Great Vessel, Great Problems:
Managing Aortic Disease

BOSTON MedFlight
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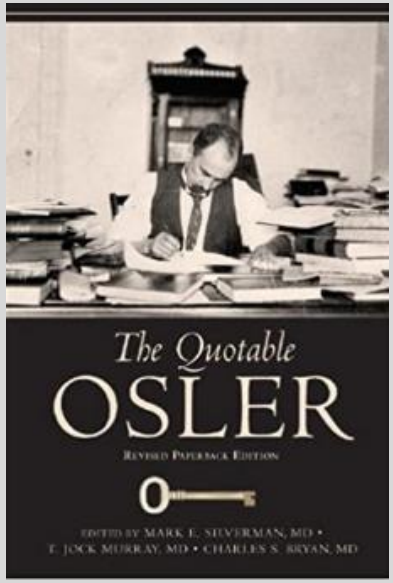
Aortic Disease

- There is no disease more conducive to clinical humility than aneurysm of the aorta



Today's Talk

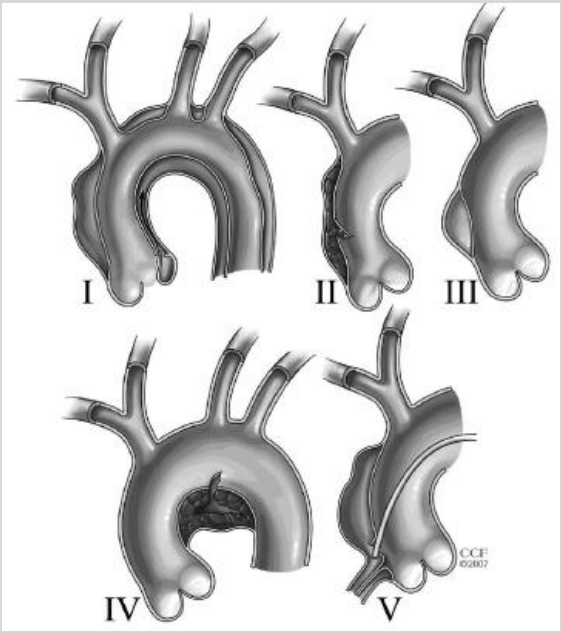
- Language
- Anatomy
- Physiology
- Diagnosis
- Treatment
- Maybe new things

Four Kinds of Problems

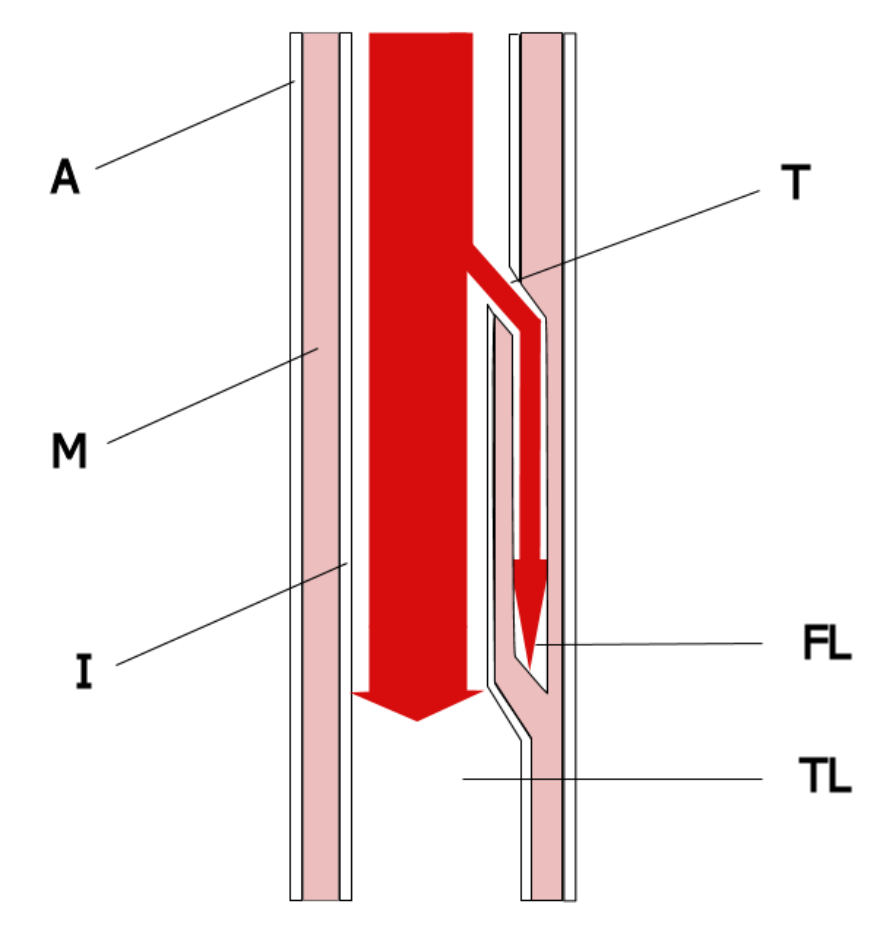
- Aortic Syndromes
- Aortic Aneurysm
- Endograft Leak
- Aortoenteric Fistula

Aortic Syndromes

- Incorporates 5 disease states with **intimal injury**
  - Classic aortic dissection
  - Intramural hematoma
  - Localized dissection without significant intimal flap
  - Penetrating aortic ulcer
  - Iatrogenic dissection



Classic Aortic Dissection



- Intimal violation
- Blood + pulsatile pressure → media
- False lumen created

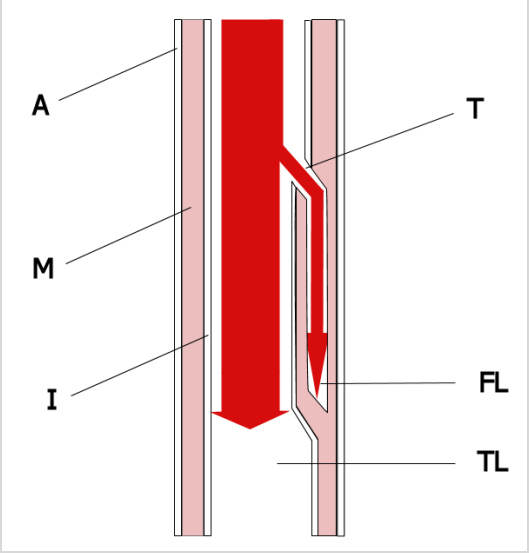
Classic Aortic Dissection

- Most common aortic catastrophe
  - 3x as likely as AAA rupture
- Initially missed in up to 38% of cases
- 2.6 – 3.5 events per 100,000 person years
- 2-3% of CCT transports

Local Dissection

- Intimal tear without flap or hematoma formation
  - Can be missed without careful evaluation of imaging
  - Patients may have associated aneurysms, AR, or effusions

Classic Aortic Dissection



Local Dissection

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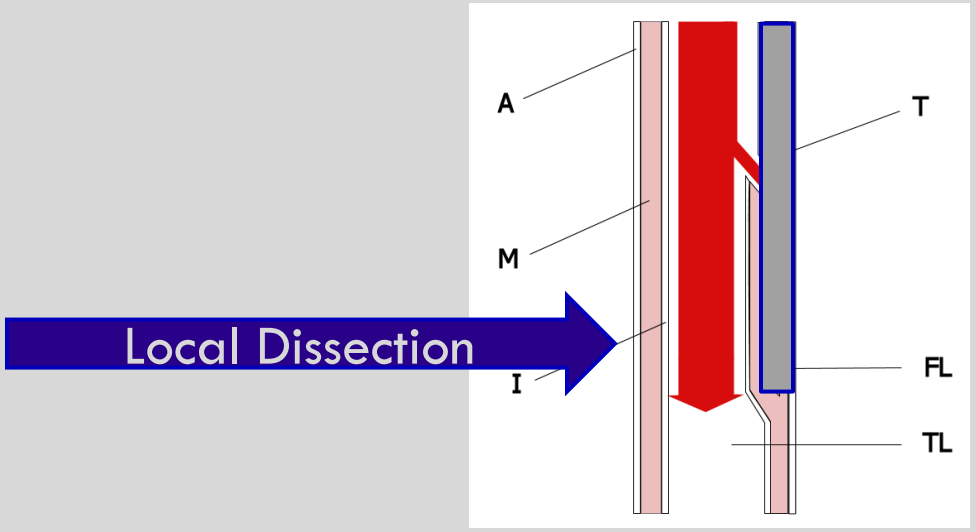
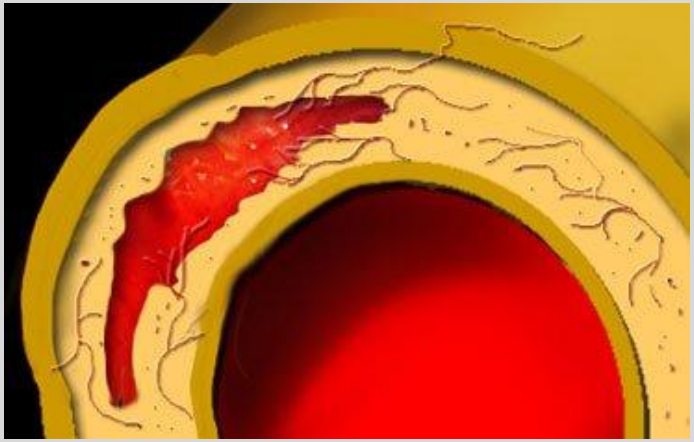


Iatrogenic Dissection

- Non-zero risk for classic or local dissection with cardiac procedure
  - Up to 0.35% of cardiac surgeries
  - Up to 0.03% of PCI
- Different than coronary artery dissection

