

Aortic Anatomy, Aneurysms and Dissections

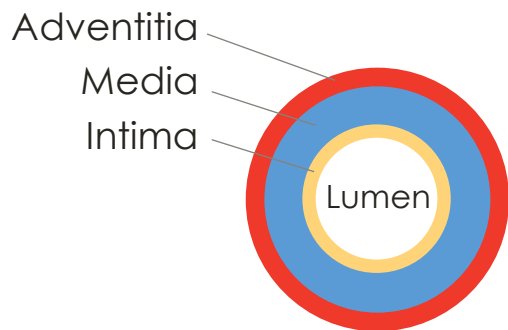
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Aortic Anatomy

- Largest artery in body arising from left ventricle and ending at the iliac bifurcation
- Consist of 3 layers: intima, media, adventitia
- Segments can be subdivided as follows: root, ascending, arch, descending, abdominal
- Normal size is 1.5 cm to 3.0 cm depending on age, gender, and segment measured
- With age, there is a loss of distensibility and compliance



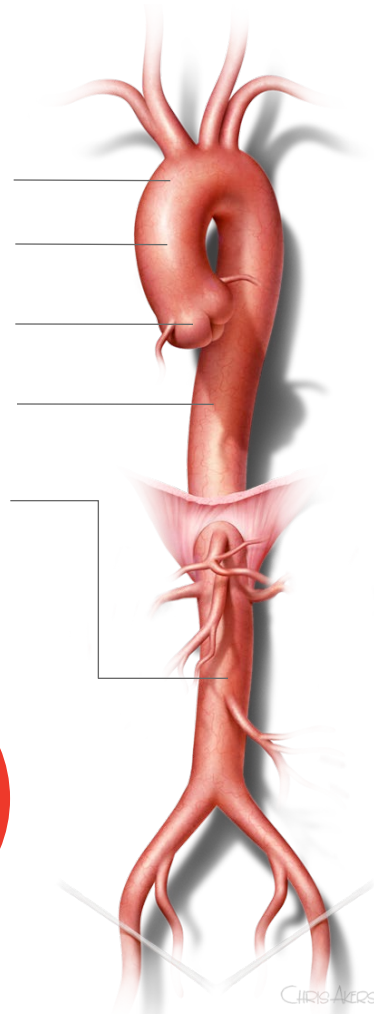
Aortic Arch

Ascending

Root

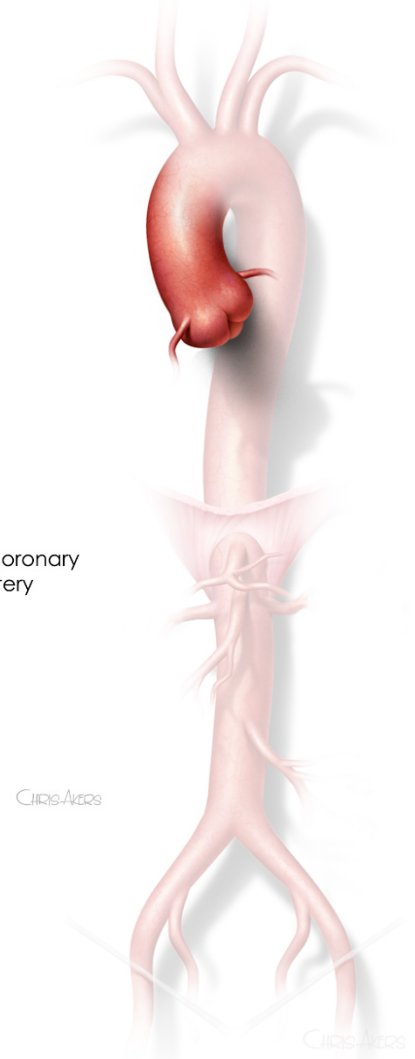
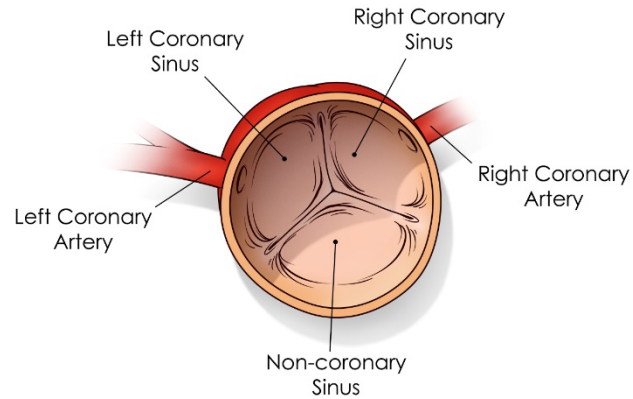
Descending

Abdominal



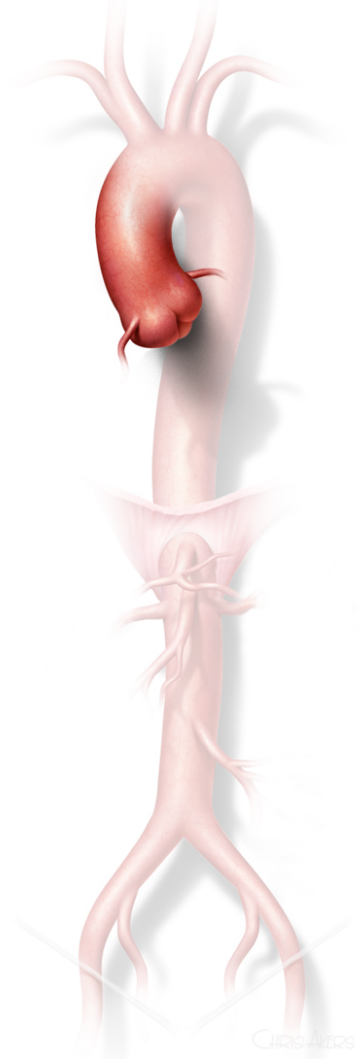
Root

- The aortic root attached to the heart
- The aortic root consists of:
 - Aortic valve:
 - Right coronary cusp
 - Left coronary cusp
 - Noncoronary cusp
 - Coronary ostia
 - Sinuses of Valsalva



