippery expanded polytetrafluoroethylene (EPTFE) as artificial chordae is often associated with difficulties in fixing the length of artificial chordae in complex cases. We report a simple technique that enables surgeons to easily determine and fix the correct length of the slippery artificial chordae.

Methods: A 5-0 EPTFE suture was placed into the head of the papillary muscle. The required neo-chord length was determined by measuring the distance between the site of implantation of the artificial chordae on the papillary muscle and a normal valve adjacent to the prolapsing segment or the opposite leaflet as a reference. After marking the 12Fr plastic tube by ink, the tube was cut. Both EPTFE sutures with needles were pulled through the plastic tubes and then passed through the prolapsing leaflet. The suture was tied without the knot slipping. Then the tubes were cut vertically by blunt scissors

Results: This technique was used in 40 patients requiring mitral repair of the broad anterior and posterior leaflet prolapse. Postoperative echocardiography showed no or trivial regurgitation in all cases. Video Case 1: A3 and P2 were prolapsing. Three pairs for A3 and five pairs for P2 neo-chordal repairs were performed. Video Case 2: A case in minimally invasive cardiac surgery.

Conclusions: Our advanced measured tube technique became our standard and is easy to determine the proper length of artificial chordae and to tie the knot accurately without special technique.

4:27 PM ***Ballroom 20D***

Hemi-Commando Procedure With Aortic Valve Homograft: Surgical Technique for Double Valve Endocarditis

J. L. Navia*, G. Olivares*

Cleveland Clinic Foundation, OH

Purpose: Repair of disrupted intervalvular fibrous body (IFB) due to prosthetic valve endocarditis (PVE) is a great challenge to the cardiac surgeon. We describe a surgical technique for reconstruction of the IFB in the setting of double aortic valve (AV) and mitral valve (MV) endocarditis using an aortic valve homograft.

Methods: This is a 64-year-old woman with a previous mechanical AV replacement who presented with shortness of breath, blood culture positive, and congestive heart failure. Echocardiogram showed mobile echo densities attached to aortic prosthesis, large echolucent space around aortic root, involvement of IFB, and MV with moderate mitral regurgitation.

Results: A re-sternotomy was made. The ascending aorta, the superior (SVC) and inferior vena cava (IVC) were cannulated. Antegrade and retrograde blood cardioplegia solution was used. The aorta was transected; the prosthetic AV was removed. The aortic annulus had 2 cm complete circumferential abscess. The SVC and the dome of the left atrium (LA) were opened; the IFB and the MV anterior leaflet were infected. A #26 AV homograft was implanted with a 3-0 Prolene running technique, and the homograft anterior MV leaflet was used to reconstruct the aortic-mitral membrane, and a #27 MV annuloplasty Duran ring. Postoperative echocardiogram showed normal AV homograft function and trivial MV regurgitation.

Conclusions: Radical complete debridement of all infected tissue is the main surgical principle of PVE and aortic root abscess treatment. This occasionally leads to resection of the IFB and consequently disruption of the fibrous skeleton of the heart, that it is successfully repaired with an AV homograft and its anterior MV leaflet.

4:39 PM ***Ballroom 20D***

Endovascular Repair of Ascending Aortic Pseudoaneurysm With Transapical Deployment of Thoracic Aortic Stent Graft

F. H. McCarthy*, P. Vallabhajosyula, J. Gottret, N. Desai, J. E. Bavaria, W. Y. Szeto*

University of Pennsylvania, Philadelphia

COMMERCIAL RELATIONSHIPS N. Desai: Consultant/Advisory Board, St Jude Medical, Inc; Speakers Bureau/Honoraria, Medtronic, Inc, W. L. Gore & Associates, Inc; J. E. Bavaria: Research Grant, W. L. Gore & Associates, Inc; W. Y. Szeto: Research Grant, Edwards Lifesciences Corporation, Medtronic, Inc, SORIN GROUP; Consultant/Advisory Board, Micro Interventional Devices, Inc

REGULATORY DISCLOSURE This presentation will address the Cook TX2 device, which has an FDA status of investigational.

Purpose: This video presents a case involving transapical endovascular repair of a pseudoaneurysm in the ascending aorta with consideration of some specific technical considerations of this novel procedure.

Methods: A 54-year-old man with a previous heart-lung transplant presented with a pseudoaneurysm at the anastomosis of the donor heart and recipient aorta. The patient had a complicated past medical history, including Hodgkin's lymphoma status post-chemotherapy, radiation, pleurodesis, and fibrothorax. The patient eventually decompensated from a cardiopulmonary standpoint requiring combined heart-lung transplantation complicated by ventilator-dependent respiratory failure requiring tracheostomy and a sternal wound infection. The patient had been turned down for open repair of his pseudoaneurysm due to his hostile chest and complicated history. The possibility of an endovascular repair was subsequently considered as the last possible treatment option.

Results: In the hybrid OR and under fluoroscopic guidance, a left-mini thoracotomy was used to access the apex of the left ventricle. A Cook Zenith TX2 thoracic endoprothesis (37 mm x 75 mm) was deployed in the ascending aorta, but a second endoprothesis (40 mm x 75 mm) was required to seal a Type 1 endoleak before achieving a successful repair.

Conclusions: Endovascular repair of an ascending aortic pseudoaneurysm is possible via a transapical approach. There still exists significant need for the development of devices designed for the ascending aorta and possible transapical delivery.

4:51 PM ***Ballroom 20D***

Mitral Valve Replacement for Repair Failure Using a Stentless Mitral Valve Made From Autologous Pericardium

H. Kasegawa, *T. Fukui, K. Naito, A. Shimizu, S. Takanashi*

Sakakibara Heart Institute, Tokyo, Japan

Purpose: To overcome the physiological challenges associated with mitral valve (MV) replacement, we developed a new design for a two-leaflet, stentless MV (called "NORMO") whose excellent function was evaluated using a pulsatile simulator (reported separately). Herein we report a new type of MV replacement procedure using a NORMO valve made from autologous pericardium

Methods: After obtaining IRB approval, a multicenter clinical study was started at six centers in Japan. We report two cases at our institute of patients experiencing severe mitral regurgitation (MR) after MV repair for complicated pathology who underwent this operation. The first case is a 28-year-old female who developed severe MR 15 years after MV repair for congenital MR. The second case is a 43-year-old female who developed dyspnea on exertion 6 years after complex MV repair for advanced rheumatic MR. Both patients requested MV repair instead of MV replacement as they desired to have children.

Results: Autologous pericardium was harvested through a median sternotomy prior to the initiation of cardiopulmonary bypass and formed along a specially designed template for the NORMO valve prior to suturing to the flexible ring (Duran ring). After removing the native mitral valve, each end of the long leaflets of the NORMO valve were connected to the papillary muscles using mattress suture, and the ring of the NORMO valve was fixed to the native mitral annulus using continuous suture. The postoperative course of the two patients was uneventful, and echo Doppler studies of the patients performed 12 months and 27 months after the operations revealed excellent performance of the leaflets with trivial (case 1) and no (case 2) MR.

Conclusions: This operation is useful for patients who desire MV repair, but have experienced a recurrence of MR requiring redo surgery after complicated mitral valve repair.

5:03 PM ***Ballroom 20D***

Repair of Left Ventricular Pseudoaneurysm Following Transapical TAVR

***B. Ramlawi**, O. Aljabbari, W. Abu Saleh, C. Barker, M. Reardon*

Houston Methodist Hospital, TX

Purpose: Pseudoaneurysm formation at the left ventricular (LV) apex is a rare complication following transapical (TA) transcatheter aortic valve replacement (TAVR). Repair of this defect may be performed via open surgical closure or percutaneous closure techniques. Timely strict blood pressure management and surgical correction are essential for good outcomes

Methods: The surgical technique involved cardiopulmonary bypass (CPB) with axillary artery cannulation using an 8 mm Dacron side graft connected to the arterial limb of CPB as well as right femoral venous cannulation. We performed a left thoracotomy using the previous thoracotomy site, which was opened and carried to the ribs. We proceeded to open the incision up to the level of the intercostal space. Exposure was done through a non-rib-spreading thoracotomy.

Results: The pseudoaneurysm sac was opened and hemostasis achieved with manual compression and then by inflating a Foley catheter inserted within the LV cavity. 3-0 prolene was used to oversew the 1 cm LV apical defect. The LV was then pressurized to ensure adequate hemostasis, and BioGlue was placed over the epicardial repair site in the false aneurysm before oversewing the sac. The patient had an uneventful postoperative recovery.

Conclusions: Open primary repair of LV apical pseudoaneurysm following TA-TAVR, using peripheral cardiopulmonary bypass cannulation, Foley-catheter occlusion of defect, followed by primary closure with pledgeted sutures and BioGlue can be performed on a beating heart safely and with good short-term outcomes.

NOTES

4:15 PM – 5:15 PM ***Room 32AB***

Surgical Motion Picture Matinee: Congenital

Moderators: *Andrew C. Fiore, St Louis, MO, and Mark D. Rodefeld, Indianapolis, IN*

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4:15 PM ***Room 32AB***

Modified Nikaidoh Operation in a Newborn With Transposition of Great Arteries With a Ventricular Septal Defect and Pulmonary Stenosis

M. Nosal*, M. Sagat, R. Poruban, P. Valentik*

Children's Heart Centre Slovak Republic, Bratislava, Slovakia

Purpose: In the transposition of great arteries with a ventricular septal defect and pulmonary stenosis (TGA/VSD/PS), the preferred approach to Nikaidoh type correction is initial palliation by systemic to pulmonary shunt, followed by complete correction at the age of 6-12 months. We present a video of a modified Nikaidoh operation in a newborn with TGA/VSD/PS.

Methods: A 3.2 kg newborn with TGA/VSD/PS was referred for surgery due to cyanosis caused by narrowing of the left ventricular outflow tract to 2.5 mm (gradient 50 mm Hg). On bypass, both proximal coronary arteries were mobilized from the epicardium. On beating heart, the aortic root was harvested from the right ventricle. On cross clamp, the pulmonary trunk, the annulus, and the outlet septum were divided. The aortic root was reimplanted into the opened pulmonary annulus. The ventricular septal defect was closed by a Dacron patch. The ascending aorta was shortened and the Le Compte maneuver was performed. The right ventricular outflow was reconstructed by a pericardial patch, to which the pulmonary trunk was directly anastomosed.

Results: The patient was weaned from bypass and the chest was left open. The bypass and cross clamp times were 206 minutes and 106 minutes, respectively. The chest was closed on the third postoperative day. The patient was extubated on 14th postoperative day following left diaphragm plication. The patient was discharged home on 40th postoperative day with free outflow from the left and right ventricle and a trace aortic insufficiency.

Conclusions: An excellent functional result can be achieved by a modified Nikaidoh operation in a symptomatic neonate with the transposition of great arteries with a ventricular septal defect and pulmonary stenosis.

4:27 PM **Room 32AB**

Complete Neonatal Repair of a Patient With Truncus Arteriosus, Left Pulmonary Artery Sling, and Long Segment Tracheal Stenosis

P. V. Anagnostopoulos, *E. C. Kenny, A. Peterson, S. Hagen, J. McMurray*

University of Wisconsin Hospitals and Clinics, Madison

COMMERCIAL RELATIONSHIPS S. Hagen: Ownership Interest, Johnson & Johnson

Purpose: This video demonstrates complete neonatal repair in a patient with multiple congenital anomalies, heterotaxy syndrome, truncus arteriosus with long segment tracheal stenosis, and a left pulmonary artery (LPA) sling.

Methods: The key steps of the complete neonatal repair are reviewed: tracheal stenosis was repaired on bypass using a slide tracheoplasty with running 7-0 PDS suture. The LPA sling was an intraoperative finding and was corrected with anterior translocation of the pulmonary artery and mobilization. Then the truncus was repaired with standard transventricular ventricular septal defect (VSD) closure with a patch and right ventricle (RV) to pulmonary artery continuity was restored with the use of a 10 mm pulmonary homograft.

Results: Intraoperative echocardiography showed good ventricular function, no residual VSD, trivial aortic and tricuspid valve insufficiency, less than half systemic RV pressures, and a well-functioning homograft with good antegrade flow in both branch pulmonary arteries. Bronchoscopy revealed widely patent tracheal reconstruction without residual narrowing.

Conclusions: Complete repair of complex neonatal cardiac lesions associated with critical tracheal stenosis is feasible and should be the surgical strategy of choice in these complex patients.

4:39 PM **Room 32AB**

Right Ventricular Overhaul Operation in Patient With Pulmonary Atresia/Intact Ventricular Septum: Successful Biventricular Conversion After One-and-a-Half Repair Operation

N. Ota[1], *S. Sivalingam*[1], *S. Sano*[2], *M. Yakub*[1]

[1]*National Heart Institute, Kuala Lumpur, Malaysia,* [2]*Okayama University Graduate School of Medicine and Dentistry, Japan*

Purpose: Pulmonary atresia with an intact ventricular septum (PA/IVS) is still one of the most difficult congenital cardiac defects to treat. The biventricular repair in patients with borderline right ventricle (RV) remains challenging. Right ventricular overhaul operation is one of the effective strategies in this group of patients with borderline RV morphology.

Methods: A 1 year, 8 months old infant weighing 9.6 kg underwent a right ventricular overhaul operation following bidirectional Glenn shunt operation. We performed right ventriculotomy, transatrial and transpulmonary resection of hypertrophied infundibular muscle, and adjustment of tricuspid valve orifice (bicuspid). The atrial septal defect was closed completely and a right ventricular outflow tract reconstruction with mono-cusp polytetrafluoroethylene patch was accomplished.

Results: The postoperative course was uneventful. Patient was discharged home on the 33rd postoperative day with excellent postoperative results under the one-and-a-half repair condition. At 8 months after the overhaul operation, angiography showed an increased RV volume. Echocardiography showed an increased tricuspid annular diameter (62.5% vs 95.6%). These data indicated that biventricular repair was feasible. Subsequently, we performed a takedown of Glenn shunt whereby we effectively converted the one-and-a-half repair to the biventricular repair, following tricuspid valve repair and pulmonary artery conduit exchange operation.

Conclusions: Adequate right ventricular decompression with RV overhaul may allow right ventricular growth by increasing antegrade blood flow through the tricuspid valve. The multistage palliative procedure, including RV overhaul operation, makes a definitive biventricular repair of pulmonary atresia with intact ventricular septum.

4:51 PM **Room 32AB**

Robot-Assisted Transitional Atrioventricular Canal Defect Repair and Maze Procedure via Left Atrial Approach

K. Mandal[1], A. Srivastava[2], L. W. Nifong[3], W. Chitwood[2]

[1]The Johns Hopkins University School of Medicine, Baltimore, MD, [2]East Carolina Heart Institute, Greenville, NC, [3]Brody School of Medicine at East Carolina University, Greenville, NC

COMMERCIAL RELATIONSHIPS W. Chitwood: Speakers Bureau/Honoraria, Intuitive Surgical, Inc; L. W. Nifong: Speakers Bureau/Honoraria, Intuitive Surgical, Inc; K. Mandal: Research Grant, ORNIM

Purpose: Minimally invasive atrial septal defect (ASD) repair is increasingly being performed; however, most of the published cases are secundum ASDs. To date, ASD variants, such as transitional atrioventricular canal defect (ostium primum), have mostly been repaired by open sternotomy and right atrial approach. We present an adult congenital patient who underwent robotically assisted transitional atrioventricular canal defect repair and Maze procedure via left atrial approach.

Methods: A 43-year-old female was referred for evaluation of progressively worsening shortness of breath. She had been noted to have a heart murmur and also had a history of paroxysmal atrial fibrillation. She was a current smoker. Transesophageal echocardiogram showed dilated right and left atria, a 2.7 cm defect at the lower interatrial septum, severe left atrioventricular (AV) valve insufficiency, and a cleft mitral valve. The right atrioventricular valve (RAVV) also had moderate insufficiency. The ejection fraction was 55% with preserved left ventricular and right ventricular function. She underwent robotically assisted repair of her transitional AV canal defect and Maze procedure as detailed in the surgical video.

Results: She had a successful repair of the transitional AV canal defect, was restored to sinus rhythm, and was discharged on postoperative day 4. She had resumed full normal activities by the third postoperative week.

Conclusions: Robotically assisted minimally invasive repair strategies can be safely employed for repair of carefully selected adult congenital patients. To our knowledge, this is the first reported case in the English literature of a transitional AV canal defect repair with concomitant Maze procedure performed using robotic assistance via a left atrial approach.

5:03 PM **Room 32AB**

Partial Sternectomy to Avoid Compression of Right Ventricle to Pulmonary Artery Conduit in the Adult Patients With Transposition of Great Arteries With Ventricular Septal Defect and Pulmonary Stenosis

J. Kwak[1], *C. Lee*[2]

[1]*Sejong General Hospital, Seoul, Republic of Korea,* [2]*Sejong General Hospital, Bucheon, Republic of Korea*

Purpose: We performed partial sternectomy to avoid compression of right ventricle (RV) to pulmonary artery (PA) conduit by sternum in a 30-year-old obese patient with d-transposition of great arteries (TGA) with ventricular septal defect (VSD) and pulmonary stenosis (PS) who had underwent Rastelli operation and VSD closure at 9 years old.

Methods: His previous Rastelli conduit was severely adherent to sternum and compressed by it, and that resulted in severe pressure gradient through the conduit around 70 mm Hg. We replaced his previous mechanical valve (23 mm) with a bioprosthetic valve (27 mm) and widened the anterior portion of the previous conduit with a polytetrafluoroethylene graft patch. Then we partially resected the left side of the upper sternum, which was expected to compress the RV-PA conduit again, and covered the conduit with a polytetrafluoroethylene patch.

Results: Postoperative computed tomography showed intact conduit contour, and 25 mm Hg of pressure gradient was measured through a newly reconstructed conduit on echocardiography. Even though the patient complained of severe wound pain and suffered from fluid collection around the conduit (which required a surgical exploration in the immediate postoperative period), he is in tolerable status after discharge. Because of his obesity, his anterior chest wall looks fine.

Conclusions: Rastelli operation is one of the surgical options to treat patients with d-TGA with VSD and PS; however, we always consider the possibility for compression of Rastelli conduit by sternum. This is the reason why we should consider aortic root translocation procedure as another option in this patient group.

NOTES

4:15 PM – 5:15 PM ***Room 31ABC***

Surgical Motion Picture Matinee: General Thoracic

Moderators: *Moishe A. Liberman, Montreal, Canada, and Betty C. Tong, Durham, NC*

COMMERCIAL RELATIONSHIPS M. A. Liberman: Research Grant, Ethicon Endo-Surgery, Inc; B. C. Tong: Consultant/Advisory Board, W. L. Gore & Associates, Inc

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

Presenting authors are listed in **bold** on each abstract.

The physician competencies addressed in this session are patient care and procedural skills and medical knowledge. These physician competencies will be addressed through a series of surgical videos followed by discussion and questions from the audience.

4:15 PM ***Room 31ABC***

Use of Forced Sternal Elevation in Adult Minimally Invasive Pectus Excavatum Repair

D. E. Jaroszewski[1], *J. Lackey*[1], *L. McMahon*[3], *D. Notrica*[2]

[1]*Mayo Clinic, Phoenix, AZ,* [2]*Phoenix Children's Hospital, AZ,* [3]*Pediatric Surgeons of Phoenix, AZ*

COMMERCIAL RELATIONSHIPS D. E. Jaroszewski: Consultant/Advisory Board, BioMet Inc; Research Grant, I-Flow, LLC

Purpose: The use of minimally invasive techniques to repair adult pectus excavatum patients has been limited by increased chest wall rigidity. Rotation of the bars for chest elevation requires more force and intercostal muscle stripping may occur. A repair technique utilizing forced sternal elevation is presented for facilitation of adult repairs.

Methods: A video is presented demonstrating a surgical technique that utilizes forced sternal elevation for the minimally invasive thoracoscopic repair of a severe adult pectus excavatum deformity. In order to facilitate adult pectus repair, a bone clamp is placed into the sternum and attached to a table-mounted retractor. The sternum is then forcefully elevated, improving visualization across the mediastinum while reducing the force required for bar placement. A thoracoscopic minimally invasive repair of pectus excavatum is completed with placement and securing of substernal metal support bars.

Results: With the patient in a supine position, bilateral subpectoral pockets are developed. Puncture incisions are made and the perforating tips of the bone clamp inserted into the sternum. The table-mounted retractor is then attached to the clamp and sternum elevated. Thoracoscopic dissection across the mediastinum is performed. The Lorenz dissector is then utilized to guide a #5 FiberWire® into the corresponding intercostal spaces adjacent to the defect. Pectus support bars are guided into position and rotated into place with the sternum still elevated to minimize transverse stripping of intercostal muscle. Bars are circumferentially attached to ribs at multiple sites with FiberWire®. The sternal elevation is released and clamp removed. The pectoralis muscles are closed over the bars and incisions closed with absorbable suture. Two single skin stitches are placed at the sternal punctures.

Conclusions: We present a simple technique of forced sternal elevation, which provides increased visualization and reduces stress on intercostal spaces during bar insertion and rotation. We believe this technique can be successfully utilized for adult minimally invasive pectus excavatum repair.

4:27 PM **Room 31ABC**

Successful Treatment of Recurrent Catamenial Pneumothorax With a Combined Laparoscopic and Video-Assisted Thoracoscopic (VATS) Approach

M. J. Magee[1], *R. Aronoff*[2]

[1]*HCA North Texas Division, Dallas,* [2]*Medical City Dallas Hospital, TX*

Purpose: Spontaneous pneumothorax in young adults is most often due to rupture of subpleural blebs. In contemporary practice, recurrent spontaneous pneumothorax is effectively managed by video-assisted thoracoscopic (VATS) resection of identified blebs and, perhaps more importantly, an effective mechanical pleurodesis. A less common, underappreciated etiology of pneumothorax in women is catamenial pneumothorax. The pathophysiology of catamenial pneumothorax requires an alternative treatment strategy for a successful outcome.

Methods: A 39-year-old woman presented with her third recurrent pneumothorax and had a right VATS apical bleb resection and pleurectomy. Catamenial pneumothorax was considered and she was placed on oral suppressive hormone therapy. She returned 4 months later with another large right pneumothorax. Due to suspected peritoneal endometriosis, fenestrations of the tendinous diaphragm, as well as inadequate pleurodesis, a combined thoracoscopic and laparoscopic approach was planned.

Results: In a partial lateral position, ports were placed in the abdomen and right hemithorax and both cavities simultaneously explored. Extensive fenestrations in the diaphragm were closed primarily from the chest and reinforced from the abdomen with a prosthetic patch. Subpleural blebs were resected and peritoneal endometriosis was treated. Her postoperative course was uneventful and she has not had a recurrence in 4 years. One year later, she had laparoscopy for symptoms of suspected recurrent endometriosis and an intact diaphragm repair was noted.

Conclusions: Catamenial pneumothorax should be considered as a possible cause of recurrent pneumothorax, particularly in young women who have failed conventional surgical treatment. When confirmed at the time of initial exploration, an alternative surgical approach that adequately corrects the pathology and thereby maximizes the chance of surgical success should be considered.

4:39 PM **Room 31ABC**

Single-Port Thymectomy Using a Subxiphoid Approach

***T. Suda**, D. Tochii, S. Ashikari, S. Tochii, Y. Takagi*

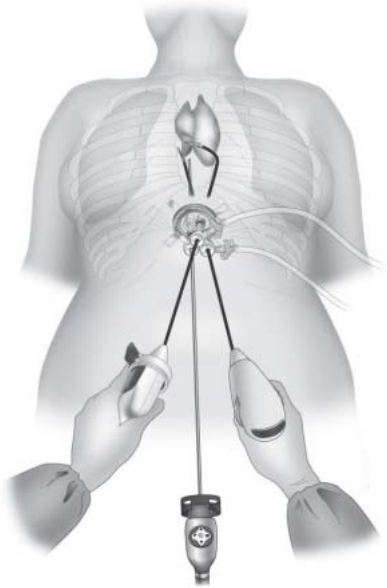
Fujita Health University, Toyoake, Japan

Purpose: With the advances made in endoscopic techniques and devices, endoscopic procedures are now being performed in a variety of surgeries. In a previous study, we reported the application of single-port thymectomy through an infrasternal approach. Here, we show the surgical technique of single-port thymectomy.

Methods: The patient was placed in a supine position with legs spread. First, a 3 cm transverse incision was made below the xiphoid process. The reverse side of the sternum was blindly dissected with a finger. A port was then inserted into the wound below the xiphoid process, and CO2 was insufflated at a pressure not to exceed 8 mm Hg. CO2 insufflation within the mediastinum gently shoved the lungs laterally and widened the space behind the sternum, markedly improving the surgical field. The thymus, thymic tumor, and surrounding fatty tissue anterior to the phrenic nerves were resected en bloc.

Results: We first performed this operation in March 2011 and to date, have performed it in 36 patients. The mean age was 54.7 years old. There were 15 women and 21 men. Nine patients had myasthenia gravis. The mean operative time was 150.3 minutes. The mean operative blood loss was 2.9 g. One patient had atrial fibrillation and one patient had phrenic nerve paralysis after operation. The mean length of stay was 4.5 days.

Conclusions: Since this single-port thymectomy procedure can be performed through a single 3 cm incision in the abdominal region, it is esthetically excellent and is among the least invasive thymectomy procedures because no sternal incision is applied and no intercostal nerve is injured.



4:51 PM ***Room 31ABC***

Laparoscopic Resection of a Giant Epiphrenic Diverticulum

A. Ashfaq[1], *K. Harold*[2], *D. E. Jaroszewski*[1]

[1]*Mayo Clinic, Phoenix, AZ,* [2]*Mayo Clinic, Scottsdale, AZ*

COMMERCIAL RELATIONSHIPS D. E. Jaroszewski: Consultant/Advisory Board, BioMet Inc; Research Grant, I-Flow, LLC

Purpose: Minimally invasive surgery has become more frequent for the resection of esophageal lesions. We report our surgical technique in the resection of a giant 10 cm epiphrenic diverticulum.

Methods: The gastrohepatic ligament was divided, exposing the right crus. Blunt dissection separated the esophagus and the surrounding fatty tissue from the right crus. The phrenoesophageal ligament was divided. Both the anterior and posterior vagus nerves were preserved. The fundus was mobilized by dividing the short gastric vessels. With gentle traction, we were able to identify the inferior border of the large diverticulum coming off the right side of the esophagus. It was then pulled laterally to identify the neck coming off the right side of the esophagus, which was approximately 3.5 cm, and transected using the Endo GIA with excellent closure and hemostasis.

Results: A solution of 1:100,000 of 5 mL of epinephrine was then injected into the muscular plane of the esophagus for hemostasis. Hook cautery on a low wattage was then used to perform a myotomy, extending approximately 10 cm up the esophagus and ensuring that it went above the staple line. We then proceeded down onto the stomach for approximately 3 to 4 cm. Intraoperative esophagogastricduodenoscopy was undertaken. The staple line was inspected, and there was no evidence of any leakage from the staple line. The crus was brought together with two interrupted 0 Ethibond sutures, and the fundus was brought behind the esophagus and interrupted sutures used to perform a Toupet fundoplication, securing the fundus to the cut edge of the esophageal musculature. The 10 and 12 mm trocar sites were then closed with figure-of-eight 0 Ethibond sutures using a suture passer. All trocars were removed under direct visualization.

Conclusions: Giant epiphrenic diverticuli are rare. However, minimally invasive resection, albeit challenging, can be safely achieved in the hands of experienced surgeons.

5:03 PM ***Room 31ABC***

Pressurized Cadaver Model in Cardiothoracic Surgical Simulation

C. L. Greene*, M. Minneti, M. Sullivan, C. Baker*

Keck School of Medicine of the University of Southern California, Los Angeles

Purpose: Simulation is increasingly recognized as an integral aspect of thoracic surgery education. However, no good models exist for numerous essential skills, including internal mammary artery (IMA) takedown. The aim of this study is to describe the technique of the pressurized cadaver for use in cardiothoracic surgical procedures focusing on IMA takedown.

Methods: Essential cardiothoracic surgical skills, like redo sternotomy and IMA takedown, are often relegated to thoracic surgery residents but have significant negative implications if performed incorrectly. Fresh tissue dissection is recognized as the gold standard for surgical simulation, but the lack of circulating blood volume limits surgical realism. The pressurized cadaver was developed to address this educational gap.

Results: There are four steps to pressurizing a cadaver. The common femoral artery is exposed using a standard technique and sized for cannulation with a 1/4" Sims connector. The cadaver is lavaged with water and repeated as necessary until all clots are removed from the arterial system. The lines are attached to the centrifugal pump and the flow is titrated to maintain the desired arterial pressure. Once the cadaver is pressurized, operations, such as median sternotomy and IMA takedown, can be simulated. The pressurized cadaver model is a high-fidelity training model for IMA takedown. Pressurized flow from bleeding vessels enhances the realism of this simulation modality.

Conclusions: Simulation with the described pressurized cadaver model has high fidelity for essential cardiothoracic procedures, including IMA takedown. This model offers the most real-life simulation for basic cardiothoracic skills and has great promise in educating young learners in advanced surgical techniques without compromising patient safety.

4:15 PM – 5:15 PM ***Room 30CD***

Late-Breaking Abstract Session: Adult Cardiac

The physician competencies addressed in this session are patient care and medical knowledge. These physician competencies will be addressed through a series of individual lectures and a brief question-and-answer session after each topic.

To view the late-breaking abstracts presented at the STS 51st Annual Meeting, please see the booklet in your meeting bag or visit www.sts.org/annualmeeting.

5:00 PM – 6:30 PM ***Ballroom 20D Foyer***

Scientific Posters and Wine

5:30 PM – 6:30 PM ***Ballroom 20D***

Business Meeting (STS Members Only)

6:45 PM – 7:45 PM

STS-PAC Reception

Join us for a special reception in support of STS-PAC, the only political action committee representing the interests of cardiothoracic surgery. The reception will be held in the Presidio Room at the San Diego Marriott Marquis. Come learn about how STS-PAC is helping to support STS advocacy in Washington, DC. This event is open to US members of STS who contribute to STS-PAC in 2015. Contributions will be accepted at the door.

7:00 PM – 10:00 PM

STS Social Event: USS Midway Aircraft Carrier Museum

Join us aboard a piece of American history— the USS Midway—for an evening of dancing, food, and cocktails. Mingle with colleagues on the flight deck while admiring a 360-degree view of San Diego's sparkling skyline, Coronado Island, and San Diego Bay's bridge. Browse meticulously restored airplanes and helicopters while savoring a renewed appreciation for courage, freedom, and service to the United States. It will be a night to remember as the evening ends with a breathtaking fireworks show over the bay.

Photo courtesy of the USS Midway Museum.

TUESDAY AT A GLANCE

6AM

7AM

6:30 AM – 4:30 PM
Registration: STS 51st Annual Meeting

8AM

7:30 AM – 8:30 AM
Early Riser Sessions

7:30 AM – 8:30 AM
Early Riser Health Policy Forum: The End of Global Surgical Payments Under Medicare?

9AM

9:00 AM – 3:00 PM
Exhibits Open

9:00 AM – 5:00 PM
Scientific Posters Open

9:00 AM – 10:00 AM
Thomas B. Ferguson Lecture: Pedro J. del Nido

10AM

10:45 AM – 11:00 AM
Award Presentations

11AM

11:00 AM – 12:00 PM
C. Walton Lillehei Lecture: Patrick T. O'Gara

12PM

12:00 PM – 1:00 PM
Ethics Debate: Must Surgeons in Training Programs Allow Residents to Operate on Their Patients to Satisfy Board Requirements?

12:00 PM – 1:00 PM
Residents Luncheon (CME)

1PM

1:00 PM – 3:00 PM

- Adult Cardiac Session: General I
- Adult Cardiac Session: Mitral Valve
- Congenital Session: Pediatric Congenital II
- General Thoracic Session: Esophageal
- General Thoracic Session: Lung Cancer II
- Patient Safety Symposium: Building a High-Performance Team for Patient Safety
- STS/EACTS: Management of the Aortic Arch in Aortic Dissection
- Strategies to Improve Outcomes With Long-Term Mechanical Circulatory Support Devices

2PM

3PM

1:00 PM – 5:00 PM
JCTSE/STS Workforce on International Relationships

3:30 PM – 5:30 PM

- Adult Cardiac Session: Aortic Valve
- Adult Cardiac Session: General II
- Cardiothoracic Surgical Education
- Congenital Session: Pediatric Congenital III
- ESTS @ STS: Controversial Issues in General Thoracic Surgery—Perspectives From Europe and North America
- General Thoracic Session: Mediastinal/Pulmonary
- Role of SBRT in Lung Cancer Treatment

4PM

5PM

SVS @ STS

6PM

7PM

8PM

9PM

New Non-CME Session

6:30 AM – 4:30 PM
Registration: STS 51st Annual Meeting

7:30 AM – 8:30 AM
Early Riser Sessions
Early Riser Health Policy Forum: The End of Global Surgical Payments Under Medicare?

9:00 AM – 10:00 AM
Thomas B. Ferguson Lecture: Pedro J. del Nido

9:00 AM – 3:00 PM
Exhibits Open

9:00 AM – 5:00 PM
Scientific Posters Open

10:45 AM – 11:00 AM
Award Presentations

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C. Walton Lillehei Lecture: Patrick T. O'Gara

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Ethics Debate: Must Surgeons in Training Programs Allow Residents to Operate on Their Patients to Satisfy Board Requirements?
Residents Luncheon

1:00 PM – 3:00 PM
Adult Cardiac Session: General I
Adult Cardiac Session: Mitral Valve
Congenital Session: Pediatric Congenital II
General Thoracic Session: Esophageal
General Thoracic Session: Lung Cancer II
Patient Safety Symposium: Building a High-Performance Team for Patient Safety
STS/EACTS: Management of the Aortic Arch in Aortic Dissection
Strategies to Improve Outcomes With Long-Term Mechanical Circulatory Support Devices

1:00 PM – 5:00 PM
JCTSE/STS Workforce on International Relationships: Globalization of Graduate Surgical Education in Cardiothoracic Surgery

3:30 PM – 5:30 PM
Adult Cardiac Session: Aortic Valve
Adult Cardiac Session: General II
Cardiothoracic Surgical Education
Congenital Session: Pediatric Congenital III
ESTS @ STS: Controversial Issues in General Thoracic Surgery—Perspectives From Europe and North America
General Thoracic Session: Mediastinal/Pulmonary
Role of SBRT in Lung Cancer Treatment
SVS @ STS

6:30 AM – 4:30 PM ***Lobby D***

Registration: STS 51st Annual Meeting

7:30 AM – 8:30 AM ***Various locations; see below***

Early Riser Sessions

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

The physician competencies addressed in these sessions are patient care and procedural skills, medical knowledge, practice-based learning and improvement, professionalism, and systems-based practice. These physician competencies will be addressed through a conversational lecture on the specific course topic.

Early Riser Session 1 *Room 25C*

Women in Thoracic Surgery—Practice Management

Robert S. D. Higgins, Columbus, OH, Susan D. Moffatt-Bruce, Columbus, OH, Peter K. Smith, Durham, NC, Richard I. Whyte, Boston, MA, and Valerie A. Williams, Cincinnati, OH

Practice management is now more important than ever. Economic pressures, health care redesign, and the political uncertainty around the Affordable Care Act have catapulted practice management to the forefront. The speakers will briefly discuss negotiating, practice growth, and coding and billing. Participants will be armed with valuable information that will foster additional thoughts on outlining a strategy to effectively manage their practice.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Explain how to frame a negotiation and the importance of negotiating from all perspectives
- Describe the concept of "BATNA" (best alternative to a negotiated agreement)
- Identify practice growth strategies
- Explain the physician fee-for-service schedule and its components
- Recognize the current and future importance of evaluation and management services for surgeons

Early Riser Session 2 *Room 26A*

Maintaining Quality Outcomes in Low-Volume Cardiac Surgery Programs: The Dilemma Facing US Government-Managed Hospitals

B. Zane Atkins, Sacramento, CA, William P. Gunnar, Washington, DC, and Theodore C. Koutlas, Coeur d'Alene, ID

This session will examine challenges faced by low-case-volume cardiac surgery programs in US military and Veterans Administration (VA) medical centers, especially in the context of the recent scandal regarding quality and access of care within the VA hospital system. The session will further touch upon the longstanding debate regarding the possible relationship between quality parameters, such as operative mortality, and volume of cases handled within a cardiac surgery program. Program speakers will also address the challenges and opportunities for the US Government-managed health system within the new era of the Affordable Care Act. Finally, the session will examine issues surrounding cardiothoracic surgery resident training within these institutions.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Discuss the challenges faced by cardiac surgeons practicing in low-volume centers at US military and VA medical centers
- Explain the debate regarding the potential link between operative mortality and volume of cases handled within a cardiac surgery program, and discuss quality measures used to evaluate a cardiac surgery program other than operative mortality
- Discuss the Veterans Health Administration's dilemma of providing far-reaching access to health care for US veterans, while preserving the highest quality of care
- Identify some of the advantages and disadvantages of a health services system administered by the US Government, especially in the new era of the Affordable Care Act
- Explain the issues surrounding cardiothoracic surgery resident training within these low-volume cardiac surgery programs

Early Riser Session 3

Room 29C

Ask the Experts—Esophageal Benign Disease

Shanda H. Blackmon, Rochester, MN, Christine L. Lau, Charlottesville, VA, and M. Blair Marshall, Washington, DC

COMMERCIAL RELATIONSHIPS M. B. Marshall: Consultant/Advisory Board, Ethicon, Inc

The session is designed to cover benign disease of the esophagus, reviewing evaluation, surgical approaches, and surgical videos of minimally invasive techniques. The learner will be exposed to various diseases, which include, but are not limited to, diverticular disease, motility diseases, foregut cysts, and perforations. The approaches will cover standard open techniques, as well as laparoscopic, thoracoscopic, and robotic approaches. Attendees will receive a video of many techniques used in the session.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Describe the standard approaches to evaluating a patient with benign esophageal disease
- Describe the operative options when surgically correcting or treating patients with various esophageal disorders
- Recognize pitfalls in certain techniques and approaches

Early Riser Session 4

Room 28B

Clinical Trials in General Thoracic Surgery

Gail E. Darling, Toronto, Canada, Linda W. Martin, Baltimore, MD, and Dennis A. Wigle, Rochester, MN

COMMERCIAL RELATIONSHIPS L. W. Martin: Consultant/Advisory Board, AtheroMed, Inc, spouse is a consultant, Boston Scientific, spouse is a consultant, Abbott, spouse is a consultant, St Jude Medical, Inc, spouse is a consultant

Clinical trials in thoracic surgical oncology form the basis for how we treat patients with thoracic malignancies. Thoracic surgeon engagement, participation, and patient enrollment are critical elements to successful studies. We will review currently accruing and pending studies relevant to thoracic surgeons.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Explain accruing and pending studies in thoracic surgical oncology
- Discuss knowledge gaps in clinical trial evidence
- Identify ongoing studies for participation

Early Riser Session 5

Room 29AB

Ask the Experts—Pulmonary Regurgitation With Tetralogy of Fallot

James A. Quintessenza, St Petersburg, FL, and James S. Tweddell, Milwaukee, WI

COMMERCIAL RELATIONSHIPS J. A. Quintessenza: Ownership Interest, Genesse BioMedical, Inc; J. S. Tweddell: Consultant/Advisory Board, CorMatrix

An expert panel will discuss issues surrounding pulmonary insufficiency in Tetralogy of Fallot (TOF), including the problem's scope, indications for surgery, and options for surgical interventions in patients ranging from newborns through adults. Short talks with diagrams/videos of surgical techniques will be used. Ample time for discussion with the experts will be available.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Recognize the importance of acute and chronic pulmonary insufficiency in TOF
- Identify the surgical options for valve preservation and repair in the neonate/infant with TOF
- Discuss the various surgical prosthetic options, relevant surgical techniques, and long-term outcomes for the older patient

Early Riser Session 6

Room 33ABC

Ask the Experts—Controversies in Mitral Valve and Atrial Fibrillation Surgery

Niv Ad, Falls Church, VA, Anelechi C. Anyanwu, New York, NY, Vinay Badhwar, Pittsburgh, PA, Steven F. Bolling, Ann Arbor, MI, Lawrence H. Cohn, Boston, MA, James L. Cox, Denver, CO, James S. Gammie, Baltimore, MD, A. Marc Gillinov, Cleveland, OH, Patrick M. McCarthy, Chicago, IL, J. Scott Rankin, Nashville, TN, and Rakesh M. Suri, Rochester, MN

COMMERCIAL RELATIONSHIPS N. Ad: Speakers Bureau/Honoraria, AtriCure, Inc, Medtronic, Inc; Consultant/Advisory Board, AtriCure, Inc, Medtronic, Inc; J. L. Cox: Consultant/Advisory Board, AtriCure, Inc; J. S. Gammie: Ownership Interest, Correx, Inc, Harpoon Medical, Inc; J. S. Rankin: Ownership Interest, BioStable Science and Engineering, Inc; R. M. Suri: Research Grant, SORIN GROUP, Edwards Lifesciences Corporation, Abbott, St Jude Medical, Inc, Medtronic, Inc; Other, Abbott, Member of the Clinical Steering Committee, St Jude Medical, Inc, Member of the Clinical Steering Committee; A. M. Gillinov: Speakers Bureau/Honoraria, AtriCure, Inc, Edwards Lifesciences Corporation, Medtronic, Inc; Consultant/Advisory Board, Abbott Vascular, On-X Life Technologies, Inc, Tendyne Holdings, Inc

Several controversies exist in mitral valve repair, including handling complex bileaflet disease, minimally invasive and robotic approaches, ischemic restrictive disease, and rheumatic pathology. Atrial fibrillation controversies extend to case selection associated with cardiac concomitant complications, lone atrial fibrillation, and lesion sets. The objective of this session is to review these latest controversies and openly debate them with esteemed faculty and audience input.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Review pathology-directed strategies in complex degenerative and restrictive mitral valve disease
- Identify technique options and case selection for minimally invasive and robotic mitral surgery
- Identify techniques and lesion sets used for surgical ablation of atrial fibrillation

Early Riser Session 7

Room 30CD

Early Career—First 5 Years in Practice

Gorav Ailawadi, Charlottesville, VA, Ahmet Kilic, Columbus, OH, and John R. Mehall, Colorado Springs, CO

COMMERCIAL RELATIONSHIPS G. Ailawadi: Consultant/Advisory Board, Abbott, Edwards Lifesciences Corporation, Mitralign; Speakers Bureau/Honoraria, St Jude Medical, Inc; J. R. Mehall: Consultant/Advisory Board, Edwards Lifesciences Corporation

The first few years after training are critical and formative to developing a cardiothoracic surgery practice. From private practice to academic settings, a number of pathways to success exist. Junior surgeons are faced with competition, case complexity, and demands for excellent outcomes. This session will focus on finding a niche, developing relationships with referring doctors, and building a successful clinical practice.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Identify the importance of building personal relationships with patients, families, and referring doctors
- Identify different options for developing a clinical niche and leverage a research niche to help grow the practice
- Recognize that outcomes are of utmost importance and when to not take on challenging cases

Early Riser Session 8 *Room 32AB*

Transitions in Your Career—From Clinician to Administrator

Paul J. Corso, Washington, DC, W. Randolph Chitwood Jr, Greenville, NC, and Alan M. Speir, Falls Church, VA

COMMERCIAL RELATIONSHIPS W. Chitwood: Speakers Bureau/Honoraria, Intuitive Surgical, Inc; A. M. Speir: Consultant/Advisory Board, Medtronic, Inc

An unintended consequence of the Affordable Care Act has been the disruption of both the administration and delivery of health care. Practices and health systems have been uniformly affected as the uncertainty and confusion over coverage and reimbursement have grown. Cardiothoracic surgeons, as a result of their experience with clinical outcomes in the STS National Database and focus on cost containment, are in a unique position to guide and govern their institutions through these challenging times in health care delivery.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Identify additional training or credentials that might be necessary in order to transition from a clinical to administrative role
- Recognize process strategies to accomplish such a career alternative
- Learn to anticipate and circumvent the barriers that exist to obstruct such a career change
- Recognize the resources that may aid in the career transition

Early Riser Session 9

Room 30AB

Impact of a Functional Heart Team on Prevention and Management of TAVR Complications—A Case-Based Discussion

Richard W. Smalling, Houston, TX, Wilson Y. Szeto, Philadelphia, PA, Vinod H. Thourani, Atlanta, GA, and E. Murat Tuzcu, Cleveland, OH

COMMERCIAL RELATIONSHIPS R. W. Smalling: Research Grant, Abbott Vascular; W. Y. Szeto: Research Grant, Edwards Lifesciences Corporation, Medtronic, Inc, SORIN GROUP; Consultant/Advisory Board, Micro Interventional Devices, Inc; V. H. Thourani: Research Grant, Edwards Lifesciences Corporation, Medtronic, Inc, SORIN GROUP; Consultant/Advisory Board, Boston Scientific, St Jude Medical, Inc; Ownership Interest, Apica Cardiovascular

In the modern era, patients undergoing cardiac surgery have a choice in endovascular or open traditional surgical therapies. In addition to transcatheter aortic valve replacement (TAVR), which is utilized in patients with severe aortic stenosis, endovascular technology for mitral and aortic disease is becoming more common ground. To accommodate this new technology, practicing cardiac surgeons, as a part of a heart team, will be required to integrate changes in their practice, including the infrastructure for patient evaluation, procedural success, and postoperative long-term follow-up. One of the most important aspects of this changing field is the decision for endovascular vs open surgical techniques. Using case-based scenarios, this session will help attendees further appreciate tips and tricks required for mitigating and managing complications associated with endovascular structural heart techniques. Speakers are experts in the use of the hybrid team for optimal patient care.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Evaluate the components required for mitigating complications with TAVR
- Evaluate the steps required to mitigate complications with endovascular mitral valve repair
- Evaluate the components required to mitigate complications associated with endovascular aortic repair

Early Riser Session 10

Room 29D

Charitable Surgical Missions—How to Set Them Up and Things to Avoid

R. Morton Bolman III, Boston, MA, Joseph A. Dearani, Rochester, MN, Jeffrey P. Jacobs, St Petersburg, FL, William M. Novick, Memphis, TN, Luca A. Vricella, Baltimore, MD, and Samuel Weinstein, New York, NY

COMMERCIAL RELATIONSHIPS W. M. Novick: Employment, International Children's Heart Foundation (ICHF), Serve as the Medical Director of the ICHF as a salaried employee; Research Grant, CorMatrix; Other Research Support, Medtronic, Inc, W. L. Gore & Associates, Inc, Scanlan International, Terumo Medical Corporation

This session will review the basic strategies required to set up a charitable surgical mission. Key structural and process elements necessary to create and sustain a successful charitable surgical mission will be discussed. Potential pitfalls and problems will be considered.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Organize a charitable surgical mission
- Describe the key components necessary to organize a charitable surgical mission
- Recognize the needs assessment necessary to create a charitable surgical mission
- Operationalize the concept of "twinning"

Early Riser Session 11

Room 28A

Coding and Billing in the ICU as a CT Surgeon

Julie R. Painter, Denver, CO, and Jay G. Shake, Temple, TX

COMMERCIAL RELATIONSHIPS J. R. Painter: Ownership Interest, Physician Reimbursement Systems, Inc

This course will provide attendees with the framework to appropriately code and bill for critical care and subsequent care in the cardiothoracic intensive care unit.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Explain current coding systems and outline the appropriate documentation for coding
- Review critical care coding
- Explain coding for physicians in training and non-physician providers
- Identify non-critical care codes
- Identify the utility of extracorporeal membrane oxygenation and ventricular assist device notes

Early Riser Session 12

Room 30E

ABTS 5-Year and 10-Year Milestones

Bryan F. Meyers, St Louis, MO, and Richard J. Shemin, Los Angeles, CA

COMMERCIAL RELATIONSHIPS B. F. Meyers: Consultant/Advisory Board, Ethicon, Inc, Varian Medical Systems, Inc

In response to elevated expectations by the American Board of Medical Specialties (ABMS) and in accordance with trends seen in all other member certifying boards, the American Board of Thoracic Surgery (ABTS) has fine-tuned the requirements for diplomates who face 5-year and 10-year milestones in the Maintenance of Certification (MOC) process. This Early Riser Session will clearly outline expectations that diplomates may face during this process. This session will be useful and pertinent to all ABTS diplomates, but it will be most useful for those in the 4th, 5th, 9th, and 10th year of the ABTS MOC cycle.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Recite their specific requirements for the upcoming 5-year or 10-year MOC milestone
- Describe a suitable QI/QA activity that will satisfy MOC-IV criteria
- Relate to others the evidence and rationale for the MOC process
- Provide feedback to ABTS and ABMS about the process and its impact on their professional activities

7:30 AM – 8:30 AM ***Room 26B***

Early Riser Health Policy Forum: The End of Global Surgical Payments Under Medicare?

Peter K. Smith, Durham, NC, and Courtney Yohe, Washington, DC

This session will cover proposed changes to Medicare global payments for surgery. Participants will learn how new Medicare policies will affect their practice revenue—now and in the future—and what can be done to prevent potentially devastating changes from taking place. An open forum will allow attendees to ask questions about Medicare payment issues.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Describe pending changes to Medicare policy
- Explain how Medicare policy will affect their coding and reimbursement practices and bottom line
- Engage in at least one advocacy activity to prevent harmful changes from taking place

The physician competencies addressed in this session are patient care and procedural skills and systems-based practice. These competencies will be addressed through a lecture that is followed by an open forum on Medicare payment issues.

9:00 AM – 3:00 PM ***Exhibit Hall***

Exhibits Open

9:00 AM – 5:00 PM ***Rooms 29-32 Foyer***

Scientific Posters Open

9:00 AM – 12:00 PM ***Ballroom 20ABC***

General Session II

Moderators: *David A. Fullerton, Aurora, CO, and Keith S. Naunheim, St Louis, MO*

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

The physician competencies addressed in this session are patient care and procedural skills and medical knowledge. These physician competencies will be addressed through a series of individual lectures and focused discussion on key points of presentations.

9:00 AM

Thomas B. Ferguson Lecture

Pedro J. del Nido, Boston, MA

COMMERCIAL RELATIONSHIPS P. J. del Nido: Consultant/Advisory Board, CorAux Technologies

10:00 AM

BREAK—Visit Exhibits and Scientific Posters

Complimentary coffee available in Exhibit Hall

10:45 AM

Award Presentations

11:00 AM

C. Walton Lillehei Lecture

Clinical Trials at the Interface of Cardiology and Cardiac Surgery—What Would Dr. Lillehei Think?

Patrick T. O'Gara, Boston, MA

The 21st century cardiologist has little appreciation for the excitement generated decades ago by several of Dr. Lillehei's pioneering innovations in cardiac surgery, including his groundbreaking work with cross-circulation, bubble oxygenators, pacemakers, and prosthetic heart valves—techniques and devices that enabled major breakthroughs in the care of patients with structural heart disease. Fewer still may know that Dr. Lillehei served as President of the American College of Cardiology in 1967, in distinguished affirmation of his leadership across all segments of the cardiovascular enterprise and well before the dawn of multidisciplinary team based care. His 1967 ACC Scientific Sessions brought more than 3,000 members to Washington, DC, and featured panel discussions with "aquanaut and astronaut" innovators, representatives from key government agencies, including the FDA and the then-Department of HEW, and expert surgeons and cardiologists in mutual review of the coronary angiograms. Dr. Lillehei's fellow Minnesotan, United States Vice President Hubert Humphrey, gave the keynote address.

As we assemble here in San Diego for the STS 51st Annual Meeting and later this March in this same city for the 64th Annual ACC Meeting, we should reflect on the legacies we share, the similar themes we continue to pursue, and the mutual recognition of the need for disruptive innovation. Our current understanding of the benefits and risks of our

interventions—be they surgical, transcatheter, device-based, or medical—has improved considerably over the past two decades and been strengthened by the joint research we have undertaken in randomized prospective clinical trials, studies of comparative effectiveness, and post-marketing surveillance. We are poised together to deliver on the promises of gene and cell-based therapies and to transition to a future of precision medicine and even less invasive surgery. I suspect that Dr. Lillehei would be concerned by the length of time between laboratory discovery and human delivery, yet he would also encourage us to embed research in routine clinical care, measure ourselves against the highest benchmarks, work tirelessly on behalf of our patients, and instill in those who follow the scientific curiosity needed to fulfill our goal of reducing the burden of cardiovascular disease.

12:00 PM – 1:00 PM

BREAK—Visit Exhibits and Scientific Posters

Complimentary coffee available in Exhibit Hall

12:00 PM – 1:00 PM ***Room 30E***

Ethics Debate: Must Surgeons in Training Programs Allow Residents to Operate on Their Patients to Satisfy Board Requirements?

Surgeons are reluctant to allow residents to operate on their patients for many reasons, including concern for patient safety and increasing external scrutiny of surgical results. Yet, to obtain board certification, residents must satisfy requirements for number of operations performed. As the volume of relatively simple operations diminishes, are surgeons in teaching hospitals obligated to allow residents to operate on their patients?

Learning Objectives

Upon completion of this activity, participants should be able to:

- Discuss balancing conflicting obligations to teach and care for patients
- Decide how much responsibility to allow residents on ethical grounds
- Identify relevant risks to consider when assigning resident operative responsibilities

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

The physician competencies addressed in this session are patient care and procedural skills and professionalism. These physician competencies will be addressed through lectures, a debate, and questions from the audience.

Facilitator: *Robert M. Sade, Charleston, SC*

PRO: *Richard G. Ohye, Ann Arbor, MI*

CON: *James Jaggers, Aurora, CO*

12:00 PM – 1:00 PM ***Room 28CD***

Residents Luncheon

This luncheon, which is open to all residents, facilitates mentorship and discussion between experienced cardiothoracic surgery leaders and resident attendees. Each attendee will be provided with discussion topics to encourage engagement. Discussion topics will address the various types of cardiothoracic surgery training programs, identification of gaps in training, and how STS can continue to support residents as they prepare to enter the workforce. Participants consistently rate the discussions and interaction with leaders as the most valued and appreciated aspect of the luncheon.

1:00 PM – 3:00 PM ***Room 32ABC***

Adult Cardiac Session: General I

Moderators: *Juan A. Crestanello, Columbus, OH, and Thomas E. MacGillivray, Boston, MA*

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

Presenting authors are listed in **bold** on each abstract.

The physician competencies addressed in this session are patient care and procedural skills and medical knowledge. These physician competencies will be addressed through a series of individual lectures and a brief question-and-answer session after each topic.

1:00 PM ***Room 32ABC***

Low Incidence of Paravalvular Leakage With the Balloon-Expandable SAPIEN 3 Transcatheter Heart Valve

D. Wendt*, F. Al-Rashid, P. Kahlert, K. El-Chilali, S. Pasa, R. Erbel, H. G. Jakob, M. Thielmann*

West-German Heart Center, University of Duisburg-Essen, Germany

COMMERCIAL RELATIONSHIPS P. Kahlert: Other, Edwards Lifesciences Corporation, Clinical Proctor

Purpose: We sought to evaluate the clinical and hemodynamic performance of the new balloon-expandable SAPIEN 3 transcatheter heart valve (S3 THV).

Methods: Between April 2013 and June 2014, a total of 36 high-risk patients presenting with aortic stenosis were treated with the new S3 THV. Clinical and hemodynamic data, as well as device and procedure parameters, were obtained at baseline, intraoperatively, and at discharge, according to VARC-2.

Results: The S3 THV was implanted in 25 patients via transapical access and in 11 patients via transaortic access. Patients' mean age was 79.3 years ± 5.0 years (mean ± SD) and 43% were female. The mean logistic EuroSCORE of all patients was 36.7% ± 12.9%, the mean STS-Score was 7.7% ± 5.8%, and the mean EuroSCORE II was 6.7% ± 5.7%. All patients underwent successful implantation (23 mm, n=8; 26 mm, n=16; 29 mm, n=12) without any intraprocedural complications or re-ballooning. The majority of patients showed no (85%) or mild paravalvular aortic regurgitation (12%); one patient showed moderate regurgitation (3%); none of the patients had more than moderate postprocedural aortic regurgitation. At 30 days, stroke incidence was 5.5% (2/36) and all-cause mortality was 5.5% (2/36, sepsis and multiorgan failure). Two patients required a new pacemaker. All patients were in NYHA functional class I or II at 30 days. At 30 days, mean pressure gradients were 10.4 mm Hg ± 4.4 mm Hg.

Conclusions: The present study shows excellent clinical and hemodynamic outcomes for high-risk transcatheter aortic valve implantation patients treated with the new S3 THV. In regard to aortic regurgitation, the S3 THV shows low incidence of postoperative aortic regurgitation, with 97% presenting less than mild aortic regurgitation.

1:15 PM ***Room 32ABC***

Transcatheter Aortic Valve Replacement (TAVR) With a Self-Expanding Valve and Surgical Aortic Valve Replacement (SAVR) for Aortic Stenosis (AS) in Patients With Prior Coronary Artery Bypass Grafting (CABG)

J. V. Conte[1], *J. Popma*[9], *J. R. Resar*[2], *D. H. Adams*[3], *G. Deeb*[5], *N. Kleinman*[4], *S. Chetcuti*[5], *T. G. Gleason*[6], *D. Ohair*[7], *G. L. Zorn*[8], *M. Reardon*[4]

[1]*The Johns Hopkins Hospital, Baltimore, MD,* [2]*Johns Hopkins University School of Medicine, Baltimore, MD,* [3]*Mount Sinai Medical Center, New York, NY,* [4]*Houston Methodist Hospital, TX,* [5]*University of Michigan Health System, Ann Arbor,* [6]*University of Pittsburgh, PA,* [7]*Aurora Health, Milwaukee, WI,* [8]*Kansas University Medical Center, Kansas City,* [9]*Beth Israel Deaconess Medical Center, Boston, MA*

COMMERCIAL RELATIONSHIPS D. H. Adams: Ownership Interest, Edwards Lifesciences Corporation, Medtronic, Inc; J. V. Conte: Consultant/Advisory Board, Medtronic, Inc; J. Popma: Research Grant, Medtronic, Inc; J. R. Resar: Research Grant, Medtronic, Inc; G. Deeb: Consultant/Advisory Board, Medtronic, Inc; Research Grant, Medtronic, Inc; S. Chetcuti: Consultant/Advisory Board, Edwards Lifesciences Corporation, Medtronic, Inc; D. Ohair: Consultant/Advisory Board, Medtronic, Inc

Purpose: TAVR and SAVR are options for the treatment of AS in patients with prior CABG. We compared survival and major clinical outcomes at 1 year in patients with prior CABG in a prospective, multicenter, randomized, pivotal trial of a self-expanding transcatheter valve.

Methods: Patients with AS at "increased surgical risk" (determined by heart team evaluation, STS PROM, and consideration of other key clinical factors) were enrolled at 45 US sites and randomized 1:1 to TAVR or SAVR. The primary endpoint was all-cause mortality. Important secondary clinical endpoints were assessed. Categorical variables were assessed using Fishers exact test or the chi-square test, continuous variables were assessed using the Student's t-test, and Kaplan-Meier estimates were used to construct survival curves. Data are presented as % (# patients) in TAVR vs SAVR patients.

Results: Of 795 randomized patients, 226 had prior CABG and received TAVR (n=115) or SAVR (n=111). Survival was 90.4% (104) with TAVR and 81.9% (91) with SAVR ($p < 0.06$). There were no significant differences in cardiovascular mortality (7.0% [8] vs 13.8% [15], $p < 0.09$) or valve-related mortality (6.2% [7] vs 1.9% [2], $p < 0.128$). There was no difference in overall stroke (10.6% [12] vs 14.3% [15], $p < 0.39$), major stroke (8.8% [10] vs 6.6% [7], $p < 0.54$), or NYHA class with 95.8% (105) and 93.8% (96) in NYHA class I/II. There was an increase in acute kidney injury (5.3% [6] vs 16.3% [18], $p < 0.007$), life-threatening or disabling bleeding (13.2% [15] vs 28.2% [31], $p < 0.0043$), major arrhythmic events (50.5% [58] vs 63.1% [70], $p < 0.04$) and a trend for higher major adverse cardiac and cerebrovascular events (17.5% [20] vs 28.1% [31] with SAVR, $p < 0.054$). Pacemaker implantation was higher with TAVR (22.1% [25] vs 10.8% [11], $p < 0.01$).

Conclusions: TAVR offers advantages in morbidity and there is a trend toward improved survival over SAVR. The treatment decision is a nuanced one, based on arterial access, comorbidities, and individual clinical factors.

1:30 PM **Room 32ABC**

A Recalibration Tool to Correct the Overestimation of Risk Provided by the STS Online Risk Calculator for Patients Presenting for AVR After Prior CABG: An Analysis Using the STS Adult Cardiac Surgery Database

C. M. Vassileva[1], *S. F. Aranki*[2], *M. Brennan*[3], *T. Kaneko*[2], *X. He*[4], *J. S. Gammie*[5], *R. M. Suri*[6], *V. H. Thourani*[7], *S. R. Hazelrigg*[1], *P. M. McCarthy*[8]

[1]*Southern Illinois University School of Medicine, Springfield,* [2]*Brigham and Women's Hospital, Boston, MA,* [3]*Duke University, Durham, NC,* [4]*Duke Clinical Research Institute, Durham, NC,* [5]*The University of Maryland, Baltimore,* [6]*Mayo Clinic, Rochester, MN,* [7]*Emory University, Atlanta, GA,* [8]*Northwestern University/Northwestern Memorial Hospital, Chicago, IL*

COMMERCIAL RELATIONSHIPS J. S. Gammie: Ownership Interest, Correx, Inc, Harpoon Medical, Inc; R. M. Suri: Research Grant, Abbott, Edwards Lifesciences Corporation, Medtronic, Inc, SORIN GROUP, St Jude Medical, Inc; Other, Abbott, Member of the Clinical Steering Committee, St Jude Medical, Inc, Member of the Steering Committee; V. H. Thourani: Research Grant, Edwards Lifesciences Corporation, Medtronic, Inc, SORIN GROUP; Consultant/Advisory Board, Boston Scientific, St Jude Medical, Inc; Ownership Interest, Apica Cardiovascular

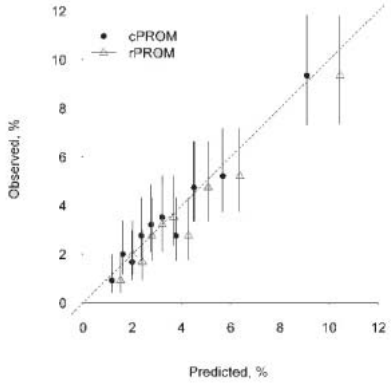
Purpose: Accurate risk assessment in patients presenting for aortic valve replacement (AVR) after prior coronary artery bypass grafting (CABG) surgery is essential for appropriate selection of surgical vs percutaneous therapy. We hypothesized that the Online STS Risk Calculator overestimates risk. Our purpose was to develop a clinically useful recalibration equation that would provide accurate risk stratification in this cohort.

Methods: The study included 6,534 patients in the STS Adult Cardiac Surgery Database (October 2009–December 2013) who underwent elective, isolated reoperative AVR for aortic stenosis after prior CABG. Case-specific Predicted Risk of Mortality (PROM) was calculated with the 2008 STS isolated valve risk model used by the Online STS Risk Calculator (raw PROM). Observed-to-expected ratios were inspected across the spectrum of risk. A cohort-specific recalibration equation was derived using logistic regression: = expit(-0.6453+0.6147*logit(PROM) -0.0709*logit(PROM)^2). The proportion of patients reclassified as low (PROM <4%), intermediate (4% to <8%), high (8% to <12%), and very high risk (>/=12%) was calculated using the recalibration equation (vs the Online STS Risk Calculator).

Results: Predicted risk of mortality by the Online STS Risk Calculator (rPROM) and by the recalibration equation (cPROM), and their relationship to observed mortality, is presented in Figure 1. The reclassification of risk categories between rPROM and cPROM is presented in Table 1. Using the recalibrated risk equation, a substantial proportion of patients were reclassified: 25.5% from intermediate to low risk, 39.7% from high to intermediate risk, and 41.5% from very high to high risk.

Conclusions: In patients presenting for AVR after prior CABG, the Online STS Risk Calculator overestimates risk for all but the lowest risk patients. A recalibration tool has been provided, and based on the recalibration equation, a substantial proportion of these patients would be downgraded to lower risk categories.

Figure 1: Predicted risk of mortality by the STS online-calculator (rPROM) and by the recalibration risk equation (cPROM) and their relationship to observed mortality rates in decile groups defined by rPROM.



Footnote: dots represent group specific mean predicted and observed mortality rates, vertical bars represent 95% exact binomial confidence intervals of observed rates.

Table 1. Distribution of risk groups by model recalibrated PROM and raw PROM. Data are presented as percent of patients within each raw PROM risk group that are reclassified to different recalibrated group.

	cPROM <4%	cPROM >=4%, <8%	cPROM >=8%, <12%	cPROM >=12%
rPROM <4%	100.0	0.0	0.0	0.0
rPROM >=4%, <8%	25.5	74.5	0.0	0.0
rPROM >=8%, <12%	0.0	39.7	60.3	0.0
rPROM >=12%	0.0	0.0	41.5	58.5

rPROM=raw PROM, based on the STS online valve risk model

cPROM=recalibrated PROM, based on the recalibrated risk equation

1:45 PM **Room 32ABC**

Dissection in Patients With Bicuspid Aortic Valve-Associated Aneurysms

***C. Wojnarski**, J. Idrees, E. E. Roselli, E. Blackstone, L. G. Svensson, B. W. Lytle*

Cleveland Clinic Foundation, OH

COMMERCIAL RELATIONSHIPS E. E. Roselli: Speakers Bureau/Honoraria, Medtronic, Inc, Terumo Medical Corporation; Consultant/Advisory Board, Edwards Lifesciences Corporation; Nonremunerative Position of Influence, SORIN GROUP; L. G. Svensson: Ownership Interest, Cardiosolutions, Inc

Purpose: Data are limited regarding the risk of aortic dissection in patients with bicuspid aortic valve (BAV) and large ascending aortic diameter. The appropriate timing of prophylactic ascending aortic replacement in patients with BAV lacks consensus. We report the natural history of BAV patients with ascending aortic diameter ≥ 4.7 cm.

Methods: From May 1995 to May 2014, 1,191 adult patients with BAV underwent cross-sectional CT or magnetic resonance imaging with sinus or tubular ascending aortic diameter ≥4.7 cm. During this 19-year period, 81.7% (n=973) underwent ascending aortic surgery, 2.7% (n=32) underwent isolated aortic valve surgery, and 15.6% (n=186) did not undergo cardiac surgery. Serial cross-sectional imaging was available for 323 patients. Patient characteristics were retrospectively obtained from the medical record. Operative outcomes were prospectively collected in a surgical database.

Results: The overall prevalence of type A dissection detected by imaging, found at operation, or on follow-up among patients with BAV and aortic diameter ≥4.7 cm was 4.4% (n=52). At time of dissection, median ascending aortic diameter was 5.6 cm (range, 4.4-22 cm) and median cross-sectional area/height ratio was 14.1 cm^2/m (range, 9.1-43 cm^2/m). Among those initially followed with serial imaging, 58% (n=186) underwent eventual ascending aortic surgery.

Conclusions: Over half of patients with BAV and ascending aortic diameter ≥4.7 cm who were initially prescribed observation required eventual aortic surgery for growth. Early prophylactic ascending replacement should be considered to reduce the high risk of preventable type A aortic dissection in patients with growing aortas or with aortas larger than approximately 5.0 cm or a cross-sectional area/height ratio of greater than approximately 10 cm^2/m.

2:00 PM ***Room 32ABC***

Hemodialysis Patients Undergoing Transcatheter Aortic Valve Replacement in the United States: A Propensity-Matched Comparison

D. Kobrin[1], *F. H. McCarthy*[1], *H. Herrmann*[2], *S. Anwaruddin*[1], *S. Kobrin*[1], *W. Y. Szeto*[1], *J. E. Bavaria*[1], *P. Groeneveld*[1], *N. Desai*[1]

[1]*University of Pennsylvania, Philadelphia,* [2]*Hospital of the University of Pennsylvania, Philadelphia*

COMMERCIAL RELATIONSHIPS N. Desai: Consultant/Advisory Board, St Jude Medical, Inc; Speakers Bureau/Honoraria, Medtronic, Inc, W. L. Gore & Associates, Inc; H. Herrmann: Research Grant, Abbott Vascular, Edwards Lifesciences Corporation, St Jude Medical, Inc, Medtronic, Inc, W. L. Gore & Associates, Inc, Siemens AG, Boston Scientific, Regado Biosciences, Cordis Corporation, CardioKinetix, MitraSpan, Inc; Consultant/Advisory Board, Edwards Lifesciences Corporation, GlaxoSmithKline, Siemens AG; Ownership Interest, Micro Interventional Devices, Inc; W. Y. Szeto: Research Grant, Edwards Lifesciences Corporation, Medtronic, Inc, SORIN GROUP; Consultant/Advisory Board, Micro Interventional Devices, Inc; S. Anwaruddin: Speakers Bureau/Honoraria, Edwards Lifesciences Corporation; J. E. Bavaria: Research Grant, W. L. Gore & Associates, Inc

Purpose: Transcatheter aortic valve replacement (TAVR) clinical trials generally excluded patients on dialysis, so the outcomes of TAVR in dialysis-dependent patients remain unknown.

Methods: All Medicare fee-for-service patients undergoing TAVR (n=5,003) or isolated surgical aortic valve replacement (SAVR) (n=32,915) between January 1, 2011, and November 30, 2012, were identified using procedural codes collected by the Centers for Medicare & Medicaid Services. Dialysis status and comorbidities were identified using diagnosis codes present on arrival for TAVR hospitalization. TAVR patients on dialysis (4.5%, n=224) were compared to the TAVR patients not on preoperative dialysis and a propensity-matched group of contemporaneous SAVR dialysis patients (n=194 pairs).

Results: TAVR patients on dialysis were younger than non-dialysis TAVR patients (79.2 years vs 84.1 years; $p < 0.01$) with a higher prevalence of comorbidities (Table 1) and increased composite incidence of stroke, acute myocardial infarction, or mortality at 30 days (15% vs 9%, $p = 0.01$) and 90 days (23% vs 15%, $p = 0.01$). Kaplan-Meier analysis showed worse survival (Figure 1a, $p < .01$) and multivariable regression found dialysis to be independently associated with worse survival (HR 1.74, 95% CI 1.33–2.27, $p < 0.01$). After propensity matching, TAVR and SAVR patients had no significant differences in age (77.6 years vs 77.9 years; $p = 0.77$) or demographics/risk factors. TAVR patients were found to have shorter length of stay (8.7 days vs 15.9 days; $p < 0.01$) and comparable survival (Figure 1b, $p = 0.53$).

Conclusions: TAVR in dialysis patients is associated with decreased survival compared to non-dialysis patients; however, it is comparable to SAVR in a propensity-matched population of dialysis patients.

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Adult Cardiac Session: General I – Continued

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Figure 1a Dialysis vs. Non-Dialysis In TAVR Patients

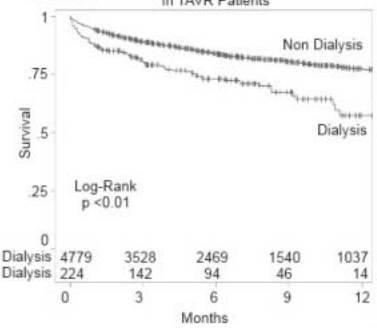
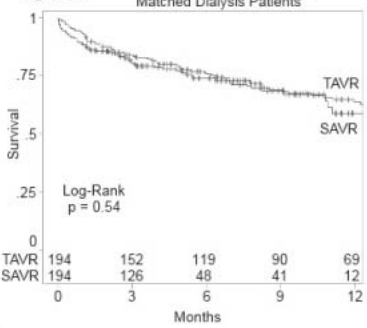


Figure 1b TAVR vs. SAVR in Propensity Matched Dialysis Patients



TAVR Patients

Demographics & Risk Factors	Dialysis (n=224)	Non-Dialysis (n=4779)	p
Male	57% (127)	51% (2428)	0.08
Age (years)	79.2 (± 9.2)	84.1 (± 7.4)	<0.01
Congestive Heart Failure	97% (218)	92% (4399)	<0.01
Peripheral Vascular Disease	88% (197)	80% (3846)	0.01
Diabetes	67% (151)	47% (2268)	<0.01
Weight loss	25% (55)	12% (572)	<0.01
30 Day Outcomes	Dialysis (n=224)	Non-Dialysis (n=4779)	p
Major Adverse Cardiac Event	15% (33)	9% (454)	0.01
Mortality	13% (28)	6% (264)	<0.01
Stroke	2% (5)	3% (165)	0.32
Acute myocardial infarction	2% (4)	2% (82)	0.94
Post-operative length of stay (Days)	8.8 (± 8.0)	6.9 (± 6.7)	<0.01
90 Day Outcomes	Dialysis (n=173)	Non-Dialysis (n=3960)	p
Major Adverse Cardiac Event	23% (39)	15% (599)	0.01
Mortality	18% (31)	11% (423)	<0.01
Stroke	3% (5)	4% (161)	0.44
Acute myocardial infarction	4% (7)	2% (91)	0.14

2:15 PM **Room 32ABC**

Magnitude of Negative Impact of Preoperative Heart Failure on Mortality During Aortic Valve Replacement in the Medicare Population

C. M. Vassileva[1], *T. Telila*[2], *S. Markwell*[1], *S. R. Hazelrigg*[1]

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Purpose: Recent guidelines advocate early surgery in asymptomatic patients with very severe aortic stenosis. To investigate if these recommendations should be liberalized further, we examined the magnitude of the negative impact of preoperative (preop) heart failure (HF) on mortality during aortic valve replacement (AVR) in the Medicare population over a 10-year period.

Methods: The study included 114,135 Medicare beneficiaries >65 years of age who underwent primary isolated AVR from 2000 through 2009. Logistic regression and Cox proportional hazards were used to model adjusted operative mortality and long-term survival, respectively, according to the presence and duration of preop HF (≤3 months vs >3 months).

Results: The incidence of preoperative comorbidities was high, and it was higher in patients with preop HF, compared to those without (Table 1). The presence of preop HF dramatically increased adjusted operative mortality, OR 1.64 (95% CI 1.54-1.74). Furthermore, preop duration of HF >3 months conferred a significant increase in adjusted OM compared to patients without preop HF, OR 2.33 (95% CI 2.13-2.54), and compared to patients with HF ≤3 months OR 1.52 (95% CI 1.40-1.64). Similarly, preop HF increased the likelihood of long-term mortality by 50%, HR 1.51 (95% CI 1.48-1.54). Long-term mortality was higher for patients with longer duration of preop HF, HR 1.90 (95% CI 1.83-1.96) compared to patients without preop HF, as well as compared to patients with HF ≤3 months, HR 1.31 (95% CI 1.27-1.35) (Figure 1).

Conclusions: The magnitude of the negative impact of preoperative HF on operative mortality and long-term survival of elderly patients undergoing primary isolated AVR is significant with over 50% increased likelihood of adverse outcome. Duration of preoperative HF is also significantly related to mortality. These data would support advocating AVR in the elderly prior to the development of heart failure.

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Figure 1: Long term survival (Kaplan-Meier) for Medicare patients after primary isolated AVR stratified by presence and duration of preoperative heart failure. The age and gender matched expected survival of the US population is shown for comparison.

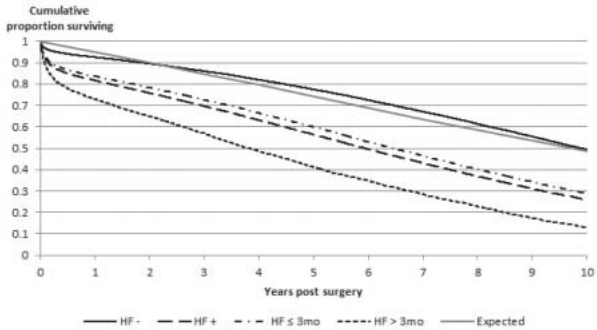

Table. Baseline characteristics of the study cohort

Variable	Overall n=114135	HF - n=65144	HF+ n=48991	p-value
Age - median (IQR)	77 (72-81)	76 (72-81)	78 (73-83)	0.0001
Female	51.2%	49.9%	52.9%	0.0001
Caucasian	92.7%	94.1%	90.9%	0.0001
Hypertension	61.8%	62.6%	60.8%	0.0001
Diabetes	23.5%	20.1%	28.0%	0.0001
PVD	4.4%	3.8%	5.2%	0.0001
Stroke	9.1%	8.3%	10.1%	0.0001
COPD	18.1%	12.3%	25.9%	0.0001
Renal Failure/ESRD	9.5%	5.3%	15.2%	0.0001
Atrial fibrillation/flutter	30.0%	20.0%	43.4%	0.0001
Prior MI	9.1%	5.1%	14.4%	0.0001
Non-elective admission	48.0%	37.5%	62.1%	0.0001

2:30 PM **Room 32ABC**

Diagnostic Balloon Aortic Valvuloplasty as a Modality to Triage Aortic Valve Replacement in Patients With an STS Risk of >15%

K. L. Greason

Mayo Medical Center, Rochester, MN

Purpose: There is controversy whether patients with aortic valve stenosis and STS risk of mortality >15% obtain benefit from aortic valve replacement. We reviewed our experience with diagnostic balloon aortic valvuloplasty in select patients as a modality to triage subsequent aortic valve replacement.

Methods: Review of 90 patients with severe aortic valve stenosis and STS risk of mortality >15% who received an aortic valve procedure from 2008 through 2013. Patient median age was 84 years (interquartile range [IQR]: 77-89), sex was male in 46 patients (51%), and STS risk of mortality was 19.1% (IQR: 16.5-24.4). Intent-to-treat included transcatheter aortic valve replacement (TAVR group) in 27 patients (30.0%) and balloon aortic valvuloplasty (BAV group) in 63 (70.0%) who were deemed too debilitated to undergo aortic valve replacement. Subsequent clinical improvement occurred after BAV in 29 patients (46.0%), and those patients then received aortic valve replacement at a median of 58 days (IQR, 25.5–134) after BAV.

Results: Treatment-related stroke or mortality occurred in nine patients (14.3%) in the BAV group and in four (14.8%) in the TAVR group ($p = 1.000$). Survival at 1 year was significantly worse in BAV group patients who received only BAV (34.3% ± 8.3%; $p < 0.001$). Survival was similar, however, in the BAV group patients who received staged aortic valve replacement (67.9% ± 8.9%) and TAVR group (77.8% ± 8.0%; $p = 0.640$).

Conclusions: Some patients with STS risk >15% don't receive mortality benefit after aortic valve replacement. Diagnostic balloon aortic valvuloplasty appropriately triages such patients for subsequent valve replacement. Patients who respond favorably to valvuloplasty may safely and effectively be treated with subsequent aortic valve replacement. Additional study is needed to identify and account for selection bias in determining treatment choice.

2:45 PM **Room 32ABC**

Prospective, Randomized Clinical Trial of Titanium Fasteners Compared to Hand-Tied Knots in Open Aortic Valve Surgery: Assessment of Time Savings, Cost, and Safety

***C. Y. Lee**, J. Lehoux, P. A. Knight*

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COMMERCIAL RELATIONSHIPS P. A. Knight: Other, LSI SOLUTIONS, Inc, LSI provides some of the funds to support research fellows in the division of cardiac surgery at URMC; C. Y. Lee: Other Research Support, LSI SOLUTIONS, Inc

Purpose: Aortic cross-clamp (AXC) and cardiopulmonary bypass (CPB) times are independent predictors of postoperative morbidity and mortality. Reducing critical times with automated titanium fasteners (TF) could improve surgical outcomes. This research compares operative times, effectiveness, and costs of TF versus hand-tied knots (HT) for prosthesis securement in aortic valve replacement (AVR).

Methods: Eighty patients enrolled in an IRB-approved prospective study underwent open AVR surgery between February 2013 and May 2014 (37 randomized to TF, 36 to HT, seven withdrawn). Baseline characteristics, concomitant procedures, AVR size and sutures did not significantly differ between TF and HT (Table 1). Combined knotting and cutting, AXC, CPB, and total OR times were captured. Cost data were calculated from hospital charges.

Results: TF provided significant operative time savings: 5.6 min saved (43%) in total knotting, 21.0 min (23%) in AXC, 27.5 min (24%) in CPB, and 31.9 min (12%) in total OR times (Figure 1). Intraoperative complications were more frequent in the HT group, including three intraoperative perivalvular leaks requiring additional suture placement, three reinstitutions of bypass, one broken suture, and one valvular insufficiency requiring redo replacement. No TF device-related complications or misfirings occurred. Postop complications included three returns to OR for bleeding (2 TF, 1 HT), five prolonged ventilator course (>24 hours) (1 TF, 4 HT), three strokes (1 TF, 2 HT), and two deaths (1 TF, 1 HT). OR costs were greater for TF vs HT ($10,428 vs $9,671, $p = 0.01$). Average hospital lengths of stay (LOS, $p = 0.77$) and total admission costs ($p = 0.12$) did not differ significantly between TF and HT (Table 1).

Conclusions: TF use results in shorter AXC, CPB, and OR times and fewer intraoperative complications in open AVR surgery. There is no significant difference in total hospital costs.

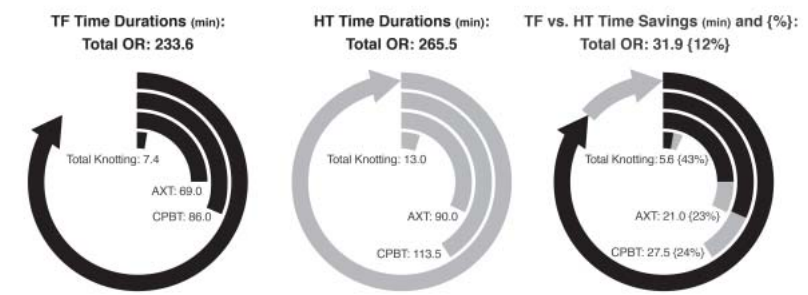

Table 1. Comparison of Patient Characteristics by Group.

Variable	Titanium Fasteners (n = 37)	Hand-Tied Knots (n = 36)	P-value
Concomitant Surgery			
CABG	11 (29.7%)	14 (38.9%)	0.601
CABG + Other	2 (5.4%)	1 (2.8%)	
Other	2 (5.4%)	4 (11.1%)	
AVR only	22 (59.5%)	17 (47.2%)	
AVR Type			
Trifecta	20 (54.1%)	26 (72.2%)	0.375
On-X	4 (10.8%)	4 (11.1%)	
Epic	1 (2.7%)	2 (5.6%)	
St. Jude Regent	2 (5.4%)	1 (2.8%)	
Edwards SAV	4 (10.8%)	0	
Mitroflow	3 (8.1%)	2 (5.6%)	
Other	3 (8.1%)	1 (2.8%)	
AVR Size	23.0 ± 1.9	23.2 ± 1.8	0.606
AVR Number of Sutures	19.5 ± 1.7	20.3 ± 2.2	0.084
AVR Knotting Time, min	7.4 ± 1.3	13.0 ± 2.9	< 0.001
AVR Knotting Time Per Suture, sec/suture	22.6 ± 3.5	38.3 ± 7.5	< 0.001
Aortic Cross-Clamp Time, min[1]	69.0 IQR: 52.0 – 88.0	90.0 IQR: 73.5 – 113.0	0.026
Cardiopulmonary Bypass Time, min[1]	86.0 IQR: 69.0 – 109.0	113.5 IQR: 91.0 – 133.0	0.020
Total OR Time, min	233.6 ± 47.2	265.5 ± 82.1	0.047
Intraoperative Complications			
Additional suture required	1 (2.7%)	3 (8.3%)	NS
Broken suture	1 (2.7%)	1 (2.8%)	
Redo valve replacement	0	1 (2.8%)	
Back on bypass	0	3 (8.3%)	
OR Time Cost	$1,959 ± $338	$2,180 ± $605	0.062
OR Supply Cost	$7,817 ± $955	$6,885 ± $893	< 0.001
Total OR Cost	$10,428 ± $1,076	$9,671 ± $1,339	0.010
ICU Length of Stay[1]	1 IQR: 1 - 3	1 IQR 1 – 4	0.558
Hospital Length of Stay[1]	7 IQR: 5.5 – 8.5	7 IQR: 4.0 – 10.5	0.767
Total Cost of Hospital Admission[1]	$23,987 IQR: $19,437 - $29,423	$21,068 IQR: $16,960 – $26,258	0.120

Notes: [1] Variables were not normally distributed, so medians and interquartile ranges (IQR) were used. Medians were compared using Wilcoxon Rank Sum tests. NS = non-significant.