Intramural Hematoma

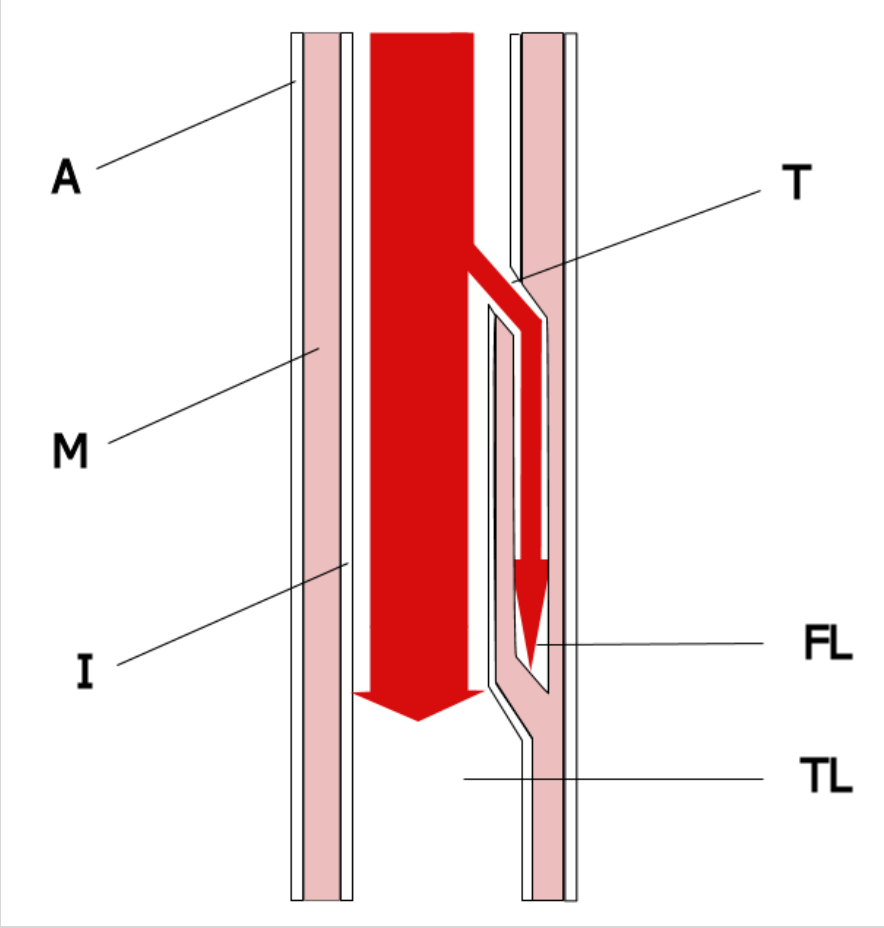
- 20% of Aortic Syndrome cases
- Intimal injury without
  - False lumen
  - Flap
  - Re-entrant blood flow
- Severe atherosclerotic disease
- 47% progression
  - 1-% resolution



Penetrating Aortic Ulcer

- Ulceration of atherosclerotic lesion penetrates intima
  - Focal lesion
  - Usually in descending aorta
  - Do not progress with the same frequency as intramural hematoma

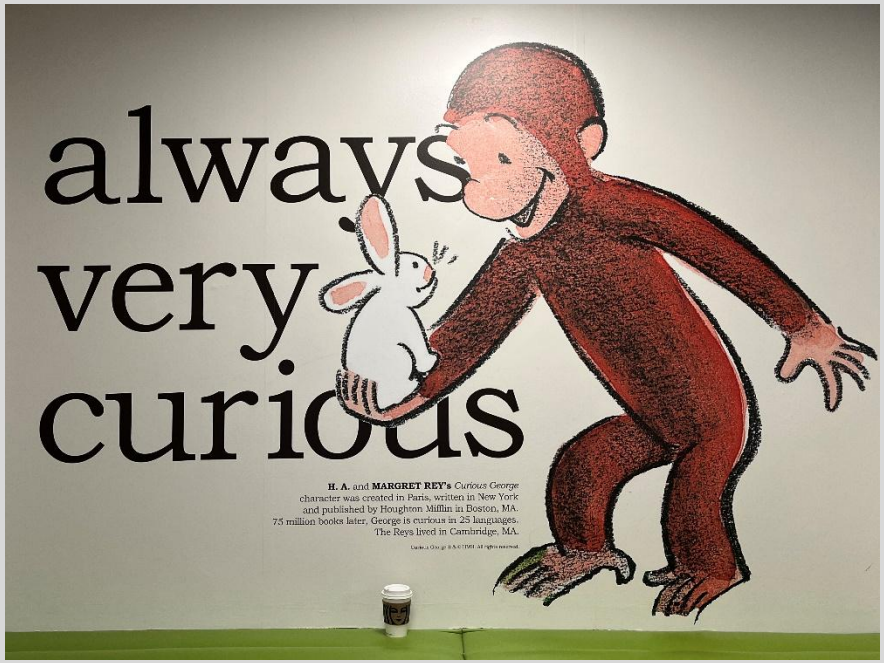
Aortic Syndrome = Classic Dissection



- Intimal Injury
  - Aortic dissection
  - Local dissection
  - Intramural hematoma
  - Penetrating aortic ulcer