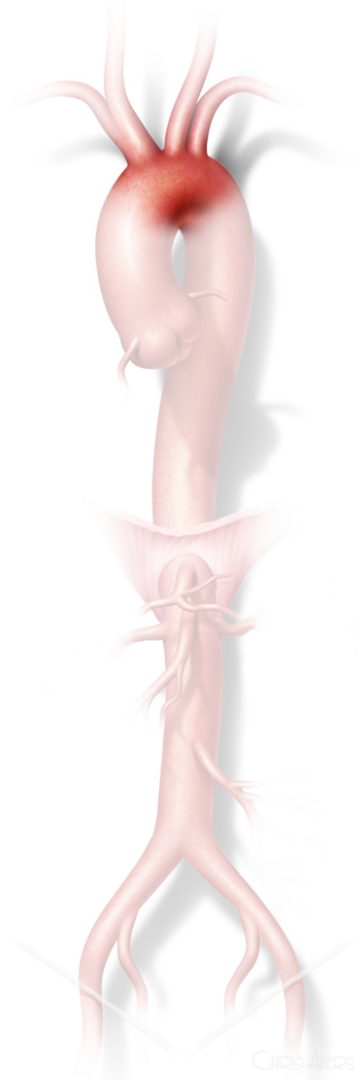
Ascending

- Root to brachiocephalic artery
- About 2 inches long
- Located posterior to the sternum



Aortic Arch

- The aortic arch is between the innominate artery and left subclavian artery.
- Encompasses the innominate artery, left carotid artery, and left subclavian artery.
- Travels from front part of the chest to the back.



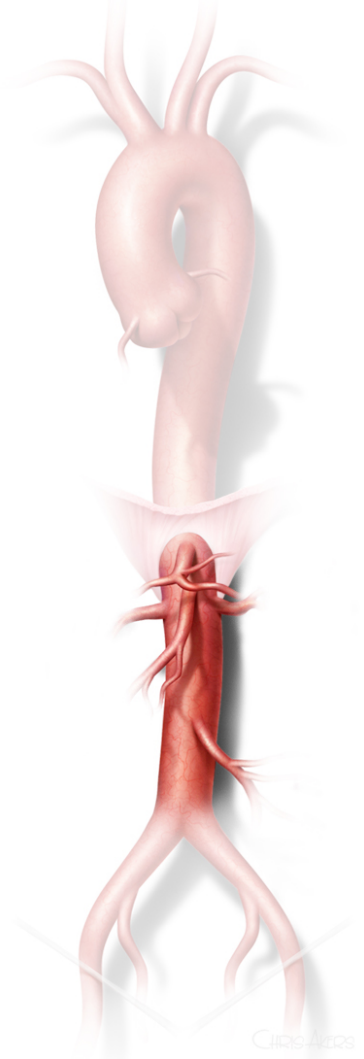
Descending Thoracic

- The descending thoracic starts at the left subclavian artery to the diaphragm:
 - Located in the back of the chest cavity
 - Continues down along the spine.
 - Behind the trachea and esophagus
- Blood Supply to intercostal arteries



Abdominal Aorta

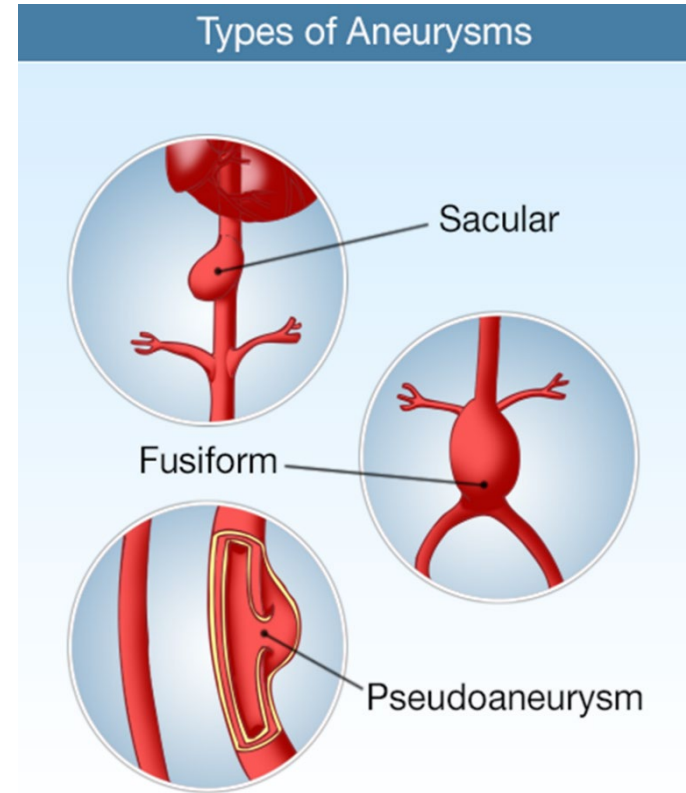
- Lower portion of the Aorta:
 - Diaphragm
 - Iliac bifurcation
- Supplies blood:
 - Celiac trunk
 - superior/inferior mesenteric arteries
 - Renal arteries
 - gonadal arteries
 - Lower extremities



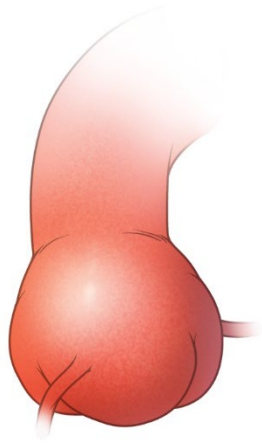
Aortic Aneurysm Definition

An aortic aneurysm is the dilation of the artery:

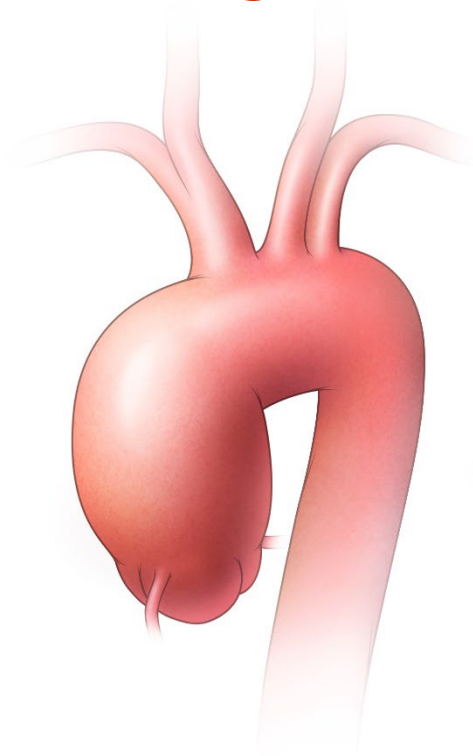
- True aneurysm includes all 3 layers
 - Fusiform
 - Saccular
- False aneurysm or pseudoaneurysm
 - Also known as contained rupture
 - Blood collection between media and adventitia