1:00 PM – 3:00 PM ***Room 31AB***

Adult Cardiac Session: Mitral Valve

Moderators: *Gorav Ailawadi, Charlottesville, VA, and Vinay Badhwar, Pittsburgh, PA*

COMMERCIAL RELATIONSHIPS G. Ailawadi: Consultant/Advisory Board, Abbott, Edwards Lifesciences Corporation, Mitralign; Speakers Bureau/Honoraria, St Jude Medical, Inc

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

Presenting authors are listed in **bold** on each abstract.

The physician competencies addressed in this session are patient care and procedural skills and medical knowledge. These physician competencies will be addressed through a series of individual lectures and a brief question-and-answer session after each topic.

1:00 PM ***Room 31AB***

100% Repairability of Degenerative Mitral Regurgitation: Results of a Dynamic Engineered Approach

G. M. Lawrie[1], *W. A. Zoghbi*[2], *S. H. Little*[2], *E. A. Earle*[2], *N. Earle*[2], *D. Shah*[2]

[1]*Texas Surgical Associates, Houston,* [2]*Houston Methodist DeBakey Heart & Vascular Center, TX*

COMMERCIAL RELATIONSHIPS S. H. Little: Research Grant, Medtronic Inc, St Jude Medical, Inc; Consultant/Advisory Board, St Jude Medical, Inc

Purpose: Advances over the last 40 years in the understanding of dynamic mitral valve function have led to the development of a repair technique that emphasizes no leaflet resection, accurate dynamic annular and chordal sizing, and preservation of the normal left ventricle outflow tract dynamics, which prevent systolic anterior motion (SAM).

Methods: The dynamic approach uses passive inflation of the left ventricle (LV) and ascending aorta with mechanically pressurized saline given at 4 L/min to achieve the late diastolic phenomenon of "diastolic mitral locking." At this point in the cardiac cycle, the LV is maximally dilated, the aorta is distended, and the mitral leaflets are opposed. This reproducible point is used to adjust the length of the artificial chordae and size the fully flexible annuloplasty ring in three dimensions to provide accurate apposition of the premarked zones of leaflet coaptation. We followed 752 consecutive patients after repair done between 2001 and 2014.

Results: There were 510 (68.8%) males. The mean age was 61.3 years ± 13.54 years. Previous coronary artery bypass was present in 35 (4.7%). Leaflet repaired was anterior in 127 patients (17%), posterior in 451 (60%), both in 55 (7.3%), and Barlow's in 119 (16%). Number of anterior leaflet chordae replaced was 3.84 ± 1.64 and number of posterior leaflet chordae replaced was 4.47 ± 1.46. Mean annuloplasty ring size was 31.16 mm ± 3.13 mm. Reparability rate was 100%. No prosthetic valve was implanted in any patient with degenerative valve disease. Isolated repair was 76% (573/752). Perioperative mortality overall was 2.3% (17/752) and for isolated repair was 1.6% (9/573). Survival at 10 years by Kaplan-Meier was 64.2%, freedom from reoperation at 10 years was 92.4%, and freedom from significant MR at 10 years was 85.8%. Predictors of reoperation (Cox analysis) were age ($p < 0.055$) and preoperative ejection fraction ($p = 0.020$).

Conclusions: This dynamic approach with leaflet preservation has enabled 100% reparability of degenerative valves with elimination of SAM. Late durability by echo has been good. We no longer employ resectional techniques. The dynamic approach offers a reproducible, reliable, and durable option for repair of mitral regurgitation from degenerative mitral valve disease.

1:15 PM **Room 31AB**

Gender Differences in Patient Presentation, Procedural Aspects, and Early Outcome in Isolated Mitral Valve Surgery

M. Mokhles[1], *S. Siregar*[2], *M. Versteegh*[2], *L. Noyez*[3], *B. van Putte*[4], *A. Vonk*[5], *J. Roos-Hesselink*[1], *A. Bogers*[1], *J. Takkenberg*[1]

[1]*Erasmus University Medical Center, Rotterdam, The Netherlands,* [2]*Leiden University Medical Center, The Netherlands,* [3]*University Hospital Nijmegen St Radboud, The Netherlands,* [4]*St Antonius Hospital, Nieuwegein, The Netherlands,* [5]*VU Medical Center, Amsterdam, The Netherlands*

COMMERCIAL RELATIONSHIPS A. Vonk: Research Grant, Edwards Lifesciences Corporation, Medtronic, Inc, SORIN GROUP; B. van Putte: Consultant/Advisory Board, AtriCure, Inc

Purpose: Little is known about how gender affects patient presentation, procedural characteristics, and early outcome in patients undergoing mitral valve (MV) surgery. The objective of this study was to compare gender differences with respect to baseline characteristics and short-term outcome in a contemporary nationwide cohort of patients that underwent isolated MV surgery.

Methods: All patients (n=3,412; 58% males [n=1,977]) who underwent isolated MV surgery (replacement: n=1,048, 30.7%; reconstruction: n=2,364, 69.3%) in the Netherlands between January 2007 and December 2011 were included in this study. Differences in patient and procedural characteristics, as well as in-hospital outcome, were compared between male and female patients.

Results: Female patients were generally older (mean age, 64 vs 61 years, $p < 0.001$), presented more often with pulmonary hypertension ($p = 0.025$), and had higher logistic EuroSCORE I ($p < 0.001$). Male patients presented more often with prior coronary artery bypass grafting surgery ($p < 0.001$) and active endocarditis ($p = 0.002$). Female patients underwent MV replacement more often (38.7% vs 24.9%; $p < 0.001$) and more often received stented bioprostheses ($p < 0.001$). Male patients more often received a mechanical prosthesis ($p < 0.001$). In-hospital mortality after MV replacement was 6.7% (n=33) and 7.2% (n=40) in male and female patients, respectively (OR 1.08, 95% CI 0.67-1.75; $p = 0.75$). In-hospital mortality after MV reconstruction was 1.4% (n=21) and 1.3% (n=11) in male and female patients, respectively (OR 0.88, 95% CI 0.42-1.84; $p = 0.74$). In males, the AUC for the logistic EuroSCORE I was 0.89 (95% CI 0.85-0.93) vs 0.85 (95% CI 0.80-0.90) in females. The calibration of the logistic EuroSCORE I model resulted in p-values of $p = 0.054$ and $p = 0.028$ for males and females, respectively.

Conclusions: Female patients undergoing isolated MV surgery are older at the time of surgery, have higher logistic EuroSCORE 1, and undergo valve replacement substantially more often. Calibration of the logistic EuroSCORE I model is not appropriate in female patients because of systematic overestimation of in-hospital mortality, indicating the need for the development of gender specific risk stratification models in this patient group.

Multivariate analyses of risk factors associated with in-hospital mortality in male and female patients

Characteristics	Males		Females	
	OR (95% CI)	p-value	OR (95% CI)	p-value
Age	1.05 (1.02-1.09)	0.002	1.10 (1.06-1.15)	<0.001
Chronic lung disease	3.91 (1.93-7.92)	<0.001		
Extracardiac arteriopathy			4.75 (1.53-14.69)	0.007
Serum creatinine (>200um/L)	4.15 (1.77-9.75)	0.001		
Active endocarditis	5.29 (2.47-11.35)	<0.001	8.26 (3.08-22.13)	<0.001
Critical preoperative state	3.95 (1.70-9.16)	0.001	4.17 (1.78-9.77)	0.001
LV function				
Good	reference			
Poor	2.01 (1.03-3.90)	0.041		
Emergent surgery	2.94 (1.24-6.97)	0.014		
Prior CABG	3.50 (1.62-7.58)	0.001		
Circ. arrest			14.40 (4.82-43.06)	<0.001
Type of procedure				
Mitral valve reconstruction			reference	
MVR			5.40 (2.25-12.95)	<0.001

1:30 PM **Room 31AB**

Long-Term Outcome of Tricuspid Valve Repair for Functional Tricuspid Regurgitation: The Berlin Experience

***A. Khan**, E. B. Delmo Walter, T. Komoda, R. Hetzer*

Deutsches Herzzentrum Berlin, Germany

Purpose: Functional tricuspid regurgitation (TR) is associated with substantially poorer survival and functional outcomes if left untreated. The aim of this study was to analyze the 25-year outcome of the various tricuspid valve (TV) repair techniques to correct functional TR.

Methods: A total of 1,353 patients (mean age 60.1 years ± 13.9 years, median 63.0 years, range 18-89 years) who underwent TV repair for functional TR between 1986 and 2011 were retrospectively reviewed. They were divided into five groups according to the repair technique: Group 1: De Vega technique (n=1,017), Group 2: Kay bicuspidalization technique (n=260), Group 3: double-orifice technique (n=48), Group 4: Sebening stitch combined with either posterior annulorrhaphy or the double-orifice technique (n=14), and Group 5: other techniques (n=14). Tricuspid and mitral valve regurgitation grade ≥3 was present in 700 (51.8%) and 529 (39.2%) patients, respectively.

Results: After a mean follow-up of 23.5 years ± 4.7 years (95% complete), freedom from repeat TV repair or replacement was 96.5% (982), 96.1% (250), 89.6% (43), 93.3% (14), and 78.6% (11) for Groups 1, 2, 3, 4, and 5, respectively. The cumulative survival rate was 81.2%, 71.6%, 58.7%, 44.7%, and 29.6% at 30 days, 1-, 5-, 10-, and 15-years, respectively. Postoperatively, 275 patients (20.3%) were in NYHA functional class III/IV compared with 1,076 (79.5%) prior to TV repair. Postoperative echocardiographic results also showed a significant improvement in TR severity, with TR grade ≤1 in 1,190 patients (87.9%) on follow-up. Risk factors associated with early mortality were age, NYHA functional class III/IV, severe tricuspid and mitral regurgitation, and urgent/emergent surgery ($p < 0.001$).

Conclusions: Based on the results of this study, TV repair must be undertaken for moderate functional TR, since prompt correction is associated with improvements in clinical and functional status and a low incidence of TV reoperation regardless of the repair technique.

1:45 PM ***Room 31AB***

The Expanding Role of Robotics in Mitral Valve Surgery With and Without Concomitant Procedures: A Single Institutional Experience of 1,257 Consecutive Cases

D. A. Murphy[1], *J. Miller*[1], *S. K. Macheers*[2], *J. Olsen*[2], *A. Herzog*[2], *S. Drobka*[2], *E. L. Sarin*[1], *V. H. Thourani*[1], *R. Guyton*[1], *M. E. Halkos*[1]

[1]*Emory University, Atlanta, GA,* [2]*Emory St Joseph's Hospital, Atlanta, GA*

COMMERCIAL RELATIONSHIPS M. E. Halkos: Consultant/Advisory Board, Intuitive Surgical, Inc, Medtronic, Inc; D. A. Murphy: Speakers Bureau/Honoraria, Edwards Lifesciences Corporation, Intuitive Surgical, Inc; V. H. Thourani: Research Grant, Edwards Lifesciences Corporation, Medtronic, Inc, SORIN GROUP; Consultant/Advisory Board, Boston Scientific, St Jude Medical, Inc; Ownership Interest, Apica Cardiovascular; R. Guyton: Consultant/Advisory Board, Medtronic, Inc

Purpose: The role of robotic instruments in mitral valve (MV) surgery continues to evolve. The purpose of this study is to assess, in the largest reported series to date, the safety, efficacy, and scope of MV surgery using a lateral endoscopic approach with robotics (LEAR).

Methods: From 2006 to 2013, a dedicated LEAR team performed 1,257 consecutive MV procedures with or without tricuspid valve (TV) repair or left or biatrial ablation. The procedures were performed robotically through five right chest ports (four robotic, one service, Figure) in conjunction with either femoral artery or ascending aortic perfusion and balloon occlusion of the aorta. Operative videos and data were recorded on all procedures and reviewed retrospectively.

Results: Mean age of all patients (patients) was 59.3 years ± 20.5 years, 46% female, 8% previous cardiac surgery, and 18% BMI >30. Ten patients (0.8%) required conversion to sternotomy. MV repair was performed in 1,164 patients (93%) with a mean ischemic time of 82 min ± 22 min and cardiopulmonary bypass (CPB) time of 114 min ± 28 min. MV replacement was performed in 93 patients (7%) with a mean ischemic time of 115 min ± 17 min and CPB time of 161 min ± 46 min. Concomitant atrial ablation was performed in 15% and TV repair in 11%. Morbidity was low for all patients (Table). Operative mortality was 0.8%. Pre-discharge echocardiograms demonstrated < mild mitral regurgitation in 96% of MV repair patients. MV reoperation was performed in 44 patients (3.8%) at a mean follow-up of 48.6 months ± 26.1 months. Application of LEAR technique to all institutional MV procedures ± TV repair ± ablation increased from 46% in the first year to over 90% in the last 3 years.

Conclusions: MV repair or replacement including concomitant procedures can be performed safely and effectively using the LEAR technique. With a dedicated robotic team, the vast majority of patients with mitral valve disorders, either isolated or with concomitant problems, can be treated using the LEAR technique.

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Adult Cardiac Session: Mitral Valve – Continued

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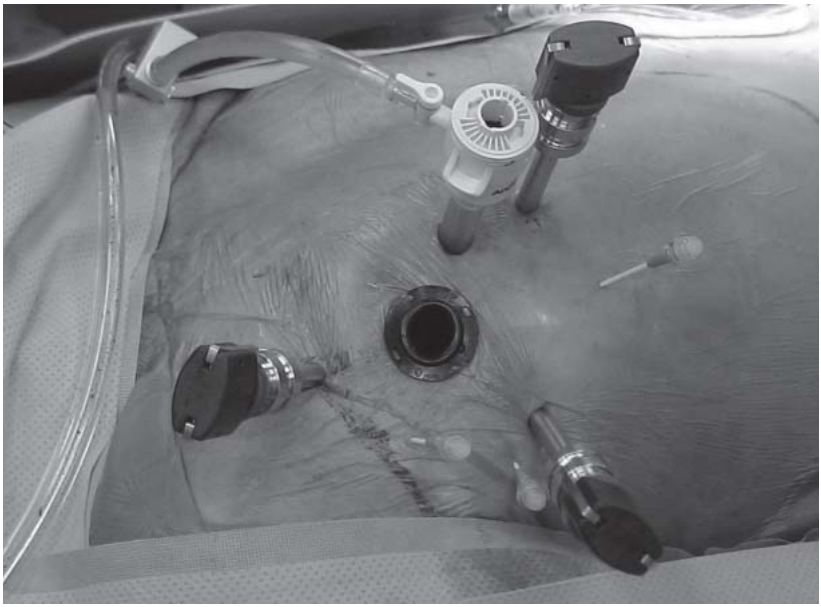


Complications	N=1,257
Stroke	9 (0.7%)
Re-exploration for bleeding	24 (1.9%)
Renal Failure	8 (0.6%)
Prolonged ventilation	49 (3.9%)
Transfusion of any blood product	201 (16%)
Aortic or iliac dissection	2 (0.2%)
Ischemic limb	0 (0%)
Chest wound infection	0 (0%)
Groin wound infection	4 (0.3%)

2:00 PM **Room 31AB**

Early Results of Mitral Valve Repair in Barlow Disease With Partial or Complete Rigid Rings: A Propensity-Matched Analysis

C. Muneretto, *G. Bisleri, L. Bagozzi, A. Repossini, C. Giacomini, N. Berlinghieri, E. Chiari*

University of Brescia Medical School, Italy

COMMERCIAL RELATIONSHIPS G. Bisleri: Speakers Bureau/Honoraria, AtriCure, Inc, Estech; C. Muneretto: Speakers Bureau/Honoraria, AtriCure, Inc

Purpose: The surgical treatment of complex mitral valve disease (Barlow like) still represents a major technical challenge. We evaluated the impact of the type of ring utilized during repair on outcomes following mitral surgery in Barlow disease.

Methods: Among 262 patients with Barlow disease scheduled to undergo mitral valve repair, a propensity-matched analysis was performed among those receiving a partial rigid ring (Group 1, G1=49 patients) or a complete rigid ring (Group 2, G2=49 patients). Matching criteria were age, female sex, BMI, NYHA class, hypertension, COPD, pulmonary hypertension, and left ventricular ejection fraction. Primary end-point was overall survival, while secondary end-points were survival free from reoperation and residual mitral regurgitation ≥2.

Results: Hospital mortality was 0% in both groups. Aortic cross clamp time was significantly shorter in G1 (G1=87 ± 26 vs G2=98 ± 29, $p = 0.043$), while systolic anterior movement (SAM) occurred only in patients with complete rings (G1=0 vs G2=5 patients, $p = 0.028$). At 1-year follow-up, Kaplan-Meier analysis depicted similar outcomes among the groups either in terms of overall survival (G1=96.6% ± 3.4% vs G2=100%, $p = 0.203$), as well as freedom from reoperation (G1=100% vs G2=97.9% ± 2.1%, $p = 0.466$) and residual mitral regurgitation ≥2 (G1=100% vs G2=97.8% ± 2.2%, $p = 0.543$).

Conclusions: The use of partial rings is associated with similar outcomes at short-term compared to complete rings in mitral valve repair for Barlow disease and with lower risk of developing postoperative SAM.

2:15 PM **Room 31AB**

Barlow's Mitral Valve Disease: A Comparison of Neochordal (Loops) and Edge-to-Edge (Alfieri) Minimally Invasive Repair Techniques

***J. da Rocha e Silva**, R. Spampinato, B. Pfannmüller, M. Misfeld, F. W. Mohr, M. A. Borger*

Leipzig Heart Center, Germany

COMMERCIAL RELATIONSHIPS M. A. Borger: Speakers Bureau/Honoraria, Edwards Lifesciences Corporation, St Jude Medical, Inc, SORIN GROUP

Purpose: Barlow's mitral valve (MV) disease remains a surgical challenge. We compared short- and medium-term outcomes of neochordal (Loop) vs edge-to-edge (Alfieri) minimally invasive MV repair in Barlow patients.

Methods: From January 2009 to April 2014, 120 consecutive patients with Barlow's disease underwent MV surgery for severe mitral regurgitation (MR). Three patients (2.5%) underwent MV replacement during the study time period. The Loop technique was performed in 64 patients (53%) and an edge-to-edge repair in 45 patients (37.5%); patients who underwent a combination of these two techniques (n=8, 6.7%) were also excluded. The median age was 48 years and 65% were male. Concomitant procedures comprised of patent foramen ovale or atrial septal defect closure (n= 25), tricuspid valve repair (n= 6), and atrial fibrillation ablation (n= 28). Follow-up was performed 24.7 months ± 17 months postoperatively and was 100% complete.

Results: No deaths occurred perioperatively or during follow-up. Aortic crossclamp (64.1 min ± 17 min vs 95.9 min ± 29 min) and cardiopulmonary bypass times (110 min ± 24 min vs 146 min ± 39 min; both $p < 0.001$) were significantly shorter in patients that received edge-to-edge repair. Although Alfieri patients received a larger annuloplasty ring (38.6 mm ± 1.5 mm vs 35.8 mm ± 2.7 mm, $p < 0.001$), the early postoperative mean gradients were higher (3.3 mm Hg ± 1.2 mm Hg vs 2.6 mm Hg ± 1.2 mm Hg; $p = 0.007$) and the effective orifice area was smaller in this group (2.8 cm^2 ± 0.7 cm^2 vs 3.0 cm^2 ± 0.7 cm^2; $p = 0.06$). The amount of residual MR was similar between groups ($p = 0.42$). However, more than mild MR requiring early MV operation was present in three Loop patients (4.7%) and no Alfieri patients ($p = 0.27$). During follow-up, one Alfieri patient developed moderate-to-severe MR and no patient in either group has undergone repeat MV surgery.

Conclusions: Minimally invasive MV repair can be accomplished with excellent early- and medium-term outcomes in patients with Barlow's disease. The edge-to-edge repair can be performed with reduced operative times when compared to the Loop technique, but results in mildly increased transvalvular gradients and mildly decreased valve opening areas.

2:30 PM **Room 31AB**

Debate: 45-Year-Old, Obese Woman With Barlow's Valve

***Use of Open Resection:** TBA*

***Use of Minimally Invasive Non-Resection:** Michael A. Borger, New York, NY*

COMMERCIAL RELATIONSHIPS M. A. Borger: Speakers Bureau/Honoraria, Edwards Lifesciences Corporation, St Jude Medical, Inc, SORIN GROUP

NOTES

1:00 PM – 3:00 PM ***Room 30CD***

Congenital Session: Pediatric Congenital II

Moderators: *Jeffrey P. Jacobs, St Petersburg, FL, and Frank G. Scholl, Hollywood, FL*

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

Presenting authors are listed in **bold** on each abstract.

The physician competencies addressed in this session are patient care and procedural skills and medical knowledge. These physician competencies will be addressed through a series of individual lectures and a brief question-and-answer session after each topic.

1:00 PM ***Room 30CD***

Does the Type of Primary Repair Influence Mode of Postrepair Pulmonary Vein Stenosis and Reintervention in Patients With Total Anomalous Pulmonary Venous Drainage?

M. Lo Rito*, T. Gazzaz, A. Saedi, D. Chetan, G. S. Van Arsdell, C. A. Caldarone, S. Yoo, O. Honjo*

The Hospital for Sick Children, Toronto, Canada

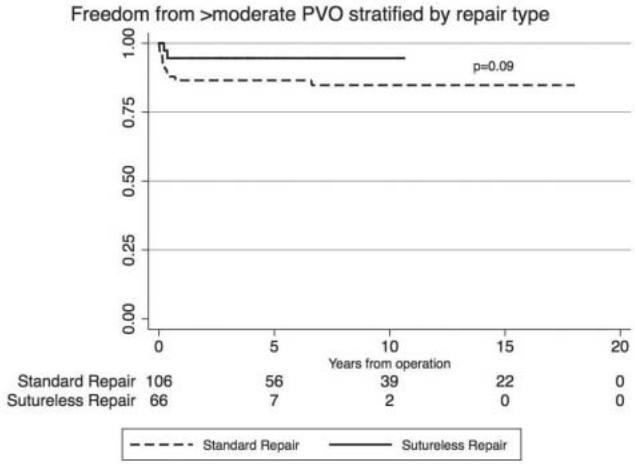
COMMERCIAL RELATIONSHIPS G. S. Van Arsdell: Ownership Interest, CellAegis Devices Inc, Medtronic, Inc

Purpose: We hypothesized that primary application of the sutureless repair (SL) for total anomalous pulmonary venous drainage (TAPVD) may have a lower incidence of post-repair pulmonary vein obstruction (PVO) and has a different mode of PVO if developed compared to standard repair (SR).

Methods: The retrospective study included all patients who underwent TAPVD repair from 1990 to 2012 except isomerism and single ventricles. The degree of PVO was expressed as mild (pulmonary vein score [PVS] 2-3), moderate (PVS 4-7), and severe (PVS >8). The mode of PVO was expressed as central (anastomosis site) or peripheral (individual veins). Mann-Whitney, Kaplan-Meier, and Cox regression models were used.

Results: TAPVD repair was performed in 195 patients (SR=126, SL=69) with mortality of 11.3% (7.2% since 2000). SL group had more infracardiac and mixed TAPVD ($p = 0.02$). During the median follow-up of 6.8 years, 15 (8.1%, 13 SR, 2 SL) of 184 hospital survivors developed > moderate PVO (7 moderate, 8 severe). There is a trend toward higher freedom from > moderate PVO in SL than SR group ($p = 0.09$, Figure). Total incidence of > moderate PVO was lower in the SL (2.9% vs 11.3%, $p = 0.05$) compared to SR patients. SR group had more central PVO ($p = 0.05$) and both two patients in SL group had peripheral PVO. SL group had significantly lower PVS (4 vs 7.4, $p = 0.0004$) among patients with > moderate PVO. Techniques at reoperation were conventional fibrous resection (6) and sutureless repair (8). The 5-year survival following reoperation was 70% with no difference between original repair types. Nine of 11 survivors are free from any PVO. No factors, including type of repair, were identified as predictors for PVO or reoperation.

Conclusions: Primary sutureless repair appeared to be associated with less incidence of post-repair PVO and with less PVO severity when developed. The sutureless repair eliminated the risk of central PVO related to anastomosis. Reoperation for PVO has reasonable survival and pulmonary vein functional outcome regardless of original repair type.


Freedom from >moderate PVO stratified by repair type
1.00
0.75
0.50
0.25
0.00
p=0.09
0
5
10
15
20
Years from operation
Standard Repair 106 56 39 22 0
Sutureless Repair 66 7 2 0 0
Standard Repair
Sutureless Repair

1:15 PM **Room 30CD**

Surgical Repair of Pulmonary Atresia/Ventricular Septal Defect/Major Aortopulmonary Collaterals With Absent Intra-pericardial Pulmonary Arteries

S. Carrillo[1], *R. D. Mainwaring*[2], *W. Patrick*[2], *N. Watanabe*[2], *V. M. Reddy*[3], *F. L. Hanley*[4]

[1]*Lucile Packard Children's Hospital at Stanford University, Palo Alto, CA,* [2]*Stanford University School of Medicine, CA,* [3]*Stanford University – Falk Center CRVB, CA,* [4]*Stanford University, CA*

Purpose: One anatomic variant of pulmonary atresia with ventricular septal defect and major aortopulmonary collaterals (PA/VSD/MAPCAs) is characterized by the absence of intrapericardial pulmonary arteries. This anatomy obviates the possibility of incorporating the pulmonary arteries for reconstruction or palliative procedures. Since there is currently no literature on this specific entity, the purpose of this study was to evaluate the surgical results in patients undergoing repair of PA/VSD/MAPCAs with absent pulmonary arteries.

Methods: This was a retrospective review of 34 patients who underwent surgical repair of PA/VSD/MAPCAs with absent pulmonary arteries between 2007 and 2014. The median age at the time of surgery was 3.4 months and the median weight was 5.2 kg. All patients underwent unifocalization of MAPCAs with an average of 3.5 ± 1.4 MAPCAs per patient.

Results: Twenty-seven of the 34 patients (79%) underwent complete single-stage surgical repair, including unifocalization of MAPCAs, VSD closure, and right ventricle to pulmonary artery conduit. Following complete repair, the average right ventricular (RV) peak systolic pressure was 30 mm Hg ± 6 mm Hg, the aortic (Ao) pressure was 91 mm Hg ± 10 mm Hg, and the RV/Ao pressure ratio was 0.34 ± 0.07. There were no deaths in the subgroup undergoing a single-stage complete repair. Seven patients (21%) were not deemed to be suitable candidates for VSD closure following their unifocalization procedure, and therefore underwent palliation with a systemic-to-unifocalized MAPCA shunt. Three of these patients have subsequently undergone complete repair with similar hemodynamics (RV/Ao pressure ratio of 0.33 ± 0.11) compared to the single-stage group.

Conclusions: The data demonstrate that the majority of patients with PA/VSD/MAPCAs and absent pulmonary arteries can undergo complete single-stage surgical repair with satisfactory postoperative hemodynamics. These results suggest that unifocalization of MAPCAs can provide a reasonable pulmonary vascular bed even in the absence of intrapericardial pulmonary arteries.

1:30 PM **Room 30CD**

Results of Primary Repair vs Shunt Palliation in Ductal-Dependent Infants With Pulmonary Atresia and Ventricular Septal Defect

***B. Alsoufi**, M. Mori, K. R. Kanter, M. Wolf, C. Samai, M. Ferguson, B. E. Kogon*

Emory University, Atlanta, GA

Purpose: Initial surgical management of ductal-dependent neonates born with pulmonary atresia and ventricular septal defect (PAVSD) involves primary biventricular repair (BVR) vs palliation with a modified Blalock-Taussig shunt (BTS). Each strategy is associated with specific advantages and shortcomings. We report current outcomes of PAVSD treatment with those two different strategies.

Methods: Between 2002 and 2012, 85 ductal-dependent PAVSD patients (excluding those with multiple aortopulmonary collaterals) underwent surgery using primary repair (BVR group: n=28, 33%) or shunt palliation (BTS group: n=57, 67%). Early and intermediate outcomes were compared between the two groups.

Results: Median age at time of surgery was 6 days and median weight was 2.8 kg, with 27 patients (32%) ≤2.5 kg. Twenty-six patients (31%) were born prematurely ≤36 weeks and 34 (40%) had associated extracardiac/genetic malformations. Overall hospital mortality was five (5.9%) and was one (3.6%) for BVR vs four (7%) for BTS ($p = 0.06$). Following BTS, 45/57 patients (79%) reached second-stage repair. Overall 8-year survival following initial surgery was 76% and was 86% for BVR vs 71% for BTS ($p = 0.18$). On multivariable analysis, the presence of extracardiac/genetic malformations was a risk factor for mortality (HR 9.1, $p = 0.003$). Freedom from conduit reoperation in 73 patients who achieved repair was 58% at 8 years and was 26% in BVR group vs 75% in BTS group ($p = 0.02$). Freedom from reoperation was 93% when a transannular patch (TAP) was used vs 52% when a conduit (RVPA) was used ($p = 0.17$). On multivariable analysis, BVR was a risk factor for reoperation (HR 5.5, $p = 0.02$).

Conclusions: Primary BVR of ductal-dependent PAVSD might offer survival advantage over palliation with BTS due to higher unplanned reoperation and interim mortality with BTS. Extracardiac/genetic malformations are common and associated with worse outcomes. If a main pulmonary artery is present, reconstruction with TAP is possible and might delay cardiac reoperation requirement.

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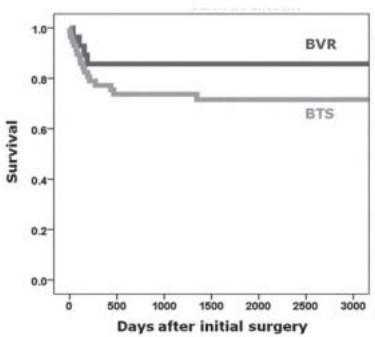
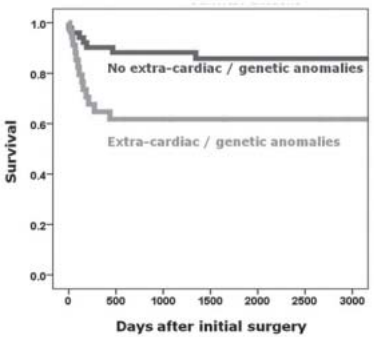
Congenital Session: Pediatric Congenital II – Continued

Abstract continued from previous page





	Overall (n=85)	BVR group (n=28)	BTS group (n=57)
Male gender	51 (60%)	16 (57%)	35 (61%)
Median age (days)	6	7	5
Median weight (Kg)	2.8	3.1	2.7
Weight ≤2.5 Kg	27 (32%)	8 (29%)	19 (33%)
Premature ≤36 weeks	26 (31%)	9 (32%)	17 (30%)
Extra-cardiac and genetic malformations	34 (40%)	15 (53%)	19 (33%)
Unplanned reoperation	11 (13%)	2 (7%)	9(16%)
ECMO	3 (4%)	0 (0%)	3 (5%)
RV to PA continuity: Conduit (RVPA) Transannular patch (TAP)	 59% 41%	 50% 50%	 64% 36%
RVPA conduit size (mm)	13	10	14

1:45 PM ***Room 30CD***

Surgical Reconstruction of Peripheral Pulmonary Arteries: Strategies, Outcomes, and New Classification

A. Alkhaldi*, O. Tamimi*

King Abdulaziz Medical City, Riyadh, Saudi Arabia

Purpose: Pulmonary artery stenosis (PAS) is classified as central (Types 1-2) and peripheral (Type 3 affects the proximal part of lobar arteries, Type 4 affects the proximal part of segmental arteries, and Type 5 affects the distal part of segmental arteries). In this study, we examine the outcomes of surgical reconstruction of peripheral PAS.

Methods: We performed a retrospective review of 31 patients with peripheral PAS who underwent surgical repair. The median age was 30 months. All patients had preoperative pulmonary angiography. Patients with intact ventricular septum (24 patients) presented with severe right ventricular dilation and dysfunction and the mean preoperative right ventricular/left ventricular pressure (RVSP/LVSP) ratio was 0.96 ± 0.25, 1.14 ± 0.23, and 1.43 ± 0.07 for types 3, 4, and 5, respectively ($p = 0.03$). The PA reconstruction was achieved in single stage using median sternotomy and cardiopulmonary bypass in 19 patients (61%), while 12 patients (39%) required planned second stage due to distal involvement of left PA branches.

Results: Eleven patients (30.6%) had Type 3, 22 patients (61.1%) had Type 4, and three patients (8.3%) had Type 5. Mean number of angioplasties performed per patient was 18 ± 8. There was no mortality in this series. Two patients required extracorporeal life support due to severe pulmonary reperfusion injury. The mean postoperative RVSP/LVSP ratio decreased to 0.27 ± 0.08, 0.36 ± 0.05, and 0.96 ± 0.06 for types 3, 4, and 5, respectively ($p < 0.0001$). The median follow-up was 48 months. Patients with Type 3 or 4 with impaired functional status showed marked improvement within weeks after surgery. Patients with Type 5 showed clinical evidence of improved cardiac output despite only modest decrease in RVSP. No surgical reintervention was needed in any patients, while balloon dilation was performed in one patient with Type 5 lesions.

Conclusions: Surgical reconstruction of diffuse peripheral PAS is feasible and associated with excellent hemodynamic and functional outcomes in patients where there is no involvement of distal segmental pulmonary arteries.

2:00 PM **Room 30CD**

Improving Surgical Outcome of Patients With Right Atrial Isomerism Complicated With Pulmonary Atresia and Major Aortopulmonary Collateral Arteries

***Y. Ide**, M. Murata, K. Sakamoto*

Mt Fuji Shizuoka Children's Hospital, Japan

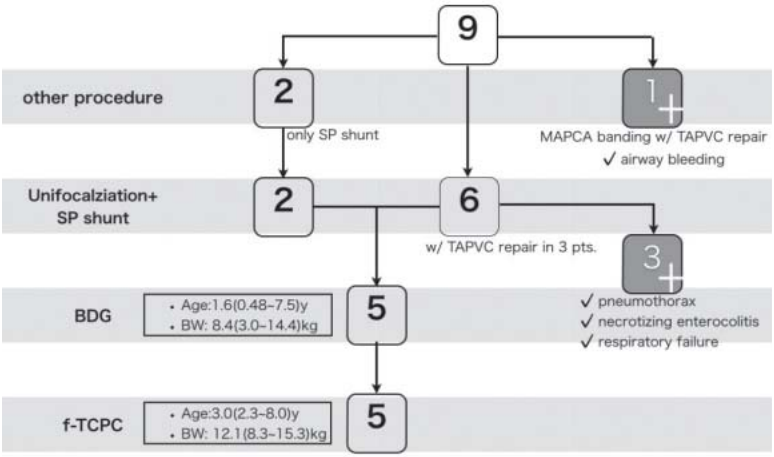
Purpose: Surgical outcomes of patients with right atrial isomerism (RAI) have been improving. However, there has been no publication of surgical repair for RAI patients complicated with pulmonary atresia/major aortopulmonary collaterals (PA/MAPCAs). We sought to report our experience of surgical interventions for RAI patients with PA/MAPCAs.

Methods: A retrospective review of RAI patients with PA/MAPCAs who required surgical interventions at a tertiary pediatric cardiac center from January 1994 to April 2014. There was no withdrawal from surgical intervention during the study period.

Results: Nine patients were identified. None were suitable for biventricular repair. They had three (1-8) MAPCAs in median. Their central pulmonary arteries (cPA) were evaluated as adequate (5), diminutive (2), and completely absent (2). As the first palliation, unifocalization with subdural-peritoneal (SP) shunt was performed in six, only SP shunt in two, and MAPCA banding in one at the median age 1.8 months (1 day-10 months) and body weight 3.3 kg (2.5-8.4). Obstructed total anomalous pulmonary venous connections were revealed in four (supra: 3, infra: 1) and repaired concomitantly. There were four mortalities: one early death (intractable pneumothorax), two hospital deaths (necrotizing enterocolitis, airway bleeding), and one interstage death (respiratory failure). The remaining five patients (56%) underwent bidirectional Glenn procedures at the age of 1.6 years (0.48-7.5) and all of them successfully completed total cavopulmonary connection (fenestrated in 4) with adequate central venous pressure (11 mm Hg ± 1.7 mm Hg) and SpO2 (91% ± 3.7%) at the age of 3.0 years (2.3-8.0).

Conclusions: Surgical outcomes for patients with RAI complicated with PA/MAPCAs are improving and the pulmonary vascular bed can be reconstructed sufficiently to allow for cavopulmonary connections. Long-term follow-up is mandatory to compare with natural history of this most serious combination.

Unifocalization of MAPCAs for patients with Right Atrial Isomerism



2:15 PM **Room 30CD**

Metrics of Surgical Quality Predict Hospital Length of Stay in Patients With Congenital Heart Disease

E. Johnson[1], *M. Zubair*[1], *L. Armsby*[1], *G. Burch*[1], *M. Good*[1], *M. Lasarev*[1], *A. Muralidaran*[2], *S. M. Langley*[1]

[1]*Oregon Health and Science University, Portland,* [2]*Doernbecher Children's Hospital at Oregon Health and Science University, Portland*

Purpose: Historically, the primary metric of quality for congenital cardiac surgery programs has been postoperative mortality. We developed a series of 10 additional metrics to assess the quality of surgical repair of congenital cardiac defects. Our aim was to determine if these metrics independently predict postoperative hospital length of stay.

Methods: A total of 1,024 consecutive index congenital cardiac surgical cases were captured as a historical cohort. Cases were excluded if the patient died prior to hospital discharge, yielding a total of 992 cases for analysis. Four demographic characteristics, 22 risk factors, and 10 metrics (unplanned postoperative extracorporeal membrane oxygenation, unplanned postoperative cardiac catheterization, revision of the primary repair, delayed sternal closure, mediastinitis, re-exploration for bleeding, postoperative complete heart block requiring permanent pacemaker, diaphragm paralysis requiring plication, vocal cord paralysis, and change in the preoperative diagnosis) were considered. Principal component analysis, multiple linear regression, and manual backwards elimination were used to construct a model for analysis.

Results: After adjusting for four demographic characteristics and 22 risk factors, increased median postoperative hospital length of stay was associated with four metrics: revision of the primary repair by a factor of 1.69 (95% CI 1.19–2.40, $p = 0.003$), complete heart block requiring a permanent pacemaker by a factor of 1.73 (95% CI 1.27–2.35, $p = 0.001$), paralyzed diaphragm requiring plication by a factor of 1.77 (95% CI 1.38–2.27, $p < 0.001$), and unplanned postoperative cardiac catheterization by a factor of 2.05 (95% CI 1.69–2.50, $p < 0.001$). The other six metrics were not significantly associated with postoperative hospital length of stay.

Conclusions: The quality of surgery during repair of congenital cardiac defects predicts hospital length of stay. Focusing on quality improvement initiatives to reduce the incidence of these metrics may decrease postoperative length of stay in this patient population.

2:30 PM **Room 30CD**

Is Atrioventricular Valve Regurgitation a Risk Factor in Functional Single Ventricle With Heterotaxy Syndrome?

K. Na[1], W. Kim[2], E. Choi[1], S. Cho[1]

[1]Seoul National University Hospital, Republic of Korea, [2]Seoul National University Children's Hospital, Republic of Korea

Purpose: Atrioventricular valve (AVV) regurgitation is known as a significant risk factor in patients with functional single ventricle with heterotaxy syndrome. Our surgical strategy for significant AVV regurgitation in this group of patients is early AVV replacement. The purpose of the study was to evaluate our surgical strategy for significant AVV regurgitation in this group.

Methods: A retrospective review was performed for patients having heterotaxy syndrome and undergoing Fontan operation between 1992 and 2013.

Results: During the study period, a total of 441 patients underwent Fontan operation and 63 patients had heterotaxy syndrome. Patients were divided into two groups: patients undergoing AVV replacement due to significant AVV regurgitation (group 1, n=13) or not (group 2, n=50). In group 1, 11 patients (84.6%) had right isomerism and two patients (15.4%) had left isomerism. Mean age at initial Fontan operation was 41.38 months ± 30.9 months and 47.2 months ± 36.6 months in group 1 and 2, respectively. Mean age at AVV replacement was 12.0 years ± 5.1 years, and all patients underwent AVV replacement during the follow-up period after initial Fontan operation. Median follow-up duration was 154.0 months ± 89.3 months. There was one in-hospital mortality in group 1. Twenty-year survivals were 73.8% ± 17.5% and 87.1% ± 8.7% in group 1 and 2, respectively, and there was no significant statistical difference (p = 0.537). There was no reoperation for prosthetic valve in group 1 during the follow-up period.

Conclusions: This study demonstrates that, in patients with functional single ventricle and heterotaxy syndrome, the long-term outcome was favorable if the patients undergo early AVV replacement for significant AVV regurgitation.

2:45 PM **Room 30CD**

Skeletonization of the Recurrent Laryngeal Nerve During Norwood and Aortic Arch Repair

K. Sughimoto[1], *H. Pratap*[2], *C. P. Brizard*[2], *I. Konstantinov*[1], *Y. D'Udekem*[2]

[1]*Royal Children's Hospital, Melbourne, Australia,* [2]*Royal Children's Hospital, Parkville, Australia*

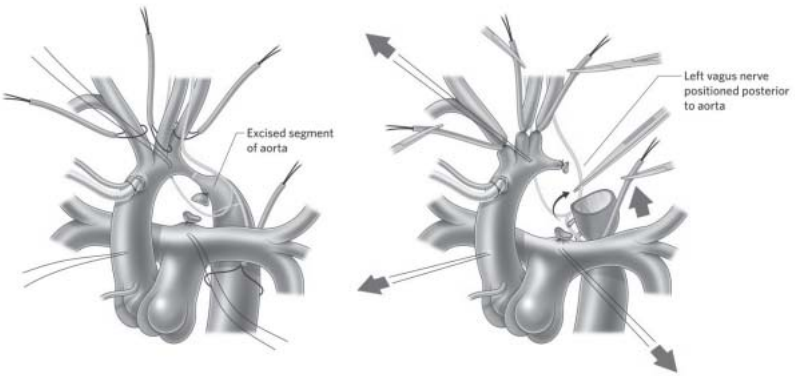
COMMERCIAL RELATIONSHIPS C. P. Brizard: Consultant/Advisory Board, Admedus, Australia

Purpose: Recurrent laryngeal nerve injury is one of the major complications during Norwood and aortic arch repair, causing swallowing dysfunction and aspiration and resulting in prolonged hospital stay in the postoperative period. We aimed to evaluate the outcomes of skeletonization of the recurrent nerve to preserve its function during Norwood and aortic arch repair.

Methods: Between July 2012 and April 2014, 12 patients underwent skeletonization of the recurrent nerve, including five Norwood procedures and seven aortic arch repairs (5 days old in median; 1 day-5.3 years). A selective cerebral perfusion was employed at 25°C. The recurrent nerve was carefully dissected with bipolar cautery. The first three pairs of intercostal arteries were cauterized and divided. The isthmus was divided and the reconstruction of the arch was performed, leaving the mobilized recurrent nerve posteriorly to the reconstructed aorta. Arch reconstructions included patching of the arch concavity in Norwood procedure and end-to-side anastomosis in other arch repairs.

Results: The median hospital stay was 49 days (range: 34-134) for Norwood procedure and 7 days (range: 4-18) arch repair, respectively. Four out of five patients after Norwood achieved the second stage of bidirectional cavopulmonary shunt. All patients in biventricular group were in NYHA I after a median of 13.6 months (range: 2-23.5). No patients showed signs of swallowing dysfunction. No patient was noted to have vocal cord palsy.

Conclusions: The skeletonization and preservation of the laryngeal recurrent nerve at Norwood procedure or aortic arch repair may effectively preserve its function.



NOTES

1:00 PM – 3:00 PM ***Room 30AB***

General Thoracic Session: Esophageal

Moderators: *Katie S. Nason, Pittsburgh, PA, and K. Robert Shen, Rochester, MN*

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

Presenting authors are listed in **bold** on each abstract.

The physician competencies addressed in this session are patient care and procedural skills and medical knowledge. These physician competencies will be addressed through a series of individual lectures and a brief question-and-answer session after each topic.

1:00 PM ***Room 30AB***

Predictors of Lymph Node Metastasis in Surgically Resected T1 Esophageal Cancer

A. Dubecz[1], *M. Schweigert*[2], *N. Solymosi*[3], *H. Stein*[1]

[1]*Klinikum Nuremberg, Germany,* [2]*Klinikum Dresden Friedrichstadt, Germany,* [3]*Szent István University, Budapest, Hungary*

Purpose: Application of endoscopic therapies for early cancers of the esophagus is limited by the possible presence of regional lymph node (LN) metastases. Our objective was to determine the prevalence and predictors of LN metastases in patients with pT1 carcinoma of the esophagus and the gastric cardia in a population-based sample.

Methods: Using the National Cancer Institute's Surveillance Epidemiology and End Results Database (2004–2010), we reviewed 1,225 patients with a mean age of 64 (± 10) years. Patients with pT1 carcinomas who underwent primary surgical resection for squamous cell carcinoma (SCC) or adenocarcinoma (EAC) of the esophagus and of the esophagogastric junction (AEG) were identified. Prevalence of lymph node metastases was assessed and survival in all types of cancer was calculated. Multivariate logistic regression was employed to identify factors predicting positive lymph node status.

Results: Most patients were male (84%) and of white race (90%). Forty-four percent of all patients had intramucosal disease, whereas submucosal invasion (T1b) was present in 692 patients (56%). Prevalence of LN metastases in EAC, SCC, and AEG was 6.4%, 6.9%, and 9.5% for pT1a tumors and 19.6%, 20%, and 22.9% for pT1b tumors, respectively. In patients with >25 LNs removed during surgery, prevalence of LN metastases in EAC, SCC, and AEG was 8.1%, 25%, and 7.4% for pT1a tumors and 27.8%, 33.3%, and 22% for pT1b tumors, respectively. Positive lymph node status was associated with worse overall 5-year survival in EAC (N0 vs N+: 78% vs 52%) and AEG (N0 vs N+: 83% vs 44%), but did not have a significant effect on the long-term survival of patients with SCC. Infiltration of the submucosa, tumor size >10 mm, and poor tumor differentiation were independently associated with the risk of nodal disease.

Conclusions: Prevalence of LN metastasis in early esophageal cancer is high in patients with T1 cancer. Inadequate lymphadenectomy underestimates lymph node status. Endoscopic treatment can be considered only in a select group of patients with early esophageal cancer.

1:15 PM **Room 30AB**

Preoperative Chemoradiation Therapy vs Chemotherapy in Patients Undergoing En Bloc Esophagectomy for Locally Advanced Esophageal Adenocarcinoma: Does Radiation Add Value?

J. Spicer[1], *B. M. Stiles*[2], *M. Sudarshan*[3], *A. Correa*[1], *L. E. Ferri*[4], *N. K. Altorki*[2], *W. L. Hofstetter*[1]

[1]*University of Texas MD Anderson Cancer Center, Houston,* [2]*Weill Cornell Medical College, New York, NY,* [3]*McGill University, Montreal, Canada,* [4]*McGill University Health Centre, Montreal, Canada*

Purpose: Preoperative chemotherapy or chemoradiation are associated with improved outcomes compared to up-front surgery in patients with locally advanced esophageal adenocarcinoma. Two randomized, controlled trials comparing these therapies included non-radical surgery and failed to reach significance. We hypothesized that additional regional therapy (radiation) does not benefit patients undergoing en bloc resection.

Methods: We performed a multi-institutional study utilizing three prospectively entered databases from high-volume esophageal centers. Inclusion criteria were patients with esophageal adenocarcinoma treated with either preoperative chemotherapy (CT) or chemoradiation (CXRT) followed by en bloc esophagectomy. To minimize issues of stage migration and heterogeneity, we limited the study to patients with cT3N+ adenocarcinoma. Survival was assessed by Kaplan-Meier method and step-wise multivariable analyses used to explore variables independently associated with survival outcomes. Radical resections included two- and three-field operations, dependent solely on surgeon/institutional preference.

Results: A total of 214 patients with cT3N+ disease were identified, of which 114 underwent preoperative CT vs 100 who underwent CXRT. A majority of patients had esophagogastric junction (51%, n=110) or distal third lesions (45%, n=96). There was a preponderance of poorly differentiated carcinomas (57%, n=122) vs moderate (29%, n=62). Median survival was 31.2 (CI 20.7-41.7) months for the CT group vs 39.2 (CI 27.3-51.0) for CXRT (p = 0.665). Mortality at 90 days was 5.3% for CT vs 4% for CXRT (p = 0.754). There were no significant differences in major postoperative morbidity between both groups. Multivariate analysis identified level of anastomosis (HR 0.43; CI 0.28-0.67-neck was reference) and number of positive lymph nodes (HR 1.06; CI 1.03-1.09) as independent predictors of overall survival. The type of preoperative therapy did not significantly influence outcome.

Conclusions: Given a modified en bloc esophagectomy, type of preoperative therapy was not a significant determinant of overall survival. Although preoperative chemoradiation did not add perioperative risk, it also did not prolong survival. The role of preoperative radiation in the setting of a planned radical resection should be further evaluated.

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General Thoracic Session: Esophageal – Continued

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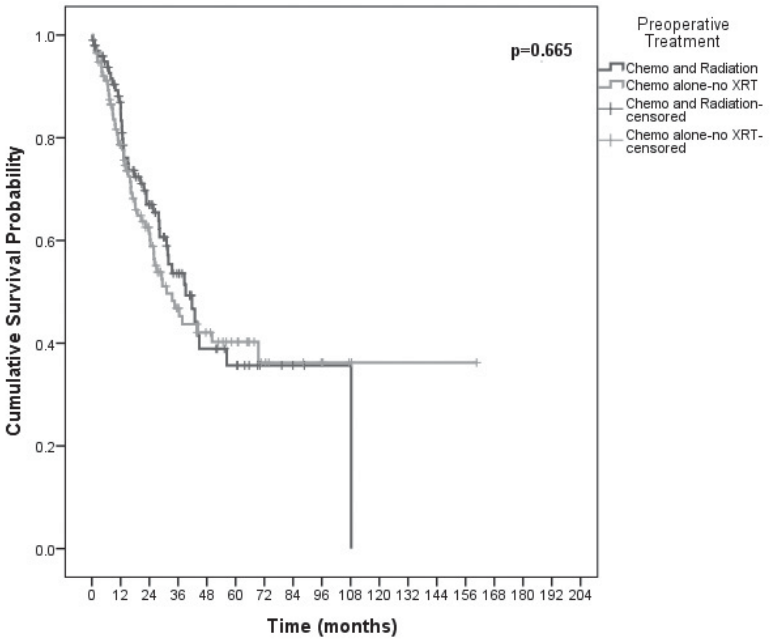

1:30 PM **Room 30AB**

Identifying Esophageal Cancer Patients at Risk for Pre- vs Postdischarge Venous Thromboembolism After Esophagectomy and the Case for Selective Extended Chemoprophylaxis

J. T. Martin[1], *A. Mahan*[1], *V. A. Ferraris*[2], *S. P. Saha*[1], *T. W. Mullett*[2], *J. B. Zwischenberger*[1], *C. Tzeng*[1]

[1]*University of Kentucky, Lexington,* [2]*University of Kentucky Chandler Medical Center, Lexington*

COMMERCIAL RELATIONSHIPS J. B. Zwischenberger: Ownership Interest, Avalon Laboratories, LLC, MAQUET; Research Grant, NIH

Purpose: Current practice guidelines recommend postoperative venous thromboembolism (VTE) chemoprophylaxis for moderate-risk patients (≥3% event rate), and extended duration chemoprophylaxis for high-risk patients (≥6%). However, large-scale studies of and recommendations for esophagectomy patients are lacking. This study was designed to evaluate the timing, rates, and predictors of post-esophagectomy VTE.

Methods: From 2005 to 2012, all patients undergoing esophagectomies for cancer were identified from the American College of Surgeons NSQIP participant use file. Timing and rates of VTE events (deep venous thrombosis [DVT] and/or pulmonary embolism [PE]) were calculated. Events were stratified as early (predischarge) or late (postdischarge). Variables associated with 30-day rates of VTE were analyzed using nonparametric tests. To determine independent associations, statistically significant univariate factors were entered into multivariate logistic regression models for early and late VTE.

Results: Among the 3,208 patients analyzed, the surgical approach was Ivor-Lewis (n=1,131, 35.3%), transhiatal (945, 29.5%), three-field (587, 18.3%), thoracoabdominal (364, 11.3%), and non-gastric conduit reconstruction (181, 5.6%). Event rates were 2.0% for PE, 3.7% for DVT, and 5.1% for VTE overall. Surgical approach was not associated with early or late VTE ($p = 0.368$). Median length of stay (LOS) was 11 days for all patients (vs 19 days, $p < 0.001$, if early VTE, and 12 days, $p = 0.359$, for patients with late VTE). Early VTE occurred on median postoperative day 9, while late VTE occurred on median day 19 ($p < 0.001$). Only 17% of VTE events occurred postdischarge. Multivariate analysis identified male gender (OR-2.09, $p = 0.018$), white race (OR-1.93, $p = 0.004$), prolonged ventilation (OR-3.24, $p < 0.001$), and other major complications (OR-1.90, $p = 0.005$) as independent predictors of early VTE. Older age (OR-1.06 per year, $p = 0.006$) and major complications (OR-3.14, $p = 0.004$) were associated with late VTE on multivariate analysis.

Conclusions: Postoperative VTE occurs in a clinically significant proportion of esophageal cancer patients with clearly identifiable risk factors for early and late events. Based on current guidelines for surgical patients at high risk for VTE, elderly patients or patients with major complications meet criteria for postdischarge, extended duration chemoprophylaxis after esophagectomy.

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General Thoracic Session: Esophageal – Continued

Abstract continued from previous page

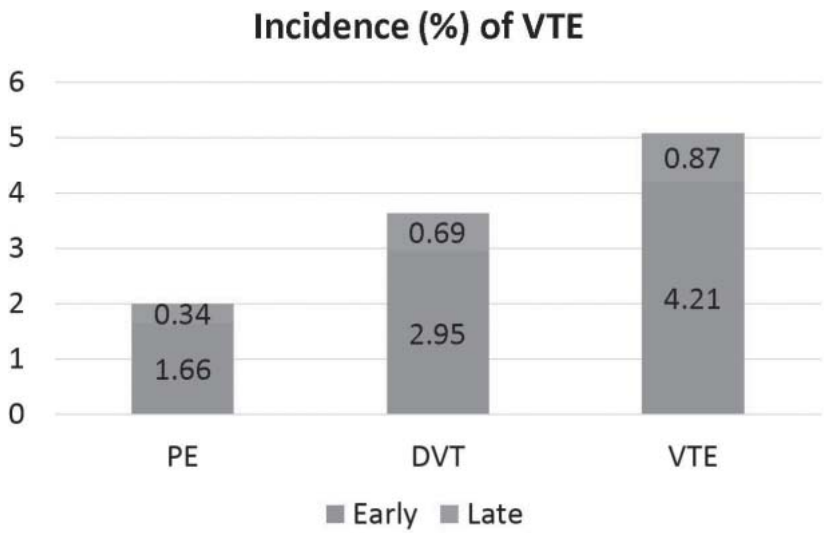


Table 1: Multivariate Analysis: Predictors of early and late venous thromboembolism.

		OR	95% CI	p-value
Early				
	Sex (Male vs Female)	2.1	1.14-3.83	0.016
	Race (White vs Other)	1.9	1.24-3.00	0.004
	Ventilator > 48 hours	3.24	2.07-5.06	<0.0001
	Major morbidity (other than VTE, failure to wean)	1.90	1.22-2.96	0.0046
Late				
	Age (per year)	1.06	1.02-1.10	0.006
	Major morbidity (other than VTE)	3.14	1.44-6.84	0.004

1:45 PM **Room 30AB**

Development of a Risk Score Model Using Preoperative Variables to Predict Mortality and Major Morbidity After Esophagectomy

J. M. Reinersman[1], *E. Habermann*[1], *M. S. Allen*[1], *C. Deschamps*[2], *K. Thomsen*[1], *F. C. Nichols*[1], *K. Shen*[1], *D. A. Wigle*[1], *S. D. Cassivi*[1]

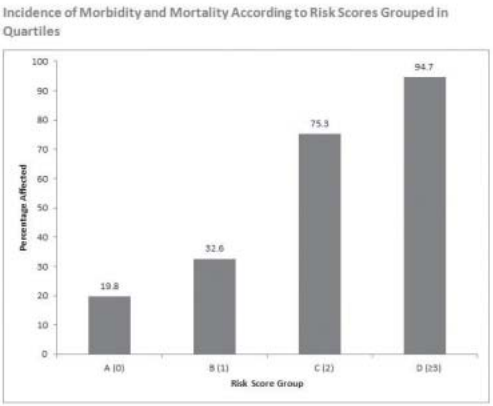
[1]*Mayo Clinic, Rochester, MN,* [2]*Fletcher Allen Health Care - University of Vermont, Burlington*

Purpose: Despite advances in perioperative care, esophagectomy is associated with significant morbidity and mortality. Our purpose was to develop a risk model to predict mortality and morbidity following esophagectomy.

Methods: A total of 343 consecutive patients with esophageal cancer who underwent esophagectomy from August 2009 to December 2012 were analyzed using a prospectively collected database. Outcomes included mortality and morbidity, defined as anastomotic leak, myocardial infarction, pulmonary embolus, pneumonia, reintubation, empyema, chylothorax, and reoperation. We compared patient factors using chi-square or Fisher's exact analyses. Predictors of morbidity and mortality were identified and used to create a risk score. Patients were grouped into four classes of risk according to this score, and the incidence of major events was assessed in each class.

Results: Morbidity was 45.8% (159/343). Combined 30-day and in-hospital mortality was 3.5% (12/343). Predictors of morbidity and mortality included prior cardiothoracic surgery, Zubrod score ≥2, diabetes mellitus requiring insulin therapy, current smoking, hypertension, female gender, and FEV1 less than 60% predicted. These variables were used to develop the risk score. Scores were calculated for each patient, who was then grouped into one of four classes with incremental risk of morbidity and mortality. Rates of events for each group were: Group A 19.8% (17/86); Group B 32.6% (45/138); Group C 75.3% (61/81); and Group D 94.7% (36/38).

Conclusions: Esophagectomy continues to have significant potential for morbidity. A data-driven risk model using preoperative variables can be developed. This allows for preoperative stratification of patients into individually distinct risk groupings. Thoracic surgeons can use this practical tool to evaluate preoperative risk and educate their patients regarding specific risks of esophagectomy.



2:00 PM **Room 30AB**

Minimally Invasive vs Open Esophagectomy for Esophageal Cancer: A Comparison of Outcomes From The Society of Thoracic Surgeons National Database

S. Sihag[1], *A. Kosinski*[2], *P. H. Schipper*[3], *H. Gaissert*[1]

[1]*Massachusetts General Hospital, Boston,* [2]*Duke Clinical Research Institute, Durham, NC,* [3]*Oregon Health and Science University, Portland*

Purpose: As open esophagectomy results in significant morbidity and mortality, minimally invasive esophagectomy (MIE) has become increasingly popular at specialized centers across the US Numerous single-institution, retrospective studies suggest that MIE is oncologically equivalent to open resection and may offer potential for decreased short-term morbidity. Here, we present the results from the first multi-institutional, large database comparison between these two approaches.

Methods: The Society of Thoracic Surgeons National Database (v2.081) was queried for all esophagectomies performed for esophageal cancer between 2008 and 2011 (n=4,025). Minimally invasive approaches included both transhiatal (n=255) and Ivor-Lewis (n=630), and these were compared directly to open transhiatal (n=1,159) and Ivor-Lewis (n=1,350) procedures, respectively. Thirty-day outcomes were examined between groups using two-sample non-parametric statistical testing at a significance threshold of $p < 0.05$.

Results: Both open and MIE groups were similar in terms of age, gender, comorbidities, clinical stage, and neoadjuvant therapy. Overall morbidity and mortality were equivalent at 38% and 3.5%. MIE was associated with longer procedure times (446.1 min ± 124.3 min vs 327.9 min ± 120.1 min, $p < 0.001$), but a shorter length of hospital stay (13.7 days ± 13.7 days vs 14.5 days ± 13.1 days, $p < 0.001$). Interestingly, patients who underwent MIE had higher rates of postoperative pulmonary events (32.6% vs 27.0%, $p = 0.001$). Open technique led to an increased rate of wound infections (6.2% vs 2.3%, $p < 0.001$).

Conclusions: MIE is safe and leads to a shorter length of hospital stay and lower rate of wound infection. However, it may not significantly reduce the rate of postoperative pulmonary events. Longer procedure times likely reflect a learning curve as many surgeons are new to MIE. Long-term survival and other oncologic outcomes merit evaluation via prospective analysis.

2:15 PM **Room 30AB**

Measuring Survival Benefit of Postresection Adjuvant Chemotherapy for Patients With Positive Lymph Nodes After Induction Chemoradiotherapy and Resection of Esophageal Cancer

A. Brescia[1], *J. Musick*[2], *J. Bell*[3], *T. Crabtree*[2], *B. F. Meyers*[4]

[1]*St Louis University School of Medicine, MO,* [2]*Barnes-Jewish Hospital/Washington University in St Louis, MO,* [3]*Washington University School of Medicine, St Louis, MO,* [4]*Washington University, St Louis, MO*

COMMERCIAL RELATIONSHIPS B. F. Meyers: Consultant/Advisory Board, Ethicon, Inc, Varian Medical Systems, Inc

Purpose: The role of adjuvant therapy in patients with positive lymph nodes (+LNs) after induction therapy and resection is controversial. The purpose of this study is to assess the survival benefit of adjuvant therapy in this population.

Methods: A single-institution esophageal cancer database was reviewed for patients undergoing resection of primary esophageal cancer between 2000 and 2013. Patients with +LNs after induction therapy and resection were studied. Adult comorbidity evaluation 27 (ACE27) scores estimated comorbidity. Kaplan-Meier estimates described survival. Multivariate analysis of factors affecting survival was performed using a Cox proportional hazards model.

Results: One hundred one of 764 total esophagectomy patients received induction therapy and had one or more +LNs on pathology. Forty-five of these patients also received adjuvant therapy: 15 (33%) received adjuvant chemotherapy alone, 23 (51%) received adjuvant radiation alone, and seven (16%) received both. Pathological stage was IB in one patient (2%), IIB in 20 (44%), IIIA in 19 (42%), and IIIB in five (11%). Among 56 node-positive patients receiving induction, but not adjuvant therapy, pathological stage was IB in four (7%), IIB in 24 (43%), IIIA in 18 (32%), IIIB in seven (13%), and IIIC in three (5%). Neither age ($p = 0.36$) nor comorbidity score ($p = 0.35$) was different between cohorts. Median length of stay after resection (LOS) was shorter for the adjuvant cohort (10 days [6-33] vs 11 [7-67]; $p = 0.03$). Survival was longer in the adjuvant cohort (Figure; $p = 0.019$). Adjuvant therapy, LOS, and number of +LNs were associated with survival by multivariate analysis (Table).

Conclusions: Optimal management of node-positive patients after induction therapy and esophagectomy remains unclear. In this series, adjuvant therapy, LOS, and number of +LNs were associated with survival. A prospective trial may guide the assessment of the role of adjuvant therapy in this patient population.

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General Thoracic Session: Esophageal – Continued

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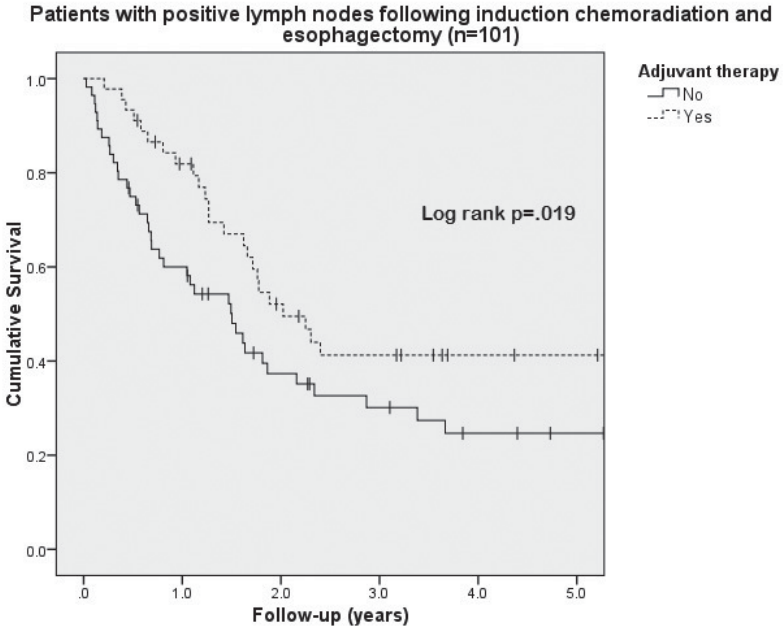


Cox proportional hazard regression model of factors associated with survival

Variable	Hazard Ratio	Confidence Interval	P-value
Length of stay (days)	1.052 per day	1.025 – 1.080	<.001
Number of positive nodes resected	1.183 per node	1.058 – 1.323	.003
Adjuvant therapy	0.522	0.314 – 0.934	.025
cT status (T3-4 vs. T0-2)	1.437	0.775 – 2.665	.249
Age	1.015 per year	0.987 – 1.044	.290
Total number of nodes resected	0.984 per node	0.955 – 1.014	.294
pT status (T3-4 vs. T0-2)	1.238	0.705 – 2.175	.457
ACE27 score	1.048	0.779 – 1.408	.758

2:30 PM ***Room 30AB***

Optimizing Functional Outcome After Esophagectomy

Kenneth A. Kesler, Indianapolis, IN

2:45 PM ***Room 30AB***

Serial Drain Amylase Levels Are Better than Barium Swallow in Ruling Out Anastomotic Leak Following Esophagectomy and May Safely Allow for Early Discharge

P. A. Linden, ***Y. Perry****, J. Kwong*

University Hospitals Case Medical Center, Cleveland, OH

Purpose: Anastomotic leaks following esophagectomy are a significant cause of postoperative morbidity and mortality. Barium esophagram (BE) and esophagogastroduodenoscopy (EGD) are commonly used to survey for leaks; however, each has inherent risks and limitations. Our group has begun evaluating for anastomotic leaks following both cervical and intrathoracic anastomoses by obtaining serial drain amylase levels. To date, there are no comprehensive studies comparing these tests.

Methods: We retrospectively reviewed 112 consecutive patients undergoing esophagectomy with both cervical and intrathoracic anastomosis. We collected daily drain amylase levels and obtained postoperative day 7 barium esophagrams to evaluate for leak. Diagnosis of leak was based on several different clinical variables. We chose any drain amylase level greater than 300 U/L within the first 5 days postop as positive for leak. The ability for each individual test to accurately diagnose an anastomotic leak was evaluated.

Results: 22/112 (19.6%) esophagectomy patients had a leak diagnosed by a combination of amylase levels, swallow, clinical factors, and endoscopy. The sensitivity and specificity for barium esophagram for these patients was 47.3% and 96%, respectively. The positive and negative predictive value for BE was 81% and 82%, respectively. For serial drain amylase, the sensitivity and specificity was 83% and 84.9%, respectively. Positive and negative predictive values were 65% and 93%, respectively. Additionally, several patients who were not sufficiently stable or alert enough to undergo barium swallow were diagnosed with an anastomotic leak by drain amylase levels alone.

Conclusions: Drain amylase levels recorded by day 5 have a better negative predictive value for esophageal anastomotic leak than barium swallow obtained on day 7. Drain amylase levels represent a noninvasive method potentially allowing for a safe, early discharge following esophagectomy.

1:00 PM – 3:00 PM ***Ballroom 20D***

General Thoracic Session: Lung Cancer II

Moderators: *Jessica S. Donington, New York, NY, and Michael Lanuti, Boston, MA*

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

Presenting authors are listed in **bold** on each abstract.

The physician competencies addressed in this session are patient care and procedural skills and medical knowledge. These physician competencies will be addressed through a series of individual lectures and a brief question-and-answer session after each topic.

1:00 PM ***Ballroom 20D***

A Decision and Cost-Effectiveness Analysis of Surgical Resection in Clinical Stage IIIA Non-Small Cell Lung Cancer at Academic and Non-Academic Centers

P. P. Samson[1], *A. Patel*[1], *C. Robinson*[1], *D. Morgensztern*[1], *S. Chang*[1], *G. Colditz*[1], *S. Waqar*[1], *T. P. Crabtree*[3], *A. S. Krupnick*[3], *S. R. Broderick*[4], *D. Kreisel*[3], *G. A. Patterson*[1], *B. F. Meyers*[1], *V. Puri*[1]

[1]*Washington University School of Medicine, St Louis, MO,* [3]*Barnes-Jewish Hospital/Washington University in St Louis, MO,* [4]*St Luke's Hospital, Chesterfield, MO*

COMMERCIAL RELATIONSHIPS B. F. Meyers: Consultant/Advisory Board, Ethicon, Inc, Varian Medical Systems, Inc

Purpose: To evaluate the relative cost-effectiveness of combination chemotherapy, radiation therapy, and surgery (CRS) vs definitive chemotherapy and radiation only (CR) in clinical Stage IIIA non-small cell lung cancer (NSCLC) patients at academic and non-academic centers.

Methods: Patients with clinical stage IIIA NSCLC receiving CR or CRS from 1998 to 2010 were identified in the National Cancer Database. Propensity score matching on patient and treatment characteristics was performed. Treatment center type was dichotomized into academic and non-academic facilities. Medicare allowable charges were used for treatment costs. The incremental cost effectiveness ratio (ICER) was based on probabilistic 5-year survival and calculated as cost per life-year gained.

Results: At non-academic centers, 6,402 matched patient pairs were identified for CR and CRS. Median survival was shorter for CR patients (16.9 months ± 0.3 months) than for CRS patients (33.5 months ± 1.0 months). From decision modeling, the incremental cost-effectiveness ratio (ICER) of surgery was $17,020. At academic centers, 3,268 matched patient pairs were identified for CR and CRS. Median survival was again shorter for CR patients (19.7 months ± 0.6 months) than for CRS patients (35.6 months ± 1.4 months). The ICER for surgery at academic centers was $18,270. Next, 3,713 academic center CRS patients were propensity matched to a non-academic CRS patient cohort. Academic patients had a small increase in both median survival (35.6 months ± 1 month vs 33.0 months ± 1 month) and overall effectiveness of surgery compared to non-academic patients. In this decision analysis model, academic centers dominated the non-academic institutions.

Conclusions: In Stage IIIA NSCLC, surgical resection is associated with a survival benefit that is cost-effective at both non-academic and academic centers within a conventional willingness-to-pay of $50,000. There is a small increase in cost-effectiveness for multimodality therapy at academic centers.

1:15 PM ***Ballroom 20D***

The Impact of Lymph Nodes Downstaging on Survival After Induction Chemotherapy for pN2 Non-Small Cell Lung Cancer

L. Spaggiari, *M. Casiraghi, A. Borri, F. Petrella, P. Solli, J. Guarize, P. Maisonneuve*

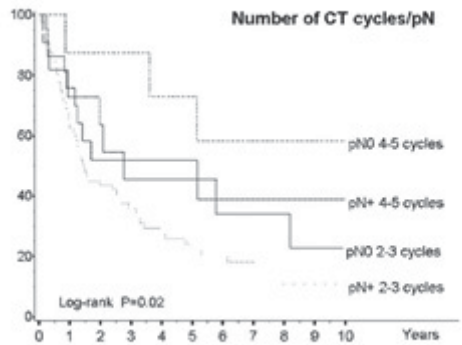
European Institute of Oncology, Milan, Italy

Purpose: Stage IIIA-N2 tumors are a heterogeneous group of patients with different clinical presentation. The aim of this study was to analyze a group of "potentially resectable" stage IIIA-pN2 non-small cell lung cancer (NSCLC) patients undergoing induction chemotherapy followed by surgery to identify prognostic factors to improve survival and to further investigate new therapy targets.

Methods: We retrospectively evaluated 141 patients with pathologically proven N2 NSCLC, with no clinical evidence of progression after induction chemotherapy. Most of the patients (73%) underwent at least three cycles of cisplatin-based induction chemotherapy. Fifteen patients (10.6%) undergoing explorative thoracotomy were excluded from the analysis. We used Kaplan-Meier method and log-rank test to assess difference of survival between groups. Multivariable analysis was performed using Cox proportional hazards regression.

Results: One hundred twenty-six patients with stable or response "potentially resectable" pN2 after induction chemotherapy underwent surgical anatomical resection after a median of 27 days (range 21-30) from the last cycle of chemotherapy. One hundred thirteen (90%) had a radical resection R0. Twenty-two patients (17%) had a pathologic downstaging (pN0) and eight (6%) a pathologic complete response. The median overall survival was 24 months, with a 5-year overall survival of 33%. At multivariable analysis, downstaging and number of cycles of chemotherapy were considered independent prognostic factors ($p < 0.02$); the benefit of downstaging was mostly due to complete pathological response ($p = 0.06$).

Conclusions: More than three cycles of chemotherapy and pathological downstaging significantly improved 5-year survival up to 75% in patients with "potentially resectable" pathologically proven N2 (Figure 1).



1:30 PM ***Ballroom 20D***

The Effects of a Multidisciplinary Care Conference on the Timeliness, Quality, and Cost of Care in Patients With Non-Small Cell Lung Cancer

R. K. Freeman*, A. J. Ascioti, M. Dake, R. Mahidhara*

St Vincent Hospital and Health System, Indianapolis, IN

Purpose: A prospective, multidisciplinary care conference (MDC) has been shown to result in measurable benefits for patients with non-small cell lung cancer (NSCLC) in single institutions. This investigation compares propensity-matched patients with NSCLC whose care was coordinated through an MDC to patients without access to an MDC across a geographically diverse system of hospitals.

Methods: The premiere database for a health system's 70 hospitals was used to identify patients undergoing treatment for NSCLC over a 5-year period. MDC and non-MDC cohorts were populated using propensity matching. Excluded were patients with other malignancies, recurrent NSCLC, and patients refusing all forms of treatment after diagnosis. The two cohorts were compared for the costs of staging and diagnosis, as well as the timeliness and quality of care metrics.

Results: Between 2008 and 2013, 13,254 patients were propensity matched. No differences in patient demographics or Charlson comorbidity scores were found. Significant differences were identified in adherence to national guidelines for staging and treatment, timeliness of care, and costs between the two groups as displayed in Table 1.

Conclusions: This investigation found that patients with NSCLC realize improved quality and timeliness of care, as well as a significant reduction in the cost of care, when that care is coordinated through an MDC. These differences persisted across a geographically diverse set of hospitals, providers, and patients. Prospective multidisciplinary conferences should be considered integral and compulsory for patients with NSCLC.

1:45 PM ***Ballroom 20D***

Salvage Pulmonary Resection for Stage III Non-Small Cell Lung Cancer After High-Dose Chemoradiotherapy

K. Suzuki[1], *S. Oh*[2], *T. Matsunaga*[2], *K. Takamochi*[2]

[1]*Juntendo School of Medicine, Tokyo, Japan,* [2]*Juntendo University, Tokyo, Japan*

Purpose: The standard treatment for stage III non-small cell lung cancer (NSCLC) is definitive chemoradiotherapy (ACCP guideline, Chest 2013). This policy is supported by the negative result of the North American Intergroup Trial 0139. Furthermore, high-dose radiotherapy of 74 Gy was shown to have a negative impact on lung cancer survival in the RTOG 0617 study. Thus, salvage surgery would be only modality for further local control.

Methods: Among 1,529 resected lung cancers between 2008 and 2013, there were 23 (1.5%) salvage pulmonary resections after definitive medical treatment. The indications for salvage were local relapse without distant metastasis or complications, such as lung abscess or hemoptysis, during chemoradiotherapy. Ages ranged from 55 to 81 years with a median of 63, and 19 patients were men. Stages were 12 IIIA and 11 IIIB. Fourteen patients had adenocarcinoma and four had squamous cell. Dose of preoperative irradiation ranged from 45 to 66 Gy with a median of 60 Gy. The interval between chemoradiation and surgery ranged from 1 to 120 months with a median of 12. We investigated short-term outcome and prognosis.

Results: There were no 30-day or 90-day mortalities. Pneumonectomy was performed in six patients, including two carinal resections. Lobectomies were performed in nine patients, including six sleeves. Postoperative complications were present in four patients (17%); two alveolar air leakages, one pneumonia, and one chylothorax needed operative repair. There was no relationship between any clinicosurgical factors and surgical outcomes. The 3-year overall and disease-free survival was 65.8% and 38.5%, respectively.

Conclusions: Salvage lung resection for curative intent after chemoradiotherapy offered acceptable short-term outcome and prognosis, which should be further investigated in the near future.

2:00 PM ***Ballroom 20D***

Late-Breaking Abstract: Do Current Lung Cancer Screening Guidelines Apply in Populations With High Granulomatous Disease Prevalence? Results From the First Brazilian Lung Cancer Screening Trial (BRELT1)

R. Santos[1], *J. Franceschini*[1], *R. Chate*[1], *M. Ghefter*[1], *A. L. Trajano, J. Pereira, J. E. Succi*[2], *H. Fernando*[3], *R. Saad Junior*[4]

[1]*Hospital Israelita Albert Einstein, São Paulo, Brazil,* [2]*Federal University of São Paulo, Brazil,* [3]*Boston Medical Center, MA,* [4]*Faculdade de Ciências Médicas da Santa Casa de São Paulo, Brazil*

COMMERCIAL RELATIONSHIPS M. Ghefter: Consultant/Advisory Board, Johnson & Johnson; H. Fernando: Consultant/Advisory Board, CSA Medical, Galil

Please see page 8 of the Late-Breaking Abstract Book for the full text of this abstract.

2:15 PM ***Ballroom 20D***

Debate: Persistent N2 Disease Following Induction Therapy

PRO: *Stephen G. Swisher, Houston, TX*

CON: *Scott J. Swanson, Boston, MA*

COMMERCIAL RELATIONSHIPS S. J. Swanson: Consultant/Advisory Board, Covidien Ltd, Ethicon Endo-Surgery, Inc; S. G. Swisher: Consultant/Advisory Board, GlaxoSmithKline

1:00 PM – 3:00 PM ***Room 29D***

Patient Safety Symposium: Building a High-Performance Team for Patient Safety

Cardiothoracic surgeons oversee multidisciplinary teams in a complex environment, not unlike high-functioning teams in sports, aviation, and the military. The competencies addressed in this symposium are targeted at team building and include: adopting tools to assess situational awareness in the operating room, using simulation training to enhance technical skills, employing checklists to optimize team performance during crisis situations, and developing leadership skills related to information transfer and communication. These competencies will be addressed through a series of individual lectures, panel discussions, and audience interactions.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Identify characteristics of high-functioning teams
- Describe strategies to assess and develop leadership skills
- Identify ways to implement simulation team training for new technology
- Describe the benefit of crisis checklists and drills for team training
- Define opportunities for team building and training with patient safety objectives

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

The physician competencies addressed in this session are patient care and procedural skills and medical knowledge. These physician competencies will be addressed through a series of lectures and a panel discussion.

Moderators: *Stephen D. Cassivi, Rochester, MN, and J. Michael DiMiao, Dallas, TX*

1:00 PM **Welcome and Introduction**

1:05 PM **Building Leadership in Patient Safety Within the Hospital Setting**
Susan D. Moffatt-Bruce, Columbus, OH

1:30 PM **Building a Safe Team Through Standardization: Lessons From the Aviation Industry**
Dann J. Runik, Dallas, TX

2:05 PM **Building a Culture of Teamwork: Lessons From the Battlefield**
Walter B. Franz III, Rochester, MN

2:30 PM **Panel Discussion and Questions**

2:55 PM **Summary**

NOTES

1:00 PM – 3:00 PM ***Room 33ABC***

STS/EACTS: Management of the Aortic Arch in Aortic Dissection

This session, presented by STS and the European Association for Cardio-Thoracic Surgery, concentrates on dilemmas at the arch faced by all cardiac surgeons who repair acute type A aortic dissections.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Explain the rationale for arch reconstruction in acute type A aortic dissection
- Evaluate when to proceed with hemiarch vs extensive total arch reconstruction in acute type A dissection
- Identify the role of distal aortic endografting and potential aortic remodeling during the treatment of acute type A dissection

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

The physician competencies addressed in this session are patient care and procedural skills, medical knowledge, and interpersonal and communication skills. These physician competencies will be addressed through a series of collaborative lectures by members of The Society of Thoracic Surgeons and the European Association for Cardio-Thoracic Surgery.

Moderators: *Joseph E. Bavaria, Philadelphia, PA, and Ruggero De Paulis, Rome, Italy*

COMMERCIAL RELATIONSHIPS J. E. Bavaria: Research Grant, W. L. Gore & Associates, Inc

1:00 PM ***Room 33ABC***

Technical Arch Options for Type A Dissection

Joseph E. Bavaria, Philadelphia, PA, and Ruggero De Paulis, Rome, Italy

COMMERCIAL RELATIONSHIPS J. E. Bavaria: Research Grant, W. L. Gore & Associates, Inc

1:15 PM ***Room 33ABC***

Axillary Artery Cannulation in Penn A Acute Aortic Dissection: Simple, Straightforward, But Is It Always Safe?

M. Buonocore[1], *A. Caiazzo*[1], *C. Amarelli*[2], *G. Petrone*[1], *G. Nappi*[1], *M. Scardone*[3], *P. Santè*[1]

[1]*Second University of Naples, Italy,* [2]*Az dei Colli, Naples, Italy,* [3]*Monaldi Hospital, Naples, Italy*

Purpose: Despite improvements in surgical techniques, neurologic injury still plays a major role after surgery for type A acute aortic dissection. Axillary artery cannulation has been introduced to simplify and ameliorate surgical management. Penn classification accurately predicts operative and hospital mortality. Bamford classification was applied to describe postoperative stroke when occurred and was correlated to clinical and surgical variables.

Methods: During 8 years of experience in a single center, 111 out of 183 patients underwent surgery for Penn A (the group at lower risk of mortality and morbidity) acute aortic dissection. Fifty-five patients received femoral cannulation and 56 received axillary cannulation. Surgical variables and outcomes and patterns of neurological damages were compared between the two groups of cannulation sites.