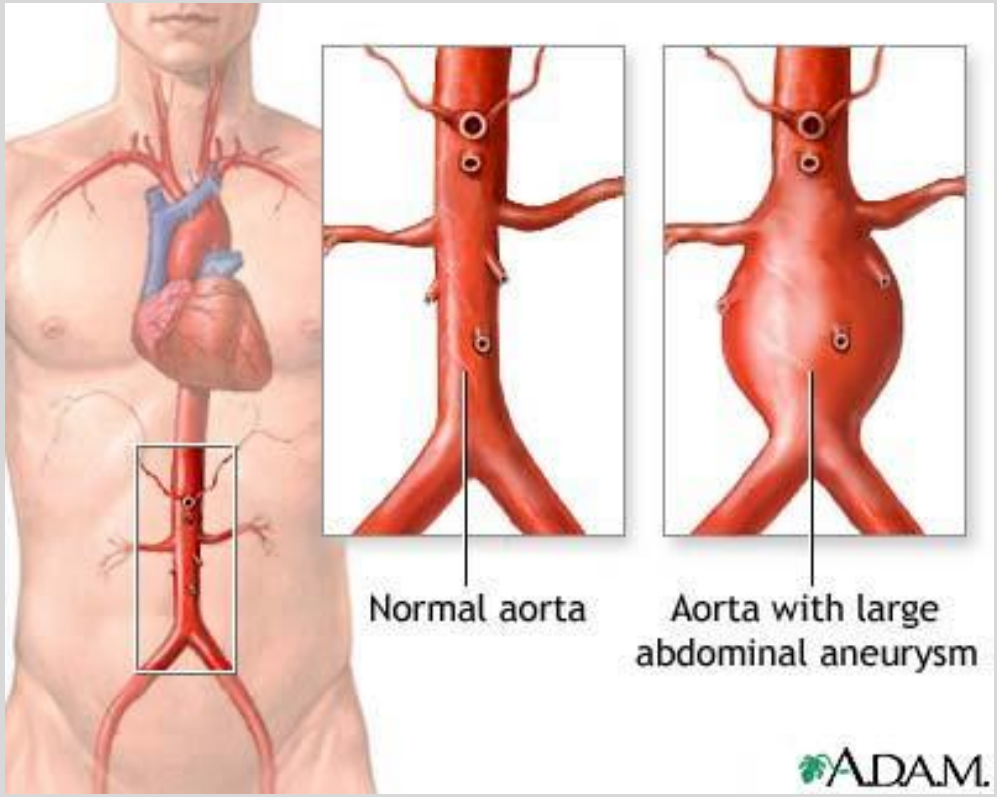
Expect Bad Information

- Disease and location nomenclature critically important
- Often confused



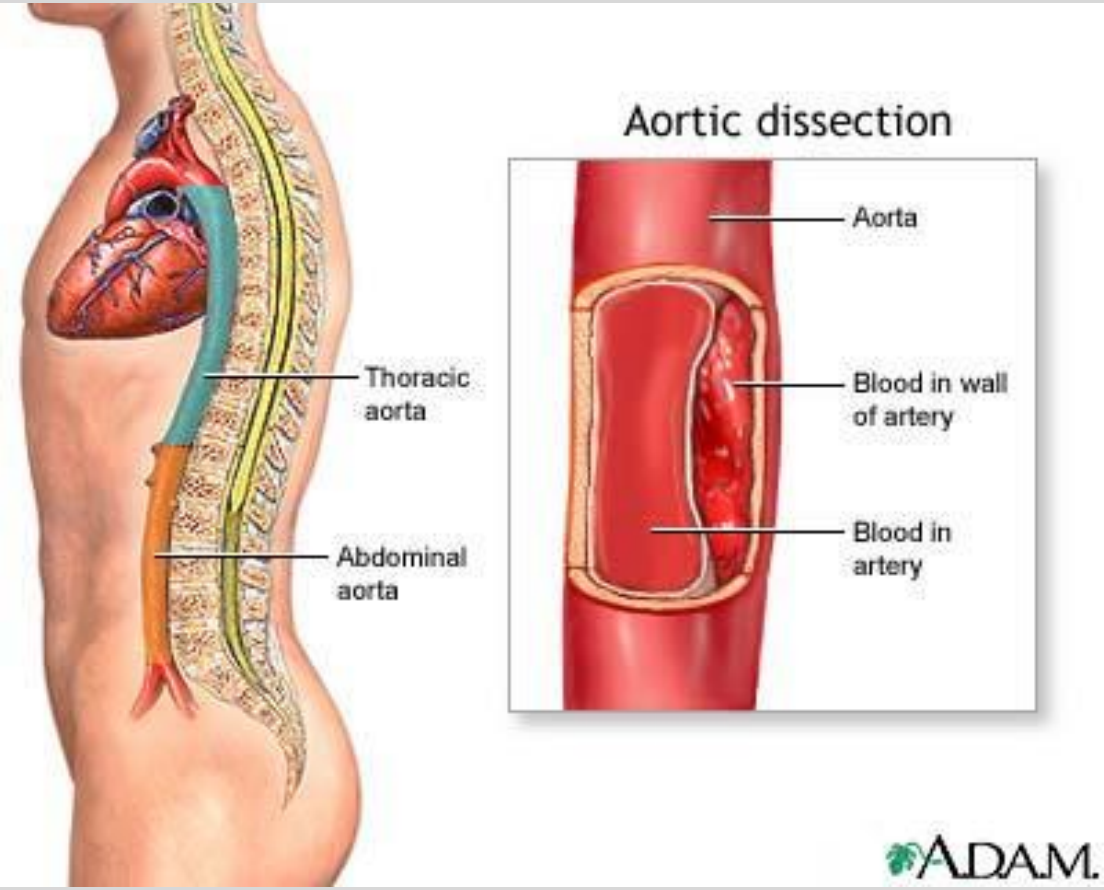
Aortic Aneurysm

- Transmural weakening
- Not intimal defect



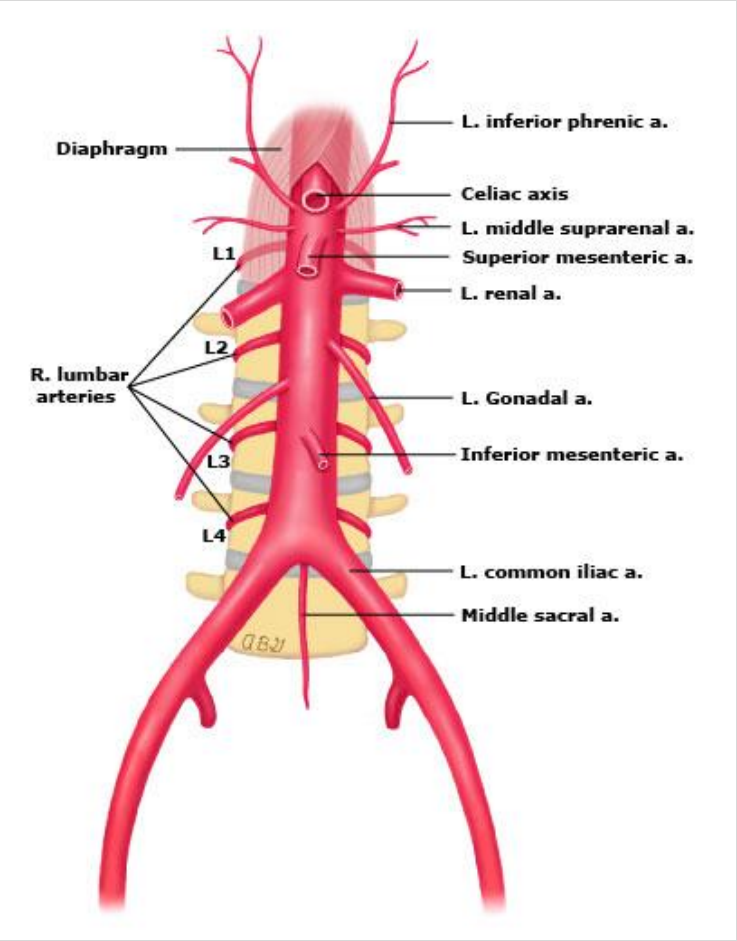
Location Descriptors

- Abdominal v. Thoracic Aorta



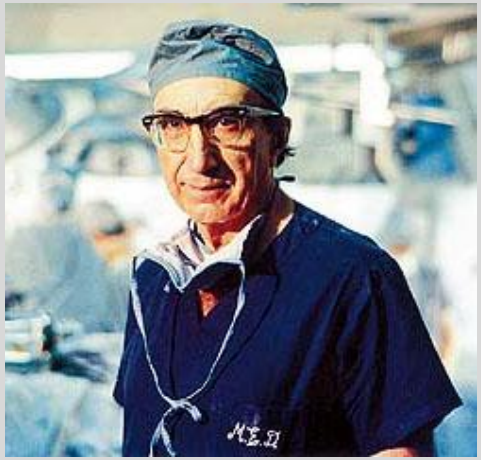
Location Descriptors

- Helpful to understand vascular anatomy



Location Descriptors

- Stanford or DeBakey Classes for Thoracic Disease



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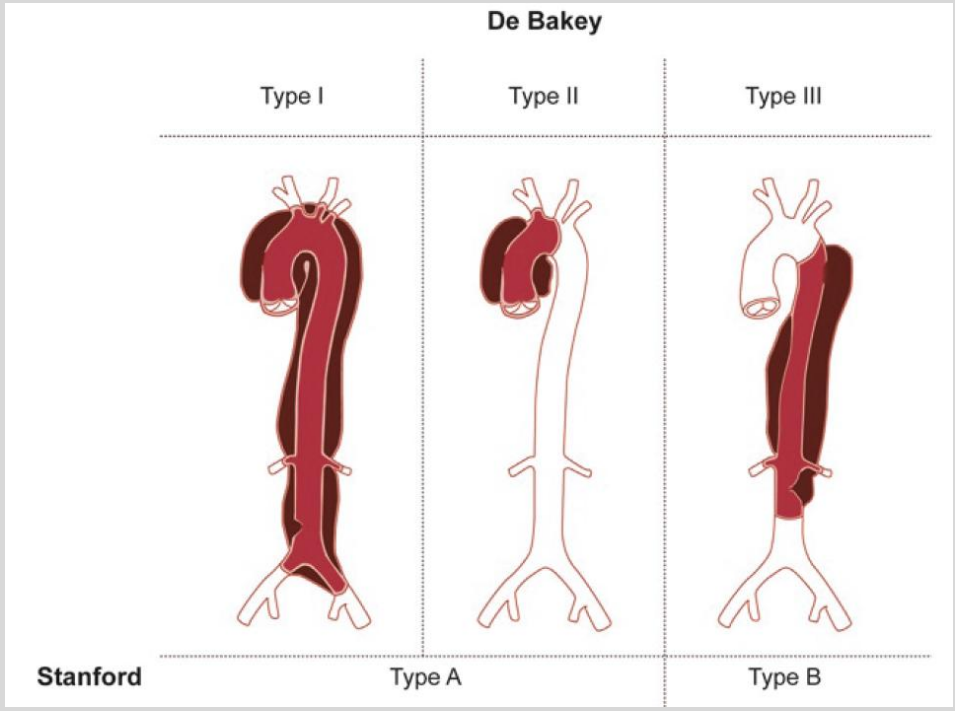
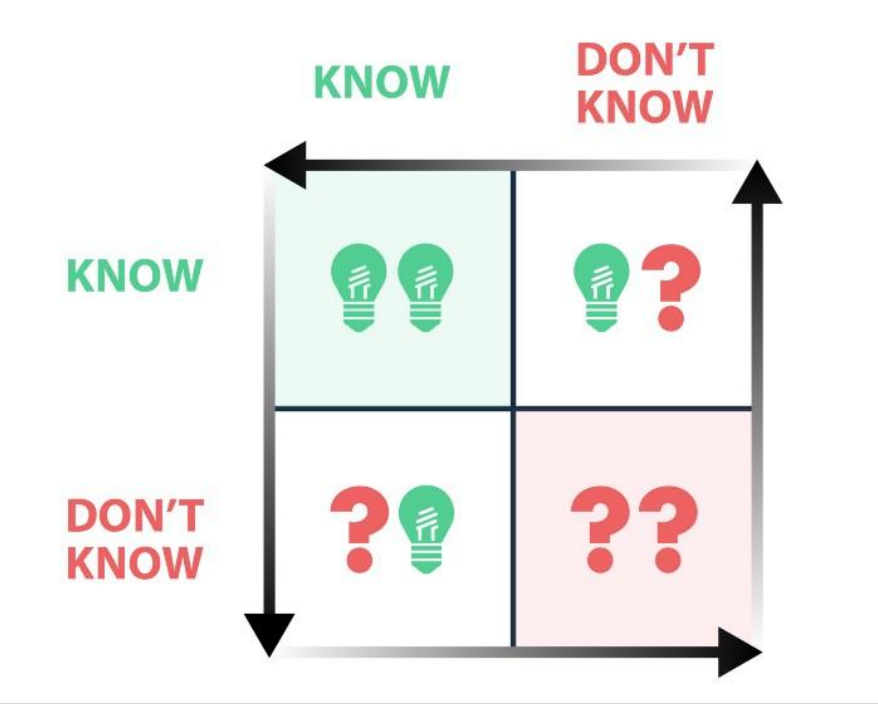


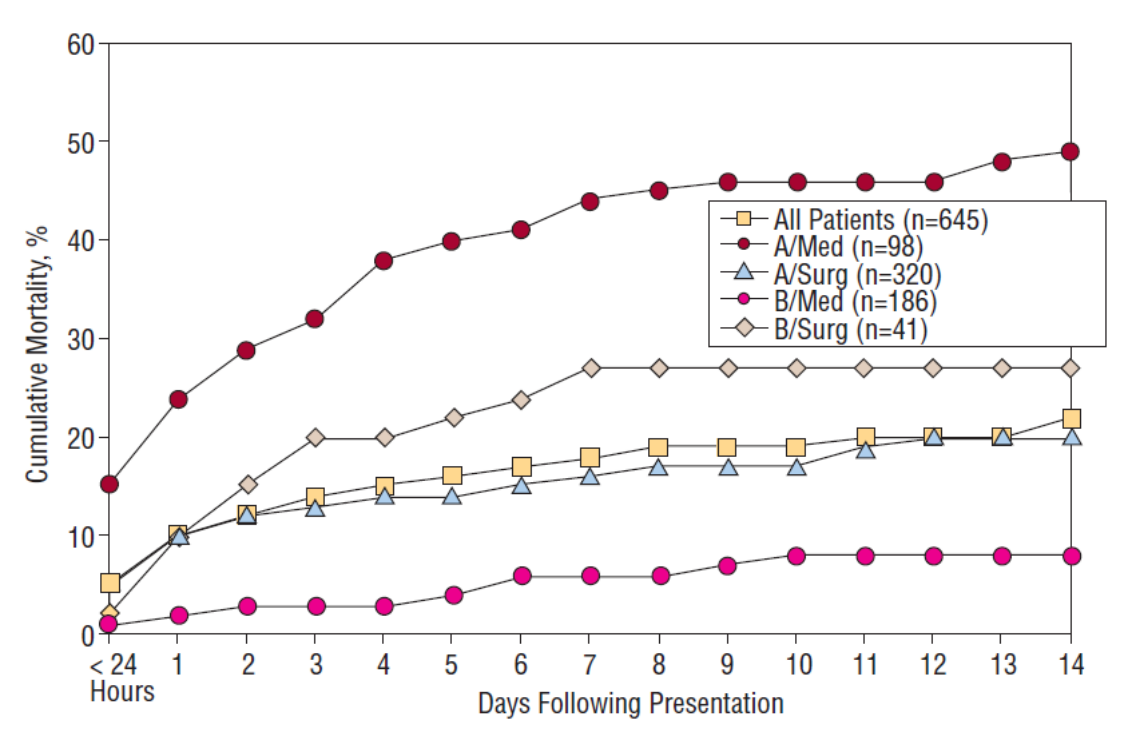
Decision Grid

- Aortic syndrome v. Aneurysm
- Abdominal v. Thoracic
  - Ascending involved



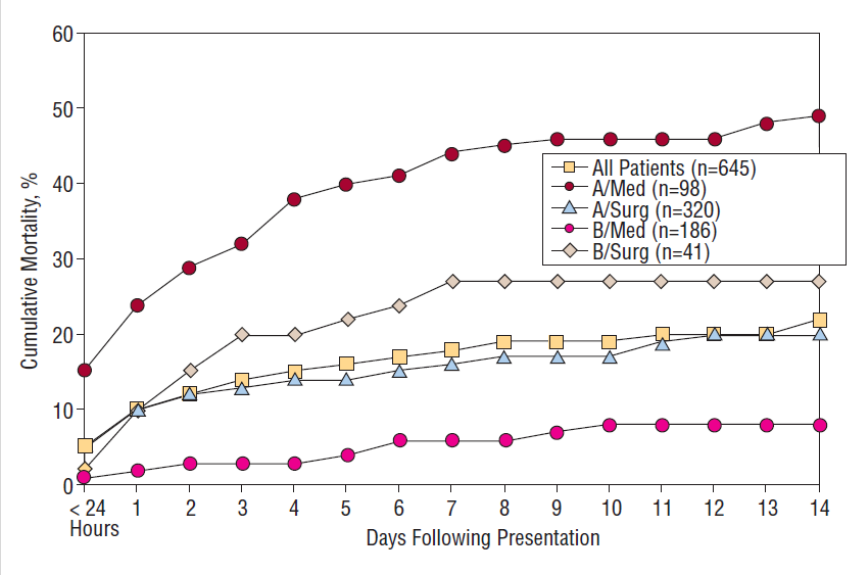
Early Mortality

- Type A disease risk
  - Aortic rupture
  - Pericardial tamponade
  - Rupture



Early Mortality

- Less risk with Type B disease
- Complications associated with
  - Rapid progression
  - Distal perfusion defect
    - Organ or limb ischemia
  - Intractable pain
  - Uncontrolled hypertension
  - Operation