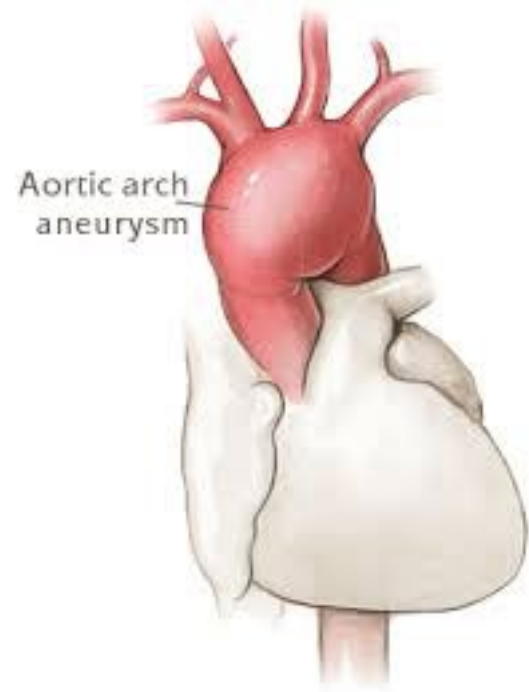
Root, Ascending, Arch Aneurysms



Aortic Root

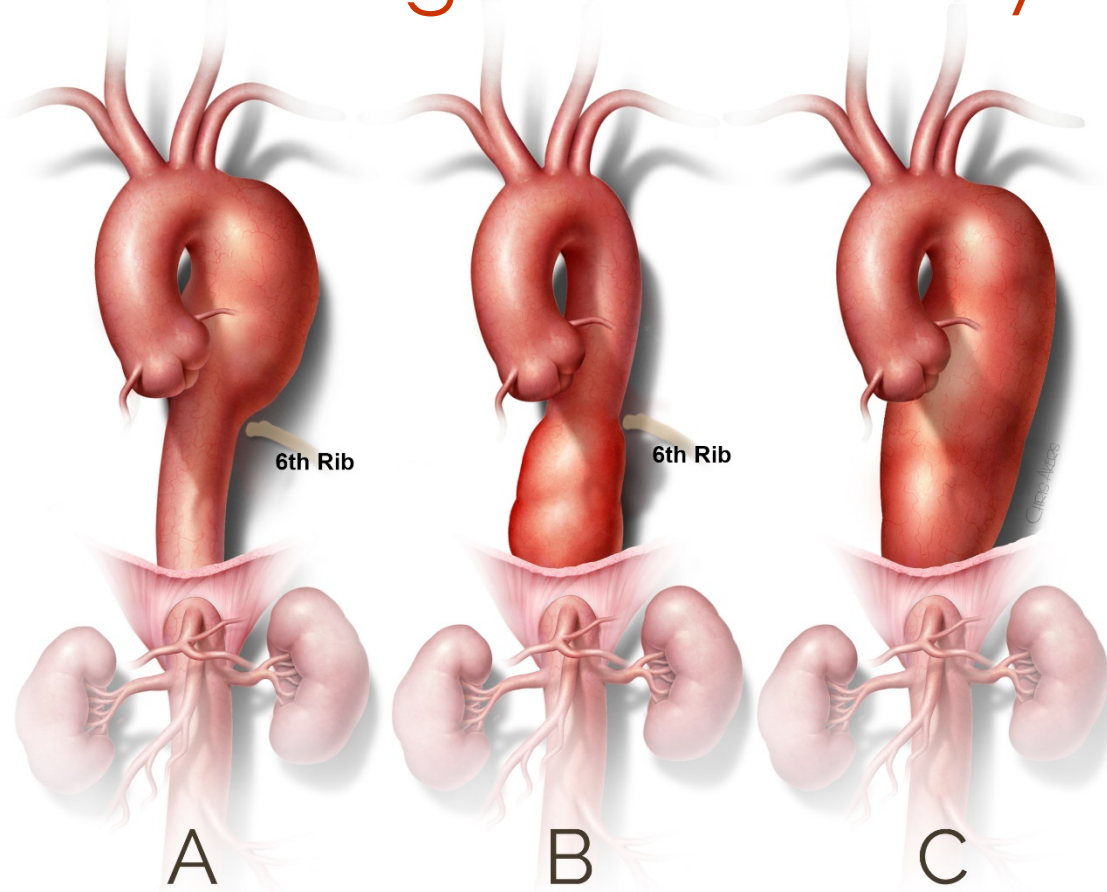


Ascending Aorta



Aortic Arch

Descending Aortic Aneurysm



Abdominal Aortic Aneurysm

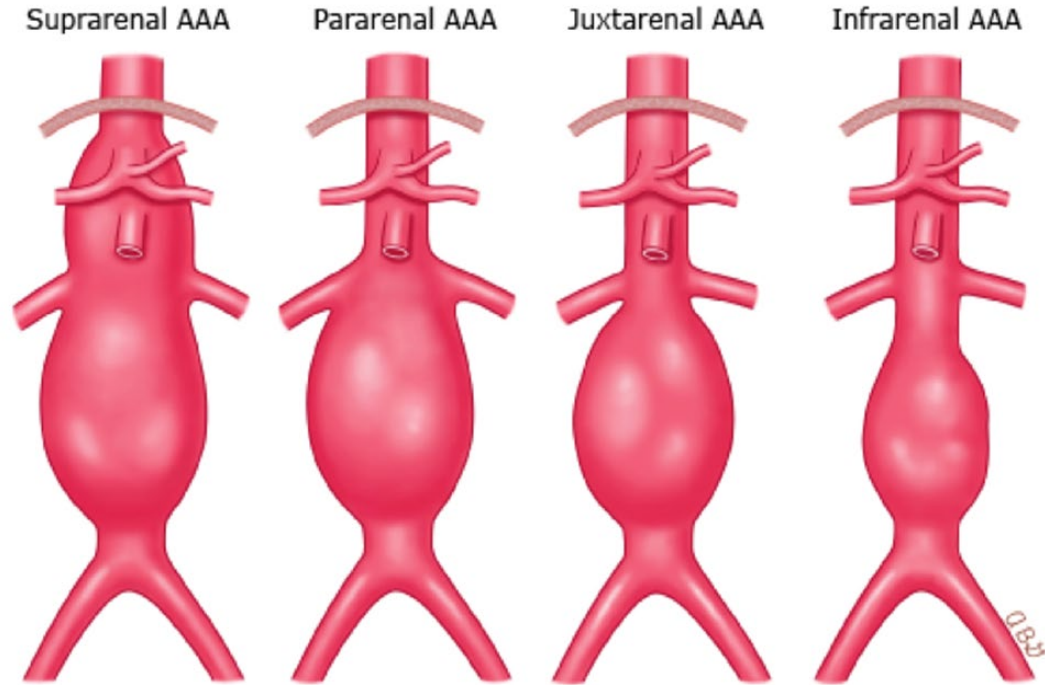
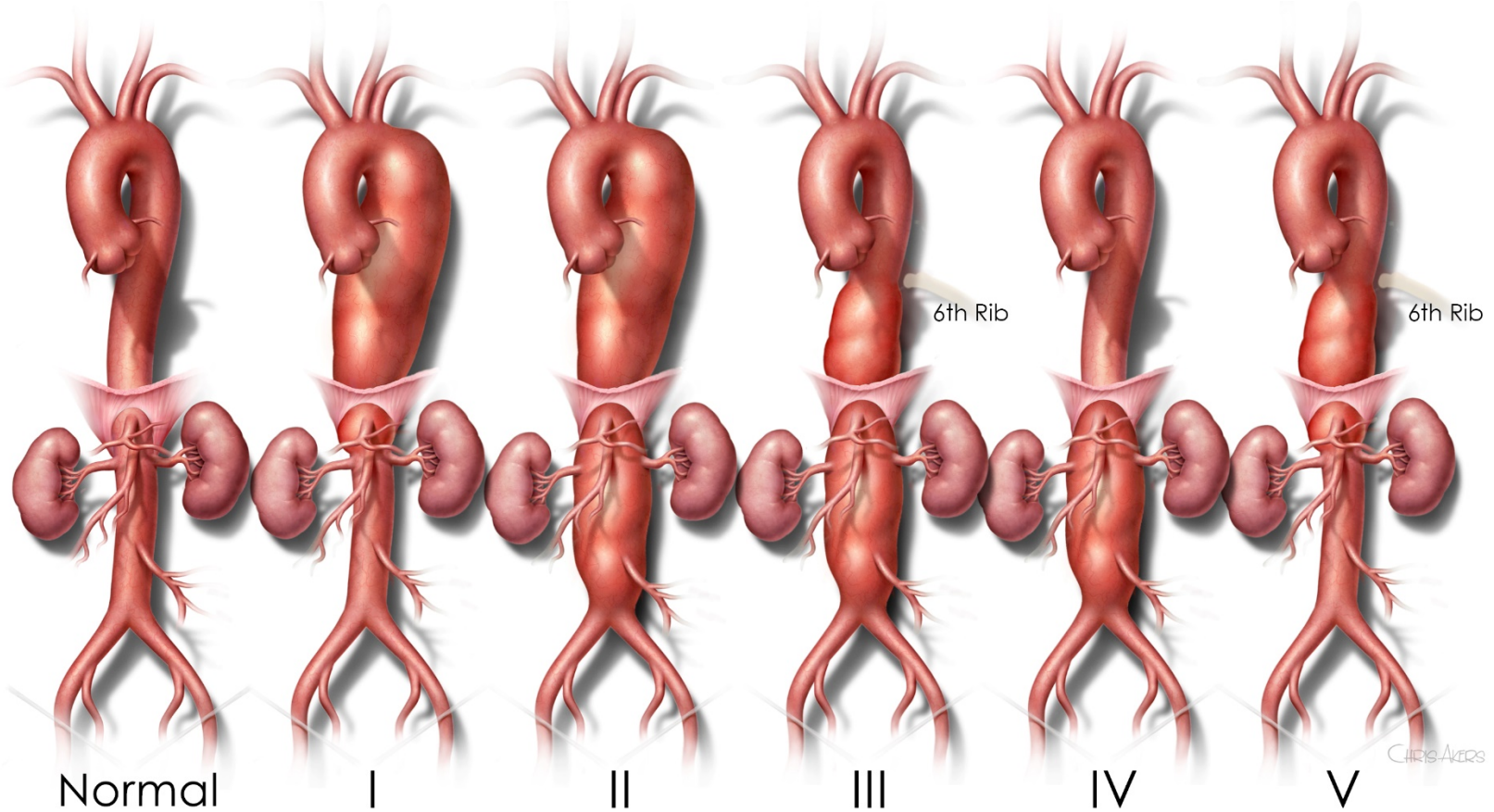


