Valvular Heart Disease: The New Frontier in Cardiovascular Medicine

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Alabama Cardiovascular Group
AN AFFILIATE OF GRANDVIEW HEALTH

GRANDVIEW MEDICAL CENTER

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Conference Theme

A Whole New World: Refresh, Refocus and Renew

2

Goals and Objectives

- After the talk the participants should be able to:
  - Identify patients at risk for valvular heart disease
  - Diagnose valvular heart disease in the early stages
  - Know when to refer to a Valve Specialist

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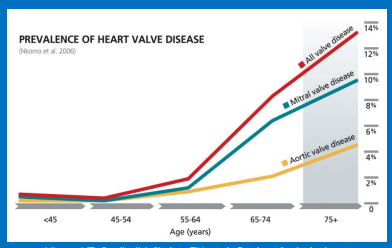
Epidemiology



Nkomo VT, Gardin JM, Skelton TN, et al. Burden of valvular heart diseases: a population-based study. Lancet 2006;368:1005-1011.

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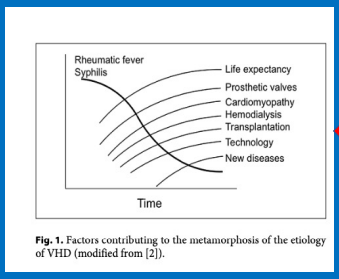
Etiology



HIGH INDEX OF SUSPICION

Fig. 1. Factors contributing to the metamorphosis of the etiology of VHD (modified from [2]).

Cardiology 2013;126:139–152 DOI: 10.1159/000354221

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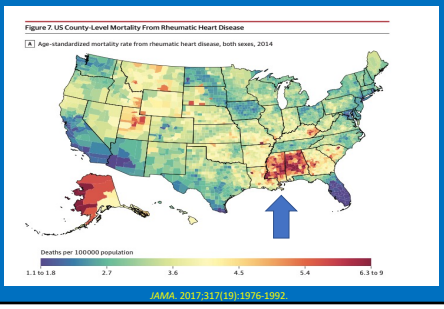
Etiology: Why is it important in Alabama?



JAMA. 2017;317(19):1976-1992.

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Types of Valve Disease

- **Valve Stenosis**
  - ❖ Obstruction to valve flow
- **Valve Regurgitation,** Insufficiency, Incompetence
  - ❖ Inadequate valve closure---→ back leakage
- **A single valve can be both stenotic and regurgitant; but both lesions cannot be severe**
- **Combinations of valve lesions can coexist**
  - ❖ Single disease process
  - ❖ Different disease processes
  - ❖ One valve lesion may cause another

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Key History Findings

- Patients with worsening valve disease do less physical activity as their symptoms progress
- They will not always admit to symptoms; they may call it "slowing down".
- Questioning should be targeted at the patient's previous level of activity

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Physical Exam

Table 2 Comparison of diagnostic accuracy of auscultation by general practitioners for the prediction of significant valvular heart disease (VHD), according to body mass index (BMI) above and below the upper limit of 'healthy weight' as defined by the World Health Organization (25 kg/m^2)

	BMI <25 kg/m^2	BMI ≥25 kg/m^2	P values for difference between groups
n	86	165	
Significant VHD	21 (24%)	15 (9%)	0.002
Sensitivity	57% (34%–78%)	27% (8%–55%)	0.40
Specificity	71% (58%–81%)	69% (61%–76%)	0.99
Positive predictive value	39% (22%–58%)	8% (2%–19%)	0.01
Negative predictive value	84% (71%–92%)	90% (83%–95%)	0.84
Positive likelihood ratio	1.95 (1.15–3.32)	0.85 (0.36–2.04)	0.11
Negative likelihood ratio	0.61 (0.36–1.02)	1.07 (0.77–1.48)	0.07

P values are for the differences between groups (BMI <25 vs ≥25) and are based on χ^2 test, with the exception of Cochran's Q test for likelihood ratios.

Gardezi SKM, *et al. Heart* 2018;**104**:1832–1835. doi:10.1136/heartjnl-2018-313082

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Comparative Accuracy of Focused Cardiac Ultrasonography and Clinical Examination for Left Ventricular Dysfunction and Valvular Heart Disease

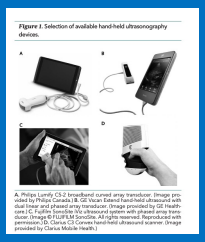

Figure 1. Selection of available hand-held ultrasonography devices.