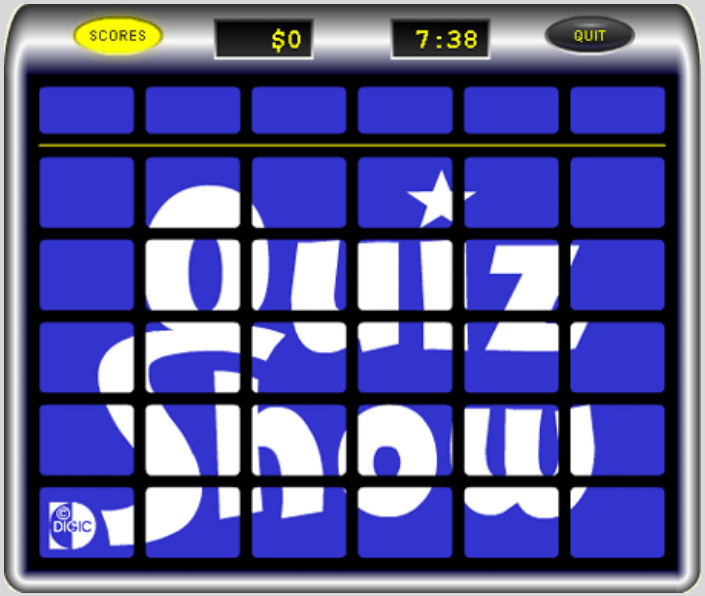


Today's Talk

- Language √
- Anatomy √
- Physiology √
- Diagnosis
- Treatment
- Possibly new things

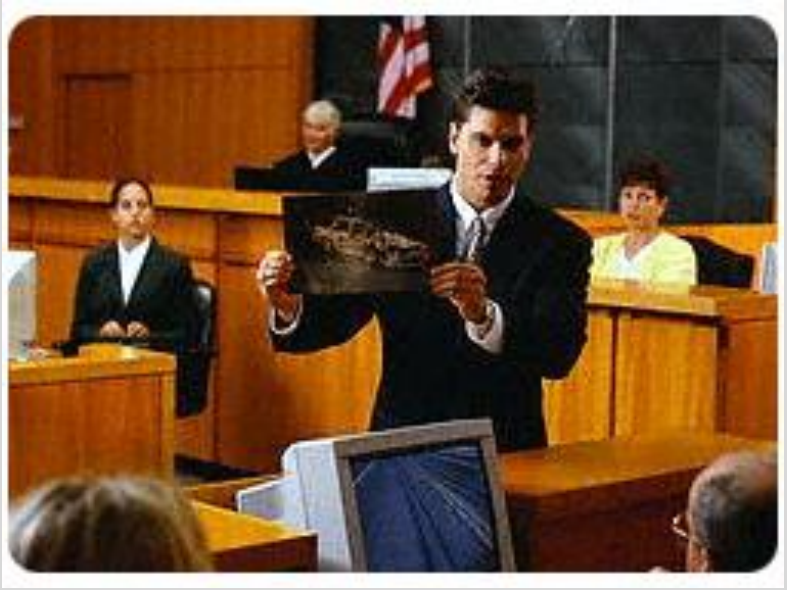
Aortic Syndrome: Diagnostic Difficulty

- AD in initial differential
  - 15 – 43%
- Diagnostic delay > 24 hours
  - 39%



Choose Wisely

- Most common malpractice diagnoses
  - Missed MI/Chest Pain – 9% (#1, #2)
  - Chest/Abdomen NOS – 3% (#3)
  - Aortic Disease – 2% (#8)



Presentation

- What is the classic teaching?

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Presentation

- What is the classic teaching?
  - Sudden onset pain
  - Sharp/tearing
  - Radiates to back
  - BP differential
  - Wide mediastinum on CXR

Symptoms

- 95% have pain initially
  - 85% sudden onset
  - Sharp (64%)
  - Ripping or tearing (51%)
  - Chest (73%)
  - Back (61%)
  - Abdomen (36%)
- 4.5% don't have pain

Hagan PG, Nienaber CA, Isselbacher EM, et al. International registry of acute aortic dissection. JAMA 2000;283:897-903

Moore AG, Eagle KA, Bruckman D, et al. Choice of imaging in acute aortic dissection. Am J Cardiol 2002;89:1235-8.

Symptoms

- BP differential (38%)
  - 18% of hypertensive patients with SBP difference > 10 mmHg
  - 53% of healthy individuals with SBP or DBP difference > 10 mmHg
    - 19% with difference > 20 mmHg

Von Kodolitsch Y, Schwartz AG, Nienaber CA. Clinical prediction of acute aortic dissection. Arch Intern Med 2000;160:2977-82.

Singer & Hollander. Arch Intern Med 1996

Pesola et al. Acad Emerg Med 2002

Decision Rule

- 83% with any three of:
  - Immediate onset chest pain
  - Tearing or ripping character
  - BP differential
  - Mediastinal widening on CXR

- 7% with absence of all

Von Kodolitsch Y, Schwartz AG, Nienaber CA. Clinical prediction of acute aortic dissection. Arch Intern Med 2000;160:2977-82.

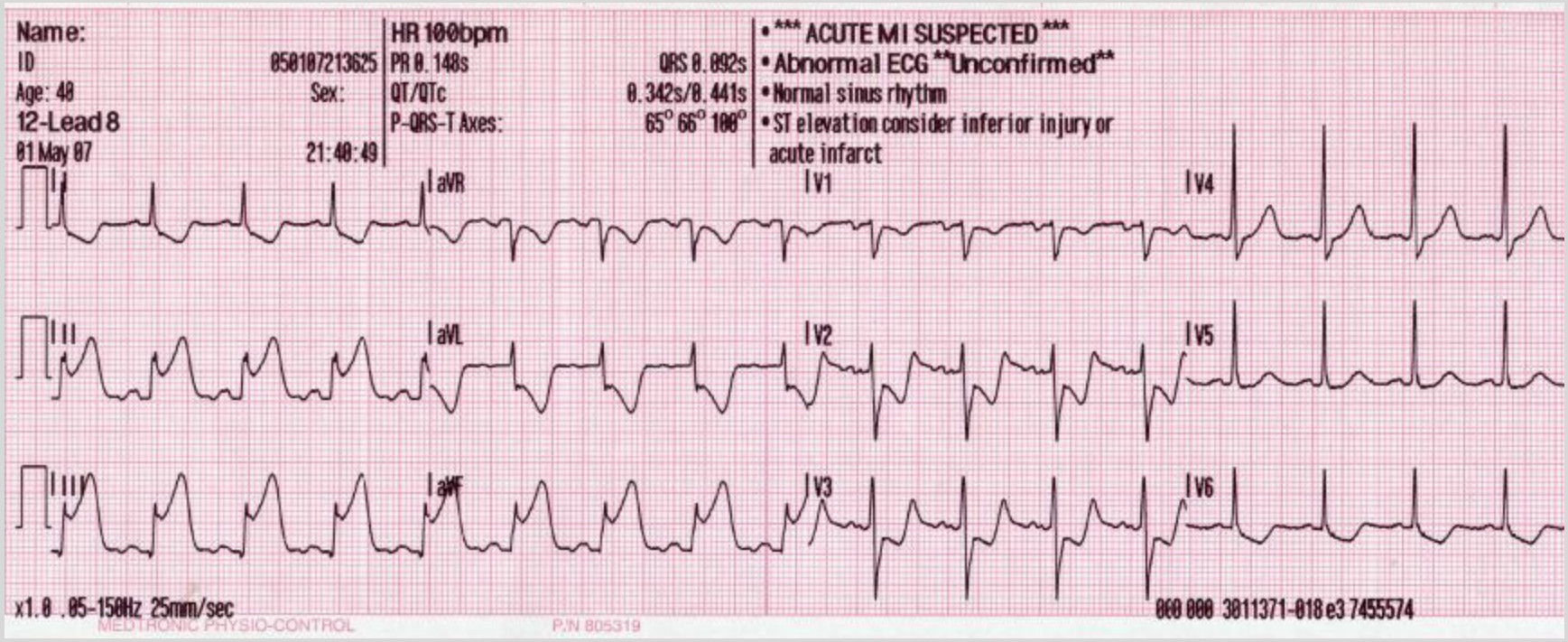
Other Symptoms and Signs

Pulse Deficit

- Present in 30% of patients
  - (+) LR 5.7
- Higher in-hospital mortality
  - 41% v. 25%
- Decision Rule:
  - Thoracic pain + Pulse Deficit = Evaluate for Aortic Dissection

Symptoms

- MI – 5% of ascending dissections
  - Inferior injury pattern



Focal Neuro Deficit

- Some neuro change in up to 20%
  - TIA/Stroke (5 – 15%)
  - Syncope (9%)
- Focal neuro deficit 17% of patients
  - (+) Likelihood ratio: 6.6 – 33
- Decision Rule: Thoracic pain (present or resolved) with neurological deficit = Evaluate for aortic dissection

Klompas. *Jama*, 2002.

D-Dimer

- D-Dimer > 400 ng/mL
  - Sensitivity 99%
  - Specificity 34%
- ? Cutoff = 10 x age ?

Chlmann et al. *Crit Care Med*, 2006

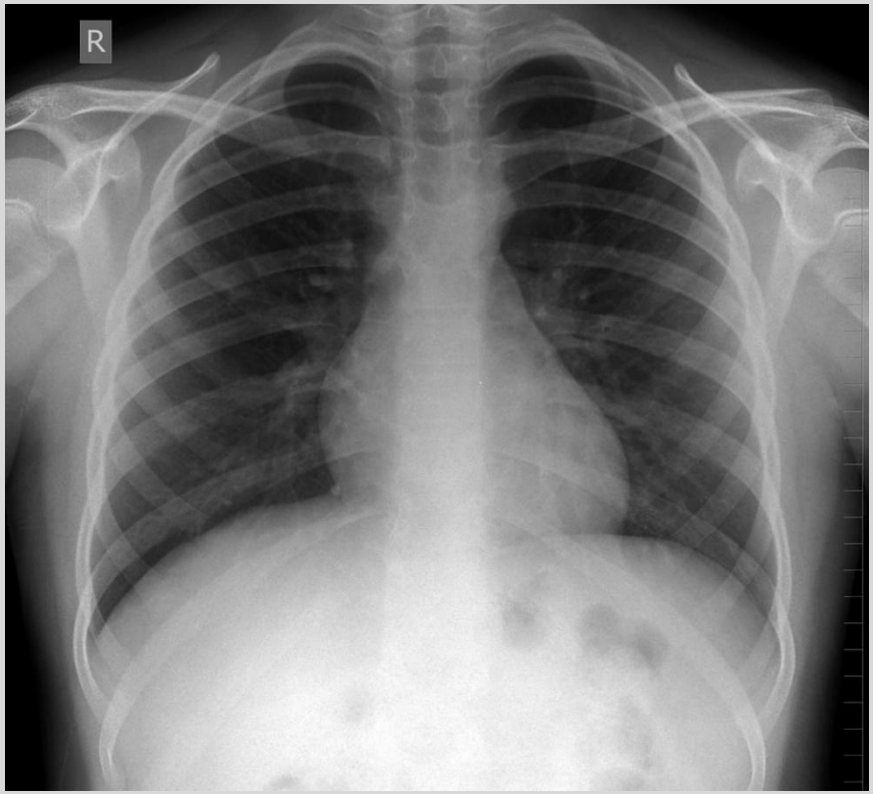
D-Dimer

- D-Dimer > 400 ng/mL
  - Sensitivity 99%
  - Specificity 34%
    - Pulmonary embolism
    - DVT
    - Myocardial infarction
    - Recent surgery (within prior week)
    - Infection or sepsis
    - Cancer
    - Concurrent systemic illness
    - Oral anticoagulant use