Figure 1: Classification of Abdominal Aortic Aneurysms. From UptoDate TM

Thoracoabdominal aortic aneurysm



Epidemiology

- Aortic disease 14th leading cause of death in the US
- Thoracic:
 - 5.6 to 10.4 per 100,000
 - Root/ascending 60%
 - Descending 35%
 - Arch < 10%
- Abdominal:
 - Infrarenal most common
 - Males 65-70: 55 per 100,000
 - Males 75-85: 112 per 100,000
 - Males >85: 298 per 100,00
 - 9928 deaths in 2017



Typical Aortic Aneurysm

- Thoracic:
 - Degenerative
 - Most common in 60-70 year olds
 - 2-4 times more common in males
- Abdominal:
 - 4-6 times more likely in males
 - 79% Smoker or history (main modifiable risk factor)
 - Caucasian
 - 70% hypertension

Clinical Manifestation

- Significant number are asymptomatic
- Thoracic aneurysms:
 - Chest pain
 - Back pain
 - Hoarseness
 - Difficulty swallowing
 - Difficulty breathing
 - Cough
 - Heart failure
 - Superior vena cava syndrome
 - Stroke

Symptoms to look out for!

In THORACIC AORTIC ANEURYSM, symptoms are more evident when the aneurysm occurs where the aorta curves down (aortic arch), they may include:



Chest pain, generally described as deep and aching or throbbing. This is the most frequent symptom.



Back pain



A cough or shortness of breath if the aneurysm is in the area of the lungs.



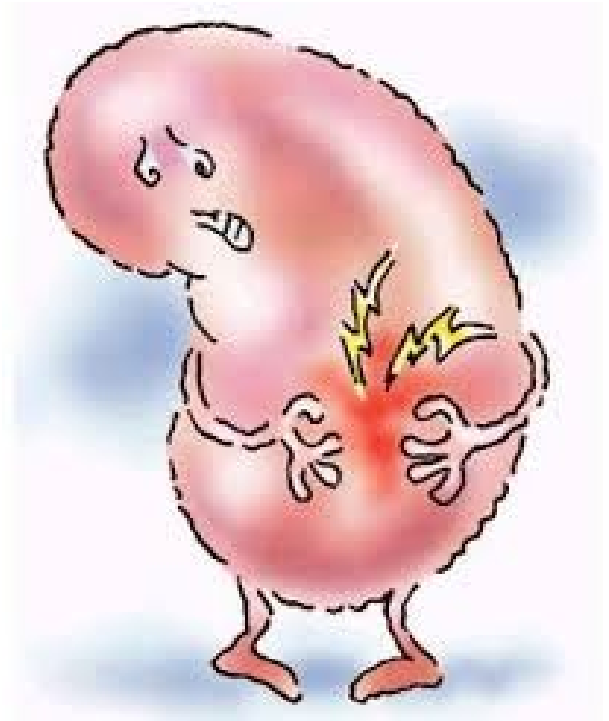
Hoarseness



Difficulty or pain while swallowing

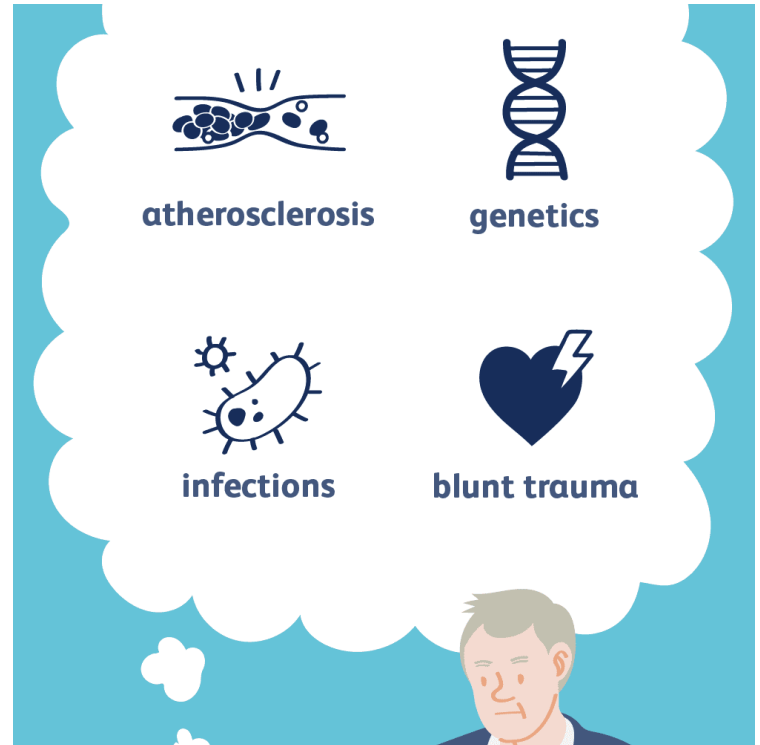
Clinical Manifestation

- Abdominal Aneurysms:
 - Abdominal, flank, back pain
 - groin pain
 - Nausea/Vomiting
 - urinary/bowel symptoms
 - Decreased flow to lower extremities
 - Pulsatile umbilical mass
- Thoracoabdominal aortic aneurysm:
 - All symptoms listed