A. Philips Lumify C5-2 broadband curved array transducer. (Image provided by Philips Canada.) B. GE Vscan Extend hand-held ultrasound with dual linear and phased array transducer. (Image provided by GE Healthcare.) C. Fujifilm SonoSite iViz ultrasound system with phased array transducer. (Image © FUJIFILM SonoSite. All rights reserved. Reproduced with permission.) D. Clarius C3 Convex hand-held ultrasound scanner. (Image provided by Clarius Mobile Health.)

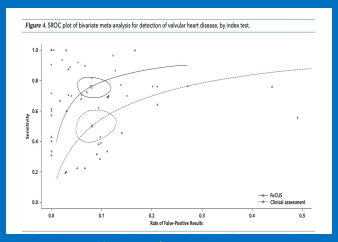

Figure 4. SROC plot of bivariate meta-analysis for detection of valvular heart disease, by index test.

Ann Intern Med. 2019;171:264-272. doi:10.7326/M19-1337

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Take Home

HISTORY

ECHOCARDIOGRAPHY

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Case Presentation

- 75-year-old female with a history of hypertension, morbid obesity and diastolic heart failure who presents with worsening lower extremity edema and shortness of breath.
- She is found to have severe tricuspid regurgitation

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First Responses?

- Too old
- No treatment
- Obese
- Frail
- Surgery is too invasive
- "Oh, the valve just has a little leakage, or the valve is just a little blocked"

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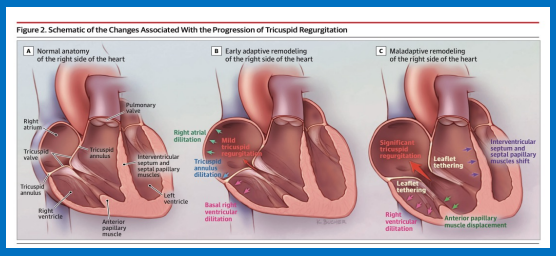
Tricuspid Valve



JAMA Cardiol. 2019;4(5):478-487.

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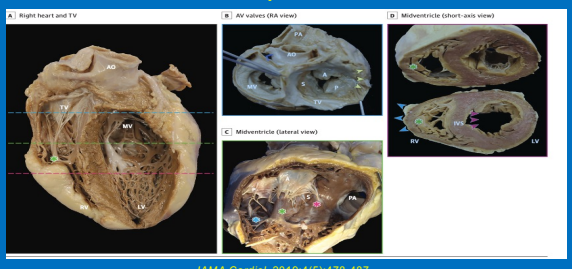
Tricuspid Valve



JAMA Cardiol. 2019;4(5):478-487.

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Tricuspid Valve

Table 1
Causes of Tricuspid Valve Regurgitation

Congenital
Ebstein's anomaly
Tricuspid valve dysplasia
Tricuspid valve hypoplasia
Tricuspid valve cleft
Double orifice tricuspid valve
Unguarded tricuspid valve orifice
Right ventricular disease
Right ventricular dysplasia
Endomyocardial fibrosis
Increased right heart pressure
Acquired
Annular dilatation
Left-sided valvular heart disease
Endocarditis
Trauma
Carcinoid heart disease
Rheumatic heart disease
Tricuspid valve prolapse
Iatrogenic (radiation, drugs, biopsy, pacemaker, ICD)
Right ventricular dilatation
Pulmonary hypertension
Primary pulmonary hypertension
Secondary to left-sided heart disease (valvular heart disease; cardiomyopathy, etc.)
Right ventricular volume overload
Atrial septal defect
Anomalous pulmonary venous drainage

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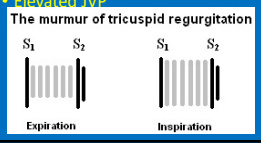
Tricuspid Valve Regurgitation: Symptoms and Physical Exam

- Right heart failure
- Peripheral edema
- Hepatic congestion
- Right upper quadrant pain

- High pitched, holosystolic murmur however it is best heard at the left lower sternal border, and it radiates to the right lower sternal border
- Elevated JVP



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Outcomes

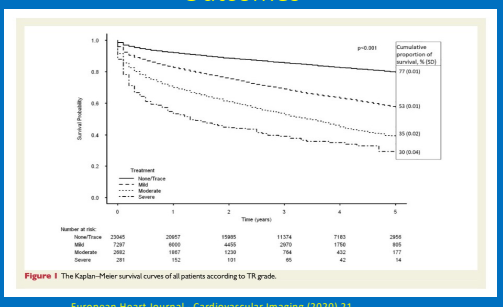

Figure 1 The Kaplan–Meier survival curves of all patients according to TR grade.