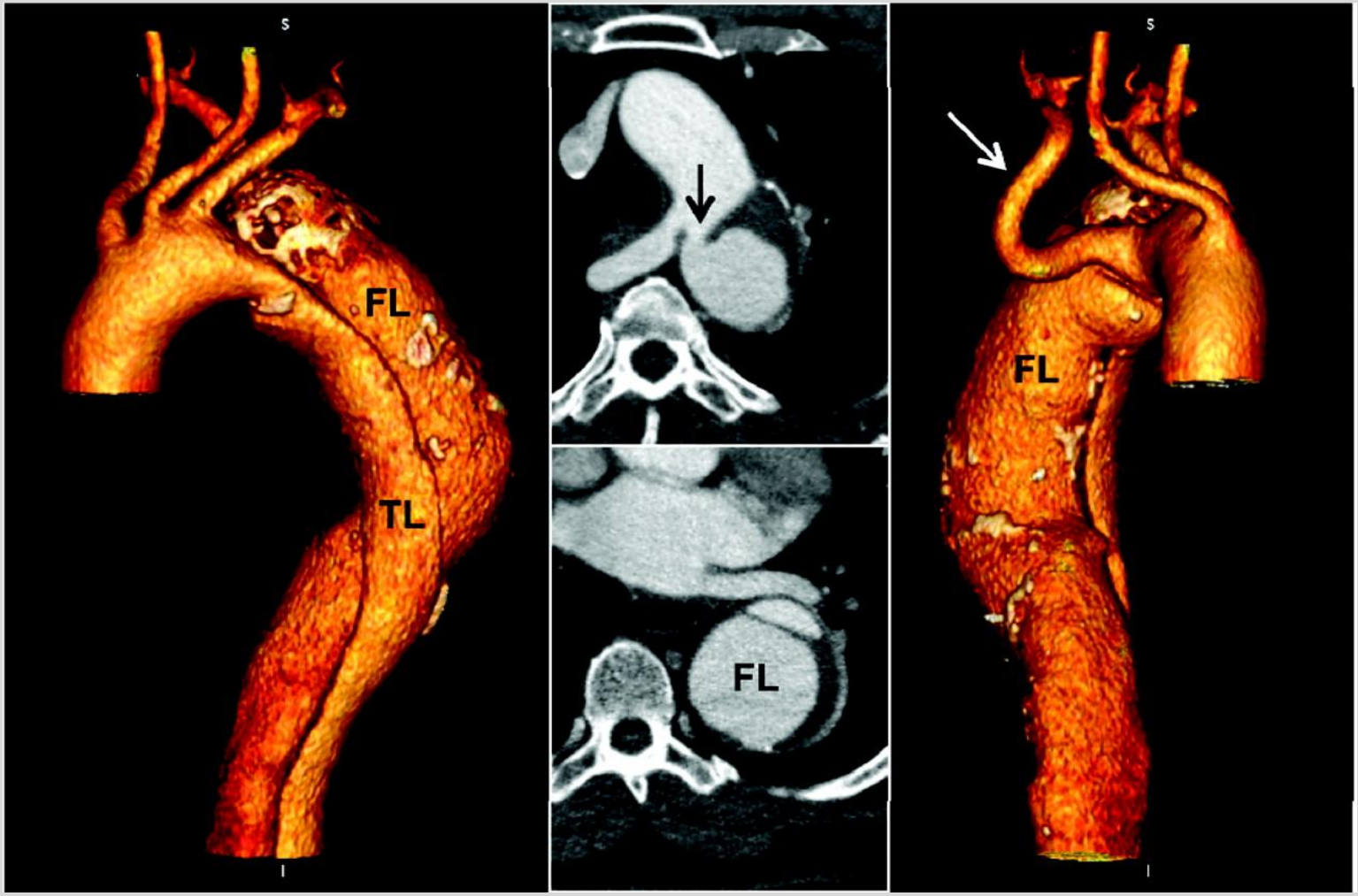
Diagnostic Imaging

Plain Chest X-Ray

- Sensitivity 64%, Specificity 86%
- Mediastinal widening on 39%
  - Indistinct aortic knob
  - Pleural effusion



CT Scan + 3D Reconstruction



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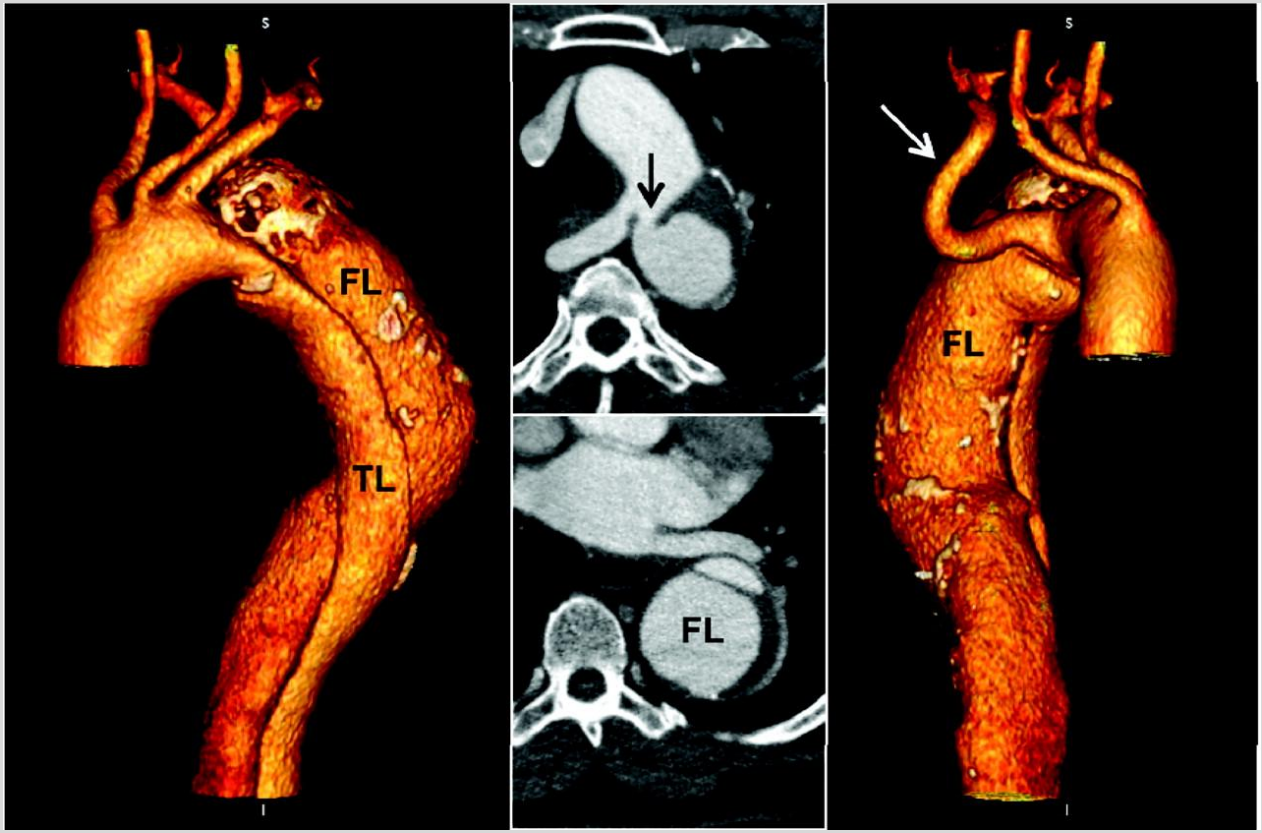


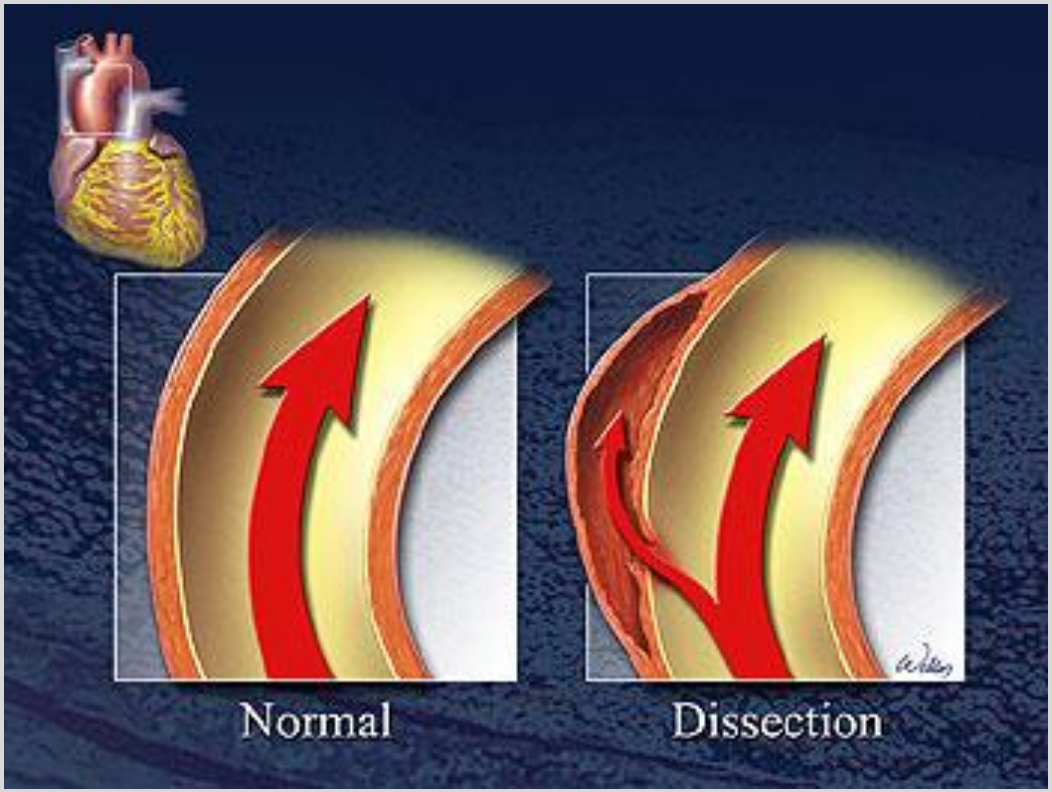
Don't worry about renal injury if creat < 1.6, or maybe at all