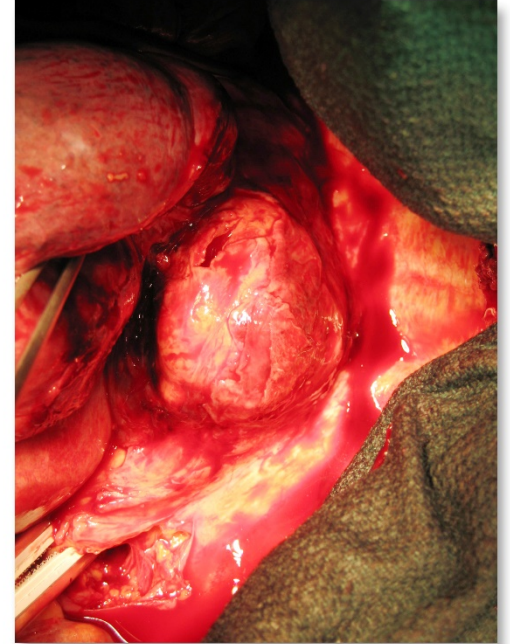
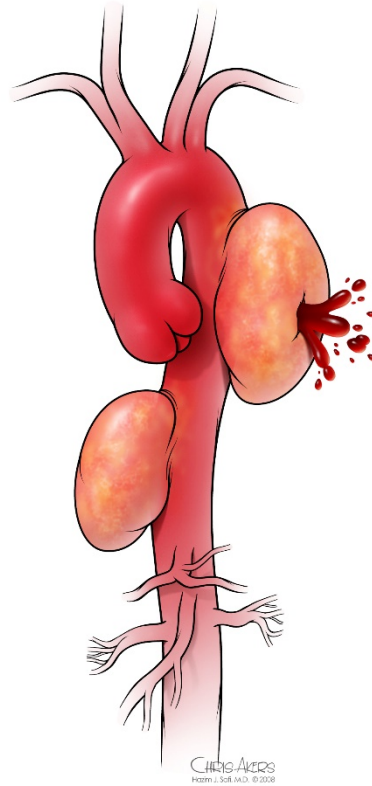
Risk Factors

- Medial degeneration
- Aortic dissection
- Atherosclerosis
- Penetrating ulcer
- Infection
- Smoking
- Trauma
- Gender
- Age
- Race
- Hypertension
- Genetic disorders or family history
- Bicuspid Aortic Valve
- coarctation
- Vasculitis



Complications and Natural History Aortic Aneurysms

- Aortic dissection
- Aortic rupture
- Aortic regurgitation
- Emboli
- Slow growth



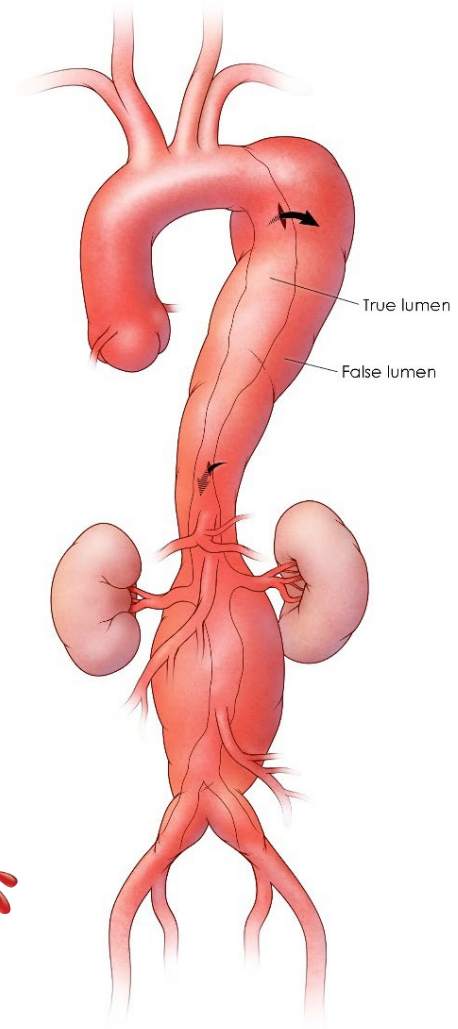
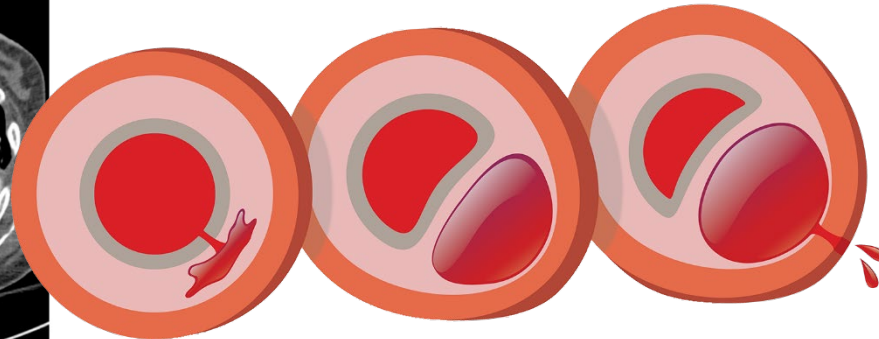
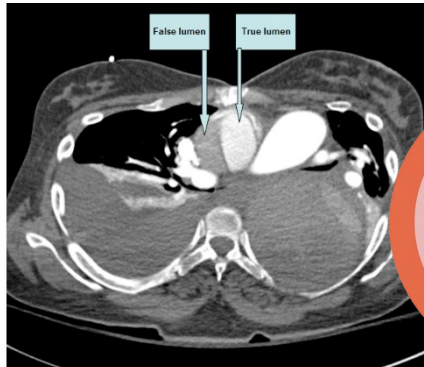
Assessing Risk for Rupture

BSA	Aortic size (cm)									
	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0
1.30	2.69	3.08	3.46	3.85	4.23	4.62	5.00	5.38	5.77	6.15
1.40	2.50	2.86	3.21	3.57	3.93	4.29	4.64	5.00	5.36	5.71
1.50	2.33	2.67	3.00	3.33	3.67	4.00	4.33	4.67	5.00	5.33
1.60	2.19	2.50	2.80	3.13	3.44	3.75	4.06	4.38	4.69	5.00
1.70	2.05	2.35	2.65	2.94	3.24	3.53	3.82	4.12	4.41	4.71
1.80	1.94	2.22	2.50	2.78	3.06	3.33	3.61	3.89	4.17	4.44
1.90	1.84	2.11	2.37	2.63	2.89	3.16	3.42	3.68	3.95	4.22
2.00	1.75	2.00	2.25	2.50	2.75	3.00	3.25	3.50	3.75	4.00
2.10	1.67	1.90	2.14	2.38	2.62	2.86	3.10	3.33	3.57	3.80
2.20	1.59	1.82	2.05	2.27	2.50	2.72	2.95	3.18	3.41	2.64
2.30	1.52	1.74	1.96	2.17	2.39	2.61	2.83	3.04	3.26	3.48
2.40	1.46	1.67	1.88	2.08	2.29	2.50	2.71	2.92	3.13	3.33
2.50	1.40	1.60	1.80	2.00	2.20	2.40	2.60	2.80	3.00	3.20