European Heart Journal - Cardiovascular Imaging (2020) 21, 157–165

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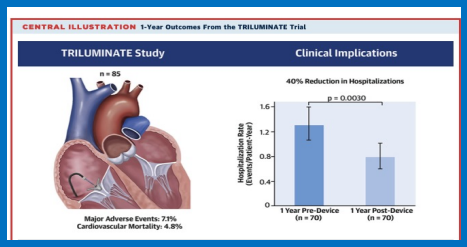
Triluminate Study: Using Tricuspid Clip



J Am Coll Cardiol 2021;77:229–39

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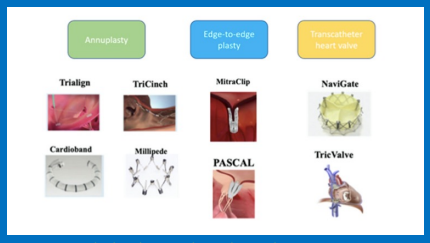
Tricuspid Valve Interventions



Overtchouk et al. BMC Cardiovascular Disorders (2020) 20:1

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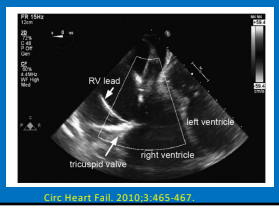
Case Presentation

- 74-year-old male with a history of morbid obesity and multiple pacemaker placements who presents with shortness of breath and anasarca



Circ Heart Fail. 2010;3:465-467

- 64-year-old male with a past medical history for a tricuspid valve replacement who presents with worsening lower extremity edema presents for evaluation of lower extremity edema

Texas Heart Institute Journal • June 2017, Vol. 44, No. 3

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Tricuspid Stenosis

Table 4
Etiology of Tricuspid Stenosis

Rheumatic heart disease
Congenital tricuspid stenosis
Right atrial tumors
Carcinoid heart disease
Endomyocardial fibrosis
Valvular vegetations
Extracardiac tumors

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Tricuspid Stenosis: Symptoms and Physical Exam

- Fatigue,
- Dyspnea
- Edema
- Ascites
- Right atrial pressure elevation causes hepatic congestion and patients often present with early satiety, right upper quadrant pain, and peripheral edema
- Giant "a" wave and diminished rate of "y" descent in the jugular venous pulse.
- Auscultation of an opening snap may be appreciated in valvular tricuspid stenosis and mid-diastolic rumble that increases with inspiration.

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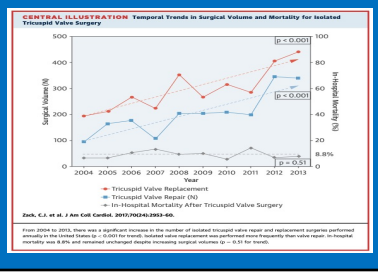
Outcomes for Isolated Tricuspid Valve Replacement



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Tricuspid Stenosis: Treatment

Key question

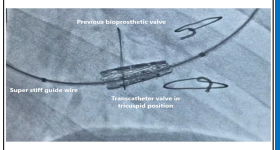
Is tricuspid valve-in-valve implantation a safe and effective therapy in patients with bioprosthetic degeneration?

Key finding(s)

Implants were deployed successfully in all cases.
No deaths were reported.
Clinical and haemodynamic status improved.

Take-home message

Tricuspid valve-in-valve implantation appears to be a safe, efficacious and encouraging treatment alternative to redo surgery.



Interact CardioVasc Thorac Surg, Volume 29, Issue 1, July 2019, Pages 59–63, https://doi.org/10.1093/icvts/ivy262

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Pulmonic Valve: Case Presentations

- 21-year-old with a history of previous pulmonic valve replacement for congenital pulmonic stenosis is lost to follow-up. He presents with worsening shortness of breath and edema.
- 46-year-old with prior surgical pulmonary valvotomy as a child presenting with severe insufficiency

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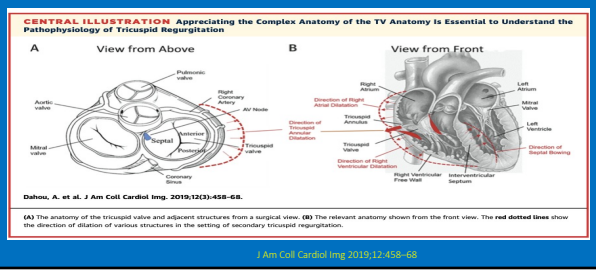
Pulmonic Valve