Results: Patients undergoing axillary artery cannulation had lower cardiopulmonary bypass time (183 min ± 61.9 min vs 205 min ± 69.2 min; $p = 0.08$) and significantly lower time of myocardial ischemia (60.9 min ± 30.44 min vs 81.7 min ± 52.2 min; $p = 0.01$) and time of cerebral perfusion (42.1 min ± 25.5 min vs 52.9 min ± 32.6 min; $p = 0.05$) when compared to femoral artery cannulation, with comparable perfusion variables (temperature, flow, lower hematocrit, higher lactate dosage after circulatory arrest). Looking at rough neurologic damage, incidence was similar (25.5% vs 16.1%), but following Bamford classification, patients undergoing axillary cannulation had a significantly higher risk of Lacunar Infarct (LACI) damage than patients undergoing femoral cannulation (10.9% vs 3.6%, $p = 0.06$). Furthermore, damage was more frequently located on the left hemisphere in the axillary group (14.5% vs 9.1%), while in the femoral cannulation there wasn't any difference (5.4% vs 7.1%).

Conclusions: In our experience, axillary artery cannulation is associated with an easier and more straightforward surgery, but is also associated with an increased risk of cerebral stroke type LACI of the left hemisphere. Accurate neurologic monitoring is suggested when axillary cannulation is performed in the setting of acute aortic dissection.

1:30 PM ***Room 33ABC***

Hybrid Type II Debranching Arch for Acute DeBakey I Dissection

Jehangir J. Appoo, Calgary, Canada

1:45 PM **Room 33ABC**

Aggressive Aortic Arch Replacement Strategy for Type A Dissection Based on Carotid Arterial Involvement or Intra-Arch Tear: Following a Strict Neurocerebral Protection Protocol Improves Outcomes

D. Trivedi, F. Navid, J. Balzer, ***T. G. Gleason***

University of Pittsburgh, PA

Purpose: International registries for aortic dissection demonstrate operative mortality rates in excess of 20% and stroke rates of 9%-25%. A system-wide standardized protocol with a defined algorithm for rapid transport, intraoperative management, and long-term surveillance will significantly improve outcomes. In 2007, this protocol was initiated for a 14-hospital health system.

Methods: Two hundred sixty-four consecutive acute type A dissections were treated per protocol with root repair/replacement and either hemi-arch (167) or total arch (92) replacement based on carotid involvement or an intra-arch tear. Cannulation was via the ascending aorta (76.8%, 203 patients), right subclavian (17.8%, 47 patients), or femoral (5.3%, 14 patients) with isolated retrograde cerebral perfusion (RCP) (59.4%, 157 patients) or antegrade cerebral perfusion (ACP) (38.2%, 101 patients). Neurocerebral monitoring with continuous electroencephalography (EEG) and somatosensory evoked potentials (SSEP) was used in 100% of cases to guide a safe period of circulatory arrest and direct postoperative imaging for identified changes. Long-term follow-up is complete. Data were collected prospectively and analyzed by logistic regression.

Results: Median diagnosis-to-incision time was 131 min ± 81 min. Thirty-day mortality and stroke rates were: 9.8% (26) and 3% (8) overall, 7% (11) and 2.5% (4) for isolated RCP, and 14.8% (15) and 3.9% (4) for ACP, respectively. 12.8% (34) patients had intraoperative EEG/SSEP changes. Mesenteric or neurocerebral malperfusion, need for concomitant coronary artery bypass grafting, cardiopulmonary bypass time, and intraoperative EEG/SSEP change predicted mortality. Only intraoperative EEG/SSEP change predicted stroke with a negative predictive value of 98.3%. Age, BMI, and reoperation for bleeding predicted prolonged length of stay.

Conclusions: Strict adherence to a standardized management protocol optimizes outcomes for type A dissection. Central cannulation and use of isolated RCP are appropriate for most patients, but carotid arterial involvement or an intra-arch tear should direct total arch replacement. A negative intraoperative EEG/SSEP strongly predicts both survival and neurologic recovery.

2:00 PM **Room 33ABC**

Frozen Elephant Trunk for DeBakey Type I Dissection

Malakh L. Shrestha, Hannover, Germany

REGULATORY DISCLOSURE This presentation will address the Vascutek Thoraflex frozen elephant trunk, which is not FDA approved. This presentation will also address the Jotec Evita, which is not FDA approved.

2:15 PM **Room 33ABC**

Optimal Technical Strategy for Acute DeBakey I Dissection: The Zone 2 Arch (Video)

Nimesh Desai, Philadelphia, PA

COMMERCIAL RELATIONSHIPS N. Desai: Consultant/Advisory Board, St Jude Medical, Inc; Speakers Bureau/Honoraria, Medtronic, Inc, W. L. Gore & Associates, Inc

REGULATORY DISCLOSURE This presentation will address the Gore TSB graft in the setting of acute dissection, which has an FDA status of investigational.

2:30 PM **Room 33ABC**

Is Total Arch Replacement Associated With Worse Outcomes During Repair of Acute Type A Aortic Dissection?

R. Rice[1], *H. Sandhu*[2], *S. Leake*[1], *K. Charlton-Ouw*[1], *A. Azizzadeh*[1], *T. C. Nguyen*[3], *C. Miller*[1], *H. J. Safi*[1], *A. L. Estrera*[1]

[1]*University of Texas Health Science Center, Houston,* [2]*University of Texas Medical School, Houston,* [3]*University of Texas Houston – Memorial Hermann*

COMMERCIAL RELATIONSHIPS A. Azizzadeh: Consultant/Advisory Board, Medtronic, Inc, W. L. Gore & Associates, Inc; A. L. Estrera: Consultant/Advisory Board, W. L. Gore & Associates, Inc; Speakers Bureau/Honoraria, MAQUET

Purpose: As hybrid endovascular techniques expand, some centers have adopted a more aggressive approach to the management of the arch during acute type A aortic dissection (ATAAD). The purpose of this study was to compare the outcomes of total arch repair vs ascending/hemiarch repair for ATAAD.

Methods: We retrospectively reviewed our prospectively maintained database of ATAAD between October 1999 and February 2013. Patients were divided into two groups: total arch repair vs ascending or hemiarch repair. Indications for arch replacement during ATAAD include aneurysm >5 cm, complex arch tear, and arch rupture. In-hospital and long-term outcomes were compared between two groups using Kaplan-Meier and log-rank statistics

Results: During the study period, we performed 387 repairs of ATAAD that were divided into 33 patients (9%) with total arch replacement and 354 patients (91%) with ascending or hemiarch replacement. Patients with total arch were older (63.5 years ± 13.7 years vs 57.6 years ± 14.5 years, $p > 0.03$) and had more frequent antegrade cerebral perfusion use, 15.2% vs 0.6%, $p > 0.0001$, but were otherwise no different than the ascending/hemiarch group. Postoperative outcomes were no different between groups (see Table 1).

Conclusions: In our experience, replacement of the entire transverse arch was not associated with worse outcomes when compared to conservative ascending/hemiarch replacement during acute type aortic dissection repair. A more aggressive approach with extended resection in order to prevent late distal complications may be considered. Further prospective evaluation is required.

Continued on next page

STS/EACTS: Management of the Aortic Arch in Aortic Dissection – Continued

Abstract continued from previous page

Table 1
Patient Characteristics

Variable	Asc / Hemi (%)	Total Arch (%)	OR*	p***
Overall	354 (91.5)	33 (8.5)		
Age (years)	57.6 ± 14.5	63.5 ± 13.7	-	0.03
Female	101 (28.5)	8 (24.2)	0.80	0.60
Rupture	58 (16.4)	7 (21.2)	1.37	0.48
Tamponade	57 (16.1)	6 (18.2)	1.16	0.76
Hypotension	75 (21.2)	6 (18.2)	0.83	0.68
Root repl	30 (8.5)	1 (3.0)	0.34	0.27
Bleeding	25 (7.1)	2 (6.1)	0.85	0.83
TND	54 (15.3)	3 (9.1)	0.56	0.34
Stroke	11 (3.1)	0 (0.0)	0.45	0.30
In-hosp Death	47 (13.3)	5 (15.2)	0.43	0.76

ACP - Antegrade Cerebral Perfusion; rDissect – retrograde dissection; In-hosp – In hospital death; TND – transient neurological deficit; Root repl - root replacement
Hypotension – defined as documented blood pressure below 90/50 mm of Hg
*For dichotomous variables, the odds ratio represents a test against a reference category whose referent odds ratio is equal to 1. For continuous data, the odds ratio refers to the increase in odds associated with a one-unit increase in the variable value.
** 95% CI = 95% confidence interval. This reflects the units against which its companion odds ratio is computed. Confidence intervals are test-based.
*** p = probability of Type I statistical error (common p value). Values without parentheses are Pearson Chi-square probabilities. Probability values in parentheses are univariate logistic regression likelihood ratio p values.

2:45 PM ***Room 33ABC***

Optimal Technical Strategy for Acute DeBakey I Dissection: Antegrade Thoracic Endovascular Aneurysm Repair With Hemi-Arch Procedure

Alberto Pochettino, Rochester, MN

NOTES

1:00 PM – 3:00 PM ***Room 30E***

Strategies to Improve Outcomes With Long-Term Mechanical Circulatory Support Devices

Advanced mechanical device technologies for cardiac and pulmonary support are providing new opportunities for both temporary and long-term patient treatment options. Two sessions, one on Monday and the other on Tuesday, will cover the complexities of patient management and new mechanical circulatory support (MCS) device technologies associated with initiating and maintaining an advanced technologies program.

This session offers a series of lectures, followed by abstract presentations on long-term MCS, including durable implantable devices, and will address patient selection and new technologies and devices.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Identify a comprehensive selection of long-term devices
- Explain the importance of proper patient selection and timing of intervention
- Describe the complex infrastructure necessary to support a mechanical circulatory assist program
- Identify pitfalls in peri- and postoperative management
- Describe regulatory oversight of MCS therapy

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

The physician competencies addressed in this session are patient care and procedural skills and medical knowledge. These physician competencies will be addressed through a series of individual lectures and a brief question-and-answer session after each topic.

Moderators: *Joseph C. Cleveland Jr, Aurora, CO, and Nahush A. Mokadam, Seattle, WA*

COMMERCIAL RELATIONSHIPS N. A. Mokadam: Consultant/Advisory Board, HeartWare International, Inc, Syncardia Systems, Inc, Thoratec Corporation

1:00 PM ***Room 30E***

Alternative Surgical Approaches to Device Implantation: Evidence for a Better Outcome?

TBA

1:15 PM ***Room 30E***

Putting the Pulse Back Into Continuous Flow Pumps: Importance of Pulse and MCS Device Complications

Robert L. Kormos, Pittsburgh, PA

REGULATORY DISCLOSURE This presentation will address the Thoratec HeartMate III device, which has an FDA status of investigational. This presentation will also address the HeartWare MVAD, which has an FDA status of investigational.

1:30 PM ***Room 30E***

Optimal Management of Valvular Heart Disease at MCS Device Implant

Scott C. Silvestry, St Louis, MO

COMMERCIAL RELATIONSHIPS S. C. Silvestry: Research Grant, HeartWare International, Inc, Thoratec Corporation; Consultant/Advisory Board, HeartWare International, Inc, Thoratec Corporation

1:45 PM **Room 30E**

Increasing Frequency of Left Ventricular Assist Devices Exchange in the United States: Is There Cause for Concern?

F. H. McCarthy[1], *D. Kobrin*[1], *J. Rame*[1], *P. Groeneveld*[1], *M. A. Acker*[2], *N. Desai*[1]

[1]*University of Pennsylvania, Philadelphia,* [2]*University of Pennsylvania Medical Center, Philadelphia*

COMMERCIAL RELATIONSHIPS M. A. Acker: Consultant/Advisory Board, HeartWare International, Inc, Thoratec Corporation; N. Desai: Consultant/Advisory Board, St Jude Medical, Inc; Speakers Bureau/Honoraria, Medtronic, Inc, W. L. Gore & Associates, Inc

Purpose: Recent reports indicate an increased prevalence and earlier onset of pump thrombosis and associated pump exchanges in patients implanted with left ventricular assist devices (LVAD), but questions remain regarding the clinical impact and current rate of pump exchanges.

Methods: All US Medicare fee-for-service patients undergoing LVAD implantations (n=3,166) between January 1, 2009, and December 31, 2012, were identified by procedural codes present on carrier claims collected by the Centers for Medicare & Medicaid Services. Pump exchange, pump removal, and heart transplantation procedures were identified by subsequent carrier claims for each patient, and date of death was collected from Medicare denominator files. The Elixhauser comorbidity index was applied to present on arrival diagnosis codes at the index hospitalization to generate common comorbidities.

Results: Compared to patients implanted prior to March 1, 2011, patients implanted after March 1, 2011, were older on average (63.9 years vs 61.2 years, $p < 0.01$), more likely to be male (82.3% vs 79.4%, $p = 0.04$) and had higher incidence of common comorbidities (Table 1). Patients from the later cohort had higher occurrence of pump exchange by Kaplan-Meier time-to-event estimates (Figure 1, $p < 0.01$) and fisher exact tests for patients with adequate possible follow-up at 3 months (.5 vs .3, $p = 0.02$), 6 months (1.6 vs .7, $p < 0.01$), and 12 (3.5 vs 1.6, $p < 0.01$) months (Figure 1). Cox regression analysis found that time-dependent pump exchange was associated with substantially worse survival (HR 2.5, 95% CI 1.8–3.4, $p < 0.01$) after adjusting for age, gender, and common comorbidities.

Conclusions: Although LVAD exchanges remain relatively uncommon, a significant increase in the incidence of the procedure has been seen since March 1, 2011. Pump exchanges are highly associated with mortality and further research is required to understand the causes of this disturbing trend.

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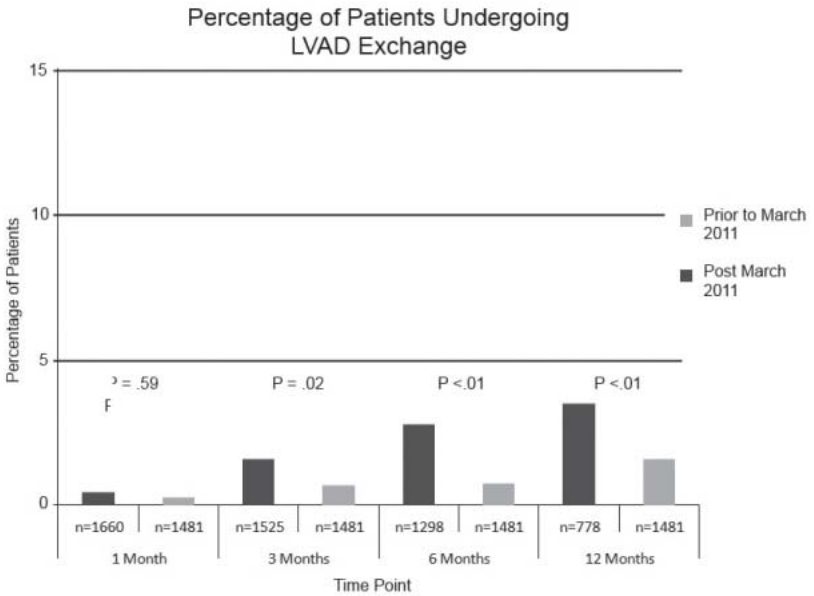
Strategies to Improve Outcomes With Long-Term Mechanical Circulatory Support Devices – Continued

Abstract continued from previous page



	Total (n=3166)	Post March 2011 (n=1685)	Pre March 2011 (n=1176)	P
Male	81.0 (2563)	82.3 (1387)	79.4 (1176)	0.04
Age (years)	62.6 (± 11.6)	63.9 (± 11.4)	61.2 (± 11.7)	<0.01
Diabetes	56.5 (1788)	58.1 (979)	54.6 (809)	0.05
Chronic Kidney Disease	67.6 (2139)	73.7 (1241)	60.6 (898)	<0.01
Obesity	22.7 (719)	28.7 (483)	15.9 (236)	<0.01

2:00 PM **Room 30E**

Left Ventricular Assist Device Inflow Position and Pump Migration Adversely Impact LVAD Function

T. Kazui[1], *A. Zhang*[1], *J. Greenberg*[2], *A. Itoh*[1], *A. Keith*[2], *G. Ewald*[1], *S. C. Silvestry*[2]

[1]*Barnes-Jewish Hospital/Washington University in St Louis, MO,* [2]*Washington University School of Medicine, St Louis, MO*

COMMERCIAL RELATIONSHIPS G. Ewald: Consultant/Advisory Board, HeartWare International, Inc, Thoratec Corporation; S. C. Silvestry: Research Grant, HeartWare International, Inc, Thoratec Corporation; Consultant/Advisory Board, HeartWare International, Inc, Thoratec Corporation

Purpose: Severe left ventricular assist device (LVAD) dysfunction necessitates pump exchange or urgent heart transplant adversely impact patients' survival. A single center report has suggested the role of cannula angle and pump position on LVAD failure. This study investigates the impact of LVAD malposition and the incidence of pump dysfunction/failure in a large series of HeartMate II (HM2) patients from a high-volume center.

Methods: Patients (n=311) who received primary HM2 LVAD between January 2008 and December 2013 at a single institution were retrospectively reviewed. Patients who underwent pump exchange for pump dysfunction/failure (PD) and patients with no pump dysfunction (NL) were compared. The angle of the inflow cannula (IC) and LVAD body (IL angle) were measured by routine chest x-ray at three time points (postoperatively, before discharge, and at follow-up). Pump position was assessed based on the position relative to the diaphragm (Figure). Pump migration was evaluated as difference in position from discharge and follow-up. Patients were also grouped by IC acute angulation (<65 degree) (malposition, MP) and the presence of pump migration (PM).

Results: Twenty-one patients were in PD (19 male) and 290 (171 male) patients were in NL. The average follow-up period was 15.8 months ± 15.0 months and 14.2 months ± 12.7 months in PD and NL. There were significant differences in IL angle between NL and PD at all time points. NL: PD, 63.6 ± 12.5 and 70.6 ± 12.3 at postoperatively (p = 0.018), 64.4 ± 12.8 and 69.5 ± 10.5 at before discharge (p = 0.039), 62.6 ± 14.2 and 67.9 ± 11.2 at follow-up (p = 0.002). There was no difference in INTERMACS profile in each group. However, 67% of pump position in PD migrated as opposed to 36% in NL (p = 0.019). Among 94 patients who had pump migration at the follow-up, 84 patients didn't develop pump dysfunction. Among 86 patients who had pump malposition post-operation, 75 patients didn't develop pump dysfunction (Table).

Conclusions: In this cohort of HM2 recipients, acute angulation and pump migration was associated with pump dysfunction and LVAD exchange. However, the majority of patients with MP (90%) and PM (87%) did not develop pump dysfunction or require exchange. These data suggest that pump position and migration may contribute to LVAD dysfunction/failure, but positional factors do not entirely account for observed pump dysfunction/failure.

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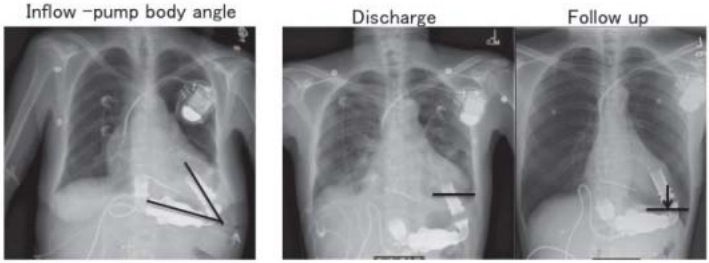
Strategies to Improve Outcomes With Long-Term Mechanical Circulatory Support Devices – Continued

Abstract continued from previous page



Table

	Pump exchange n=21	No pump dysfunction n=290
Age	55 ± 13	56 ± 12
Male	19 (90.5%)	171 (82.5%)
INTERMACS		
1	6 (29%)	91 (31%)
2	12 (57%)	170 (59%)
3	1 (5%)	18 (6%)
4	2 (9%)	11 (4%)
Maximum LDH (IU/l)	2940 ±2192*	912 ± 969*
BMI pre op	29.3 ± 6.0	29.0 ± 5.8
BMI at outcome	29.3 ± 5.7	29.0 ± 6.1
X ray angle: inflow-pump body		
Post op (degree)	63.6 ± 12.5*	70.6 ± 12.3*
Discharge (degree)	64.4 ± 12.2*	69.6 ± 10.5*
Follow up (degree)	62.6 ± 14.2*	67.9 ± 11.2*
Pump migration (n=94)	10 (10%)#	84 (90%)
No pump migration (n=152)	5 (3%)#	147 (97%)
Pump malposition (n=86)	11 (13%)♮	75 (87%)
No pump malposition (n=225)	10 (4%)♮	215 (96%)

*: p<0.05, #: p<0.05, ♮: p<0. 05

2:15 PM **Room 30E**

Contributory Role of PET-CT in Diagnosis and Clinical Management of Infections in Patients Supported With a Continuous-Flow Left Ventricular Assist Device

A. Maria Dell Aquila[1], S. Mastrobuoni[2], S. Alles[1], J. Sindermann[1], M. Scherer[1]

[1]University Hospital Münster, Germany, [2]St Luc's Hospital, Universite Catholique du Louvain, Brussels, Belgium

COMMERCIAL RELATIONSHIPS M. Scherer: Consultant/Advisory Board, Thoratec Corporation

Purpose: The current study sought to demonstrate the advantages offered by PET-CT in patients supported with continuous-flow left ventricular assist devices (CF-LVADs) and the consequent impact on clinical decisions.

Methods: Between April 2009 and September 2013, a total of 40 PET-examinations were performed in 31 patients (78.1% men, mean age 51.0 years ± 14.9 years) supported with a CF-LVAD (third generation LVAD in 77.4%). In group A (19 examinations), PET-CT was performed in order to detect infectious focus in patients with positive blood culture but without external signs of driveline involvement. In group B (21 examinations), PET-CT aimed to assess the internal extension of infection in patients with external signs of driveline infection.

Results: In 50.0% of the cases in group A, abnormal F-18 fluorodeoxyglucose (FDG) uptake (9 patients) was related to VAD components. Matching the results with the final diagnosis, we reported nine true positive, eight true negative, no false negative, and two false positive. New information not related to VAD was found in nine cases (50%): pneumonia in three, colon diverticulitis in three, sternal dehiscence in one, paravertebral abscess in one, and erysipelas in another case. In group B, superficial abnormal FDG uptake was found at the piercing site of the driveline in two patients, deeper extension of infection along the driveline in 10, initial involvement of the pump housing and full involvement of the device in four and two, respectively. These findings changed the clinical management in 84.21% and in 85.71% of the cases of group A and B, respectively: 16 patients were scheduled for urgent transplantation, four underwent surgical revision of the driveline, prolonged antibiotic therapy was needed in seven, and a colonoscopy was required in three cases.

Conclusions: This single-center experience highlights the diagnostic value of PET-CT in detecting the localization and internal extension of infection to internal VAD components. Moreover, this information notably influences the therapeutic management.

2:30 PM **Room 30E**

Long-Term Progression of Aortic Insufficiency Is Less in Patients Supported With HVAD LVADs Compared to HeartMate II Patients

S. C. Silvestry[1], *T. Kazui*[2], *A. Keith*[2], *G. Ewald*[3], *A. Itoh*[3]

[1]*Washington University in St Louis, MO,* [2]*Washington University School of Medicine, St Louis, MO,* [4]*Barnes-Jewish Hospital/Washington University in St Louis, MO*

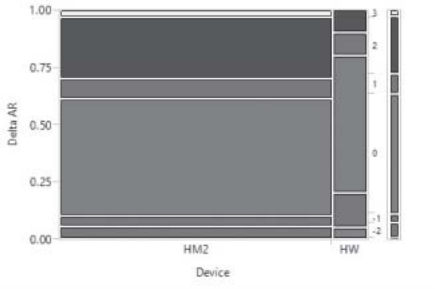
COMMERCIAL RELATIONSHIPS G. Ewald: Consultant/Advisory Board, HeartWare International, Inc, Thoratec Corporation; S. C. Silvestry: Research Grant, HeartWare International, Inc, Thoratec Corporation; Consultant/Advisory Board, HeartWare International, Inc, Thoratec Corporation

Purpose: The development of significant aortic insufficiency (AI) with continuous-flow left ventricular devices (CF-LVADs) is a significant problem associated with prolonged duration of support. Factors impacting AI include less native heart ejection, hypertension, and the presence of AI at LVAD implant. To date, no study has examined differences between CF-LVADs and progression of AI.

Methods: We retrospectively reviewed echocardiographic assessments from primary LVAD implants for patients receiving either the HeartMate II (HMII) or HeartWare (HW) ventricular assist devices between January 16, 2009, and May 24, 2013. We estimated the effect of continuous-flow assist devices on valvular function by calculating the change in valve dysfunction (0=none, 1=trace, 2=mild, 3=moderate, and 4=severe) from the preoperative to the last postoperative assessment. A chi-square test of independence was performed to examine the relationship between the two devices.

Results: The average follow-up in days for HMII patients (n=167) was 297.6 ± 307.5 and 208.1 ± 235.6 for HW patients (n=21) (p = 0.125). The average age in years was 54.8 ± 13.9 and 59.0 ± 12.1 for HMII and HW patients, respectively (p = 0.152). Pulmonary artery systolic pressures were not different between the groups at implant. Post-implantation, a significantly lower number of HW patients experienced worsened aortic insufficiency, with a total of 20.0% progressing one (10.0%) or two (10.0%) grades vs a total of 38.76% in the HMII group declining by one (8.75%), two (26.88%), and three (3.13%) grades (X2=14.16, p = 0.028). There was no difference seen between devices regarding the change in mitral or tricuspid valve performance (X2=8.65, p = 0.279 and X2=6.70, p = 0.569, respectively). No patient in either group underwent isolated procedures for aortic insufficiency. Post-implant, HM patients had a higher mean pulmonary artery systolic pressure (PASP) of 31.7 mm Hg ± 10.5 mm Hg vs 24.0 mm Hg ± 8.6 mm Hg in HW patients (p = 0.007).

Conclusions: Progression of AI was significantly less in HW patients compared to HMII patients. Mitral insufficiency did not differ between the groups, suggesting adequate unloading in both groups with greater PASP unloading with HW. The reason for these observed differences is not clear and may be related to unloading mechanisms, differences in outflow graft size, or aortic anastomotic differences.



2:45 PM ***Room 30E***

Discussion

1:00 PM – 5:00 PM ***Room 29AB***

JCTSE/STS Workforce on International Relationships: Globalization of Graduate Surgical Education in Cardiothoracic Surgery

This session, from the Joint Council on Thoracic Surgery Education and the STS Workforce on International Relationships, will focus on new educational approaches to cognitive and technical skills acquisition for trainees in cardiothoracic surgery. Featured speakers from around the world will explain how the internet and electronic options, such as learning management systems, are rapidly allowing the globalization of educational approaches from preschool to graduate medical education. This session will also describe how these options can be implemented into surgical education on a global scale and how the global population of patients with cardiothoracic disease will be impacted.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Outline what role e-learning systems can play in the instruction and assessment of cardiothoracic surgical training
- Define the global initiatives in cardiothoracic surgical education
- Discuss if current electronic content and learning management systems can contribute to the globalization of quality resident education
- Evaluate how much individualization of e-learning systems is necessary for adoption in the global marketplace
- Estimate the reasonable cost expectations in e-learning should the thoracic surgical community consider such a direction
- Identify the barriers to globalizing resident education in cardiothoracic surgery

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

The physician competencies addressed in this session are professionalism and interpersonal and communication skills. These physician competencies will be addressed through a series of lectures followed by in-depth discussion.

Moderator: *Edward D. Verrier, Seattle, WA*

1:00 PM **Welcome and Introduction**

1:10 PM **Intercollegiate Surgical Curriculum Programme: Lessons Learned in Curriculum Development/Can Such Efforts Be Globalized?**
Chris Munsch, Leeds, United Kingdom
COMMERCIAL RELATIONSHIPS C. Munsch: Speakers Bureau/Honoraria, Vascutek UK

1:25 PM **Discussion**

1:40 PM **Standards for Technical Skill Proficiency: Can Such Skills Be Measured and Applied?**
James I. Fann, Stanford, CA, and Paul T. Sergeant, Leuven, Belgium
COMMERCIAL RELATIONSHIPS J. I. Fann: Consultant/Advisory Board, Apica Cardiovascular; P. T. Sergeant: Other, Ethicon, Inc, Medtronic, Inc, Educational consultancy without any direct personal benefit or income

1:55 PM **Discussion**

2:10 PM **JCTSE Creation of a Content and Learning Management System: Potential Global Applicability**
Craig J. Baker, Los Angeles, CA, and Stephen C. Yang, Baltimore, MD

2:25 PM **Discussion**

2:40 PM **Can Formative Feedback and Electronic Curriculum Design Provide Meaningful Alternatives to Summative Examinations?**
Ara A. Vaporciyan, Houston, TX

2:55 PM **Discussion**

3:10 PM **Break**

3:25 PM **Perspectives of the European Board of Thoracic and Cardiovascular Surgery: Are Credentialing Standards Local?**
Timothy R. Graham, Birmingham, United Kingdom, and Jose L. Pomar, Barcelona, Spain
COMMERCIAL RELATIONSHIPS J. L. Pomar: Speakers Bureau/Honoraria, Abbott, Edwards Lifesciences Corporation, Medtronic, Inc; Consultant/Advisory Board, iVascular

3:40 PM **Discussion**

3:55 PM **Perspectives of the Asian Society of Cardiovascular and Thoracic Surgery: Representing 60% of the World Population and Immense Surgical Training Challenges**
Yuichi Ueda, Nara, Japan

4:10 PM **Discussion**

4:20 PM **Perspectives of the Brazilian Society of Cardiovascular Surgery: Would Standardizing the Curriculum Improve Competency?**
Walter J. Gomes, São Paulo, Brazil

4:35 PM **Discussion**

4:45 PM **Panel Discussion**
Kazuhiro Hashimoto, Tokyo, Japan, and A. Pieter Kappetein, Rotterdam, The Netherlands

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3:00 PM – 3:30 PM

BREAK—Visit Scientific Posters

3:30 PM – 5:30 PM ***Ballroom 20D***

Adult Cardiac Session: Aortic Valve

Moderators: *Wilson Y. Szeto, Philadelphia, PA, and Vinod H. Thourani, Atlanta, GA*

COMMERCIAL RELATIONSHIPS W. Y. Szeto: Research Grant, Edwards Lifesciences Corporation, Medtronic, Inc, SORIN GROUP; Consultant/Advisory Board, Micro Interventional Devices, Inc; V. H. Thourani: Research Grant, Edwards Lifesciences Corporation, Medtronic, Inc, SORIN GROUP; Consultant/Advisory Board, Boston Scientific, St Jude Medical, Inc; Ownership Interest, Apica Cardiovascular

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

Presenting authors are listed in **bold** on each abstract.

The physician competencies addressed in this session are patient care and procedural skills and medical knowledge. These physician competencies will be addressed through a series of individual lectures and a brief question-and-answer session after each topic.

3:30 PM ***Ballroom 20D***

Transfemoral Transcatheter Aortic Valve Replacement Will Replace Aortic Valve Replacement in Aortic Stenosis Patients by 2017: Will You Be Left Behind?

Joseph E. Bavaria, Philadelphia, PA

COMMERCIAL RELATIONSHIPS J. E. Bavaria: Research Grant, W. L. Gore & Associates, Inc

3:45 PM ***Ballroom 20D***

Techniques for and State-of-the-Art Lecture for Aortic Valve Repair in Patient With Aortic Insufficiency

Gebrine El-Khoury, Brussels, Belgium

4:00 PM ***Ballroom 20D***

The Prognostic Impact of Chronic Lung Disease in 12,139 Patients Undergoing Transcatheter Aortic Valve Replacement: Results From the STS/ACC TVT Registry™

R. M. Suri[1], *V. H. Thourani*[2], *M. Brennan*[3], *K. L. Greason*[4], *D. Dai*[3], *V. Mathew*[1], *V. T. Nkomo*[1], *A. Zajarias*[5], *C. Rihal*[1], *C. M. Vassileva*[6], *M. J. Mack*[7], *D. R. Holmes*[1]

[1]*Mayo Clinic, Rochester, MN,* [2]*Emory University, Atlanta, GA,* [3]*Duke University, Durham, NC,* [4]*Mayo Medical Center, Rochester, MN,* [5]*Washington University, St Louis, MO,* [6]*Southern Illinois University School of Medicine, Springfield,* [7]*Baylor University, Plano, TX*

COMMERCIAL RELATIONSHIPS V. Mathew: Research Grant, Edwards Lifesciences Corporation; R. M. Suri: Research Grant, Abbott, Edwards Lifesciences Corporation, Medtronic, Inc, SORIN GROUP, St Jude Medical, Inc; Other, Abbott, Member of the Clinical Steering Committee, St Jude Medical, Inc, Member of the Steering Committee; V. H. Thourani: Research Grant, Edwards Lifesciences Corporation, Medtronic, Inc, SORIN GROUP; Consultant/Advisory Board, Boston Scientific, St Jude Medical, Inc; Ownership Interest, Apica Cardiovascular; A. Zajarias: Consultant/Advisory Board, Edwards Lifesciences Corporation; Research Grant, Edwards Lifesciences Corporation; M. J. Mack: Nonremunerative Position of Influence, Abbott Vascular, Edwards Lifesciences Corporation

Purpose: Chronic lung disease (CLD) is known to increase the risk of both surgical and transcatheter aortic valve replacement (TAVR). We sought to understand the prognostic impact of CLD severity upon outcomes following TAVR and the potential influence of transfemoral (TF) vs non-TF approaches in this patient population.

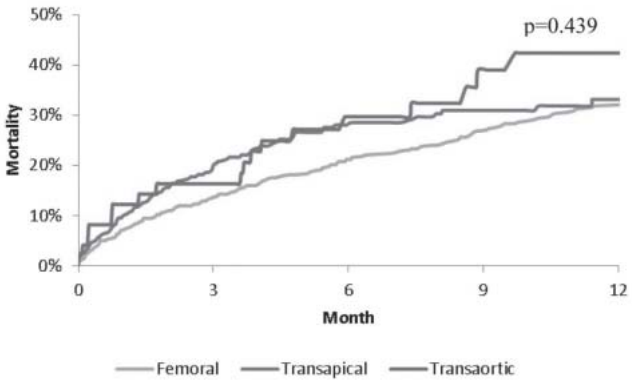
Methods: Patients undergoing TAVR (n=12,139) from 2011 to 2014 in the STS/ACC Transcatheter Valve Therapies (TVT) Registry™ were studied. In-hospital outcomes were evaluated in the overall cohort. One-year CMS-linked mortality and stroke data were

available in a subset of 6,012 patients. The risk-adjusted associations between access route and post-TAVR outcomes were stratified by CLD severity.

Results: In this cohort (median age, 84 years; 51% female), moderate-to-severe CLD was present in 28% (14% moderate, 14% severe); 50% of those with severe CLD required home oxygen. Compared to those with no or mild CLD, patients with severe CLD more frequently underwent a transaortic (TAo) approach (8% vs 4%, $p < 0.01$), but were similarly likely to be treated via transapical (TA) or TF routes. In those with severe CLD, in-hospital mortality was lower (5.2%, $p < 0.01$) in TF and similar for TA and TAo patients (8.8% vs 9.2%, $p = 0.98$); but these differences did not persist at 1 year (Figure). Although patients with severe CLD had a higher risk of post-TAVR 1-year mortality (adjusted HR 1.46, 95% CI 1.25-1.70 vs no/mild CLD); the 1-year adjusted risks of mortality and stroke were similar across TF, TA, and TAo access routes ($p = 0.19$ death and $p = 0.99$ stroke).

Conclusions: Among this very large, real-world cohort of patients undergoing TAVR, those with severe CLD had a higher risk of early- and mid-term death; however, no significant differences in mid-term mortality or stroke were observed across varying access routes. Further study is required to identify strategies to mitigate risk associated with severe CLD in patients undergoing TAVR.

Unadjusted Mortality Rate by Access Route among Patients with Severe Chronic Lung Disease



4:15 PM **Ballroom 20D**

Early Surgery for Infective Endocarditis With Cerebral Emboli Is Not Associated With Worsened Postoperative Outcomes

R. Sorabella[1], *S. Han*[2], *M. Grbic*[1], *H. Yerebakan*[1], *S. Vasan*[2], *M. Najjar*[4], *E. Castillero*[2], *J. Vandenberg*[2], *D. Lambert*[2], *P.A. Kurlansky*[3], *M. R. Williams*[1], *Y. Naka*[1], *M. Argenziano*[1], *C. Smith*[1], *H. Takayama*[4], *B. Kalesan*[1], *R. Gordon*[1], *I. George*[1]

[1]*Columbia University College of Physicians and Surgeons, New York, NY,* [2]*Columbia University, New York, NY,* [3]*Florida Heart Research Institute, Miami,* [4]*Columbia University Medical Center, New York, NY*

COMMERCIAL RELATIONSHIPS Y. Naka: Consultant/Advisory Board, Biomet, Inc, Medtronic, Inc, Thoratec Corporation, Transmedics Inc; M. Williams: Consultant/Advisory Board, Edwards Lifesciences Corporation, Medtronic, Inc; C. Smith: Other, Edwards Lifesciences Corporation, as Surgical PI, I receive reimbursement for travel and customary expenses related to PARTNER Trial management

Purpose: Surgery for patients presenting with infective endocarditis (IE) complicated by cerebrovascular accident (CVA) prior to 2 weeks of observation is thought to carry elevated risk of postoperative complications. Our aim is to compare outcomes of IE patients who undergo surgery early after embolic CVA diagnosis with patients without preoperative CVA.

Methods: All patients undergoing surgery for IE between 1995 and 2013 at our institution were reviewed. Patients undergoing surgery >14 days after CVA diagnosis (n=9) and those with purely hemorrhagic CVAs were excluded from analysis (n=6). In total, 320 patients were identified for inclusion and stratified according to the presence (STR, n=42) or absence (NoSTR, n=278) of a preoperative embolic CVA. Primary outcomes of interest were development of clinically significant postoperative CVA, length of stay, and 30-day mortality.

Results: Mean time to surgical intervention from CVA onset was 6.2 days ± 4.2 days. Aortic (n=125, 39%), mitral (n=106, 33%), multiple (n=82, 26%), and prosthetic (n=112, 35%) valves were affected equally in both STR and NoSTR groups. S. aureus (17 [41%] STR vs 60 [23%] NoSTR, $p = 0.01$) and annular abscess at surgery (22 [52%] STR vs 78 [28%] NoSTR, $p = 0.002$) were more prevalent in STR vs NoSTR, though the incidence of preoperative vegetation >1 cm was equivalent between groups. Other major comorbidities were comparable among cohorts. There was no significant difference in 30-day mortality (5 [12%] STR vs 22 [8%] NoSTR, $p = 0.37$), rate of clinically significant postoperative stroke (4 [10%] STR vs 14 [5%] NoSTR, $p = 0.27$) or postoperative length of stay (20.7 days ± 15.2 days STR vs 19.8 days ± 28.5 days NoSTR, $p = 0.84$] between groups.

Conclusions: Early surgical intervention in patients with IE complicated by preoperative embolic CVA does not lead to significantly worsened postoperative outcomes when compared to patients undergoing surgery without preoperative CVA. Early surgery in high-risk patients warrants consideration, particularly in those with S. aureus infection and/or annular abscess.

Table. Comparison of Treatment Groups

	STR	NoSTR	p-value
Demographics			
Total, n	42	278	
Age, years (mean ± SD)	54.7 ± 16.1	58.9 ± 16.0	0.11
Male, n (%)	182 (66)	25 (60)	0.45
Pre-op EF, % (mean ± SD)	54.9 ± 7.4	49.6 ± 11.4	<0.001
Clinical Characteristics, n (%)			
Hx of diabetes	8 (20)	61 (22)	0.72
Hx of MI	3 (7)	44 (16)	0.15
Hx of ESRD	6 (15)	31 (11)	0.60
Prior cardiac surgery	17 (42)	130 (47)	0.53
Vegetation > 10mm	17 (43)	108 (41)	0.82
Annular abscess	22 (52)	78 (28)	0.002
Organism, n (%)			
S. aureus	17 (41)	60 (23)	0.01
Coagulase-negative staphylococci	10 (24)	44 (17)	0.49
Viridans streptococci	2 (5)	27 (10)	0.40
Entercoccus species	4 (10)	40 (15)	0.34
Outcomes			
30-day mortality, n (%)	5 (12)	22 (8)	0.37
Post-op stroke, n (%)	4 (10)	14 (5)	0.27
Post-op LOS, days (mean ± SD)	20.7 ± 15.2	19.8 ± 28.5	0.84

Abbreviations: EF=ejection fraction, ESRD=end stage renal disease, LOS=length of stay, MI=myocardial infarction, SD=standard deviation

4:30 PM ***Ballroom 20D***

Sutureless vs Sutured Bioprostheses: A Single Center, Propensity-Matched Study

A. Messina*, E. Villa, M. Cirillo, M. Dalla Tomba, G. Troise*

Poliambulanza Foundation Hospital, Brescia, Italy

COMMERCIAL RELATIONSHIPS M. Cirillo: Other, SORIN GROUP, Proctor for Perceval valves

REGULATORY DISCLOSURE This presentation will address the Sorin Perceval device, which has an FDA status of investigational.

Purpose: The aim of this propensity-matched, single-center study was to compare early clinical and echocardiographic outcomes of patients undergoing aortic valve replacement (AVR) with sutured (Group A) vs sutureless bioprosthesis (Group B) for severe aortic valve stenosis.

Methods: We reviewed 324 AVR performed in our center from January 2012 to December 2013. Based on a propensity score analysis, two groups with 52 matched pairs were created. Variables used were age, sex, body surface area, left ventricular outflow tract diameter, NYHA class, diabetes, hypertension, associate procedures, and left ventricular ejection fraction. All patients received a clinical and echocardiographic evaluation at follow-up.

Results: Mean age was 79 years ± 5 years and 78 year ± 5 years in group A and B, respectively, with 61% of females in group A vs 76.9% in group B. Associate procedures were performed in 69% (18/26) of patients in group A vs 76.9% (20/26) group B (p = ns). Cardiopulmonary bypass and cross-clamp times were 136.6 min ± 49 min and 93.6 min ± 32.2 min in group A vs 91.6 min ± 20.1 min and 66.08 min ± 25.4 min in group B (p = 0.001). In-hospital mortality, stroke, and acute myocardial infarction were nihil in both groups. Median echocardiographic follow-up was 12 months (range: 4-12 months) and mean transprosthetic gradients were 14 mm Hg ± 6.4 mm Hg and 10.7 mm Hg ± 4.4 mm Hg (p = 0.06) in group A and B, respectively. Mean indexed Effective Orifice Area (EOA) was 0.88 cm^2/m^2 ± 0.47 cm^2/m^2 in group A and 0.91 cm^2/m^2 ± 0.24 cm^2/m^2 in group B (p = 0.08). No paravalvular leakage was found, while one (3.8%) mild intraprosthetic regurgitation was detected in group B. Mortality at follow-up was 3.8% (1/26) in each group.

Conclusions: This study highlights the shorter cross-clamp and CPB times obtained with sutureless prostheses in a cohort of patients with AVR and high prevalence of associate procedures. Better hemodynamic performance of sutureless valves did not reach significance and neither outcome differed. Long-term results and larger studies will clarify these issues.

4:45 PM **Ballroom 20D**

Transcatheter Aortic Valve Replacement in 531 Nonagenarians: An Analysis of the PARTNER Randomized and Nonrandomized Continued Access Trial

V. H. Thourani[1], *C. Don*[2], *S. Kodali*[6], *J. Rajeswaran*[3], *R. M. Suri*[4], *G. S. Aldea*[5], *E. Blackstone*[3], *V. Babaliaros*[1], *M. R. Williams*[6], *R. Makkar*[7], *L. G. Svensson*[3], *S. R. Kapadia*[3], *A. Pichard*[8], *W. Y. Szeto*[9], *B. G. Leshnower*[10], *G. Ailawadi*[11], *H. S. Manian*[12], *M. Leon*[6], *M. J. Mack*[13]

[1]*Emory University, Atlanta, GA,* [2]*University of Washington, Seattle,* [3]*Cleveland Clinic, OH,* [4]*Mayo Clinic, Rochester, MN,* [5]*University of Washington Medical Center, Seattle,* [6]*Columbia University Medical Center, New York, NY,* [7]*Cardiovascular Intervention Center, Los Angeles, CA,* [8]*Medstar Washington Hospital Center, Washington, DC,* [9]*University of Pennsylvania, Philadelphia,* [10]*Emory University School of Medicine, Atlanta, GA,* [11]*University of Virginia Health System, Charlottesville,* [12]*Washington University School of Medicine, St Louis, MO,* [13]*Baylor University, Plano, TX*

COMMERCIAL RELATIONSHIPS G. Ailawadi: Consultant/Advisory Board, Abbott, Edwards Lifesciences Corporation, Mitralign; Speakers Bureau/Honoraria, St Jude Medical, Inc; V. Babaliaros: Speakers Bureau/Honoraria, InterValve Inc; Consultant/Advisory Board, BARD Medical, Direct Flow Medical, Inc; S. Kodali: Consultant/Advisory Board, Edwards Lifesciences Corporation; Consultant/Advisory Board, Thubrikar Aortic Valve, Inc; M. Leon: Other, Edward Lifesciences Corporation, Received travel reimbursements related to activities as an unpaid member of the PARTNER Trial Executive Committee; B. G. Leshnower: Speakers Bureau/Honoraria, Medtronic, Inc; R. Makkar: Research Grant, Edwards Lifesciences Corporation, St Jude Medical, Inc; Consultant/Advisory Board, Abbott Laboratories, Cordis Corporation, Medtronic, Inc; Ownership Interest, Entourage Medical Technologies; R. M. Suri: Research Grant, Abbott, Edwards Lifesciences Corporation, Medtronic, Inc, SORIN GROUP, St Jude Medical, Inc; Other, Abbott, Member of the Clinical Steering Committee, St Jude Medical, Inc, Member of the Steering Committee; L. G. Svensson: Ownership Interest, Cardiosolutions, Inc; W. Y. Szeto: Research Grant, Edwards Lifesciences Corporation, Medtronic, Inc, SORIN GROUP; Consultant/Advisory Board, Micro Interventional Devices, Inc; V. H. Thourani: Research Grant, Edwards Lifesciences Corporation, Medtronic, Inc, SORIN GROUP; Consultant/Advisory Board, Boston Scientific, St Jude Medical, Inc; Ownership Interest, Apica Cardiovascular; M. R. Williams: Research Grant, Direct Flow Medical, Inc, Medtronic, Inc; Consultant/Advisory Board, Edwards Lifesciences Corporation, Medtronic, Inc; M. J. Mack: Nonremunerative Position of Influence, Abbott Vascular, Edwards Lifesciences Corporation; A. Pichard: Consultant/Advisory Board, Edwards Lifesciences Corporation, Proctor

Purpose: There has been increasing scrutiny that utilizing new technology to treat the extreme elderly (>90 years old) may be a futile endeavor. The purpose of this study was to describe clinical outcomes in nonagenarians undergoing transcatheter aortic valve replacement (TAVR) in the PARTNER trial.

Methods: Outcomes in 531 nonagenarians who underwent TAVR with a balloon-expandable valve (April 2007 to February 2012) in the PARTNER trial were examined. Two hundred two patients had transapical (TA) TAVR and 329 had transfemoral (TF) TAVR. Important clinical events (including death, stroke, and re-hospitalization) were fully adjudicated, and echocardiographic results were analyzed in a core laboratory. Overall time-varying risk of death and survival was compared with an age-sex-race matched US population.

Results: The mean age for all patients was 92.7 years ± 2.1 years; 51% were female. Overall 30-day mortality was 7.2% (TF: 4.0% and TA: 12.0%, $p = 0.0003$). Following the early increase in TA mortality, mid-term mortality was similar between TF and TA patients (Figure). Independent predictors for intermediate death were history of gastrointestinal bleeding, cerebral vascular accident, lower albumin, and reduced hemoglobin. After an early increasing risk of death immediately after TAVR that extends for 6 months, the risk of death after TAVR was similar to the US age-sex-race-matched population. Postoperative 30-day complications included stroke in 3% (TF: 3.6% vs TA: 2%, $p = 0.28$), major vascular complications in 6.2% (TF: 5.8% vs TA: 6.9%, $p = 0.59$), and major adverse events (death, stroke, bleeding, vascular complication) in 34.0% (TF 35.0% vs TA 32.0%, $p = 0.47$).

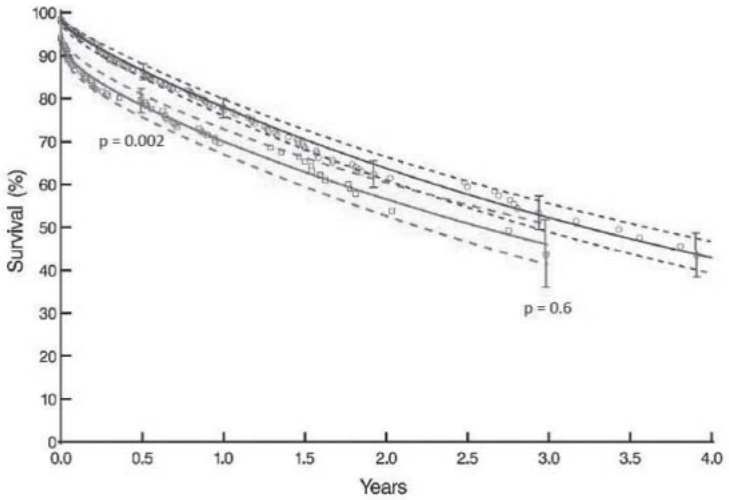
Continued on next page

Adult Cardiac Session: Aortic Valve – Continued

Abstract continued from previous page

Paravalvular aortic regurgitation at 30 days was moderate to severe in 12.1% (TF: 15.4% vs TA: 5.4%, $p = 0.003$). The median postop length of stay was 6 days for all patients (TF: 5 days vs TA: 8 days).

Conclusions: TAVR in nonagenarians resulted in favorable short- and mid-term clinical outcomes. Although TA procedures were associated with increased early mortality, there was no increased risk of later death. Referral for TAVR in nonagenarians should not be discouraged on the basis of age alone.



5:00 PM ***Ballroom 20D***

Contemporary Outcomes of Reoperative Aortic Valve Replacement: A Reference Guide to Valve-in-Valve Transcatheter Aortic Valve Replacement—Findings From the STS Adult Cardiac Surgery Database

T. Kaneko[1], *C. M. Vassileva*[2], *B. R. Englum*[3], *S. Kim*[3], *P. Saha-Chaudhuri*[6], *M. Yammine*[1], *J. Brennan*[3], *R. M. Suri*[4], *V. H. Thourani*[5], *S. F. Aranki*[1]

[1]*Brigham and Women's Hospital, Boston, MA,* [2]*Southern Illinois University School of Medicine, Springfield,* [3]*Duke University Medical Center, Durham, NC,* [4]*Mayo Clinic, Rochester, MN,* [5]*Emory University, Atlanta, GA,* [6]*Duke University, Durham, NC*

COMMERCIAL RELATIONSHIPS R. M. Suri: Research Grant, Abbott, Edwards Lifesciences Corporation, Medtronic, Inc, SORIN GROUP, St Jude Medical, Inc; Other, Abbott, Member of the Clinical Steering Committee, St Jude Medical, Inc, Member of the Steering Committee; V. H. Thourani: Research Grant, Edwards Lifesciences Corporation, Medtronic, Inc, SORIN GROUP; Consultant/Advisory Board, Boston Scientific, St Jude Medical, Inc; Ownership Interest, Apica Cardiovascular

Purpose: Reoperative aortic valve replacement (reop AVR) after previous AVR is a complex procedure involving root dissection and extensive tissue resection. With increasing use of valve-in-valve transcatheter aortic valve replacement (TAVR) for failed aortic bioprostheses in highly selected patients, an evaluation of contemporary outcomes of reop AVR is warranted.

Methods: The study included 3,380 patients from the STS Adult Cardiac Surgery Database (July 2011–September 2013) who underwent elective, isolated reop AVR after previous AVR. Outcomes in these patients were compared to 54,183 patients with isolated primary AVR during the same period. Reop AVR patients were classified into risk groups based on STS predicted risk of mortality (PROM).

Results: Among reop AVR cases, 2,974 (88.0%) were first-time reoperations, and 2,213 (75.3%) were performed for failed bioprosthesis. Compared to primary AVR patients, those undergoing reop AVR were younger (66 vs 70 years, $p < 0.001$). Compared to primary AVR, reop AVR was associated with higher operative mortality (4.6% vs 2.2%, $p < 0.0001$), composite operative mortality and major morbidity (21.6% vs 11.8%, $p < 0.0001$), postoperative stroke (1.9% vs 1.4%, $p = 0.02$), pacemaker requirement (11.0% vs 4.3%, $p < 0.0001$), and vascular complications (0.06% vs 0.01%, $p = 0.04$). Among the high-risk cohort of patients undergoing reop AVR, the observed mortality rate was lower than expected (O/E ratio 0.70 for both STS PROM >12% and 8% to <12%), with results closer to expected in lower-risk patients (O/E ratio 0.96 for PROM <4%, 1.06 for 4% to <8%).

Conclusions: Currently, reop AVR after previous AVR shows acceptable morbidity and mortality. However, it has twice as high mortality, composite outcome of mortality, and major morbidity and pacemaker implantation rate. PROM overestimates the risk for high-risk patients. These results will serve as a benchmark for future valve-in-valve TAVR and may have an impact on future procedural selection.

Continued on next page

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Table 1. Postoperative outcomes for reop AVR after previous AVR and primary AVR

	Reop AVR (N=3380)		Primary AVR (N=54183)		P-value*
Outcomes	N	%	N	%	
Operative Mortality	157	4.64	1200	2.21	<.0001
Composite outcome of mortality and major morbidity	729	21.57	6369	11.75	<.0001
Stroke	64	1.89	761	1.40	0.0203
Pacemaker requirement	370	10.95	2337	4.31	<.0001
Vascular Complication	2	0.06	7	0.01	0.0369

* P-value was attained using Chi-square test.

5:15 PM ***Ballroom 20D***

Five-Year Clinical and Hemodynamic Outcomes Following Transcatheter Aortic Valve Implantation

A. D'Onofrio, *M. Facchin, R. Bianco, G. Tarantini, E. Manzan, L. Besola, C. Tessari, M. Napodano, P. Buja, G. Isabella, G. Gerosa*

University of Padova, Italy

COMMERCIAL RELATIONSHIPS A. D'Onofrio: Consultant/Advisory Board, Edwards Lifesciences Corporation; G. Tarantini: Other, Edwards Lifesciences Corporation, Speaking Fee; G. Gerosa: Research Grant, Edwards Lifesciences Corporation; Speakers Bureau/Honoraria, SORIN GROUP, St Jude Medical, Inc, HeartWare International, Inc; Other, Edwards Lifesciences Corporation, Proctor for TAVI

Purpose: Transcatheter aortic valve implantation (TAVI) is a therapeutic option in high-risk or inoperable patients suffering from severe symptomatic aortic valve stenosis (SSAVS). Concerns still exist regarding long-term results and freedom from valve-related adverse events. The aim of this single-center retrospective study was to assess long-term clinical and hemodynamic outcomes in patients undergoing TAVI.

Methods: From 2007 to 2013, 321 consecutive patients underwent TAVI at our institution. Data were prospectively collected in our "ad hoc" TAVI database and retrospectively analyzed. Preoperative variables were defined according to the EuroSCORE definitions and outcomes were reported according to the VARC and VARC-2 definitions. Patients underwent clinical and echocardiographic follow-up at our "TAVI-dedicated" outpatient clinic. Multivariate logistic regression analysis was performed in order to identify independent predictors of mortality at follow-up.

Results: Transfemoral (TF) and transapical (TA) TAVI were performed in 221 (69%) and 100 (31%) patients, respectively. All-cause 30-day mortality was 4.7% with no differences between TA and TF. Thirty-day cardiovascular death, stroke, and myocardial infarction were not different between groups. Acute kidney injury (AKI) rate was higher in TA patients (23% vs 8.1%; $p < 0.001$). Access-related complications were more frequent in the TF group (35.8% vs 13%; $p < 0.001$). Early safety in TF and in TA groups was 16.3% and 29%, respectively ($p = 0.007$). Efficacy at 1 year was 26.8%, with no differences between groups. Mean follow-up was 22.3 months ± 17.8 months (range: 1-74 months). Patients with paravalvular leak of any grade had a significantly worse survival than patients with no leak (Figure 1). Overall survival rates at 1, 3, and 5 years were 85.5% ± 2.1%, 69.9% ± 3.2%, and 61% ± 4.3%, respectively. Independent predictors of all-cause mortality at follow-up were: previous myocardial infarction (OR 2.7), any grade of paravalvular leak (OR 2.5), and AKI (OR 3.1). Mean gradient and effective orifice area at follow-up were: 10.7 cm^2/m^2 ± 12.0 cm^2/m^2 and 1.1 cm^2/m^2 ± 0.9 cm^2/m^2, respectively.

Conclusions: Our data show that TAVI has good early and long-term clinical and hemodynamic outcomes in high-risk or inoperable patients with SSAVS. Paravalvular leak of any grade has a significant impact on survival.

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Adult Cardiac Session: Aortic Valve – Continued

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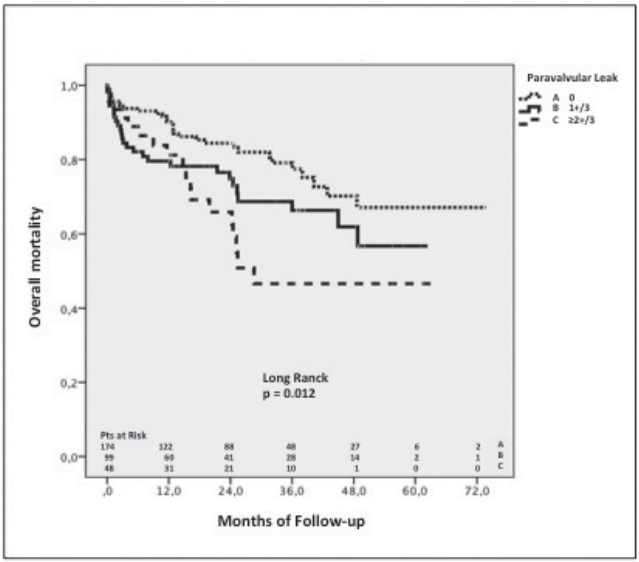

NOTES

3:30 PM – 5:30 PM ***Room 32AB***

Adult Cardiac Session: General II

Moderators: *Rosemary F. Kelly, Minneapolis, MN, and Alan M. Speir, Falls Church, VA*

COMMERCIAL RELATIONSHIPS A. M. Speir: Consultant/Advisory Board, Medtronic, Inc

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

Presenting authors are listed in **bold** on each abstract.

The physician competencies addressed in this session are patient care and procedural skills and medical knowledge. These physician competencies will be addressed through a series of individual lectures and a brief question-and-answer session after each topic.

3:30 PM ***Room 32AB***

Frailty in the Cardiac Surgical Patient: How Should We Measure It?

L. Halpin, S. Holmes, C. Miller, D. Lamont, D. Shuman, ***N. Ad***

Inova Heart and Vascular Institute, Falls Church, VA

COMMERCIAL RELATIONSHIPS N. Ad: Speakers Bureau/Honoraria, AtriCure, Inc, Medtronic, Inc; Consultant/Advisory Board, AtriCure, Inc, Medtronic, Inc

Purpose: As part of continuing efforts to improve patient risk assessment, capturing frailty has become important. However, a single marker of frailty, such as gait speed, may not provide consistently reliable information regarding risk. This study evaluated the impact of frailty and gait speed on patient outcomes following cardiac surgery.

Methods: A prospective study was conducted on 162 older patients (≥65 years) awaiting coronary artery bypass grafting (CABG), valve, or CABG/valve surgery. Patients were assessed using the Cardiovascular Health Study (CHS) scale, which includes criteria based on weight loss, exhaustion, physical activity, walk time (gait speed), and grip strength. Major outcome was defined as a composite of operative mortality and major morbidity.

Results: Mean age was 74.3 years ± 6.5 years and 25% were female. Frailty was identified in 39 patients using CHS criteria. Frail patients had higher median ICU stays (53 hours vs 27 hours, $p = 0.004$), higher median total length of stay (8 days vs 5 days, $p < 0.001$), and greater likelihood to have at least one STS-defined complication (56% vs 31%, $p = 0.01$), but were not different from non-frail patients on major outcome (13% vs 16%, $p = 0.79$), operative mortality (0% vs 0.8%, $p > 0.99$), or readmissions <30 days (6% vs 11%, $p = 0.74$). Examining absolute gait speed found no relationship to incidence of at least one STS-defined complication (OR=1.09, $p = 0.22$) or major outcome (OR=0.92, $p = 0.53$) in multivariate analyses. Similarly, using the cut-off for slow gait speed also was not related to incidence of at least one STS-defined complication (OR=1.38, $p = 0.54$) or major outcome (OR=0.40, $p = 0.24$). There was, however, a significant correlation between higher body mass index and slower gait speed (r=0.21, $p = 0.01$).

Conclusions: STS has recommended gait speed to identify cardiac surgery patients at increased risk of adverse outcomes. This study found no relationship between gait speed and outcome. Although walk tests are simpler than other frailty assessments, this study supports findings indicating that frailty should be assessed with multidimensional methods.

3:45 PM **Room 32AB**

HITting the Target: A Retrospective Quality Review of the Diagnosis and Treatment of Heparin-Induced Thrombocytopenia (HIT) in a Quaternary Center

*J. Konen[3], K. Nguyen[3], C. Swenson[3], M. Merren[4], T. Wainscott[1], T. A. Timek[1], **P. Wilton**[2]*

[1]West Michigan Cardiothoracic Surgeons PLC, Grand Rapids, [2]Spectrum Health, Grand Rapids, MI, [3]Michigan State University College of Human Medicine, East Lansing, [4]Michigan State University College of Human Medicine, East Lansing/Spectrum Health, Grand Rapids, MI

Purpose: The objective of this study was to assess adherence to evidence-based guidelines for the diagnosis and treatment of heparin-induced thrombocytopenia (HIT).

Methods: The study included all adult patients that were admitted to a quaternary center during a 12-month period who had thrombocytopenia and a heparin dependent antibody (HDA) test. The following data were collected: platelet count, HDA screen, Serotonin Release Assay (SRA), type and timing of heparin administration, presence of thrombosis, and treatment with argatroban. The patients were risk stratified based on their 4T score using their nadir platelet count into low, intermediate, and high.

Results: There were 306 patients who met study criteria: 13.4% (41/306) patients had a positive HDA screen, and 1.6% (19/306) were SRA positive. The low probability group represented 62.7% (192/306), and 9.3% (18/192) tested positive for HDA. 3.6% (7/192) were further screened with SRA and were negative, but 3.1% (6/192) received argatroban. Furthermore, 7.3% (14/192) HDA-negative patients received argatroban. The intermediate probability group represented 28.8% (88/306) patients and 18.2% (16/88) tested positive for HDA. 9.1% (8/88) were further screened with SRA, 3.4% (3/88) tested positive, and 2.3% (2/88) received argatroban. Furthermore, 3.4% (3/88) HAD-negative patients received argatroban and 3.4% (3/88) SRA-negative patients received argatroban. The high probability group represented 8.5% (26/306), and 26.9% (7/26) tested positive for HDA. 15.4% (4/26) were further screened with SRA, 7.7% (2/26) tested positive, and 100% received argatroban. 19.2% (5/26) HDA-negative patients and 7.7% (2/26) SRA-negative patients received argatroban.

Conclusions: These results confirmed significant opportunities to reduce overdiagnosis and overtreatment of HIT. Increased use of the 4T score would identify the intermediate to high-risk patients, thus defining which patients to further investigate for HIT. Conversely, a low 4T score would suggest further investigation is unnecessary.

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Adult Cardiac Session: General II – Continued

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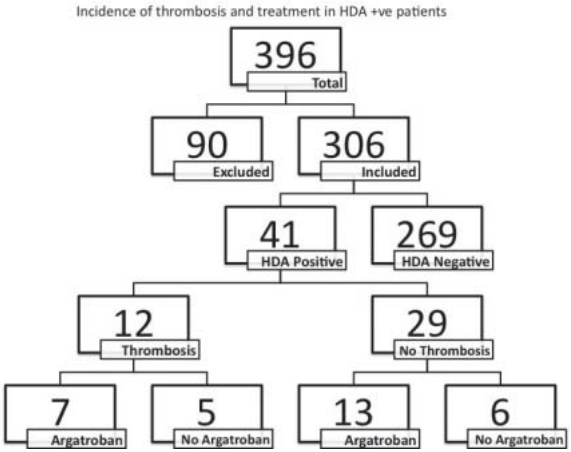

4:00 PM **Room 32AB**

Outcomes of Elective Ascending Aorta Repair: Comparison of Isolated vs Multicomponent Operations

J. Idrees, *E. E. Roselli, D. Johnson, A. Lowry, J. Reside, E. Blackstone, L. G. Svensson*

Cleveland Clinic Foundation, OH

COMMERCIAL RELATIONSHIPS E. E. Roselli: Speakers Bureau/Honoraria, Medtronic, Inc, Terumo Medical Corporation; Consultant/Advisory Board, Edwards Lifesciences Corporation; Nonremunerative Position of Influence, SORIN GROUP; L. G. Svensson: Ownership Interest, Cardiosolutions, Inc

Purpose: To analyze outcomes of patients undergoing elective ascending aorta repair and compare them after isolated repair (iAoR) vs repair combined with additional procedures (mAoR).

Methods: From 2006 to 2010, 1,889 patients underwent ascending aorta repair (iAoR, n=212; mAoR, n=1,677) for chronic asymptomatic ascending aorta disease. Mean age was 60 years ± 15 years, and mean maximum proximal aortic diameter was 49 mm ± 10 mm (iAoR 52 mm ± 10 mm, mAoR 49 mm ± 10 mm; $p = 0.003$) Three-dimensional computed tomography analysis was performed on all patients. Propensity matching used 64 preoperative variables, including age, gender, aortic morphology and diameter, connective tissue disorder, aortic calcification, and aortic valve morphology.

Results: Hospital death was 2.1% (iAoR 0.5%, mAoR 2.3%; $p = 0.08$). Postoperative stroke occurred in 2.6% and was more common following iAoR (4.7%) than mAoR (2.4%) ($p = 0.05$), but this unadjusted difference was not maintained after propensity matching. Occurrence of renal dialysis (iAoR and mAoR both 1.0%; $p = 1.0$), bleeding (iAoR 4.1%, mAoR 5.1%; $p = 0.6$) prolonged ventilation (iAoR 26%, mAoR 33%; $p = 0.12$), and length of stay (iAoR 10 days ± 8 days, mAoR 11 days ± 7 days; $p = 0.07$) were similar before and after matching. Patients were more likely to undergo mAoR if they were diabetic or had connective tissue disorder or calcified arch. iAoR was more common in patients with prior cardiac surgery and larger aortic diameter (iAoR 49 mm ± 12 mm, mAoR 47 mm ± 10 mm; $p = 0.009$). At 30 days, 1 year, and 4 years, the estimated survival was 97%, 93%, and 87%, respectively, and the freedom from reintervention was 98%, 90%, and 89%, respectively. Both were similar between the groups.

Conclusions: Ascending aortic aneurysms should be treated aggressively even when encountered while performing a multicomponent procedure, because elective ascending aorta repair is safe and effective. Postponing repair of the ascending aorta may increase the risk of stroke during a subsequent operation.

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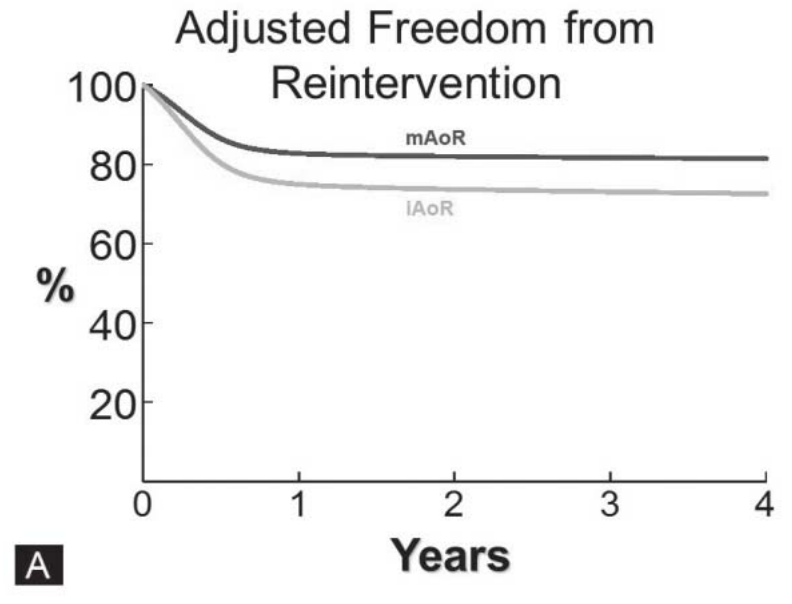

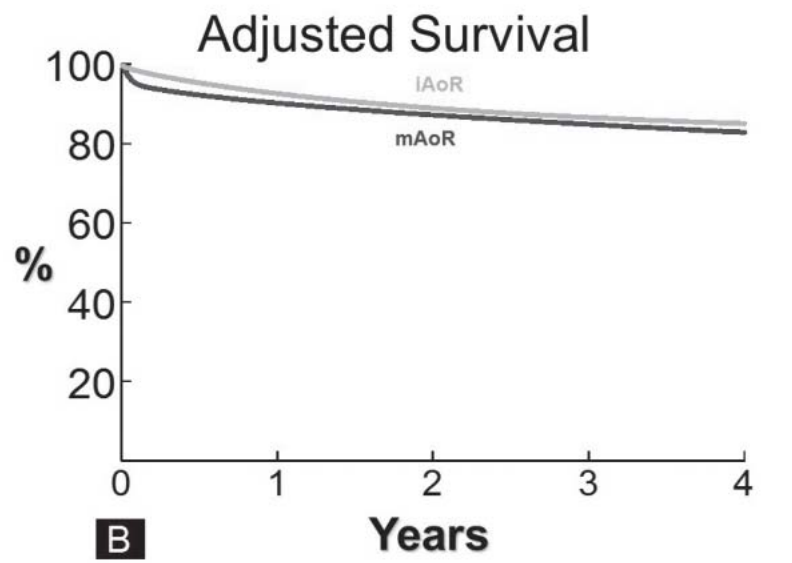

4:15 PM **Room 32AB**

Preoperative Renal Function Predicts Hospital Costs and Length of Stay in Coronary Artery Bypass Grafting: A Society of Thoracic Surgeons National Database Analysis

D. J. LaPar[2], *J. B. Rich*[1], *J. M. Isbell*[2], *C. Brooks*[2], *I. Crosby*[3], *L. T. Yarboro*[2], *R. K. Ghanta*[3], *J. A. Kern*[3], *M. A. Quader*[4], *A. M. Speir*[5], *G. Ailawadi*[3]

[1]*Mid-Atlantic Cardiothoracic Surgeons Ltd, Norfolk, VA,* [2]*University of Virginia, Charlottesville,* [3]*University of Virginia Health System, Charlottesville,* [4]*Virginia Commonwealth University, Richmond,* [5]*Cardiac, Vascular & Thoracic Surgery Associates, Falls Church, VA*

COMMERCIAL RELATIONSHIPS J. A. Kern: Consultant/Advisory Board, SORIN GROUP; Speakers Bureau/Honoraria, CorMatrix, Edwards Lifesciences Corporation; A. M. Speir: Consultant/Advisory Board, Medtronic, Inc; G. Ailawadi: Consultant/Advisory Board, Abbott, Edwards Lifesciences Corporation, Mitralign; Speakers Bureau/Honoraria, St Jude Medical, Inc

Purpose: Renal failure (RF) remains a major source of morbidity after cardiac surgery. While the relationship between poor renal function and worse cardiac surgical outcomes is well established, the ability to predict the impact of preoperative renal insufficiency on hospital costs and health care resource utilization remains unknown.

Methods: Patient records from The Society of Thoracic Surgeons National Database linked with estimated cost data were evaluated for isolated coronary artery bypass grafting (CABG) operations (2000-2012). Patients with documented preoperative renal failure were excluded. Preoperative renal function was determined using calculated creatinine clearance (CrCl). Multivariable regression analyses utilizing restricted cubic splines evaluated the continuous relationship between CrCl and risk-adjusted outcomes.

Results: A total of 46,577 isolated CABG operations were evaluated with a median STS PROM of 1.2% (0.7, 2.4), including 9% off-pump CABG. Median CrCl was 85 ml/min (range: 2-120), and median total costs was $25,011. After adjustment for preoperative risk factors, worsening CrCl (declining renal function) was highly associated with greater total costs of hospitalization (coef = -122, $p < 0.001$, Figure) and postoperative length of stay (coef = -0.03, $p < 0.001$). Furthermore, predicted total costs were incrementally increased by 12%, 22%, and 33% with worsening of CrCl from 80 ml/min to 60, 40, and 20 ml/min. As expected, decreasing CrCl was also associated with an increased risk-adjusted likelihood for hemodialysis and mortality (both $p < 0.001$, Table).

Conclusions: Preoperative renal function is highly associated with the cost of CABG. Assessment of renal function may be used to preoperatively predict cost and resource utilization. Optimizing renal function preoperatively has the potential to improve patient quality and costs by approximately 6% ($1,250) for every 10 ml/min improvement in creatinine clearance.

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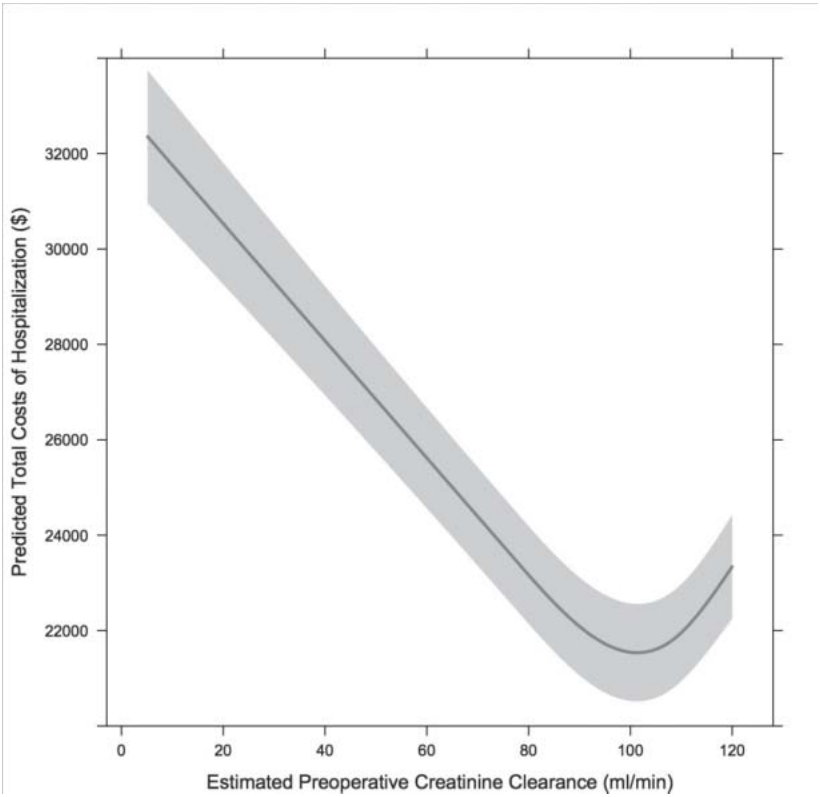

Table: Adjusted effect of preoperative creatinine clearance on outcomes: increasing CrCl is associated with a reduced likelihood of postoperative hemodialysis and mortality.

Outcome	Wald Chi-square	OR (95%C.I.)	P	Model c-statistic
Postoperative Hemodialysis	69.7	0.64 [0.53,0.77]	<0.001	0.80
Mortality	16.1	0.90 [0.78,0.98]	<0.001	0.79

4:30 PM **Room 32AB**

Renal Dysfunction and Hemodilution: What Is the Acceptable Hematocrit Threshold on Cardiopulmonary Bypass?

P. Narayan[1], *R. Ghatanatti*[2], *A. Teli*[3], *K. Roy Chowdhuri*[2], *A. Mondal*[2], *G. Sengupta*[2], *M. Datta*[2]

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Purpose: Renal dysfunction following cardiopulmonary bypass (CPB) ranges from subclinical injury to established renal failure. Hemodilution during cardiopulmonary bypass has been thought to be an important determinant of postoperative renal injury. In this study, we have attempted to assess the independent effect of hemodilution and aim to identify the optimal hematocrit where hemodilution-induced renal injury is minimal.

Methods: A prospective, observational study was conducted on 200 consecutive cardiac patients between February 2012 and July 2013 at a single center. One hundred fifty patients were included in the study group, which was further subdivided on the basis of lowest hematocrit (Hct) as mild hemodilution (Hct >25%), moderate hemodilution (21%-25%) and severe hemodilution (<21%) categories. Fifty patients were included in the high-risk study group. The primary outcome of the study was renal outcome measure, which was assessed by comparing the creatinine clearance across the groups.

Results: The creatinine clearance decreased over a period of time in all three groups. Compared to mild or moderate hemodilution, the reduction in creatinine clearance was significantly higher in the group with severe hemodilution ($p \leq 0.0001$). However, there was no significant difference in creatinine clearance reduction between the mild and moderate hemodilution groups ($p = 0.813$, 95% CI -8.41-10.68).

Conclusions: Based on our observations, we would like to propose that a hematocrit of 21% should be considered the critical threshold. Hematocrit below this value of 21% during cardiopulmonary bypass is associated with the most significant deterioration in creatinine clearance.

4:45 PM **Room 32AB**

Establishing the "Real World" Cost-Effectiveness of Transcatheter Aortic Valve Replacement: A Propensity-Matched STS National Database Analysis

*G. Ailawadi[2], **D. J. LaPar**[3], A. M. Speir[1], R. K. Ghanta[2], I. Crosby[2], M. A. Quader[4], J. B. Rich[5]*

[1]Cardiac, Vascular & Thoracic Surgery Associates, Falls Church, VA, [2]University of Virginia Health System, Charlottesville, [3]University of Virginia, Charlottesville, [4]Virginia Commonwealth University, Richmond, [5]Mid-Atlantic Cardiothoracic Surgeons Ltd, Norfolk, VA

COMMERCIAL RELATIONSHIPS A. M. Speir: Consultant/Advisory Board, Medtronic, Inc; G. Ailawadi: Consultant/Advisory Board, Abbott, Edwards Lifesciences Corporation, Mitralign; Speakers Bureau/Honoraria, St Jude Medical, Inc

Purpose: The PARTNER trial suggested an economic advantage for transcatheter aortic valve replacement (TAVR) for high-risk patients in a clinical research trial. The purpose of this study was to evaluate the cost-effectiveness of TAVR in the "real world" by comparing TAVR costs and outcomes to those for intermediate and high-risk surgical AVR (SAVR) patients.

Methods: Data from 17 centers within The Society of Thoracic Surgeons National Database (2011-2013) linked with estimated cost data was evaluated for isolated TAVR and SAVR operations (n=5,578). TAVR (n=340) patients were 1:1 propensity matched to SAVR (n=340) patients using calculated STS PROM scores to compare costs and outcomes. SAVR patients were further stratified into intermediate-risk (SAVR-IR: PROM 4-8%, n=226) and high-risk (SAVR-HR: PROM >8%, n=114).

Results: Median STS PROM for TAVR was 6.32% compared to 6.30% for SAVR (SAVR-IR 4.6% and SAVR-HR 12.4%). Transfemoral TAVR was most common (61%). Mortality was higher for TAVR (10%) compared to SAVR (6%, $p < 0.047$), while SAVR accrued higher major morbidity (27% vs 14%, $p < 0.001$) and longer postoperative hospital duration (7 days vs 6 days, $p < 0.001$). Interestingly, TAVR incurred 2x the median total costs compared to SAVR ($69,921 vs $39,075, $p < 0.001$), largely driven by the cost of the valve (all $p < 0.001$). SAVR accrued higher blood product- and ICU-related costs. Among SAVR subgroups (Table), SAVR-IR demonstrated the most exaggerated cost savings vs TAVR. Transfemoral TAVR had slightly lower mortality (6% vs 15%, $p = 0.07$) and costs ($68,223 vs $72,568, $p = 0.06$) compared to transapical TAVR.

Conclusions: The initial experience of TAVR at these centers demonstrated that TAVR provides acceptable outcomes, particularly with a transfemoral approach. However, due to the current cost of the valves, TAVR may not provide the most cost-effective strategy for lower-risk patients.

Table: Propensity matched comparison of primary outcomes for TAVR versus intermediate and high-risk SAVR patients.

Outcome	TAVR (n=340)	SAVR-IR: PROM 4-8% (n=226)	SAVR-HR: PROM>8% (n=114)	*P*
	Median %	Median %	Median %	
STS PROM (%)	6.3% [3.9,9.9]	4.6% [4.1,6.3]	12.4% [9.9,16.3]	<0.001
Operative Mortality	10.0%	4.9%	7.9%	0.08
Composite Major Morbidity	13.8%	23.5%	34.2%	<0.001
Myocardial Infarction	0.0%	0.0%	0.0%	-
Stroke	2.4%	2.2%	3.5%	0.75
Pneumonia	2.4%	4.0%	6.1%	0.15
Prolonged Ventilation	11.5%	18.1%	22.8%	0.007
Renal Failure	5.0%	7.5%	14.9%	0.002
New Onset Hemodialysis	3.2%	1.8%	7.9%	0.01
Postoperative LOS (d)	6 [4,9]	7 [5,10]	8 [6,13]	<0.001
Total ICU LOS (hrs)	48 [26,96]	62 [29,120]	80 [50,144]	<0.001
Total Costs ($)	$69,921 [58163,87121]	$37,293 [29579,48822]	$43,580 [33892,61915]	<0.001

5:00 PM **Room 32AB**

Is Ascending Aorta Replacement During Aortic Valve Replacement Free of Risk?

J. Goldberg[1], *J. Kim*[2], *S. Melnitchouk*[2], *J. N. Baker*[2], *J. D. Walker*[2], *G. Vlahakes*[2], *T. E. MacGillivray*[2], *T. M. Sundt*[2]

[1]*Massachusetts General Hospital, Harvard Medical School, Lebanon, NH,* [2]*Massachusetts General Hospital, Harvard Medical School, Boston*

COMMERCIAL RELATIONSHIPS T. M. Sundt: Consultant/Advisory Board, Thrasos Therapeutics

Purpose: Recommendations for proactive aortic replacement in patients undergoing aortic valve replacement are increasingly aggressive; however, the associated incremental risk remains a matter of debate. Prior studies are limited in their statistical power due to small numbers of patients.

Methods: From January 2002 through December 2013, 2,960 patients undergoing aortic valve replacement were identified in our cardiac surgery database. There were 2,676 who underwent surgery without aorta replacement (AVR) and 284 had concomitant aorta replacement (AVR+Ao). Operative mortality (30-day or in-hospital) and major complications were compared unadjusted and after adjustment using propensity scores based on 30 pre-specified variables.

Results: AVR+Ao patients had significantly fewer baseline comorbidities (younger and lower prevalence of advanced heart failure, coronary disease, lung disease, and urgency; all p values <0.01). Unadjusted operative mortality rates were similar (3.5% and 3.4% in AVR+Ao and AVR, respectively; $p = 0.94$) as were major complications (cardiac arrest, need for mechanical support, neurologic injuries, reoperation for bleeding, deep sternal infection, requirement for dialysis, pneumonia, and pulmonary thromboembolism; 14.8% (42) vs 13.3% (357); $p = 0.50$). After propensity score adjustment, however, AVR+Ao had higher operative mortality (odds ratio, 2.57; 95% CI, 1.27-5.20; $p = 0.008$) and major complications (odds ratio, 1.84; 95% CI, 1.26-2.68; $p = 0.001$) compared with AVR. The increased risk of mortality and morbidity was further validated by inverse-probability-treatment weighting and multivariable analysis (Table).