Management of Aortic Syndrome

- Common management themes
  - Classic
  - Local
  - (Iatrogenic)
  - Intimal hematoma
  - Penetrating aortic ulcer

Immediate Management

- Control shearing force (dP/dt)



Immediate Management

- Rate control first
  - Beta-blockade
    - Esmolol
    - Labetalol
  - Goal: HR 60 - 70

Immediate Management

- Pressure control, as needed
  - Nicardipine
    - Clevidipine
  - (Sodium Nitroprusside)
  - Goal: SBP 90 – 100

Immediate Management

- Patients transferred from community hospitals
  - 41.9% had HR>80
  - Only 53.9% had beta blockers
  - 32% had SBP<120
  - Only 54% of remaining pts had BP reduction agents started
  - Mean SBP=158

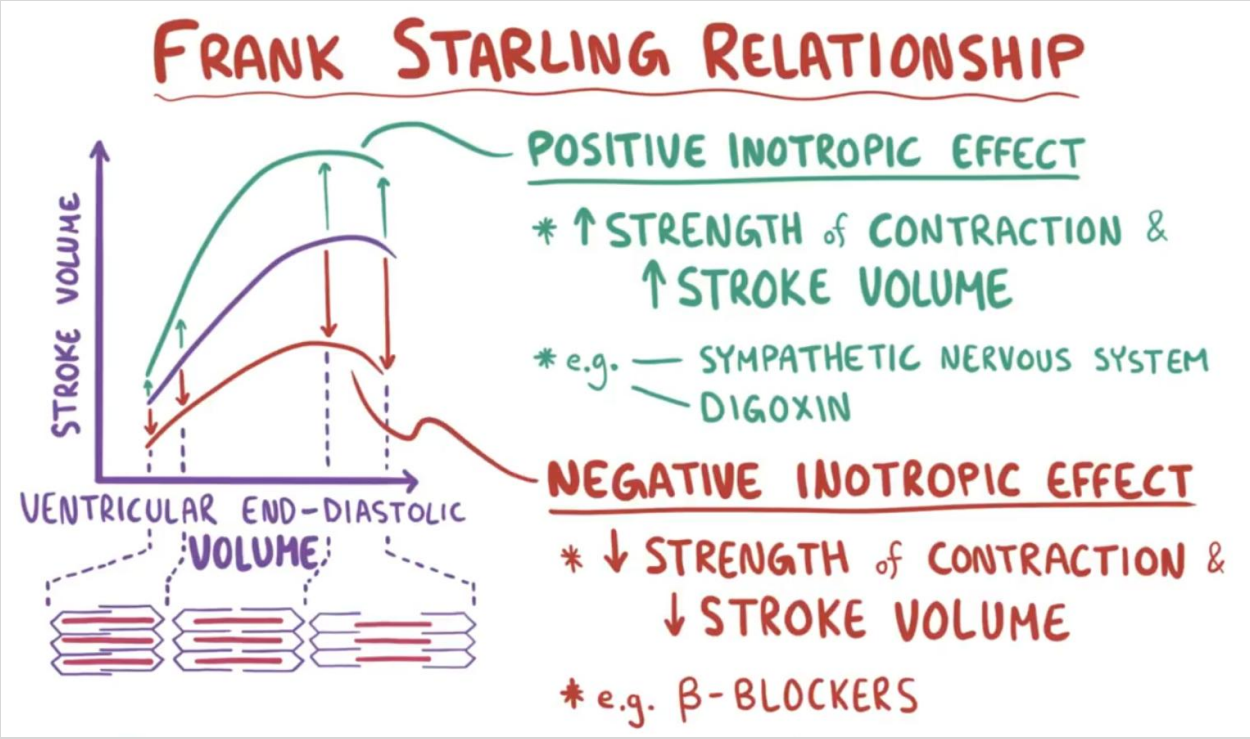
Winsor et al. Inadequate hemodynamic management in patients undergoing interfacility transfer for suspected aortic dissection. *Am J Emerg Med*, 2005.

Immediate Management

- Don't go looking for trouble
  - Current/resolved HYPOtension or need for support

Immediate Management

- Don't go looking for trouble
  - CO = HR x SV

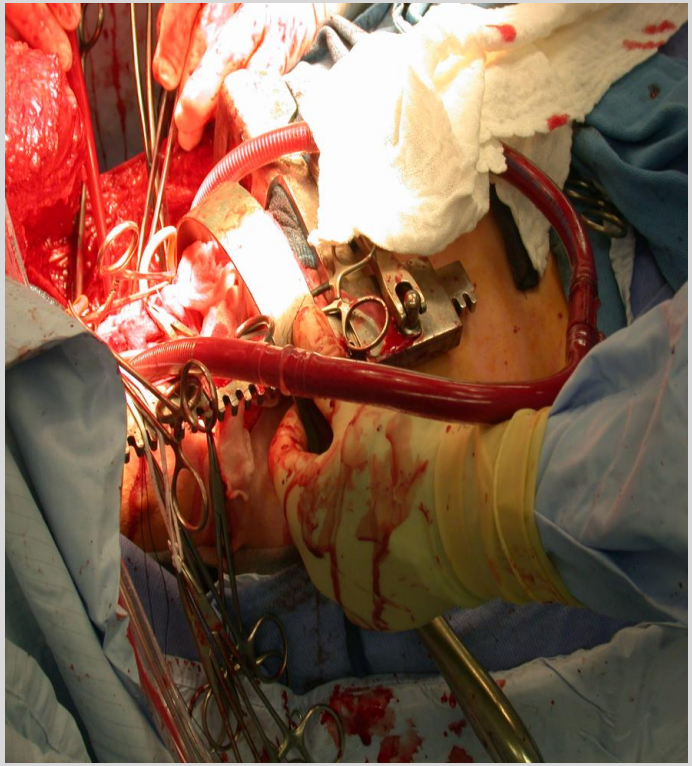


Immediate Management

- Control pain
  - Primary outcome not secondary outcome
  - 0.15 mg/kg morphine inadequate for up to half of patients

Long-Term Management

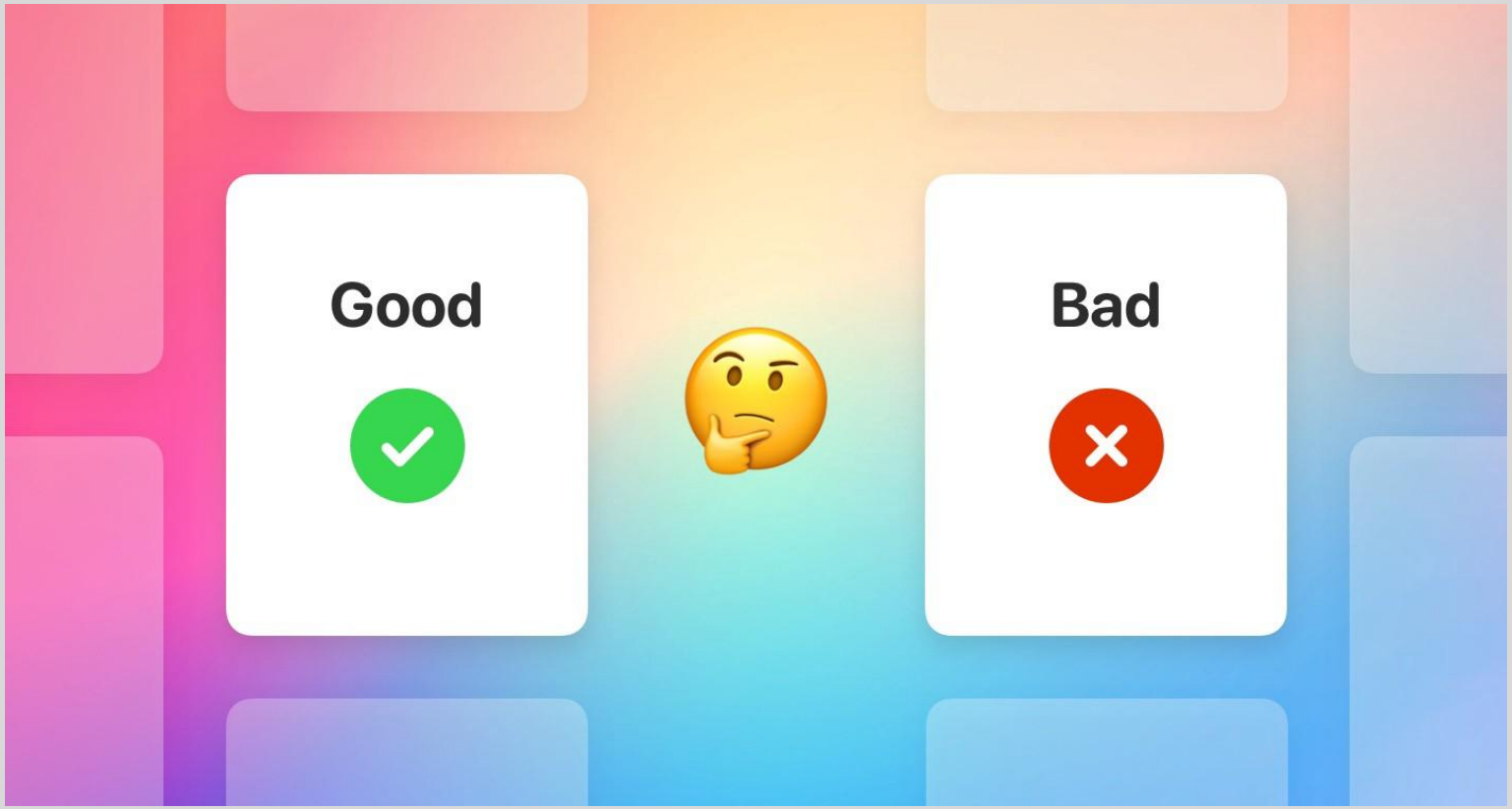
- Type A Disease – Surgical Emergency
- Death 1% per hour over first day w/o operation
- Operative mortality 15 – 20%
  - Bypass
    - +/- hypothermic circ arrest



Long Term Management

- Type B = Medical management
  - Survival up to 80% at five years
  - No improvement with operation or early endovascular repair