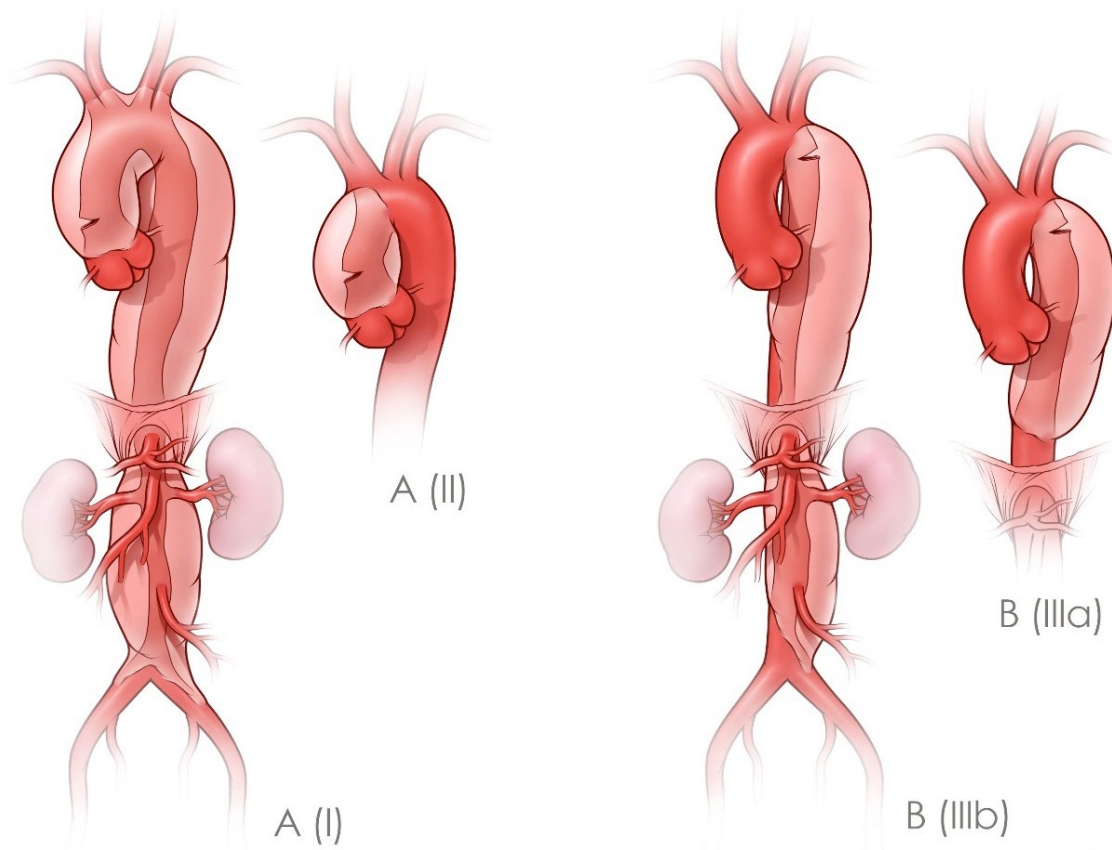
- = low risk (~4% per yr)
- = moderate risk (~8% per yr)
- = severe risk (~20% per yr)

Dissection Definition

- Disruption of the intimal layer develops allowing blood flow within the medial layers of the aortic wall.
- The blood flow can continue to separate the layers proximally and distally
- Acute dissection is within 14 days of the initial incident, subacute 2-6 weeks, chronic after 6 weeks

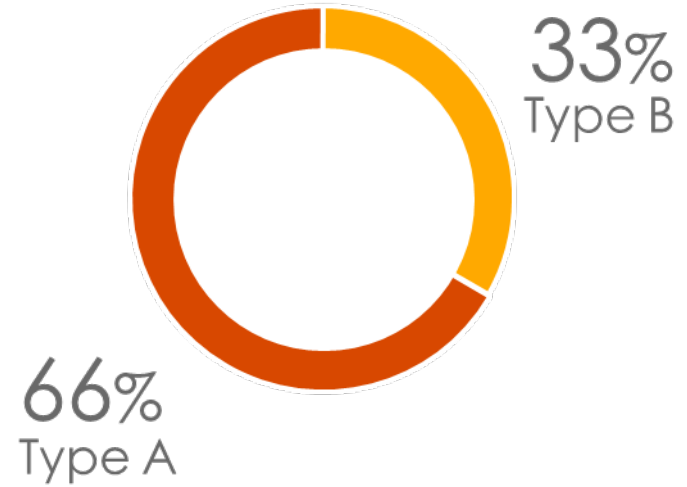


Classifications of Aortic Dissection



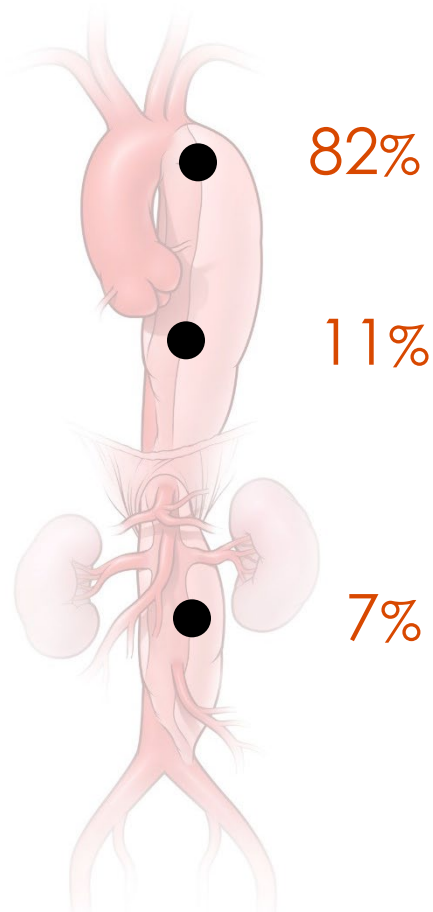
Epidemiology

- 14 per 100,000 adults/year
- 10 - 12,000 new cases yearly
- 2/3 type A, 1/3 type B
- 65% male
- 79% Caucasian
- Mean age: Male 63 / Female 67
- Increase incident during winter months