Conclusions: When adjusted for comorbidities, the risks of early mortality and morbidity were almost doubled by concomitant aorta replacement in patients undergoing AVR, suggesting there is an incremental risk that must be considered when planning to include proactive aortic replacement.

Table. Adjusted odds ratios of adverse outcomes of concomitant aorta replacement compared with control group

	Odds Ratio	95% Confidence Interval	P value
Operative mortality			
Propensity-adjusted	2.57	1.27-5.20	0.008
IPTW	1.66	0.95-2.92	0.076
Multivariable*	2.09	1.04-4.23	0.039
Major complications			
Propensity-adjusted	1.84	1.26-2.68	0.001
IPTW	1.50	1.09-2.07	0.014
Multivariable*	1.76	1.21-2.55	0.003

** Variables included in the multivariable model were age, diabetes, dialysis, chronic lung disease, New York Heart Association functional class of III or IV, pulmonary artery pressure, previous cardiac surgery, preoperative balloon pump implantation, and combined coronary or mitral surgeries. Abbreviation: IPTW, inverse-probability-treatment-weighting.*

5:15 PM **Room 32AB**

Mid-Term Results of Valve-Sparing Aortic Root Replacement in Patients With Expanded Indications

S. Miyahara[1], *K. Ymanaka*[1], *Y. Nomura*[1], *N. Morimoto, T. Inoue*[2], *M. Matsumori*[2], *K. Okada*[1], *Y. Okita*[2]

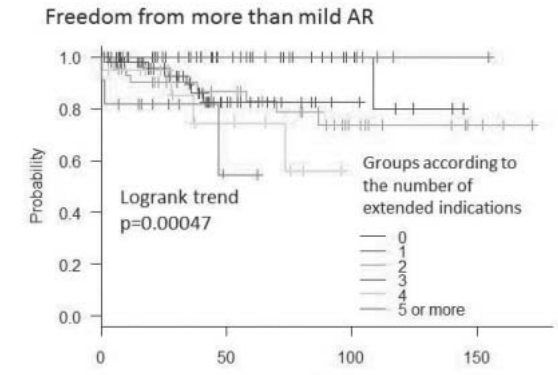
[1]*Kobe University Graduate School of Medicine, Japan,* [2]*Kobe University, Japan*

Purpose: The indications for valve-sparing aortic root reimplantation (VSRR) have been expanded during past two decades. In this study, the mid-term results of VSRR for various indications were investigated.

Methods: From 2000 to 2013, 183 consecutive patients undergoing VSRR were enrolled. Expanded indications—defined as a patient on the marginal operative indication—included age 65 years or older (n=33), age 15 years or younger (n=4), acute type A aortic dissection (AAAD) (n=21), aortitis (n=8), reoperative root replacement (n=11), cusp prolapse (n=67), large aortoventricular junction of greater than 28 mm (n=42), preoperative severe aortic regurgitation (AR) (n=89), left ventricular ejection fraction ≤40% (n=12), left ventricle dilation (n=66), NYHA class III or greater (n=5), need for total arch replacement (n=29), and concomitant mitral valve repair (n=12).

Results: The overall survival at 5 years was 96.6%. Freedom from greater than mild AR and reoperation at 5 years occurred in 85.8% and 92.9%, respectively. Cox proportional hazard model revealed that AAAD and cusp prolapse were at risk for late AR recurrence (HR, 6.13; $p = 0.0029$ and HR, 3.10; $p = 0.031$, respectively). After 2009, freedom from late AR in the cusp prolapse group improved ($p = 0.064$ vs control). One hundred fifty-eight patients (86.3%) had undergone VSRR for one or more expanded indications; the number of expanded indications per individual ranged from 0 to 6 (median, 3.0 per patient). Both freedom from recurrent AR and reoperation were worse as the number of expanded indications increased (Log-rank trend $p = 0.00047$ and $p = 0.001$, respectively).

Conclusions: Surgical outcomes of VSRR in these patient cohorts were satisfactory with some room for improvement in patients with cusp prolapse. Although the indications for VSRR are being expanded, a larger number of expanded indications were associated with poor outcomes in terms of longevity of valve function.



Number at risk

0	25	16	6	0
1	30	12	5	1
2	48	24	10	3
3	50	14	1	0
4	19	6	0	0
5 or more	11	1	0	0

3:30 PM – 5:30 PM ***Room 30AB***

Cardiothoracic Surgical Education

Moderators: *Shari L. Meyerson, Chicago, IL, and Ara A. Vaporciyan, Houston, TX*

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

Presenting authors are listed in **bold** on each abstract.

The physician competencies addressed in this session are professionalism and interpersonal and communication skills. These physician competencies will be addressed through a series of lectures and a brief question-and-answer session after each topic.

3:30 PM ***Room 30AB***

Automated Video Analysis of Surgical Dexterity Correlates Highly With Expert Evaluation: Proof of Concept for a New Technique to Expand Surgical Simulation Training

E. L. Sarin[1], *Y. Sharma*[2], *M. E. Halkos*[1], *V. H. Thourani*[1], *I. Essa*[2]

[1]*Emory University, Atlanta, GA,* [2]*Georgia Institute of Technology, Atlanta*

COMMERCIAL RELATIONSHIPS M. E. Halkos: Consultant/Advisory Board, Intuitive Surgical, Inc, Medtronic, Inc; V. H. Thourani: Research Grant, Edwards Lifesciences Corporation, Medtronic, Inc, SORIN GROUP; Consultant/Advisory Board, Boston Scientific, St Jude Medical, Inc; Ownership Interest, Apica Cardiovascular

Purpose: Simulation training in cardiothoracic surgical education is being steadily disseminated. Video analysis using Objective Structured Assessment of Technical Skills (OSATS) criteria is an accepted standard. However, it requires each video to be viewed and scored by an examiner. An automated technique using advanced video analysis could serve as an adjunct to direct feedback from surgical mentors.

Methods: Eighteen participants of varying surgical skill were videotaped performing a simple suturing task. Participants varied in skill from third-year medical student to attending cardiothoracic surgeon. Using a Creative Intel Perceptual camera, we were able to record Red Green Blue (RGB) and depth videos simultaneously for each participant along with synchronized acceleration data from wireless accelerometers on the dominant wrist and needle driver. Colored gloves were used to distinguish between dominant and non-dominant hands. ELAN software was used to synchronize acceleration data with the video data. Videos were scored using a standard OSATS scoring method by a single attending cardiac surgeon. Pearson's correlation coefficient R and p-value were calculated between the true and predicted scores.

Results: The methods employed for video capture generated a rich dataset (approximately 1GB) for each participant (Figure 1). Subsequent analysis demonstrated that the depth and acceleration data correlated highly with OSATS scoring, particularly for the dominant hand (Table 1). The video analysis also accurately identified and classified temporary deviations in technique in real time to enable targeted feedback based on the particular action.

Conclusions: Automated video analysis of surgical tasks correlates highly with OSATS scoring, particularly with depth and acceleration data. Further validation of this technique may enable an expansion of surgical simulation training by assisting educators in providing high-value feedback to their trainees.

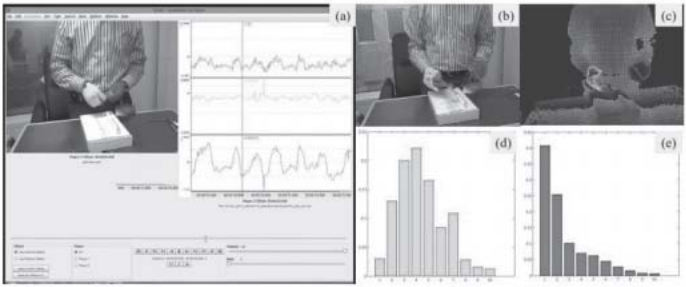


Figure 1. (a) Screen shot of a video along with x, y, and z acceleration data displayed in ELAN software used for synchronization; (b) Sample RGB frame with right and left hand masks obtained after hole filling; (c) Aligned depth frame corresponding to the RGB frame in (b); (d) depth histogram corresponding to the dominant hand; (e) depth histogram corresponding to the non-dominant hand

OSATS Prediction

OSATS	Feature	R	p val
Respect for tissue	All STIPs	0.63	0.00008
Time and motion	Dominant hand STIPs, depth and acceleration	0.79	0.00000009
Instrument handling	All STIPs	0.653	0.00003
Suture handling	Dominant hand STIPs, depth, blob and acceleration	0.72	0.000003
Flow of operation	Dominant hand STIPs, depth, and acceleration	0.646	0.00008

STIP= SpatioTemporal Interest Point
Note that dominant hand STIPs, acceleration and depth features combined result in statistically significant (p-val <0.01) correlation between true and predicted scores

3:45 PM **Room 30AB**

A Decade of Change: Training and Career Paths of Cardiothoracic Surgery Residents 2003-2014

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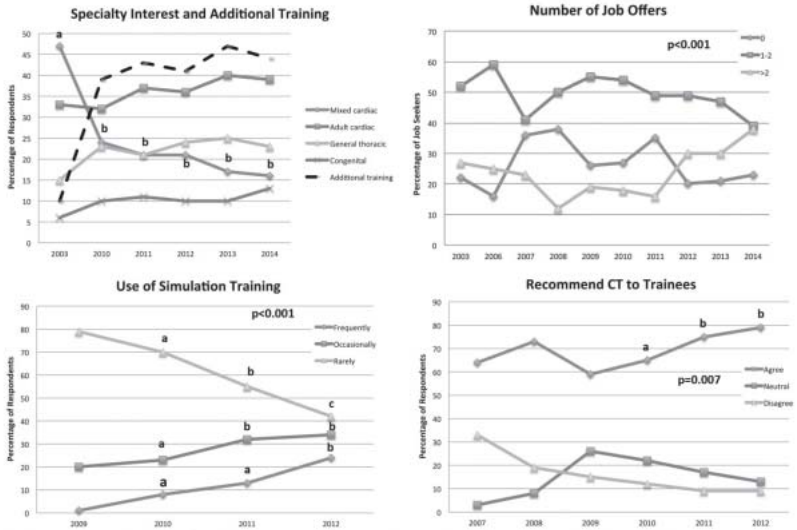
Purpose: Over the past decade, cardiothoracic surgery education has undergone tremendous change with the advent of new technologies, implementation of integrated programs, and work hour restrictions, to name a few. The goal of this study was to assess how residents' career paths, training, and perceptions changed during this period.

Methods: The 2006-2014 surveys that accompany the Thoracic Surgery Residents Association/Thoracic Surgery Directors Association in-training exam (ITE) taken by cardiothoracic surgery residents were analyzed, along with a 2003 survey sent to all graduating cardiothoracic surgery residents. Of 2,563 residents, 2,434 (95%) responded. Comparison between years was performed using the general linearized model and Pearson chi-square test.

Results: Over the past decade, fewer residents were interested in mixed adult cardiac and thoracic practices (Graph, 16/80, 20% in 2014 vs 41/79, 52% in 2003, $p = 0.004$). More residents recommended cardiothoracic surgery to potential trainees (237/317, 79% in 2014 vs 191/299, 65% in 2010, $p = 0.007$). Job offers increased from a low of 12% (14/112) in 2008 with ≥3 offers to 34% (27/80) in 2014. Use of simulation increased from 1% (3/267) using simulation frequently in 2009 to 24% (71/313) in 2012 ($p < 0.001$). Debt increased from 0% (0/79) >$200,000 in 2003 to 40% (36/90) in 2013 ($p < 0.001$). Compared to residents in traditional programs, more integrated residents in 2014 were interested in adult cardiac (Chart, 47/88, 53% vs 65/200, 31%) and congenital (19/88, 22% vs 16/200, 7%), while less were interested in general thoracic (4/88, 5% vs 62/200, 31%, $p < 0.001$). More integrated residents planned on additional training (58/88, 66% vs 72/200, 36%, $p < 0.001$).

Conclusions: With the changes in cardiothoracic surgery training over the last decade, residents' career paths have changed substantially with an overall improved job market and more residents likely to recommend the career to trainees.



P-values represent the overall p-value comparing all years. "Mixed cardiac" refers to a mix of cardiac and thoracic surgery. For a given parameter, data points with the same letter on a line were not statistically significantly different; data points with different letters were statistically significantly different with a p-value <0.05; data points with no letters were not statistically significantly different. Only mean data was available for 2006-2009 precluding statistical comparison between these years and the remaining years. Residents were queried regarding specialty interest and additional training in separate questions, but their responses are plotted on the same graph in order to consolidate information.

Continued on next page

Cardiothoracic Surgical Education – Continued

Abstract continued from previous page

		Integrated (n=88, 31%)	Traditional (n=200, 69%)	p-value
Interest				<0.001
	Adult Cardiac	47 (53%)	65 (33%)	
	Aortic	4 (5%)	11 (6%)	
	Congenital	19 (22%)*	16 (8%)*	
	General Thoracic	4 (5%)*	62 (31%)*	
	Heart Failure	5 (6%)	6 (3%)	
	Mixed Cardiac	9 (10%)	39 (20%)	
	Other	0 (0%)	1 (1%)	
Additional Training				<0.001
	Aortic	7 (8%)	15 (8%)	
	Congenital	19 (22%)*	17 (9%)*	
	Endovascular	7 (8%)	5 (3%)	
	Min invasive cardiac	11 (13%)*	4 (2%)*	
	Min invasive thoracic	3 (3%)	9 (5%)	
	Other	2 (2%)	12 (6%)	
	Transplant	9 (10%)	10 (5%)	
	None	30 (34%)*	128 (64%)*	
Adequately Trained after Residency				0.038
	Strongly agree	52 (59%)*	89 (45%)*	
	Agree	26 (30%)*	87 (44%)*	
	Neutral	8 (9%)	15 (8%)	
	Disagree	1 (1%)	9 (5%)	
	Strongly disagree	1 (1%)	0 (0%)	
Adequately Prepared for Boards				0.014
	Strongly agree	37 (42%)*	56 (28%)*	
	Agree	41 (47%)	94 (47%)	
	Neutral	8 (9%)*	45 (23%)*	
	Disagree	1 (1%)	5 (3%)	
	Strongly disagree	1 (1%)	0 (0%)	
Debt				0.27
	<100K	25 (28%)	77 (39%)	
	100-200K	20 (23%)	43 (22%)	
	200-300K	28 (32%)	45 (23%)	
	>300K	15 (17%)	35 (17%)	
Practice Type				0.049
	Academic	50 (57%)*	88 (44%)*	
	Private	12 (14%)*	51 (26%)*	
	Undecided	26 (30%)	61 (31%)	

*indicates groups that were statistically significantly different. Min=minimally

4:00 PM **Room 30AB**

A Case Simulator to Help Evaluate Residency Program Volume in an Era of Changing Technology

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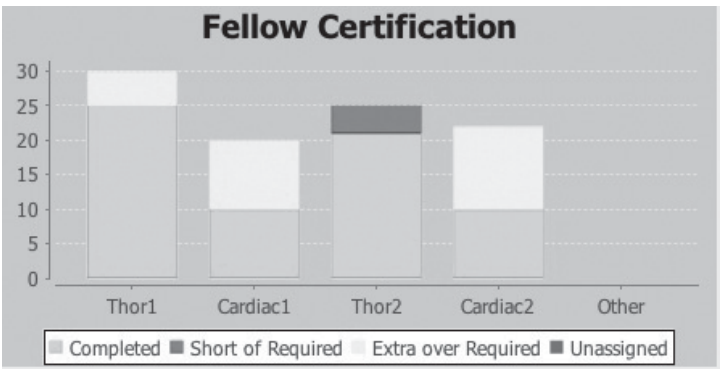
COMMERCIAL RELATIONSHIPS R. M. Reddy: Research Grant, GlaxoSmithKline; Speakers Bureau/Honoraria, Covidien Ltd

Purpose: As resident index-procedures have become less invasive, programs are in need of metrics to ensure how many residents they can train. We evaluated a case distribution simulation model to examine the mediastinoscopy and endobronchial ultrasound (EBUS) program volume needed to train thoracic surgery residents.

Methods: A computer model was created to simulate case distribution based on annual case volume, number of trainees, and rotation length. Single institution mediastinoscopy and EBUS volume data (2011-2013) were applied, and 10,000 simulations run to predict the likelihood of residents achieving American Board of Thoracic Surgery (ABTS) case requirements during a 2-year program.

Results: The average number of mediastinoscopies performed annually was 43. When simulating pre-2012 ABTS requirements (cardiac track 10, thoracic track 25), there was only a 6% probability of all four residents meeting requirements (Figure 1- sample one year simulation shows inequitable case distribution). When re-evaluating using the post-2012 requirements (cardiac 10, thoracic 15) with the same resident compliment, the likelihood of all four residents meeting their requirements increased to 88%. Concurrently evaluating the EBUS volume (mean 19 cases/year) in the post-2012 era (cardiac 0, thoracic 10), there was only a 23% likelihood that all four residents will meet the minimum number of cases. Despite the apparent number of average cases exceeding the minimum numbers needed to train, unpredictable case arrivals result in less than 100% of residents meeting requirements.

Conclusions: This model provides a metric to predict the probability of residents meeting case requirements while accounting for the unpredictable and inequitable case occurrence that is inherent to residency training. This tool can determine the ability of a residency program to meet ABTS requirements for any operation.



4:15 PM **Room 30AB**

Predictors of Career Choice Among Cardiothoracic Surgery Trainees

V. Tchantchaleishvili[1], *D. J. LaPar*[7], *D. D. Odell*[8], *W. Stein*[10], *M. Aftab*[9], *K. Berfield*[14], *A. L. Eilers*[12], *S. S. Groth*[8], *J. F. Lazar*[2], *M. P. Robich*[9], *A. A. Shah*[3], *D. Smith*[4], *E. H. Stephens*[5], *C. T. Stock*[13], *W. F. Denino*[11], *T. C. Nguyen*[6]

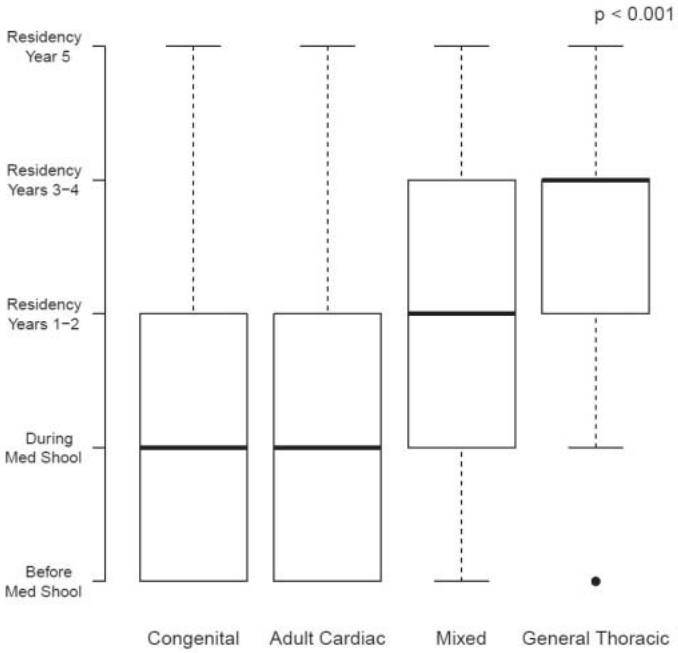
[1]*University of Rochester Medical Center, NY,* [2]*Pinnacle Health, Harrisburg, PA,* [3]*Duke University Medical Center, Durham, NC,* [4]*Bluhm Cardiovascular Institute of Northwestern University, Chicago, IL,* [5]*Columbia University, New York, NY,* [6]*University of Texas Houston – Memorial Hermann,* [7]*University of Virginia, Charlottesville,* [8]*University of Pittsburgh, PA,* [9]*Cleveland Clinic Foundation, OH,* [10]*Emory University, Atlanta, GA,* [11]*Medical University of South Carolina, Charleston,* [12]*University of Texas Health Science Center at San Antonio,* [13]*Massachusetts General Hospital, Boston,* 14*University of Washington, Seattle*

Purpose: The impact of factors influencing career choice among cardiothoracic surgery (CTS) trainees remains poorly defined in the modern era. We sought to examine associations between CTS trainee characteristics and future career aspirations.

Methods: The 2012 Thoracic Surgery In-Training Exam survey results were utilized to categorize respondents according to career interest: congenital, adult cardiac (AC), mixed cardiac/thoracic, and general thoracic (GT) surgery. Residents included in the study belonged to one of four training pathways accredited by Accreditation Council for Graduate Medical Education (ACGME): 6-year integrated (I-6), 4+3 joint training (JT), or either 2- or 3-year traditional fellowship programs. Univariate and multivariable analyses were utilized to identify trainee characteristics associated with career interest categories.

Results: With a nearly 100% response rate, 300 responses from trainees in ACGME-accredited CTS programs were included in the analysis. Multivariable regression identified three factors associated with CTS career choice: decision time to pursue CTS (Figure, $p < 0.001$), type of CTS training pathway (Table, $p < 0.001$), and primary motivator to pursue CTS ($p = 0.002$). GT trainees were more likely to commit to CTS during senior years of training and more likely to enroll in traditional fellowships, while individuals pursuing AC or congenital were more likely to commit earlier during training and more commonly enrolled in I-6 or JT pathways. Moreover, GT trainees were predominantly influenced by early mentorship ($p = 0.025$ vs AC), while AC trainees were more likely to be influenced by types of operations ($p = 0.047$ vs GT).

Conclusions: Career choice in CTS appears strongly associated with level of training, as well as type of training pathway. These results demonstrate the importance of maintaining all four currently approved ACGME training pathways to retain balance and diversity in future CTS practices.


p < 0.001
Residency Year 5
Residency Years 3–4
Residency Years 1–2
During Med Shool
Before Med Shool
Congenital
Adult Cardiac
Mixed
General Thoracic

4:30 PM **Room 30AB**

Recruiting the Best and Brightest Into Cardiothoracic Surgery: Medical Student Summer Scholars Program Revisited

R. S. Higgins[1], *A. Kilic*[2], *V. C. Daniel*[1], *R. E. Merritt*[2], *S. D. Moffatt-Bruce*[1], *J. A. Crestanello*[2], *B. A. Whitson*[2], *C. Ferguson*[1], *T. Williams*[1], *P. Ross*[2]

[1]*The Ohio State University, Columbus,* [2]*The Ohio State University Wexner Medical Center, Columbus*

COMMERCIAL RELATIONSHIPS P. Ross: Consultant/Advisory Board, Pinnacle Biologics Inc, Intuitive Surgical, Inc; Research Grant, Pinnacle Biologics Inc

Purpose: Recent attention on the supply of cardiothoracic surgeons entering the field has provoked renewed interest in the development of a systematic approach to increase interest among medical students. The evolution of integrated cardiothoracic residency programs for these potential applicants underscores the need for exposure to practice expectations and clinical lifestyle for the successful student.

Methods: We initiated a Summer Scholars program for medical students at The Ohio State University in 2010. The summer scholars rotated for an 8-week clinical program (2 weeks each on congenital, adult thoracic surgery, cardiac surgery, and a research or elective period). Their clinical experience included full integration on the service, including daily OR cases, team rounds, and clinic. Each summer scholar had a mentor who guided the experience. We encouraged the students to present a case report at the end of the program. To evaluate the medical student experiences since the inception of the program, we surveyed the participants about their experiences, selected residencies and career paths, and influence on their choices.

Results: There were 15 summer scholars from 2010 to 2013: nine males and six females. Fourteen participants completed the survey, one dropped out of medical school. Projected residency programs were internal medicine (two females), general surgery (three males, two females) ophthalmology (one male), orthopedic surgery (one male), cardiothoracic surgery (three males), and urology (one female and one male). Significant career influences ranked by importance included work/life balance (9), academic potential (7), lifestyle considerations (6), professional distinctions (3), and residency issues (2). Medical students preferred academic (10) vs private practice (1), six wanted to be employed in a large group, and seven thought they should be hospital employees. The first group of summer scholars has participated in the Match: two females chose pediatrics and internal medicine, one male matched in general surgery with expectation to pursue cardiothoracic surgery, and one male matched in an integrated 6-year program in cardiothoracic surgery.

Conclusions: Clinical exposure to cardiothoracic surgery in a mentored setting can enhance and influence medical student exposure and selection of surgical training. Cardiothoracic surgery programs must continue to address lifestyle and work/life issues to be competitive for the best and brightest applicants.

4:45 PM **Room 30AB**

Training Surgical Assistants Can Improve the Process of Adoption of Video-Assisted Thoracic Surgery (VATS) Lobectomy

S. L. Meyerson[1], *S. Balderson*[2], *T. D'Amico*[2]

[1]*Northwestern University, Chicago, IL,* [2]*Duke University Medical Center, Chapel Hill, NC*

COMMERCIAL RELATIONSHIPS S. Balderson: Consultant/Advisory Board, Covidien Ltd; T. D'Amico: Consultant/Advisory Board, Scanlan International, Inc

Purpose: Despite overwhelming evidence of decreased pain, fewer complications, and shorter length of stay with equivalent oncologic outcomes, adoption of VATS lobectomy has been slow in the community. This study evaluates the role of training surgical assistants to ease the transition to VATS lobectomy.

Methods: A half-day training course for physician assistants on the specific skills needed to assist with VATS lobectomy was developed, including hands-on practice with a validated simulator. Each participant completed a needs assessment prior to the course and a course assessment afterwards. One-year follow-up data were obtained from the first cohort to determine the effects of the course on their practice.

Results: The course was offered in 2013 and 2014, and 44 physician assistants participated. Attendees reported difficulty providing optimal camera visualization (n= 25, 56%) and anticipating the next steps of the operation to provide proactive assistance (n=38, 86%). After completing the course, 90% (n=39) felt more confident in their ability to provide optimal visualization for the operating surgeon, and 93% (n=40) felt more confident in their ability to recognize and anticipate the steps of a VATS lobectomy. Seven of the 20 attendees in the first offering of the course (35%) completed the follow-up survey. All reported they were better able to provide camera visualization and follow the steps of the operation, 71% (n=5) reported feeling less frustrated after leaving the operating room, and 57% (n=4) reported that cases flowed more smoothly.

Conclusions: Specific simulator-based training directed at surgical assistants may improve the adoption of new technology by mechanisms including improved visualization and better understanding of methods to facilitate the operation and avoid frustration. This type of training should be made available to assistants of surgeons learning new operations.

5:00 PM **Room 30AB**

Basic Cardiac Surgery Skills on Sale for $22.50

M. Kunkala, *P. G. Rowse, R .Ruparel, Z. Li, D. Farley, L. D. Joyce, J. M. Stulak*

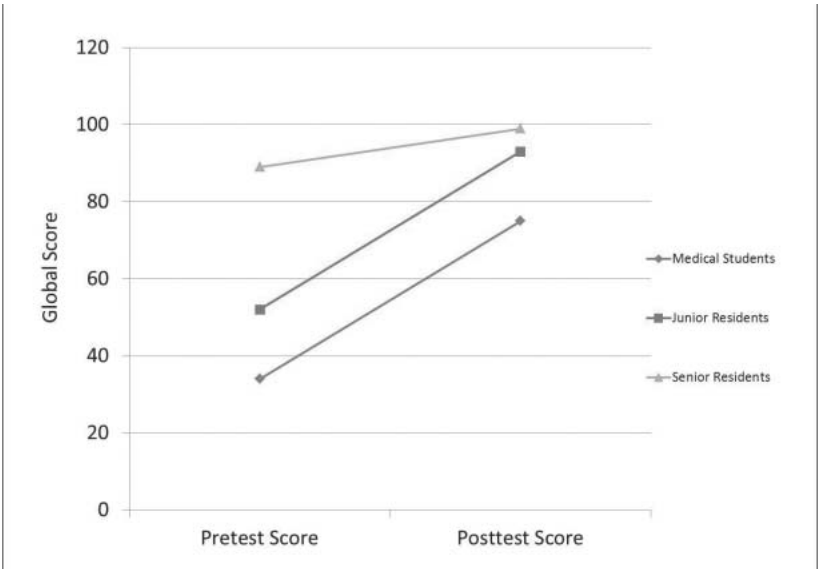
Mayo Clinic, Rochester, MN

Purpose: Current duty-hour restrictions require efficient training. Simulation is an attractive method that allows deliberate practice in a low-stakes environment, but little data have analyzed the utility of low-cost simulation in cardiothoracic surgery. The purpose of this study was to evaluate the merit of a low-cost, low-fidelity, aortic anastomosis simulation curriculum.

Methods: Twenty participants (11 medical students, nine integrated surgery residents) completed an aortic anastomosis (pretest) on a porcine heart. Participants were then given access to a 14-minute online video created by a cardiac surgeon and a low-cost task-trainer for self-directed practice. Five weeks later, participants returned for a posttest. Pre- and posttest performances (perfect score=110, passing score=29) were filmed, de-identified, and viewed independently by two blinded cardiac surgeons using an assessment tool crafted for the national cardiothoracic simulation effort funded by an Agency for Healthcare Research and Quality grant. Participants were anonymously surveyed following the posttest.

Results: Aortic anastomosis performance scores improved from pretest (median = 43; range: 24-103) to posttest (median = 83; range: 54-107, $p < 0.001$). Pass rates also improved (35% vs 95%, $p < 0.001$). Medical students' scores improved most ($p = 0.01$; Figure 1). All participants reported improved confidence in performing the task and all but two participants felt that the online video was essential to better performance. The cost of the curriculum totaled $22.50/person with 6 hours of total staff time required for assessment.

Conclusions: We demonstrate that a simple but structured aortic anastomosis curriculum can effectively and significantly improve the skills of junior residents to a level comparable with senior residents with minimal expense and staff time commitment. Such a curriculum may be of great value to both traditional and integrated cardiothoracic training programs.


120
100
80
60
40
20
0
Global Score
Pretest Score
Posttest Score
Medical Students
Junior Residents
Senior Residents

5:15 PM **Room 30AB**

The Impact of Thoracic Residents on Surgical Outcomes and Failure to Rescue Patients Having Noncardiac Thoracic Operations

V.A. Ferraris[1], *J. T. Martin*[2], *A. Mahan*[2], *S. P. Saha*[2]

[1]*University of Kentucky Chandler Medical Center, Lexington,* [2]*University of Kentucky, Lexington*

Purpose: Questions persist regarding the effect of surgical resident involvement on operative outcomes, especially with the advent of resident duty hour limits. Non-cardiac thoracic operations, including esophageal and pulmonary resections, have high acuity and are likely to expose differences in outcomes with and without surgical resident involvement, if they exist. We wondered how resident involvement impacts surgical outcomes in this group of patients.

Methods: We evaluated surgical outcomes in patients entered into the ACS-NSQIP database undergoing operations performed by cardiothoracic surgeons for resections of lung and esophagus. The analysis assessed procedures done by attending surgeon only (ATTEND) or done with resident involvement (RESIDENT). Outcome measures included complication rates and failure to rescue rates (FTR). Propensity analysis with adjustments for operative complexity, comorbidities, and patient demographics allowed careful matching between procedures with ATTEND or RESIDENT.

Results: Of the 22,168 patients having operations by cardiothoracic surgeons, 6,157 patients (28%) had serious postoperative complications (SPC), and 655 of these patients (3.0%) died. Logistic regression suggested that involvement of surgical residents in procedures predicted small incremental increased SPC (odds ratio = 1.09, $p < 0.001$), slightly improved FTR (odds ratio = 0.85, $p = 0.07$), but overall decreased mortality (odds ratio = 0.76, $p = 0.001$). Sixty percent of FTR occurred in 40% of patients with the highest preoperative logistic probability of developing SPC. Complication rates did not differ between procedures performed by ATTEND or RESIDENT, but the ability to prevent operative mortality in patients with complications (FTR) improved significantly with resident involvement, both before and after propensity-matched comparisons (Table).

Conclusions: We found that surgical resident involvement translates to decreased operative mortality, and the biggest contribution to this decreased mortality is improved rescue of patients having serious postoperative complications after lung and esophageal operations. We speculate that teaching programs provide infrastructure, including vigilant postoperative care that facilitates treatment of SPC and potentially salvages lives after complicated operations.

	Serious postoperative complication rates		Failure to rescue rates	
	Unadjusted (n = 22,168)	Propensity matched (n = 7,981)	Unadjusted (n = 22,168)	Propensity matched (n = 7,981)
Attending Only	31.0%	31.4%	11.8%	11.7%
Resident involvement	30.0%	31.8%	9.4%*	8.3%**

*p=0.003,
**p<0.0001

NOTES

3:30 PM – 5:30 PM ***Room 30CD***

Congenital Session: Pediatric Congenital III

Moderators: *Bret A. Mettler, Nashville, TN, and Glen S. Van Arsdell, Toronto, Canada*

COMMERCIAL RELATIONSHIPS G. S. Van Arsdell: Ownership Interest, CellAegis Devices Inc, Medtronic, Inc

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

Presenting authors are listed in **bold** on each abstract.

The physician competencies addressed in this session are patient care and procedural skills and medical knowledge. These physician competencies will be addressed through a series of individual lectures and a brief question-and-answer session after each topic.

3:30 PM ***Room 30CD***

Does Forward Flow Through the Pulmonary Valve After Bidirectional Cavopulmonary Shunt Benefit Patients at Fontan Operation?

K. Sughimoto[1], *J. Mathew*[2], *Y. D'Udekem*[3], *R. Weintraub*[1], *C. P. Brizard*[3], *I. Konstantinov*[1]

[1]*Royal Children's Hospital, Melbourne, Australia,* [2]*The Hospital for Sick Children, Toronto, Canada,* [3]*Royal Children's Hospital, Parkville, Australia*

COMMERCIAL RELATIONSHIPS C. P. Brizard: Consultant/Advisory Board, Admedus, Australia; R. Weintraub: Consultant/Advisory Board, Actelion Pharmaceuticals US, Inc

Purpose: The impact of leaving restricted forward flow (RFF) through the pulmonary valve (PV) at the time of bidirectional cavopulmonary shunt (BCPS) is still controversial. We aimed to clarify the long-term effect of additional forward flow on the single ventricular circulation.

Methods: Between 2000 and 2010, 323 patients had BCPS. Patients who had Kawashima, Damus-Kaye-Stansel type anastomosis, pulmonary artery septation, or Ebstein anomaly repair were excluded. Thus, 128 patients were enrolled in the study, including 62 patients with RFF via PV (Group I) and 66 patients in whom the PV was closed entirely (Group II). We compared hospital stay at BCPS and Fontan operations, preceding surgery to BCPS, pleural effusion, Nakata index prior to Fontan operation, number of operations between BCPS and Fontan operation, atrioventricular regurgitation (AVVR), and oxygen saturation before Fontan operation. The demographics and outcomes are shown in the Table.

Results: Prior to BCPS, 23% (14/62) of patients in Group I and none in Group II had pulmonary artery (PA) banding, while more patients in Group II had systemic-to-PA shunts as compared to Group I (63 vs 16, $p < 0.01$). Fontan operation was completed in 57% (35/62) of patients in Group I and in 68% (45/66) of patients in Group II ($p = 0.173$). There was no significant difference in hospital stay or duration of pleural drainage at BCPS between the two groups. Prior to Fontan operation, patients with RFW had a higher Nakata index (250 ± 108 vs 199 ± 64, $p = 0.016$). No significant difference was observed in number of surgical procedures between BCPS and Fontan operations, AVVR, or oxygen saturation before Fontan operation. Patients in Group I had shorter hospital stay after Fontan operation (12.7 days ± 6.2 days vs 20.0 days ± 17.8 days; $p = 0.023$).

Conclusions: Patients with RFW had better developed pulmonary arteries and shorter hospital stay after Fontan operation.

variables	BCPS with forward flow (62)	BCPS without forward flow (66)	*p*-value
Hospital stay after BCPS (days)	9.5 ±10.2	10.6 ± 19.1	0.711
Nakata index prior to Fontan operation (mm^2/m^2)	250 ± 108	199 ± 64	0.016
AVV regurgitation prior to Fontan operation			
none or trivial	26 (74%)	27(60%)	0.269
mild	6 (17%)	13 (29%)	
moderate	3 (9%)	5 (11%)	
Fontan Completion	35 (57%)	45 (68%)	0.173
Hospital stay after Fontan operation (days)	12.7 ± 6.2	20.0 ± 17.8	0.023

AVV: atrio-ventricular valve; BCPS: bidirectional cavo-pulmonary shunt

3:45 PM **Room 30CD**

Cardiopulmonary Bypass Prime Volume Impacts Perioperative Adverse Outcomes in Pediatric Cardiac Surgery

A. Muralidaran[1], *M. Zubair*[2], *A. Hohimer*[2], *M. Lasarev*[2], *J. You*[2], *S. M. Langley*[2]

[1]*Doernbecher Children's Hospital at Oregon Health & Science University, Portland,* [2]*Oregon Health & Science University, Portland*

Purpose: Cardiopulmonary bypass (CPB) prime volume in pediatric cardiac surgery has been associated with the need for postoperative blood transfusion. We sought to examine whether CPB prime volume calculated as a ratio of the patient's blood volume correlated with adverse postoperative outcomes in children undergoing cardiac surgery.

Methods: The charts of 298 consecutive children weighing less than 10 kg who underwent cardiac surgery on CPB were evaluated. Prime-blood volume ratio, defined as total prime volume divided by patient's estimated blood volume, was calculated. A ratio >1.0 means the prime volume is greater than the patient's blood volume. Input variables included prime-blood volume ratio, total prime volume, Risk-Adjustment for Congenital Heart Surgery Score (RACHS-1), and CPB time. Outcome variables of interest were duration of mechanical ventilation, total hospital length of stay, and volume of blood cells transfused in the intensive care unit (ICU).

Results: Prime-blood volume ratio ranged from 0.40 to 2.77. Multivariable regression models revealed an association of hospital length of stay with prime-blood volume ratio ($p = 0.049$), CPB time ($p = 0.001$), total prime volume ($p = 0.002$), and RACHS-1 score ($p = 0.002$). Controlling for the above-mentioned variables, each 0.5-point increase in the prime-blood volume ratio correlated with an increase in the median total length of stay by 32% (95% CI: 0.1% to 75%). Similarly, each 0.5-point increase in the prime-blood volume ratio was associated with a doubling (95% CI: 1.7 to 2.5 fold) of the median mechanical ventilation duration, even after adjusting for the other covariates. Odds of ICU red blood cell transfusion were strongly associated with RACHS-1 score ($p < 0.001$). For subjects who received any blood transfusion in the ICU, the median volume administered was 56% (95% CI: 32 to 85%; $p < 0.001$) higher for each 0.5 point increase in the prime-blood volume ratio, even after adjustment for CPB time and total prime volume ($p < 0.001$).

Conclusions: Higher prime-blood volume ratio correlates with increased duration of mechanical ventilation, hospital stay, and volume of red blood cells transfused in the ICU. Minimizing prime-blood volume ratio may reduce perioperative morbidity.

4:00 PM **Room 30CD**

Influence of Morphology and Initial Surgical Strategy on Survival of Infants With Tricuspid Atresia in the Current Era

B. Alsoufi*, T. Slesnick, B. Schlosser, M. Mori, B. E. Kogon, R. Sachdeva, K. R. Kanter*

Emory University, Atlanta, GA

Purpose: Tricuspid atresia (TA) is a heterogeneous single ventricle anomaly in which initial presentation and consequently timing/mode of palliation vary based on anatomy and degree of pulmonary/systemic outflow obstruction. We report current era outcomes of multi-stage palliation of infants with TA and examine if anatomic and, subsequently, surgical factors influence survival.

Methods: From 2002 to 2012, 106 infants with TA underwent multi-stage surgical palliation. Great vessels orientation was normal in 82 (78%) and transposed in 24 (22%). Antegrade pulmonary blood flow was absent in 15 (14%), restricted in 58 (55%), and unrestricted in 33 (31%). Twenty-one (20%) had anatomic substrate to develop systemic ventricular outflow tract obstruction, and 20 (19%) had concomitant arch obstruction. Competing risks analyses were performed to model events after first palliative surgery (death, transition to second stage Glenn or transplantation), and subsequently after Glenn (death, transition to third stage Fontan or transplantation) and to examine associated risk factors affecting outcomes.

Results: Median age was 15 days (IQR 5-88) and median weight was 3.7 kg (IQR 3.0-5.0) with 12 (11%) ≤2.5 kg. Seventeen (16%) were premature ≤36 weeks and 14 (13%) had extracardiac/chromosomal abnormalities. Seventy-nine patients (74%) required early palliation, including modified Blalock-Taussig shunt (n=47, 44%), Norwood (n=18, 17%), and pulmonary artery band (n=14, 13%), while Glenn was the first surgery in the remaining 27 patients (26%). Hospital mortality was six (5.6%). By 1 year after first stage surgery, 85% had Glenn, 3% had transplantation, and 12% had died. Risk factors for death without Glenn included presence of extracardiac/chromosomal abnormalities (HR=12.4, $p < 0.001$) and postoperative extracorporeal membrane oxygenation support (HR=3.9, $p = 0.05$). By 5 years after Glenn, 79% had Fontan, 2% had died, and 19% remained alive awaiting Fontan. Overall survival 8 years following initial surgery was 85% (92% after band, 86% after Glenn, 81% after shunt, and 78% after Norwood, $p = 0.33$). While extracardiac/chromosomal anomalies continued to significantly affect survival, other tested anatomic and surgical variables were insignificant.

Conclusions: Despite morphologic and physiologic variations necessitating different palliative sequences, multi-stage palliation outcomes of various TA subtypes are comparable and generally good with the exception of patients with associated extracardiac/chromosomal abnormalities. The bulk of mortality is inter-stage, indicating continued opportunity for improvement in monitoring and managing patients during this critical period.

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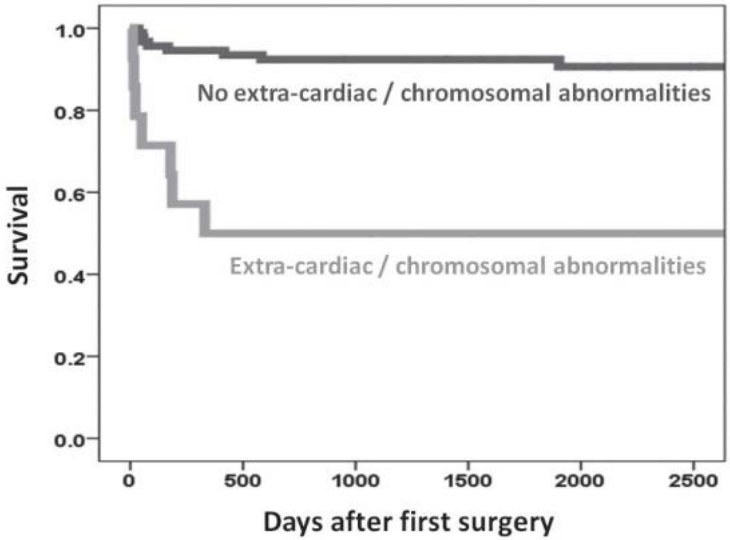
Congenital Session: Pediatric Congenital III – Continued

Abstract continued from previous page



4:15 PM ***Room 30CD***

Perioperative Vasopressin Results in Reduced Length of Hospital Stay After the Fontan Operation

T. S. Kumar[1], *C. J. Knott-Craig*[2]

[1]*Rama Krishna Nursing Home, Trichy, India,* [2]*Le Bonheur Children's Hospital, Memphis, TN*

Purpose: Although early postoperative outcomes following Fontan operation have improved over time, the length of hospital stay is still prolonged due to persistent chest tube output. We hypothesized that use of vasopressin in the perioperative period would reduce chest tube output by maintaining vascular tone, thereby limiting third-spacing and the need for volume replacement.

Methods: We retrospectively analyzed 31 consecutive patients undergoing Fontan operation between 2008 and 2012. In 2010, vasopressin was introduced as part of the standard management of patients undergoing Fontan operation. The patients were grouped according to the use (VP, n=23) or non-use (no-VP, n=7) of vasopressin (0.3-0.5 mU/kg/min) in the perioperative period. The end-points analyzed were hospital mortality, length of hospital stay, and chest tube output.

Results: The VP and no-VP subgroups were well matched for age and weight (14.9 kg vs 15.5 kg, p = NS). There was no hospital mortality. The length of stay in the VP group was 11.2 days ± 2.3 days compared to 18.4 days ± 3.6 days in the no-VP group (p = 0.01). Daily chest tube output decreased significantly in the VP subgroup but not in the no-VP subgroup (p = 0.01).

Conclusions: Use of vasopressin in the early postoperative period is associated with reduced chest tube output and length of hospital stay after the Fontan operation.

4:30 PM **Room 30CD**

Anomalous Aortic Origin of the Coronary Arteries With Intramural Course: Mid-Term Results Using Patch Angioplasty

N. Carvalho Guerra[1], *G. Nesseris*[2], *S. Ramanan*[3], *X. G. Roques*[4], *F. Roubertie*[5]

[1]Hospital de Santa Maria, Lisbon, Portugal, [2]University of Padova, Italy, [3]Medical College of Calicut, India, [4]Bordeaux Heart University Hospital, Pessac, France, [5]CHU Bordeaux, France

Purpose: Anomalous aortic origin of a coronary artery (AAOCA) is a rare congenital heart defect associated with a frequent intramural course. AAOCA is usually treated by unroofing technique with potential compromise of the aortic valve commissure. We assessed outcomes of using patch angioplasty of AAOCA.

Methods: Between 2006 and 2013, 11 patients with AAOCA underwent patch angioplasty of the proximal anomalous coronary artery under normothermic cardiopulmonary bypass. Six patients were males, and the mean age was 16 years (8-63). Preoperatively, three patients were asymptomatic, seven had chest pain or syncope on exertion, and one presented with an acute myocardial infarction. Mean follow-up time was 3 years. Postoperatively, all patients were followed up echocardiographically, had stress test, and underwent computed tomographic coronary angiogram (CT-CA).

Results: Two patients had the left main stem ostium in the right coronary sinus; the rest had a right coronary ostium in the left coronary sinus. All had separate ostia with intramural course. Diagnosis was confirmed by CT-CA in nine cases. A patch angioplasty using non-treated autologous pericardium was performed in 10 patients, and one received a saphenous vein patch due to unexpected pericardial adhesions. Mean cardiopulmonary bypass and aortic cross clamp time were 83 min ± 18 min and 45 min ± 10 min, respectively. One patient had additional ventricular septal defect closure, and one needed an extracorporeal membrane oxygenation support for 5 days. There were no hospital or late deaths. Postoperatively, no patient had complaints of angina; last echocardiographic control showed no aortic regurgitation; stress test showed no abnormality and CT-CA demonstrated patency of the coronary artery.

Conclusions: Patch angioplasty of an AAOCA is a safe and reproducible technique to treat this potential lethal defect. At mid-term, no patient had signs of myocardial ischemia. Long-term durability of this technique is yet to be determined.

4:45 PM **Room 30CD**

Changes in Risk Profile Over Time in the Population of a Pediatric Heart Transplant Program

O. Reinhartz[1], *K. Maeda*[2], *B. A. Reitz*[2], *S. Hollander*[1]

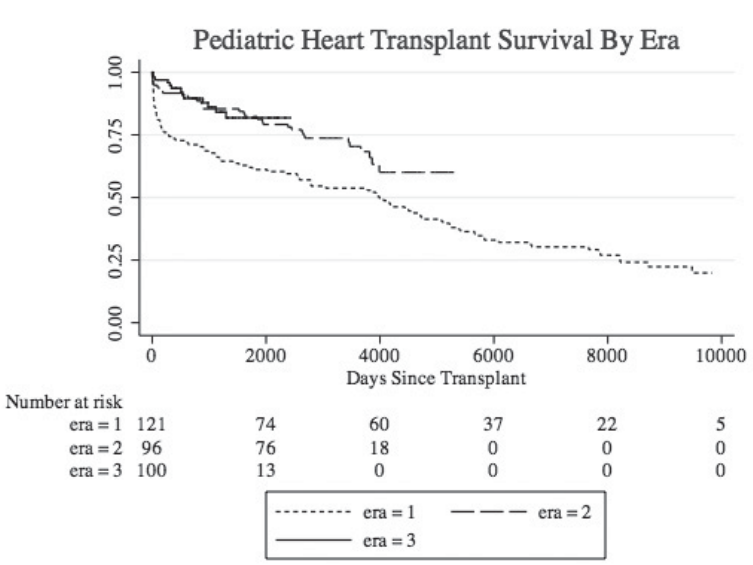
[1]*Stanford University, CA,* [2]*Stanford University School of Medicine, CA*

Purpose: Single center data on pediatric heart transplantation (PHTX) spanning long time frames is sparse. We attempted to elucidate how risk profile and outcomes of a large center changed over time.

Methods: We divided all 323 PHTX done in our center into three groups by era: the first 123 cases ("era 1") beginning in 1974, the second 100 cases ("era 2") beginning in 1998, and the most recent 100 cases ("era 3") beginning in 2007. Differences in age at transplant, indication, mechanical support status, and survival for each era were analyzed.

Results: Three hundred twenty-three pediatric heart transplants were performed at a single institution between August 1974 and May 2014. The average age at time of treatment was 9.6 years (range: 11 days–18.8 years) in era 1; 3 years (range: 2 months–18.2 years) in era 2; and 8.5 years (range: 11 days–20.6 years) in era 3. The percentage of infants transplanted increased from 9% in both era 1 and 2 to 18% in era 3. The indication of end-stage congenital heart disease vs cardiomyopathy increased from 8% in the early era to 34% and 43% in the two most recent eras, respectively. Only two (2%) patients were transplanted from mechanical support in era 1, compared to 16% in era 2 and 33% in era 3. Survival by era is shown in Figure 1.

Conclusions: The rate of infants in our institution has recently doubled. Ventricular assist device support has increased dramatically. Transplantation for end-stage congenital heart disease is increasingly common. Despite this higher risk profile, survival of PHTX patients has been similar over the last 16 years. It is improved compared to our earliest era.



5:00 PM **Room 30CD**

Outcomes With Early Biventricular Assist Device in Pediatric Heart Failure: A Single Center Experience of 31 Patients

J. Miller[1], *M. Henn*[1], *D. Epstein*[2], *T. Guthrie*[2], *R. Schuessler*[3], *K. Simpson*[2], *C. Canter*[2], *P. Eghtesady*[2], *U. S. Boston*[2]

[1]*Barnes-Jewish Hospital/Washington University in St Louis, MO,* [2]*St Louis Children's Hospital, MO,* [3]*Washington University School of Medicine, St Louis, MO*

Purpose: Biventricular assist device (BiVAD) support is considered a risk factor for worse outcomes when compared to left VAD (LVAD) alone. It remains unclear if this is due to the device itself or the underlying disease severity. We aimed to show that early BiVAD support is not associated with poor outcomes.

Methods: A prospectively collected database was analyzed evaluating all pediatric patients (≤18 years old) who underwent BiVAD placement. From April 2005 to December 2010 (era 1), BiVADs were utilized exclusively. From January 2011 to June 2014 (era 2), LVAD use alone was considered on an individual basis, with a low threshold for BiVAD support. All BiVADs were extracorporeal, pneumatically driven, pulsatile devices.

Results: There were 31 patients who received BiVAD support. The initial era included 22 patients (71%) and the latter era nine (29%), with no difference in long-term survival (p = 0.76). Diagnosis was myocarditis or dilated cardiomyopathy in 27 (87%), congenital heart disease in three (10%), and allograft rejection in one (3%). All patients were INTERMACS profile 1 or 2 with 10 (32%) on extracorporeal membrane oxygenation prior to BiVAD. Total BiVAD duration was 1,292 patient days with a median duration of 38 days (IQR 15-54) (Table 1). Survival to transplant was achieved in 25 (81%), two (6%) remain alive on BiVAD support, and four (13%) died on device (Figure 1). Overall survival was 84% with a median follow-up post-BiVAD implantation of 58 months (IQR 37-90). Major adverse event rates were: hemorrhagic at 0.62/100 days of support, major infection at 1.39/100 days of support, and cerebral vascular accident at 0.77/100 days of support.

Conclusions: Early BiVAD support provides a good approach to bridge patients to transplantation with excellent long-term survival, though with a risk of adverse events. Previous studies identifying BiVAD support as a risk factor for poor outcomes is likely due to patient selection, late RVAD placement, and institution inexperience with BiVAD.

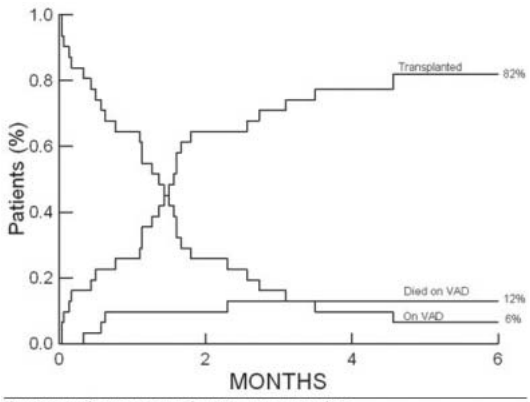


Figure 1. Competing outcomes analysis over 6 months for 31 patients

Table 1. Outcomes

Outcome Or Complication	
BiVAD Support	
Total duration of BiVAD support (d)	1292
Per patient duration of BiVAD support (d), median (IQR)	38 (15-54)
Time to extubation (d), median (IQR)	3 (1-7)*
ICU duration (d), median (IQR)	11 (7-27)‡
BiVAD associated complications	
Patients with Cerebrovascular accident	9 (26%)
Total CVA [rate*]	10 [0.77]
Patients with Major Infection	16 (32%)
Total infections [rate*]	18 [1.39]
Patients with Hemorrhage	7 (23%)
Total hemorrhagic events [rate*]	8 [0.62]
Patients requiring pump change§	16 (52%)
Total pump changes [rate*]	64 [5.0]
Outcome	
Survived to transplant	25 (81%)
Alive on support	2 (6%)
Expired while on device	4 (13%)
Current Status	
Alive	26 (84%)
Follow-up from BiVAD (m), median (IQR)	58 (37-90)
Post OHT	
Time to extubation (d), median (IQR)	1.2 (0.5-3.0)
ICU duration (d), median (IQR)	5 (4-7)

*Rate is events per 100 days of BiVAD support

* 2 patients did not survive to extubation

‡1 patient remains in ICU on VAD support and was excluded

§Changing of both pumps at one time is considered 2 pump changes

5:15 PM ***Room 30CD***

Discussion

3:30 PM – 5:30 PM ***Room 33ABC***

General Thoracic Session: Mediastinal/Pulmonary

Moderators: *Leah M. Backhus, Seattle, WA, and Christopher R. Morse, Boston, MA*

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

Presenting authors are listed in **bold** on each abstract.

The physician competencies addressed in this session are patient care and procedural skills and medical knowledge. These physician competencies will be addressed through a series of individual lectures and a brief question-and-answer session after each topic.

3:30 PM ***Room 33ABC***

Early Surgical Outcomes of En Bloc Resection Requiring Vertebrectomy for Malignancy Invading the Thoracic Spine

G. Mody*, C. Bravo Iñiguez, K. Armstrong, M. Martinez, M. Ferrone, C. Bono, J. Chi, J. Wee, A. Lebenthal, S. J. Swanson, Y. Colson, R. Bueno, M. T. Jaklitsch*

Brigham and Women's Hospital, Boston, MA

COMMERCIAL RELATIONSHIPS S. J. Swanson: Consultant/Advisory Board, Covidien Ltd; Ethicon Endo-Surgery, Inc; C. Bono: Consultant/Advisory Board, United Health Care; Other, Wolters Kluwer, Royalties for edited books

Purpose: En bloc resection of T4 lung cancers with direct invasion to the spine has led to the development of a surgical sequence for resection: prone posterior stabilization, reposition, thoracotomy, lobectomy, vertebrectomy, and anterior spine stabilization in one procedure. This technique expanded indications for vertebrectomy to selected patients with sarcoma and metastatic disease. We review our experience to identify areas for clinical improvement.

Methods: Operative case logs were cross-checked with billing data from 2003 to 2014 with CPT codes for vertebrectomy. Thirty-two cases involving en bloc resection of malignancy invading at least one thoracic vertebra were selected. Benign cases were excluded. Outcomes data were analyzed using summary statistics.

Results: Series includes 14 men and 18 women with a median age of 54 years (range 18-77 years). Twenty-five patients (78%) received preoperative chemoradiotherapy. Nineteen total and 13 partial vertebrectomies were performed. Average number of vertebrae resected was 1.6 (range 1-4). Median operative length was 8.5 hours (range 2.8-14.5), mean blood loss 923 ml (SD + 477 ml), and median length of stay 8 days (range 3-56). Major morbidity followed 56% of cases (Table 1). One patient was non-ambulatory due to diffuse metabolic weakness; the remaining were ambulatory. One patient required reoperation 4 months postop for hardware migration. Discharges were to home 69%, rehab 25%, and 3% to hospice (1 patient) after 56 days. Thirty-day mortality was 3% (PE). Overall median survival was 43.6 months and 1-year survival was 75% (Figure 1).

Conclusions: En bloc vertebrectomy for malignant disease is feasible for T4 tumors. Our one stage/two team approach allows completion of the operation within a standard day but is associated with long operative time. There was a 9% pulmonary embolus and 9% postoperative pneumonia rate. These rates may improve with decreased operative times. Median long-term survival exceeded 3.5 years. Review of available data warrants future prospective studies.

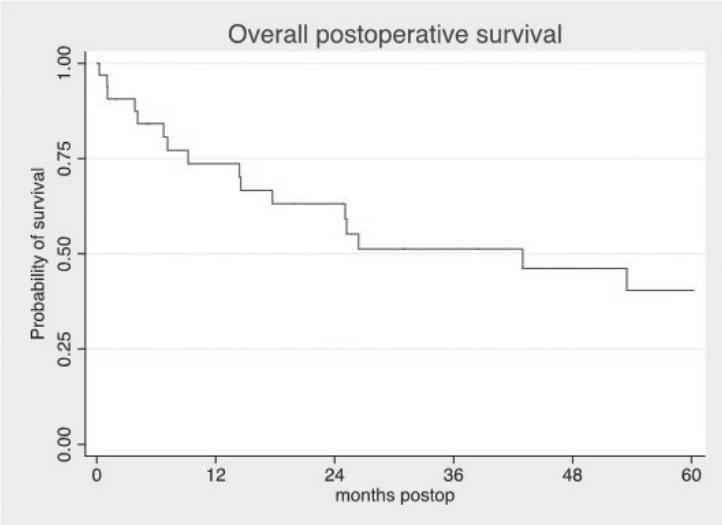


Table 1. Morbidity

Overall complication rate: 56% (18/32 patients)

Complication	Frequency	Percentage
Pneumonia	3	9%
Pulmonary Embolism	3	9%
Ventilator Dependency >48 hrs	1	3%
Pleural Effusion	5	16%
Airway Obstruction Requiring Bronchoscopy	3	9%
Atrial Fibrillation	2	6%
Heart Failure Leading to Low Output Syndrome	1	3%
Weakness but Patient can Ambulate	6	19%
Non Ambulatory	1	3%
Persistent Altered Mental Status	1	3%

3:45 PM **Room 33ABC**

PET-Negative Mediastinum Does Not Assure Freedom From N1 and N2 Lymph Nodes in Clinical Stage 1A and 1B Lung Cancer

***H. J. Soukiasian**, D. Liou, H. Merry, R. J. McKenna*

Cedars-Sinai Medical Center, Los Angeles, CA

Purpose: Our clinical impression is that the false negative rate for the PET scan for nodes is higher than predicted. Therefore, we evaluated 18-fluoro-2-deoxy-d-glucose PET-CT (PET) negative clinical stage 1A and 1B lung cancer.

Methods: In our database, 976 patients were identified with clinical stage 1A and 1B non-small cell lung cancer (NSCLC) by PET. Their mediastinal lymph node pathology was compared to the preoperative PET staging of mediastinal lymph nodes.

Results: The 976 patients with preoperative clinical stage 1 by PET included Stage 1A (674 patients) and 1B (302 patients). Pathologic N1 or N2 nodes were found in 200/976 patients (20.5% false negative rate) by PET for nodal staging. Pathologic N1 or N2 nodes were present in clinical stage 1A 104/674 (15.4%). N1 was present in 57/674 (8.5%) and N2 was positive in 47/674 (6.9%) for clinical stage 1A group. For clinical stage 1B, 96/302 (31.8%) had pathologic positive N1 or N2 nodes. N1 was pathologic positive in 61/302 (20.2%) and N2 was positive in 35/302 (11.6%) for clinical stage 1B group.

Conclusions: PET negative mediastinum in clinical stage 1A and 1B is associated with a relatively high false negative rate in our series. This may be due to PET variability at different institutions, as well as aggressive lymphadenectomy. Our data emphasizes the need for surgical staging and not relying on clinical staging by PET alone.

4:00 PM **Room 33ABC**

Pneumonectomy for Locally Advanced Non-Small Cell Lung Cancer (NSCLC): The Impact of Neoadjuvant Therapy

S. R. Broderick[1], *A. Patel*[2], *T. P. Crabtree*[3], *J. Bell*[2], *D. Kreisel*[3], *A. S. Krupnick*[3], *G. A. Patterson*[2], *B. F. Meyers*[2], *V. Puri*[2]

[1]*St Luke's Hospital, Chesterfield, MO,* [2]*Washington University School of Medicine, St Louis, MO,* [3]*Barnes-Jewish Hospital/Washington University in St Louis, MO*

COMMERCIAL RELATIONSHIPS B. F. Meyers: Consultant/Advisory Board, Ethicon, Inc, Varian Medical Systems, Inc

Purpose: To evaluate short- and long-term outcomes and the impact of neoadjuvant therapy in patients who require pneumonectomy for locally advanced NSCLC.

Methods: Patients who underwent pneumonectomy for clinical stage IIIA NSCLC were abstracted from the National Cancer Database. Individuals who were treated with neoadjuvant therapy followed by resection (neoadjuvant group) were compared to those who underwent surgery followed by adjuvant therapy (adjuvant group). Logistic regression was performed to identify factors associated with 30-day mortality. A Cox proportional hazards model was fitted to identify factors associated with survival.

Results: A total of 1,038 patients underwent pneumonectomy for stage IIIA NSCLC with R0 resection. Seven hundred thirty-nine (71%) received neoadjuvant therapy and 299 (29%) underwent resection followed by adjuvant therapy. The two groups were well matched for age, gender, race, income, Charlson comorbidity score, and tumor size. The 30-day mortality rate in the neoadjuvant group was 7.8% (57/739) compared to 1.7% (5/299) in the adjuvant group ($p < 0.001$). Median survival was similar between the two groups: neoadjuvant 25.9 months vs 31.3 months adjuvant ($p = 0.74$). A multivariable logistic regression model for 30-day mortality demonstrated that increasing age, annual income <$35,000, neoadjuvant therapy, and right-sided resection were associated with elevated risk of 30-day mortality. A multivariable Cox model for survival demonstrated that increasing age was predictive of shorter survival while administration of neoadjuvant therapy did not confer a survival advantage over adjuvant therapy ($p = 0.57$).

Conclusions: The majority of patients who require pneumonectomy for clinical stage IIIA NSCLC receive neoadjuvant chemoradiotherapy without an improvement in survival. In these patients, primary resection followed by adjuvant chemoradiotherapy may provide superior short-term and equivalent long-term outcomes.

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General Thoracic Session: Mediastinal/Pulmonary – Continued

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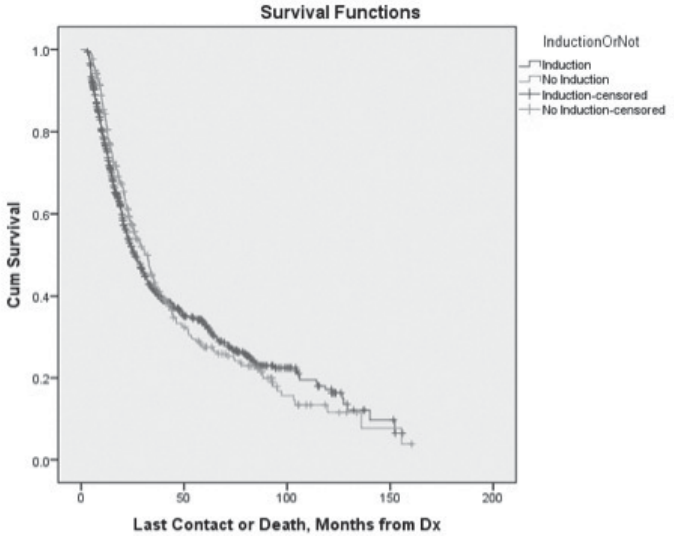

4:15 PM ***Room 33ABC***

Idiopathic Subglottic Stenosis: Factors Affecting Outcome Following Single-Stage Repair

H. Wang*, C. D. Wright, J. C. Wain, H. C. Ott, D. J. Mathisen*

Massachusetts General Hospital, Boston

Purpose: Idiopathic subglottic stenosis is a rare inflammatory condition affecting the subglottic larynx. We have treated 263 (only two males) patients with this condition. The purpose of this study is to determine factors affecting outcome and predisposing to complications.

Methods: Information was gathered from chart reviews and surveys.

Results: Median time from diagnosis to surgery was 24 months. Antinuclear antibodies when measured were positive in 76 patients (47%). Prior tracheal procedures were done in 22%, and 70% had prior endoscopic procedures. Resection of the posterior cricoid mucosa with tracheal membranous wall flap was done in 57%. Tailored cricoplasty was performed in 40%. Extubation in OR was achieved in 94%. Steroids for edema were required in 24%. Anastomotic complications occurred in 30 patients; granulations (17) and subcutaneous air (7). Twenty-four patients have recurrence requiring dilation. Risk factors for anastomotic complications and recurrence were edema requiring steroids, use of mitomycin C, and vocal cord involvement (Table 1). Follow-up was available in 227 patients. A survey in 180 patients revealed (10 point scale) effectiveness 9.4, satisfaction 9.4, and symptom improvement 9.4. A normal voice was present in 36%, change in voice 42%, and 53% had difficulty projecting their voices.

Conclusions: Single stage reconstructive surgery resulted in 95% good-to-excellent results. Recurrence developed in 5%. Stents, postoperative edema, mitomycin use, and vocal cord involvement are risks for recurrence. Positive hormone receptors in tissues require further clarification.

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General Thoracic Session: Mediastinal/Pulmonary – Continued

Abstract continued from previous page

	Complications				Recurrence			
Factor	Univariate		Multivariate		Univariate		Multivariate	
	p	Hazard Ratio	p	Hazard Ratio	p	Hazard Ratio	p	Hazard Ratio
ANA (-)(N=88)	0.096	3.0	0.037	3.4	---	---	---	---
Prior Tracheostomy (N=59)	0.043	2.6	---	---	0.012	---	---	---
MMC Treatment (N=27)	0.013	3.4	---	---	0.026	3.2	---	---
Not Extubated (N=16)	0.023	3.7	---	---	0.012	4.4	---	---
Edema with Dyspnea (N=64)	<0.001	4.2	<0.001	6.6	---	---	---	---
Stent (N=5)			---	---	0.005	27.5	<0.001	178.0
Laser > 3 (N=52)					0.007	3.3	---	---
Length > 3cm (N=18)					0.006	10.2	---	---
Vocal Cord Abnormality (N=11)					0.001	9.9	0.003	16.8

MMC= Mitomycin C

4:30 PM **Room 33ABC**

Surgical Techniques and Long-Term Results of Pulmonary Artery Reconstruction in Patients With Non-Small Cell Lung Cancer

D. Galetta, *A. Borri, R. Gasparri, F. Petrella, L. Spaggiari*

European Institute of Oncology, Milan, Italy

Purpose: Pulmonary artery reconstruction associated with lung resection is technically feasible with low morbidity and mortality. We assessed our experience with partial or circumferential resection of the pulmonary artery (PA) during lung resection.

Methods: Between 1998 and 2013, we performed PA angioplasty in 150 patients with lung cancer. Seventy-five patients received induction chemotherapy. Partial PA resection was performed in 146 cases. PA reconstruction was performed by running suture in 113 and using a pericardial patch in 33 (21 autologous and 12 heterologous). A circumferential PA resection was performed in four patients and reconstruction was made in polytetrafluoroethylene in two and by a custom-made bovine pericardial conduit in two cases. Bronchial sleeve resection was associated in 56 cases; in six cases, superior vena cava reconstruction was required. Thirty-two patients had stage I disease, 43 stage II, 51 IIIA, and 17 IIIB. Seven patients had a complete response after induction therapy.

Results: The procedure-related complications were two massive hemoptysis leading to death (operative mortality, 1.3%); 33 patients had pulmonary complications, 28 cardiac, and 17 air leaks. Overall 5- and 10-year survival were 50% and 39%, respectively. Five- and 10-year survivals for stages I and II vs stage III were, respectively, 66% vs 32% and 56% vs 20% ($p < 0.0001$). Five-year survivals were 61% for N0 and N1 nodal involvement vs 28.1% for N2; 10-year survivals were 45% vs 28% ($p = 0.001$). Induction therapy does not influence survival. Multivariate analysis yielded advanced stage, N2 status, and adenocarcinoma as negative prognostic factors.

Conclusions: Pulmonary artery reconstruction is safe, with excellent long-term survival. Our results support this technique as an effective option for patients with lung cancer.

4:45 PM **Room 33ABC**

Incidence and Factors Associated With Hospital Readmission Following Pulmonary Lobectomy

B. M. Stiles, *A. Poon, G. Giambrone, L. Gaber-Baylis, J. Eskreis-Winkler, X. Sun, A. Roberts-Selzer, P. C. Lee, J. Port, S. Paul, N. K. Altorki, P. Fleischut*

New York Presbyterian Hospital - Weill Cornell Medical College, NY

Purpose: Readmission rates following major procedures are used to benchmark quality of care. Pulmonary lobectomy is a potentially morbid procedure often performed in high-risk patient populations. Understanding factors associated with readmission and readmission diagnoses may lead to preventive interventions in this population.

Methods: Analyzing the State Inpatient Databases (part of the Healthcare Cost and Utilization Project of the Agency for Healthcare Research and Quality), we reviewed all lobectomies performed (2009-2011) on patients >/=18 years of age in California, Florida, and New York. The group was further subdivided into open (OL) vs minimally invasive lobectomy (MIL:VATS/robotic). Unique identifiers were used to determine 30- and 90-day readmission rates and diagnoses. Regression analysis with assessment for colinearity was performed to determine factors associated with readmission.

Results: A total of 22,676 lobectomies were identified (58.8% OL vs 41.2% MIL; median age=68; median length of stay=6 days). Most patients (59.9%) had routine discharge home (home health care=29.3%; transfer to other facility=8.8%; mortality=1.9%). The 30-day readmission rate was 12.1% (OL=12.7% vs MIL=11.2%, $p = 0.001$), while the 90-day readmission rate was 19.7% (OL=21.2% vs MIL=17.6%, $p < 0.001$). The most common readmission diagnoses were pulmonary (25.3%), cardiovascular (15.6%), complications related to surgical/medical procedures (15.2%), malignancy-related/hematologic (12.9%), and infectious (7.7%). Predictors of readmission are listed (Table: Adjusted odds ratio estimates & Wald confidence intervals for 90-day readmission). OL did not independently predict readmission (OR 1.01; CI 0.94-1.09). Death during 30- and 90-day readmission were 5.7% and 4.4%, respectively.

Conclusions: Readmission is a frequent event after pulmonary lobectomy and is strongly influenced by preoperative comorbidities and postoperative complications. The mortality rate at readmission is higher than that of the initial admission for lobectomy. Resources and services should be directed to patients at risk for readmission and multicomponent care pathways developed, which may circumvent the need for repeat hospitalization.

	Predictor	Odds Ratio	95% Confidence Limits	P-value
Preoperative Factors	Medicaid payer (referent=Medicare)	1.23	1.04-1.44	0.0129
	DEYO Co-morbidity Index	1.09	1.07-1.10	<0.0001
	COPD	1.16	1.08-1.25	<0.0001
	CHF	1.29	1.07-1.54	<0.0001
	Coagulopathy	1.43	1.11-1.84	0.0062
	Weight loss	1.40	1.14-1.73	0.0016
	Anemia	1.93	1.19-3.12	0.0075
Complications	Cardiovascular	1.11	1.0-1.22	0.0497
	Pulmonary	1.14	1.05-1.23	0.0014
	Infectious	1.52	1.30-1.77	<0.0001

5:00 PM ***Room 33ABC***

What's New in the Management of Mediastinal Germ Cell Tumors
Kenneth A. Kesler, Indianapolis, IN

5:15 PM ***Room 33ABC***

The Importance of Participation in the International Thymic Malignancy Interest Group
Frank C. Detterbeck, New Haven, CT

3:30 PM – 5:30 PM ***Room 30E***

ESTS @ STS: Controversial Issues in General Thoracic Surgery—Perspectives From Europe and North America

This collaborative session by STS and the European Society of Thoracic Surgeons will provide current perspectives from Europe and North America on a variety of controversial issues in general thoracic surgery. Expert thoracic surgeons will discuss topics, including the surgical management of malignant mesothelioma, CT screening for lung cancer, credentialing surgeons for new technologies and procedures, and the role of robotics in the surgical management of lung and esophageal malignancies.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Describe the surgical treatment options for malignant mesothelioma
- Review the challenges in CT screening for lung cancer
- Recognize the challenges for safely credentialing general thoracic surgeons in new technologies or procedures
- Discuss the role of robotics in the surgical management of lung and esophageal malignancies

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

The physician competencies addressed in this session are patient care and procedural skills, medical knowledge, and interpersonal and communication skills. These physician competencies will be addressed through a series of collaborative lectures by members of The Society of Thoracic Surgeons and the European Society of Thoracic Surgeons.

Moderators: *Sean C. Grondin, Calgary, Canada, and Dirk E. M. Van Raemdonck, Leuven, Belgium*

3:30 PM **Introduction**

3:32 PM **Surgical Management of Malignant Mesothelioma: European Perspective**
Isabelle Opitz, Zurich, Switzerland

3:42 PM **Surgical Management of Malignant Mesothelioma: North American Perspective**
Marc De Perrot, Toronto, Canada

3:52 PM **Panel Discussion**

4:00 PM **Challenges in CT Screening for Lung Cancer: European Perspective**
Gaetano Rocco, Naples, Italy
COMMERCIAL RELATIONSHIPS G. Rocco: Speakers Bureau/Honoraria, Covidien Ltd, Synthes Holding AG, Takeda Pharmaceutical Company; Nonremunerative Position of Influence, Baxter International Inc, Travel reimbursement and honoraria

4:10 PM **Challenges in CT Screening for Lung Cancer: North American Perspective**
Douglas E. Wood, Seattle, WA
COMMERCIAL RELATIONSHIPS D. E. Wood: Consultant/Advisory Board, Spiration, Inc; Research Grant, Spiration, Inc

4:20 PM **Panel Discussion**

4:30 PM **Challenges in Credentialing Surgeons in New Technologies or Procedures: European Perspective**
Gilbert Massard, Strasbourg, France

4:40 PM **Challenges in Credentialing Surgeons in New Technologies or Procedures: North American Perspective**
Shanda H. Blackmon, Rochester, MN

4:50 PM **Panel Discussion**

5:00 PM **Role of Robotics in the Surgical Management of Lung and Esophageal Malignancies: European Perspective**
Alper S. Toker, Istanbul, Turkey

5:10 PM **Role of Robotics in the Surgical Management of Lung and Esophageal Malignancies: North American Perspective**
Robert J. Cerfolio, Birmingham, AL

COMMERCIAL RELATIONSHIPS R. J. Cerfolio: Speakers Bureau/Honoraria, Intuitive Surgical, Inc, Life Science Technologies

5:20 PM **Panel Discussion**

5:28 PM **Closing Remarks**

3:30 PM – 5:30 PM **Room 29D**

SVS @ STS

This session will focus on vascular surgery topics relevant to practicing cardiothoracic surgeons. Cardiothoracic and vascular surgeons will provide perspectives on the contemporary management of type B aortic dissection—both acute (uncomplicated/complicated) and chronic dissection—as well as on the management of severe carotid stenosis (asymptomatic/symptomatic) in patients undergoing coronary artery bypass grafting (CABG) surgery.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Formulate a plan based on published data for management of patients with severe carotid stenosis undergoing CABG surgery
- Identify treatment options for patients with acute and chronic type B dissection
- Describe the advantages and disadvantages of best medical management vs endovascular intervention in type B dissection

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

The physician competencies addressed in this session are patient care and procedural skills and medical knowledge. These physician competencies will be addressed through a series of collaborative lectures by members of The Society of Thoracic Surgeons and the Society for Vascular Surgery.

Moderators: *A. Michael Borkon, Kansas City, MO, and Jason T. Lee, Stanford, CA*

3:30 PM **Room 29D**

Long-Term Survival and Quality of Life After Extent II Thoracoabdominal Repair in Marfan Syndrome

R. Ghanta[1], M. Price[1], C. Nalty[2], O. A. Preventza[2], K. de la Cruz[1], S. A. LeMaire[2], ***J. S. Coselli[2]***

[1]Baylor College of Medicine/Texas Heart Institute, Houston, [2]Baylor College of Medicine, Houston, TX

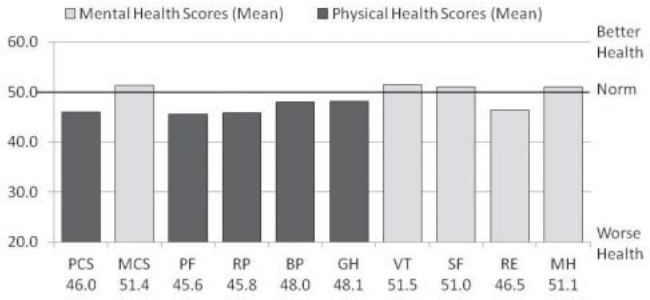
COMMERCIAL RELATIONSHIPS J. S. Coselli: Consultant/Advisory Board, Medtronic, Inc, Vascutek a Terumo Company; Research Grant, Edwards Lifesciences Corporation, GlaxoSmithKline, Medtronic, Inc, W.L. Gore & Associates, Inc; S. A. LeMaire: Consultant/Advisory Board, Baxter International, Inc, Medtronic, Inc; O. A. Preventza: Consultant/Advisory Board, Medtronic, Inc

Purpose: Aortic pathology remains a major source of morbidity and mortality for patients with Marfan syndrome. Extensive thoracoabdominal aortic aneurysm (TAAA) repair can prevent aortic catastrophe but carries substantial risk. We evaluate long-term survival and quality of life after contemporary Crawford extent II TAAA repair in patients with Marfan syndrome.

Methods: From 2004 to 2010, 49 consecutive Marfan syndrome patients underwent extent II TAAA repair: 41 elective, six urgent, and two emergent. Patient median age was 45 years. Aorta-related symptoms were present in 36 patients (73%) and aortic dissection was present in 45 (92%). Operative adjuncts included cerebrospinal drainage in 47 (96%), left heart bypass in 46 (94%), and cold renal perfusion in 47 (96%). Quality of life (QoL) was assessed in 24 patients with a 12-item survey (SF-12v2® Health Survey) at a median of 5.9 years postoperatively. QoL data were normalized and compared with data from the general population.

Results: There were no operative deaths or incidents of stroke, paraparesis, or paraplegia. Renal failure necessitating hemodialysis occurred in two patients (4%). The most frequent complication was vocal cord paralysis (43%). Long-term Kaplan-Meier survival at 6 years was 84% ± 6%. The 24 patients with QoL data had a slightly lower physical component score (PCS) (46.0 ± 10.6) and a slightly higher mental component score (MCS) (51.4 ± 10.4) than the general population (50 ± 10 for both PCS and MCS).

Conclusions: Operative treatment of extensive TAAA in Marfan syndrome patients enables excellent long-term survival and quality of life. Cerebrospinal fluid drainage, left heart bypass, and cold renal perfusion are critical adjuncts for improving outcomes.



Abbreviation
PCS = Physical Component Summary
MCS = Mental Component Summary
PF = Physical Functioning
RP = Role Physical
BP = Bodily Pain
GH = General Health
VT = Vitality
SF = Social Functioning
RE = Role Emotional
MH = Mental Health

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SVS @ STS – Continued

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Outcome	Marfan Extent II TAAA Repairs (n = 49)
Operative	
Death	0
Stroke	0
Paraparesis or Paraplegia	0
Renal Failure Necessitating Hemodialysis	2 (4%)
Atrial Fibrillation	4 (8%)
Vocal Cord Paralysis	21 (43%)
Long-term	
Survival (mean ± SD)	
2-Year Survival	98 ± 2%
6-Year Survival	84 ± 6%
Quality of Life (mean ± SD)	
Physical Component Score	46.0 ± 10.6
Mental Component Score	51.4 ± 10.4

3:45 PM **Room 29D**

Nationwide Outcomes Following Open Descending Thoracic Aortic Repair: An Analysis of Over 5,000 Medicare Patients

J. Schaffer[1], *B. Lingala*[1], *M. Dake*[1], *Y. J. Woo*[2], *R. Mitchell*[2], *D. Miller*[3]

[1]*Stanford Hospital and Clinics, Palo Alto, CA,* [2]*Stanford University School of Medicine, CA,* [3]*Stanford University Medical Center, CA*

COMMERCIAL RELATIONSHIPS D. Miller: Consultant/Advisory Board, Abbott Vascular, Edwards Lifesciences Corporation, Medtronic, Inc; M. Dake: Research Grant, W. L. Gore & Associates, Inc; Consultant/Advisory Board, W. L. Gore & Associates, Inc; Research Grant, Cook, Medtronic, Inc

Purpose: Treatment of descending thoracic aortic (DTA) pathologies changed with the advent of stent-graft endovascular repair (TEVAR); however, TEVAR is an unproven long-term strategy, and many DTA pathologies are not amenable to TEVAR, requiring open descending thoracic aortic repair (SURG). As higher-risk patients were shunted to TEVAR, we hypothesized the risk of SURG should have fallen over time.

Methods: We analyzed Medicare patients undergoing SURG for DTA (for all aortic pathologies) from 1999 to 2010. ICD-9 codes were used to determine aortic pathology, while surgeon-billed CPT codes were used to identify operative procedures performed. Patient demographics, comorbidities, previous operations, operative characteristics, hospital volume, and inter-hospital variability were included as covariates in our analysis. Inter-hospital variability was assessed using a shared-frailty model, and the top one-third of hospitals (associated with the best long-term survival) were identified as "high-performing" hospitals. Survival distributions were estimated and compared with Kaplan-Meier methods and log-rank test. Cox proportional hazards was used to identify predictors of death.

Results: Patient comorbidities and operative characteristics differed significantly by aortic pathology. Median survival of the entire cohort (n=5,578) was 4.3 years, with 1-, 5-, and 10-year survival estimates of 64%, 46%, and 24%, respectively. Survival curves stratified by aortic pathology are shown in Figure 1. Patients suffering from aortic rupture had the worst prognosis (median survival 45 days, $p < 0.001$). Multivariable analysis (Table 1) identified age, male gender, aortic rupture, concomitant cardiac, thoracoabdominal or abdominal aortic surgery, and comorbidities (including prior myocardial infarction, congestive heart failure, atrial fibrillation, chronic obstructive pulmonary disease, chronic kidney disease, anemia, history of stroke, or dementia) as variables associated with death after SURG. Less complex aortic pathology (isolated aneurysm limited to the thoracic aorta) was associated with superior survival. Additionally, undergoing SURG at a high-volume or a high-performing hospital, more recent year of operation, and having a lumbar cerebrospinal fluid drain placement were associated with an improved survival estimate.