J Am Coll Cardiol Img 2019;12:458–68

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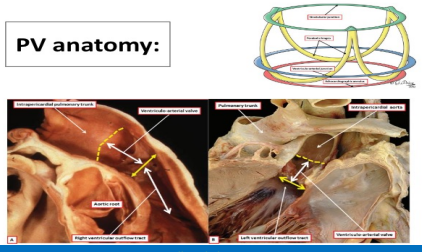
Pulmonic Valve

PV anatomy:



J Am Coll Cardiol Img 2019;12:458–68

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Etiology

- Congenital
- Prior surgery
- Prior Valve replacement
- Usually lost to follow-up

Table 1
Etiological Classification of Acquired Pulmonary Valve Stenosis

Valvular	Carcinoid heart disease
	Radiation-induced valvular disease
	Rheumatic heart disease
Intrinsic	Primary cardiac tumors
	Twin–twin transfusion syndrome
	Pericardial band/ring—chronic pericarditis
External	Unruptured aneurysms of the sinus of Valsalva
	Pericardial/myocardial abscess
	Mediastinal mass

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Pulmonic Valve Stenosis: Symptoms and Physical Exam

- Exercise intolerance
- Breathlessness
- Fatigue

- A-wave
- A RV precordial lift or heave, and a left parasternal systolic thrill at the second intercostal space.
- The first heart sound (S1) is normal, and the second heart sound (S2) splitting is widened because of prolonged pulmonic ejection (pulmonic component of S2 [P2] is delayed).
- The P2 component is soft and in severe pulmonic stenosis may be absent—single second sound. In RV failure and hypertrophy, the third and fourth heart sounds (S3 and S4) are rarely audible at the left parasternal fourth intercostal space.
- A click in congenital PS is thought to result from abnormal ventricular wall tension. The click occurs early in systole (very near S1) and is not affected by hemodynamic changes.
- A harsh crescendo–decrescendo ejection murmur is audible and is heard best at the left parasternal second (valvular stenosis) or fourth (infundibular stenosis) intercostal space with the diaphragm of the stethoscope when the patient leans forward. Unlike the aortic stenosis murmur, a PS murmur does not radiate, and the crescendo component lengthens as stenosis progresses. The murmur grows louder immediately with Valsalva release and with inspiration; the patient may need to be standing for this effect to be heard.

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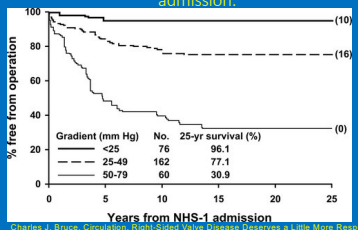
Kaplan–Meier curves of percentage free from surgery for 300 PS patients managed medically, grouped by gradient at admission to the First Natural History Study (NHS-1). Numbers in parentheses indicate number of patients remaining under observation 25 years after admission.



Charles J. Bruce. Circulation. Right-Sided Valve Disease Deserves a Little More Respect, Volume: 119, Issue: 20, Pages: 2726-2734, DOI: (10.1161/CIRCULATIONAHA.108.776021)

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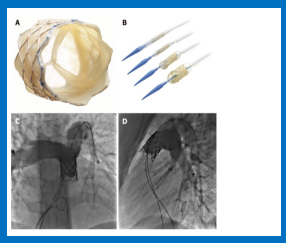
Melody Pulmonic Valve



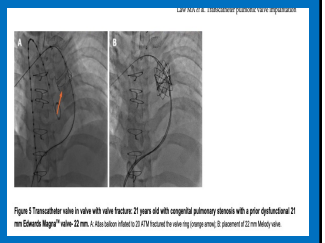


Figure 5 Transcatheter valve in valve with valve fracture: 21 years old with congenital pulmonary stenosis with a prior dysfunctional 21 mm Edwards Magna™ valve. 22 mm. A: Also balloon inflated to 23 ATM fractured the valve ring (orange arrow); B: placement of 22 mm Melody valve.

World J Cardiol 2021 May 26; 13(5): 117-129

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Pulmonic Regurgitation

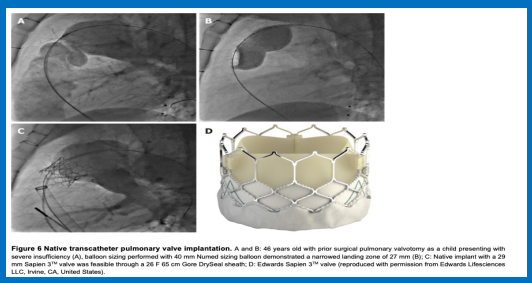

Figure 6 Native transcatheter pulmonary valve implantation. A and B: 46 years old with prior surgical pulmonary valvotomy as a child presenting with severe insufficiency (A), balloon sizing performed with 40 mm Numed sizing balloon demonstrated a narrowed landing zone of 27 mm (B); C: Native implant with a 29 mm Sapien 3™ valve was feasible through a 26 F 65 cm Gore DrySeal sheath; D: Edwards Sapien 3™ valve (reproduced with permission from Edwards Lifesciences LLC, Irvine, CA, United States).