Hypotension in Dissection Patients

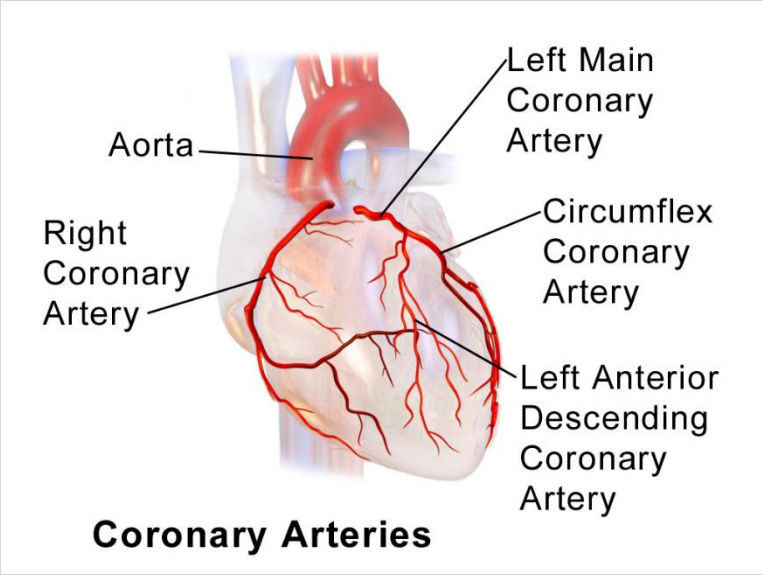


Hypotension in Dissection Patients

- Differential Diagnosis
  - Aortic rupture
  - Cardiogenic shock
  - Tamponade
  - SIRS-type shock

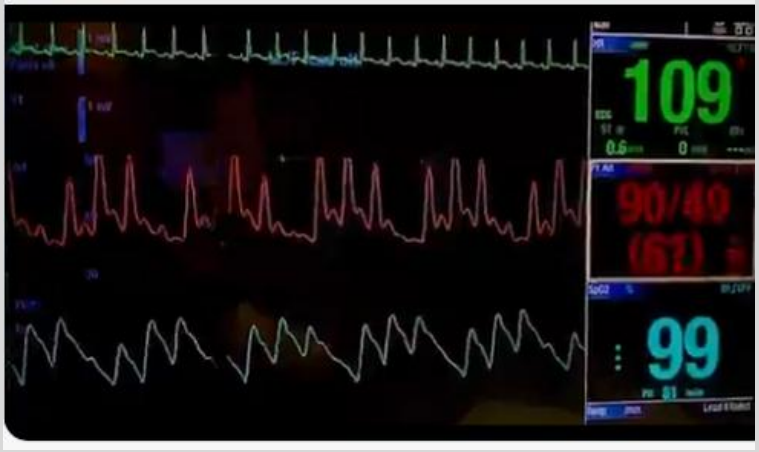
Hypotension in Dissection Patients

- Aortic rupture
  - Hypovolemic, hemorrhagic shock
- Cardiogenic shock
  - MI from coronary artery occlusion
    - EKG changes
    - +/- bradycardia
  - Acute aortic regurg
    - LV overload
    - +/- hypoxemia



Hypotension in Dissection Patients

- Tamponade
  - Narrowing pulse pressure
  - JVD
  - EKG amplitude
  - Pulsus paradoxus
    - Look at the SpO2
  - Ultrasound



Hypotension in Dissection Patients

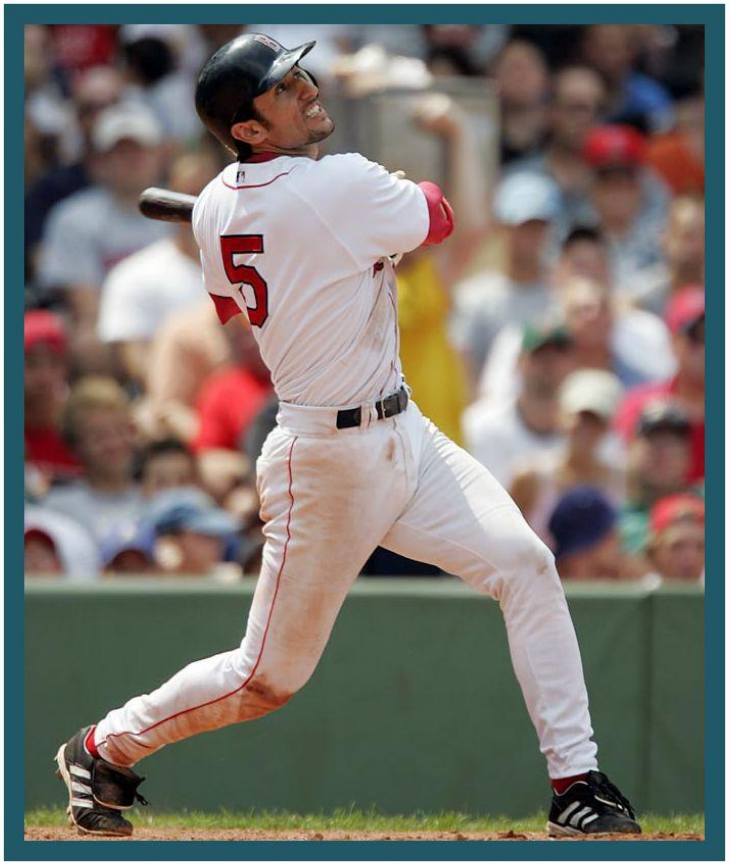
- SIRS-type shock
  - Mesenteric or other end-organ ischemia

Descending thoracic aorta:
Visceral branches: pericardial, bronchial, esophageal, mediastinal arteries
Parietal branches: intercostal, subcostal arteries and superior phrenic arteries

Descending abdominal aorta:
Anterior group: celiac trunk, superior mesenteric, inferior mesenteric arteries
Lateral group: suprarenal, renal, gonadal (testicular in males, ovarian in females) arteries
Dorsal group: inferior phrenic arteries, lumbar arteries, median sacral artery
Terminal branches: left and right common iliac artery

Hypotension in Dissection Patients

- Differential Diagnosis
  - Aortic rupture
  - Cardiogenic shock
  - Tamponade
  - SIRS-type shock
  - Failure to listen



Hypotension in Dissection Patients

- So …
  - TURN OFF THE ANTI-IMPULSE THERAPY
  - Resuscitate a rupture
  - Pressor support for cardiogenic or septic shock
    - Mildly
    - Cardiogenic shock may be RV > LV
  - Drain a tamponade
    - Temporize with volume to open RV

Hypotension in Dissection Patients

- How much resuscitation?

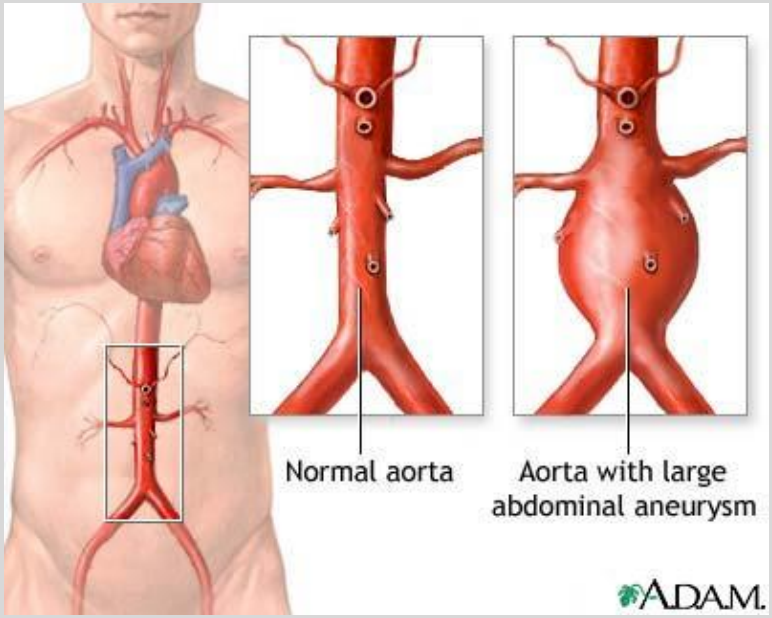
There Is More!

Aortic Aneurysm

- Aneurysm
  - Permanent localized dilatation
  - At least 50% increase in diameter
  - Covered by all 3 layers
- Pseudoaneurysm
  - Disruption of arterial wall
  - Extravasation of blood contained by periarterial connective tissue

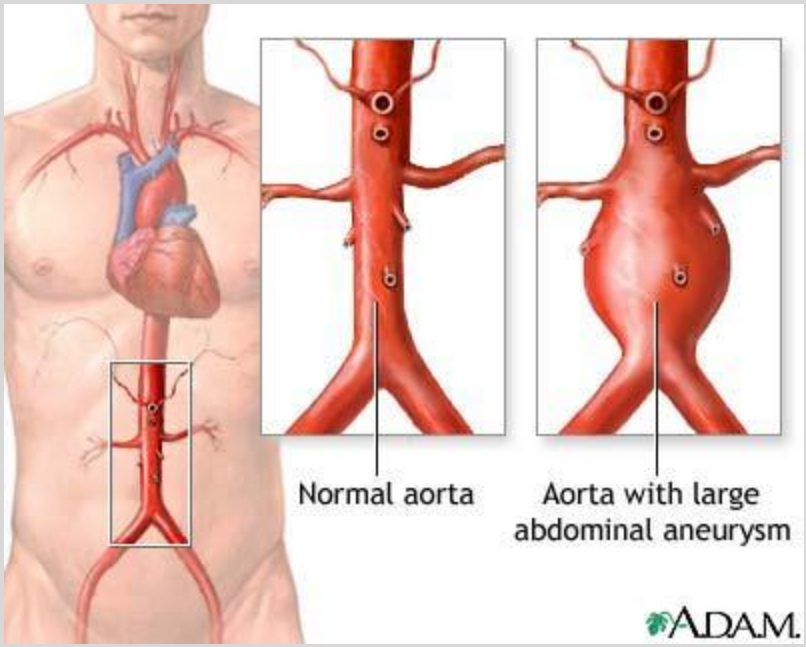
Aortic Aneurysm

- Transmural weakening, not intimal defect
- As aneurysm size increases, dilation increases wall tension and increases rate of expansion



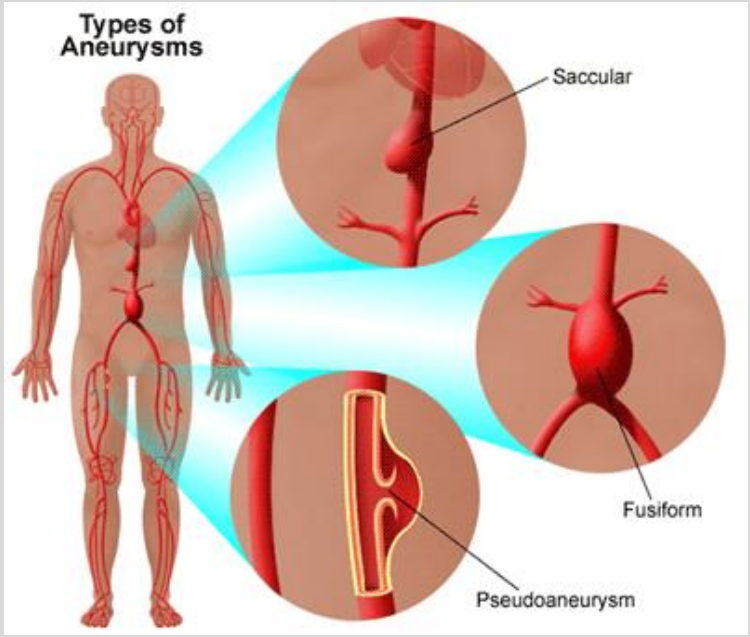
Aortic Aneurysm

- Rupture risk associated with size
  - < 4 cm: 0%
  - 4 – 5 cm: 0.5 to 5%
  - 5 – 6 cm: 3% to 15%
  - 6 – 7 cm: 10% to 20%
  - 7 – 8 cm: 20% to 40%
  - Greater: 30% to 50%