Conclusions: Survival after SURG of the DTA is influenced by the complexity of the aortic pathology. Aortic rupture is associated with a poor prognosis, while simple isolated thoracic aortic aneurysm is conversely associated with better survival. Hospital volume and a separate "hospital performance" effect are independently associated with improved SURG outcomes, as were a more recent year of surgery and the use of a lumbar drain.

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SVS @ STS – Continued

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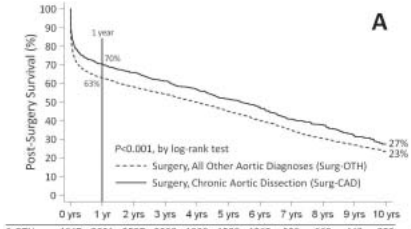

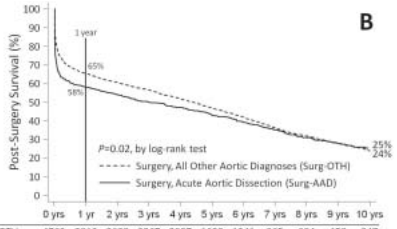

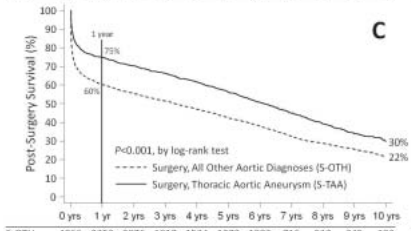

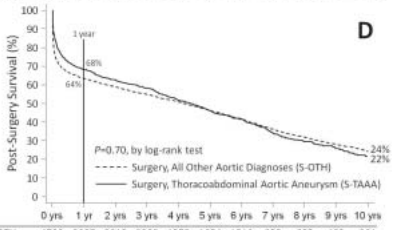

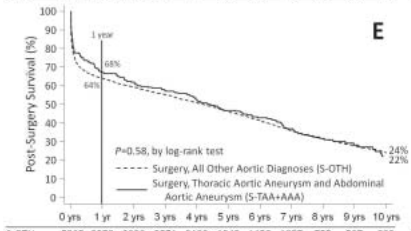

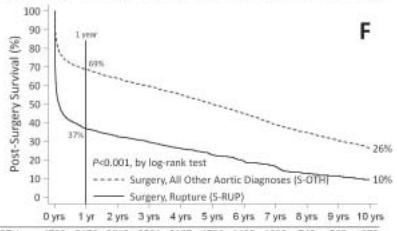

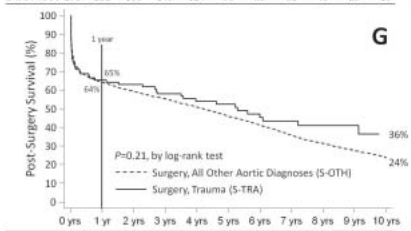

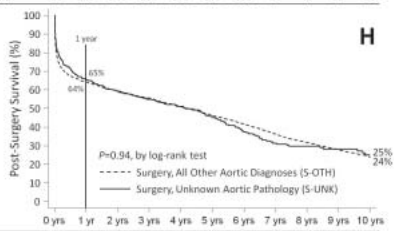

Table 1. Univariate and multivariable Cox regression analysis of predictors of post-surgical survival

	Multivariable hazard ratio (95% CI)	P	Univariate hazard ratio (95% CI)	P
Demographics				
Age at operation	1.035 (1.030-1.040)	**<0.001**	1.038 (1.034-1.043)	**<0.001**
Gender (male)	1.10 (1.03-1.18)	**0.005**	0.99 (0.93-1.06)	0.87
Race (African American)	0.96 (0.87-1.06)	0.47	0.98 (0.89-1.08)	0.70
Insurance in addition to Medicare (ie HMO)	1.00 (0.76-1.32)	0.99	0.86 (0.65-1.13)	0.29
Aortic pathology				
Chronic aortic dissection			0.83 (0.75-0.91)	**<0.001**
Acute aortic dissection			1.12 (1.02-1.23)	**0.02**
Thoracic aortic aneurysm	0.81 (0.74-0.88)	**<0.001**	0.70 (0.65-0.75)	**<0.001**
Thoracoabdominal aortic aneurysm			0.98 (0.89-1.08)	0.71
Thoracic aortic aneurysm and concomitant abdominal aortic aneurysm			0.96 (0.82-1.12)	0.58
Aortic rupture	2.03 (1.85-2.22)	**<0.001**	2.21 (2.03-2.41)	**<0.001**
Aortic trauma			0.84 (0.63-1.11)	0.22
Missing aortic pathology			0.99 (0.87-1.14)	0.94
Comorbidities				
History of myocardial infarction	1.30 (1.10-1.53)	**0.002**	1.56 (1.33-1.83)	**<0.001**
Congestive heart failure	1.21 (1.12-1.30)	**<0.001**	1.40 (1.31-1.50)	**<0.001**
Atrial fibrillation	1.12 (1.03-1.23)	**0.01**	1.33 (1.22-1.45)	**<0.001**
Hypertension	0.97 (0.88-1.07)	0.56	1.14 (1.04-1.25)	**0.003**
Chronic obstructive pulmonary disease	1.28 (1.19-1.37)	**<0.001**	1.38 (1.29-1.47)	**<0.001**
Chronic kidney disease	1.24 (1.13-1.36)	**<0.001**	1.45 (1.34-1.57)	**<0.001**
End stage renal disease (on hemodialysis)	1.53 (1.28-1.83)	**<0.001**	1.48 (1.26-1.74)	**<0.001**
Diabetes	1.00 (0.92-1.09)	0.98	1.13 (1.04-1.23)	**0.005**
Anemia	1.13 (1.05-1.22)	**0.001**	1.35 (1.26-1.44)	**<0.001**
Stroke/TIA/Alzheimer's/ Dementia	1.12 (1.03-1.23)	**0.01**	1.33 (1.22-1.45)	**<0.001**
History of cancer	1.02 (0.92-1.13)	0.67	1.19 (1.08-1.32)	**0.001**
Previous operations				
Open ascending aorta and/or transverse arch	0.88 (0.76-1.02)	0.08	0.85 (0.74-0.98)	**0.03**
Open thoracoabdomial aorta	1.27 (0.90-1.80)	0.18	1.79 (1.27-2.52)	**0.001**
Operative center characteristics				
Year of operation	0.983 (0.970-0.997)	**0.02**	0.99 (0.98-1.01)	0.21
High-volume open descending thoracic aortic repair hospital (≥50)	0.70 (0.64-0.76)	**<0.001**	0.70 (0.65-0.76)	**<0.001**
High performing open descending thoracic aortic repair hospital	0.42 (0.39-0.45)	**<0.001**	0.47 (0.44-0.51)	**<0.001**
Operation characteristics				
Use of cardiopulmonary bypass	0.96 (0.90-1.03)	0.27	0.91 (0.86-0.98)	**0.007**
Concomitant cardiac surgery (CABG/Valve/MCS/Tx)	1.18 (1.05-1.33)	**0.005**	1.08 (0.97-1.21)	0.14
Concomitant ascending aorta and/or transverse arch	1.32 (1.19-1.45)	**<0.001**	1.01 (0.93-1.11)	0.74
Concomitant thoracoabdominal aorta	1.33 (1.08-1.65)	**0.009**	1.23 (0.99-1.51)	0.06
Concomitant abdominal aorta	1.11 (1.03-1.21)	**0.01**	1.17 (1.08-1.26)	**<0.001**
Concomitant visceral abdominal aorta branch	1.23 (0.98-1.56)	0.08	1.29 (1.03-1.62)	**0.03**
Concomitant head/neck (SCA/CCA/vertebral) artery			0.85 (0.72-1.01)	0.06
Adjunct Procedures				
Lumbar drain placement	0.88 (0.77-0.98)	**0.04**	0.79 (0.70-0.90)	**<0.001**

4:00 PM ***Room 29D***

Vascular Access for TEVAR/TAVR: Thinking Out of the Box

Keith B. Allen, Kansas City, MO

COMMERCIAL RELATIONSHIPS K. B. Allen: Research Grant, Biomet, Inc

4:15 PM ***Room 29D***

Results and Experience With Open vs Endoconduits for Femoral Approaches

Ravi Veeraswamy, Atlanta, GA

4:30 PM ***Room 29D***

Management of Descending Aorta With Type A Dissection

Eric E. Roselli, Cleveland, OH

COMMERCIAL RELATIONSHIPS E. E. Roselli: Speakers Bureau/Honoraria, Medtronic, Inc, Terumo Medical Corporation; Consultant/Advisory Board, Edwards Lifesciences Corporation; Nonremunerative Position of Influence, SORIN GROUP

REGULATORY DISCLOSURE This presentation will discuss the off-label use of Cook TX2, Gore TAG, and Medtronic Valiant thoracic stentgrafts during hybrid procedures.

4:45 PM ***Room 29D***

Lessons Learned With TEVAR in the Ascending Aorta

Rodney A. White, Torrance, CA

COMMERCIAL RELATIONSHIPS R. A. White: Research Grant, Medtronic, Inc, Volcano Corporation, W. L. Gore & Associates, Inc; Speakers Bureau/Honoraria, Medtronic, Inc

REGULATORY DISCLOSURE This presentation will address the Medtronic Ascending Aortic Endograft, which has an FDA status of investigational.

5:00 PM ***Room 29D***

Traumatic Aortic Disruption: Prioritizing Repair

Anthony L. Estrera, Houston, TX

COMMERCIAL RELATIONSHIPS A. L. Estrera: Consultant/Advisory Board, W. L. Gore & Associates, Inc; Speakers Bureau/Honoraria, MAQUET

5:15 PM ***Room 29D***

Controversies Surrounding Traumatic TEVAR

Mark A. Farber, Chapel Hill, NC

COMMERCIAL RELATIONSHIPS M. A. Farber: Consultant/Advisory Board, Bolton Medical, Cook, Endologix, Inc, W. L. Gore & Associates, Inc; Other Research Support, Cook; Research Grant, Bolton Medical, Cook, Endologix, Inc, W. L. Gore & Associates, Inc

REGULATORY DISCLOSURE This presentation will address the Cook BAI, which has an FDA status of investigational.

NOTES

3:30 PM – 5:30 PM ***Room 31ABC***

Role of SBRT in Lung Cancer Treatment

Stereotactic body radiation therapy (SBRT) is becoming a frequent choice for treatment of lung cancer in high-risk or non-surgical patients. This session is designed to update the latest available data on SBRT and debate its potential role in surgically appropriate patients. Included is a discussion of how a surgeon can get involved in an SBRT program.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Describe contemporary results of SBRT in lung cancer
- Outline the essential elements and practical aspects of starting an SBRT program with surgeon involvement
- Explain the role of alternative minimally invasive treatments for lung cancer in high-risk surgical patients

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

The physician competencies addressed in this session are patient care and procedural skills, medical knowledge, and professionalism. These physician competencies will be addressed through a series of lectures that will focus on the role of SBRT and debate its role in surgically appropriate patients.

Moderators: *Neil A. Christie, Pittsburgh, PA, and Stephen R. Hazelrigg, Springfield, IL*

3:30 PM **Contemporary Results With SBRT**
Robert Timmerman, Dallas, TX
COMMERCIAL RELATIONSHIPS R. Timmerman: Research Grant, Varian Medical Systems, Inc

4:00 PM **Comparison of Surgical Results and SBRT**
Traves Crabtree, St Louis, MO

4:30 PM **Role of Alternate Minimally Invasive Treatments for Lung Cancer**
Hiran C. Fernando, Boston, MA
COMMERCIAL RELATIONSHIPS H. C. Fernando: Consultant/Advisory Board, CSA Medical Inc, Galil Medical Inc

4:45 PM **Integration of SBRT/Ablative Techniques Into a Surgeon's Practice—The UPMC Approach**
Neil A. Christie, Pittsburgh, PA

5:00 PM **Roundtable Discussion: The Future Role of SBRT in Early Stage Lung Cancer**

NOTES

6AM

7AM

8AM

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10AM

11AM

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6:30 AM – 9:30 AM
Registration: STS University

7:00 AM – 9:00 AM
STS University

9:30 AM – 11:30 AM
STS University
(courses repeated)

New

Non-CME Session

6:30 AM – 9:30 AM Registration: **STS University**

7:00 AM – 9:00 AM STS University

9:30 AM – 11:30 AM STS University (courses repeated)

6:30 AM – 9:30 AM ***Lobby D***

Registration: STS University

7:00 AM – 9:00 AM and repeated 9:30 AM – 11:30 AM ***Hall G***

STS University

Unless otherwise noted in this *Abstract Book* or by the speakers, speakers have no commercial relationships to disclose and will be presenting information only on devices, products, or drugs that are FDA-approved for the purposes they are discussing.

The physician competencies addressed in each STS University course are medical knowledge and practice-based learning and improvement. These physician competencies will be addressed through hands-on sessions to gain knowledge and practical application experience.

Course 1: TAVR/TEVAR, Guidewires, and Sheaths

Course Directors: *Michael P. Fischbein, Stanford, CA, and Wilson Y. Szeto, Philadelphia, PA*

COMMERCIAL RELATIONSHIPS W. Y. Szeto: Research Grant, Edwards Lifesciences Corporation, Medtronic, Inc, SORIN GROUP; Consultant/Advisory Board, Micro Interventional Devices, Inc

New wire skills are required for transcatheter aortic valve replacement (TAVR) and thoracic endovascular aortic repair (TEVAR). This course will introduce attendees to wires, catheters, and novel endovascular techniques for the treatment of aortic stenosis and thoracic aortic disease. The hands-on lab experience will provide participants with the opportunity to either practice or observe an expert perform a variety of procedures utilizing the latest technology, including transfemoral, direct aortic, left subclavian, and transapical TAVR, as well as all aspects of TEVAR.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Compare techniques for transfemoral, direct aortic, subclavian artery, and TAVR
- Classify the techniques required to expertly perform TEVAR and practice the implant procedure with consideration of technical pitfalls
- Compare and appraise techniques with different wires and catheters used to perform TAVR and TEVAR

Course 2: Mitral Valve Repair

Course Directors: *Gorav Ailawadi, Charlottesville, VA, and Harold G. Roberts Jr, Aventura, FL*

COMMERCIAL RELATIONSHIPS G. Ailawadi: Consultant/Advisory Board, Abbott, Edwards Lifesciences Corporation, Mitralign; Speakers Bureau/Honoraria, St Jude Medical, Inc; H. G. Roberts: Research Grant, Medtronic, Inc

Surgical correction for mitral valve disease can often be a technical challenge and requires a thorough understanding of the pathophysiology for any given patient. Recent data have suggested equivalent short-term outcomes comparing repair to replacement in the setting of severe ischemic mitral regurgitation (MR). Meanwhile, an alarmingly high rate of replacement is performed in patients with degenerative MR, particularly with bileaflet and anterior leaflet prolapse. Finally, the armamentarium for the surgeon now includes less invasive approaches, such as robotic mitral valve surgery and percutaneous mitral repair with the MitraClip system.

This course will provide hands-on experience with total chordal-sparing mitral valve replacement, papillary muscle sling for ischemic MR, MitraClip procedure, posterior leaflet techniques, bileaflet prolapse techniques, and robotic mitral surgery.

Participants will practice advanced mitral valve repair guided by international leaders in advanced open and minimally invasive/robotic repair. The objective is to guide participants in performing mitral valve surgery for a broad range of pathologies, as well as the complete approaches to the mitral valve.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Describe approaches to ischemic MR, including performing a complete chordal sparing mitral valve replacement
- Explain technical options for repair in posterior, anterior, and bileaflet pathologies
- Develop an understanding of less invasive options for mitral valve disease, including robotic surgery and percutaneous mitral repair (MitraClip)

Course 3: Valve-Sparing Aortic Root Replacement

Course Directors: *Duke E. Cameron, Baltimore, MD, and Edward P. Chen, Atlanta, GA*

This course will provide interactive, hands-on instruction on the surgical techniques and critical steps necessary for performing a successful valve-sparing aortic root replacement (VSRR). Faculty members and proctors who are familiar with the operation will be readily available to provide assistance and consultation throughout the course.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Describe the anatomy of the aortic root
- Summarize the technical steps necessary for successful performance of a VSRR
- Apply different methods in choosing a graft size
- Discuss leaflet repair and annuloplasty methods

Course 4: Aortic Root Enlarging Procedures

Course Directors: *John W. Brown, Indianapolis, IN, and S. Adil Husain, San Antonio, TX*

COMMERCIAL RELATIONSHIPS J. W. Brown: Ownership Interest, Correx, Inc; Speakers Bureau/Honoraria, CryoLife, Inc; Other Research Support, CryoLife, Inc; Nonremunerative Position of Influence, Medtronic, Inc

This course will review the anatomic approaches and surgical techniques employed in performing aortic root enlarging procedures. Surgical strategies addressed will include Nicks, Manougian, Mavroudis, Ross Konno, upsizing the aortic root—Bentall type procedure, and myectomy/myotomy techniques.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Identify the anatomy and appropriate surgical landmarks in the left ventricular outflow tract and aortic valve apparatus
- Describe the incision sites and overall surgical techniques for a variety of root enlargement strategies
- Discuss surgical pitfalls associated with each strategy and mechanisms by which to delineate options based upon patient and anatomic substrate

Course 5: ICU/ECHO

Course Directors: *Haney Mallemat, Baltimore, MD, and Glenn J. R. Whitman, Baltimore, MD*

This course will review the utilization of a focused ultrasound examination of the heart and major vessels, such as the aorta and IVC. Attendees will gain hands-on experience with live models. Topics will include basic cardiac anatomy and physiology as visualized by three common transthoracic views, inferior vena cava (IVC) evaluation to determine intravascular volume, and ultrasound techniques for central vein visualization and cannulation.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Generate an echocardiographic parasternal, apical, and subcostal view of the heart
- Evaluate the IVC to help determine volume status
- Evaluate the abdominal aorta for potential abnormality
- Use ultrasound to safely accomplish subclavian and internal jugular venous cannulation

Course 6: Long-Term Circulatory/Respiratory Support

Course Directors: *Ashish S. Shah, Baltimore, MD, and Scott C. Silvestry, St Louis, MO*

COMMERCIAL RELATIONSHIPS S. C. Silvestry: Research Grant, HeartWare International, Inc, Thoratec Corporation; Consultant/Advisory Board, HeartWare International, Inc, Thoratec Corporation

Advanced mechanical device technologies for cardiac and pulmonary support offer new treatment options for patients with end-stage cardiopulmonary disease. Medical centers not performing heart or lung transplantation are able to utilize these technologies as a bridge to recovery or decision making, bridge to transplantation, or as permanent cardiac therapy.

Faculty will demonstrate techniques for short- and long-term cardiac and pulmonary support with an emphasis on longer-term support. Basic and advanced implantation LVAD techniques, management options, and surgical decision making at the time of implant will be taught by leaders in the field. Interactive hands-on stations will cover the treatment options for potential intra-operative and post-implant problems, such as right heart failure, infection, and device failure.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Identify a comprehensive selection of short- and long-term devices
- Explain the importance of proper patient selection and timing of intervention
- Determine which concomitant procedures should be considered and executed
- Identify pitfalls in peri- and postoperative management
- Access hands-on knowledge of implant techniques, speed adjustments, and troubleshooting

Course 7: Advanced Endotracheobronchial Procedures

Course Directors: *Rafael Andrade, Minneapolis, MN, and Moishe A. Liberman, Montreal, Canada*

COMMERCIAL RELATIONSHIPS M. A. Liberman: Research Grant, Ethicon Endo-Surgery, Inc

Endobronchial ultrasound (EBUS) and endoscopic ultrasound (EUS) have attained firm places in the endoscopic diagnostic and staging armamentarium of mediastinal lymph nodes. Electromagnetic navigation bronchoscopy (ENB) is an interesting technology aimed at facilitating the endoscopic biopsy of peripheral lung lesions. Airway stenting and rigid bronchoscopy are important tools for the palliation of malignant disease and the treatment of benign disease in general thoracic surgical practice. In this course, leaders in the field will direct focused, hands-on stations where attendees can practice these techniques on models and simulators. Small group sessions will facilitate opportunities for close instructor/learner interaction.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Discuss how EBUS and EUS are used in mediastinal staging
- Explain the complementary roles of EBUS and EUS
- Describe potential indications and limitations of ENB
- Identify potential pitfalls and ways in which to avoid complications during rigid bronchoscopy and airway stent insertion

Course 8: VATS Lobectomy

Course Directors: *Shanda H. Blackmon, Rochester, MN, and Shari L. Meyerson, Chicago, IL*

This course will review the indications, patient selection, technical steps, and recent advances for performance of video-assisted thoracoscopic surgical (VATS) lobectomy. This session is dedicated to hands-on training utilizing porcine heart-lung blocks for course participants to perform a VATS left upper lobectomy. Stations include multiple instrument and energy device options.

Learning Objectives

- Upon completion of this activity, participants should be able to:
- Describe the indications and steps to perform a VATS lobectomy
- Discuss potential pitfalls and strategies for intraoperative troubleshooting to successfully achieve minimally invasive lobectomy
- Identify instruments and other technologies available for performance of minimally invasive lobectomy

Course 9: Advanced Esophageal and Tracheal Procedures

Course Directors: *Sidharta P. Gangadharan, Boston, MA, and Thomas K. Varghese Jr, Seattle, WA*

Tracheal and esophageal resection and reconstruction require unique technical skills to achieve success and minimize complications, such as leaks and stricture. Unfortunately these cases are relatively few in number nationwide, and many practitioners have difficulty in achieving competence during their training programs. Participants will be introduced to several techniques for airway and esophageal reconstruction with emphasis on the different technical aspects ("pearls") of the anastomosis from content experts.

The course will provide a hands-on experience for two tracheobronchial techniques—tracheal sleeve anastomosis and tracheobronchoplasty—and two esophageal anastomotic techniques—hybrid linear stapled anastomosis and hand-sewn anastomosis. Skills learned in the course by participants can be incorporated into practice.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Utilize principles of tracheal resection/anastomosis and sleeve resection/reconstruction
- Demonstrate the tracheobronchoplasty procedure for tracheomalacia
- Perform two types of esophageal stapled anastomosis—hybrid linear and end-to-end
- Perform a hand-sewn esophagogastric anastomosis

Course 10: Atrial Switch, Double Switch: The Mustard and the Senning

Course Directors: *Sitaram M. Emani, Boston, MA, and John E. Mayer Jr, Boston, MA*

COMMERCIAL RELATIONSHIPS J. E. Mayer: Consultant/Advisory Board, Medtronic, Inc

Learn how to perform this essential part of a double switch. Patients who undergo atrial switch procedures and survive to adulthood may present with complications from their repair. It is essential for today's surgeon to be facile with yesterday's techniques. In this course, you will learn the complexities of Mustards and Sennings from the masters.

Learning Objectives

Upon completion of this activity, participants should be able to:

- Explain the surgical options for creating atrial level re-routing of systemic and pulmonary venous return
- Describe the techniques of the Mustard and Senning procedures with particular attention to avoidance of systemic and pulmonary venous obstruction and damage to the sino-atrial and atrioventricular nodal tissue
- Recognize the indications for applying these two techniques in the management of complex congenital defects, including L-transposition of the great arteries, D-transposition of the great arteries, and certain forms of heterotaxy syndrome anatomy

Adult Cardiac

P1

Impact of Energy Source on Rhythm Restoration by Left Atrial Size and Duration of Atrial Fibrillation Following the Cox-Maze Procedure: Propensity-Score Matched Analysis

H. Je, S. Holmes, G. Pritchard, N. Ad
Inova Heart and Vascular Institute, Falls Church, VA

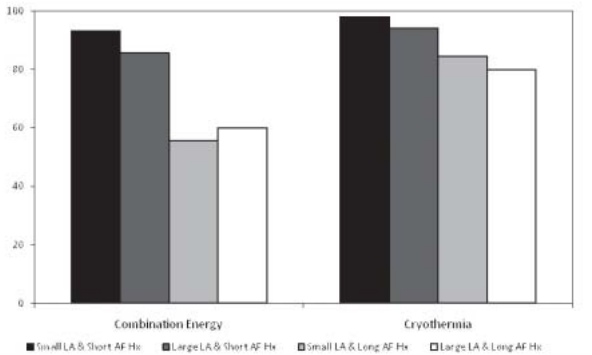
COMMERCIAL RELATIONSHIPS N. Ad: Speakers Bureau/Honoraria, AtriCure, Inc, Medtronic, Inc; Consultant/Advisory Board, AtriCure, Inc, Medtronic, Inc

Purpose: Surgical ablation for atrial fibrillation (AF) is dependent on ablation technology creating reliable transmural lesions. Experience and prior studies have found that only bipolar radiofrequency (BRF) and cryothermia (Cryo) are credible. Cryoablation was compared to BRF plus Cryo in Cox-Maze procedure patients, focusing on left atrial (LA) size and AF duration.

Methods: First-time median sternotomy, concomitant, Cox-Maze procedures were included (n=400). Large LA was defined as ≥5.5 cm and longer AF duration was ≥5 years. Outcomes were return to sinus rhythm (SR) and return to SR off antiarrhythmic drugs (AAD) at 1 year following surgery. Patients with Cryo-only ablation were propensity-score matched to those who received a combination of BRF and Cryo, resulting in 176 pairs of patients.

Results: After matching, preoperative characteristics and traditional predictors of SR, such as duration of AF (36.5 vs 36.2 months, $p = 0.95$), were similar. Cryo alone was superior to combination energy for SR (96% vs 88%, $p = 0.04$) and SR off AAD (94% vs 84%, $p = 0.03$) at 1 year. After adjusting for LA size, odds of success for Cryo alone remained higher for SR (OR=3.04, $p = 0.04$) and SR off AAD (OR=3.07, $p = 0.04$) at 1 year. The LA size groups did not differ in percent with Cryo alone (51% vs 48%, $p = 0.57$). The negative effect of higher LA size and AF duration on SR off AAD was attenuated by Cryo alone ($p = 0.17$), but not combination energy ($p = 0.007$; Figure).

Conclusions: This study demonstrated the potential advantage of Cryo energy only over combined BRF and Cryo in patients undergoing concomitant Cox-Maze procedure, especially in patients with larger LA size and longer duration of AF. These results may reflect the inherent limitation of the BRF treatment algorithm that is based on healthy animal atrial tissue.



P2

Determinants of Operative Mortality in Patients With Acute Ruptured Type A Aortic Dissection

R. Afifi[1], H. Sandhu[2], S. Leake[1], A. Azizzadeh[1], K. Charlton-Ouw[1], C. Miller[1], T. C. Nguyen[3], A. L. Estrera[1], H. J. Safi[1]
[1]University of Texas Health Science Center, Houston, [2]The University of Texas Medical School, Houston, [3]University of Texas Houston – Memorial Hermann

COMMERCIAL RELATIONSHIPS A. Azizzadeh: Consultant/Advisory Board, Medtronic, Inc, W. L. Gore & Associates, Inc

Purpose: Acute type A aortic dissection is well established in the literature as a surgical emergency with high mortality. We compared those who presented with ruptured acute type A aortic dissection (rAAAD) to those without in order to characterize patients at an increased risk of death within 24 hours.

Methods: We retrospectively reviewed our database of acute type A aortic dissections (AAAD) between 1999 and 2013. We analyzed the presenting clinical manifestations, predisposing factors, and hemodynamic data along with perioperative data. In-hospital and long-term outcomes were compared between two groups using Kaplan-Meier and log-rank statistics.

Results: We repaired 417 AAADs; of these, 63 patients (15%) presented with rAAAD. Overall 30-day mortality was 59/417 (14%); 16/63 (25%) in the ruptured and 43/354 (12%) in the non-ruptured (OR 2.5, $p < 0.006$). Upon admission, 31 of 63 patients with rAAAD were hypotensive. Mortality within 24 hours of AAAD was 9/63 (14%) in patients with rupture and 8/355 (2%) in patients without (OR 7.23, $p < 0.0001$). Patients at highest risk for early mortality were those who were over 70 years old and who presented with aortic branch malperfusion (OR 5.4, $p < 0.002$). Although the overall 24-hour mortality was much higher in the ruptured than the intact patients, the odds ratios for advance age and malperfusion were identical between the two strata. Long-term survival in the non-ruptured patients was 77% at 5 years and 58% at 10 years; in the ruptured group, these values were 55% and 43%, respectively ($p < 0.0001$).

Conclusions: Surgical repair of AAAD can be performed with acceptable results, even in the setting of aortic rupture. Age greater than 70 years and branch vessel malperfusion increase the risk of early mortality five-fold. Long-term survival rate is excellent for non-ruptured and acceptable for rAAAD.

P3

Transcatheter Aortic Valve Replacement Results in Significant Improvement of Pulmonary Function Testing Postoperatively in Patients With Severe Aortic Stenosis

R. Gilmore[1], V. Babaliaros[1], J. Binongo[1], S. A. Iturra[1], E. L. Sarin[1], C. Devireddy[1], B. G. Leshnower[1], K. Mavromatis[1], R. A. Guyton[2], A. Simone[1], P. Keegan[1], A. Rahman[1], V. H. Thourani[1]

[1]Emory University, Atlanta, GA, [2]The Emory Clinic, Inc, Atlanta, GA

COMMERCIAL RELATIONSHIPS V. Babaliaros: Speakers Bureau/Honoraria, InterValve Inc; Consultant/Advisory Board, BARD Medical, Direct Flow Medical, Inc; C. Devireddy: Consultant/Advisory Board, Medtronic, Inc; R. A. Guyton: Consultant/Advisory Board, Medtronic, Inc; B. G. Leshnower: Speakers Bureau/Honoraria, CryoLife, Inc, Medtronic, Inc, St Jude Medical, Inc; V. H. Thourani: Research Grant, Edwards Lifesciences Corporation, Medtronic, Inc, SORIN GROUP; Consultant/Advisory Board, Boston Scientific, St Jude Medical, Inc; Ownership Interest, Apica Cardiovascular; A. Simone: Consultant/Advisory Board, Edwards Lifesciences Corporation; P. Keegan: Consultant/Advisory Board, Abbott Vascular, Edwards Lifesciences Corporation

Purpose: Chronic obstructive pulmonary disease (COPD) has been defined as a significant risk factor for early morbidity and late mortality following transcatheter aortic valve replacement (TAVR). The relationship of severe aortic stenosis, heart failure, and COPD remains incompletely understood. The purpose of this study was to evaluate the impact of TAVR on postoperative pulmonary dysfunction and changes in b-type natriuretic peptide (BNP).

Methods: A retrospective analysis was done in a US academic center of consecutive TAVR patients from April 2008 to April 2014. A total of 112 patients had pulmonary function tests (PFT) and serum BNP performed prior to and ~30 days following TAVR; of these, 56 patients were found to have preoperative COPD based on The Society of Thoracic Surgeons' definition (24 mild, 12 moderate, and 20 severe). For comparisons involving baseline variables, chi-squared tests (or Fisher's exact test) or two-sample t-tests were performed. Changes in outcome levels from preop to postop were assessed using the paired t-test.

Results: TAVR was performed in 27 patients by a transfemoral (TF) approach and in 29 patients by a non-TF approach. Patients in the moderate and severe COPD groups were more likely to have a higher STS PROM than patients with mild COPD preoperatively ($p = 0.01$, Table 1). Comparison of pre- and postoperative PFT among all COPD categories showed a 13% improvement in forced vital capacity (FVC) ($p < 0.0001$, Table 1) and a 15% improvement in forced expiratory volume in 1 second (FEV1) ($p < 0.0001$, Table 1). There was a significant postoperative decrease in BNP of -24% ($p < 0.01$, Table 1). An improvement of at least one COPD severity category was observed postoperatively in 29% of patients with mild COPD preoperatively, 75% of patients with moderate COPD, and 55% of patients with severe COPD (Figure 1). There was no mortality in any patient group.

Conclusions: In patients with severe aortic stenosis, TAVR is associated with a significant postoperative improvement of pulmonary function and BNP. Following TAVR, the reduction in COPD severity was most evident in those with moderate and severe pulmonary dysfunction.

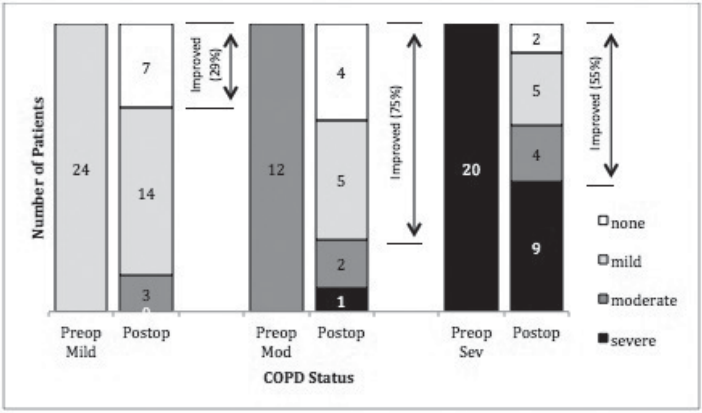


Figure 1. Changes in COPD severity class preoperatively versus postoperatively (COPD=chronic obstructive pulmonary disease, Preop=preoperative, Postop=postoperative, Mod=moderate, Sev=severe)

	Mild COPD (n=24)	Moderate COPD (n=12)	Severe COPD (n=20)	*P* value
TF TAVR n (%)	11 (54)	7 (42)	9 (55)	0.73
Age (years, mean±SD)	78 ± 8	81 ± 6	79 ± 9	0.58
Male n (%)	11 (46)	6 (50)	10 (50)	0.95
STS PROM score (mean±SD)	0.11 ± 0.06	0.18 ± 0.07	0.15 ± 0.06	0.01
Postop pneumonia n (%)	6 (25)	2 (17)	3 (15)	0.69
Postop vent hrs (hrs, mean±SD)	8.3±12.4	10.8±8.0	7.8±6.6	0.34
Total ICU LOS (hrs, mean±SD)	43.9±35.3	29.1±27.5	26.8±18.4	0.12
Postop LOS (days, mean±SD)	6.1 (5.0) ± 4.7	4.9 (5.5) ± 2.4	4.8 (4.5) ± 1.8	0.37
	Preop	Postop	% change	
FEV1 (% pred, mean (95% CI))	55.6 (52.2,59.1)	64.2 (60.2,68.2)	15%	< 0.0001
FVC (% pred, mean (95% CI))	63.8 (60.0,67.5)	71.9 (67.6,76.1)	13%	< 0.0001
FEF (% pred, mean (95% CI))	40.6 (34.1,48.4)	44.7 (36.4,54.9)	10%	0.34
BNP (pg/mL, mean (95% CI))	352.4 (265.3,468.1)	269.3 (192.9,376.0)	-24%	< 0.01

Table 1. Study outcomes (TF=transfemoral, TAVR=transcatheter aortic valve replacement, STS PROM=Society of Thoracic Surgery Predicted Risk of Mortality, Preop=preoperative, Postop=postoperative, FEV1=forced expiratory volume in 1 second, FVC=forced vital capacity, FEF 25-75%=forced expiratory flow 25-75%, BNP=b-type natriuretic peptide)

P4

Routine Genetic Testing for Thoracic Aortic Aneurysm in a Clinical Setting

B. Ziganshin, A. Bailey, C. Coons, D. Dykas, L. Tanriverdi, L. Liu, M. Tranquilli, P. Tsipouras, A. Bale, J. Elefteriades
Yale University School of Medicine, New Haven, CT

COMMERCIAL RELATIONSHIPS J. Elefteriades: Research Grant, Medtronic, Inc

Purpose: Genetics play an important etiologic role in thoracic aortic aneurysm and dissection (TAD), with a number of genes proven to cause syndromic and familial TAD. At our center, we initiated a clinical program for routine genetic testing of individuals for TAD via whole exome sequencing (WES). Here, we present our initial results.

Methods: WES was offered as an ongoing clinical test to 114 patients (mean age 59.2 years ± 15.0 years, range 15-83, 77 males [67.5%]) with TAD. Thirteen patients were declined testing for insurance reasons. DNA was extracted from saliva samples collected in Oragene kits. DNA exonic fragments were sequenced on the Illumina HiSeq platform. Mean coverage of the exome was approximately 100x with 96% of the exome covered at least eight times. The resulting sequence was analyzed for single nucleotide variants and small insertions and deletions differing from the reference genome (Human Genome 19, HG19). To date, genetic results were available for 72 patients (71.3%). Demographics are presented in the Table.

Results: The following gene panel was tested via WES: ACTA2, COL1A1, COL3A1, COL5A1, COL5A2, FBN1, MYH11, MYLK, SMAD3, TGFβ2, TGFBR1, and TGFBR2 (see Figure). Fifty-seven patients (79.2%) had no mutations in the panel of tested genes. One patient (1.4%) had a previously reported heterozygous mutation in the MYLK gene (a missense mutation S1759 [TCC>CCC]). Twelve patients (16.7%) were identified as having suspicious mutations of unknown significance (previously unreported) in one or more of these genes: ACTA2 (n=2), COL5A1 (n=1), COL5A2 (n=1), FBN1 (n=4), MYH11 (n=3), MYLK (n=1), and TGFBR1 (n=1).

Conclusions: Previously reported mutations were identified in less than 2% of patients with TAD (much lower than 20% expected from the literature). A high number of previously unreported mutations was identified. Routine genetic screening of patients with TAD provides information that enables genetically personalized care and permits identification of novel mutations responsible for aortic pathology.

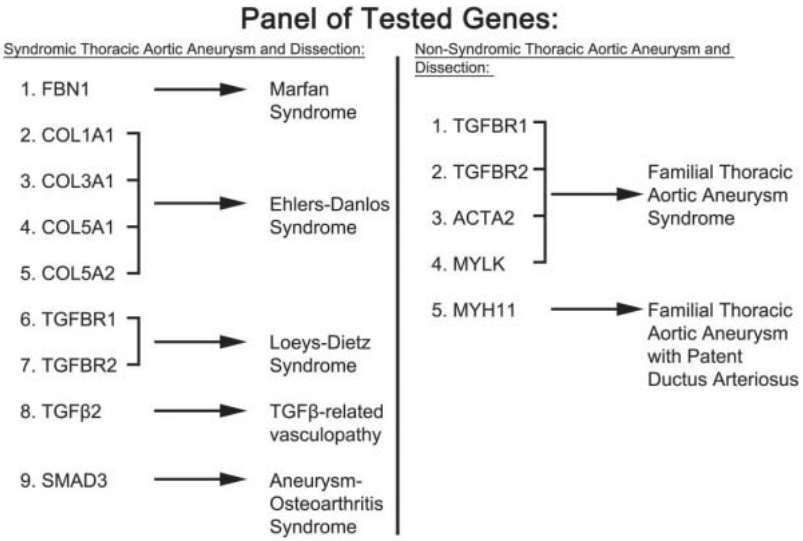


Table. Demographics of individuals with completed genetic screening for thoracic aortic pathology via whole exome sequencing.

Variable	Value	Percentage
Total number of patients	72	100%
Mean age	56.1 ± 15.4	—
Males	51	70.8%
Females	21	29.2%
Disease of the ascending aorta/arch	64	88.9%
Disease of the descending/thoracoabdominal aorta	4	5.6%
Thoracic aortic aneurysm	61	84.7%
Thoracic aortic dissection	7	9.7%
No aortic pathology:	5	6.9%
Strong family history:	3	4.1%
Suspected connective tissue disorder:	2	2.8%

P5

Endovascular Repair for Thoracic Aortic Pseudoaneurysms: Single Center Experience in 98 Patients

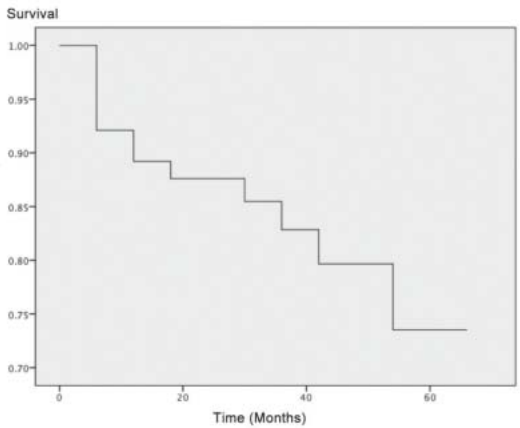
W. Ma[1], Y. Xue[2], W. Zhang[2], L. Sun[2], L. Huang[2]
[1]Yale University School of Medicine, New Haven, CT, [2]Beijing Anzhen Hospital of Capital Medical University and Beijing Institute of Heart, Lung and Blood Vessel Diseases, China

Purpose: Aortic pseudoaneurysm is a rare but lethal clinical entity. Surgical management is often complicated by poor outcomes and experience with endovascular repair is limited. We seek to report our early and mid-term outcomes of endovascular repair in 98 patients with thoracic aortic pseudoaneurysm.

Methods: Between February 2009 and June 2014, 98 patients with thoracic aortic pseudoaneurysm were treated with endovascular repair at our institution. Mean age was 54.8 years ± 13.7 years and 78 (79.6%) were males. There were 19 emergent or urgent (19.4%) and 79 selective (80.6%) cases. Patients were followed up by aortic computed tomographic angiography at 1, 3, 6, and 12 months and annually thereafter to monitor stent-graft patency, thrombosis, size of the pseudoaneurysm, and the aorta.

Results: The procedure was successful in 100% (98/98) of patients. Early mortality occurred in three emergent or urgent patients (15.8%, 3/19; overall 3.1%, 3/98), due to hemorrhagic shock, heart failure, and bronchial asthma, each in one. No deaths occurred in selective patients. Complications included left arm ischemia in four cases, stroke in one, and encapsulated effusion in one. Ninety-one patients were followed up for a median duration of 30 months (range, 1-61 months). Late complications included hemoptysis in two cases, stroke in one, and renal insufficiency in one. Late deaths occurred in 12 patients (12.6%, 12/95). Estimated survival rate after endovascular repair was 88.8% ± 4.0% (mean ± standard error) and 80.4% ± 6.0% at 1 year and 3 years, respectively (Figure 1).

Conclusions: Endovascular repair is an effective approach for thoracic aortic pseudoaneurysm with encouraging short- and mid-term results. Emergent or urgent patients with unstable hemodynamics tend to have higher rates of mortality and morbidity. Endovascular repair should be carefully selected for thoracic aortic pseudoaneurysm patients with appropriate anatomic conditions.



P6

Characterization of Intraoperative Electroencephalography During Aortic Hemiarch Replacement With Moderate Hypothermic Circulatory Arrest

J. Keenan, H. Wang, A. Ganapathi, B. Englum, M. Schechter, A. Husain, G. Hughes
Duke University Medical Center, Durham, NC

COMMERCIAL RELATIONSHIPS G. Hughes: Consultant/Advisory Board, W. L. Gore & Associates, Inc; Speakers Bureau/Honoraria, Medtronic, Inc

Purpose: Cerebral electrical activity by electroencephalography (EEG) during moderate hypothermic circulatory arrest (MHCA) with selective antegrade cerebral perfusion (SACP) has not previously been described. The purpose of this study was to characterize EEG during MHCA with SACP in order to discern whether adjunctive EEG augments the safety of this procedure.

Methods: Retrospective cohort study of all patients undergoing hemiarch replacement utilizing MHCA and unilateral SACP via the right axillary artery with intraoperative EEG monitoring from July 1, 2013, to May 1, 2014, as identified from a prospectively maintained institutional aortic surgery database. MHCA was defined as a targeted minimum nasopharyngeal temperature of ≥20.1˚C–28.0˚C, in accordance with recent international consensus guidelines. Available intraoperative EEG reports were reviewed, and abnormal findings suggestive of cerebral ischemia were characterized. Additionally, intraoperative measures to address abnormal EEG findings were described. Finally, patient/procedural characteristics and outcomes of the cohort were determined.

Results: During the study period, 45 patients underwent hemiarch replacement with MHCA/unilateral SACP and intraoperative EEG monitoring (Table). The majority (n=40, 88.9%) had intraoperative EEG findings not concerning for cerebral ischemia, generally characterized by symmetric reduction of brain wave amplitude during cooling that was maintained during unilateral SACP. There were five patients (11.1%) who developed EEG abnormalities suggestive of cerebral ischemia. Three of these patients developed sudden suppression of brain wave amplitude shortly after circulatory arrest that subsequently resolved upon initiation of SACP. In contrast, in two patients, EEG findings suggestive of ischemia persisted even after initiation of SACP. One of these patients had asymmetry of brain wave amplitude that resolved after transitioning to bilateral ACP. The other patient had global brain wave suppression, which was resolved by increased systemic cooling (Figure). There were no deaths or adverse neurologic outcomes observed in the cohort (Table).

Conclusions: MHCA/unilateral SACP during hemiarch replacement appears adequate for neuroprotection in most patients; however, >10% develop ischemic EEG changes after MHCA initiation. In a majority of these cases, the abnormal EEG changes resolve with SACP, but in >4% of patients, unilateral SACP provides inadequate neuroprotection, and additional protective measures are required.

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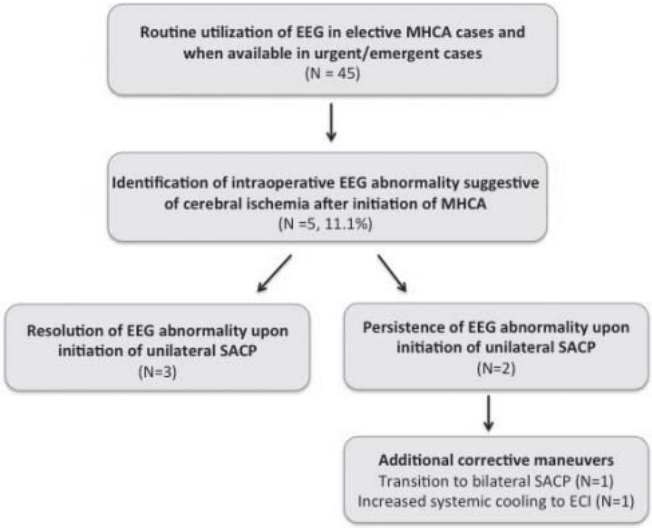

Figure: Schematic of the utilization of electroencephalography and interventions upon recognition of abnormal EEG findings during aortic hemiarch replacement with moderate hypothermic circulatory arrest and selective anterograde cerebral perfusion. EEG: electroencephalography; MHCA: moderate hypothermic circulatory arrest; SACP: selective anterograde cerebral perfusion; ECI: electrocerebral inactivity

Table: Procedural characteristics and outcomes of patients who had intraoperative EEG monitoring during hemiarch replacement with MHCA and unilateral SACP

	Total Cohort (N=45)	Abnormal EEG (N=5)
Patient/Procedural Characteristics		
Age	60.0 ± 14.0	61.4 ± 7.8
Root Replacement		
Bentall Procedure	10 (22.2%)	1 (20%)
Valve Sparing Root	4 (8.9%)	0
Ascending Aorta Repair		
Supracoronary ascending repair	11 (24.4%)	1 (20%)
Wheat	20 (44.4%)	3 (60%)
Procedural Status		
Elective	42 (93.3%)	5 (100%)
Urgent	2 (4.4%)	0 (0%)
Emergent	1 (2.2%)	0 (0%)
Minimum Nasopharyngeal Temp (°C)	21.4 ± 3.2	21.0 ± 3.1
Minimum Core Body Temp (°C)	27.1 ± 1.8	27.0 ± 1.0
Cooling Time (minutes)	62.8 ± 23.4	58.2 ± 9.4
Systemic Circulatory Arrest Time (minutes)	15.1 ± 4.0	15.6 ± 2.5
Electrocerebral Inactivity	2 (4.4%)	0 (0%)
Abnormal electroencephalography	5 (11.1%)	5 (100%)
In-hospital/30-day Outcomes		
Death	0 (0%)	0 (0%)
Stroke	0 (0%)	0 (0%)
Transient Ischemic Attack	0 (0%)	0 (0%)
Mental status change at discharge	0 (0%)	0 (0%)

Continuous variables reported as means ± standard deviation.

P7

Outcomes of Isolated Aortic Valve Replacement in the Pre- and Post-Transcatheter Aortic Valve Implantation Era

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Quebec Heart & Lung Institute, Quebec City, Canada

Purpose: Transcatheter aortic valve implantation (TAVI) has provided a new interventional option for high-risk patients suffering from severe symptomatic aortic stenosis (AS); however, the impact of TAVI on the practice of surgical aortic valve replacement (SAVR) is yet to be known. We assessed whether introduction of TAVI affected the preoperative characteristics and outcomes of patients undergoing SAVR in a high-volume single center.

Methods: Between January 2003 and December 2013, there were 1,593 patients who underwent isolated SAVR. The first TAVI procedure was performed in May 2007. The study period was divided into two distinct cohorts of patients undergoing isolated SAVR before and after the first TAVI procedure. Cox regression multivariable analyses were performed to determine the independent risk factors for early events. All clinical data were collected prospectively.

Results: A total of 529 patients underwent isolated SAVR before and 1,064 after the introduction of TAVI. During the same period 448 TAVI were performed. There was a significant rise in the mean number of isolated SAVR (159.6 vs 130.8 cases/year) and its ratio to the total number of cardiac surgery cases per year (9.1% vs 7.2%) after the introduction of TAVI ($p < 0.0001$). Patients in the post-TAVI era undergoing SAVR had a higher proportion of multiple risk markers, such as body mass index >30 kg/m^2, hypertension, diabetes, recent myocardial infarction, and chronic atrial fibrillation (all $p < 0.05$). Post-TAVI era patients also tended to be older and had a higher prevalence of coronary artery disease and peripheral vascular disease. In-hospital mortality was significantly lower during the post-TAVI era (1.8% vs 3.6%, $p = 0.03$). The independent risk factors for in-hospital mortality were pre-TAVI era (OR 2.3, $p = 0.01$), older age (OR 1.1, $p = 0.001$), creatinine clearance (OR 1.1, $p < 0.0001$), and use of a small (≤21 mm) prosthetic valve size (OR 2.5, $p = 0.01$).

Conclusions: The number of isolated surgical AVR procedures increased after the introduction of TAVI. Also, there was a significant reduction in operative mortality despite increasing baseline risks of patients undergoing SAVR. Patient referrals for TAVI should take into consideration the improved results of conventional surgery.

P8

Gene Expression Is Uniquely Correlated in Patients With Atrial Fibrillation and Neurocognitive Decline After Cardiopulmonary Bypass

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COMMERCIAL RELATIONSHIPS F. W. Sellke: Consultant/Advisory Board, The Medicines Company, CLS Behring

Purpose: Atrial fibrillation (AF) and neurocognitive decline (NCD) are common postoperative complications after cardiopulmonary bypass (CPB). Utilizing genomic microarray, we investigated whether unique correlations in gene expression in patients with both AF and NCD exist.

Methods: Twenty-three cardiac surgery patients were prospectively matched. All underwent neurocognitive assessments preoperatively and 4 days postoperatively. Blood collected pre-CPB, 6 hours post-CPB, and on postoperative day 4 was hybridized to Affymetrix Gene Chip U133 Plus 2.0 microarrays. Gene expression in patients who developed postoperative AF and NCD (n=6; AF+NCD) was compared with gene expression in patients with AF and normal cognitive function (n=5; AF+NORM) and patients with sinus rhythm and normal cognitive function (n=10; SR+NORM). Pathway analysis was performed on commonly expressed genes with a false discovery rate of 0.05 and a fold change of >1.5.

Results: Eleven patients developed AF. Six of these also developed NCD. Of the 12 patients with SR, only two developed NCD. AF+NCD patients had unique regulation of 21 genes preoperatively, 24 genes 6 hours after CPB, and 35 genes 4 days postoperatively ($p < 0.05$). Pathway analysis demonstrated that these genes are largely involved in inflammation, cell death, and cardiac remodeling.

Conclusions: Patients who developed AF and NCD have unique patterns of gene expression compared to normal patients and patients with only AF, suggesting common pathways for development of these conditions. Further exploration of these uniquely regulated genes may provide insight into predisposing factors of these morbid outcomes.

P9

Does Preexisting Mitral Valve Insufficiency Impact the Early Outcome and Long-Term Results in Patients Undergoing TAVI?

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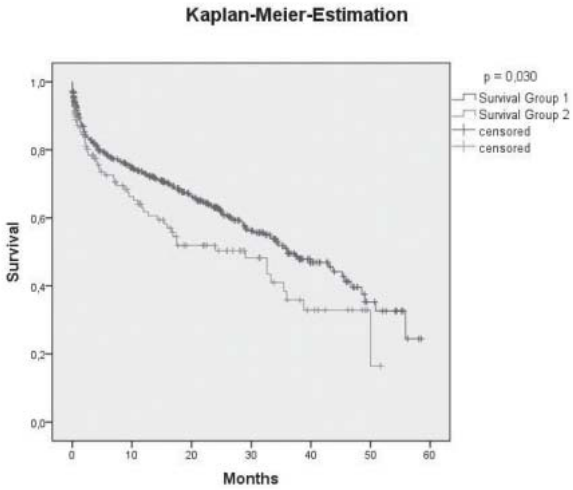
COMMERCIAL RELATIONSHIPS H. Baumbach: Research Grant, Edwards Lifesciences Corporation; Consultant/Advisory Board, Edwards Lifesciences Corporation

Purpose: Mitral valve disease in patients with severe aortic stenosis is a well-known comorbidity. With the increasing number of TAVI procedures, multidisciplinary teams face this entity more frequently. Evidence-based therapeutic strategies for those patients are requested.

Methods: We retrospectively analyzed data of 575 prospectively enrolled TAVI patients. Those without or with trivial mitral insufficiency (n=445, group 1) were compared to those with preexisting mitral valve insufficiency moderate or greater (n=130, group 2). Follow-up investigation was performed for up to 60 months. Patients with transcatheter procedures in mitral position were excluded from this study.

Results: Patients of group 1 were younger (81.3 years ± 5.5 years vs 82.8 years ± 5.0 years, $p = 0.007$), with a better preserved left ventricular ejection fraction (55.3% ± 13.5% vs 50.4% ± 14.9%, $p = 0.001$), and less frequent comorbidities, eg, pulmonary hypertension (70.0% vs 53.7%, $p = 0.001$), resulting in a lower EuroSCORE (30.5% ± 17.1% vs 36.2% ± 19.4%, $p = 0.003$). Thirty-day mortality was comparable (n=42 [9.4%] vs n=15 [11.5%], $p = 0.481$), as were ventilation time (19.9 days ± 86.5 hours vs 21.7 days ± 102.5 hours, $p = 0.283$) and ICU stay (2.9 days ± 6.1 days vs 3.7 days ± 8.6 days, $p = 0.474$). The long-term survival was affected significantly as shown in the Kaplan-Meier curves (see below), but re-hospitalization for cardiac reasons (n=88 [19.8%] vs n=30 [23.1%], $p = 0.277$) did not differ during the follow-up for up to 5 years.

Conclusions: Preexisting mitral valve insufficiency does not impact 30-day mortality and early outcome, but influences the long-term survival significantly. Therefore, a mitral insufficiency should be treated, possibly in a staged secondary intervention.



P10

Aortic No-Touch Off-Pump Coronary Artery Bypass Grafting With Full Skeletonized In Situ Arterial Grafts in SYNTAX Era

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Purpose: The "aortic no-touch technique" is a useful method that avoids aortic manipulation by using in situ arterial grafts combined with off-pump coronary artery bypass (OPCAB) grafting. The aim of this study was to clarify the efficacy of aortic no-touch OPCAB with the full skeletonized in situ arterial grafts compared with the SYNTAX trial.

Methods: Between January 2006 and December 2013, 300 patients underwent aortic no-touch OPCAB at our institute. Our strategy of isolated CABG is directed toward obtaining complete myocardial revascularization using all in situ arterial grafts with OPCAB and sequential grafting technique. All arterial grafts were harvested by full skeletonized fashion with an ultrasonic scalpel. The primary end point was the occurrence of in-hospital, 12-month, and 36-month major cardiovascular or cerebrovascular event (MACCE). Event rates of MACCE were based on life tables, and overall MACCE was determined by Kaplan-Meier analysis.

Results: Cumulative 1-year survival was 98.4%, and freedom from MACCE was 96.1%. Cumulative 3-year survival and freedom from MACCE were 96.4% and 85.8%, respectively. There were no significant differences in baseline characteristics among the patients of this study group and the surgical arm of the SYNTAX trial. The event rate of myocardial infarction in our group (1 year; 0.4%, 3 year; 1.5%) was significantly lower than those of both arms of the SYNTAX trial ($p < 0.01$). Repeat revascularization in our group (1 year; 3.1%, 3 year; 10.5) was significantly lower than those of the percutaneous coronary intervention (PCI) arm of the SYNTAX trial ($p < 0.001$). No intraoperative stroke was observed in our study group. The event rate of stroke was significantly lower in our study (1 year; 0.4%, 3 year; 1.4%) than in the surgical arm of the SYNTAX trial ($p < 0.04$). There was a clear trend toward a reduction of the event rate of stroke in the aortic no-touch technique compared with the PCI arm of the SYNTAX trial.

Conclusions: Aortic no-touch OPCAB using all full skeletonized in situ arterial grafts and sequential technique can further improve the advantage of surgical treatment with respect to PCI.

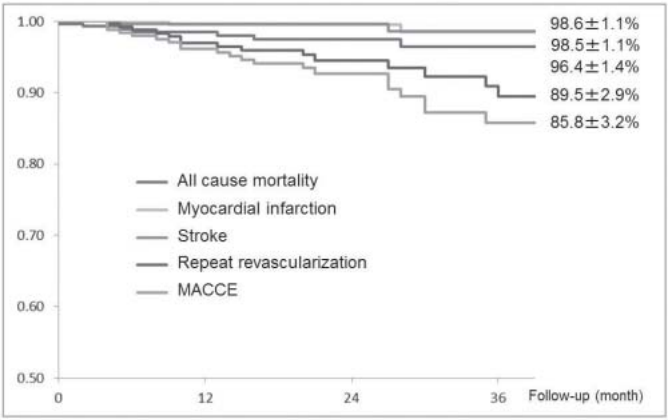

Fig 1. Kaplan-Meier curves for survival.
(MACCE=major adverse cardiovascular or cerebrovascular event.)

Table : Comparison With the Syntax Trial

12 Month' Follow-up	OPCAB No-Touch (n=300)	CABG Syntax (n=897)	Taxus Syntax (n=903)	p value (vs CABG)	p value (vs Taxus)
All-cause mortality	1.6%	3.5%	4.4%	NS	0.03
Myocardial infarction	0.4%	3.3%	4.8%	0.003	<0.001
Stroke	0.4%	2.2%	0.6%	0.04	NS
Repeat revascularization	3.1%	5.9%	13.5%	0.05	<0.001
MACCE	3.9%	12.4%	17.8%	<0.001	<0.001
36 Month' Follow-up	(n=289)	(n=827)	(n=885)		
All-cause mortality	3.6%	6.7%	8.6%	0.05	0.003
Myocardial infarction	1.5%	3.6%	7.1%	0.07	<0.001
Stroke	1.4%	3.4%	2.0%	NS	NS
Repeat revascularization	10.5%	10.7%	19.7%	NS	<0.001
MACCE	14.2%	20.2%	28.0%	0.03	<0.001

P11

Are Continuous-Flow Left Ventricular Assist Devices (CF-LVAD) on Track to Compete With Heart Transplantation? A Propensity-Score Matched Analysis of CF-LVAD vs Heart Transplant for Patients in United Network for Organ Sharing Status II (UNOS-II)

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COMMERCIAL RELATIONSHIPS L. Jacquet: Consultant/Advisory Board, Thoratec Corporation

Purpose: The improved outcomes of third-generation continuous-flow left ventricular assist devices (CF-LVAD) in bridge-to-transplant and destination-therapy patients have raised the question whether CF-LVADs may compete with heart transplantation (HTx) in terms of survival for transplant-eligible patients. We assessed the hypothesis that survival after LVAD is improved compared to HTx in adult patients listed in UNOS status II.

Methods: We identified all patients >18 years of age in the Organ Procurement and Transplantation Network database listed for their first heart transplant in the US in UNOS status II with no mechanical circulatory support at time of listing and who were not candidates for multiorgan transplant between January 2011 and March 2014. Two hundred eight patients received a third-generation CF-LVAD while listed and 1,120 patients received heart transplantation without LVAD. CF-LVAD and HTx patients were then matched 1:1 by mean of the closest-neighbor Propensity Score (PS), and survival of the two groups was estimated with the Kaplan-Meier method.

Results: One hundred seventy-nine LVAD patients could be PS-matched with an HTx patient. The matched groups were similar for several baseline characteristics (p = ns). In the LVAD subgroup, 173 patients received a heart transplant after a median support of 6.8 months (IQR: 3.8-11.4), four patients (2.2%) were still on LVAD, one patient (0.5%) died while on support, and one was removed from the waiting list. Survival with CF-LVAD was 99% compared to 91% of HTx at 18 months postoperatively (p = 0.002). Overall survival of the LVAD patients, considering also survival after transplant, was similar to survival of HTx patients (83% vs 91%, respectively, at 2 years, p = 0.25).

Conclusions: In conclusion, heart transplant candidates listed in status II and supported with CF-LVAD have shown an improved 18-month survival compared to HTx recipients. Cumulative survival of CF-LVAD patients who also received heart transplant was similar to survival of cardiac recipients who did not receive mechanical support.

P12

The SYNTAX Score: Does It Explain the Gender Difference in Mortality Following Coronary Artery Bypass Surgery?

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Purpose: Female patients have always had a worse outcome following coronary artery bypass surgery specifically and cardiac surgery in general compared with male patients. This is reflected in the current risk scoring systems. We hypothesized that the difference in mortality may be explained by differences in the complexity of coronary artery anatomy.

Methods: One hundred male and 100 female consecutive elective patients who underwent coronary artery bypass surgery over a 2-year period in our department were included in the study. A blinded observer calculated anatomical SYNTAX score data for all patients.

Results: The two groups of patients were similar in age (66.8 years ± 9.0 years vs 68.1 years ± 8.7 years; $p = 0.31$) and Logistic EuroSCORE (3.3 ± 2.7 vs 4.0 ± 2.9; $p = 0.06$); however, the female patients had a significantly higher anatomical SYNTAX score (39.6 ± 13.7 vs 32.8 ± 9.8; $p = 0.0002$), total number of lesions (4.3 ± 1.5 vs 3.6 ± 1.2; $p = 0.0019$), and number of bifurcated lesions (0.5 ± 0.6 vs 0.2 ± 0.3; $p = 0.0002$).

Conclusions: The higher complexity of coronary anatomy in females may explain the difference in predicted mortality following cardiac surgery. The anatomical SYNTAX score should be included in the risk scoring and stratification of patients undergoing coronary artery bypass surgery.

P13

Conversion After Off- or On-Pump Coronary Artery Bypass Grafting: Insights From a Large Multinational Randomized Trial

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Purpose: Emergent and late conversions from off- to on-pump coronary artery bypass grafting (CABG) have been associated with worse outcomes in a few clinical trials and retrospective series; however, it remains unclear as to which risk factors are associated with conversion.

Methods: Among 4,752 patients randomly assigned to off- or on-pump CABG, the incidence of off-to-on conversion was 7.9% (186/2,356) and on-to-off conversion was 6.6% (155/2,362). The primary study outcome was a composite of death, stroke, myocardial infarction, or new renal failure requiring dialysis. We assessed the risk factors and outcomes of converted patients.

Results: Reasons for off-to-on conversion included emergent conversion for hypotension or ischemia (n=75), small or intramuscular coronaries (n=83), and arrhythmias (n=21). Off-to-on converted patients required increased surgery time, need for intra-aortic balloon pump, blood transfusions, intensive care unit stay, and a higher incidence at 1 year of the composite outcome (Figure), death, and nonfatal myocardial infarction compared to non-converted off-pump patients (all $p < 0.01$ except death: $p = 0.02$). All these differences in outcome in off-to-on patients persisted despite a 1:4 propensity score matching adjustment, excepting no difference for death. Outcomes of elective off-to-on conversions were no different compared to non-converted patients ($p = 0.35$). Independent predictors of emergent conversions included chronic atrial fibrillation, not receiving beta-blockers preoperatively, urgent surgery, higher dyspnea class, and more grafts planned (Table). Most on-to-off conversions were due to a calcified aorta (n=101). On-to-off converted patients had a lower transfusion rate ($p < 0.01$), but all other outcomes were no different compared to non-converted on-pump patients.

Conclusions: Emergent off-to-on conversion is associated with worse outcomes. Elective conversion should be considered when risk factors for emergent conversion are present.

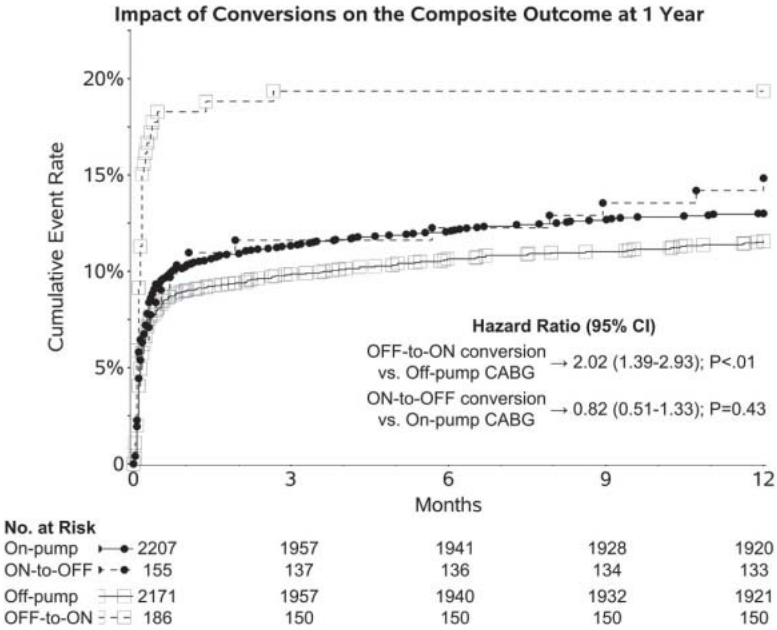

Table. Independent predictors of OFF-to-ON emergent conversion in the off-pump CABG treatment group.*

	Odds Ratio (95% CI)	*P Value*
Chronic atrial fibrillation	3.25 (1.36-7.73)	<.01
Beta blockers preoperatively	0.49 (0.32-0.74)	<.01
Urgent surgery	1.86 (1.09-3.17)	0.02
NYHA functional class		<.01
• I or II (reference)	1	-
• III	1.57 (0.94-2.61)	0.08
• IV	2.73 (1.21-6.15)	0.02
Planned number of distal anastomoses		0.01
• 1 or 2 targets (reference)	1	-
• 3 or 4 targets	2.18 (1.20-3.97)	0.01
• 5 or 6 targets	3.64 (1.37-9.70)	0.01

* Logit-link generalized estimating equations were used to account for institutional variations in conversion rates in the estimation of the independent predictors of emergent conversion.

P14

SYNTAX Score Affects Long-Term Outcomes of Conventional Coronary Artery Bypass Grafting for Complex Coronary Artery Disease

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Purpose: We retrospectively analyzed long-term outcomes after conventional coronary artery bypass grafting (CABG), routinely employed for complex coronary artery disease among the patients with low (0-22), intermediate (23-32), and high (≥33) SYNTAX scores.

Methods: This study enrolled 396 consecutive patients with stable left main and/or three-vessel disease who routinely underwent CABG from 2000 through 2009. A comparison among the three groups (low score, n=161; intermediate score, n=149; high score, n=86) was performed, looking at the primary endpoint of major adverse cardiac and cerebrovascular events (MACCE), including all-cause death, stroke, myocardial infarction (MI), and repeat revascularization. We also analyzed the effects of variables on MACCE at 10 years after the operation.

Results: The overall 10-year MACCE rates in patients with low, intermediate, and high SYNTAX scores were 24.3%, 33.2%, and 48.0%, respectively ($p = 0.004$). This was largely because of an increased rate of repeat revascularization at 10 years (3.1% in low, 15.7% in intermediate, and 17.4% in high score, $p = 0.001$). The cumulative rates of the combined outcomes of death/stroke/MI in patients with low, intermediate, and high SYNTAX scores were 20.2%, 25.8%, and 37.9%, respectively ($p = 0.15$). In the multivariate analysis, the SYNTAX score was demonstrated to be the only significant predictor of MACCE at 10 years (HR 1.04, $p = 0.0022$) and repeat revascularization at 10 years (HR 1.05, $p = 0.0063$).

Conclusions: The SYNTAX score is indicative of long-term outcomes after conventional CABG for complex coronary disease. These results suggest that patients with lower SYNTAX scores, who are believed to be percutaneous coronary intervention (PCI) candidates, should undergo CABG for better MACCE and repeat revascularization; these CABG outcomes should provide a suitable benchmark against which long-term PCI outcomes could be compared.

P15

Blood Transfusion Modifies the Impact of Preoperative Hematocrit on Perioperative Outcomes Following Non-Emergent Coronary Artery Bypass Surgery

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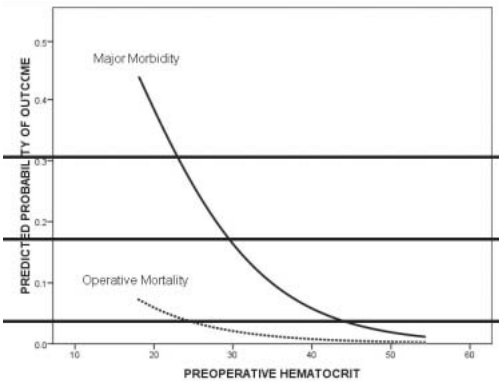
COMMERCIAL RELATIONSHIPS N. Ad: Speakers Bureau/Honoraria, AtriCure, Inc, Medtronic, Inc; Consultant/Advisory Board, AtriCure, Inc, Medtronic, Inc

Purpose: The association between lower preoperative hematocrit (Hct) and risk for morbidity/mortality following cardiac surgery is well established. This study examined whether the impact of low preoperative Hct on patient outcome is modified by blood transfusion and operative risk following non-emergent coronary artery bypass grafting (CABG) surgery.

Methods: Non-emergent first-time isolated CABG patients were included (n=2,241). Logistic regressions assessed the effect of Hct on operative mortality and major perioperative morbidity. Interaction of STS risk score and Hct on outcome was assessed with blood transfusion adjustment.

Results: Mean age was 63.0 years ± 10.1 years, preoperative Hct was 38.9% ± 4.8%, and STS score was 1.3% ± 1.9%. Lower Hct predicted major morbidity (OR=0.89, $p < 0.001$) and operative mortality (OR=0.89, $p = 0.01$) in univariate analyses (Figure). After adjustment for STS score and STS score by Hct interaction, lower Hct remained predictive of major morbidity (OR=0.90, $p < 0.001$) and operative mortality (OR=0.87, $p = 0.02$). Lower preoperative Hct was predictive of blood transfusion during hospital stay (OR=0.86, $p < 0.001$) with adjustment for STS score and the interaction term. When added to outcome analyses, blood transfusion significantly predicted operative mortality (OR=9.1, $p < 0.001$), but eliminated the predictive effect of lower Hct (OR=0.93, $p = 0.26$); however, major morbidities remained significantly predicted by lower Hct (OR=0.95, $p = 0.04$) after addition of blood transfusion (OR=7.0, $p < 0.001$). The O/E ratio for operative mortality was 0.29 in patients without blood products, whereas the O/E ratio was 1.37 for patients with any blood transfusion.

Conclusions: Blood transfusion and low preoperative Hct negatively impact major outcomes after non-emergent CABG across all levels of STS risk. Preoperative strategies to mitigate anemia and decrease blood transfusion in non-emergent CABG patients should be implemented to improve outcomes and reduce costs.



P16

Trends, Predictors, and Outcomes of Stroke After Surgical Aortic Valve Replacement in the United States

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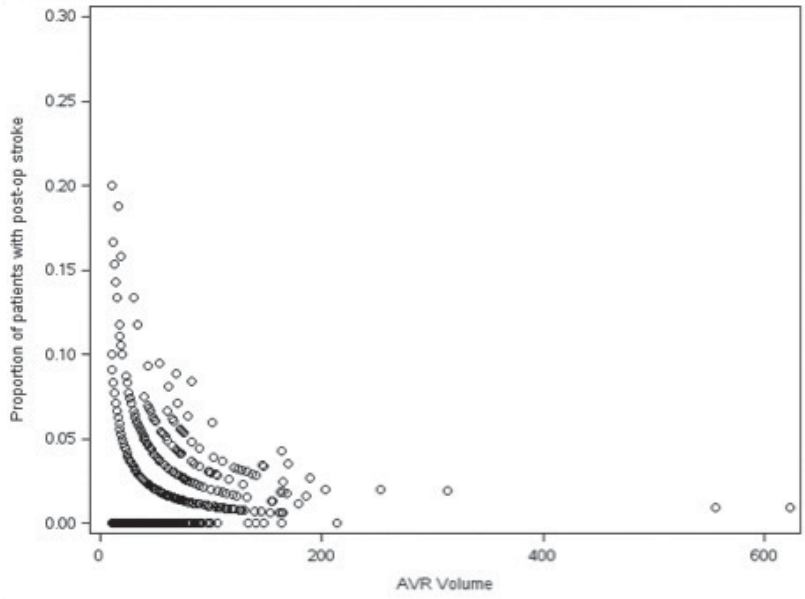
COMMERCIAL RELATIONSHIPS D. R. Johnston: Speakers Bureau/Honoraria, Edwards Lifesciences Corporation, St Jude Medical, Inc; J. F. Sabik: Research Grant, Abbott, Edwards Lifesciences Corporation; Consultant/Advisory Board, Medtronic, Inc, SORIN GROUP; N. G. Smedira: Consultant/Advisory Board, Edwards Lifesciences Corporation

Purpose: Improvements in care have resulted in decreased mortality after aortic valve replacement (AVR), but postoperative stroke remains a major cause of morbidity in these patients. Our objectives were to use a large national database to identify risk factors for postoperative stroke and determine incremental mortality, resource usage, and cost of stroke.

Methods: We identified 355,345 patients who underwent isolated AVR between 1998 and 2011 from the Nationwide Inpatient Sample. Mean age was 65.7 years. Multivariable regression was used to identify risk factors for postoperative stroke, and propensity matching was performed to determine the effect of a postoperative stroke on outcomes. Patients were stratified according to Elixhauser comorbidity score (ECS) into low (0-5), medium (6-15), and high risk (16+) categories.

Results: Postoperative stroke after isolated AVR occurred in 5,092 patients (1.45%). The incidence of stroke declined from 1.69% in 1999 to 0.94% in 2011 ($p < 0.001$). Increasing age and higher comorbidities were the main predictors of postoperative stroke (each $p < 0.001$). The highest volume centers (>200 AVRs/year) had the lowest rate of stroke (1.2%). After multivariable adjustment, high-volume centers were associated with lower odds of stroke in medium-risk patients (odds ratio [OR] 0.59; 95% confidence interval [CI] 0.37-0.94) and in high-risk patients (OR 0.39, 95% CI 0.22-0.68) compared to the lowest-volume centers (Figure). For low-risk patients, volume was not associated with stroke. Among propensity-matched pairs, patients who suffered a stroke were hospitalized for 4.2 days longer (95% CI 2.8-5.5, $p < 0.001$), had an average of $11,014 higher costs (95% CI $7,094-14,934, $p < 0.001$), and had 2.74 times higher odds of in-hospital mortality (95% CI 1.97-3.80, $p < 0.001$) compared to those without a stroke complication.

Conclusions: The overall incidence of stroke after AVR has decreased in United States population, but it remains a significant cause of morbidity in medium- and high-risk patients. Superior outcomes can be achieved with medium- to high-risk patients at high-volume centers.


Proportion of patients with post-op stroke
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
200
400
600
AVR Volume

P17

What Is the Best Surgical Approach for Aortic Valve Stenosis in Elderly Patients With Previous CABG? A Comparison Between Traditional Aortic Valve Replacement and Transapical TAVR From Two Real-World Multicenter Surgical Registries

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COMMERCIAL RELATIONSHIPS A. D'Onofrio: Consultant/Advisory Board, Edwards Lifesciences Corporation; G. Gerosa: Research Grant, Edwards Lifesciences Corporation; Speakers Bureau/Honoraria, HeartWare International Inc, SORIN GROUP, St Jude Medical, Inc; Other, Edwards Lifesciences Corporation, Proctor for TAVI

Purpose: To evaluate the best surgical approach between traditional redo-AVR (rAVR) and full sternotomy and transapical TAVR (TaTAVR) in patients in the eighth decade of life who have already undergone previous coronary artery bypass grafting (CABG) surgery.

Methods: Thirty-day follow-up outcomes were analyzed for 239 previous CABG elderly patients enrolled in two multicenter registries because of aortic valve stenosis who were treated with rAVR (126 patients) or TaTAVR (113 patients), according to VARC-2 and also stratifying by propensity matching.

Results: The TaTAVR group proved older and sicker (Table 1) and demonstrated a higher incidence of stroke (5.3% vs 0.8%, $p = 0.04$), major bleeding (9.7% vs 0.8%, $p < 0.01$), 30-day mortality (7.1% vs 1.6%, $p = 0.03$), and worse "early safety" (24.8% vs 15.1%, $p = 0.04$) than the rAVR group, but also had a lower need for permanent pacemaker (4.4% vs 11.9%, $p = 0.03$). Perioperative acute myocardial infarction (AMI), prolonged (>24 hours) intubation, AKIN2/3, need for dialysis, cardiovascular 30-day mortality, overall and cardiovascular death at follow-up, follow-up acute heart failure (AHF), stroke, reinterventions on AVR, and thromboembolisms were comparable (p = ns). After propensity matching by age, EuroSCORE II, NYHA, left ventricular ejection fraction, and major comorbidities, a comparable population of 56 patients was selected, showing comparable perioperative major bleeding, AMI, stroke, prolonged intubation, need for dialysis or permanent pacemaker, "early safety," 30-day and follow-up overall and cardiovascular mortality, follow-up AHF, stroke, reinterventions on AVR, and thromboembolisms ($p > 0.05$). TaTAVR reported a trend toward a lower incidence of perioperative AKIN2/3 (3.6% vs rAVR: 21.4%, $p = 0.05$).

Conclusions: Reported differences in early and follow-up mortality and morbidity after TaTAVR and rAVR reflect differences in baseline risk profiles. Cost-effectiveness considerations, rather than clinical results, should guide the surgical choice. Patients at higher perioperative renal risk could benefit from a preferential TaTAVR indication.

Variables	rAVR (126)	TaTAVR (113)	P
Age	75.0±5.0	78.9±6.4	<.01
Euroscore II	11.6±8.8	17.8±11.5	<.01
Female gender	42 (33.3%)	46 (40.7%)	.15
Critical state	1 (0.8%)	3 (2.7%)	.27
NYHA class I	3 (2.4%)	2 (1.8%)	
NYHA class II	24 (19.0%)	22 (19.5%)	
NYHA class III	84 (64.7%)	73 (64.6%)	
NYHA class IV	15 (11.9%)	16 (14.2%)	.95
Systemic hypertension	90 (71,4%)	102 (90.3%)	<.01
Diabetes mellitus	59 (46.8%)	37 (32.7%)	.02
Renal disease	30 (23.8%)	71 (62.8%)	<.01
Vasculopathy	27 (21.4%)	78 (69.0%)	<.01
COPD	29 (23.0%)	21 (18.6%)	.25
Neurologic dysfunction	24 (19.0%)	7 (6.2%)	<.01
Pervious myocardial infarction	40 (31.7%)	7 (6.2%)	<.01
LVEF >50%	78 (61.9%)	52 (46.0%)	
LVEF 30-50%	44 (34.9%)	53 (46.9%)	
LVEF<30%	4 (3.2%)	8 (7.1%)	.03
Pulmonary Hypertension	22 (17.5%)	63 (55.8%)	<.01

P18

Is Conventional Open Surgery Still a Good Option for Aortic Arch Aneurysm in Patients of Advanced Age?

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Purpose: The advent of debranched thoracic endovascular aortic repair (TEVAR) as a treatment strategy for arch aneurysm in of septuagenarian and octogenarian patients has been drastically changed. Although TEVAR has advantages for patients of advanced age, it is not always applicable, and elderly patients may require open surgical repair.

Methods: Between January 2008 and April 2014, 157 patients over age 75 (mean age 79.3 years ± 3.3 years, range 75 to 92, 111 male) underwent conventional total arch replacement. There were 39 emergent operations (acute aortic dissection type A in 30 patients, rupture of arch aneurysm in nine). The perioperative risk factors were stroke in 40 patients, coronary artery disease in 48, chronic obstructive pulmonary disease in 16, chronic kidney disease in 18, and re-sternotomy in 13.

Results: Mean follow-up time was 1.75 years ± 1.10 years. Mean cardiopulmonary bypass (CPB) time was 251.5 minutes ± 68.9 minutes, and mean circulatory arrest time was 62.6 minutes ± 15.4 minutes. Mean lowest nasopharyngeal temperature was 23.2°C ± 3.4°C. Concomitant procedures were performed in 29.3% of patients (46/157 coronary artery bypass grafting in 32 patients, aortic valve replacement in 17, and Bentall operation in two). The hospital mortality rate was 7.6% (12/157) in all cases, 5.2% in elective cases, 15.4% in emergent cases, and 3.9% in elective cases without concomitant surgery. Postoperative complications were major stroke in seven patients (4.5%) and respiratory disorder in 24 (15.3%). No patients had spinal cord complication. The 1- and 3-year survival rates were 88.5% and 79.9% in all cases and 98.0% and 91.0% in elective cases without concomitant surgery, respectively. Univariate analysis demonstrated that the risk factors for early mortality were ruptured aneurysm ($p = 0.004$), CPB time more than 4 hours ($p = 0.031$), and transfusion volume more than 2,000 cc ($p = 0.001$).

Conclusions: Even in patients more than 75 years old, the recent surgical results of conventional open arch repair was acceptable, especially in elective cases without concomitant surgery. Thus, conventional open repair could be a last resort for aortic arch diseases.

P19

Hybrid Coronary Revascularization Is Better Than Multivessel PCI-Stenting: A Propensity-Matched Analysis

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COMMERCIAL RELATIONSHIPS G. Bisleri: Speakers Bureau/Honoraria, Atricure, Inc, Estech

Purpose: Hybrid revascularization (HCR), meaning minimally invasive direct coronary artery bypass combined with percutaneous coronary intervention (PCI), is gaining new popularity for coronary revascularization, not only in high-risk patients but even as a planned strategy. Despite current guidelines and the proven superiority of left internal mammary artery to left anterior descending artery (LIMA-LAD), PCI is still largely performed in patients with LAD proximal lesions. We compare hybrid revascularization and multiple PCI-stenting results.

Methods: We retrospectively analyzed 100 hybrid and 100 multivessel PCI revascularizations. All mitral valve disease (MVD) was discussed within the heart team and the ideal strategy identified. A propensity score matching was performed between the two groups and 54 patients from each series selected. Early results were evaluated, and survival analysis for all-cause mortality, cardiac death, and major adverse cardiac and cerebrovascular events (MACCE) was performed.

Results: 61/108 patients had two-vessel disease and 7/108 (four HCR and three PCI patients) had left main involvement. There were 12 LAD total occlusion in HCR and eight in MVD PCI. Nine MVD PCI patients and 11 HCR patients had recent ST segment elevation myocardial infarction. No hospital mortality was reported. Survival rate was superior in HCR than in the PCI group at 60 months (95% CI: 86.8%, 82.6%-93% vs 80.7%, 74.1%-87.3%, $p = 0.34$). Freedom from cardiac death survival rate at 60 months was better in HCR than in PCI (95% CI: 92.6%, 87%-98.2% vs 85.7%, 79.3%-92.1%, $p = 0.24$). Freedom from MACCE survival rate at 60 months was better in HCR group than in PCI (95% CI: 74.8%, 67%-82.6% vs 54.6%, 46.8%-62.4%, $p = 0.025$).