World J Cardiol 2021 May 26; 13(5): 117-129

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Case Presentation

- 61-year-old male with a past medical history for hypertension, CAD, and mitral regurgitation who presents to the hospital after being lost to follow-up with worsening shortness of breath and edema.
  - EF is 20%
  - The patient was diuresed with the assistance of a dobutamine infusion but continued to have severe mitral regurgitation and severe shortness of breath

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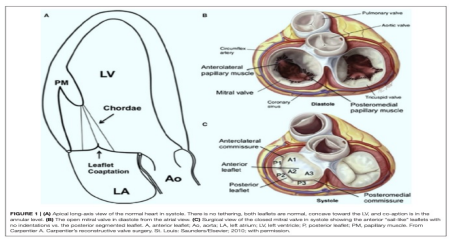
Mitral Valve



Topilsky Y (2020) Mitral Regurgitation: Anatomy, Physiology, and Pathophysiology—Lessons Learned From Surgery and Cardiac Imaging. *Front. Cardiovasc. Med.* 7:84. doi: 10.3389/fcvm.2020.00084

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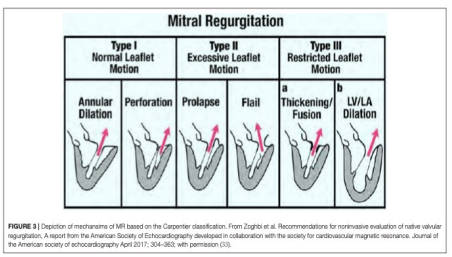
Mitral Valve



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Etiology

Table 1
Etiology and Mechanism of MR

		MR mechanism				
		Organic MR			Functional MR	
		Type I*	Type II**	Type IIIa***	Type I*	Type IIIb***
MR etiology	Nonischemic	*Endocarditis*: perforation *Degenerative*: annular calcification *Congenital*: cleft leaflet	*Degenerative*: billowing/ flail leaflets *Endocarditis*: ruptured chordae *Traumatic*: ruptured chord/PM *Rheumatic*: acute RF	*Rheumatic*: chronic RF *Iatrogenic*: radiation/ drug *Inflammatory*: lupus/ anticardiolipin, eosinophilic endocardial disease, endomyocardial fibrosis	Cardiomyopathy, myocarditis left ventricular dysfunction (any cause)	
	Ischemic		Ruptured PM		Functional ischemic MR	

*Type I: Mechanism involves normal leaflet movement
**Type II: Mechanism involves excessive valve movement
***Type III: Restricted valve movement, IIIa in diastole, IIIb in systole
MR, mitral regurgitation; PM, papillary muscle; RF, rheumatic fever.

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Mitral Regurgitation: Symptoms and Physical Exam

- SOB
- Congestive Heart failure
- Paroxysmal Nocturnal Dyspnea
- Atrial Fibrillation

- Palpable apical thrill is characteristic of severe MR
- Systolic murmur, heard best at the apex with the patient in the left lateral decubitus position.
  - The murmur is often holosystolic.

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Quantitative Determinants of the Outcome of Asymptomatic Mitral Regurgitation

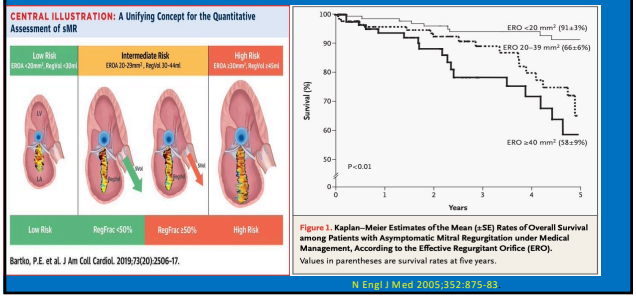

Figure 1. **Kaplan–Meier Estimates of the Mean (±SE) Rates of Overall Survival among Patients with Asymptomatic Mitral Regurgitation under Medical Management, According to the Effective Regurgitant Orifice (ERO).**
Values in parentheses are survival rates at five years.