Typical Aortic Dissection

- **Type A**
 - 90% type AI
 - 10% type All
- **Type B**
 - 82% proximal
 - 11% mid
 - 7% distal
- 75% uncomplicated



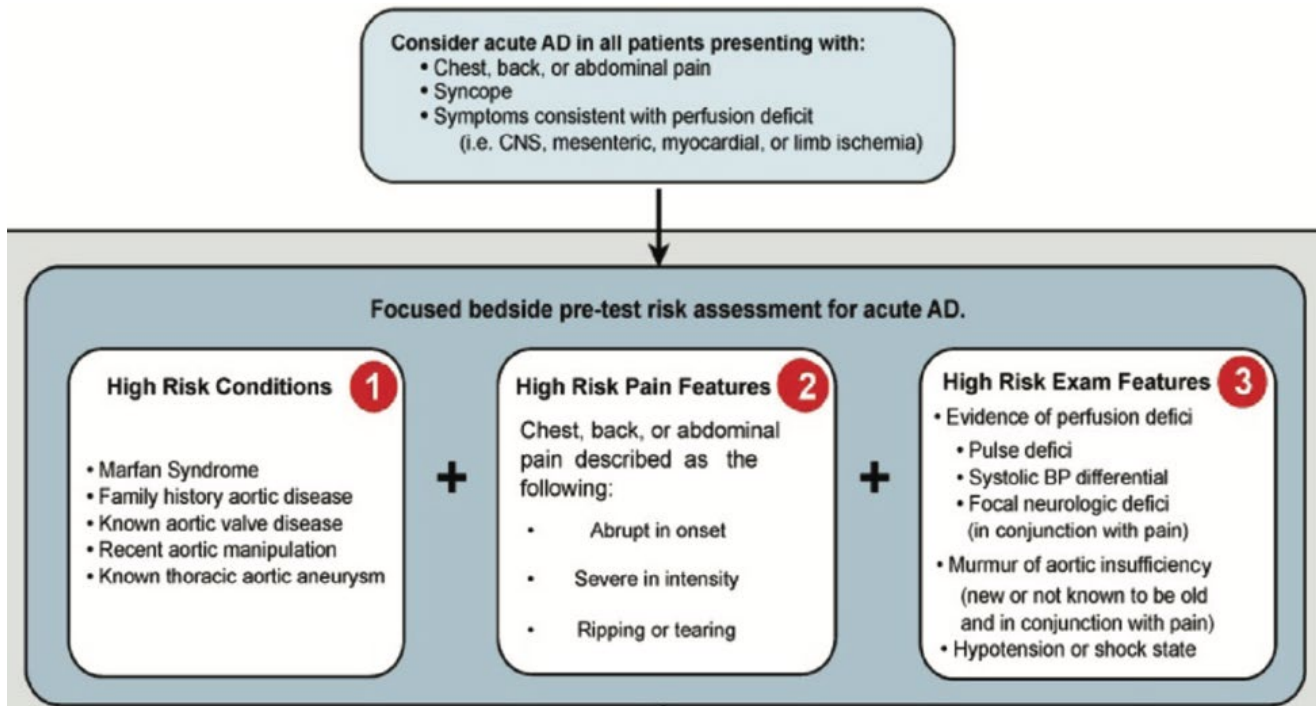
Risk Factors for Aortic Dissection

- Hypertension
- Intramural hematoma
- Penetrating atherosclerotic ulcers
- Genetics
- Pregnancy
- Elevated Cholesterol
- Trauma
- Preexisting aortic aneurysm
- Aortic coarctation
- Inflammatory disease
- Aortic instrumentation or surgery
- Cocaine Use
- Diabetes
- Smoking
- Bicuspid Aortic Valve
- High intensity weightlifting
- Gender
- Age

Clinical Manifestations

- Acute onset severe pain
- hypotension or hypertension
- nausea/vomiting
- weak pulse in arm/leg compared to other side; blood pressure differential
- Lower extremity ischemia
- leg paralysis or numbness, tingling, weakness of lower extremities
- may have symptoms similar to stroke
- anxiety or feeling of looming doom
- new murmur or s/s of CHF
- NSTEMI
- hemoptysis
- diaphoresis
- hoarseness, difficulty swallowing, cough
- syncope or AMS
- s/s of cardiac tamponade
- Some can present with only mild pain or no pain

Aortic Dissection Detection Risk Score



From Rogers et al., Sensitivity of the Aortic Dissection Detection Risk Score, a Novel Guideline-Based Tool for Identification of Acute Aortic Dissection at Initial Presentation. *Circulation*. 2011.

Complications and Natural History

- Rupture
- Malperfusion:
 - Neurologic
 - Visceral (e.g., Celiac, SMA, Renal)
 - Spinal Cord
 - Lower Limb
- Cardiac Tamponade
- Congestive heart failure
- Aneurysmal degeneration of False Lumen
- Uncontrollable Hypertension
- Uncontrollable Pain
- Mortality 25-30%

Diagnostic Tools

- CTA (gold standard)
- Echocardiogram
- MRA
- IVUS
- Aortography
- CXR
- Ultrasound
- Biochemical markers:
Plasma D-dimer



Patient Education

- No smoking
- Avoid heavy lifting or straining
- Blood pressure management
- Avoid Fluoroquinolone use
- Symptoms to monitor for
- Follow-up imaging
- Discussing diagnosis with family members
- Support groups

LIVE  ON

*Living In Spite of Vascular Disease Education
& Outreach Network*

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