Conclusions: A better, although not statistically significant, all-cause and cardiac death survival rate was found in the HCR group. MACCE incidence was significantly higher in the PCI group due to LAD repeated revascularization.

P20

Diagnostic and Therapeutic Role of Emergency Postoperative Coronary Angiography After Cardiac Surgery

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Purpose: To evaluate the diagnostic and therapeutic role of emergency coronary angiography (ECA) in the setting of acute ischemic/hemodynamic instability after cardiac surgery.

Methods: Between January 2005 and December 2013, data were collected from a consecutive cohort of 4,824 patients who underwent cardiac surgery at our institution. Patients who underwent emergent coronary angiography due to new onset of ST-segment changes on electrocardiogram (ECG), ventricular arrhythmias, cardiac arrest or hemodynamic collapse, new changes in regional wall motion, or any other relevant clinical suspect of myocardial ischemia during postoperative intensive care unit stay were included in the study.

Results: Thirty-five patients (0.7% of the overall population) were enrolled. Seventeen (48%) received isolated coronary surgery, while 18 (52%) underwent valve/aortic or combined operations. The most common indications to ECA were new ECG or echo signs of acute ischemia (63%). Mean time from primary operation to ECA was 51 hours. Graft failure was the main angiographic finding (48%), followed by native coronary artery occlusion (26%) and coronary spasm (11%). Two patients (6%) underwent reoperation (Group 1), 14 (40%) underwent percutaneous interventions (PCI) (Group 2), and 19 (54%) were managed conservatively (Group 3). In-hospital mortality was 100% in Group 1, 0% in Group 2, and 5% in Group 3; 93% of cases who underwent PCI had complete resolution of the ischemic/hemodynamic problems. No complications related to angiography occurred. Kaplan-Meier survival curves differed significantly according to the post-angiography management (Figure 1). At multivariate analysis, combined surgery and the strategy of treatment were independent predictors of long-term mortality.

Conclusions: ECA is safe and consents resolution of the instability in the great majority of cases. ECA should be the first-line measure in case of acute ischemic/hemodynamic instability

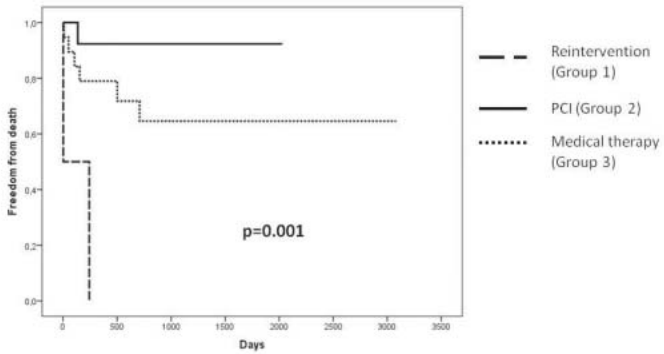

Fig.1- Kaplan Meier survival curves in the three groups.

P21

Effect of STEMI vs NSTEMI on Outcomes in Patients Undergoing Non-Emergent Coronary Artery Bypass Grafting After Acute Myocardial Infarction

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Purpose: Although patients with ST-elevation myocardial infarctions (STEMI) are known to have worse outcomes compared to those with non-ST elevation myocardial infarctions (NSTEMI), such differences are not well described in the subset of patients undergoing coronary artery bypass grafting (CABG). The purpose of this study is to compare postoperative outcomes of patients undergoing non-emergent CABG within 1 week after STEMI vs NSTEMI.

Methods: A retrospective study was performed on patients undergoing non-emergent isolated CABG within 1 week from an MI from 2008 to 2012. Postoperative outcomes for patients with STEMI vs NSTEMI were compared within each group. Mann-Whitney test was used to compare continuous factors. Chi-square test was used to compare categorical factors.

Results: Out of the 446 patients undergoing non-emergent isolated CABG between 1 and 7 days after an MI, 122 patients (27.3%) had a STEMI. Patients undergoing CABG between 1 and 7 days after a STEMI had more left main disease (22.9% vs 2.7%, $p < 0.01$), lower ejection fractions (median: 40% vs 45%, $p = 0.02$), and more preoperative intra-aortic balloon pump (64.7% vs 30.9%, $p < 0.01$) as compared to NSTEMI patients. There were no differences in rates of major complication (22.9% vs 17.3%, $p = 0.17$) and mortality (1.64% vs 1.54%, $p = 0.94$) between STEMI and NSTEMI patients. There were also no differences in length of intensive care unit stay (median: 51 hours vs 49 hours, $p = 0.53$) and hospital stay (median: 8 days vs 8 days, $p = 0.83$) between the two groups.

Conclusions: Despite increased preoperative risk factors in patients with STEMI, there are no differences in major outcomes between STEMI and NSTEMI patients undergoing CABG between 1 and 7 days after MI.

P22

The Transcaval Approach as an Alternative to Transapical Access for Valve Delivery During Transcatheter Aortic Valve Replacement: Is It as Crazy as It Sounds?

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COMMERCIAL RELATIONSHIPS A. Greenbaum: Ownership Interest, Inventor on patent applications for devices for caval-aortic access that have been assigned to my employer, Henry Ford Hospital; R. Lederman: Ownership Interest, United States National Institutes of Health, Co-inventor of devices to close caval-aortic access ports, for which rights have been assigned to my employer, the United States National Institutes of Health; M. Guerrero: Research Grant, Edwards Lifesciences Corporation; Consultant/Advisory Board, Edwards Lifesciences Corporation; Other, Edwards Lifesciences Corporation, Proctor; W. O'Neill: Consultant/Advisory Board, Edwards Lifesciences Corporation, Medtronic, Inc

Purpose: Transapical access is an approved alternative approach in patients undergoing transcatheter aortic valve replacement (TAVR) with inadequate femoral arteries. Placement of large sheaths can also be achieved by a transcaval approach to the aorta via the inferior vena cava. We compared our experience with transapical and transcaval approaches to TAVR.

Methods: Univariate analysis compared baseline demographics, in-hospital, and 30-day outcomes among patients who underwent TAVR between October 2012 and March 2014 via either transapical (n=26) or transcaval (n=25) access.

Results: Baseline demographics were similar between the two groups except that the transcaval group had more females, fewer patients with renal disease, and fewer who had undergone prior coronary bypass surgery (Table). Those undergoing transcaval TAVR were more often transfused, both during and after the procedure. Procedural success, operative mortality, and postoperative length of stay were similar for both groups. Readmission within 30 days was more common in the transapical group. No deaths in either group were directly related to the access procedure itself. All follow-up imaging to date has shown stable closure of the caval-aortic access site.

Conclusions: The results of this initial experience demonstrate that transcaval aortic access and valve delivery is feasible and may represent an alternative approach to transapical access in patients undergoing TAVR who lack suitable femoral arterial access.

Table

	TA (n=26)	TC (n=25)	p-value
Demographics			
Age(years), mean± SD	82 ± 8	82 ± 9	0.967
Female, n (%)	9 (35)	21 (84)	<0.001
BMI, mean± SD	27.4 ± 4.6	28.8 ± 6.7	0.415
STS risk score, mean± SD	8.3 ± 3.9	8.2 ± 3.5	0.902
Prior CABG, n (%)	15 (58)	7 (28)	0.032
Renal insufficiency, n (%)	17 (71)	7 (33)	0.012
Atrial arrhythmia, n (%)	11 (46)	11 (44)	0.897
Moderate/severe lung disease, n (%)	5 (19)	2(8)	0.244
Peripheral arterial disease, n (%)	11 (46)	13 (52)	0.666
Prior stroke, n (%)	7 (28)	2 (8)	0.066
Outcomes			
Procedural success, n (%)	24 (92)	22 (88)	0.605
Transfusion during, n (%)	1 (4)	8 (32)	0.008
Transfusion post, n (%)	6 (23)	15 (60)	0.007
Operative Mortality, n (%)	3 (12)	1 (4)	0.316
Stroke, n (%)	3 (12)	1 (4)	NS
Length of stay (days), mean± SD	8.2 ± 5.2	10.4 ± 8.3	0.282
Readmission, n (%)	7 (30)	1 (5)	0.027

P23

Outcome of Extreme-Risk Transapical TAVI Patients (mean log EuroSCORE >30%) With Impaired vs Normal Left Ventricular Function: Who Benefits More?

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COMMERCIAL RELATIONSHIPS W. Wisser: Speakers Bureau/Honoraria, Edwards Lifesciences Corporation

Purpose: Transapical transcatheter aortic valve implantation (TA-TAVI) is an emerging treatment option for frail and conventional inoperable patients. In this study, we compared the early and mid-term results of TAVI in extreme high-risk patients with reduced (rLVEF) and normal left ventricular function (nLVEF).

Methods: Between April 2007 and March 2013, 97 extreme risk patients (mean age 80 years ± 7 years, 50.4% male) with severe, symptomatic aortic stenosis (mean aortic valve area 0.6 cm^2 ± 0.2 cm^2, mean aortic gradient 53 mm Hg ± 12 mm Hg) who were rejected for open heart surgery underwent TA-TAVI procedure. Forty-nine patients (mean age 81 years ± 6 years, 45.1% male) had an rLVEF (35.9% ± 9.9%) and 48 patients nLVEF (61.5% ± 9.9%). The estimated perioperative mortality of patients with rLVEF and nLVEF, according to log ES, was 38.5% ± 19.5% and 30.8% ± 20.5% , ES II 18.0% ± 15.5% and 12.4% ± 11.2%, STS Score 8.4% ± 6.3% and 8.1% ± 5.4% for patients with rLVEF and nLVEF, respectively.

Results: Implantation was successful in 93 patients; the remaining four patients were converted to conventional valve replacement. The in-hospital mortality was 8.5% and 12.8%; the estimated overall postoperative survival rate using Kaplan-Meier analysis was 78.2% and 73.3% at 1 year, 66.0% and 60.3% at 2 years, and 48.8% and 60.3% % at 3 years for rLVEF and nLVEF, respectively. Postoperatively, three patients had a stroke (two patients with rLVEF) and three patients required a pacemaker implantation (all rLVEF). The median postoperative hospital stay was 15 and 21 days for rLVEF and nLVEF, respectively. After 3 years, the majority of patients still live in their private home.

Conclusions: Even in cases of frail and extreme risk patients, TA-TAVI is a suitable therapy option with promising results. Patients with rLVEF benefit from a shorter in-hospital stay and lower postoperative mortality rate up to 2 years follow-up compared to patients with nLVEF. Further outcome improvement can be achieved by refining the patient evaluation focused on improvement of quality of life.

P24

Safety and Efficacy of del Nido Cardioplegia for Acquired Heart Disease in Adults

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Purpose: del Nido cardioplegia (dNC) for myocardial protection is an alternative to multidose protocols. dNC has been used in congenital heart surgery, but there are few reports of its use in adults. Our purpose herein is to report our favorable experience in using dNC in adult acquired cardiac surgical procedures.

Methods: A retrospective review was conducted on 119 consecutive adult patients with acquired heart diseases who underwent on-pump surgery using dNC at a US-based health care system between February 2013 and April 2014. During same period, 1,127 on-pump surgery cases utilizing high potassium blood cardioplegia (BC) served as the bases for comparison. Propensity score regression adjustment using 21 variables, including STS PROM, was conducted to address selection bias. Preoperative, operative, and postoperative variables are compared between the two groups (Table).

Results: Of 119 consecutive cases with dNC, there were 16 (13%) isolated coronary artery bypass grafting (CABG) surgery, 37 (31%) isolated valve surgery, 19 (16%) valve + CABG, and four (3%) aortic surgery. Mean cross-clamp time was 110 minutes ± 40 minutes and mean bypass time was 141 minutes ± 47 minutes. Mean dNC dose was 2.4 ± 1.4; retrograde administration, in addition to antegrade dose, was used in 44 (37%). Thirty-day mortality occurred in three patients (3%), stroke in seven (6%), cardiac arrest in two (2%), renal failure in six (5%), readmission within 30 days in 20 (17%), intra- or postop initiation of intra-aortic balloon pump in four (3%), reoperation in three (3%), and prolonged ventilation in 21 (18%). Of 119 with dNC, 60 cases met STS risk models for CABG, valve, and combined valve + CABG procedures and were analyzed with propensity score regression. No significant difference in cardioplegia-related postoperative outcomes were observed between dNC and BC (Table).

Conclusions: Our results indicate that dNC is a safe and effective operative myocardial solution for adult complex heart diseases. Continued studies would expand our knowledge and understanding of the value of dNC for protecting myocardial tissue during complex cardiac operations.

	Propensity score adjusted logistic regression		
	OR	95% CI	p-value
Thirty-day mortality	0.7	(0.10, 4.64)	0.71
Readmission within Thirty-day	1.98	(0.96, 4.06)	0.06
New renal failure after operation	0.81	(0.14, 4.73)	0.82
Return to the OR for reoperation	0.61	(0.11, 3.47)	0.58
Requirement for IABP intra-postoperatively	1.73	(0.29, 10.55)	0.55
Postoperative atrial fibrillation	1.46	(0.82, 2.60)	0.2
Postoperative cardiac arrest	0.63	(0.10, 3.92)	0.62
Prolonged ventilation	1	(0.49, 2.05)	0.99

P25

Safe Surgery Saves Lives (SSSL): Quality and Safety Improvement in Cardiac Surgery—A Single-Center Experience

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Purpose: Cardiac surgery is a high-risk area of medicine that requires a culture of safety. Adapting the checklist of the World Health Organization published in 2009 for our unit, we introduced the Safe Surgery Saves Lives (SSSL) program with the aim to optimize the patient hospitalization process and analyze potential sources of errors.

Methods: From April 2011 to December 2013, we included 1,111 patients that were operated on in our department and collected the data from our adapted SSSL checklists. The results of SSSL documentation were entered into a database for statistical evaluation and were divided into three phases: first phase (2011), second phase (2012), and third phase (2013).

Results: Missing or incomplete preoperative documentation required for the SIGN-IN was observed in 43% (300 patients) by the end of the first phase. During the second phase, missing or incomplete documentation decreased to 26% (407 patients) and to 21% in the third phase (404 patients). Analysis of incomplete documents showed that emergent procedures contributed to a large amount of missing documentation. Missing documents were reduced from 25% to 10%. Major surgical strategy was changed in the first phase in 18% of the cases, dropping to 9% in the second phase and 10% in the third phase. The SIGN-OUT procedure allows notation of important diversions from routine postoperative protocol. These cases included 3% in phase 1 and 2% in both phase 2 and 3. Errors arising from instrument, sponge, and needle count were 1.7%, 1.5%, and 0.5%, respectively. Deficient SIGN-OUT procedure of the team was 4%, 5%, and 8%, respectively. SSSL results have generated a significant number of critical incident reports.

Conclusions: This evaluation indicates that the impact of an SSSL program in a modern surgical department is significant and the detection of potentially harmful errors can be made in the preoperative stage of patient care.

P26

Abandon the Pump in CABG to Prevent Renal Injury? A Prospective Randomized Trial

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Purpose: Cardiopulmonary bypass increases the risk of renal impairment. To which extent structural damage causes functional decline is unknown. We compared conventional extracorporeal circulation (CECC), minimized extracorporeal circulation (MECC), and off-pump coronary bypass grafting (OPCAB) with respect to perioperative kidney injury.

Methods: One hundred twenty patients undergoing CABG were randomly assigned to three different study groups (CECC, MECC, or OPCAB). Blood and urine samples were collected at baseline and up to 72 hours after surgery. Urinary protein markers of tubular injury were neutrophil gelatinase associated lipocalin (NGAL), alpha-glutathione S-transferase (α-GST), liver fatty acid binding protein (L-FABP), and kidney injury molecule I (KIM I). Serum creatinine, blood urea levels, and estimated glomerular filtration rate (eGFR) were determined to monitor renal function. Urinary values were corrected for volume variation, whereas serum values were normalized to hematocrit. Data were analyzed by mixed-model analysis.

Results: Most tubular proteins peaked at or within 6 hours after ICU arrival and differed significantly between groups. KIM I demonstrated late peak levels at 48 hours postop. Serum creatinine and blood urea increased until 72 hours postop, whereas eGFR decreased. Creatinine and eGFR did not show significant differences between groups. Twelve patients developed acute kidney injury (≥50% increase in serum creatinine within 7 days), distributed equally in all groups.

Conclusions: Early markers of renal cell damage indicate a harmful effect of extracorporeal circulation with MECC being of intermediate risk; however, perioperative changes in renal function occur independent of extracorporeal perfusion.

Table: Maximum values; median [range]; *$p < 0.05$ vs baseline; #$p < 0.05$ vs CECC

Parameter	CECC	MECC	OPCAB
NGAL (µg/mg)	35.5[3.2-2507]*	15.1[0-1622]	8.2[1.5-209]#
L-FABP (µg/mg)	18.0[1.8-1360]*	4.5[0.9-1443]#	2.2[0.5-20.7]#
α-GST (µg/mg)	36.9[8.6-272]*	21.8[0-176]#	22.0[0-57.2]#
KIM I (µg/mg)	8.5[1.6-21.8]*	7.3[1.5-32.7]*	6.3[2.0-63.2]*
Crea (µmol/L)	121[86.4-465]*	128[74.0-241]*	116[55.4-191.5]*
Urea (mmol/L)	7.7[3.6-24.7]*	7.9[4.9-18.6]*	6.7[2.4-14.1]*#
eGFR (ml/min)	76.0[12.0-112.0]*	74.0[33.0-102.0]*	73.5[48.0-98.0]*

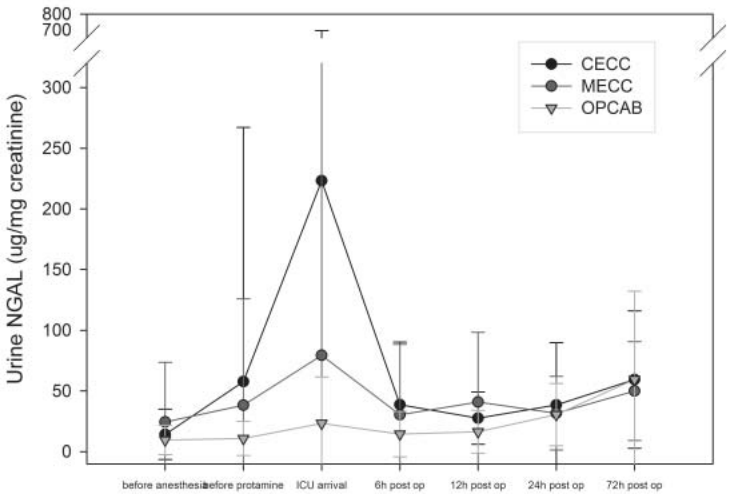

Figure: mean urine NGAL concentrations at various timepoints measured by ELISA and corrected for urine creatinine excretion

P27

Long-Term Results of the Freestyle Aortic Bioprosthesis in Patients 60 Years Old and Younger

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Purpose: Controversy remains as to whether biologic prostheses are appropriate in younger patients due to the risk of structural valve deterioration (SVD), anticoagulant-related bleeding, and thromboembolism with mechanical valves. The purpose of this study is to evaluate the long-term results of the Freestyle stentless aortic bioprosthesis in patients ≤60 years of age.

Methods: A total of 474 patients ≤60 years of age were identified from 2,004 patients who had a stentless Freestyle aortic valve implant at a single institution from January 1, 1998, to December 31, 2012. Phone interviews, recent echocardiograms, chart review, and Social Security Death Index enabled data collection. Cumulative incidence estimated by Kaplan-Meier time-to-event methods were used to analyze survival and major adverse valve-related outcomes. All Freestyle implants, regardless of associated cardiac surgical procedures, were analyzed.

Results: Follow-up was 94% complete. Mean follow-up was 6.4 years ± 3.8 years with 3,033 total patient years. Mean age was 51.1 years (range 23-60). Thirty-day mortality was 1.3%. Survival at 5, 10, and 15 years was 88%, 73.1%, and 57.4%, respectively. There were 207 full root and 267 subcoronary implants. Freedom from structural valve deterioration at 5, 10, and 15 years was 100%, 87.6%, and 69.9%, respectively. Of the 23 cases of SVD, 19 were subcoronary implants and four were root replacements ($p = 0.009$). All cases required reoperation at a mean of 9.4 years with a 30-day mortality of zero patients. Freedom from operated endocarditis was 99.1% at 5 years and 96% at both 10 and 15 years. The incidence of thromboembolic events was 0.16% per patient year.

Conclusions: In patients ≤60 years of age, the Freestyle bioprosthesis has excellent freedom from endocarditis and thromboembolic events. Durability to date is good with superior freedom from SVD in full root vs modified subcoronary implants. Freestyle valves remain an excellent option for aortic valve replacement in young to middle-aged patients.

P28

An Economic Analysis of Distant Referral Surgery for Mitral Valve Disease

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COMMERCIAL RELATIONSHIPS D. S. Likosky: Research Grant, Agency for Healthcare Research and Quality (AHRQ); Speakers Bureau/Honoraria, SpecialtyCare; Consultant/Advisory Board, American Society of Extracorporeal Technology

Purpose: Mitral valve (MV) repair for degenerative disease is superior to replacement. Despite being a quality marker, MV repair rates vary widely among surgeons and centers. This study's objective was to analyze outcomes and economic value (quality/cost) of distant referral to a destination mitral center of excellence (MCoE).

Methods: Between January 2011 and June 2013, 746 patients who underwent MV repair at a single center were assessed. From this single-surgeon cohort, 104 in-state patients (IN) for elective low-risk isolated MV repair (± tricuspid valve repair/atrial septal defect repair; no atrial fibrillation [AF], aortic valve replacement, coronary artery bypass, or Redo) were matched 4:1 with 26 out-of-state patients (OUT). STS outcome metrics and financial data (charges, professional fees, and total payments, which included travel costs paid by OUT) were compared between groups.

Results: No differences in preop demographics/STS risk, length of stay (LOS), readmissions, AF, or other complications (Table 1) between IN vs OUT were detected. Repair rate was 100% (n=130) with no residual mitral regurgitation and no mortality. Major postop complications were one reversible ischemic neurologic deficit (IN) and one reop at day 5 for Gortex failure (OUT). At follow-up, all patients (n=130) were NYHA I and without mitral regurgitation. Median total payments for surgery and hospitalization were $50,927 IN vs $51,439 OUT ($p$ = ns), which included median added travel costs of $1,688 (mean distance 1,520 miles). Assuming a 99% MCoE degenerative MV repair rate vs 70% nationally (STS), the modeled net benefit (cost of redo bioprosthesis, anticoagulation, etc) of distant referral to a destination MCoE increases life expectancy (8 years) and generates substantial economic benefit with positive net present value to patients ($22,816) and payers ($6,590) alike.

Conclusions: Distant referral and travel to a destination MCoE is a cost-effective way to improve both repair rates and quality of life. In an era of evolving payment models, focusing on higher quality at lower cost is an appealing opportunity and may have policy implications for degenerative mitral patients.

Continued on next page

Abstract continued from previous page

Table 1			
Variable	**In-state (n=104)**	**Out-of-state (n=26)**	***P* value**
Preoperative Data			
Age	57.3 ± 13.3	58.9 ± 14.2	.588
Female gender	33.7 (35)	57.7 (15)	.041
Ejection fraction (%)	60 (60-65)	60 (60-65)	.267
Operative Data			
Total OR time (min)	271 (253-290)	265 (255-285)	.684
Received intraoperative blood products	8.7 (9)	3.8 (1)	.686
Mitral implant size	32 (30-34)	32 (28-34)	.575
Postoperative Outcomes			
Any complication	30.8 (32)	34.6 (9)	.814
Atrial fibrillation	25.0 (26)	15.4 (4)	.436
LOS (days)	4 (3-5)	4 (3-5)	.496
Mortality	0 (0)	0 (0)	1.000
Related readmission <30 days	1.9 (2)	0 (0)	1.000
Financial Data			
Total charges	$57,519 ($52,626 - $65,320)	$57,386 ($53,391 - $62,883)	.637
Total payments*	$50,927 ($42,988 - $66,791)	$51,439 ($44.676 - $55,592)	.723

Data presented as mean ± standard deviation, % (n), or median (interquartile range). MV: mitral valve repair; OR: operating room; LOS: length of stay. *Payments do not include professional fees but do include travel expenses for the out-of-state cohort.

P29

The Relationship Between Predicted Risk of Mortality and Transfusion in Isolated Primary Valve Surgery

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Purpose: Transfusion has been linked with increased postoperative morbidity and mortality following cardiac surgery. The purpose of this study was to describe the correlation between predicted risk of mortality (PROM) and transfusion in patients who underwent isolated primary valve surgery.

Methods: A retrospective review of the STS National Database of adults undergoing isolated primary valve surgery from 2003 to 2013 at a US academic center was performed (n=1,665). Patients were compared based on timing of transfusion: no transfusion (NONE, n=362 [21.7%]), intraoperative (INTRA, 268 [16.1%]), postoperative (POST, 314 [18.9%]), and both intra- and postoperative transfusion (BOTH, 721 [43.3%]), as well as incrementally by PROM. Adjusted outcomes were calculated after matching PROM, procedure, preoperative hemoglobin, and cardiopulmonary bypass times.

Results: There were no 30-day mortalities in the NONE group and lower rates of stroke, renal failure, and mediastinitis. The adjusted effect of timing of transfusion for combined outcomes (death, stroke, myocardial infarction, deep sternal wound infection, or renal failure) was worst in the BOTH group (HR=4.38, $p < 0.001$), but also significant for INTRA (HR=2.89, $p = 0.023$) and POST (HR=3.95, $p = 0.002$) cohorts when compared to NONE. Composite event rates when stratified by PROM showed a nonlinear relationship (Table 1). For each percent increase in PROM, the odds of transfusion increased 52%. The mean PROM for patients in NONE group was 1.8%, and for all other groups was 4.1%. The correlation between PROM and any transfusion was r=0.244, and the correlation between PROM and total red blood cell units transfused was r=0.30.

Conclusions: Patients who were transfused after isolated valve surgery had higher calculated PROM. Incremental increases in PROM yielded higher risk of transfusion. This study suggests that the association between transfusion and clinical outcomes may be partly explained by the higher PROM among patients who ultimately received transfusions.

Table 1 – Composite Event* Rates By Transfusion Group and PROM Stratifications

PROM Range	NONE	INTRA	POST	BOTH	Overall
0% to 1%	2 (1.5)	2 (5.6)	4 (5.8)	5 (9.6)	13 (4.5)
1% to 2%	2 (1.9)	3 (5.2)	4 (4.1)	10 (7.6)	19 (4.9)
2% to 3%	0 (0.0)	3 (6.1)	4 (7.3)	9 (6.3)	16 (5.4)
3% to 4%	2 (10.5)	5 (12.8)	4 (18.2)	11 (12.0)	22 (12.8)
4% to 5%	1 (9.1)	0 (0.0)	5 (25.0)	7 (12.1)	13 (12.6)
5% to 7%	0 (0.0)	2 (9.1)	1 (6.3)	12 (13.6)	15 (11.2)
8% or More	0 (0.0)	3 (11.1)	4 (18.2)	26 (19.4)	33 (17.5)
Overall	9 (2.5)	18 (6.7)	27 (8.6)	86 (11.9)	8.4%

*Death, Stroke, MI, DSWI, or Renal Failure

P30

Coronary Artery Bypass After Prior Percutaneous Intervention Confers Higher Risk When Compared to Primary Surgery: A Meta-Analysis

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Purpose: Use of multivessel percutaneous interventions (PCI) is increasing. Data comparing the outcomes of primary coronary artery bypass grafting (CABG) vs CABG in patients with prior PCI are limited. Thus, we compared early clinical events between primary CABG (pCABG) and CABG in patients with prior PCI (PCI/CABG).

Methods: A systematic review of published English literature (January 2000–March 2014) was performed to obtain original studies comparing clinical events between the pCABG and PCI/CABG cohorts. Primary endpoint studied was early mortality; other relevant clinical events were also compared. Adjusted or propensity-matched data were abstracted when available. A random-effect Mantel Haenzel analysis was performed. Results are presented as risk ratios (RR) (95% confidence interval) with pCABG as the control cohort; $p < 0.05$ is considered statistically significant.

Results: From 14 studies (84,983 pCABG and 14,775 PCI/CABG patients), we found that PCI/CABG had a higher early mortality (RR 1.54 [1.1-2]; $p < 0.01$). This was confirmed by the adjusted analysis. PCI/CABG patients had a 46% higher chance of postoperative myocardial infarction ($p = 0.06$). PCI/CABG patients also suffered from more renal failure (RR=1.46 [1.0-2.0]; $p = 0.06$). Intra-aortic balloon pump insertion was less in the primary CABG cohort (RR 1.86 [1.0-3.4]; $p = 0.04$). Renal failure was favorable in the primary CABG cohort (RR 1.25 [1.0-1.5]; $p < 0.01$). Postoperative stroke rates were comparable.

Conclusions: Coronary bypass after percutaneous intervention may increase patient risk. This fact needs to be understood while selecting treatment options for patients with multivessel disease.

P31

Evaluation of Graft Patency in Off-Pump vs On-Pump CABG: The PATENCY-CORONARY Trial

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COMMERCIAL RELATIONSHIPS T. M. Kieser: Consultant/Advisory Board, Medistim USA, Ethicon, Inc; C. Chartrand-Lefebvre: Research Grant, Fonds de recherche Santé Québec (FRQS), Quebec Bio-Imaging Network (QBIN), Canadian Institutes of Health Research (CIHR), Bracco Diagnostic Inc; Other Research Support, Philips Healthcare; Other, TeraRecon, Inc, Research collaboration

Purpose: The CORONARY trial demonstrated similar results between off-pump coronary artery bypass grafting (OPCABG) compared with on-pump CABG (ONCABG) at 1 year. We sought to determine whether OPCABG compared to ONCABG is associated with lower CABG patency, and if there is an association between graft failure and clinical outcomes.

Methods: PATENCY-CORONARY (NCT01414049) is a Canadian, multicenter, prospective trial of the CORONARY international trial (n=4,752 patients, NCT00463294). Patients reaching their 1-year follow-up underwent graft patency assessment using an electrocardiogram-gated computed tomography angiography (CTA). Among the 570 patients from three high-volume OPCABG Canadian centers who were eligible for PATENCY-CORONARY (no kidney failure, no atrial fibrillation, and NYHA <4), 141 were included. We assessed the association between graft failure and the occurrence of CORONARY primary outcomes, a composite of death, angina, myocardial infarct, stroke, renal failure, and new coronary revascularization (CABG or percutaneous coronary intervention).

Results: Mean age was 69 years ± 6 years, 84% were men, and 63 patients (45%) were operated on-pump. A total of 455 distal anastomoses were evaluable: 146 left internal mammary artery, 10 right internal mammary artery, eight radial artery, and 295 saphenous veins (including sequential grafts). Patency rate (% of non-occluded grafts) was 88.8% (213/240) and 94.9% (204/215) in OPCABG and ONCABG, respectively ($p = 0.02$). These 38 occlusions occurred in 26 patients. After taking into account the correlation in repeated occlusions in the same patients with random effects models, the difference was no longer significant ($p = 0.11$). Graft failure (occlusion or stenosis >50%) was 14.6% (35/240) vs 11.2% (24/215) in OPCABG and ONCABG, respectively ($p = 0.28$). Patency for left anterior descending was 90% (124/138), diagonals 88% (73/83), circumflex lateral 93% (124/133), and right coronary 95% (95/101). For patients presenting at least one occluded graft, functional classes and clinical outcomes were not different. Patients with graft occlusions had a greater number of grafts performed than initially planned and significantly longer cardiopulmonary bypass or cross-clamp times.

Conclusions: CTA can reliably evaluate graft patency post-CABG and may represent a valuable alternative to conventional invasive coronary angiography. In this cohort, graft patency was not different for the OPCABG or ONCABG patients, and graft occlusion did not affect clinical outcomes.

P32

Is There Any Benefit to Using the Radial Artery as an Additional Arterial Conduit During Bilateral In Situ Internal Thoracic Artery Grafting? A Propensity Score-Matched Study

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Purpose: A strategy of bilateral internal thoracic artery (BITA) grafting has been associated with improved outcomes following coronary artery bypass grafting (CABG) surgery. We sought to evaluate the early outcomes and long-term survival among patients with multiple vessel disease that underwent in situ BITA grafting with the radial artery as an additional arterial conduit compared to those who underwent in situ BITA grafting with additional saphenous vein grafts.

Methods: Between 1991 and 2013, 1,750 consecutive patients with triple-vessel disease or left main plus right coronary system disease underwent primary isolated in situ BITA grafting plus radial artery (n=255) or saphenous vein graft (n=1,495) with at least one ITA to the left anterior descending artery. All clinical data were collected prospectively. Propensity score matching was used to create two comparable cohorts: BITA-radial patients (n=243) matched to BITA-saphenous vein patients (n=1,298). Among matched patients, the radial artery was used to revascularize the right coronary system in 51 patients, the circumflex system in 175 patients, and the diagonal artery in 17 patients. The date of death was obtained from provincial vital statistics.

Results: Matched groups had similar preoperative and operative characteristics. There was no difference in operative mortality between matched BITA-radial and BITA-saphenous vein groups (n=2 [0.8%] vs n=6 [0.5%], respectively, $p = 1.0$). The median follow-up was 7.6 years (interquartile range, 6.5-9.9) and 8.2 years (interquartile range, 3.6-13.5) for BITA-radial and BITA-saphenous vein matched groups, respectively. Five, 10, and 15-year survival rates were 98.3%, 91.8%, and 91.8%, among the matched BITA-radial patients vs 97.0%, 91.2%, and 82.3% in the matched BITA-saphenous vein group ($p = 0.6$). When we included only patients who had the radial artery grafted to a coronary artery with a high degree of stenosis (>90%), five, 10, and 15-year survival rates were also similar among the matched BITA-radial vs BITA-saphenous vein groups ($p = 0.5$).

Conclusions: The use of the radial artery as an additional arterial graft in patients with triple-vessel disease undergoing in situ bilateral thoracic artery CABG does not prolong late survival when compared to BITA patients who received additional saphenous venous grafts.

P33

Maximizing the Efficacy of Mitral Valve Repair Surgery in a Completely Video-Guided, Minimally Invasive Fashion: Rings and Neochordae in the "Respect Rather Than Resect" Era

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Purpose: Mitral valve repair (MVR) widely represents the treatment of choice for degenerative mitral valve disease. A minimally invasive, completely video-guided approach has recently become the standard of care at our institution. The aim of the study was to demonstrate that two pairs of expanded polytetrafluoroethylene (ePTFE) neochordae and ring implantation can fix almost the entire volume of degenerative mitral valve (MV) insufficiency.

Methods: Since January 2010, a port access, minimally invasive, video-guided approach through a 4-5 cm anterior minithoracotomy has been the standard of care for all patients (without preoperative selection) undergoing mitral and tricuspid surgery at our institution. From January 2010 to March 2014, 649 patients underwent cardiac surgery through this approach. Among them, 579 (83.7%) received an MVR. A degenerative pathology underlying severe MV regurgitation was the indication for surgery in 534 patients (362 male, mean age 61.3 years ± 13.4 years). The technique of choice to repair the MV was the ePTFE neochordae implantation associated with a posterior flexible ring implantation.

Results: ePTFE neochordae were implanted on the posterior, anterior, or both leaflets in 500 (93.6%), five (0.9%), and 29 patients (5.4%), respectively. Mean pairs of neochordae for posterior leaflet were 1.77 ± 0.7. The annuloplasty was performed in all patients using a flexible band, pericardium, or a closed ring in 523 (97.9%), seven (1.3%), and four (0.9%) patients, respectively. Associated procedures were tricuspid valve surgery in 55 patients, patent foramen ovalis closure in 112 patients, and atrial fibrillation treatment in 54 cases. Observed mortality was 2.4% overall and 1.4% in patients with a <6% EuroSCORE log. No aortic dissection or conversion to standard sternotomy were observed. At discharge, no more than trivial or at least mild residual MV regurgitation was observed. Ten patients (1.8%) received an edge-to-edge stitch and it was assumed as failure of repair.

Conclusions: Our results showed that fixing the posterior prolapsing segments with an average of two pairs of neochordae, in addition to an annular stabilization, allows us to achieve an effective MVR in more than 90% of cases. Avoiding resections and sliding maneuvers is particularly suitable for a minimally invasive technique.

P34

Should Bicuspid Aortic Valve Resuspension Be Prohibited in Acute Type A Aortic Dissection Patients?

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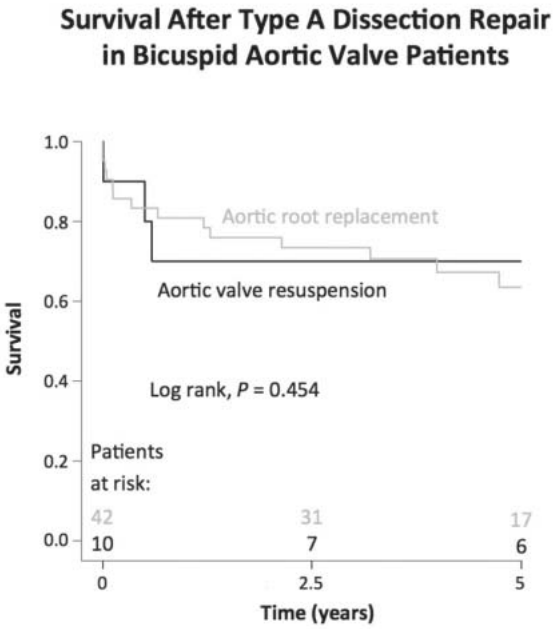
COMMERCIAL RELATIONSHIPS N. Desai: Consultant/Advisory Board, St Jude Medical, Inc; Speakers Bureau/Honoraria, Medtronic, Inc, W. L. Gore & Associates, Inc; W. Y. Szeto: Research Grant, Edwards Lifesciences Corporation, Medtronic, Inc, SORIN GROUP; Consultant/Advisory Board, Micro Interventional Devices, Inc; J. E. Bavaria: Research Grant, W. L. Gore & Associates, Inc

Purpose: There are no data on fate of the preserved bicuspid aortic valve (BAV) in patients with acute type A aortic dissection. We investigated the primary surgery and mid-term results in BAV patients who underwent aortic valve resuspension vs composite aortic root replacement (CVG) for acute aortic dissection type A.

Methods: Among 826 consecutive patients operated on for acute type A aortic dissection between 1993 and 2013 at two tertiary centers in the United States and Europe, 52 had BAV (67% males, median age 55 years ± 14 years). Ten patients who underwent aortic valve resuspension were compared with 42 CVG patients. Median follow-up was 4.3 ± 4.1 years.

Results: Both groups were at similar age (resuspension 61 years ± 13 years vs CVG 55 years ± 15 years, $p = 0.242$) and had similar risk factors profile. Moderate to severe aortic valve regurgitation was observed in 20% of resuspension and 45% of CVG patients ($p = 0.174$). Resuspension patients required shorter cardiopulmonary bypass and cross-clamp times (187 min ± 52 min vs 237 min ± 74 min, $p = 0.018$; 115 min ± 38 min vs 204 min ± 57 min, $p = 0.001$, respectively). In-hospital mortality was observed in 10% of resuspension and 14% of CVG patients ($p = 0.976$). Proximal reoperation occurred in one CVG patient for a coronary button aneurysm 1 year after initial surgery. Four patients developed moderate aortic valve regurgitation at 2, 3, 8, and 11 years after aortic valve resuspension. There was no severe aortic regurgitation and no need for proximal reintervention in the resuspension group. Overall survival was 70% ± 15% vs 64% ± 8% at 5 years in resuspension and CVG group (log rank $p = 0.454$, Figure 1).

Conclusions: BAV resuspension in type A dissection patients showed good short- and mid-term results. Resuspension of a functionally normal BAV can be performed with acceptable results and full root replacement is not always necessary.


Survival After Type A Dissection Repair in Bicuspid Aortic Valve Patients
Survival
1.0
0.8
0.6
0.4
0.2
0.0
Aortic root replacement
Aortic valve resuspension
Log rank, P = 0.454
Patients at risk:
42
10
31
7
17
6
0
2.5
5
Time (years)

P35

Outcomes of Reoperative Aortic Arch Repair in Patients With Chronic DeBakey Type I Dissection

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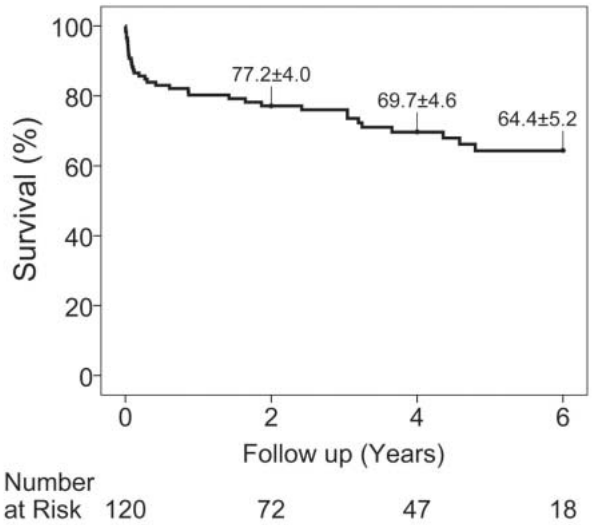
COMMERCIAL RELATIONSHIPS J. S. Coselli: Consultant/Advisory Board, Medtronic, Inc, Vascutek Ltd. a Terumo Company; Research Grant, Edwards Lifesciences Corporation, GlaxoSmithKline, Medtronic, Inc, W. L. Gore & Associates, Inc; S. A. LeMaire: Consultant/Advisory Board, Baxter, Medtronic, Inc; O. A. Preventza: Consultant/Advisory Board, Medtronic, Inc

Purpose: In patients who have undergone proximal aortic repair for acute DeBakey type I aortic dissection, subsequent aortic surgical intervention traditionally carries significant morbidity and mortality risks. To better define these risks, we examined our contemporary experience with aortic arch replacement in patients with chronic type I aortic dissection.

Methods: Data were prospectively collected from 2005 through 2013 regarding 120 consecutive repairs of the transverse aortic arch in patients with chronic DeBakey type I dissection (92 male [77%]; median age 58 years [range 15-83 years]). The median interval between initial proximal aortic repair and subsequent aortic arch repair was 8 years (range 61 days-32 years). Thirty-seven patients (31%) had Marfan syndrome or another connective tissue disorder. A composite endpoint, adverse outcome, was defined as early death or permanent stroke, renal failure, paraplegia, or paraparesis. We used univariate and bivariate analyses to examine associations between potential risk factors and early death.

Results: Twenty-six repairs (22%) were either emergent or urgent, and 29 (24%) involved failure of the index repair. Total arch replacement was performed in 88 patients (73%), hemiarch in 32 (27%), and elephant trunk in 64 (53%). Thirty-two patients (27%) had concomitant aortic root procedures. Unilateral antegrade cerebral perfusion (ACP) was used in 42 patients (35%), bilateral ACP in 75 (63%), and no ACP in three (3%). There were 17 early deaths (14%) and adverse outcome occurred in 23 (19%): six patients (5%) had permanent stroke, nine (8%) had permanent renal failure, and two (2%) developed permanent paraplegia/paraparesis. Of the potential risk factors examined—including age, previous stroke, full arch repair, urgent/emergent status, and concomitant aortic root replacement—none were associated with early mortality; however, a trend was noted between preoperative left ventricular hypertrophy and early death ($p = 0.085$). There were 18 late deaths, yielding an actuarial 6-year survival of 64.4% ± 5.2%.

Conclusions: In survivors of DeBakey type I aortic dissection, secondary surgical intervention for aortic arch pathology can result in acceptable survival and morbidity rates. Early survival does not appear to be influenced by age, history of stroke, or complexity of repair; however, preoperative cardiac status may influence mortality.


100
80
60
40
20
0
Survival (%)
77.2±4.0
69.7±4.6
64.4±5.2
0
2
4
6
Follow up (Years)
Number at Risk
120
72
47
18

P36

Development of a Risk Prediction Model for Aortic Surgery Using the National Institute for Cardiovascular Outcomes Research (NICOR) Database

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COMMERCIAL RELATIONSHIPS A. Oo: Speakers Bureau/Honoraria, Vascutek Ltd. a Terumo Company

Purpose: Reliable predictive tools in aortic surgery that allow identification of patients at increased risk of mortality and the ability to risk-adjust their published outcomes are necessary. Our objective was to develop a UK aortic surgery risk model from centrally submitted NICOR Society for Cardiothoracic Surgery (SCTS) data.

Methods: Between April 2007 and March 2012, 8,071 records from the SCTS database were analyzed. Multivariable logistic regression using the forward stepwise technique was used to identify independent predictors of in-hospital mortality from a development cohort operated on from April 2007 to March 2010. The model was validated using data from April 2010 to March 2012.

Results: In the development cohort, in-hospital deaths were 450/4,558 (9.9%). Variables associated with in-hospital mortality included: severity of disease, concomitant cardiac disease, non-elective surgery, aortic pathology, surgery on the arch, descending or abdominal aorta, and other preoperative comorbid characteristics. The area under the receiver operating curve was 0.81 and the Hosmer-Lemeshow goodness-of-fit chi-squared test was $p = 0.54$. In the validation cohort, in-hospital deaths were 341/3,513 (9.7%). Patients were stratified into low (<5%), medium (5%–11%), and high (≥12%) risk categories; expected risk was well calibrated across all the categories ($p = 0.97$, 0.89, and 0.54, respectively).

Conclusions: This model helps to predict in-hospital mortality, which can be used to provide patient-specific estimates of the risk of in-hospital mortality and for risk-adjustment when analyzing outcomes.

P37

Transaortic Approach: Impact on Clinical Outcomes for Patients Receiving Transcatheter Aortic Valve Replacement (TAVR)

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COMMERCIAL RELATIONSHIPS J. Leitner: Speakers Bureau/Honoraria, Edwards Lifesciences Corporation

Purpose: For transcatheter aortic valve replacement (TAVR) candidates with poor vascular access, the option is usually a transapical approach (TA). Given the results observed after the TA, the solution of the transaortic (TAo) route is appealing, based on the surgical familiarity with aortic cannulation and the proximity of the insertion site to the aortic valve.

Methods: We retrospectively reviewed our first 70 consecutive patients submitted to the STS/ ACC TVT Registry™ (47% female) who received a TAVR using the Edwards SAPIEN valve from February 7, 2012, to May 14, 2014. We focused on two main groups (transfemoral [TF], n=33 and TAo, n=29), removing eight patients with TA route from analysis. Table I summarizes patient demographics. STS risk score was 6.75 in TF vs 9.48 in TAo group (p = 0.01).

Results: Contrast volume, fluoroscopy time, and fluoroscopy dose—dose area product (FluoroDoseDAP) were significantly lower for TAo. Procedure time was 127 minutes for TAo and 160 minutes for TF (p = 0.08). More than one valve was required in six TF procedures and none in the TAo group. There was one aortic dissection (TF), but no other vascular complications. TVT device success was 79% for TF and 97% for TAo (p = 0.032). Length of stay was similar in both groups (6.4 days vs 6.6 days). Before discharge, there were three transient ischemic attacks, one in TF and two in TAo patients (3.03% and 6.90%, respectively), and three strokes, all in TF patients (9.09%). In-hospital deaths occurred in three TF patients (9%) and one TAo patient (3%). At 30-day follow-up, average aortic insufficiency severity was 1.33 for TF and 0.79 for TAo (p = 0.03). There were no neurological events, but one death in each group.

Conclusions: Procedural advantages (fewer pacing runs, no balloon valvuloplasty, and improved precision of valve deployment) afforded by the TAo approach have resulted in improved clinical outcomes in our highest risk profile TAVR patients. The TAo approach should be an integral part of every heart team's armamentarium in patients who require TAVR.

Variable	Mean ± SD, TF	Mean± SD, TAo	n, (%) TF	n, (%) TAo
Age	86.32 ± 5.35	85.90 ± 6.93		
LVEF	50.5 ± 9.5	49.2 ± 13.2		
Prior Pacemaker			**3, (9.09%)**	**9, (31.03%)**
Prior MI			7, (21.21%	5, (17.24%)
Prior stroke			5, (15.15%)	4, (13.79%)
Prior PAD			3, (9.09%)	7, (24.13%)
Prior CABG			5, (15.15%)	6, (20.7%)
Afib			14, (42.42%)	12, (41.38%)
STS risk score	**6.75 ± 2.36**	**9.48 ± 5.62**		

Afib: atrial fibrillation. PAD: Peripheral artery disease. **In Bold, p<0.05**

Table I. Pre-operative variables

P38
Off-Pump Bilateral Internal Thoracic Artery Grafting

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Purpose: The long-term benefit of bilateral internal thoracic grafts (BITA) is well established. Even then, there is reluctance among surgeons to adopt routine BITA grafting. We have used BITA grafting routinely in consecutive coronary artery bypass grafting (CABG) patients. The objective of this study is to analyze early results of our BITA grafting and establish safety of BITA use in all patients.

Methods: All cases of isolated, consecutive, unselected CABG performed by the first author were included in this retrospective study. Operation records of all the patients were analyzed. BITA were used in situ—one was used to graft the left anterior descending coronary artery (LAD) and the other was used as inflow for a composite graft with radial artery, which was used for bypassing all vessels other than LAD. If the clinical situation demanded, a vein graft was also used. Our technique of dual inflow of both in situ ITA allows easy bailout by using additional vein grafts at the surgeon's discretion.

Results: BITA was used in 574 patients out of 602 (95.35%). Incidence of early death was 1.33% (8/602), stroke 0.5% (3/602), and reoperation for bleeding 0.17% (1/602). Deep sternal wound infection was not seen in any patient, but nine patients (1.5%) had superficial wound infections, which healed with dressing. The low stroke rate justifies the aortic-no-touch technique. BITA grafting is often avoided in diabetic, female, obese, old age, and other high-risk patients. We have used BITA in 95% of our unselected CABG patients without any major deep sternal infection.

Conclusions: The low incidence of major infection may be attributed to the preserved immunity because of the absence of an inflammatory response and less use of blood and blood product by avoiding cardiopulmonary bypass. In addition, routine use of skeletonized BITA may have contributed. Our limited experience has proved BITA grafting during off-pump CABG can be safely adopted routinely with excellent early results.

P39

Late Outcomes of Long Left-Sided Coronary Artery Endarterectomy for Diffuse in Operable Coronary Artery Disease

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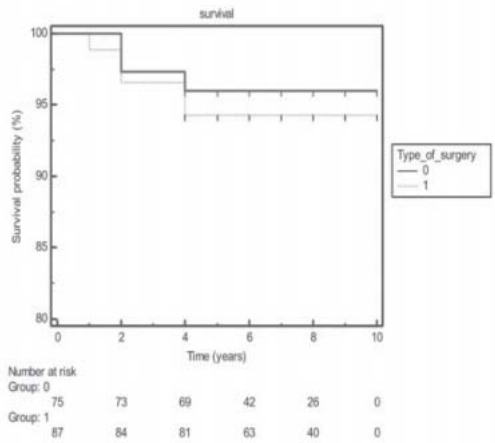
COMMERCIAL RELATIONSHIPS A. El-Gamel: Consultant/Advisory Board, Fisher & Paykel Healthcare Limited, Medtronic, Inc; Speakers Bureau/Honoraria, Edward Lifesciences Corporation

Purpose: Diffuse in operable atherosclerosis of the left coronary system may require unconventional surgical treatment. Long left coronary artery branches endarterectomy (LLCE) as an adjuvant to coronary artery bypass grafting (CABG) has been associated with increased morbidity and mortality with debated long-term results.

Methods: We aim to study the early and late outcomes after LLCE-CABG compared to CABG, in the era of dual antiplatelet therapy. We performed a retrospective analysis of data collected prospectively on 87 patients undergoing LLCE between February 1999 and September 2007 by a single surgeon, using a long open (2.5-4 cm) dissection and venous patch. We compared outcomes with 75 propensity-matched CABG patients by the same surgeon, using Cox's regression analysis.

Results: Sixty-six percent of the LLCE group (58/87) had diffuse atheroma in the left anterior descending artery (LAD), while 31% (27/87) involved both LAD and branches of the circumflex artery (Cx). Three percent (3/87) involved Cx. Cross-clamp time (43.29 min vs 59.04 min, $p = 0.019$) and bypass time (57.29 min vs 74.04 min, $p = 0.007$) were significantly higher in the LLCE group. There were no significant differences in early (1% vs 1.3%) and late mortality (4% vs 4.5% at 10 years). The hospital length of stay (5.58 days vs 6.67 days, $p = 0.03$) was higher in the LLCE group compared to the CABG group.

Conclusions: This significant long-term survival demonstrates that LLCE can be an attractive adjunct to CABG in otherwise inoperable diffuse coronary disease. The use of retrograde cardioplegia and antiplatelets may have contributed to this excellent outcome; further research is required to confirm these findings.



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Variable	CABG + CE (n=87)	CABG (n=75)	p value
Number of grafts			
One	4	4	
Two	9	16	1.00
Three	42	44	0.08
Four	16	20	0.20
Five	1	1	0.25
			1.00
Arterial grafts	1.32(0-4)	1.28(0-4)	0.72
Vein grafts	1.66(0-4)	1.72(0-3)	0.71
IMA used	89%	94%	0.31
Cross clamp time (minutes)	60.5	45.5	0.012
Bypass time (minutes)	77.2	62	0.018
Coronary Endarterectomy +			
vein patch	58	0	
LAD only	26	0	
LAD + Cx	3	0	
Cx only			

P40

Aortic Valve Replacement in the Moderately Elevated Risk Patient: A Population-Based Analysis of Outcomes

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COMMERCIAL RELATIONSHIPS D. S. Likosky: Research Grant, Agency for Healthcare Research and Quality (AHRQ); Speakers Bureau/Honoraria, SpecialtyCare; Consultant/Advisory Board, American Society of Extracorporeal Technology; H. J. Patel: Research Grant, Edwards Lifesciences Corporation, Medtronic, Inc, W. L. Gore & Associates, Inc

Purpose: As transcatheter aortic valve replacement (TAVR) therapy transitions from inoperable or high-risk patients to those considered moderate risk, a contemporary evaluation of surgical aortic valve replacement (SAVR) in this latter group is warranted.

Methods: Using a statewide cardiothoracic surgical quality collaborative database, we analyzed outcomes and identified predictors of a composite endpoint (30-day mortality, stroke, and dialysis) for 2,501 patients (2007-2014) undergoing AVR (1,009) or AVR/coronary artery bypass grafting (1,492) with a preoperative STS predicted risk of mortality (PROM) of 4%-8% (mean 5.5%, IQR 4.6%-6.3%). We further repeated this analysis among TAVR hospitals (14 TAVR hospitals, 19 non-TAVR hospitals).

Results: Thirty-day mortality was observed in 3.8%. Morbidity included stroke (2.2%) and renal failure (AKIN stage 1-3 43.7%), though 5.4% required dialysis. 21.1% required prolonged ventilator support. After a median length of stay of 8 days, 34.8% were discharged to extended care facilities. Independent predictors of the composite outcome included STS Predicted Risk of Mortality (PROM) score ($p$trend < 0.001) and moderate to severe pulmonary hypertension (OR 1.88, p < 0.001). Compared to those presenting with pure aortic stenosis (AS), mixed AS/aortic insufficiency (AI) was independently protective of the composite outcome (OR 0.50, p < 0.001), whereas pure AI was not (OR 0.83, p = 0.47). While findings were similar among TAVR hospitals, increasing PROM was not a significant predictor among non-TAVR hospitals (p > 0.59).

Conclusions: This population-based contemporary assessment suggests that moderate-risk patients undergoing SAVR experience favorable outcomes. While increasing PROM is important in preoperative evaluation of risk, other factors, such as preexisting pulmonary hypertension and indication for operation, should be considered as TAVR expands into this group of patients.

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Univariate Analysis of Patient Demographics and Selected Outcomes

Variable	Composite Endpoint (n=237)	No Event (n=2264)	p Value
Age: years	76.1	75.9	0.74
Diabetes	49.0%	43.9%	0.15
Prior PCI*	29.5%	22.7%	0.01
Prior CABG	14.8%	15.5%	0.77
Hypertension	91.6%	89.4%	0.29
Atrial fibrillation	36.1%	30.1%	0.17
COPD	35.4%	36.0%	0.87
PAD	23.2%	22.4%	0.79
Cerebrovascular disease	24.5%	24.0%	0.87
Chronic kidney disease (GFR< 30mL/min)	8.0%	6.2%	0.27
NYHA class III or IV	38.0%	39.3%	0.70
BMI, median	29.3	28.3	0.05
Urgent operative status	35.0%	39.6%	0.17
Preoperative hematocrit (mg/dL)	35.9	36.4	0.2
Ejection Fraction: mean	53.1	53.3	0.78
Pulmonary Hypertension*	27.9%	18.5%	<0.001
Liver Disease	1.2%	3.5%	0.51
STS PROM*, mean and IQR	5.7% (4.7-6.5%)	5.5% (4.5-6.3%)	0.04
Outcomes			
AKIN renal failure stage 2 or 3	45.2%	2.7%	<0.001
Deep sternal wound infection	2.1%	0.4%	<0.001
Prolonged ventilator dependence	56.5%	17.4%	<0.001
Need for intra-aortic balloon pump	12.7%	1.7%	<0.001
Duration of hospitalization, median days	15.0	8.0	<0.001
Discharge to home	33.8%	62.2%	<0.001

P41

Early and Long-Term Results of Mitral Valve Surgery Are Not Altered by Concomitant Tricuspid Ring Valvuloplasty

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Purpose: Despite recent publications recommending systematic surgical correction of tricuspid regurgitation at the time of mitral valve replacement (MVR) surgery, there are little long-term data to substantiate this approach. We reviewed our long-term outcomes of patients undergoing tricuspid ring annuloplasty (TRA) at the time of MVR.

Methods: From 2008 to 2014, we performed a series of 618 consecutive MVR: 436 (Group I) as an isolated procedure and 182 (Group II) with a concomitant TRA in patients with mitral insufficiency and various degrees of tricuspid regurgitation based on clinical, echo, and hemodynamic assessment. An additional concomitant coronary artery bypass grafting (CABG) surgery was performed in 267 cases (43.2%). Data have been reviewed retrospectively from our STS National Database and hemodynamic files. Main baseline variables are depicted in Table I.

Results: Early morbidity was not statistically different between Groups I and II except for heart block, which was more common in Group II (8.25%, $p = 0.005$), and new onset atrial fibrillation, which was more common in Group I (23.6%, $p < 0.001$). Early observed mortality was 1.83% in Group I and 3.30% in Group II ($p = 0.26$). We used multivariate logistic regression analysis to adjust for 38 perioperative variables. After adjustment, early mortality was 1.79% vs 1.96% ($p = 0.85$). Cardiac index, age, presence of left main disease, CABG, and systolic pulmonary artery (PA) pressure were determined to be independent predictors of early mortality, and age, systolic PA pressure, and presence of peripheral vascular disease were predictors of late mortality. Kaplan-Meier cumulative probability of survival at 5 years (Figure 1) was similar in both Groups (81.35% and 77.52% in Group I and II, respectively): Log-Rank test $p = 0.24$ after adjusting for baseline differences.

Conclusions: TRA concomitant to MVR does increase bypass and cardiac exclusion times. Despite those constraints, early major morbidity, mortality, and length of stay were not adversely affected by the addition of TRA. Moreover, late survival in patients requiring TRA with MVR appears to be the same as MVR alone, suggesting the transformation of double valve to single valve disease.

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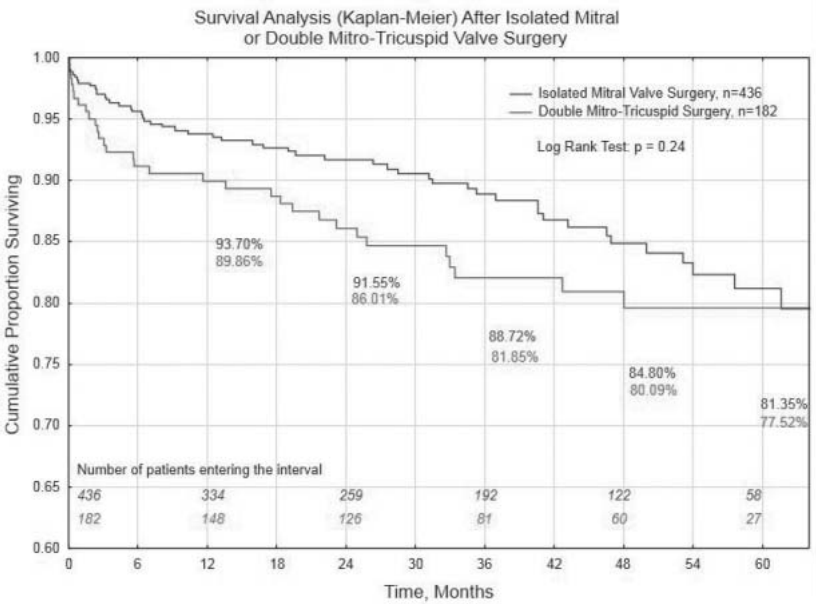

Baseline Variables for Group I (MVR alone) and Group II (MVR+TRA)

Variable	Mean ± SD Group I, n=436	Mean ± SD Group II, n=182	p value
Age, years	65.66 ± 11.70	69.82 ± 10.29	<0.01
BMI	27.14 ± 5.01	26.06 ± 5.93	0.02
LOS, days	10.84 ± 9.01	12.28 ± 10.43	0.08
NYHA Class	2.98 ± 0.54	2.97 ± 0.60	0.95
EF, %	47.21 ± 13.59	48.34 ± 11.92	0.33
PAP, Systolic	44.40 ± 16.13	49.11 ± 18.76	0.002
PAP, Diastolic	20.10 ± 5.98	21.7 ± 8.82	0.045
PAP, Mean	30.30 ± 11.43	33.06 ± 12.19	0.01
CI, L/mn/m2	2.51 ± 0.77	2.44 ± 0.84	0.39
Perfusion time, min	137.65 ± 56.20	147.75 ± 50.98	0.03
Clamping time, min	101.59 ± 43.47	109.46 ± 41.64	0.03

CI: Cardiac Index. PA: Pulmonary artery
LOS: Length of stay. EF: Ejection fraction

Basic Science

P42

Constructive Myocardial Remodeling of a Tissue-Engineered Extracellular Matrix Cardiac Patch Confirmed by Cardiac Magnetic Resonance Imaging

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COMMERCIAL RELATIONSHIPS A. Patel: Other Research Support, Philips Healthcare

Purpose: The functional remodeling of extracellular matrix (ECM) scaffolds, applied to repair myocardial tissues, has not been fully investigated. In particular, the assessment of regional functions, such as contractility and perfusion, remains unestablished. In this study, we evaluated the remodeled scaffolds using cardiac magnetic resonance (CMR) imaging as an adjunct to histology.

Methods: The tissue-engineered cardiac patch, derived from porcine small intestinal submucosa ECM, was implanted into the porcine right ventricle to repair a surgically created, full-thickness defect (n=4). At 60 days post-implant, histology and CMR with strain-encoding (SENC), rest perfusion, and T1 Mapping by modified Look-Locker inversion recovery for extracellular volume (ECV) fraction calculation were performed.

Results: Histology: Remodeled ECM consisted of well-organized repopulated host cells, including a monolayer of endocardial endothelial cells, as well as scattered isolated islands of cardiomyocytes. Enhanced angiogenesis was confirmed by the capillary density analysis (27.9 mm^2 ± 10.1 mm^2 vs Dacron control: 18.5 mm^2 ± 5.2 mm^2). CMR: SENC showed contractility in the ECM patch area (peak longitudinal strain: -13.6% ± 1.7% vs self-controlled normal right ventricle: -17.9% ± 1.6%). Perfusion revealed reasonably restored blood perfusion in the ECM (relative maximum upslope: 11.5 ± 1.1 vs self-controlled normal right ventricle: 16.0 ± 2.2 and self-controlled normal left ventricle: 17.2 ± 4.2). ECV of the patch region was visualized and calculated, yielding 78% ± 14% in the patch, whereas self-controlled ECV values were 23% ± 4% in normal left ventricle and 27% ± 3% in normal right ventricle.

Conclusions: The ECM patch demonstrated constructive myocardial remodeling with positive contractility and blood perfusion in a porcine preparation. CMR was an excellent modality to assess the regional and biological myocardial function of implanted ECM patches.

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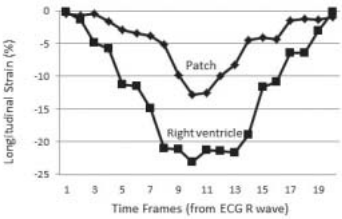
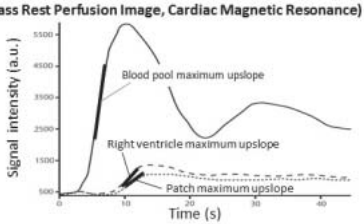
Longitudinal Myocardial Strain
(Strain-Encoding Cardiac Magnetic Resonance)



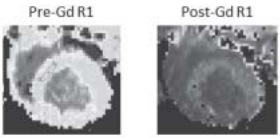
The more negative the strain, the more the contractility

Relative Maximum Upslope
(First Pass Rest Perfusion Image, Cardiac Magnetic Resonance)



Relative maximum upslope:
The ratio of maximum upslope in the signal intensity curve of myocardium to blood pool.

Extracellular Volume (ECV) Fraction
(T1 mapping Cardiac Magnetic Resonance)



T1 maps generated from Modified Look-Locker Inversion-recovery images acquired after (Post-Gd) and before (Pre-Gd) administration of a gadolinium (Gd) contrast agent and the reciprocal of each pixel value is taken to generate R1 maps.

Region of interest (ROI) were obtained from separate regions.

$$ECV = \frac{(1\text{-hematocrit}) \times \Delta R1_{myocardium}}{\Delta R1_{blood}}$$

$$\Delta R1 = (\text{pre-Gd R1 ROI}) - (\text{post-Gd R1 ROI})$$

P43

An Innovative Needleless Liquid Jet Injection Delivery Method Featuring S100A1 Gene Therapy Demonstrates Cardiac-Specific Expression and Preserves Left Ventricular Function in Ischemic Cardiomyopathy

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Purpose: S100A1 is a validated heart failure transgene based on preclinical data. A key rate-limiting problem with viral mediated therapy is delivery, whereby achieving this with percutaneous intracoronary infusion (PCI) is problematic. PCI's major disadvantage is inefficient transfer across the endothelial barrier between the capillary and the myocyte interstitial environment. Here, we evaluate a needleless liquid jet device as an alternative direct cardiac-specific method.

Methods: A liquid jet device (Figure 1A) was optimized for surgical application. Then, 24 rats received a baseline echo and infarct creation via left anterior descending coronary artery (LAD) ligation and were divided into three separate groups (n=8 each): a Liquid Jet Injection (LJ) with saline control group and two experimental groups consisting of a single dose 1.2 x1011 vg of two different vectors—Group 2 ssAAV9.S100A1 (SS) and Group 3 scAAV9.S100A1 (SC). For each rat, the LJ device fired three separate 100 uL injections projected at the exposed left ventricle from 25 cm above the thoracotomy. After 10 weeks, all rats were evaluated with echo, QPCR for ssAAV9.S100A1 genome copies (GC), and S100A1 IHC fluorescence quantification normalized to control.

Results: The jet kinetics featured a 110 m/s firing velocity with dispersion factor optimal delivery (Figure 1B). All animals survived the procedures and there was no difference in baseline function between the groups. At 10 weeks, however, all groups demonstrated decline from baseline, but the LJ S100A1 therapy groups significantly preserved left ventricle function with significantly higher ejection fraction; SS group (60% ± 3%) and SC group (57% ± 4%) vs saline (44% ± 3%), $p < 0.05$ (Figure 1C). Heart QPCR testing showed robust therapeutic S100A1 in the SS (10,147 ± 3,993 copies per 100 ng DNA) and SC (35,155 ± 5,808 copies per 100 ng DNA) groups, while liver detection was lower in both (40 ± 40 and 28,707 ± 2,844, respectively). S100A1 protein expression was (4.3 ± 0.2) and (6.1 ± 0.3) fold higher than controls in the SS and SC groups respectively, $p < 0.05$.

Conclusions: The LJ method offers a promising cardiac-specific delivery profile and could become an alternative direct cardiac delivery method. With more evaluation, this could add significant value for clinical trials, especially for patients who are excluded from PCI due to preexisting adeno-associated virus immunity.

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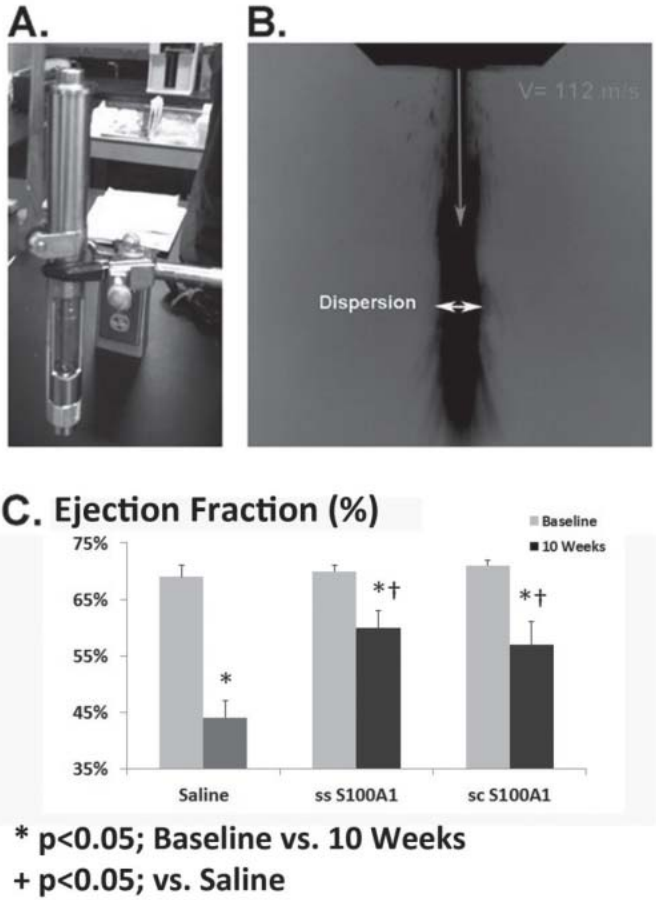
Figure 1



*** p<0.05; Baseline vs. 10 Weeks**

+ p<0.05; vs. Saline

P44

Evaluation of Spinal Cord Protective Threshold of Serum Memantine, an NMDA Receptor Antagonist, in a Rabbit Model of Paraplegia

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COMMERCIAL RELATIONSHIPS T. Yamamoto: Speakers Bureau/Honoraria, Astellas Pharma Inc, Novartis Pharma KK; H. Suzuki: Research, Daiichi Sankyo Company Ltd

Purpose: Previously, we have shown that oral memantine pretreatment is effective against spinal cord ischemia (SCI) after aortic clamping in a rabbit model. In this study, we evaluated the threshold of serum memantine for prevention of SCI following infrarenal aortic clamping in a rabbit model.

Methods: Forty-two New Zealand White rabbits were divided into seven groups. Preoperatively, oral memantine was given starting from 60 mg once daily (OD) for 7 days in the initial group, then reducing the dose and/or duration to 60 mg OD for 5 days, 30 mg OD for 5 days, 30 mg OD for 3 days, 15 mg OD for 3 days, 30 mg single dose, and 60 mg single dose in the subsequent six groups. Paraplegic model was created by clamping both infrarenal aorta and inferior vena cava for 45 minutes. Vitals, motor evoked potentials (MEP), modified Tarlov score (0-5), serum memantine concentration, and histopathology of lumbar spinal cord were evaluated.

Results: Mean value of serum memantine for all rabbits was 4.3 ng/ml ± 3.6 ng/ml (range; 0.3-19.3 ng/ml). Fifty percent of all rabbits (21/42) showed spinal protection (modified Tarlov score of 4 or 5). ROC curve analysis showed serum level of 4.5 ng/ml as a cutoff value for spinal protection (sensitivity 86%, specificity 62%, AUC 0.785, $p = 0.002$). Sixteen rabbits had serum level ≥4.5 ng/ml (Group A) and the remaining 26 rabbits had serum level <4.5 ng/ml (Group B). Further comparison was done between groups A and B. Baseline and intraoperative vitals were similar in groups A and B. Mean modified Tarlov score at 6, 24, 48, and 72 hours was 4.5 ± 0.9 and 2.4 ± 1.6, in groups A and B, respectively ($p < 0.001$) (Figure 1A). Modified Tarlov score showed positive correlation with serum memantine level (Spearman's rho =0.618, $p = 0.01$) (Figure 1B). Results of MEP and histopathology were significantly better for group A compared to group B (Table 1).

Conclusions: By utilizing different oral treatment regimens (dose and duration) in seven different groups, we showed that memantine is protective against SCI at serum levels ≥4.5 ng/ml in a rabbit model. Thus, oral memantine treatment can be a potential adjunct for spinal protection during thoracic and thoracoabdominal aortic surgeries.

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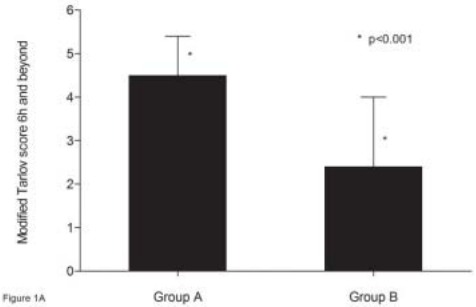

Figure 1A

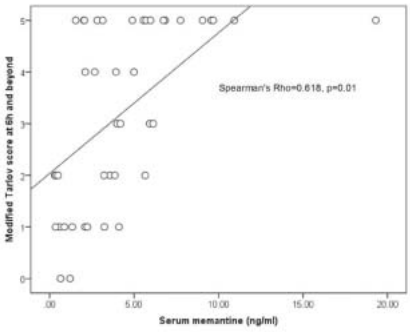

Figure 1B

Table 1			
Variables	**Group A (n=16)**	**Group B (n=26)**	**p value**
MEP parameters			
Baseline amplitude, mean ± SD (mV)	17.2 ± 5.5	15.3 ± 6.1	0.318
% amplitude loss from baseline value by the end of surgery, mean ± SD	10.1 ± 25.3	62.1 ± 43.8	<0.001
Time to flat after aortic clamp, mean ± SD (min)	14.2 ± 7.3	8.5 ± 6.8	0.016
Reappearance of MEP after aortic declamp, yes, % (n/n)	100 (16/16)	61.5 (16/26)	0.004
Time to reappearance after aortic declamp, mean ± SD (min)	6.4 ± 11.3	13.0 ± 19.5	0.254
Histopathology, % (n/n)			0.039
Normal cords	68.8 (11/16)	26.9 (7/26)	
Mild ischemia	6.2 (1/16)	3.8 (1/26)	
Moderate ischemia	18.8 (3/16)	34.6 (9/26)	
Severe ischemia	6.2 (1/16)	34.6 (9/26)	

P45

Adult Bone Marrow-Derived Stem Cell Therapy Preserves the Ischemic Cardiomyocytic Mitochondrial Membrane Potential During Reperfusion

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Purpose: Cardiomyocyte death during acute myocardial ischemia reperfusion injury (IRI) has been attributable to mitochondrial dysfunction. Adult bone marrow-derived stem cell (BMSC) therapy can, however, significantly attenuate IRI. Thus, we investigated whether BMSC therapy had a role in the modulation of cardiomyocytic mitochondrial inner membrane potential during IRI.

Methods: Anesthetized male Wistar rats were subjected to IRI by 25-minute reversible left anterior descending coronary artery (LAD) occlusion and 2 hours of reperfusion. BMSC therapy was by intravenous injection of 10 million adult bone marrow-derived stem cells (CD34+, CD45+, CD133+, c-Kit+) at the onset of reperfusion. Cardiomyocytes isolated from the myocardial IRI region were stained with JC-1 to detect mitochondrial inner membrane potential. JC-1 fluorescence was analyzed by flow cytometry to quantify cardiomyocytic mitochondrial membrane potential.

Results: When compared to controls, BMSC maintained a significantly higher mitochondrial inner membrane potential (control -34.5 mV ± 15 mV vs BMSC -145.3 mV ± 5 mV, $p < 0.0001$, n=5). When compared to sham and ischemia preconditioned hearts, BMSC-treated cardiomyocytes demonstrated a magnitude of the mitochondrial inner membrane potential that was comparable (sham -136.3 mV ± 15 mV vs ischemia preconditioning -142.4 mV ± 3 mV vs BMSC -145.3 mV ± 5 mV, $p > 0.05$, n=5).

Conclusions: Adult bone marrow-derived stem cell therapy prevented the collapse of the cardiomyocytic mitochondrial inner membrane potential during regional IRI. This effect was comparable to the preservation of mitochondrial function afforded by ischemia preconditioning.

P46

Miniplegia vs Blood Cardioplegia With Buckberg Solution in Elective Aortic Valve Replacement: A Prospective, Randomized, Non-Inferiority Controlled Trial

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Purpose: Antegrade intermittent blood cardioplegia with Buckberg solution is widely used in elective aortic valve replacement. Use of miniplegia could simplify myocardial protection in this setting. Our objective was to compare both strategies in terms of non-inferiority.

Methods: A prospective, randomized, controlled trial was performed. Primary endpoint was demonstrating non-inferiority of miniplegia vs intermittent blood cardioplegia in elective aortic valve replacement. For sample size calculation, a maximum increase +15% in mean peak postoperative troponin T of a previously studied cohort of patients receiving 4:1 blood cardioplegia was considered non-inferior (D=+474.24 ng/L). Study power was 90%, and $p < 0.05$ was considered statistically significant. Secondary endpoints were differences in troponin curve, reperfusion and postoperative rhythm, hematocrit, use of inotropic and vasopressor drug support, intensive care unit (ICU) length of stay, and postoperative mortality.

Results: Sixty-six patients were enrolled and randomized. There were no significant differences in baseline, preoperative, and intraoperative variables. Peak troponin T in the miniplegia group was non-inferior to 4:1 blood cardioplegia with Buckberg solution group ($p = 0.036$). Patients in the miniplegia group showed a higher incidence of spontaneous sinus rhythm after myocardial ischemia (18/33, 54.5% vs 8/33, 24.2%, $p = 0.005$) and fewer patients required defibrillation (9/33, 27.7% vs 21/33, 63.6%, $p = 0.03$) for ventricular reperfusion arrhythmias. Postoperatively, there were no differences in troponin T release, inotropic and vasopressor drug support, ICU stay, and postoperative mortality.

Conclusions: Miniplegia used as myocardial protection in elective aortic valve replacement is non-inferior to blood cardioplegia. Preferential return to sinus rhythm and lower incidence of reperfusion arrhythmias in the miniplegia group could reflect a better myocardial protection during cardioplegic arrest. Ease of administration and inexpensive use of miniplegia are additional benefits.

P47

Effect of Hydrogel in Cell-based Therapy in a Porcine Model of Chronic Myocardial Ischemia

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Purpose: Hyaluronic acid (HA)-based hydrogels have been reported to enhance stem cell survival following transplantation in rodent models. We investigated the effects of encapsulating mesenchymal stem cells (MSCs) in HA-serum hydrogels (synthesized by cross-linking HA by autologous serum) in a large animal model of chronic myocardial ischemia.

Methods: In a porcine model of chronic myocardial ischemia, MSCs were injected with and without hydrogel into chronically ischemic myocardium in order to compare cell survival at several time points following transplantation. Injections were made outside the ischemic zone as well to serve as an additional internal control. Animals were sacrificed at 2, 4, 6, and 12 weeks following cell transplantation.

Results: Transplantation of MSCs encapsulated in hydrogel boosted retention of transplanted cells in the injected area and stimulated angiogenesis compared to areas devoid of hydrogel injections in the short term. Of note, MSCs exited the hydrogel and migrated into the surrounding myocardium despite homogeneous dispersion of MSCs in the injected hydrogel. This suggests that once injected, MSCs have more affinity to host tissues. At all time points, intramyocardial injection of hydrogel was associated with fibrosis and inflammatory cell infiltration in the hydrogel-containing region.

Conclusions: Transplantation of MSCs encapsulated in HA-serum hydrogels enhanced myocardial cell retention and promoted angiogenesis. Evidence of fibrosis was seen in injected sites. Based on these results, future studies of encapsulated cell delivery in transmurally infarcted myocardium are warranted in order to optimize the beneficial usage of HA-serum hydrogels in cell-based therapy.

P48
Interleukin-6 Is Critical to Experimental Thoracic Aortic Aneurysm Formation

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COMMERCIAL RELATIONSHIPS G. Ailawadi: Consultant/Advisory Board, Abbott, Edwards Lifesciences Corporation, Mitralign Inc; Speakers Bureau/Honoraria, St Jude Medical, Inc

Purpose: Thoracic (TAA) and abdominal aortic aneurysms (AAA) represent related but distinct inflammatory processes. As interleukin-6 (IL-6) is thought to play an important role in vascular pathology and has been shown to correlate with TAA size, it is hypothesized that IL-6 is critical in aneurysmal disease.

Methods: Murine TAAs (n=7) or AAA (n=8) were created using a novel model in C57/B6 mice by treating the intact aorta with elastase adventitially. Cytokine profiles of developing aneurysms were analyzed with antibody arrays. Separately, to determine the role of IL-6, murine thoracic (n=7) or abdominal (n=7) aortas of WT and IL-6 knockout (KO) mice were treated with elastase. Finally, to determine if this pathway could be targeted pharmacologically, the thoracic animals treated with either IL-6 receptor antagonist (n=8, tocilizumab) or vehicle (n=5). To examine the translatability to human disease, human TAA and AAA specimens were analyzed with cytokine array.

Results: Elastase treatment of murine WT thoracic and abdominal aortas yielded dilation of 86.8% ± 9.6% and 85.6% ± 16.2%, respectively ($p < 0.05$). IL-6, CXCL13, and MMP-9 were elevated in murine TAA compared to AAA ($p = 0.004$, 0.028, and 0.001, respectively). Importantly, IL-6 KO mice demonstrated significantly smaller TAA relative to wild-type mice (WT: 100.13% vs IL-6 KO: 76.546%, $p = 0.04$), while IL-6 KO mice were not protected from AAA ($p = 0.732$). Pharmacologic IL-6 receptor inhibition resulted in significantly smaller TAA compared to control (tocilizumab: 71.5% ± 13.2% vs Vehicle: 103.6% ± 20.7%, $p = 0.005$, Figure 1). Human TAA had significantly greater levels of IL-6 ($p < 0.0001$) compared to AAA.

Conclusions: IL-6 expression is significantly greater in both murine and human TAA compared to AAA, suggesting fundamental differences in the two disease processes. IL-6 is critical in experimental TAA and may be a potential pharmacologic target for thoracic aneurysmal disease.

Cardiothoracic Surgical Education

P49

Declining Cardiothoracic Surgeon Involvement in the Management of Aortic Dissections: Impact of Endovascular Technologies and Implications for Training

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COMMERCIAL RELATIONSHIPS T. Guy: Consultant/Advisory Board, Edwards Lifesciences Corporation, Johnson & Johnson, Medtronic, Inc; G. H. Wheatley: Consultant/Advisory Board, Bolton Medical, Medtronic, Inc

Purpose: Cardiothoracic (CT) surgeons have been instrumental in managing aortic dissections (AD). Involvement of other qualified specialists with proficiency in AD therapies has created flux regarding the role of CT surgeons and challenged existing training paradigms. We studied how specialty involvement in treating AD has changed in the endovascular era.