N Engl J Med 2005;352:875-83

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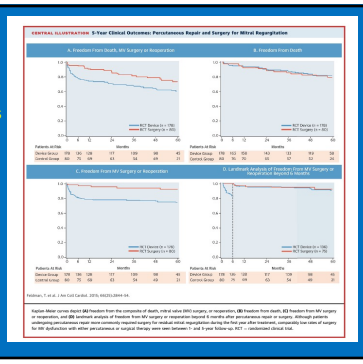
Randomized Comparison of Percutaneous Repair and Surgery for Mitral Regurgitation 5-Year Results of EVEREST II

J Am Coll Cardiol 2015;66:2844–54



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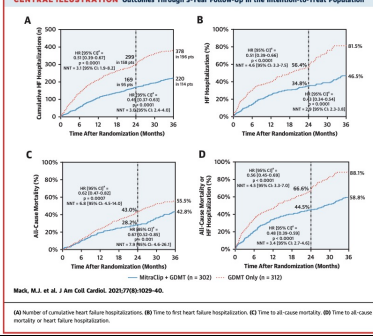
COAPT Trial: Mitral Clip for Functional MR

Michael J. Mack et al. *J Am Coll Cardiol* 2021; 77:1029-1040



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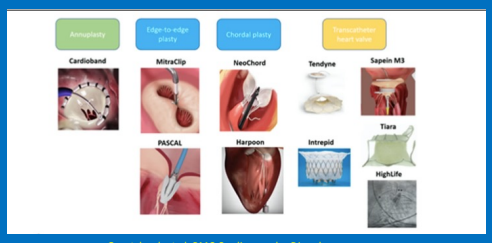
Percutaneous Mitral Interventions



Overtchouk et al. BMC Cardiovascular Disorders (2020) 20:1

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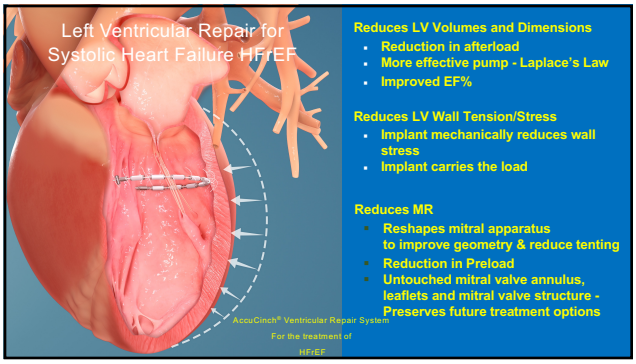

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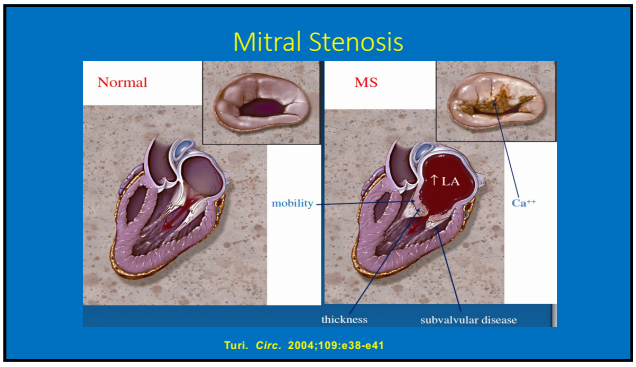

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Case Presentations

- 42-year-old female with a past medical history significant for rheumatic fever who presents for evaluation of worsening shortness of breath and lower extremity edema
- She is found to have severe rheumatic mitral stenosis
- 75-year-old male with a past medical with past medical history for bioprosthetic valve replacement who present with worsening shortness of breath
- He is found to have severe stenosis of his bioprosthetic valve.

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Etiology

- Rheumatic Fever
- Mitral annular calcification (MAC): while MAC is commonly seen in the elderly and patients with advanced renal disease, it rarely causes significant MS .
- Radiation valvulitis: which typically manifests 10 to 20 years after mediastinal radiation therapy
- Congenital causes: very rare, such as cor triatriatum, parachute mitral valve, double-orifice mitral valve, or supravalvular mitral ring
- Systemic inflammatory disorders such as lupus erythematous and rheumatoid arthritis may occasionally lead to valvulitis and resulting MS
- Obstructing lesions such as a large atrial myxoma or infected vegetation which may cause functional MS

Curr Cardiol Rep (2017) 19: 73

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Mitral Stenosis: Symptoms and Physical Exam

- Dyspnea on exertion,
- Orthopnea
- Paroxysmal nocturnal dyspnea
- Atrial Fibrillation

- Right ventricular lift if pulmonary hypertension has developed
- A diastolic thrill may be palpated in the left lateral decubitus position
- After S2, the mitral valve opens with a snap
- A low-pitched mitral rumble follows the opening snap and may be punctuated by presystolic accentuation if the patient is in sinus rhythm

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Mitral Stenosis: Outcomes

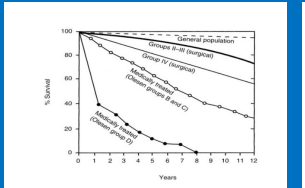

Figure 3. Survival according to therapy and symptomatic status for patients with MS. Groups II, III, and IV are roughly equivalent to groups B, C, and D, respectively. Reproduced from Roy and Gopanath[27] with permission.