Methods: We performed a PubMed review of literature published in 2003 and 2013 with "aortic dissection" in the title. Case studies and entries with incomplete author or identifying information were excluded. Author number and specialty affiliation, degree of multispecialty collaboration, country of origin, and treatment focus were recorded. Involvement of endovascular technologies was also noted relative to type of AD.

Results: We identified a total of 366 publications in 2013 and 147 in 2003. After eliminating case reports and incomplete entries, there were 198 publications in 2013 compared to 49 in 2003, which represented a 404% increase. CT surgeons represented 47.9% (581/1,212) of the authors in 2013 compared with 36.9% (96/260) in 2003, while vascular surgeons (VS) represented 11% (134/1,212) and 8.1% (21/260), respectively. The ratio of Type A:Type B AD publications was 2.18:1 in 2013 and 2.2:1 in 2003. 61.2% (30/49) of Type B AD publications had an endovascular focus in 2013 vs 70% (7/10) in 2003. CT surgeons comprised 20.4% (34/167) of authors in publications with an endovascular Type B focus in 2013 compared with 13% (9/69) in 2003, while VS comprised 55.1% (92/167) in 2013 and 21.7% (15/69) in 2003. (Figure 1)

Conclusions: VS have become the predominant specialty involved in Type B AD therapies, which has paralleled the rise in endovascular technologies. As endovascular therapies become available for Type A AD, it is imperative that CT surgeons are adequately trained in endovascular techniques in order to remain preeminent in managing AD.

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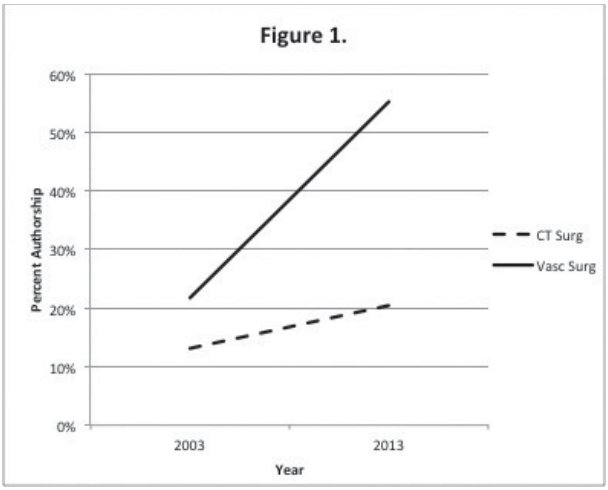

P50

Understanding Why Residents May Inaccurately Log Their Role in Operations: A Look at the 2013 In-Training Exam Survey

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Purpose: With increased time and quality pressures, it may be more difficult for residents to get independent operative experience. This may lead residents to bend the rules regarding operations they record as a "surgeon."

Methods: The 2013 In-Training Exam (ITE) surveyed 312 cardiothoracic surgery residents and was used to contrast residents in standard cardiothoracic surgery residencies (2-3 year CT residencies; Group S, n=216) with those in integrated 6-year or combined 3+4 year programs (Group I, n=96). Questions ask residents to self-report how often cases are recorded inaccurately as "surgeon" if the resident is clearly the first assistant on the case.

Results: Residents in Group S reported a higher percentage of cases that met the American Board of Thoracic Surgery (ABTS) criteria of "surgeon" than did Group I ($p = 0.053$), but were less likely to meet case requirements if all cases were logged according to ABTS guidelines ($p = 0.03$). Among residents who indicated a tendency to log cases incorrectly, they had lower self-reported 2012 ITE percentiles ($p = 0.0006$), were less likely to meet their case requirement if cases were logged properly ($p < 0.001$), and felt less prepared for ABTS board exams ($p < 0.001$). There were strong correlations among questions regarding the accuracy of the log and those regarding preparedness for complex surgery and career. Table 1 shows responses of residents who felt they were not likely to meet case requirements. Programs that are felt to deal poorly with the 80-hour week predicted being unprepared for ABTS exams ($p = 0.004$), feeling unprepared at completion of program ($p = 0.001$), and not having adequate technical experience ($p = 0.044$).

Conclusions: Increasing constraints may put pressure on trainees to inaccurately log cases in order to meet requirements.

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Table 1.

	"No" (n=34)	"Yes" (n=270)
My program does not offer residents sufficient opportunities to operate.	14 (41.18)*	20 (7.41)
Cases are not diverse and do not offer training in various surgical techniques and procedures.	9 (26.47)*	14 (5.19)
Cases are too complex for my level of training.	6 (17.65)	45 (16.67)
My program focuses too much on simulation training and not enough on real cases.	2 (5.88)	5 (1.85)
I miss out on surgical opportunities due to my program's adherence to the 80-hour work week requirement.	3 (8.82)	50 (18.52)
My program does not know how to work around the 80-hour work week requirement in order to maximize cases.	3 (8.82)	17 (6.30)
I am not familiar with my program's surgical decision-making process.	5 (14.71)	38 (14.07)
My training environment (i.e., personality dynamics) make it difficult to gain hands-on surgical experience.	18 (52.94)*	28 (10.37)

Responses to follow up questions among those who answered the following question "No" or "Yes": *If you correctly log your cases based on the requirements, will you meet your case requirements by the completion of your program? (Reminder: results will be kept anonymous.)* *p<.0001

Congenital

P51
The Mid-Term Outcomes of Bioprosthetic Pulmonary Valve Replacement in Children

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Purpose: The longevity of bioprosthetic valves in pulmonary position among children has not been well studied. The objective of this study was to assess the outcomes of bioprosthetic pulmonary valve replacement in children.

Methods: This is a retrospective review of all bioprosthetic pulmonary valve replacements in children between 1992 and 2013 at a single institution. Major outcomes studied included bioprosthetic valve survival and its function.

Results: One hundred thirty-six bioprosthetic pulmonary valve replacements were identified. The median age and body weight at operation were 13.2 years and 48.4 kg. There was one early death and three late deaths during the median follow-up of 5.9 years (0 to 19.6 years). The actuarial transplant-free survival was 97.5% at 10 years. There were 38 bioprosthesis reinterventions with 25 reoperations and 13 catheter-based reinterventions. The freedom from bioprosthesis reintervention was 89.6% and 56.4% at 5 and 10 years. Echocardiographic bioprosthesis dysfunction (more than 50 mm Hg peak gradient or more than moderate insufficiency) was found in 52 patients. Freedom from bioprosthesis dysfunction was 74.7% and 37.3% at 5 and 10 years. The results from the proportional hazard models showed that age and bioprosthesis size indexed to body surface area were significantly associated with freedom from bioprosthesis reintervention ($p < 0.001$ and $p = 0.039$, respectively), while age and the bioprosthesis type were significantly associated with freedom from bioprosthesis dysfunction ($p = 0.026$ and $p = 0.009$, respectively).

Conclusions: Bioprosthetic pulmonary valve replacement in children had excellent early outcomes and rapidly deteriorating mid-term outcomes. Careful and close follow-up will be necessary for children who have bioprosthesis in pulmonary position.

P52

Perioperative Blood Management Program in Infants Undergoing Open Heart Surgery

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Purpose: The limitation of alternative transfusion (Tx) practices in infants increases the benefits of blood conservation. The aim of this study was to determine general risk factors and explore the comparative clinical effectiveness of a cardiopulmonary bypass (CPB) related blood conservation program on perioperative outcome in a pediatric population undergoing cardiac surgery.

Methods: We retrospectively analyzed a collected database of 254 infants (8.3 months ± 3.5 months) who underwent biventricular repair utilizing CPB over a 36-month period. Patients were randomized into "blood conservation" (significantly less prime volume, condensed circuit, cerebral saturation-rSO2, retrograde priming, hemofiltration, pole mounted vents) (BC, n=135) and "conventional" (control, n=119) cohorts. There were no statistical differences in age, gender, weight, and preoperative-postoperative hemoglobin levels between groups. Blood samples were collected at baseline (T1), at the end of the CPB (T2), and 24 hours (T3) postoperatively. Cerebral oxygenation (rSO2) was measured by near-infrared spectroscopy and rSO2 desaturation risk score was calculated by multiplying rSO2 below 50% by time (sec).

Results: rSO2 desaturation risk >6,000 (%) was 11.9 ± 4 in BC group and 28.9 ± 8 in control ($p < 0.05$). The need for blood transfusion was significantly lower in BC group (22 vs 86 patients) ($p < 0.01$). Significant predictors of Tx are listed in Table 1.

Conclusions: Circuit size and hemodilution are important risk factors for Tx in pediatric population. It is feasible to perform congenital procedures safely without Tx by using combined blood management strategies.

Table 1: Significant Predictors of Allogeneic Transfusions

RISK FACTORS	Odds Ratio	Confidence Interval	MULTIVARIATE *p* value
Lower Body Surface Area	3.38	1.300-10.3	0.007
Lower Preoperative Hematocrit	3.9	1.300-9.500	0.0035
Lower Red Blood Cell Mass	1.7	0.950-0.970	0.05
Increased Total Crystalloid Volume	3.6	1.2-12.5	0.04
Conventional Circuit Size	6.2	1.190-20.540	0.03
Increased Postoperative bleeding at 24 hours	3.6	1.250-9.150	0.003

P53

Current Outcomes and Risk Factors for the Norwood Operation in Patients With Hypoplastic Left Heart Syndrome

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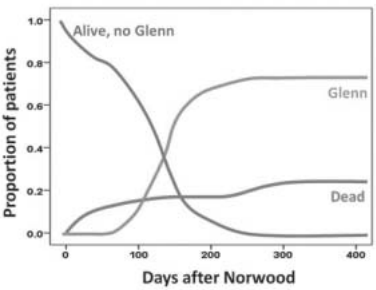
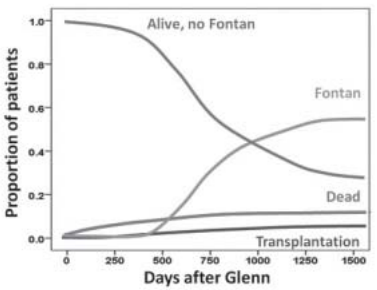
Purpose: We sought to review the current era experience with multistage palliation of neonates with hypoplastic left heart syndrome (HLHS) and examine patient, anatomic, surgical, and clinical risk factors influencing outcomes.

Methods: Retrospective review of HLHS patients who underwent Norwood 1st stage (N1S) palliation from 2002 to 2012 was performed (219/303 Norwood operations). Competing risks analyses modeled events after N1S (death, progression to Glenn or heart transplantation) and after subsequent Glenn (death, progression to Fontan or heart transplantation), and examined risk factors affecting those outcomes.

Results: Median age was 5 days (1-69 days), 27 (12%) were ≤ 2.5 kg, 26 (12%) were premature ≤36 weeks, and 17 (8%) had chromosomal/extracardiac anomalies. Source of pulmonary blood flow at N1S was modified Blalock-Taussig (n=47, 21%) or Sano shunt (n=172, 79%). Thirty-day mortality was 18 (8%). Prior to Glenn, 16 patients (7%) needed reoperations, mainly (n=12 patients) shunt related. Competing risks analysis showed that 1 year after N1S, 26% have died and 74% have undergone Glenn; 5 years after Glenn, 9% have died, 4% have undergone transplantation, 54% have undergone Fontan, and 33% were alive awaiting Fontan. Overall 8-year survival was 66%. On multivariable analysis, risk factors for mortality included chromosomal/extracardiac anomalies (HR: 8.1, $p = 0.004$), modified Blalock-Taussig shunt (HR: 10.7, $p = 0.001$), unplanned reoperation (HR: 8.3, $p = 0.004$), and postoperative extracorporeal membrane oxygenation requirement (HR: 15.9, $p < 0.001$). While there was a trend for worse survival with prematurity (HR: 3.2, $p = 0.08$) and low weight at N1S (HR: 1.8, $p = 0.09$), anatomic factors, such as HLHS subtype, ascending aorta diameter, and restrictive atrial septum, did not affect survival ($p > 0.1$, each).

Conclusions: This current single-institution experience demonstrates that patient factors (ie, prematurity, low weight, and extracardiac anomalies) continue to adversely affect survival. Conversely, surgical and perioperative management advances, along with Sano shunt utilization, might have neutralized the effect of anatomic factors on survival. Technical imperfections requiring reoperations are associated with failure to progress through palliation stages and diminished survival.





P54

Impacts of Aortic Valve Morphology and Annular Size of Aortic Valve on Left Ventricular Outflow Tract Obstruction After Primary Repair of Coarctation of the Aorta or Interruption of the Aortic Arch With Ventricular Septal Defect

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Purpose: We investigated the effects of aortic valve (AV) morphology and annular size of the AV on left ventricular outflow tract obstruction (LVOTO) after primary repair of coarctation of the aorta (CoA) or interruption of the aortic arch (IAA) with ventricular septal defect (VSD).

Methods: Seventy-one patients survived for at least 5 years after primary repair of CoA/IAA with VSD between December 1996 and December 2005. There were 43 CoA and 28 IAA patients. We defined LVOTO when the left ventricular outflow tract or AV flow velocity was higher than 3.0 m/s. The morphology of the AV was bicuspid in 23 cases and tricuspid in 48 cases.

Results: A logistic regression analysis showed that an AV annular size less than 80% of the normal size (<80%AV) (odds ratio: 6.1, $p = 0.030$) and a bicuspid AV (odds ratio: 5.1, $p = 0.030$) were significant risk factors for LVOTO after primary repair of CoA/IAA with VSD. Freedom from reoperation for LVOTO were 95.4% in the tricuspid AV and 83.7% in the bicuspid AV cases ($p = 0.027$), and 93.8% in the patients with an AV annular size greater than 80% of the normal size and 85.1% in those with an AV annular size less than 80% of the normal size ($p = 0.477$) at 12 years after the primary repair. There were six reoperations, including four cases with a bicuspid AV and two cases with a tricuspid AV. All four bicuspid AV cases had valvular stenosis that was treated by two Ross-Konno procedures and two aortic valve replacements with annular augmentation. Both of the tricuspid AV cases had discrete type LVOTO treated by a modified Konno procedure.

Conclusions: Both a <80%AV and a bicuspid AV are risk factors for LVOTO after primary repair of CoA/IAA with VSD. The bicuspid AV cases more frequently underwent reoperation than did the tricuspid AV cases. A bicuspid AV led to more frequent valvular stenosis than tricuspid AV, which exhibited subaortic stenosis.

P55

Norwood Stage I Palliation in Patients Less Than 2.5 kg: Outcomes and Risk Analysis

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COMMERCIAL RELATIONSHIPS E. A. Bacha: Consultant/Advisory Board, CorMatrix

Purpose: Hospital mortality of hypoplastic left heart syndrome (HLHS) patients who underwent a Norwood procedure at a weight ≤2.5 kg hovers around 40% in literature. We aimed to 1) assess early and mid-term outcomes in this specific population in a dedicated neonatal cardiac program and 2) determine factors associated with poor outcomes.

Methods: We analyzed outcomes (early and late mortality, reintervention, and morbidity) in patients ≤2.5 kg status post Norwood at our institution (retrospective study: January 2006-May 2014) and performed a risk analysis. Twenty-eight patients were included. Mean follow-up was 26.2 months ± 27 months.

Results: Twenty-four patients (86%) had HLHS (aortic atresia/mitral atresia in half) and four had an HLHS variant. The mean size of the ascending aorta was 2.6 mm ± 1.5 mm. Coronary fistulae, ventricular dysfunction, and atrioventricular valve regurgitation were present in two patients each. Median weight at surgery was 2.29 kg (range 2-2.5 kg). A Sano as opposed to a Blalock-Taussig (BT) shunt was done in 22 patients (78.6%). Timing of surgery was delayed in five patients (18%) to allow maturation because of prematurity or extracardiac condition. Hospital mortality rate was 10.7% (3/28). Two patients (7%) required an early unplanned reintervention (BT shunt, aortic arch revision) and one underwent a late aortic arch revision. The late mortality/heart transplant rate was 8% (2/25). Stage II and stage III procedures were performed in 19 (76%) and eight (32%) of survivors. The univariate risk analysis is presented in Table 1.

Conclusions: The Norwood procedure in HLHS patients ≤2.5 kg can be achieved with excellent early and mid-term outcomes. Delayed surgery, preoperative comorbidities, and postoperative extracorporeal membrane oxygenation, neurologic complications, and dialysis were associated with higher hospital mortality. Small ascending aortic size was associated with early reintervention and late mortality/transplant.

ENDPOINT	HOSPITAL MORTALITY	UNPLANNED REINTERVENTION	MORBIDITY	LATE MORTALITY/ TRANSPLANT
PREOPERATIVE VARIABLES				
Gestational age	NS	NS	NS	NS
Low birthweight	**p=0.03**	NS	NS	NS
Delayed surgery	**p=0.05**	NS	NS	NS
HLHS/HLHS variant	NS	NS	NS	NS
Small ascending aortic size	NS	**p=0.02**	NS	**p=0.02**
Ventricular dysfunction	trend, p=0.10	NS	NS	NS
Moderate AVVR	trend, p=0.10	NS	NS	NS
Inotropic support	NS	NS	trend, p=0.09	NS
Mechanical ventilation >7days	trend, p=0.09	NS	NS	NS
High creatinine	NS	trend, p=0.08	NS	NS
Preoperative comorbidities	**p=0.03**	NS	trend, p=0.08	NS
INTRAOPERATIVE VARIABLES				
Surgeon	trend, p=0.10	NS	NS	NS
Sano/BT shunt	NS, p=0.52	NS, p=0.72	NS, p=0.85	NS, p=0.44
POSTPERATIVE VARIABLES				
Inotropic support >7 days	NS	trend, p=0.09	NS	NS
Length of mechanical ventilation	**p=0.02**	NS	NS	NS
ECMO	**p=0.04**	NS	NS	NS
Neurological complications	**p=0.03**	NS	NS	NS
Renal failure requiring dialysis	**p=0.04**	NS	NS	NS
Postoperative length of stay	NS	**p=0.03**	NS	NS

P56
Long-Term Durability of Mitral Valve Repair Performed Before the Age of Five

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Purpose: Excellent results have been reported after mitral valve repair in adult patients. In children, however, difficulties exist due to fragile tissue and complex anatomy. Also, an artificial ring is not feasible. The aim of this paper is to investigate long-term outcomes of mitral valve repair in small children.

Methods: Until 2012, mitral valve repairs were performed for regurgitation on 52 patients aged younger than 5 years. The maximal follow-up period was 24.2 years. Six patients had a functionally single ventricle. Local (Kay-Reed) annuloplasty was the sole technique applied on 25 patients. In three patients, Alfieri's edge-to-edge technique was used. Repairs for the remaining 24 patients employed one of the following procedures to address abnormalities of the leaflet or chord: closure of the cleft or commissure (10), sliding leaflet technique on the posterior leaflet (6), artificial chord placement (5), chordal shortening technique (2), and closure of the hole on the leaflet (1).

Results: There were two early (<30 days) and one late death. Nine patients required reoperation for residual regurgitation. Estimated survival and freedom from reoperation at 20 years were 93.0% ± 4.0% and 76.0% ± 7.1%. For patients undergoing repair of the abnormalities of the leaflet or chord, freedom from reoperation at 5 years was 93.3% ± 6.4%. On the other hand, it was 67.1% ± 11.0% for those repaired solely with a local annuloplasty ($p = 0.0796$). Postoperative degree of mitral regurgitation was mild or less in 91.7% of the former group and 72.0% of the latter ($p = 0.0684$). Two of three patients undergoing Alfieri's technique required reoperation: one due to postoperative valvular stenosis and the other to dehiscence of the edge-to-edge suture. The single ventricle repair group showed lower freedom from reoperation at 5 years (33.3% ± 19.3%) compared with two-ventricle repair (83.7% ± 6.8%, $p = 0.002$). Postoperative mitral regurgitation was mild or less in 50.0% of the former group and 90.0% of the latter ($p = 0.0462$).

Conclusions: Excellent long-term survival was seen after mitral valve repair performed on patients younger than 5 years. Reoperation is unlikely if a geometric abnormality of the leaflet or chord is identified and addressed. Also, there was a high likelihood of residual regurgitation and reoperation in patients with a single ventricle.

P57

Surgical Strategy for Pulmonary Atresia, Ventricular Septal Defect, and Major Aortopulmonary Collateral Arteries (PA/VSD/MAPCA) With Absent or Hypoplastic Central Pulmonary Artery

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Purpose: PA/VSD/MAPCA is a complex lesion that is challenging to manage surgically, especially when the central pulmonary artery (cPA) is absent or hypoplastic. This study reports our experience with one-stage unifocalization of the MAPCA, cPA plasty, and palliative right ventricular outflow tract reconstruction (pRVOTR), followed by definitive repair in the second stage.

Methods: From 2000 through 2014, the cPA was reconstructed in 20 patients under cardiopulmonary bypass using a Y-shaped autologous pericardial roll, and MAPCAs were anastomosed directly to the roll with the pRVOTR, resulting in an RVOT diameter that was 75% of the normal pulmonary annulus. The mean age was 1.1 years (range, 0.8-4.6 years), and body weight was 8.6 kg (range, 3.3-16.9 kg). MAPCA banding was performed in one patient and Blalock-Taussig shunts were created in five. Before surgery, the strategy for unifocalization of the MAPCA and pulmonary reconstruction was planned using images from 3D computed tomographic angiography.

Results: The mean follow-up was 5.6 years (maximum, 12.4 years). There was one surgical death (respiratory failure) and one late death (sepsis). All patients except one (surgical death) achieved definitive repair with complete VSD closure after 1.1 years ± 0.4 years. No patient required reoperation. The PA systolic pressure was 27.5 mm Hg ± 11.4 mm Hg after unifocalization + pRVOTR and decreased to 23.9 mm Hg ± 5.6 mm Hg after definitive repair. Oxygen saturation was 79% before and 88% after unifocalization + pRVOTR.

Conclusions: Staged surgical treatment of PA/VSD/MAPCA with absent or hypoplastic cPA resulted in excellent early to mid-term results. pRVOTR might be a good option to obtain adequate pulmonary blood flow.

P58
Complications and Risk Assessment of 21 Years in Pediatric Pacing

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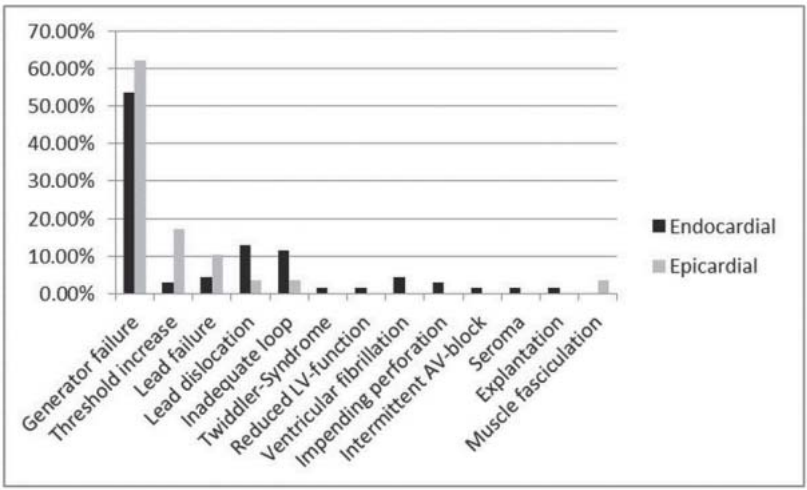
COMMERCIAL RELATIONSHIPS B. Osswald: Speakers Bureau/Honoraria, BIOTRONIK, Boston Scientific, Medtronic, Inc, St Jude Medical, Inc, Spectranetics

Purpose: Children who require cardiac pacemaker implantation are at risk for specific complications related to their small bodies. In children less than 15 kg, a superior method of pacing (epicardial vs endocardial) has not been established. Our study aims to analyze complications and to identify risk factors of pediatric pacemaker systems.

Methods: All pacemaker-related operations in pediatric patients up to the age of 18 years from 1989 through 2010 were retrospectively evaluated. Endocardial and epicardial pacemaker systems were included. Patients were divided into three weight groups (<15 kg, 15-30 kg, >30 kg) with separate analysis of idiopathic and postoperative dysrhythmia. Perioperative complications, as well as indications for revision, were investigated. In addition, a risk-factor assessment of venous occlusion was done in patients with endocardial systems.

Results: A total of 149 pacemaker operations were performed in 73 patients. Thirty-two patients did not have a previous cardiac operation. Indications for revision included box exchange, lead-related problems, pacemaker pocket, impaired left ventricular function, and pectoral muscle stimulation. Threshold-related revisions were more common with epicardial than endocardial systems (17.2% vs 2.9%, respectively) as was lead failure (10.3% vs 4.3%, respectively). Other lead problems included lead dislocation, inadequate redundant loop, and Twiddler-Syndrome. These were more common in the endocardial group (26.1% vs 6.9%). Venous thrombosis occurred in 13.7% of all endocardial patients. In the weight group less than 15 kg, the rate was 25%, compared to 8.6% for patients equal to or greater than 15 kg (relative risk [RR]=2.9). The relative risk was also calculated for age under 1 year (RR=1.5), female gender (RR=3.3), history of cardiac surgery (RR=0.7), single-chamber vs dual-chamber system (RR=5.3), and unipolar vs bipolar leads (RR=1.5).

Conclusions: Cardiac pacing is particularly challenging in children facing a large number of reoperations during their lifetimes. The lack of clear superiority of either epicardial or endocardial pacing systems requires an individual concept. Whether children <15 kg are at higher risk for venous occlusion is controversial. However, our study suggests an increased risk.



Risk factor	Relative risk	Odds Ratio
Age less than one year vs. greater one year	1.5	1.6
Weight less than 15 kg vs. greater 15 kg	2.9	3.6
Female vs. male	3.3	4.0
Malformation vs. no malformation	0.3	0.3
Cardiomyopathy vs. no cardiomyopathy	2.2	2.5
Postoperative vs. non-postoperative	0.7	0.6
Single-chamber-system vs. dual-chamber-system	5.3	6.6
Unipolar vs. bipolar electrode	1.5	1.5

P59

Fast-Track Staged Approach Is Beneficial for Systemic Oxygen Saturation After Fontan Completion

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Purpose: The optimal age of Fontan completion is still controversial. Recommendations for performing Fontan procedures in early infancy are based on better post-Fontan exercise capacity due to the earlier elimination of cyanosis. In this report, we will present new insights for better outcomes of Fontan procedure performed in early infancy when looking at oxygen saturation level.

Methods: Between September 1996 and November 2013, 57 patients with a functional single ventricle underwent total cavopulmonary connection at our hospital. Patients were subdivided into either group L (less than 1.5 year; n=25) or group H (higher than 1.5 year; n=32), depending on the age at Fontan completion (FC). Patients' medical records were retrospectively reviewed, and both perioperative variables and postoperative catheterization data were analyzed in terms of systemic oxygen saturation levels.

Results: There were two mortalities during the follow-up period of 7.3 years ± 4.0 years. In group L, mean age at bidirectional cavopulmonary shunt (BCPS) (5.0 months ± 1.3 months vs 11.2 months ± 5.7 months; $p < 0.001$) and Fontan completion (1.2 years ± 0.1 years vs 2.8 years ± 1.9 years; $p < 0.001$) were significantly earlier, and interstage duration between BCPS and Fontan completion was significantly shorter (9.0 months ± 1.7 months vs 14.4 months ± 11.8 months; $p < 0.05$). Pre-Fontan patient demographic data were almost identical between groups. Most patients (90%) underwent extracardiac total cavopulmonary connection using polytetrafluoroethylene graft. Post-Fontan catheterization data revealed significantly higher oxygen saturation on group L (93.2% ± 3.6% vs 89.7% ± 6.5%; $p < 0.05$) at 1 year, which kept its dominance (93.9% ± 2.6% vs 90.8% ± 3.6%; $p < 0.05$) at 5 years. Multivariate stepwise regression analysis revealed that the duration of BCPS (coefficient= -0.684, 95% CI -1.252 to -0.117; $p < 0.05$) at 1 year and age at Fontan completion (coefficient = -3.41, 95% CI -6.702 to -0.129; $p < 0.05$) at 5 years were independent determinants of higher post-Fontan oxygen saturation.

Conclusions: A fast-track staged approach aiming for Fontan completion in early infancy has a positive impact on long-term outcomes of Fontan surgery, as evidenced by better post-Fontan oxygen saturation.

P60

Effect of Intercurrent Operation and Systemic Hemodynamics on Developmental Trajectory in Infants and Children With Congenital Heart Disease

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COMMERCIAL RELATIONSHIPS J. S. Tweddell: Consultant/Advisory Board, CorMatrix

Purpose: Children with congenital heart disease are at increased risk of abnormal neurodevelopment (ND). Both demographic and perioperative physiologic factors have been associated with developmental delay (DD). We sought to identify procedural and physiologic factors assessed during outpatient visits that were associated with DD.

Methods: Children with CHD at high risk for DD and who completed at least three ND assessments with the Bayley Scales of Infant Development-III (BSID3) over the first 3 years of life were included in this study. The number of cardiac procedures, duration of hospitalization, feeding status, height, weight, arterial saturation, and cerebral and somatic oxygen saturations by near infrared spectroscopy (NIRS) were recorded at each visit and used as predictors of composite BSID3 language, motor, and cognitive scores and trajectories (change over time) in general linear models.

Results: Data on 178 children over 648 visits were analyzed, with ages at first and last assessment 9 months ± 3 months and 28 months ± 5 months, respectively. Fifty-one had one-ventricle (1V), 88 had two-ventricle (2V), and 39 had genetic syndrome (GS) conditions, of whom 36 had 2V anatomy. Both 1V and 2V groups had positive trajectories for motor performance, while the GS group showed low and decreasing performance. Higher arterial saturation and narrower cerebral and somatic arteriovenous differences by NIRS (Sa-vO2C and Sa-vO2S) were associated with better or improving motor performance. Incremental cardiopulmonary bypass (CPB) time was a risk factor for poorer language and motor performance, while hospital length of stay and tube feedings were major risk factors in all domains. Total and incremental times for deep hypothermic circulatory arrest (DHCA), extracorporeal membrane oxygenation (ECMO), open and total surgical procedures, and birth weight were not risk factors.

Conclusions: Patient physiologic status assessed by outpatient arterial and regional oximetry is associated with ND performance. Incremental surgical procedures are not associated with DD when adjusted for CPB time and physiologic status. Treatment strategies directed at improving physiologic status may improve neurodevelopmental outcomes.

Continued on next page

Abstract continued from previous page

Mixed effects regression of predictors for BSID3 composite scores

	Cognitive (N=614)	Language (N=606)	Motor (N=614)
Composite Slopes			
1V anatomy	1.608 [-0.272,3.488]	1.757 [-0.0904,3.604]	4.277 ### [2.538,6.016]
2V anatomy	0.664 [-0.757,2.085]	0.150 [-1.225,1.525]	3.183 ### [1.890,4.475]
Genetic Syndrome	-1.425 [-3.576,0.727]	-2.629 # [-4.716,-0.543]	0.129 [-1.835,2.094]
Parameter Estimates			
SaO2 (%)	0.0985 [-0.160,0.357]	0.218 [-0.0348,0.472]	0.358 ** [0.120,0.597]
Sa-vO2C (%)	0.0242 [-0.113,0.161]	-0.0363 [-0.172,0.0998]	-0.178 ** ## [-0.304,-0.0516]
Sa-vO2S (%)	-0.0762 [-0.171,0.0182]	-0.0360 [-0.130,0.0575]	-0.154 *** # [-0.241,-0.0680]
CPB time (min)	-0.00658 [-0.0293,0.0162]	-0.00841 # [-0.0295,0.0127]	-0.00611 ## [-0.0275,0.0152]
DHCA time (min)	0.0953 [-0.0330,0.224]	0.129 * [0.00775,0.250]	0.0852 [-0.0349,0.205]
Highest STS Category	1.577 [-0.324,3.477]	1.769 * [0.0119,3.527]	1.170 [-0.627,2.966]
Total Open	-1.964 [-6.134,2.205]	-3.464 [-7.359,0.431]	-1.448 # [-5.368,2.472]
Total Closed	-0.808 [-4.624,3.007]	-2.192 [-5.727,1.343]	-0.613 [-4.216,2.990]
Total Procedures	-0.411 [-1.507,0.686]	-0.203 [-1.229,0.824]	-0.313 [-1.346,0.719]
Hospital LOS (days)	-0.0483 * [-0.091,-0.005]	-0.0430 * [-0.085,-0.0015]	-0.0412 * [-0.082,-0.001]
Feeding all PO	0 [0,0]	0 [0,0]	0 [0,0]
Feeding PO#GT	-3.078 [-7.166,1.010]	-4.355 * [-8.437,-0.273]	-9.287 *** [-13.08,-5.494]
Feeding all GT	-6.255 ** [-10.52,-1.987]	-4.962 * [-9.118,-0.805]	-15.13 ***## [-19.10,-11.16]
ECMO use	1.215 [-5.921,8.351]	2.172 [-4.660,9.005]	3.640 [-3.003,10.28]
Birthweight (kg)	2.313 [-0.488,5.113]	-0.604 [-3.183,1.974]	0.997 [-1.657,3.652]
1V anatomy	0 [0,0]	0 [0,0]	0 [0,0]
2V anatomy	-1.087 [-6.825,4.651]	-3.620 [-8.984,1.744]	0.691 [-4.709,6.092]
Genetic Syndrome	-19.85*** [-26.27,-13.42]	-19.25*** [-25.24,-13.25]	-25.04*** [-31.09,-19.00]
(model constant)	86.93*** [62.27,111.6]	83.71*** [59.91,107.5]	70.64*** [47.71,93.58]
(model R2)	0.391	0.355	0.575

Data are point estimates for parameter coefficients, with 95% confidence intervals in brackets
* p<0.05, ** p<0.01, *** p<0.001 for mixed model parameter
# p<0.05, ## p<0.01, ### p<0.001 for within-patient slope

P61

Blalock-Taussig Shunt in Neonates With Functionally Univentricular Heart

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Purpose: Blalock-Taussig shunt (BTS) in neonates with functionally univentricular heart (f-UVH) remains challenging with high mortality. We reviewed our strategy of BTS in neonates with f-UVH.

Methods: A retrospective review was performed of all neonates with f-UVH undergoing BTS at our institution from October 2003 to November 2013. Patients with complex heart disease who needed cardiopulmonary bypass at the initial surgery were excluded (eg, hypoplastic left heart syndrome, asplenia syndrome accompanied by total anomalous pulmonary venous connection with pulmonary venous obstruction). Medical records were evaluated to determine patient demographics, operative data, and long-term outcomes.

Results: Fifty-one neonates were included. The mean age and body weight at surgery were 14 days ± 7 days and 3.0 kg ± 0.5 kg. Surgery was performed through sternotomy (n=28) or thoracotomy (n=23). A 3 mm expanded polytetrafluoroethylene vascular graft was mostly used (n=33), followed by 3.5 mm graft (n=16) and 4 mm graft (n=1). Original BTS was performed in one patient whose body weight was 1.7 kg. Concomitant surgical procedures of a patent ductus arteriosus (PDA) were performed in 34 patients (PDA ligation, n=13; PDA banding, n=21). There was no early mortality. Forty-eight patients (94%) achieved bidirectional cavopulmonary shunt (BCPS) at 5 months after BTS. Cardiac catheterization before BCPS revealed sufficient growth of the pulmonary artery (pulmonary artery index, 245 cm^2/m^2 ± 116 cm^2/m^2), low ventricular end-diastolic pressure (6 mm Hg ± 2 mm Hg), and excellent ventricular ejection fraction (62% ± 8%). The atrioventricular valve regurgitation remained mild or less, and valve repair was not needed at BCPS. Freedom from total cavopulmonary connection (TCPC) completion was 14.6% ± 5.5% at 2 years. Overall survival rate was 94.0% ± 3.4% at 5 years.

Conclusions: BTS with a small-caliber graft and meticulous management of PDA could prevent f-UVH from volume overload and yield sufficient growth of pulmonary vasculature. Those led to a high success rate of TCPC completion and an excellent survival rate.

P62

Patient Selection Minimizes Recurrent Arch Obstruction in Patients Undergoing Aortic Coarctation Repair via Left Thoracotomy

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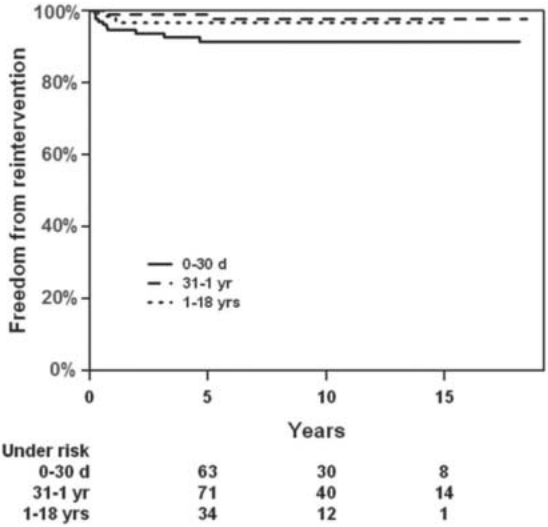
Purpose: Surgical results for aortic coarctation (CoA) repair have steadily improved. We favor a thoracotomy only for children with arch hypoplasia limited to the distal arch/isthmus or those at high risk for cardiopulmonary bypass (CPB). Our goal was to analyze the long-term outcomes of patients undergoing CoA repair via left thoracotomy.

Methods: All patients <18 years old that underwent initial repair for CoA through left thoracotomy from 1995 to 2013 were included. Patients were classified into three groups: 143 (42%) neonates (0-30 days), 122 (36%) infants (31 days-1 year), and 78 (23%) older children (1-18 years). Data were analyzed with chi-square or log-rank tests.

Results: A total of 343 patients (129 females [38%]) with a median age of 53 days (2 days-17 years) and weight 4.1 kg (1.3-87 kg) underwent repair with extended end-to-end anastomosis (291, 85%), end-to-end anastomosis (44, 13%), interposition graft (2, 0.6%), or subclavian flap (6, 2%). Preoperative prostaglandin was used in 118 (83%) neonates. Concomitant diagnoses included isolated ventricular septal defects (58, 17%), Shone's complex (53, 16%), or other complex congenital heart disease (18, 5%). Genetic syndromes were present in 52 (15%). Major complications occurred in 56 patients (16%). No patient developed paraplegia. Perioperative mortality was 1% (n=4, all neonates). At a median follow-up of 6 years (4 days-19 years), recoarctation requiring intervention occurred in only 14 patients (4%) (10 catheter procedures, 6 surgical repairs; 10 neonates) (Figure). At last follow-up, 92 patients (27%) were hypertensive or remained on cardiac medications. As a reference, during the same period, 275 infants underwent arch reconstruction with CPB due to a hypoplastic proximal arch or concomitant cardiac procedures.

Conclusions: CoA repair via left thoracotomy is associated with low morbidity, mortality, and reintervention rates. These results are likely partly related to adequate patient selection based on size of the proximal aortic arch.



	0-30d	30d-1y	>1y	p-value
N	143(42)	122(36)	78(23)	
Patient characteristics				
Gender	54(38)	47(39)	25(36)	N/A
Weight(kg), median(range)	3.1(1.4-4.6)	5.3(1.3-5.2)	21(7-87)	N/A
Prior balloon dilation	0	11(9)	8(10)	0.001
Shock or moderate/severe ventricular dysfunction	42(29)	28(23)	0	<0.001
Genetic syndromes	28(20)	13(11)	7(9)	0.039
Concomitant CHD				
Isolated VSD	35(25)	20(16)	3(4)	<0.001
Shone's complex	30(21)	19(16)	5(4)	0.008
Other complex CHD†	8(6)	8(7)	2(3)	.453
Outcomes				
Perioperative HTN	28(20)	58(48)	55(71)	<0.001
Vocal cord dysfunction	7(5)	5(4)	0	0.15
Other complications‡	30(21)	17(14)	9(12)	.115
Perioperative mortality	4(3)	0	0	0.06
Reinterventions	10(7)	2(2)	2(3)	0.07∫
HTN or cardiac meds at last follow-up	37(31)	36(35)	19(34)	0.87

All data in n(%), unless specified otherwise.
CHD: congenital heart disease, HTN: hypertension, VSD: ventricular septal defect.
† Includes Ebstein's anomaly, cor triatriatum, atrioventricular septal defect, transposition of the great arteries, Taussig Bing, heterotaxy, and ruptured sinus of valsalva aneurysm s/p aortic root replacement.
‡ Includes pneumothorax, chylothorax, reoperation for bleeding, wound infection/dehiscence, venous thrombosis, arrhythmia, necrotizing enterocolitis and infectious complications.
∫ Log-rank test.

P63

Does Prior Innominate Vein Occlusion Preclude Successful Bidirectional Superior Cavopulmonary Connection Creation?

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Purpose: Low superior vena cava (SVC) blood flow has recently been identified as a marker for bidirectional superior cavopulmonary connection (SCPC) failure and death. Prior innominate vein occlusion (IVO) is considered a significant anatomic risk factor for SCPC failure. However, single ventricle patients have limited alternatives. We evaluated outcomes of infants that underwent SCPC with prior IVO.

Methods: Between February 1995 and June 2014, eight patients with either a single SVC with IVO (n=6) or bilateral SVCs without an innominate vein with occlusion of one SVC (n=2) underwent a SCPC. The occlusion was due to an indwelling line in five patients. These patients were compared to eight patients with normal upper body venous drainage who underwent SCPC. Patients were evaluated for preoperative risk factors (including SVC size, pulmonary artery size, Nakata index, and pulmonary vascular resistance), operative factors, and clinical outcome to determine the impact of prior innominate vein occlusion on SCPC failure and death.

Results: There were no significant differences in preoperative risk factors between the two groups (Table). There was a trend toward smaller branch PA size and Nakata index in the study group ($p = 0.06$). There were no SCPC takedowns or mortalities. There was no significant difference in median postoperative length of stay: 7 (5-32) days vs 5 (4-32) days, $p = 0.5$. Study patients had lower median oxygen saturation at discharge, 81% (74-88) vs 85% (79-89), $p = 0.05$. At 28 (3-228) months follow-up, three patients underwent successful Fontan completion.

Conclusions: Although patients with prior IVO had lower systemic oxygen saturations, they did not demonstrate increased SCPC failure or mortality rate. Innominate vein occlusion should not preclude performance of SCPC. Physiologic, rather than anatomic, evaluation of systemic venous return may be more useful to predict outcome following SCPC.

Preoperative Risk Factors	Innominate Vein Occlusion	Patent Innominate Vein	P value
Age, months	5(4-16)	5.4(4.3-10.3)	0.77
Weight kg	6.5(4.2-8.2)	5.8(4.6-8.6)	0.83
Body surface area, m2	0.3(0.22-0.4)	0.29(0.25-0.38)	0.88
SVC diameter mm	7(6-7.8)	7.3(5-9.7)	0.58
Nakata index mm2/m2	148(84-363)	233(152-343)	0.06
TPG mm	9(4-11)	8.5(4-14)	0.90
Rp	2.9(1.25-6.3)	2.3(1.4-3.6)	0.38

Table 1. Preoperative Risk Factors

P64

Augmentation of the Lesser Curvature With an Autologous Vascular Patch in Complex Aortic Coarctation and Interruption

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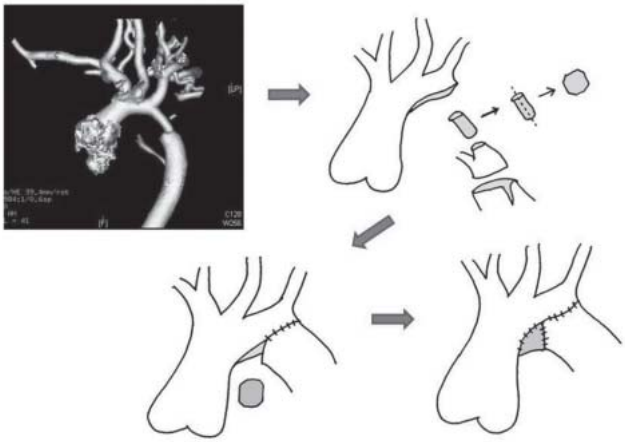
Purpose: Reconstruction of the aortic arch in patients with complex aortic coarctation or interruption continues to be a challenge because of early left main bronchial compression or recoarctation and late Gothic arch formation. We propose a novel technique for arch reconstruction augmenting the lesser curvature with an autologous vascular patch, which can relieve tension on the anastomosis without a prosthetic material.

Methods: We retrospectively reviewed 33 patients with coarctation and arch hypoplasia (n=32) or arch interruption (n=1) who underwent arch reconstruction with an autologous vascular patch from 2007 to 2012. Mean age at surgery was 45.5 days ± 58.1 days. Mean body weight was 4.0 kg ± 1.3 kg. All operations were performed under cardiopulmonary bypass and antegrade selective cerebral perfusion (mean duration, 35.7 min ± 11.9 min). Combined intracardiac anomalies (n=29, 88%) were corrected simultaneously. The reconstructed arch was supplemented in the lesser curvature with an autologous vascular patch that was harvested from the aortic isthmus (n=25), pulmonary artery (n=4), left subclavian artery (n=2), aberrant right subclavian artery (n=1), and distal arch (n=1).

Results: One patient (3%) died of acute respiratory distress syndrome. All survivors were discharged at 19 days ± 13 days postoperatively without any neurologic complication or bronchial obstruction. During follow-up (mean duration, 25.9 months ± 12.2 months), no recoarctation was observed and no patient needed reoperation.

Conclusions: Augmenting the lesser curvature with an autologous vascular patch during arch reconstruction resulted in excellent mid-term outcomes. Not only can a more natural shape of the arch and less tension on the anastomosis be obtained, but complications, such as left main bronchial obstruction or recoarctation, can also be minimized. Long-term follow-up is needed to evaluate the late development of aneurysm or hypertension.

Operative Techniques



P65

Transesophageal Echocardiogram-Guided Minimally Invasive Perventricular Device Closure of Perimembranous Ventricular Septal Defects

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Purpose: This report describes our clinical experience and mid-term follow-up results of minimally invasive perventricular device closure of perimembranous ventricular septal defects guided by transesophageal echocardiogram.

Methods: From May 2011 to May 2014, 187 patients with perimembranous ventricular septal defects aged 6 months to 31 years (median age, 2.4 years) were enrolled for minimally invasive perventricular device closure of their defects with an inferior partial median sternotomy of 2-3 cm. The size of the device and the process of the operation were monitored by transesophageal echocardiogram. Patients were followed up at the outpatient clinic at 3 months, 6 months, 1 year, and every year after the operation with echocardiography and electrocardiogram at each visit.

Results: The defects were closed successfully in 179 patients (95.7%), and eight patients were converted to conventional surgical repair. Six patients (3.4%) had incomplete right bundle branch block. One patient presented with intermittent complete atrioventricular block in the fourth day after operation and restored sinus rhythm by drug treatment after 5 days. Trivial residual shunt was observed in eight patients (4.5%) during the procedure. Most patients were discharged 4-5 days after the operation. Follow-up in all patients ranged from 1 month to 3 years (median, 15.3 months) and revealed no aortic regurgitation, malignant arrhythmia, or device dislocation. However, three patients (1.7%) had trivial residual shunt.

Conclusions: Minimally invasive perventricular device closure of perimembranous ventricular septal defects was a safe and effective intervention under guidance of transesophageal echocardiogram. However, long-term follow-up was necessary.

P66

High Prevalence of Hypertension and End-Organ Damage Late After Coarctation Repair in Patients With Normal Transverse Arches Detected Using Noninvasive Techniques

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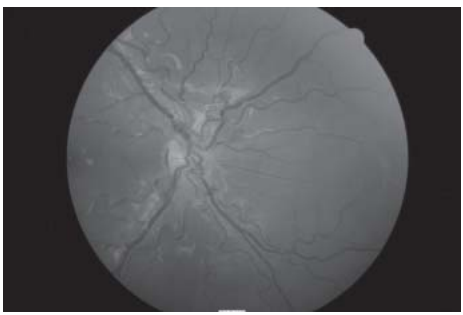
COMMERCIAL RELATIONSHIPS C. P. Brizard: Consultant/Advisory Board, Admedus Australia; R. Kawasaki: Consultant/Advisory Board, Office Future Co, Japan; Speakers Bureau/Honoraria, Alcon Japan Ltd, Bausch & Lomb Japan, Kowa Company Ltd, MSD KK, Novartis Japan, Takeda Pharmaceuticals Japan

Purpose: To (1) determine the prevalence of hypertension late after coarctation repair in patients with normal-sized transverse arches, and (2) evaluate the potential for end-organ damage related to hypertension after coarctation repair. There are currently no studies specifically investigating end-organ damage and hypertension after coarctation repair using noninvasive techniques.

Methods: Eighty-two patients aged ≥10 years who had a coarctation repair and were quoted to have a normal-sized aortic arch between 1978 and 2010 underwent a transthoracic echocardiogram, 24-hour blood pressure (BP) monitoring, and retinal imaging. Median age at repair was 1 year (interquartile range: 0-6); 49% (40/82) were operated on in the first year of life.

Results: After a follow-up of 24 years ± 7 years, 27% (22/82) and 50% (41/82) suffered from resting hypertension and resting prehypertension, respectively. On 24-hour BP monitoring, 63% (50/80) and 21% (17/80) suffered from hypertension and prehypertension, respectively. Arch reobstruction (echo gradient >25 mm Hg) was present in only 16% (13/82) of patients and in only 16% (8/50) of patients with hypertension on 24-hour BP monitoring. Abnormal 24-hour BP (hypertension/prehypertension) was associated with a smaller central retinal artery equivalent on retinal imaging (137 ± 2 micrometers vs 147 ± 3 micrometers, $p = 0.03$), and three patients demonstrated extremely tortuous/kinked vessels (Figure). Left ventricular hypertrophy on echocardiography was present in 64% (32/50) of patients with hypertension on 24-hour BP monitoring, compared to only 40% (12/30) of those with normal 24-hour BP ($p = 0.04$).

Conclusions: There is a high rate of hypertension late after coarctation repair, even in patients with unobstructed arches. The presence of retinal imaging abnormalities and left ventricular hypertrophy signals the presence of end-organ damage in this young adult population. Regular follow-up with 24-hour BP monitoring is warranted.



P67

Updates on the 20-Year Outcome of Simultaneous Anterior Mitral Leaflet Retention Plasty and Septal Myectomy in Hypertrophic Obstructive Cardiomyopathy

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Purpose: Various surgical strategies to provide relief of left ventricular outflow tract obstruction (LVOT) and correction of mitral regurgitation in hypertrophic obstructive cardiomyopathy (HOCM) have evolved, yet reports on long-term outcomes of each technique are scarce. We give an update on our 20 years' experience with standardized surgical treatment of HOCM.

Methods: Between 1994 and 2014, 57 patients (mean age 38 years ± 2.5 years, range 6 months–76 years) underwent surgery for HOCM with septal myectomy and anterior leaflet retention plasty (ALRP) directed to obviate systolic anterior motion (SAM) phenomenon. Preoperative mean LVOT pressure gradient was 98.34 mm Hg ± 7.6 mm Hg (range 60-160 mm Hg) with moderate-severe mitral insufficiency (MI). Under cardiopulmonary bypass (CPB), standard transaortic septal myectomy was performed by resecting long blocks of septal myocardium, continuing the incision apically beyond the point of the mitral-septal contact. Through a left atriotomy, the segment of anterior mitral leaflet (AML) closest to the trigones was sutured to the corresponding posterior annulus on both sides. Thus, the mobility of the AML is limited in its anterior segment, unable to produce SAM and MI.

Results: Mean LVOT pressure gradient significantly decreased to 12.5 mm Hg ± 1.7 mm Hg ($p < 0.001$). Septal thickness was reduced from a preoperative mean of 28.9 mm ± 4.7 mm to 11.2 mm ± 1.2 mm ($p < 0.001$). During a mean follow-up period of 17.5 years ± 1.4 years (range 3 months-20.2 years), MI was trivial in 87% and SAM was nonexistent in all, sustained at each patient's latest follow-up. Two patients underwent immediate valve replacements 24 hours postoperatively for severe residual MI. Two underwent replacement at 1 year and 5 years after ALRP for recurrent MI. Two received permanent pacemakers either during the primary operation or eventually during the course of follow-up. Twenty-year freedom from repeat mitral valve intervention was 92.9%. Two heart transplant patients died from multiorgan failure 2.1 years and 15.2 years after HOCM. Three died of sudden cardiac death, 3.1, 6.6, and 11 years postoperatively. Twenty-year cumulative survival rate was 91.2%.

Conclusions: Long-term follow-up of HOCM patients who underwent simultaneous septal myectomy and anterior leaflet retention plasty showed sustained absence of SAM, attenuation of MI, absence of residual LVOT obstruction, and sustained improvement in hemodynamic and functional status.

P68

Performance Assessment of the Temporary Viscous Impeller Pump in Total Cavopulmonary Connections With Various Offsets

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Purpose: Temporary cavopulmonary assist using a percutaneous viscous impeller pump (VIP) can stabilize the univentricular Fontan circulation toward biventricular physiology. Not all patients have the same anatomy at the cavopulmonary junction. The purpose of this study is to characterize VIP performance in the setting of total cavopulmonary connection (TCPC) anatomic offset.

Methods: Computational fluid dynamic (CFD) modeling (Star-CCM+) is used to study the effect of the VIP performance at various degrees and combinations of left/right (0.15-1 caval diameter [D]) and anteroposterior (0.05-0.25 D) vena caval offset. Hydraulic performance and flow distribution was assessed.

Results: A rotary blood pump, based on the von Karman viscous pump, augments four-way flow in an idealized TCPC in the ideal pressure range (2-6 mm Hg). Modest offset in the TCPC (left/right <0.25 D and/or anteroposterior <0.15 D) minimally affects performance of the VIP. Larger offset in the TCPC reduces VIP performance compared to the idealized TCPC at the same rotation speed. However, this diminution in pressure augmentation is easily counteracted by increasing rotational speed by 200 to 800 RPM.

Conclusions: The VIP can safely and reliably support patients temporarily with a univentricular circulation without obstructing TCPC flow, even with a 100% anatomic offset. The magnitude of anatomic offset becomes less prominent with somatic growth. Clinical translation of this technology will provide temporary stabilization of the univentricular circulation in a more stable biventricular physiologic state.

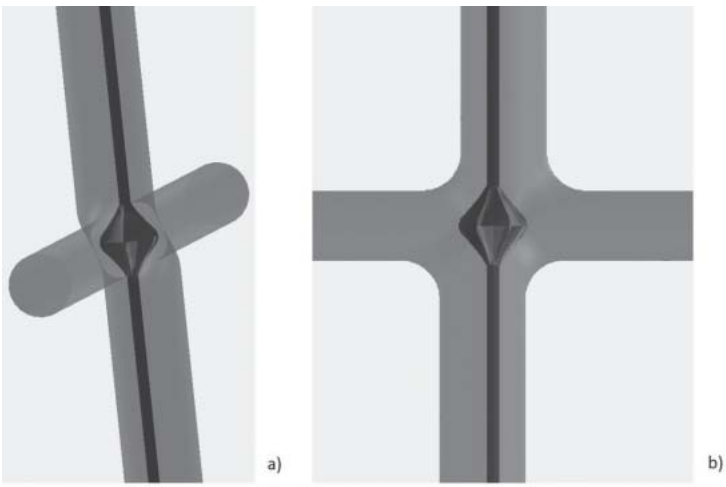

Figure: Two examples of offset geometries studied. a) Anteroposterior caval offset of 25% (0.25 D); b) Left/right caval offset of 25% (0.25 D).

P69

Prolonged White Matter Inflammation After Cardiopulmonary Bypass in a Juvenile Porcine Model

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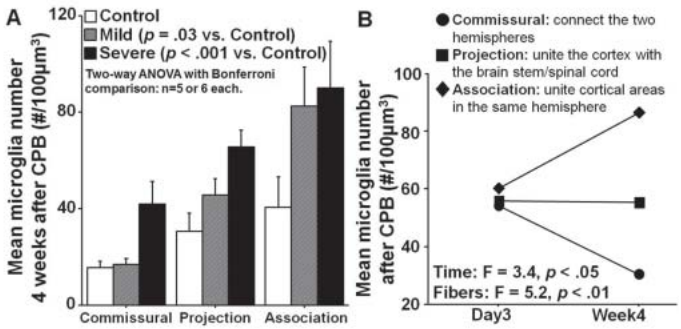
Purpose: White matter (WM) injury is common after neonatal cardiopulmonary bypass (CPB). We have demonstrated that the inflammatory response to CPB (SIRS) is an important mechanism of WM injury. Microglia are brain-specific immune cells that respond to inflammation in the brain and can exacerbate injury. We hypothesized that microglia activation is an important component of WM injury caused by CPB.

Methods: Juvenile piglets were randomly assigned to one of three CPB-induced brain insults: i) no-CPB (Control: No-insult n=10); ii) 34°C-full-flow CPB for 60 min (Mild-CPB: SIRS n=12); and iii) 25oC-circulatory-arrest for 60 min (Severe-CPB: SIRS with ischemia-reperfusion/reoxygenation n=12). Animals were sacrificed 3 days or 4 weeks postoperatively and the brains were retrieved. Microglia and proliferating cells in the WM were immunohistologically identified using specific antibodies (Iba1, Ki67). Antibody-positive cells were blindly quantified using a stereology system. Seven analyzed WM regions in each brain were categorized into three fiber connections (1: Commissural, 2: Projection, 3: Association fibers, Figure B) based on a porcine WM atlas that we developed using diffusion-tensor imaging.

Results: Microglia numbers significantly increased on day 3 after Severe-CPB ($p < 0.001$), but not after Mild-CPB. Fiber categories did not affect these changes. On post-CPB week 4, proliferating cell number, blood leukocyte number and interleukin 6 levels, and neurological scores had normalized. However, both Mild-CPB and Severe-CPB displayed significant increases in the microglia number compared with Control (Figure A). Thus, brain-specific inflammation after CPB persists despite no changes in systemic biomarkers. Microglia numbers were significantly different among fiber categories ($p < 0.001$), being highest in Association and lowest in Commissural connections (Figure A). Thus, there was a WM-fiber-dependent microglia reaction to CPB (Figure B).

Conclusions: This study demonstrates prolonged microglia activation in WM after CPB. This brain-specific inflammation is systemically silent. It is connection fiber dependent, which may impact specific connectivity deficits observed after CPB. Controlling microglia activation after CPB is a potential therapeutic intervention to limit neurological deficits following CPB.



Critical Care

P70

Blood Pressure Management After Cardiac Surgery Is Associated With Glial Fibrillary Acidic Protein Release

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COMMERCIAL RELATIONSHIPS J. V. Conte: Consultant/Advisory Board, Medtronic, Inc; A. Everett: Ownership Interest, ImmunArray Ltd; C. Hogue: Research Grant, NIH, Ornim, Inc, Covidien Ltd, CSL Behring

Purpose: Hemodynamic management after cardiac surgery is still controversial due to the unavailability of a monitoring system to define individualized optimal blood pressure. The purpose of this study was to assess whether blood pressure management based on cerebral autoregulation monitoring is associated with the release of glial fibrillary acidic protein (GFAP).

Methods: Blood samples were collected in 121 patients undergoing cardiac surgery at discontinuation of cardiopulmonary bypass (CPB) and postoperative day 1 for GFAP assay. During surgery, cerebral autoregulation was monitored with near infrared spectroscopy (NIRS) generating the variable cerebral oximetry index (COx), which is a continuous, moving Pearson's correlation coefficient between mean arterial pressure (MAP) and NIRS signals. When autoregulated, there is no correlation between cerebral blood flow and MAP, and COx approaches zero. Optimal blood pressure was defined as the MAP with the lowest COx in the operating room. Blood pressure was recorded in 15-minute intervals in the intensive care unit (ICU).

Results: Seventeen patients (14.1%) had low cardiac output syndrome (LCOS) as defined by usage of inotropes for more than 24 hours or new requirement for intra-aortic balloon pump, and 65 patients (53.7%) had average MAP below the optimal blood pressure in the ICU. After adjusting for GFAP collected at discontinuation of CPB, LCOS (coefficient, 2.07; 95% CI, 1.31-3.27; $p = 0.002$) and average MAP below the optimal blood pressure (coefficient, 1.77; 95% CI, 1.27-2.48; $p = 0.001$) were independently associated with increase in GFAP on postoperative day 1.

Conclusions: Empiric blood pressure management results in end-organ injury to the brain, as evidenced by postoperative elevations in GFAP. Integration of cerebral autoregulation monitoring may be useful in hemodynamic guidance after cardiac surgery.

P71

Sequentially Updated Discharge Model for Optimizing Hospital Resource Use and Surgical Patients' Satisfaction

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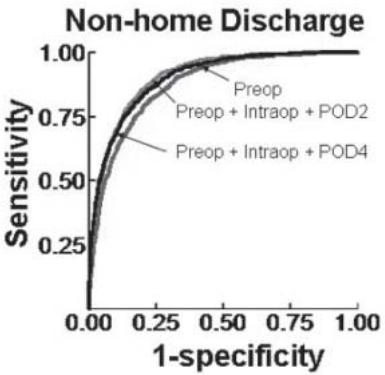
COMMERCIAL RELATIONSHIPS D. R. Johnston: Speakers Bureau/Honoraria, Edwards Lifesciences Corporation, St Jude Medical, Inc; W. Barsoum: Research Grant, Stryker, Zimmer, Inc, CoolSystems, Inc, DJO Global, Active Implants LLC, The Medicines Company, Ohio Third Frontier Grant, American Geriatrics Society, The Orthopaedic Research and Education Foundation; Ownership Interest, OtisMed Corporation, Custom Orthopaedic Solutions inc, iVHR, Inc; Consultant/Advisory Board, KEF Holdings, Stryker; Other, Stryker, Zimmer, Inc, Exactech, Shukla Medical, royalties

Purpose: The ability to predict cardiac surgical patients' length of stay (LOS) and discharge to a continuing care facility (non-home discharge) may allow early discharge planning and optimize use of limited hospital resources. We developed a sequentially updated tool for postoperative discharge planning for both patients and care teams.

Methods: Using preoperative, intraoperative, and postoperative day (POD) 2 and POD4 variables, we performed a logistic regression analysis to create and validate a model to predict early (<4 days), average (5-8 days), delayed (9-14 days), late (>15 days), and non-home discharge.

Results: Accuracy of the LOS model using preoperative variables alone was very good and had a C-statistic of 0.79 that improved with the sequential addition of intraoperative and POD2 (C=0.87) and POD4 (C=0.89) variables. At 48 hours, the strongest predictors were preoperative creatinine, postoperative albumin, elevated blood urea nitrogen, atrial fibrillation, and ICU stay >48 hours. Including POD4 variables, the strongest predictors of lengthened stay were red blood cell use, postoperative albumin, white blood cells on POD4, ICU stay >4 days, and ICU readmission. Preoperative variables alone produced a highly predictive model (C=0.88) of non-home discharge, and the sequential addition of intraoperative and POD2 (C=0.91) and POD4 data (C=0.90) only marginally improved classification (Figure).

Conclusions: LOS can be predicted with preoperative data, but sequential addition of intraoperative and postoperative variables substantially improves prediction of LOS for identifying patients appropriate for early discharge. In contrast, non-home discharge is more dependent on preoperative variables, which can be used by patients and care teams to preoperatively and proactively identify patients for non-home discharge.



P72

A Prediction Model for Unplanned Cardiac Surgery Intensive Care Unit (CSICU) Readmissions

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Purpose: Unplanned CSICU readmissions (bouncebacks) after heart surgery are associated with increased hospital morbidity and mortality. Forecasting which patient will bounce back is challenging. This study aimed to develop a mathematical model that can predict a patient's individualized risk for bounceback.

Methods: We analyzed all isolated coronary artery bypass grafting and aortic valve replacement patients (n=532) between May 2013 and March 2014. Univariate logistic regression was used to examine the relationship between each of 165 perioperative variables and the occurrence of a bounceback. We then performed a multivariate logistic regression analysis on 21 of those variables with p-values <0.05. The most parsimonious predictive model was created by using a stepwise selection methodology aiming for the lowest Akaike Information Criterion (AIC) score. We confirmed the final model's calibration with the Hosmer-Lemeshow test and its performance by determining the area under the receiver operating curve (AUROC).

Results: The most parsimonious model had an AIC score of 66.1 and utilized three predictors: the preoperative New York heart failure classification, the CSICU length of stay, and the patient's height. The AUROC was 0.79. The model had excellent calibration with a Hosmer-Lemeshow p-value of 0.48. The mortality of the 35 patients who bounced back was six times higher than those who did not, 11.4% (4/35) vs 1.8% (9/497) ($p = 0.002$). Furthermore, the average hospital length of stay was 24.8 days versus 12.2 days ($p < 0.001$) and the average cost of hospitalization was $147,000 vs $67,000 ($p < 0.001$).

Conclusions: Bounceback after CSICU transfer is associated with a significant increase in mortality and utilization of health care resources. Understanding an individual patient's risk of bounceback may better direct care after transfer and decrease the chance of this potentially devastating and costly event.

General Thoracic

P73

A Biomimetic Model of Lung Cancer Culture Based on Native Lung Scaffolds Allows for Ex Vivo Testing of Therapeutic Agents

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Purpose: Most candidate therapeutic agents for cancer fail to demonstrate in vitro efficacy, precluding subsequent in vivo pre-clinical testing. A 3-dimensional biomimetic cell culture system may provide an enhanced platform for the assessment of therapeutic efficacy ex vivo. We demonstrated that a novel perfusable 3D culture system for non-small cell lung cancer (NSCLC) based on decellularized lung scaffolds (DLS) allows for ex vivo testing of different therapeutic agents.

Methods: Whole rat lungs underwent constant-pressure perfusion decellularization with sodium dodecyl sulfate via the pulmonary artery (PA). DLS were placed in a custom bioreactor facilitating perfusion of cell-specific media via the PA. Human lung adenocarcinoma cells (H358) were seeded into DLS by tracheal delivery and cultured for 7 to 10 days. Tumor-DLS were treated with an oncolytic Herpes Simplex Virus type-1 (hrR3 1x108 Plaque Forming Units; n=3) or cisplatin (1.1 mM; n=2), with PBS serving as control (n=3). Tissue collected 48 hours after treatment was analyzed by histology and cytotoxicity assessed by a redox-based assay.

Results: The human NSCLC cell line H358 showed engraftment, proliferation, and tumor nodule formation when cultured in DLS. Proliferation rates in DLS were lower when compared to 2D cultures (Ki67: 63% in DLS vs 84% in 2D; $p = 0.025$). Treatment with virus (hrR3) decreased tumor burden to 74% ± 14% of that seen in controls ($p = 0.033$). Replicating virus was confirmed within tumor nodules via β-galactosidase staining. Treatment with cisplatin effectively reduced tumor burden by >99% ($p < 0.0001$ vs control, $p = 0.006$ vs virus).

Conclusions: The 3D culture of NSCLC in decellularized lung scaffolds can establish robust tumor formation and is suitable for testing of various therapeutic agents. This biomimetic culture platform provides natural microarchitectural barriers and constant vascular perfusion, creating an improved model for further cancer therapy applications.

P74

Why General Surgeons Perform Lobectomies in the United States

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Purpose: A significant proportion of lobectomies in the United States are performed by general surgeons. Lobectomies performed by thoracic surgeons are associated with reduced complications and improved survival, and this has led to proposals to restrict lobectomies to high-volume thoracic centers. The aim of the present study was to document geographic variability in lobectomies performed by general and thoracic surgeons, using a Medicare database.

Methods: 2012 Medicare Provider Utilization and Payment Data were utilized. This dataset provides information on physician specialty, submitted charges, and place of service, based on zip code. Procedures were identified based on CPT codes for open and video-assisted thoracoscopic surgical lobectomy, bilobectomy, or pneumonectomy.

Results: A total of 7,663 anatomic pulmonary resections were identified. Of these, 35% (n=2,639) were performed by general surgeons and the remainder (n=5,024) by cardiothoracic surgeons. Cardiothoracic surgeons performed 17.9 resections per year vs 16.2 resections for general surgeons (p = ns). Procedures were performed in 273 zip codes. Lobectomies were performed by both general and thoracic surgeons in only 11% (n=30) of these zip codes.

Conclusions: 89% of lobectomies performed in the US are in zip codes where either a thoracic surgeon or a general surgeon practice, but not both. This suggests that general surgeons perform these operations because thoracic surgeons are not practicing in the same region. Consequently, policies aimed at limiting lobectomies to thoracic surgeons only may be difficult to implement.

P75

What Is the Optimal Transplant for Elderly Patients With Idiopathic Pulmonary Fibrosis?

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Purpose: Bilateral lung transplantation (BOLT) provides greater long-term survival for patients with idiopathic pulmonary fibrosis (IPF) when compared to single lung transplantation (SOLT). However, the long-term benefit may not be fully realized in high-risk patients who may suffer from increased early mortality following BOLT.

Methods: We conducted a retrospective review of the United Network for Organ Sharing (UNOS) database from 1990 to 2013, identifying patients by diagnosis code for IPF. Patients were limited to those 65 years of age or older to define a high-risk cohort. Patients undergoing multiorgan transplantation were excluded. Patients were grouped based on the use of single vs bilateral lung transplantation. Groups were compared for baseline differences. A 1:1 nearest-neighbor algorithm propensity match was performed. Kaplan-Meier analysis was performed to determine differences in survival in the adjusted cohort. The log-rank test was used to determine significance at specific time points.

Results: A total of 1,748 patients met criteria for inclusion in the study, 550 (31.5%) of whom underwent bilateral lung transplantation. There were significant differences at baseline when comparing the SOLT to BOLT groups in median age (68 vs 67, $p < 0.001$), preoperative hypertension (4.8% vs 2.4%, $p = 0.021$), smoking history (57.9% vs 66.4%, $p = 0.001$), functional status at transplant ($p < 0.001$), median lung allocation score (45 vs 49, $p < 0.001$), and median baseline O2 requirement (3 vs 4 L, $p < 0.001$). Following propensity matching, 994 patients remained (497 in each group). No significant differences in baseline variables remained. With regard to survival, SOLT was associated with decreased 6-month mortality while BOLT was associated with decreased 5-year mortality (Table, Figure).

Conclusions: BOLT is associated with increased long-term survival for patients over 65 years of age with IPF, in spite of an inverse relationship in 6-month mortality compared to SOLT. Selecting high-risk patients to undergo a SOLT procedure may lead to marginally improved 6-month survival, but a notable decrease in 5-year survival.

Figure: Kaplan-Meier analysis demonstrating survival differences between patients undergoing single vs bilateral lung transplantation.

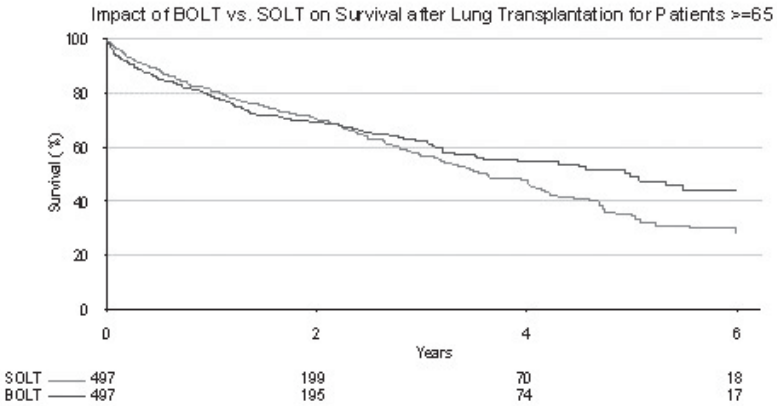

Table: Differences in survival between single and bilateral lung transplantation at various time points along with hazard ratio associated with BOLT as compared to SOLT.

Time	SOLT (95% Confidence Interval)	BOLT (95% Confidence Interval)	p-value
2 Months	95.2% (93.3%, 97.1%)	92.3% (90.0%, 94.7%)	0.068
6 Months	88.6% (85.8%, 91.5%)	85.5% (82.3%, 88.7%)	0.135
1 Year	80.6% (76.9%, 84.4%)	78.9% (75.2%, 82.8%)	0.406
5 Years	34.4% (28.0%, 42.4%)	49.1% (42.5%, 56.8%)	0.249

P76

Gastroesophageal Reflux Aspiration in the Post-Lung Transplant Patient: A Targeted Bile Acid Metabolomic and Lipidomic Approach

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COMMERCIAL RELATIONSHIPS D. Lederer: Consultant/Advisory Board, XVIVO, ImmuneWorks

Purpose: We used a metabolomics approach in the bronchial washings from lung transplant patients to investigate gastroesophageal reflux aspiration. Given the detergent properties of bile acids, we also applied a lipidomic approach to explore the effect of bile acids on bronchoalveolar lipids.

Methods: Bronchial washings (229 samples) were prospectively collected from 138 patients at routine surveillance posttransplant bronchoscopies. Utilizing liquid chromatography-mass spectrometry methods, samples were retrospectively assayed in a semiquantitative fashion for conjugated and unconjugated bile acids and lipids and surfactant phospholipids.

Results: Bronchial washings were positive for bile acids in 29/229 samples. Presence of bile acids associated with higher levels of monosialodihexosylganglioside, lactosylceramide, sphingomyelin, dihydrosphingomyelin, and cholesteryl ester than samples without bile acids (Mann-Whitney, $p < 0.05$). Samples with bile acids showed a strong direct correlation with diacylglycerol (Spearman r=0.75, $p = 0.0004$) and with triglycerides (r=0.5, $p = 0.002$). No difference was noted when comparing conjugated and unconjugated bile acids. When comparing samples with high (upper quartile >0.20), median (interquartile 0.02-0.16), and low (lower quartile <0.01) levels of bile acids, we observed statistically significant differences for cholesteryl-ester, diacylglycerol, triglycerides, sphingomyelin, e-phosphatidylcholine, monosialodihexosylganglioside, lysophosphatidylcholine, lysophosphatidylcholine ester, and lysophosphatidylinositol (Kruskal-Wallis, $p < 0.05$). Post-hoc analysis showed that cholesteryl ester, sphingomyelin, e-phosphatidylcholine, monosialodihexosylganglioside, lysophosphatidylcholine, lysophosphatidylcholine ester, and lysophosphatidylinositol all decreased while diacylglycerol increased with greater levels of bile acids (Mann-Whitney, $p < 0.05$).

Conclusions: Duodenogastroesophageal aspiration detected by targeted bile acid metabolomics was present in 13% of samples. Bile acids in lung-transplant bronchial washings altered lipid and surfactant phospholipid profiles in a dose-dependent fashion. This original finding supports the biologic role of bile acids in lung-allografts rather than solely being an aspiration marker.

P77

Allogeneic Blood Transfusion After Lung Transplantation—Impact on Early Rejection, Function, and Late Survival Outcomes

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Purpose: In general cardiothoracic surgery, allogeneic blood transfusion (ABT) is associated with poor outcomes, but its impact on the bilateral lung transplant (BLT) population remains unclear. ABT has been associated with immunomodulation in other solid-organ transplants. Thus, we investigated the impact of ABT on rejection, survival, and functional outcomes.

Methods: Retrospective review of 311 adult patients who underwent BLT from 2003 to 2013. Patients were stratified based on the amount of blood products transfused within 24 hours of surgery.

Results: 174 male and 137 female patients (mean age 41.4 years ± 14.0 years) underwent BLT, using cardiopulmonary bypass for cystic fibrosis (48.9%), lung fibrosis (12.2%), emphysema (27.0%), bronchiectasis (5.8%), pulmonary hypertension (1.3%) and others (4.5%). The median number of red blood cells (RBC) in the first 24 hours was 3 (0-40) units, fresh frozen plasma (FFP)=2 (0-26) units, platelets (Plts)=1 (0-7) units. Pretransplant diagnosis did not affect transfusion rates. Survival was not influenced by whether patients were transfused with more or less than the median number of units of RBC ($p = 0.162$) or FFP ($p = 0.298$) (Figure 1), but survival was adversely affected by Plts ($p = 0.032$) (Figure 2). Time to first treated rejection/death was not statistically different whether patients were transfused with more or less than the median number of units of RBC ($p = 0.233$), FFP ($p = 0.146$), or Plts ($p = 0.701$). Rate of rejection and number of episodes per patient at 1 year posttransplant were similar for all groups (Figure 3 & Table 1). Mean forced expiratory volume in 1 second (FEV1) at 6 months was significantly better for patients transfused with more than the median number of units of RBC (2.66 vs 2.83, $p < 0.0001$), FFP (2.61 vs 2.89, $p < 0.0001$) and Plts (2.73 vs 2.82, $p < 0.0001$).

Conclusions: Blood transfusion has no effect on survival, but platelet transfusion has an adverse effect. Blood product administration does not affect early rejection outcomes. Interestingly, lung function at 6 months is significantly better for patients with more blood products transfusion.

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Figure 1: Survival Outcomes for Groups stratified by median number of RBC transfused in the first 24 hours

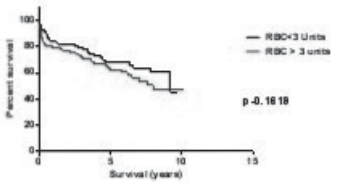

Figure 2: Survival Outcomes for Groups stratified by median number of Platelets transfused in the first 24 hours

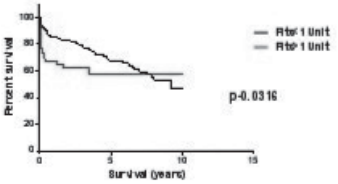

Figure 3: No. of Treated/Severe Rejection Episodes Per Patient at 1 year Post-Tx Based on Blood Products

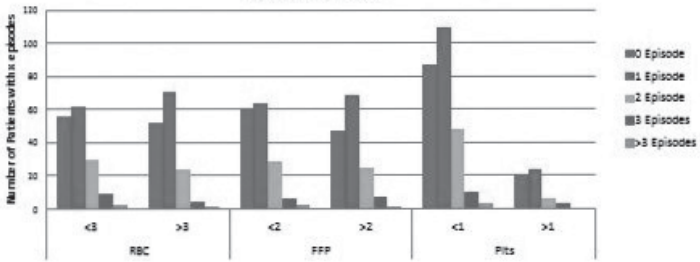

Table 1: Effect of Blood Products Transfusion on Rate of Rejection and Number of Treated Rejection Episodes Per Patient

Type of Blood Products	RBC		FFP		Plts	
Units of Products	<3	>3	<2	>2	<1	>1
Rate of Treated Rejection 1 year Post-Transplant	0.99	0.38	0.46	0.97	0.47	0.83
No. of Treated Rejection Per Patient 1 year Post-Transplant	RBC		FFP		Plts	
	<3	>3	<2	>2	<1	>1
0 Episode	56	52	61	47	87	21
1 Episode	62	71	64	69	109	24
2 Episodes	30	24	29	25	48	6
3 Episodes	9	4	6	7	10	3
>3 Episodes	2	1	2	1	3	0

P78
Left Upper Lobectomy After Coronary Artery Bypass Grafting

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COMMERCIAL RELATIONSHIPS R. J. Cerfolio: Speakers Bureau/Honoraria, Intuitive Surgical, Inc, Life Science Technologies

Purpose: Left upper pulmonary lobectomy after coronary artery bypass grafting (CABG) using internal mammary artery and/or vein grafts risks injury to the grafts.

Methods: A retrospective review of a prospective database of patients who underwent left upper lobectomy after having a previous CABG.

Results: Between June 1998 and June 2014, 458 patients underwent a left upper lobectomy and 53 (11.6%) of them had a previous CABG. All but three patients had a left internal mammary artery (LIMA) used for the bypass. The median time between CABG and left upper lobectomy was 2.1 years. Fifty patients (94%) had adhesions between their lung and the bypass grafts and 43 patients (81%) were graft dependent. Eight patients (15%) had transient intraoperative hypotension. Four patients (8%) had a sliver of their lung left on the grafts. Two had a postoperative myocardial infarction, and there was one operative mortality (attributed to acute respiratory distress). Final pathology showed non-small cell lung cancer in 92% (four patients had N1 disease, and two had microscopic N2 disease). All had complete R0 resection, and all had complete thoracic lymphadenectomy.

Conclusions: Left upper lobectomy after CABG in patients who are graft dependent is safe. Usually, the entire lung can be safely mobilized off the grafts (most notably, the LIMA pedicle) without embolization, or a small sliver of lung can be left on the grafts using a stapler. An R0 resection with lobectomy and complete lymph node removal can be accomplished. Intraoperative hypotension is not uncommon.

P79

Pathologic Upstaging in Patients Undergoing Resection for Stage I Non-Small Cell Lung Cancer (NSCLC): Are There Modifiable Predictors?

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COMMERCIAL RELATIONSHIPS B. F. Meyers: Consultant/Advisory Board, Ethicon, Inc, Varian Medical Systems, Inc

Purpose: A substantial proportion of patients with clinical stage I NSCLC have more advanced disease on final pathologic review. Modifiable perioperative factors may predict upstaging in patients with clinical stage I disease.

Methods: Data from patients with clinical stage I NSCLC undergoing surgical resection were obtained from the National Cancer Database. Information on patient- and tumor-related variables, therapy modalities, and outcomes was abstracted. Logistic regression models were used to identify variables that predict upstaging.

Results: From 1998 to 2010, 55,653 patients with clinical stage I NSCLC underwent surgical resection; of these, 9,530 patients (17%) had more advanced disease on final pathologic review. Of upstaged patients, 27% had T3 or T4 tumors, 74% had positive lymph nodes, and 4% were found to have distant metastasis. Patients with larger tumors (38 mm vs 29 mm, $p < 0.001$) and a delay >8 weeks from diagnosis to resection ($p = 0.003$) were more likely to be upstaged. Upstaged patients also had more lymph nodes examined (10.9 vs 8.2, $p < 0.001$) and were more likely to have positive resection margins (10% vs 2%, $p < 0.001$). Median survival was lower in upstaged patients (39 months vs 73 months) (Figure 1). Predictors of upstaging in logistic regression analysis included larger tumor size, delay in resection >8 weeks, positive resection margins, and number of lymph nodes examined (Table 1). There was a linear relationship between the number of lymph nodes examined and the odds of upstaging (1-3 nodes, OR 2.02; >18 nodes OR 6.04).

Conclusions: Pathologic upstaging continues to be a significant problem with implications for treatment and outcomes in clinical stage I NSCLC. A thorough analysis of regional lymph nodes is critical to identify patients with more advanced disease.

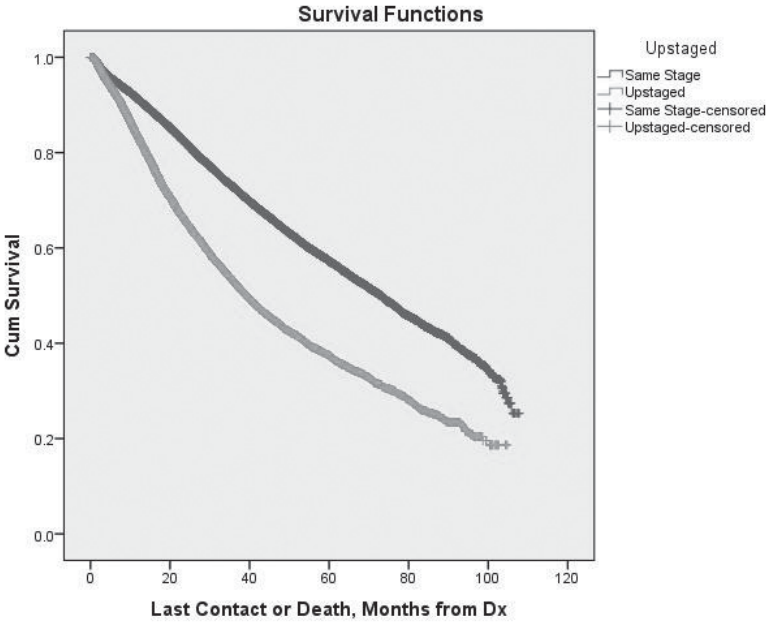

Table 1 – Logistic regression analysis for predictors of upstaging

Variable	Odds ratio (OR) for upstaging	95% Confidence Interval	*P* value
Male gender	1.07	1.01-1.12	0.01
Tumor Size (cm)	1.11	1.09-1.12	<0.001
Delay >8 weeks	1.10	1.04-1.16	0.001
Positive resection margin	4.30	3.88-4.77	<0.001
Number of lymph nodes examined			
1-3	2.02	1.67-2.45	<0.001
4-6	2.87	2.38-3.47	<0.001
7-9	3.76	3.11-4.55	<0.001
10-12	4.11	3.39-4.98	<0.001
13-15	4.50	3.69-5.49	<0.001
16-18	5.64	4.59-6.92	<0.001
>18	6.04	4.98-7.34	<0.001

P80

Risk Stratification of Resected Esophageal Adenocarcinoma: Analysis of Driver Mutations and Gene Amplifications

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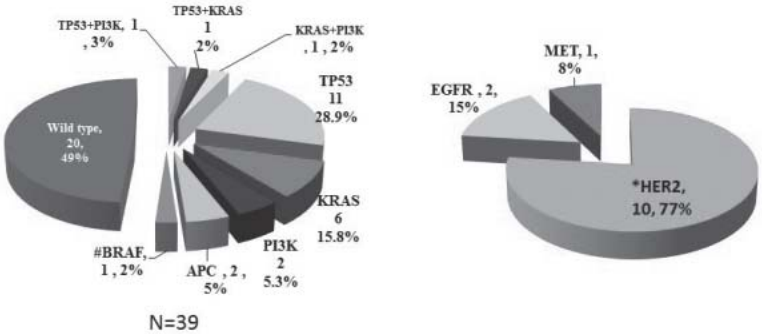
Purpose: Adenocarcinoma of the distal esophagus and esophagogastric junction (EGJ) have received much attention because of increasing frequency and poor outcome despite multimodality therapy. Driver mutations and gene amplifications in resected esophageal adenocarcinoma are not widely investigated. Opportunity exists to discover actionable mutations in resected esophageal adenocarcinoma.

Methods: We analyzed driver mutations harbored in the coding regions of 25 selected genes (95 point mutations) using a multiplex PCR-based assay and HER1, HER2, MET, PI3K amplifications using fluorescent in situ hybridization in patients who underwent esophagectomy for distal esophagus and EGJ adenocarcinoma from 2009 to 2013. Disease free survival (DFS) and overall survival (OS) were compared in patients with TP53, KRAS, PI3K, BRAF, APC mutant, and the wild-type tumors using Kaplan-Meier methods and Cox regression models. The impact of HER2 expression and outcomes were also analyzed.

Results: Of 54 distal esophagus and EGJ adenocarcinoma patients, five driver mutations were observed in 39 patients, including TP53 (11/39, 28.2%), KRAS (6/39, 15.4%), PI3K (2/11, 5.1%), BRAF (1/39, 2.6%), and APC (2/39, 5.1%) (Figure 1A). Double driver mutations (3/39, 7.9%) were shared in three patients with TP53 and KRAS (1/39, 2.6%), TP53 and PI3K (1/39, 2.6%), and KRAS and PI3K (1/39, 2.6%), respectively. Amplifications in HER2 (10/45, 22.2%), MET (1/34, 2.9%), and EGFR (2/17, 11.8%) were observed (Figure 1B) where directed therapy was altered in five patients (ie, one patient received induction and four patients received adjuvant Herceptin). In the targeted patients with HER2 amplification who received Herceptin, mean progression-free survival time was 18.8 (range 7-41 months) vs 8.9 (1-28 months) [$p = 0.089$] and OS was 35.7 (range 26-46 months) vs 24.2 (range 20-29 months) [$p = 0.053$], compared to Herceptin naive patients. We did not identify any significant difference in DFS and OS (inclusive of all stages) between TP53, KRAS, or any mutation compared to wild-type patients.

Conclusions: Oncogenic driver mutations are under-investigated in resected distal esophageal and EGJ adenocarcinoma. Different therapeutic opportunities may become available if routine tumor genotyping is employed in the treatment of esophageal adenocarcinoma. We recommend the routine use of driver mutation and gene amplification analysis for esophageal cancer.

Figure 1. Driver mutations [A] and amplification [B] subtype for EAC patients



*HER2 amplification in 22.2%(10/45) patients. 50%(5/10) HER2 amplification patients received Herceptin plus chemotherapy ... mean DFS 18.8 months (range 7-41 months) and OS 35.7 months (range 26-46 months).
#One patient harbored BRAF mutation and was treated with a BRAF inhibitor.

P81
Clinical Outcomes of Reoperation for Failed Antireflux Surgery

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COMMERCIAL RELATIONSHIPS B. Louie: Consultant/Advisory Board, Torax Medical Inc

Purpose: The use of minimally invasive approaches for reoperative antireflux surgery (ARS) is increasing; however, efficacy comparisons of primary ARS, first reoperation, multiple reoperations, and Roux-en-Y gastrojejunostomy (REY) procedures are lacking, even in literature on open approaches. The purpose of this study is to compare patient outcomes among these groups.

Methods: We performed a retrospective review of patients who underwent revisional surgery following failed ARS from 2003 to 2013. Identified patients were initially divided into three groups (G): G1 - 1 reoperation, G2 - >1 reoperation, G3 - REY. Groups 1 and 2 were further divided into open (O) and minimally invasive (MI) groups. A control group (CG) of patients who had primary ARS for matched indications was included. Patients underwent physiologic testing and quality of life assessment (QOL-RAD, GERD-HRQL, swallowing score) preoperatively, short-, and medium- to long-term postoperatively. Results are expressed as median (IQR) unless otherwise stated.

Results: We identified 102 reoperative patients, age=56 (45-63): G1=84, G2=12, G3=6; and 103 controls, age=56 (47-67). Prior repairs were durable for 55 (20-120) months. Reasons for primary failure included: 16% (13/79) fundoplication herniation, 9% (7/79) fundal herniation, 4% (3/79) fundoplication slippage, 5% (4/79) fundoplication disruption, and 66% (52/79) combination. G1 had pre- and postoperative outcomes similar to the CG (Table). Intraoperative complications were slightly higher in reoperations, but postoperative complications were comparable. G2 outcomes were also similar to CG and G1, but postoperative QOL tended to be inferior. Patients in G3 had a higher BMI, with a higher rate of postoperative complications. The majority of G1 procedures were performed MI=68 vs O=16, while G2 was MI=6 vs O=6. There were no significant differences in operative and short-term postoperative data between MI and O (data not shown). At 12 (7-20) months follow-up, QOL-RAD was significantly lower in O-G2 (3.2) vs O-G1 (6.3), $p < 0.05$.

Conclusions: Initial revisional surgery following failure of primary ARS may be performed with similar complication rates, outcomes, QOL and symptom control to those following the primary repair, while subsequent reoperations may result in slightly inferior outcomes. A minimally invasive approach offers similar outcomes with improved postoperative QOL compared to open procedures.

	CG [N=103]	G1 [N=84]	G2 [N=12]	G3 [N=6]
PRIMARY SURGERY				
Nissen	74% (76/103)	66% (56/84)	83% (10/12)	100% (6/6)
Hill	25% (26/103)	30% (25/84)	17% (2/12)	0
Toupet	0	4% (3/84)	-	0
PREOPERATIVE DATA				
BMI	28.4 (25.4-32.2)	30.8 (27.2-33.6)	29.8 (26.6-34.1)	39.7 (33.9-44.2)*
Median QOL-RAD (IQR)	4.0 (2.8-5.2)	3.9 (2.3-4.5)	3.5 (2.9-4.3)	4.2 (3.0-6.0)
Median HRQL (IQR)	22.0 (12.0-30.0)	26.0 (16.0-34.0)	13.0 (12.0-28.0)	16.0 (13.0-24.0)
Median Dysphagia Score (IQR)	40.5 (27.3-45.0)	33.0 (20.0-40.0)	30.5 (23.8-38.8)	28.5 (26.0-41.5)
REOPERATIVE DATA				
Nissen	-	81% (68/84)	67% (8/12)	-
Hill	-	18% (15/84)	25% (3/12)	-
Toupet	-	1% (1/84)	8% (1/12)	-
Collis performed	4% (4/103)	4% (3/84)	0	0
Intraoperative complications	5% (5/103)	19% (16/84)	33% (4/12)	33% (2/6)
POSTOPERATIVE DATA				
Postoperative complications	8% (8/103)	7% (6/84)	8% (1/12)	17% (1/6)
Return to OR	2% (2/103)	4% (3/84)	0	33% (2/6)
Readmissions	7&% (7/103)	13% (11/84)	8% (1/12)	50% (3/6)
SHORT-TERM POSTOPERATIVE [2 MONTHS (2-3)]				
Median QOL-RAD (IQR)	6.6 (5.7-7.0)	6.7 (6.0-7.0)	4.5 (3.4-6.6)	-
Median HRQL (IQR)	5.0 (2.0-8.0)	4.0 (2.0-7.5)	5.0 (1.0-7.0)	-
Median Dysphagia Score (IQR)	28.0 (15.4-36.0)	28.0 (21.0-45.0)	26.8 (25.4-33.8)	-
Resolution of Primary Symptom	95% (77/81)	89% (56/63)	73% (8/11)	100% (1/1)
LONG-TERM POSTOPERATIVE [12 MONTHS (7-20)]				
Median QOL-RAD (IQR)	6.9 (6.0-7.0)	6.4 (5.1-7.0)	4.3 (3.2-5.4)	-
Median HRQL (IQR)	4.0 (1.0-8.0)	5.5 (4.0-8.8)	9.0 (4.5-12.5)	-
Median Dysphagia Score (IQR)	45.0 (36.5-45.0)	40.5 (24.5-45.0)	38.0 (32.5-41.5)	-
Resolution of Primary Symptom	78% (38/49)	83% (34/41)	40% (2/5)	100% (1/1)
*$p<0.05$				

P82

Pre-Treatment Dysphagia in Esophageal Cancer May Eliminate the Need for Staging by Endoscopic Ultrasonography

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Purpose: Neoadjuvant therapy is typically given to patients with non-metastatic T3-4 esophageal cancers as identified by endoscopic ultrasound (EUS). We have noted that patients with dysphagia have a higher EUS T stage. We hypothesize that the patient dysphagia score is predictive of an EUS T3-4 tumor, thus potentially eliminating the need for EUS in esophageal cancer patients with dysphagia.

Methods: We performed a prospective, IRB-approved, intent-to-treat, single-cohort study in which patients with potentially resectable esophageal cancer completed a standardized four-tiered dysphagia score survey. EUS was performed as part of our standard evaluation. The dysphagia score was compared to the EUS T stage to determine whether presence of dysphagia predicted EUS T3-4 tumors.

Results: One hundred fourteen consecutive patients were enrolled between August 2012 and February 2014. EUS and dysphagia scores were recorded. Eighty-eight (77%) received neoadjuvant therapy, 20 did not, and six did not consent or pursued treatment elsewhere. Eighty patients underwent an open esophagectomy (43) or minimally invasive esophagectomy (37). Thirty patients did not undergo resection for metastatic disease (12), progression (6), poor performance status or death after induction therapy (5), treatment elsewhere (3), and other (4). Sixty-one patients (54%) had dysphagia (grade 1-4) and 53 patients (46%) did not. In patients with dysphagia, 40 were grade 1, 15 patients were grade 2, and six patients were grade 3-4. Among patients with any dysphagia, 89% (54/61) had EUS T stage of 3-4, whereas 53% patients (28/53) without dysphagia had EUS T stage 3-4 ($p < 0.001$).

Conclusions: The presence of dysphagia with esophageal cancer was highly predictive of EUS T3–4. For our patient population, 54% of patients currently undergoing a staging EUS could potentially forego EUS prior to neoadjuvant therapy. In contrast, patients without dysphagia should still undergo EUS.

EUS T Stage	Dysphagia		
	No	Yes	Total
3 or 4	28 53%	54 89%	82
2 or less	25 47%	7 11%	32
Total	53	61	114

Dysphagia Score: 0: Able to eat normal diet. 1: Able to eat some solid food. 2: Able to eat semisolids only. 3. Able to swallow liquids only. 4: Unable to swallow.

P83

Nonanatomic Prognostic Factors in Surgically Resected T1-3N0 Esophageal Squamous Cell Carcinoma

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Purpose: The purpose of this study was to determine the patterns and risk factors for recurrence in patients with node-negative esophageal squamous cell carcinoma (ESCC).

Method: We retrospectively analyzed the medical records of 286 patients who had confirmed T1-3N0 ESCC by curative esophagectomy without neoadjuvant therapy. The following potential prognostic factors for recurrence were investigated: age, sex, pathologic T status, location of tumor, grade of differentiation, lymphatic invasion, venous invasion, perineural invasion, and maximum standardized uptake value (SUVmax).

Results: There were 266 male patients with a mean age of 65.3 years ± 7.5 years. The median follow-up period was 52.3 months. The mean number of lymph nodes dissected was 38.0, and all lymph nodes were negative for tumor. The T-stage distribution was as follows: T1, 189 patients (66%); T2 , 32 patients (11%); T3, 65 patients (23%). T status, venous invasion, perineural invasion, and SUVmax ≥6 were significant risk factors for recurrence based on univariate analysis. Multivariate analysis showed venous invasion [hazard ratio (HR), 3.86; $p = 0.003$] and SUVmax ≥ 6 (HR, 2.55; $p = 0.006$) as independent risk factors for recurrence. The 5-year recurrence-free survival (RFS) was 37.2% for patients with venous invasion and 69.3% for those without ($p < 0.001$). The 5-year RFS was 54.6% for patients with SUVmax ≥6 and 79.4% for those with SUVmax <6 ($p < 0.001$).

Conclusions: Venous invasion and high SUVmax could be important prognostic factors, along with anatomical determinants such as TNM staging system, in patients with node-negative ESCC. Effective surveillance and individualized adjuvant therapy may help improve the outcome of patients with node-negative ESCC, particularly when accompanied by venous invasion and high SUVmax.

Fig 1. *Freedom from recurrence (A) and recurrence-free survival (B) curves according to the prognostic factors.*

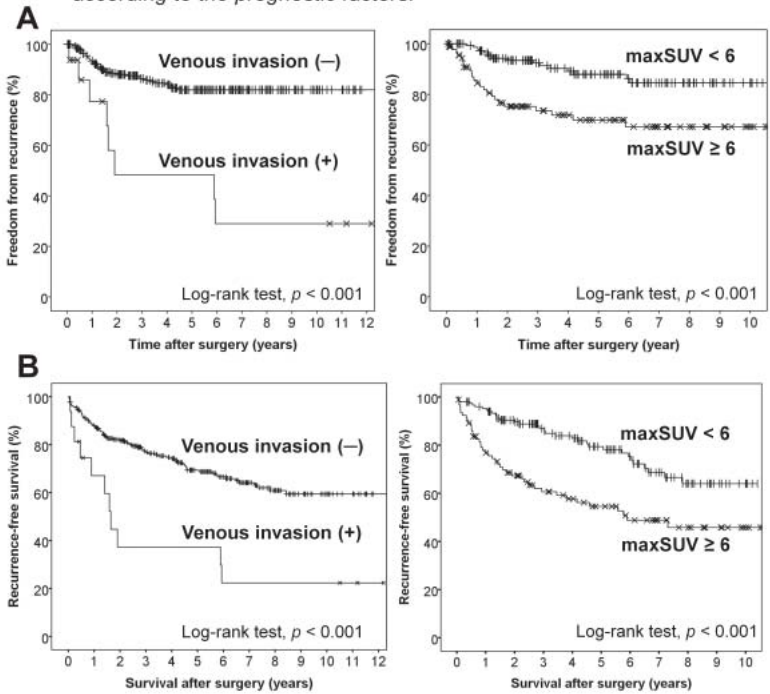

Table 1. *Risk Factors for Recurrence in Node-Negative Esophageal Squamous Cell Carcinoma.*

Variables	Univariate Analysis	Multivariate analysis	
	P	HR (95% CI)	P
Age, years	0.567		
Sex (female vs male)	0.131		
T status (T1 vs T2/T3)	< 0.001		
Location of tumor (lower vs upper/middle)	0.277		
Grade of differentiation (G1 vs others)	0.600		
Lymphatic invasion	0.138		
Venous invasion	<0.001	3.860 (1.567-9.509)	0.003
Perineuronal invasion	0.002		
SUVmax (≥ 6 vs < 6)	< 0.001	2.553 (1.310-4.973)	0.006

SUVmax = maximum standardized uptake value; HR = hazard ratio; CI = confidence interval.

P84

Impact of Positive Margins on Survival in Patients Undergoing Esophagectomy for Esophageal Cancer

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COMMERCIAL RELATIONSHIPS T. D'Amico: Consultant/Advisory Board, Scanlan International

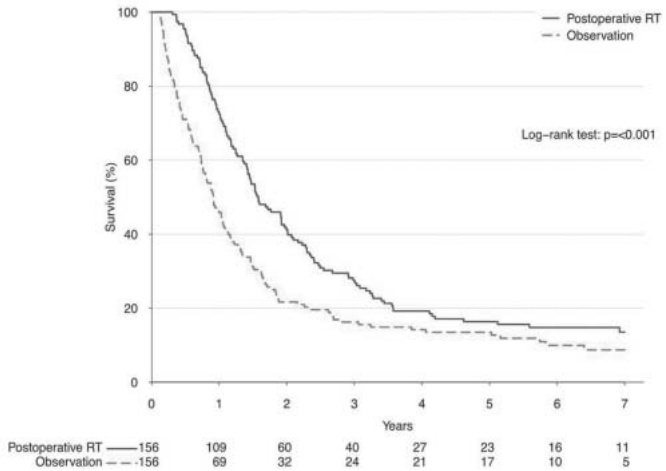
Purpose: Treatment that includes esophagectomy represents the best option for cure for many patients with esophageal cancer. We analyzed the impact of incomplete resection on outcomes after esophagectomy for esophageal cancer.

Methods: The incidence of positive margins for patients who underwent esophagectomy without induction therapy for pathologic T1-3N0-1M0 esophageal cancer of the mid- and lower esophagus from 2003 to 2006 in the National Cancer Database was analyzed with multivariate logistic regression. The impact of positive margins on survival was assessed using Kaplan-Meier and Cox proportional hazard analysis.

Results: Positive margins occurred in 312 of 3,095 (10%) patients who met study criteria. Increasing clinical T status was an independent predictor of positive margins in multivariate analysis, but the chance of positive margins decreased with larger facility case volumes (Table). The presence of clinical nodal disease was not predictive of an incomplete resection. The 5-year survival of patients with positive margins was significantly worse than that of patients with negative margins (15% [95% CI 11.4-19.7] vs 46.3% [95% CI 44.4-48.3%], $p < 0.001$). Both microscopic residual disease (HR 1.35 [95% CI 1.14-1.60], $p = 0.001$) and gross residual disease (HR 2.11 [95% CI 1.71-2.61], $p < 0.001$) predicted worse survival in multivariate analysis of the entire cohort. Receiving adjuvant radiation therapy improved 5-year survival of patients with positive margins (16.4% [95% CI 11.3-23.6%] vs 13.5% [95% CI 9-20.3%], $p < 0.001$) (Figure).

Conclusions: Positive margins occur not uncommonly when patients undergo esophagectomy without induction treatment and are associated with poor survival. Adjuvant therapy only marginally improves survival. Future studies are needed to better evaluate whether induction therapy can lower the incidence of positive margins.

Figure 2. Survival among margin+ patients following surgery



Predictors of positive margins (multivariate logistic regression)

Risk Factor	Odds Ratio	95% Confidence Interval	*p*-value
Clinical T stage			
T2	2.88	1.32 – 6.27	0.01
T3	8.29	3.92 – 17.52	<0.001
T4	14.98	2.38 – 94.41	0.004
Female sex	0.94	0.48 – 1.84	0.86
Facility volume (per 10 cases)	0.13	0.03 – 0.63	0.01
Age (per decade)	1.12	0.88 – 1.42	0.367
Race			
Black	1.19	0.40 – 3.56	0.76
Other	0.70	0.08 – 5.83	0.74
Charlson comorbidity score (per unit)	1.16	0.79 – 1.72	0.45
Education above median	1.09	0.61 – 1.96	0.77
Income above median	1.32	0.71 – 2.48	0.38
Clinical nodal disease	0.69	0.39 – 1.22	0.20
Patient travel distance	1.03	0.99 – 1.06	0.17

P85

Endoscopic Ultrasound Estimates for Tumor Depth at the Gastroesophageal Junction Are Less Accurate for Early Mid-Stage Patients: Implications for the Liberal Use of Endoscopic Resection

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COMMERCIAL RELATIONSHIPS D. C. Rice: Consultant/Advisory Board, Olympus America, Inc; S. G. Swisher: Consultant/Advisory Board, GlaxoSmithKline

Purpose: Endoscopic ultrasound (EUS) frequently guides the treatment of esophageal carcinoma. Studies historically report greater than 80% sensitivity and 90% specificity, but our experience suggests less accuracy in staging tumors at the gastroesophageal (GE) junction. The objective of this study is to determine the accuracy of EUS for determining the depth of GE junction cancer.

Methods: IRB approval was granted for this study. A retrospective review of a prospective database at a high-volume institution was performed for patients with GE junction esophageal cancer who underwent EUS staging and resection (surgical or endoscopic) without neoadjuvant therapy from 1995 to 2014. Patient, tumor, EUS, and pathologic characteristics were examined.

Results: For the 181 patients who met the criteria, the median age was 66 years, 83% were male, 91% were Caucasian, and 98% had adenocarcinoma. EUS (u) and pathologic (p) distribution are shown in Table 1. Concordance between uT and pT was 48%, with 23% under-staged and 29% over-staged. EUS was accurate in: uT0 6% (1/18), uT1a 56% (23/41), uT1b 58% (41/71), uT2 10% (2/21), and uT3 70% (21/30). Inaccurate EUS depth had potential to lead to over-treatment in 38% (27/71) of uT1b and 76% (16/21) of uT2 (Figure 1a). Pathologic T1a tumors were greater than uT1a 50% of the time (Figure 1b). Logistic regression revealed tumor length (continuous variable) to be associated with inaccurate uT ($p = 0.017$). Accurately staged tumors were significantly longer than inaccurately staged tumors (2.7 vs 1.7 cm, $p = 0.011$).

Conclusions: Although EUS plays an important role in assessing tumor depth and lymph node status in esophageal cancer, early to intermediate GE junction tumors are frequently over-staged. This highlights the importance of diagnostic endoscopic resection to augment EUS staging for determining accurate tumor depth and selecting correct therapy.

Figure 1:Figure 1: Bar graphs demonstrating (a) the distribution of pathologic depth of EUS T2 tumors, and (b) the distribution of EUS depth of pathologic T1a tumors.

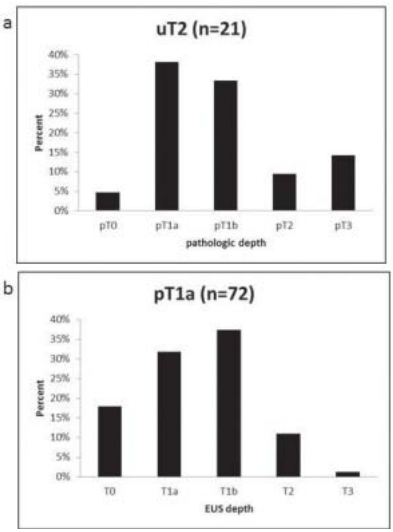

Table 1

tumor depth (n=181)	pathological n (%)	EUS n (%)	EUS incorrect n (%)	understaged/ overstaged %
T0	4 (2.2)	18 (9.9)	17 (94.4)	94.4/0.0
T1a	72 (39.8)	41 (22.7)	18 (43.9)	16.0/2.0
T1b	72 (39.8)	71 (3.92)	30 (42.2)	4.2/38.0
T2	7 (3.9)	21 (11.6)	19 (90.5)	14.3/76.2
T3	24 (13.3)	30 (16.6)	9 (30.0)	6.7/23.3
T4	2 (1.1)	0 (0)	-	-

P86

Feasibility of Segmentectomy in Clinical-T1b Lung Cancer Patients With Radiological Solid Dominant Appearance on Thin-Section CT Scan

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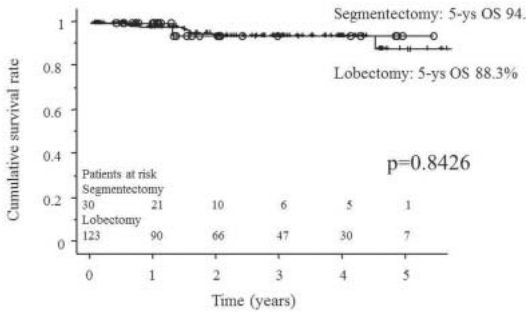
Purpose: A phase III trial regarding the feasibility of segmentectomy for small-sized lung cancer is under way in Japan. But the appropriate operative strategy for c-T1b lung cancer is still controversial, especially for those of radiologically solid dominant appearance based on thin-section CT scan.

Methods: We examined surgically resected 153 c-T1b lung cancers with radiological solid dominant (SD) appearances based on thin-section CT scan. Radiological SD was defined as 0.5 ≤consolidation/tumor ratio (CTR) <1.0. Preoperative thin-section CT was reviewed and maximum standardized uptake value (SUVmax) on positron emission tomography was recorded for all. Several clinicopathological factors were evaluated to elucidate the prognostic factors using a multivariate analysis. Survival was calculated by Kaplan-Meier estimation.

Results: The cohort was consisted of 67 male and 86 female, with an average age of 69 years. Regarding the radiological findings of c-T1b SD lung cancer, the mean tumor size was 24 mm and the mean CTR was 0.69 (range: 0.50-0.96). Pathological nodal metastasis, lymphatic invasion, vascular invasion, and pleural invasion were found in six (4%), 26 (17%), 20 (13%), and 15 (10%) patients, respectively. Lobectomy was performed in 123 (80%) and segmentectomy in 30 (20%), with no differences between them in demographics, comorbidities, or clinicopathological factors. Relapse-free survival (RFS) and overall survival (OS) of c-T1b SD lung cancer was 84.5% and 89.4%. According to operative modes, RFS in patients who underwent lobectomy and segmentectomy was 82.4% and 94.1% (p = 0.4406). Based on multivariate analysis, carcinoembryonic antigen and SUVmax levels were significant predictive factors of postoperative recurrence (p = 0.0281, 0.0095), whereas operative modes were not affected (p = 0.4057). Furthermore, OS in patients who underwent lobectomy and segmentectomy was equivalent (88.3% vs 94.1%, p = 0.8426) (Figure), and any significant factors related to the OS were not detected.

Conclusions: The surgical outcomes of c-T1b SD lung cancer are excellent and equivalent despite their surgical modes, which is due to the existence of ground glass opacity component. In the future, a prospective study should be addressed to elucidate the feasibility of segmentectomy for c-T1b SD lung cancer.



Survival curve based on the operative mode

P87

Thoracic Revised Cardiac Risk Index Is Associated With Prognosis After Resection for Stage I Lung Cancer

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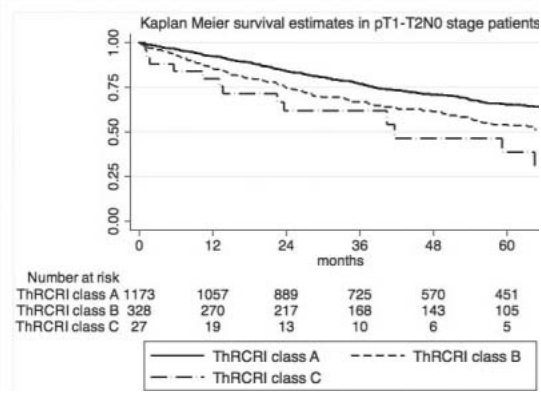
COMMERCIAL RELATIONSHIPS A. Brunelli: Consultant/Advisory Board, Medela; M. K. Ferguson: Nonremunerative Position of Influence, CTSNet.org, officer and editor; Other, Elsevier, I receive royalties and a stipend for editorial services, Springer, I receive royalties; G. Varela: Consultant/Advisory Board, Atrium Medical Corporation; Other Research, Covidien Ltd, Baxter

Purpose: Thoracic Revised Cardiac Risk Index (ThRCRI) has been shown to be useful in assessing lung resection candidates for risk of postoperative major cardiac events. The objective of this investigation is to evaluate whether ThRCRI is an independent prognostic factor after resection for pathological stage I non-small cell lung cancer (NSCLC).

Methods: Observational analysis of 1,530 patients (2000-2011) undergoing lobectomy (1,432) or pneumonectomy (98) for pathological stage I (T1 or T2-N0 only) NSCLC in three thoracic surgery units. Survival was calculated by the Kaplan-Meier method. The log-rank test was used to assess differences in survival between groups. The relationships between the survival and several baseline and clinical variables were determined by Cox multivariate analyses.

Results: Median follow-up was 77 months. Median and mean ThRCRI scores were 0 (range 0-4) and 0.4. Patients were assigned to risk classes according to their ThRCRI score: Class A (score 0-1), 1,174 patients; Class B (score 1.5-2.5), 329 patients; Class C (score >2.5), 27 patients. Patients in class A had longer 5-year and median overall survival (66% and 98 months) compared to those in class B (54% and 68 months) and C (38% and 42 months) (log-rank test, $p < 0.0001$). ThRCRI remained an independent prognostic factor after Cox regression analysis (HR 1.2, $p = 0.007$) with age (HR 1.03, $p < 0.0001$), pT stage (HR 1.5, $p < 0.0001$), and FEV1 (HR 0.98, $p < 0.0001$). Cancer-specific survival was longer in patients with ThRCRI class A compared to class B and C (5-year survival, 78%, 72%, and 48%, respectively) (log-rank test $p = 0.04$). Mortality from cardiac events during follow-up was 0.2% in class A, 7% in class B, and 18% in class C ($p < 0.0001$).

Conclusions: ThRCRI represents a useful prognostic score in patients undergoing resection for early stage lung cancer. Patients with a score greater than 2.5 should be counseled about their increased risk of major perioperative cardiac events and their expected decreased long-term survival.



P88

Impact of Surveillance on Long-Term Outcomes for Early Stage Non-Small Cell Lung Cancer Following Surgical Resection

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COMMERCIAL RELATIONSHIPS D. Flum: Ownership Interest, BenchMarket Medical; Consultant/Advisory Board, Pacira Pharmaceuticals, Inc, Patient-Centered Outcomes Research Institute (PCORI); Nonremunerative Position of Influence, Surgical Consulting LLC, Expert Witness/Legal case review

Purpose: The relationship between lung cancer surveillance and survival is not well characterized. We sought to examine whether an association exists between the use of surveillance imaging and long-term survival among resected early stage non-small cell lung cancer (NSCLC) patients.

Methods: A retrospective cohort study was conducted using SEER-Medicare data (1995-2010). Patients with stage I and II NSCLC undergoing surgical resection were categorized by first imaging modality and outpatient clinic visit during the initial surveillance period. Primary outcomes were post-resection overall and lung cancer-specific survival.

Results: Only 24% of patients received CT scans as their first imaging and 88% received an outpatient clinic visit during the initial surveillance period (4-8 months following resection). Overall 5-year survival by first surveillance imaging was 61% for CT, 58% for chest X-ray, and 60% for no imaging. Following adjustment, there was no difference in overall survival for patients receiving surveillance CT (HR 1.04; 95% CI 0.96-1.14) compared to no imaging. Clinic visit was associated with a lower risk of death (HR 0.84; 95% CI 0.79-0.89) compared to no imaging. On subanalysis restricted to those patients with demonstrated initial follow-up, CT was associated with a lower overall risk of death for stage I patients (HR 0.85; 95% CI 0.74-0.98), but not for Stage II (HR 1.01; 95% CI 0.71-1.42). There was no difference in lung cancer-specific survival associated with surveillance CT for either stage I or stage II patients.

Conclusions: Surveillance CT imaging is associated with better overall survival among stage I patients who are followed after resection, but not lung cancer-specific survival. Potential reasons for this association include early detection of new or recurrent cancers or healthy patient selection bias. Proving a survival benefit attributable to routine surveillance imaging requires a prospective randomized trial.

P89

Chest Wall Sarcomas: Impact of Adjuvant Radiation Therapy on Survival Following Surgical Resection in a Propensity Score-Matched Large Population Cohort

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Purpose: Chest wall sarcomas are rare tumors of the bones and soft tissues surrounding the thoracic cavity. The objective of this study is to evaluate the impact of adjuvant radiation therapy on survival following surgical resection using the Surveillance, Epidemiology, and End Results (SEER) database.

Methods: We queried the SEER database for all surgically resected, histologically proven primary chest wall sarcomas between 1998 and 2010. Exclusion criteria included pediatric sarcomas, multiple malignancies, and unknown grade, stage, or radiation therapy status. Chi-square tests were performed to identify covariates associated with receiving adjuvant radiation therapy. Propensity scoring was used to generate a matched cohort of patients who received adjuvant radiation following surgery and patients who underwent surgery alone. Cox regression and Kaplan-Meier analyses were performed to determine covariates associated with overall survival.

Results: A total of 1,013 patients (636 surgery alone, 377 surgery with radiation) were included in the cohort prior to matching based on the selection criteria. Gender ($p = 0.049$), tissue origin ($p < 0.001$), histological type ($p < 0.001$), tumor size ($p = 0.002$), and grade ($p < 0.001$) were independently associated with receiving radiation therapy. Kaplan-Meier survival analysis of propensity score matched groups (340 matched pairs radiation therapy + surgery vs surgery alone) showed no difference in the effect of adjuvant radiation therapy on overall survival. Cox regression showed improved survival of adjuvant radiation therapy only in grade 4 sarcomas ($p = 0.002$).

Conclusions: In a propensity-matched large population cohort, adjuvant radiation therapy appears to improve survival following surgical resection only in high-grade chest wall sarcomas. Further randomized controlled trials are required to determine the efficacy of adjuvant radiation therapy in this population.

P90

The Safety of Thoracoscopic Surgery for Lung Cancer in Patients Taking Antiplatelet Agents Without Interruption

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Purpose: We assessed the safety of thoracoscopic surgery for lung cancer in patients taking antiplatelet agents (APAs) without interruption.

Methods: Between January 2009 and May 2014, there were 110 patients taking APAs at the time of deciding thoracoscopic surgery for lung cancer. The patients were divided into a non-interruption group (group N, n=39) and interruption group (group I, n=71). Intraoperative and postoperative outcomes were compared retrospectively.

Results: There was no difference in patient demographics, including age, sex, number of cardiac co-morbidities, and number of APAs between the two groups except for the proportion of patients taking clopidogrel (14 [35.9%] vs 7 [9.9%]) (Table 1). Lobectomy was performed in most patients from both groups (36 [92.3%] vs 66 [93.0%], $p = 0.698$). Surgical outcomes, such as thoracotomy conversion rates, operative time, and estimated blood loss, were not statistically different in both groups (Table 1). There was no reoperation due to bleeding, major adverse cardiac events, or mortality in both groups. Transfusion rates, total chest tube drainage, duration of chest tube, and length of hospital stay were similar in both groups (Table 1).

Conclusions: This study showed that patients who were receiving APAs without interruption could safely undergo thoracoscopic surgery for lung cancer. Larger data are mandatory to verify these results.

Table 1. Demographic and perioperative outcomes

Variables	Group N (n=39)	Groups I (n=71)	*p* value
Age (median, range)	70 (58-83)	70 (52-85)	0.276
Sex, No (%)			
Male	26 (66.7%)	49 (69)	0.800
Cardio-Vascular co-morbidities, No. (%)			0.155
0	2 (5.1%)	9 (12.7%)	
1	16 (41%)	38 (53.5%)	
2	19 (48%)	20 (28.2%)	
3 +	2 (5.1%)	4 (5.6%)	
Antiplatelet agent, No. (%)			0.468
Aspirin	30 (76.9%)	60 (84.5%)	0.324
Clopidogrel	14 (35.9%)	7 (9.9%)	0.001
Other	4 (10.4%)	12 (17.1%)	0.330
Primary site, No (%)			0.940
right	25 (64.1%)	45 (64.4%)	
left	14 (35.9%)	26 (36.6%)	
Adhesion, No. (%)	18 (46.2%)	22 (31.0%)	0.114
Operation			0.698
Bilobectomy	0	1 (1.4%)	
Lobectomy	36 (92.3%)	66 (93%)	
Segmentectomy	3 (7.7%)	4 (5.6%)	
Reoperation due to bleeding	0	0	
Thoracotomy conversion, No. (%)	2 (5.1%)	2 (2.8%)	0.614
Operative time (min), median (range)	125 (54-307)	138 (60-331)	0.938
Hb down (mg/dl), Mean ± SD	1.176 ± 1.56	1.060 ± 1.09	0.682
Blood loss (ml), median (range)	75 (0-2900)	50 (0-3900)	0.463
Transfusion	5 (12.8%)	2 (2.8%)	0.095
Chest tube drainage for 3 day (ml), median (range)	690 (310-2280)	720 (130-3080)	0.950
Duration of chest tube (day), median (range)	4 (2-15)	4 (2-18)	0.408
Length of hospital stay (day), median (range)	5 (3-18)	5 (3-18)	0.656

Hb down (Preop Hemoglobin – Hemoglobin at Postoperative day #1)

P91

Logistic Regression Decision Aid for In-hospital Mortality in 1,082 Flail Chest Patients

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Purpose: Operative repair of flail chest appears to be superior to standard methods of care but is underused. There is uncertainty about the indications. The objective of this study was to create a simple decision aid using preoperative covariates to calculate individual risk of mortality in flail chest patients.

Methods: Data from the Ontario Trauma Registry identified 1,082 adult flail chest patients who survived ≥24 hours after admission to one of 11 lead trauma hospitals from January 1, 1999, to March 31, 2009. Logistic regression model predictors were selected from 15 parameters. Survivors and non-survivors of flail chest were compared using independent t tests and Fisher's exact tests adjusting for multiple testing with the Bonferonni correction ($p < 0.003$). The final model was validated for calibration and discrimination using the Hosmer-Lemeshow goodness of fit test and optimism-corrected c index. Risk scores for mortality were calculated using the method developed to produce the Charlson Comorbidity Index.

Results: The derived decision aid uses six risk factors that are easily obtained during the initial assessment of the trauma patient: age, Glasgow Coma Score, ventilation, definitive airway, CPR, and comorbidities (Hosmer-Lemeshow test $p = 0.14$, optimism-corrected c index 0.828). It was determined that <6 points is consistent with <2% observed mortality, six to 12 points with <10% mortality, 12 to 14 points with 27% mortality, and 15 or more points with 45% mortality. Using this point system, 87% of the sample would have a predicted risk of mortality less than 10%.

Conclusions: This is the first study to examine the risk of in-hospital mortality in flail chest patients. This model has the potential to be a useful tool for surgeons considering operative repair of flail chest.

P92

Perioperative Red Blood Cell Transfusion: Independent Risk Factor for Acute Respiratory Distress Syndrome After Pneumonectomy

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Purpose: Pneumonectomy is associated with high risk of respiratory complications. Blood transfusions have been shown to increase risk of Acute Respiratory Distress Syndrome (ARDS). Our objective was to determine if perioperative transfusions are associated with increased rates of ARDS in adult patients undergoing elective pneumonectomy.

Methods: Retrospective cohort study of consecutive pneumonectomies performed at a tertiary hospital between 2003 and 2013. Multivariable logistic regression was performed to adjust for demographic variables, lung function, comorbidities, postoperative fluid balance, preoperative radiation or chemotherapy, and era of treatment (2003-2008 vs 2009-2013). ARDS was defined according to Berlin criteria.

Results: ARDS occurred in 24% (n=38) of the 161 pneumonectomies. Packed red blood cells (*p*RBCs), fresh frozen plasma (FFP), and platelets were transfused in 27% (n=43), 6% (n=9), and 2% (n=3) of patients, respectively. On adjusted analyses considering pRBC use as a binary variable, pRBC use was the only independent predictor of ARDS (OR=3.9, 95% CI: 1.7-8.8, $p = 0.001$). On adjusted analyses considering pRBC use as a continuous variable, incremental use of pRBC units independently predicted ARDS (OR=1.3, 95% CI: 1.1-1.6, $p < 0.001$). Use of intraoperative steroids independently predicted lower rates of ARDS (OR=0.3, 95% CI: 0.09-0.8, $p = 0.02$) but did not appear to abrogate the deleterious effects of pRBC use.

Conclusions: Perioperative pRBC use appears to be an independent risk factor for ARDS after pneumonectomy. Use of pRBCs showed a significant dose-response relationship with ARDS. Platelets and FFP did not appear to increase risk of ARDS but this may be due to the low utilization rate of these blood products. Our findings support minimizing pRBC use during the perioperative care of pneumonectomy patients.

P93

Discharging Patients Home Using a Digital Chest Tube Drainage System

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COMMERCIAL RELATIONSHIPS R. J. Cerfolio: Speakers Bureau/Honoraria, Intuitive Surgical, Inc, Life Science Technologies

Purpose: Some patients with air leaks cannot be sent home on outpatient devices because they develop subcutaneous emphysema or enlarging pneumothorax. The purpose of this study was to review outcomes of patients who were discharged home using a digital outpatient device.

Methods: A retrospective review of a prospective database of patients who underwent pulmonary resection and were discharged home on a digital air leak system that has self-contained suction (DSS).

Results: From June 2008 to June 2012, 783 patients underwent pulmonary resection by one surgeon and 88 were discharged home on a DSS. The most common operation was an upper lobectomy in 43 patients (49%). The most common indications for the DSS was air leak monitoring in 62 (70%) and subcutaneous emphysema in 21 patients (24%). The median size of the air leak was 400 cc (range, 120 to 3000 cc). The median hospital length of stay was 4.5 days. Eight patients developed complications at home requiring readmission (alarms or malfunction in four). Three were readmitted. The remaining 80 patients all had their chest tubes removed after the air leaks were less than 20 cc/breath (n=73) or with a continued air leak after being home on DSS for 3 weeks at home (n=7).

Conclusions: A DSS device is safe and effective for the home therapy of persistent or large air leaks. Careful education prior to discharge is mandatory to prevent confusion from alarms. The DSS allows a subset of patients to go home who otherwise could not and reduces hospital length of stay.

P94

Prognostic Score of Long-Term Survival After Extrapleural Pneumonectomy for Malignant Pleural Mesothelioma

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Purpose: Despite multimodality therapy in malignant pleural mesothelioma (MPM) being associated with median survival of 18 months, a small proportion of patients undergoing extrapleural pneumonectomy (EPP) experience long-term survival (LTS). This study aims to explore predictors of LTS after EPP and to define a prognostic score.

Methods: From January 2000 to December 2010, we retrospectively reviewed clinical, pathological, and oncological factors in a multicenter cohort of 468 patients undergoing EPP for MPM. LTS was defined as survival longer than 3 years. Chi-square test was used to evaluate the associations. A multivariate logistic regression model was developed using stepwise regression and, using a re-sampling procedure, a cross-validation technique that evaluates the replication stability of the final model was also investigated. Survival curves were calculated by Kaplan-Meier method. ROC analyses were used to estimate the optimal cut-off of continuous variables and AUC (Area Under Curves) for accuracy model.

Results: One hundred and seven patients (22.9%) survived at least 3 years after EPP. Median overall, cancer-specific, and relapse-free survival were 60 (95% CI 51-69), 63 (95% CI 54-72), and 49 (95% CI 39-58) months, respectively (Figure 1). At multivariate analysis, age (OR: 0.51, 95% CI 0.31-0.82), epithelial histology (OR: 7.07, 95% CI 1.56-31.93), no history of asbestos exposure (OR: 3.13, 95% CI 1.13-8.66), and ratio between metastatic and resected lymph nodes (RL) <22% (OR: 4.12, 95% CI 1.68-10.12) were independent predictors of LTS. According to this model (AUC: 0.75, SE: 0.04, $p < 0.0001$), we built a scoring system (Table 1) predictive of LTS: in particular, 93.5% of LTS patients had scores greater than 6 vs 54.3% of non-LTS patients ($p < 0.0001$).

Conclusions: Our clinicopathological model facilitates the prediction of LTS after surgery for MPM and could be used for tailoring postoperative therapy.

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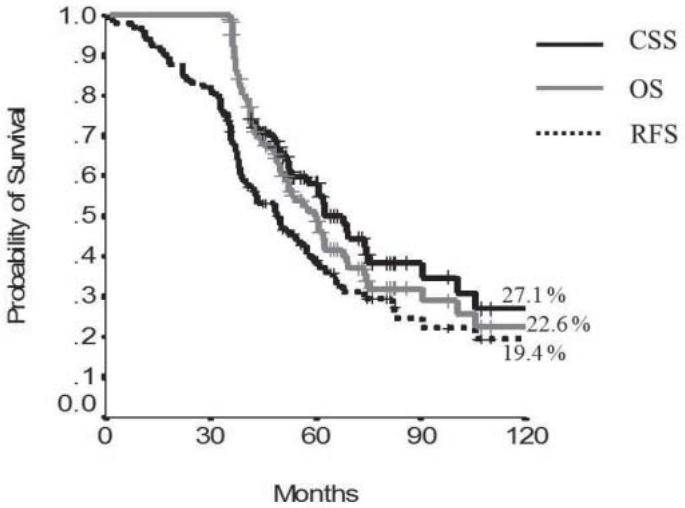

Table 1. Score assigned to each variable associated with long-term survival after EPP for MPM

VARIABLES		ASSIGNED POINTS [RANGE: 1 – 12]
Age	< 50 years	3
	> 50 years	1
Asbestos exposure	No	2
	Yes	0
RL*	< 22 %	3
	> 22 %	0
Histology	Epithelial	4
	Non-Epithelial	0

***RL: Ratio between metastatic and resected Lymph-nodes**

P95

Clinical Prediction of Pathologic Complete Response in Superior Sulcus Non-Small Cell Lung Cancer: Is There a Role for Selective Surgery?

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COMMERCIAL RELATIONSHIPS B. F. Meyers: Consultant/Advisory Board, Ethicon, Inc, Varian Medical Systems, Inc; S. G. Swisher: Consultant/Advisory Board, GlaxoSmithKline

Purpose: Management of superior sulcus non-small cell lung cancer (SS-NSCLC) continues to evolve, with surgery following induction chemoradiotherapy supported by several studies, with variable pathologic complete response (pCR) rates. Previous efforts to identify clinical predictors of pCR have been unsuccessful. We aimed to analyze our experience with resected SS-NSCLC and to investigate clinical features suggestive of pCR among patients who received chemoradiation (CXRT) preoperatively.

Methods: A multi-institutional retrospective review was performed of all patients who underwent SS-NSCLC resection from January 1988 to July 2013. Tumors of the superior sulcus were defined as involvement of the apical chest wall on pretreatment imaging. Data were collected pertaining to comorbidities, staging, induction therapy, imaging findings, operative details, and outcomes. Logistic regression modeling was performed to identify predictors of death, recurrence, and pCR.

Results: During the study period, 102 patients underwent resection for SS-NSCLC following induction therapy, consisting of CXRT in 75 (73.5%), chemotherapy in 15 (14.7%), and radiation in 12 (11.8%). These included 63 (61.7%) T3 and 25 (24.5%) T4 tumors, with 81 (79.4%) clinical N0 and 16 (15.7%) cN+. After a median follow-up of 18.0 months, overall (OS) and disease-free survival were 51.0% and 45.1% for the whole group. On multivariate regression, independent predictors of OS included pCR (p = 0.01, HR 0.243, CI 0.106-0.555) and age (p = 0.007, HR 1.049, CI 1.013-1.085). Although pCR was rare within the chemo and radiation alone groups, this was a common occurrence (24/75 [32%]) in those who received CXRT. In an effort to identify preoperative predictors of pCR, we focused on the CXRT group for multivariate regression analysis. pCR was independently predicted by degree of size reduction on imaging (p = 0.015, HR 1.042, CI 1.008-1.078), with histology showing a trend toward significance (p = 0.073). Of interest, radiation dose was not associated with pCR overall or among CXRT patients.

Conclusions: Preoperative CXRT frequently resulted in pCR, and treatment response on imaging was associated with the likelihood of achieving pCR. Future study should focus on the ability to accurately predict pCR from presurgical clinical variables. Identification of accurate predictors may ultimately permit the application of selective surgery in SS-NSCLC, reserving operative intervention for those individuals most likely to benefit from additional local-regional therapy following CXRT.

P96

Pleurodesis for Prolonged Alveolar Air Leakage Could Set Off the Advantage of Preserved Lung Function Following Segmentectomy for Lung Cancer

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Purpose: Postoperative alveolar air leakage (AAL) following segmentectomy is one of the major complications, especially when the inter-segmental plane is made with electrocautery. Prolonged AAL sometimes needs pleurodesis, and its effects on postoperative lung function remain unclear. The purpose of this study was to investigate the relationship between postoperative pleurodesis and postoperative pulmonary function in patients who underwent segmentectomy.

Methods: The retrospective study group consisted of 213 patients: 150 patients underwent segmentectomy (S group), 20 patients underwent segmentectomy followed by pleurodesis (S-pleuro group), and the other 43 underwent lobectomy (L group) between February 2008 and October 2013. All the study patients were subjected to spirometry, including forced vital capacity (FVC) and forced expiratory volume in 1 second (FEV1) before surgery and 6 and 12 months postoperatively to statistically compare the change in each group.

Results: The postoperative loss of both FVC ($p = 0.03$) and FEV1 ($p = 0.02$) at 12 months postoperatively was significantly higher in the S-pleuro group than in the S group, and the degree of functional reduction in the S-pleuro group was equivalent to the L group (Figure 1). A significant correlation was also found between performing pleurodesis due to prolonged air leakage and using electrocautery for creating the inter-segmental plane compared with using a stapler ($p = 0.03$).

Conclusions: The present study demonstrated that segmentectomy has a significant advantage of preservation of postoperative pulmonary function over lobectomy. However, segmentectomy followed by pleurodesis caused as much loss of postoperative pulmonary function as lobectomy, and the preserved functional benefit was impaired by performing pleurodesis. It should be considered for the intraoperative prevention of prolonged air leakage when the inter-segmental plane is created by electrocautery.

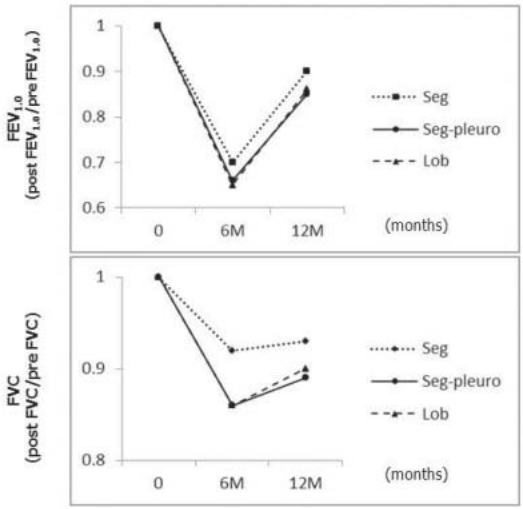

Fig 1. Forced expiratory volume in 1 second ($FEV_{1.0}$) and forced vital capacity (FVC) before surgery, and at 6 and 12 months after surgery in patients undergoing segmentectomy (n=150), segmentectomy followed by pleurodesis (n=20) and lobectomy (n=43).

P97

Survival After Lung Retransplantation in the Last Decade (2004–2013): Better or Worse?

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Purpose: Outcomes of lung retransplantation (LRT) have historically been worse compared to primary lung transplantation (LPT). United Network for Organ Sharing Registry data from 2004 to 2013 was used to analyze survival outcomes after adult (≥18 years) LRT.

Methods: LRT was performed in 584 out of 14,257 registry patients during the study period. Cox proportional hazards regression models were created using multiple donor and recipient variables to determine the prognosticators of survival after LRT. Kaplan-Meier curves were plotted to determine and compare survival after LRT and LPT.

Results: The median ages for LRT and LPT were 49 years (range: 18-74 years) and 58 years (range: 18-81 years), respectively ($p < 0.001$). The median survival after LRT was 2.6 years compared to 5.6 years after LPT. One-year, 3-year, and 5-year survival rates were 71.1%, 46.3%, and 34.5% for LRT, and 84.3%, 66.5%, and 53.3% for LPT ($p < 0.001$). The time interval between transplants was a significant prognosticator on multivariate analysis, with longer survival noted for patients who had LRT at least 1 year (HR 0.53 [95% CI 0.34-0.88]; $p = 0.008$) after their primary transplant. Worse survival was noted with single lung transplants (HR 1.49 [95% CI 1.06-2.07]; $p = 0.021$); transplants done from 2009 to 2013 (HR 1.40 [1.01-1.94]; $p = 0.041$); and recipients with ≥2 previous transplants (HR 2.55 [95% CI 1.14 – 5.72]; $p = 0.023$). Lung allocation score was associated with worse survival on univariate analysis, but not on multivariate analysis. The only significant donor variable was death due to stroke or intracranial hemorrhage (HR 1.98 [95% CI 1.23-3.18]; $p = 0.004$).

Conclusions: Absolute long-term survival after LRT continues to improve. However, survival after LRT is still worse compared to LPT and is predicted by multiple donor and recipient factors. Careful selection of patients for LRT based on these factors may help in better utilization of resources and improving outcomes.

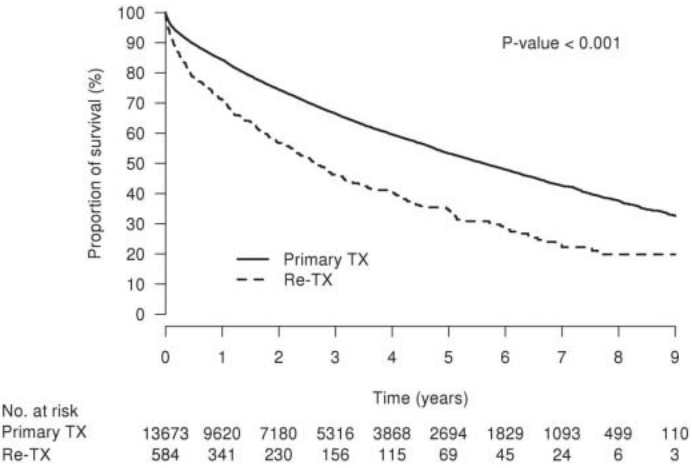

Table 1: Associations of recipient and donor characteristics with overall survival following lung retransplant

	Single variable analysis		Multivariable analysis	
Variable	RR (95% CI)	P-value	RR (95% CI)	P-value
Donor Characteristics:				
Ischemic time (› 4 hours)	0.80 (0.63, 1.01)	.059	0.87 (0.64, 1.20)	0.41
Donor pulmonary infection	0.86 (0.68, 1.08)	0.19	0.94 (0.70, 1.26)	0.67
Donor Cigarette use	0.95 (0.68, 1.33)	0.75	1.02 (0.67, 1.55)	0.94
Death mechanism donor	Test of overall difference: P = 0.0033		Test of overall difference: P = 0.045	
Gunshot wound	1.00 (reference)	N/A	1.00 (reference)	N/A
Blunt injury	1.34 (0.95, 1.89)	0.0990	1.36 (0.90, 2.07)	0.149
Stroke/ICH	1.80 (1.30, 2.50)	**0.0004**	1.98 (1.23, 3.18)	**0.004**
Other	1.37 (0.90, 2.08)	0.1436	1.46 (0.87, 2.46)	0.151
Gender donor(male)	0.82 (0.66, 1.04)	**.010**	1.13 (0.82, 1.55)	0.46
Donor age (10 year increase)	1.08 (0.99, 1.17)	0.077	1.01 (0.89,1.15)	0.85
Recipient Characteristics:				
No. of years between previous transplant and re-transplant	Test of overall difference: P = 0.001		Test of overall difference: P = 0.023	
Less or 1 year	1.00 (reference)	N/A	1.00 (reference)	N/A
More than 1 year and less or 3 year	0.699 (0.519, 0.942)	**0.018**	0.53 (0.34,0.88)	**0.008**
More than 3 year	0.597 (0.453, 0.786)	**<0.001**	0.54 (0.34, 0.88)	**0.013**
Gender recipient (male)	0.99 (0.79, 1.23)	0.93	1.06 (0.80, 1.40)	0.67
Age at re-transplant (10 year increase)	0.98 (0.91, 1.06)	0.67	1.08 (0.99, 1.17)	0.072
Transplant Type (single)	1.29 (1.04, 1.62)	**0.02**	1.49 (1.06, 2.07)	**0.021**
Recipient BMI	1.003 (0.98, 1.03)	0.79	0.98 (0.95, 1.02)	0.33
Transplant Year(2009-2013)	1.20 (0.94, 1.53)	0.14	1.40 (1.01, 1.94)	**0.041**
Number of Previous Transplant(>1)	1.47 (0.76, 2.87)	0.25	2.55 (1.14, 5.72)	**0.023**
Recipient Cigarette use	0.97 (0.77, 1.24)	0.84	1.28 (0.89, 1.82)	0.18
ECMO	1.62 (0.96, 2.75)	.071	1.30 (0.66, 2.59)	0.45
Match Lung Allocation Score (per 5 unit increase)	1.06 (1.03, 1.09)	**<0.001**	1.04 (0.99, 1.09)	0.067
Diagnosis(Acute Rejection/Primary Graft Failure)	1.51 (1.12, 2.04)	**.01**	0.97 (0.57, 1.67)	**0.011**

Relative risks, 95% confidence intervals, and p-values result from Cox proportional hazards regression models. Relative risks correspond to presence of the given characteristic (categorical variables) or the increase given in parenthesis (continuous variables). ECMO= extracorporeal membrane oxygenation. RR=relative risk. CI=confidence interval.. N/A= not applicable.

POSTER ABSTRACTS

P98

Single-Port Video-Assisted Thoracoscopic Lung Resection—A Multi-institutional Series of 208 Cases

P. Hsu[1], W. Lin[2], Y. Chang[2], C. Liu[3]
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Purpose: Pulmonary wedge resection and lobectomy through single-port video-assisted thoracoscopic surgery (VATS) were first described in 2004 and 2011, respectively. Recently, single-port VATS has become an innovative alternative to the standard two- or three-port VATS for lung resection. In this report, a multi-institutional analysis was performed to understand the applicability and generalizability of single-port VATS lung resection.

Methods: The clinicopathological factors and perioperative parameters of 208 patients who underwent single-port VATS lung resection in Koo Foundation Sun Yat-Sen Cancer Center, Taipei Veterans General Hospital, and Wan-Fang Hospital were collected and analyzed.

Results: The single-port VATS lung resection was performed for primary lung cancers, metastatic lung tumors, and benign lung diseases in 132, 28, and 48 patients, respectively. The procedures included one pneumonectomy, 100 lobectomies, 33 segmentectomies, and 74 wedge resections. The mean operative time and blood loss were 158 minutes ± 82 minutes (range: 21-495) and 85 mL ± 163 mL (range: 0-1,400), respectively. The conversion rate and postoperative complication rate were 2.4% (5/208) and 11.5% of patients (24/208), respectively. The mean duration of chest tube drainage and hospital stay was 2.4 days ± 2.0 days and 5.1 days ± 2.2 days, respectively. For patients with lung cancer, the mean tumor size was 2.5 cm ± 1.4 cm (range: 0.4-7.0) and the mean dissected lymph node number was 22.3 ± 12.4 (range: 1-57). Of note, 12 lung resections (four lobectomies and eight wedge resections) were completed with subxiphoid approach.

Conclusions: Single-port VATS lung resection for malignant and benign lung disease is a safe and feasible procedure with good perioperative results. The current multi-institutional analysis demonstrates its generalizability and supports its spread in the future. Furthermore, the subxiphoid approach has potential to decrease trauma to the intercostal space.

P99

Ivor Lewis Esophagectomy With Extended Two-Field Lymphadenectomy for Esophageal Cancer: A Single Institution Experience of 1,342 Consecutive Patients

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Purpose: Ivor-Lewis procedure is commonly used for treating esophageal cancer in Western countries. In China, however, left thoracotomy is traditionally preferred, and data on the Ivor-Lewis approach are rare. In this study, we aimed to evaluate the postoperative outcomes and survival of Ivor-Lewis esophagectomy with extended two-field lymphadenectomy in a large, single-center series.

Methods: From January 2006 to December 2012, 2,702 patients with esophageal cancer underwent esophagectomy. Of these patients, 1,375 (50.9%) received an Ivor-Lewis surgery. Patients who received chemotherapy or radiotherapy pre-surgery (n=15), underwent minimally invasive esophagectomy (n=8), or those with tumors in the upper esophagus (n=10) were excluded. A total of 1,342 patients with middle and lower esophageal cancer were analyzed retrospectively.

Results: The predominant pathological type was esophageal squamous cell carcinoma (n=1,280, 95.4%). In-hospital and 30-day mortality was 1% (n=14) and 0.89% (n=12), respectively. Overall morbidity was 28.7%. Pneumonia was the most common complication (11.5%), as well as the leading cause of in-hospital death (n=6, 43%). The incidence of intrathoracic leak was 3.8%, while the in-hospital mortality of leak patients was 5.9% (Table 1). The median number of resected lymph nodes was 21. For esophageal squamous cell carcinoma (ESCC), the frequency of lymph node metastasis was 14.2% in the upper mediastinum, 17.5% in the middle mediastinum, 12.3% in the lower mediastinum, and 28.4% in the abdomen. The overall 3- and 5-year survival was 57.7% and 42.7%, respectively. Five-year survival stratified by stage was 100% (stage 0), 74.4% (stage I), 54.6% (stage IIa), 49% (stage IIb), 24% (stage III), and 8% (stage IV) (Figure 1).

Conclusions: Ivor-Lewis esophagectomy with extended two-field lymphadenectomy can be applied safely with good long-term survival in an experienced center. The upper mediastinal lymph nodes are commonly involved in middle and lower ESCC.

Figure1 Kaplan-Meier plot of the overall survival, stratified by stage

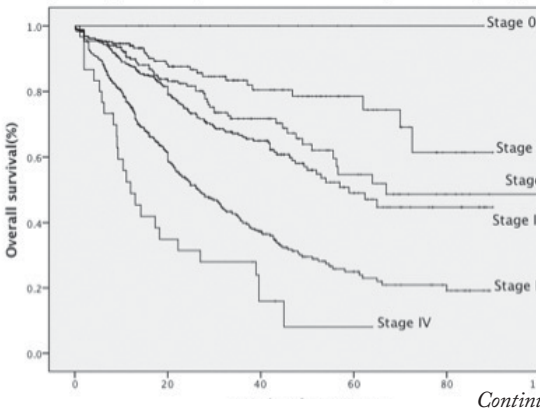

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TABLE 1 Postoperative outcomes

	N=1,342
Intraoperative data	
Operative time (min)	203 ± 37
Blood transfusion	68 (5.1)
Hospital stay (days)	
Median	19
Range	(9-161)
Postoperative hospital stay (days)	
Median	11
Range	(6-157)
Postoperative complications	385 (28.7)
Pneumonia	154 (11.5)
Intrathoracic leak	51 (3.8)
Chylothorax	34 (2.5)
Vocal cord paralysis	50 (3.7)
Arrhythmia	75 (7.1)
Respiratory failure	28 (2.1)
Heart failure	8 (0.6)
Delayed gastric emptying	77 (5.7)
Pleural effusion	60 (4.5)
Wound infection	51 (3.8)
Intestinal obstruction	4 (0.2)
Abdominal cavity infection	3 (0.2)
Empyema	13 (1)
Stomach bleeding	3 (0.2)
Pulmonary embolism	1 (0.07)
Cerebrovascular accident	5 (0.4)
Deep venous thrombosis	6 (0.4)
Splenectomy	8 (0.6)
Reoperations	30 (2.2)
Leak associated	12 (40)
Thoracic duct ligation	10 (33.3)
Intestinal obstruction associated	2 (6.6)
Abdominal cavity infection (debridement)	3 (10)
Bleeding associated	2 (6.6)
Empyema (debridement)	2 (6.6)
Mortality (30-day)	12 (0.89)
Mortality (In-hospital)	4 (1.0)
Cause of in-hospital death	N=14
Pneumonia	6 (43)
Intrathoracic leak	3 (21)
Chylothorax	1 (7)
Pulmonary embolism	1 (7)
Cerebrovascular accident	1 (7)
Upper gastrointestinal bleeding	1 (7)
Cardiac arrest	1 (7)

P100

Improving Operating Room Resource Utilization Through Optimized Scheduling of Major Pulmonary Resections

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COMMERCIAL RELATIONSHIPS S. Gilbert: Other, Bristol Myers Squibb Co, Eli Lilly & Co, Merck & Co Inc, Pfizer Inc, Sanofi Sponsored ADR, stock ownership

Purpose: Health care resources are costly and should be used judiciously and efficiently. Predicting the duration of surgical procedures is key to optimizing operating room resource utilization and providing timely access to thoracic surgical care. Our objective was to create a predictive model of operative time in patients undergoing pulmonary lobectomy.

Methods: This is a single-institution, retrospective review of lobectomy operations (2009-2012). The surgical team included the surgeon and assistant(s). Nursing staff turnover was defined according to manufacturing industry standards as the ratio of the number of instances a nursing team member leaves the operating room over the nursing team size. Univariate and multivariate analyses, with operating surgeon as a random effect, were used to estimate the impact of different factors on surgical time (skin-to-skin) and total procedure time (patient in the room to patient out of the room).

Results: A total of 236 simple lobectomies were performed by five surgeons, most commonly for lung cancer (95%). FEV1%, nursing staff turnover, and pleural adhesions were significant predictors of surgical time, while tumor size and need for decortication showed strong trends (Table 1). FEV1%, nursing staff turnover, tumor size, pleural adhesions, and need for decortication were significantly associated with total procedure time, while surgical team size showed a statistical trend. Age, Charlson Comorbidity Index, affected lobe, surgeon experience, and pack-years of smoking had no significant impact on operative time. After multivariate analysis, FEV1%, nursing staff turnover, and pleural adhesions remained significant predictors of both surgical time and total procedure time.

Conclusions: A simple model to predict operative time was created using mainly factors that can be measured or controlled preoperatively. Scheduling of anatomic pulmonary resections can be optimized by using this approach to generate procedure time estimates that are both surgeon and patient specific.

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Abstract continued from previous page

	Mean Increase in Surgical Time (minutes [95% CI])	*p*	Mean Increase in Total Procedure Time (minutes [95% CI])	*p*
Univariate Analysis				
Need for Pulmonary Decortication	16 [-0.5-33]	0.06	21 [3-39]	**0.03**
Pleural Adhesions	21.09 [9-33]	**<0.01**	20 [7-33]	**<0.01**
Tumor Size (per 1 cm increase)	3 [-0.2-7]	0.06	5 [2-9]	**<0.01**
FEV1% (per 1% decrease)	0.4 [0.1-0.8]	**0.03**	0.5 [0.1-0.9]	**0.01**
Nursing Staff Turnover	45 [-0.7-91]	**0.05**	54 [13-68]	**<0.01**
VATS vs Thoracotomy	12 [9-33]	0.09	2 [-14-18]	0.8
Surgical Team Size (per 1 person increase)	3 [-6-12]	0.47	9 [-0.8-19]	0.07
Multivariate Analysis				
Need for Pulmonary Decortication	4 [-15-24]	0.7	8 [-13-28]	0.5
Pleural Adhesions	19 [5-32]	**<0.01**	16 [1-30]	**0.03**
Tumor Size (per 1 cm increase)	2 [-2-5]	0.36	3 [-0.6;7]	0.1
FEV1% (per 1% decrease)	0.44 [0.1-0.8]	**0.02**	0.5 [0.2-0.9]	**<0.01**
Nursing Staff Turnover	27.95 [3-53]	**0.03**	44 [17-70]	**<0.01**
Surgical Team Size (per 1 person increase)	N/A	N/A	5 [-5-14]	0.3

P101

Prognostic Value of the Protocadherin 10 Promoter Methylation Status in Curatively Resected Pathological Stage I Non-Small Cell Lung Cancer

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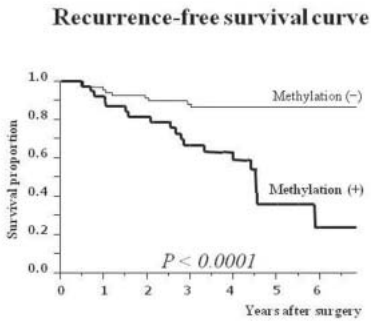
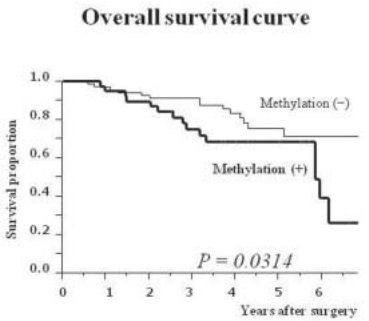
Purpose: Although curative surgical resection is the current treatment of choice for stage I non-small cell lung cancer (NSCLC), relapse after surgery is noted in approximately 30% of patients with curatively resected pathological stage I NSCLC. Identifying biomarkers that would help select patients with a high risk of relapse after complete resection is an important aspect of the strategy for lung cancer treatment.

Methods: Using the methylation-specific polymerase chain reaction assay, methylation of the protocadherin 10 (PCDH10) promoter was assessed in cancer tissues of 109 patients who underwent curative resection of pathological stage I NSCLC between June 2005 and November 2011. We attempted to identify clinical correlations between PCDH10 promoter methylation status and disease outcome.

Results: PCDH10 promoter methylation was detected in 39 of 109 patients (35.8%). The frequency of PCDH10 methylation was significantly higher among female vs male patients ($p = 0.0429$) and among those with adenocarcinoma vs other histologic types ($p = 0.0453$). The 3-year recurrence-free and overall survival rates were 89.8% and 91.3% for patients without PCDH10 methylation and 66.7% and 75.2% for those with PCDH10 methylation, respectively (recurrence-free survival: $p < 0.0001$, overall survival: $p = 0.0314$). The adjusted hazard ratio for recurrence-free survival according to the PCDH10 methylation status was 3.45 ($p = 0.0022$), as calculated by Cox proportional hazard regression analysis.

Conclusions: PCDH10 methylation is a potential biomarker that predicts poor prognosis after curative resection of pathological stage I NSCLC. Determination of the PCDH10 methylation status may assist in patient stratification for deciding the appropriate adjuvant treatment strategy.





P102

Achalasia Subtype Determines Clinical Presentation and Response to Laparoscopic Heller Myotomy

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Purpose: Since the introduction of high-resolution manometry (HRM) and the Chicago Classification of achalasia, evidence has emerged that symptomatic presentations and outcomes following surgical myotomy may vary between different subtypes. The aim of this study was to test this hypothesis by retrospectively reviewing our experience with laparoscopic Heller myotomy (LHM) for the various subtypes of achalasia.

Methods: The charts of all patients undergoing LHM at our institution between August 2005 and June 2013 were retrospectively reviewed. Subtyping of achalasia was performed based on pretreatment HRM according to the Chicago Classification. Symptomatic outcomes were assessed by a mailed questionnaire.

Results: A total of 182 LHMs were performed for achalasia during the study period. Contact information was available for 109 of these patients. Fifty questionnaires were returned for analysis (response rate of 46%) with a median follow-up of 29.5 months. Fourteen patients had achalasia type I (28%), 25 type II (50%), six type III (12%), and five variant achalasia (10%). Patients with types I and II experienced more preoperative dysphagia ($p = 0.009$), while patients with type III and variant achalasia had more heartburn ($p = 0.035$). A significant improvement for each symptom was found after LHM ($p = 0.000$) when assessing the entire cohort. When comparing subtypes, the symptoms of chest pain and regurgitation responded better to treatment for patients with types I and II than for patients with type III and variant achalasia ($p = 0.01$), though the improvement in dysphagia was similar between groups.

Conclusions: Achalasia represents a spectrum of pathophysiology, a fact highlighted by the use of HRM. Achalasia subtypes present differently and vary in their response to surgical therapy. HRM is an important preoperative tool for stratifying surgical outcomes.

Quality Improvement

P103

Predictors of Prolonged Length of Stay After Lobectomy: Can We Define the At-Risk Group?

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COMMERCIAL RELATIONSHIPS Z. T. Hammoud: Speakers Bureau/Honoraria, Intuitive Surgical, Inc

Purpose: In the current health care environment, length of stay (LOS) has become an increasing focus of attention for cost reduction. The ability to predict factors that contribute to increased LOS may provide useful targets for LOS reduction. By utilizing a large outcomes dataset, we hypothesized that we would be able to predict factors responsible for prolonged LOS after lobectomy.

Methods: Under IRB approval and Data Use Agreement of the American College of Surgeons, data from the National Quality Improvement Project from 2005 to 2012 were reviewed focusing on current procedural terminology (CPT) codes for all lobectomies (32,663 and 32,480). Outlier status for LOS was defined as >75th percentile. Data were analyzed in R (R Core Team 2013).

Results: A total of 6,727 cases were reviewed, of which 4,001 were performed by thoracotomy and 2,726 by video-assisted thoracoscopic surgery. The 75th percentile LOS was 9 days. In univariate analysis, thoracotomy, wound infection, unplanned intubation, failure to wean from ventilator, urinary tract infection, pneumonia, and emergency surgery were all predictors of LOS outlier. In multivariate analysis, frailty, emergency surgery, operative time, and thoracotomy were all preoperative predictors of LOS outlier with OR and 95% CI of 8.4 (5.1-13.8), 3.6 (1.9-6.8), 1.0 (1.002-1.004), and 2.7 (2.4-3.1) respectively (all p values < 0.001).

Conclusions: Utilizing a large dataset, we have identified several preoperative predictors of LOS outlier status. By identifying factors that lead to increased LOS, we can begin to target these areas and reduce LOS. As the health care environment continues to evolve and scrutinize hospital costs, reducing LOS is critical. Further studies are required to validate our data and to assess overall impact on cost of care.

P104

Cardiac Arrest After Open Heart Surgery: Improved Processes Save Lives

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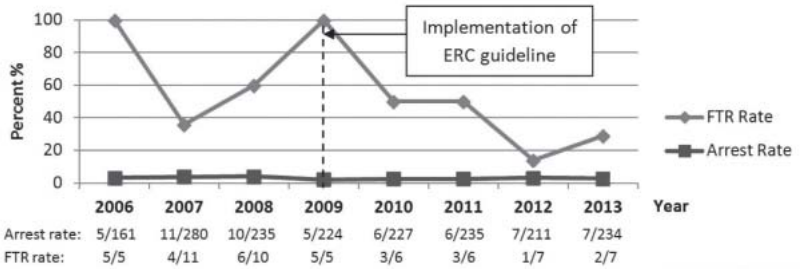
Purpose: Failure to rescue (FTR) patients who arrest after open heart surgery is an important quality metric, as this highly lethal complication represents the most extreme measure of our ability to save lives at risk. Yet sparse literature exists to define this problem or direct interventions that improve outcomes.

Methods: We reviewed the incidence and outcomes of postoperative cardiac arrest in our hospital over an 8-year period. We instituted European Resuscitation Council (ERC) guidelines in 2010 and compared arrest outcomes before and after this training began. Data were abstracted from the STS National Database from January 1, 2006, to December 31, 2013. FTR was defined as a cardiac arrest that resulted in hospital mortality.

Results: We operated on 1,807 patients during this time period and cardiac arrest occurred in 57 (3.2%). There were 29 mortalities, yielding a FTR rate of 51% (29/57). When compared to the overall group, patients who arrested were more likely to be female (44% [25/57] vs 32% [559/1,750], $p = 0.042$) and non-elective status (47% [27/57] vs 26% [454/1,750], $p = 0.001$), but were of similar age (64 vs 66 years, $p = 0.367$). No significant differences were noted between FTR and arrest survivors with respect to age (65 vs 70 years), gender (females 56% vs males 47%), operative status (elective = 43% [13/30], urgent = 58% [11/19], emergent = 62% [5/8]), and complexity of procedure (eg, isolated aortic valve = 43% [3/7] vs combined aortic valve/bypass = 62.5% [5/8]). After implementing ERC guidelines, the arrest rate fell slightly (2.9% [26/907] vs 3.4% [31/900], $p = 0.504$), but the incidence of FTR was significantly reduced (35% [9/26] vs 65% [20/31], $p = 0.034$) as depicted below.

Conclusions: Implementation of ERC standards significantly reduced the incidence of FTR after cardiac arrest. Adoption of the ERC guidelines should be considered by cardiac surgery programs to improve survival after postoperative cardiac arrest.



P105

Impact of a Multidisciplinary Rapid Assessment of Complex Pleural Effusion (RACE) Program on Efficiency of Patient Care

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COMMERCIAL RELATIONSHIPS K. Yasufuku: Research Grant, Olympus America, Inc, Covidien Ltd, Ethicon, Inc, Intuitive Surgical, Inc, Veran Medical Technologies, Inc, Siemens AG; Other Research Support, Novadaq Corp

Purpose: To assess the impact that the implementation of a Rapid Assessment of Complex Pleural Effusion (RACE) Program had on the management of patients with malignant pleural effusions (MPE) at a tertiary thoracic surgical center. The program utilized a multidisciplinary approach to care for patients with MPE, providing ambulatory assessment and elective, outpatient, definitive management of pleural effusions.

Methods: We used an endoscopy room with combined endoscopic and operating room capability to transfer procedures to an outpatient setting. Two major definitive management options were offered to patients: awake pleuroscopy with talc poudrage or insertion of a tunnelled pleural catheter. We assessed early program efficiency measures in terms of consultation wait times (targeting 24 hours and 5 days for in- and outpatients, respectively) and definitive procedure (target 10 days). We collected hospital administrative and RACE Program data on the following endpoints: hospital admissions for MPE, length of stay before (2011-2012) and after (2013-Jan 2014) implementation of the program, wait times for in- and outpatient assessment, and definitive procedure (mean ± SD).

Results: Since the launch, 112 patients were managed through the RACE Program. Implementation of the RACE Program and its defined care pathways resulted in a reduction in overall admissions for MPE to our main cancer hospital (64%) and to our hospital network (23%). Average inpatient and outpatient waiting times for RACE Program consultation were 1.03 days ± 3.17 days and 3.96 days ± 3.22 days, respectively; $p < 0.005$. The average wait times for definitive procedures for in- and outpatients were 4.75 days ± 8.49 days and 8.40 days ± 8.20 days, respectively; $p = 0.102$.

Conclusions: Establishment of a multidisciplinary RACE Program allowed the introduction of effective ambulatory management of patients with malignant pleural effusions. We were able to achieve our target improvement in wait times for consultation and definitive treatment and also decrease hospital admissions. This has resulted in a significant improvement in both efficiency of care and the patient experience in our cancer center.

P106

A Review of Medical Malpractice Claims Involving Cardiothoracic and Vascular Surgeons

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Purpose: Cardiothoracic and vascular surgeons are estimated to have nearly a 100% risk of facing a medical malpractice suit over their career; however, no study has investigated the nature of claims against cardiothoracic surgeons and their outcomes. The present study was undertaken to document this using a national database.

Methods: We obtained physician-level data on malpractice claims from a large, physician-owned professional liability insurer that provided coverage to physicians in every US state. Data were extracted to determine the nature of each claim, alleged error, and financial outcome.

Results: A total of 704 cases were identified from 1991 to 2005 (adult cardiac [n=437, 62.1%], pediatric cardiac [n=19, 2.7%], general thoracic [n=125, 17.8%], and vascular [n=125, 17.8%]). Surgery was considered elective in 241 cases (37.9%) and emergent in 119 (18.7%). Death occurred in 237 (35.9%) of these cases, 37 (18%) in the operating room. A surgical procedure was performed in 642 (91.3%) of cases. Neurologic complications, sternal wound infection, and retained foreign body were the most frequent surgical complications (Table). The mean time to resolution was 16.9 months. 13.8% of claims resulted in an indemnity, and the average payment was $269,885. The cost for malpractice defense was $21,193 per case.

Conclusions: Malpractice cases encompassed a variety of diagnoses and operative procedures. The most common complications alleged in malpractice suits were neurologic and infectious; however, many lawsuits alleged errors outside of an operative procedure, such as delay in diagnosis. The majority of claims did not lead to an indemnity payment.

Diagnosis	Operation Performed	Alleged Error	Surgical Complication
CAD (*n*=327, 50.7%)	CABG (*n*=314, 49.8%)	Surgical complication (*n*=419, 59.7%)	Neurologic complication (*n*=71, 17.2%)
Valvular disease (*n*=85, 13.2%)	Valve surgery (*n*=91, 14.4%)	Misdiagnosis (*n*=36, 5.1%)	Sternal wound infection (*n*=39, 9.4%)
Peripheral vascular disease (*n*=52, 8.1%)	Pulmonary resection (*n*=40, 6.3%)	Delay in treatment (*n*=36, 5.1%)	Retained foreign body (*n*=44, 10.7%)
Lung Cancer (*n*=50, 7.8%)	Aneurysm repair (*n*=31, 4.9%)	Complication related to positioning (*n*=29, 4.1%)	Other infection (*n*=37, 9%)
Aortic Aneurysm (*n*=26, 4.0%)	Lower extremity bypass (*n*=31, 4.9%)	Complication related to line or catheter insertion (*n*=29, 4.1%)	Postoperative bleeding (*n*=35, 8.5%)
Carotid artery disease (*n*=20, 1.3%)	Pacemaker/Defibrillator (*n*=14, 2.2%)	Medication error/ overdose (*n*=28, 4%)	Respiratory failure (*n*=30, 7.3%)
Congenital heart disease (*n*=20, 1.3%)	Esophageal surgery (*n*=13, 2.1%)	Not specified (*n*=112, 16%)	Intraoperative arrest (*n*=27, 6.5%)
Benign Esophageal Disease (*n*=8, 1.2%)	AV graft/fistula (*n*=13, 2.1%)	Other (*n*=18, 2.6%)	Intraoperative bleeding (n=25, 6.1%)
Endocarditis (*n*=8, 1.2%)	Carotid endarterectomy (*n*=12, 1.9%)		Nerve injury (n=35, 5.8%)
Esophageal Cancer (*n*=6, 0.9%)	Mediastinoscopy (*n*=6, 1.0%)		Renal failure (n=20, 4.8%)
Thoracic outlet syndrome (*n*=3, 0.5%)	First rib resection (*n*=3, 0.5%)		MI or recurrent angina (n=19, 4.6%)
Renal disease (*n*=13, 0.2%)	Other (*n*=98, 15.5%)		GI tract perforation (n=13, 3.1%)
Hyperhydrosis (*n*=1, 0.2%)			Wrong vessel grafted (n=12, 2.9%)
			Other (n=72, 17.4%)

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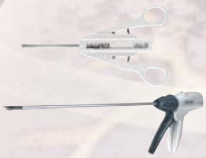

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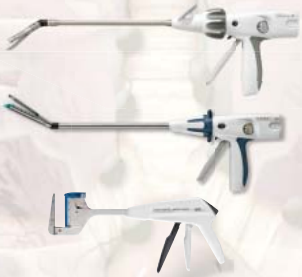

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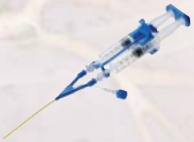

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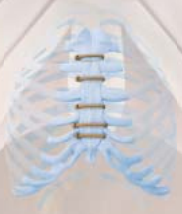

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