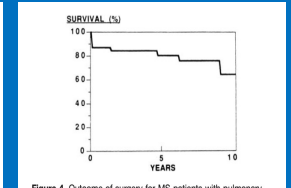

Figure 4. Outcome of surgery for MS patients with pulmonary hypertension. High operative risk is demonstrated. Reproduced from Vincens et al[28] with permission.

Circulation. 2005;112:432-437

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Rheumatic Mitral Stenosis Treatment

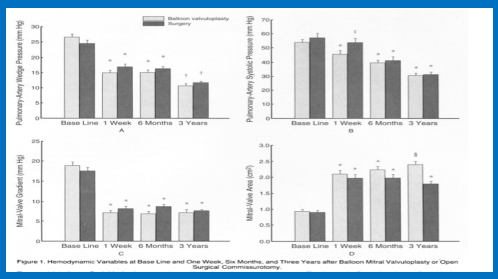

Figure 1. Hemodynamic Variables at Base Line and One Week, Six Months, and Three Years after Balloon Mitral Valvuloplasty or Open Surgical Commissurotomy.

N Engl J Med 1994;331:961-7

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Mitral Stenosis Treatment

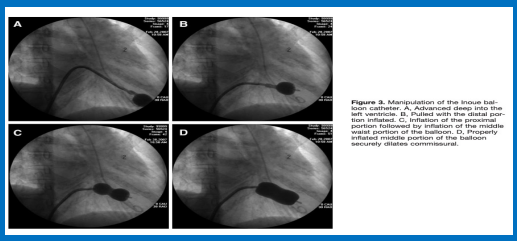

Figure 3. Manipulation of the Inoue balloon catheter. A, Advanced deep into the left ventricle. B, Initial inflation of the distal portion followed by inflation of the middle waist portion of the balloon. D, Properly inflated middle portion of the balloon securely dilates commissural.

Circulation. 2009;119:e211-e219.

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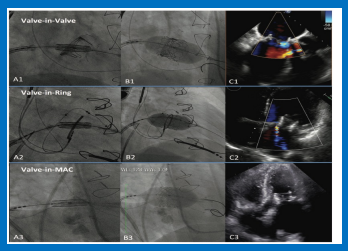
Mitral Valve interventions



European Heart Journal (2019) 40, 452–455 EDITORIAL
doi:10.1093/eurheartj/ehy725

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Case Presentation

- 92-year-old who presented to the hospital with worsening shortness of breath
- His EF had declined to 20%
- Given frailty and low ejection fraction was turned down for surgery
- Balloon valvuloplasty was performed. His functional status improved
- He then underwent transcatheter valve replacement

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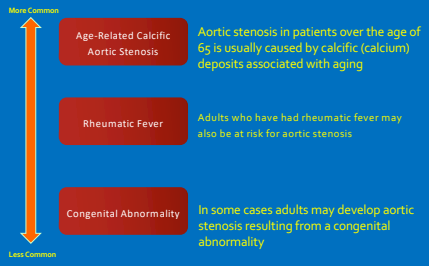
What Causes Aortic Stenosis in Adults?



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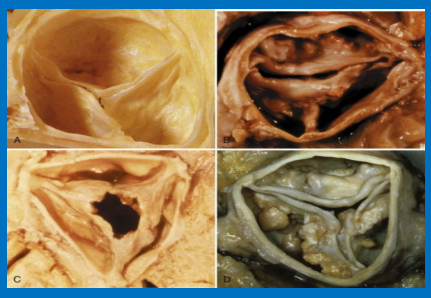
3 Major Etiologies for aortic stenosis



Images courtesy of John Webb, MD at St. Paul's Hospital and Renu Virmani, MD at the CVPath Institute

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Aortic Stenosis: Symptoms and Physical Exam

- Heart Failure
- Angina
- Syncope

- Carotid Parvus et Tardus
- Laterally displaced PMI
- Soft A2
- Crescendo-Decrescendo systolic murmur
- Timing of peak murmur and NOT intensity predicts severity

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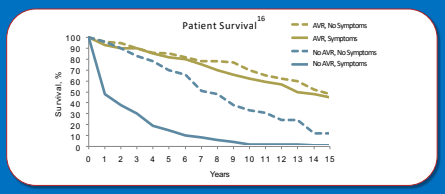
Aortic Valve Replacement Greatly Improves Survival

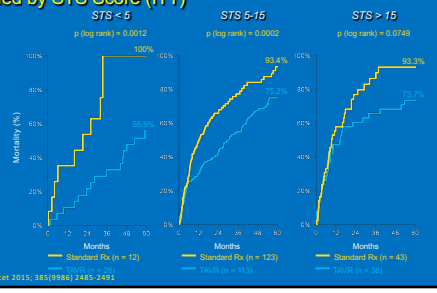


- Study data demonstrate that early and late outcomes were similarly good in both symptomatic and asymptomatic patients
- It is important to note that among asymptomatic patients with SAS, omission of surgical treatment was the most important risk factor for late mortality

Brown ML, Pellikka PA, Schaff HV, et al. J Thorac Cardiovasc Surg 2008; 135(2): 308-15

56

All-Cause Mortality Stratified by STS Score (ITT)



Lancet 2015; 385(9986):2485-2491

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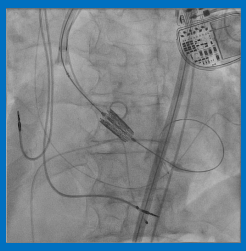
Patient WG



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Case Presentation

- A 52-year-old with history of a severe cardiomyopathy was placed on ECMO.
- While on ECMO the patient has severe aortic insufficiency.
- TAVR performed

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Aortic Insufficiency: Etiologies

- **Aortic leaflet/cusp abnormalities**
- Infectious: Bacterial endocarditis
- Congenital: Bicuspid aortic valve (often associated with calcification)
- Inflammatory: Rheumatic fever, systemic lupus erythematosus, or SLE, rheumatoid arthritis, or RA, Behcet's syndrome
- Degenerative: Myxomatous (floppy) valve, senile calcification
- Others: Trauma, post-aortic valve valvuloplasty, diet drug valvopathy, carcinoid valve disease (requires lung metastases or patent foramen ovale [PFO])
- **Aortic root abnormalities**
- Aortic root dilation: Marfan syndrome, syphilitic aortitis, idiopathic aortitis, Ehlers-Danlos syndrome, relapsing polychondritis, hypertension-related annulo-aortic ectasia
- Loss of commissural support: Aortic dissection, trauma, supracristal ventricular septal defect (VSD)
- **Other congenital abnormalities**
- Supravalvular aortic stenosis (can occur in William's syndrome)
- Coarctation of the aorta

https://www.healio.com/cardiology/learn-the-heart/cardiology-review/topic-reviews/aortic-regurgitation

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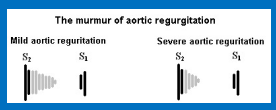
Aortic Regurgitation: Symptoms and Physical Exam

- Shortness of Breath
- Congestive heart failure
- Visible cardiac and arterial pulsations are common due to the large stroke volume
- High pitches diastolic murmur



https://www.healio.com/cardiology/learn-the-heart/cardiology-review/topic-reviews/aortic-regurgitation

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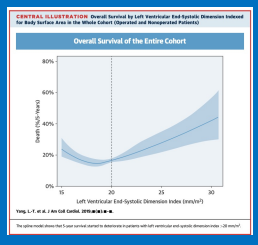
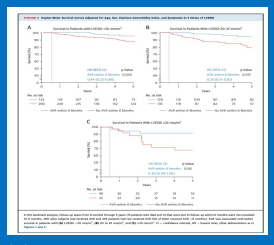
Outcomes in Chronic Hemodynamically Significant Aortic Regurgitation





JACC 2019 Apr 16;73(14):1741-1752

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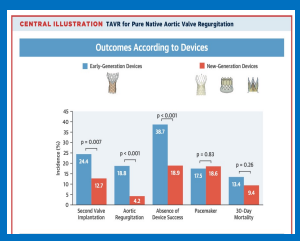
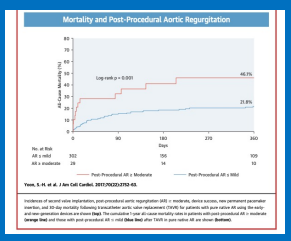
Transcatheter Aortic Valve Replacement in Pure Native Aortic Valve Regurgitation





Yoon, S.-H. et al. J Am Coll Cardiol. 2017;70(22):2752–63.

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Conclusions

- New World: Percutaneous interventions
- Refresh, Renew, Refocus: History and Physical Exam
- There are options for patients with severe valve disease

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