Aortic Aneurysm

- Saccular aneurysm higher rupture risk



Aortic Aneurysm

- Mycotic aneurysm
  - Vessel wall defect with associated infection
  - Commonly at vessel bifrucations
  - Risk factors
    - Arterial injury
      - Surgery/Trauma
      - Graft
      - IVDA
    - Prior infection
    - Immunosuppression

Aortic Aneurysm

- Mycotic aneurysm
  - Common pathogens
    - Salmonella
    - Staph (MRSA)
    - Syphilis
    - Mycobacterium

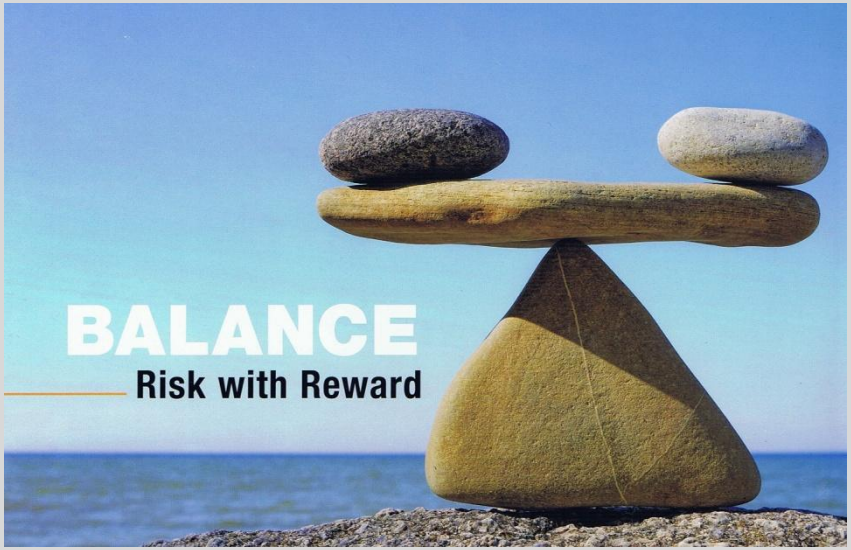
Rank*	State
1	Nevada
2	New Mexico
3	Mississippi
4	California
5	Oklahoma
6	Arizona
7	Alaska
8	Georgia
9	Louisiana
10	Florida

Emergent Management: Aneurysm

- Not often accompanied by hypertension
- Tolerate hypotension

Emergent Management: Aneurysm

- Anti-impulse therapy based on risk
  - Bigger aneurysms
    - > 5.5 cm
  - Higher aneurysms
    - Abdominal → Thoracic → Arch
  - Nature of aneurysm
  - Height of vital signs



Emergent Management: Aneurysm

- Anti-impulse therapy based on risk
- Probably ok to skip in the majority of cases

Aortic Aneurysm Repair

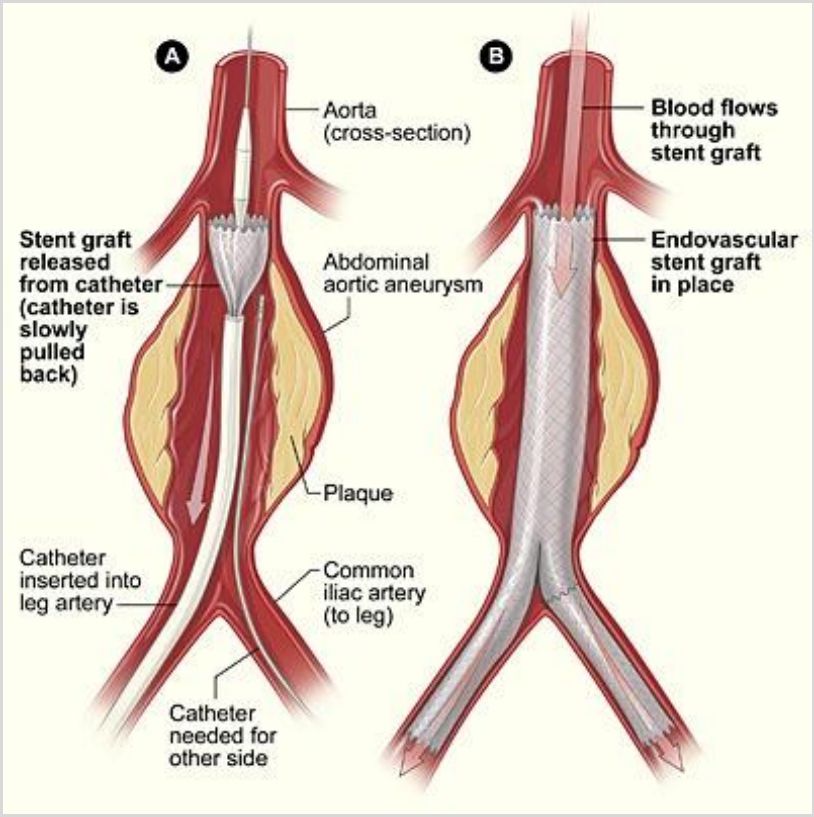
- Intervention
  - Operation
    - Ascending aorta or arch
    - Saccular or mycotic
  - Endovascular repair (probably) for
    - Any > 5 cm
    - Rapid growth
    - Associated connective tissue disease
    - Associated dissection
- Medical management for anything else

Endovascular Repair

- Described in 1964, reported in 1991
- Advantages
  - Decreased hospital stay
    - 2 ICU + 5 inpatient with open repair
  - Avoids surgical risks and complications
  - Available to patients too sick for OR

Endovascular Repair

- Endovascular Repair



Endovascular Repair

- Open repair
  - Higher 30 day mortality (OR 3.56) and complications
  - At 6 years
    - Lower death (OR 0.83)
    - Rupture (OR 0.76)
    - Re-intervention (OR 0.67)

Original Investigation | Surgery

May 13, 2022

Long-term Outcomes Associated With Open vs Endovascular Abdominal Aortic Aneurysm Repair in a Medicare-Matched Database

Kevin Yei, BS[1]; Asma Mathlouthi, MD[1]; Isaac Naazie, MD, MPH[1]; et al

» Author Affiliations | Article Information

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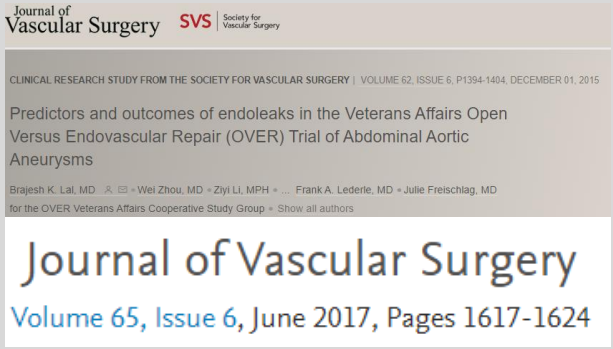
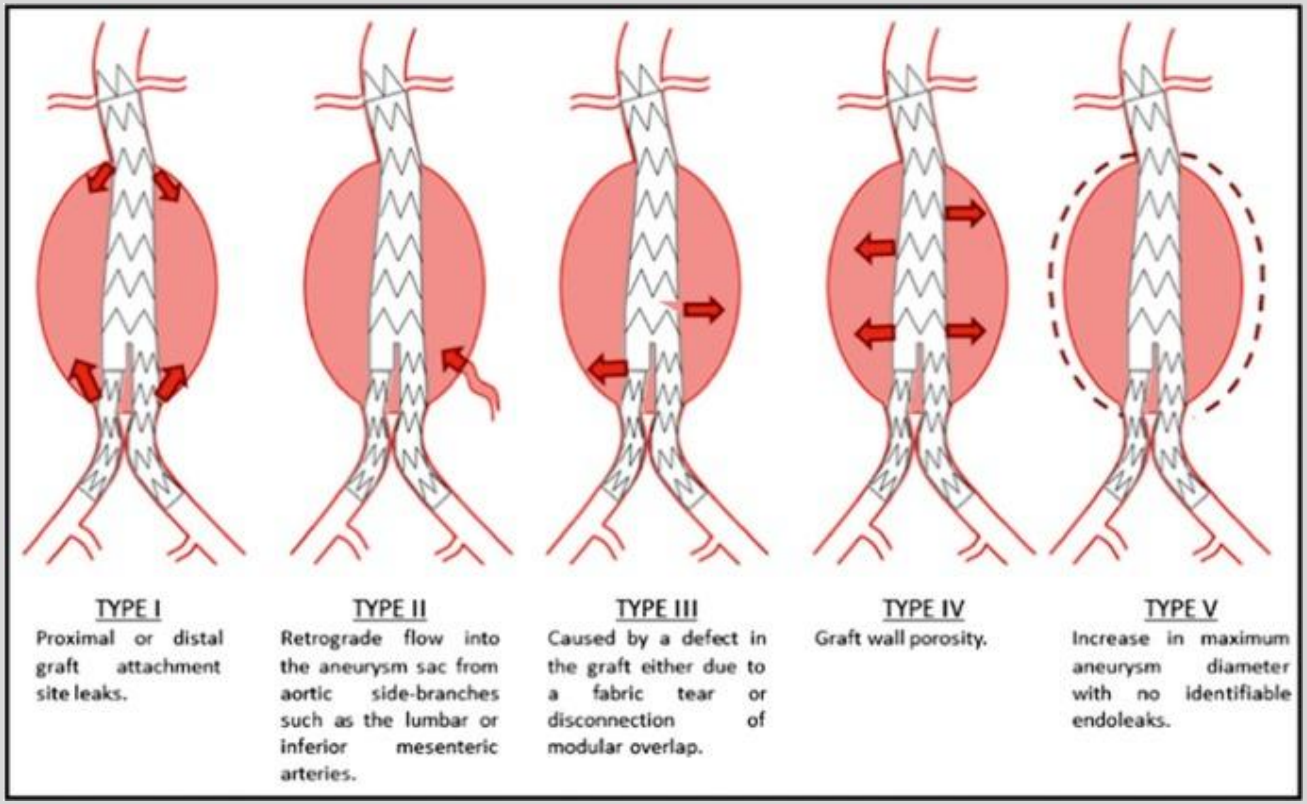
Endograft Leak

- Incidence
  - Up to 30.5% endoleak rate
  - About 20% of patients with emergency or elective endovascular repair require a second procedure within 30 months

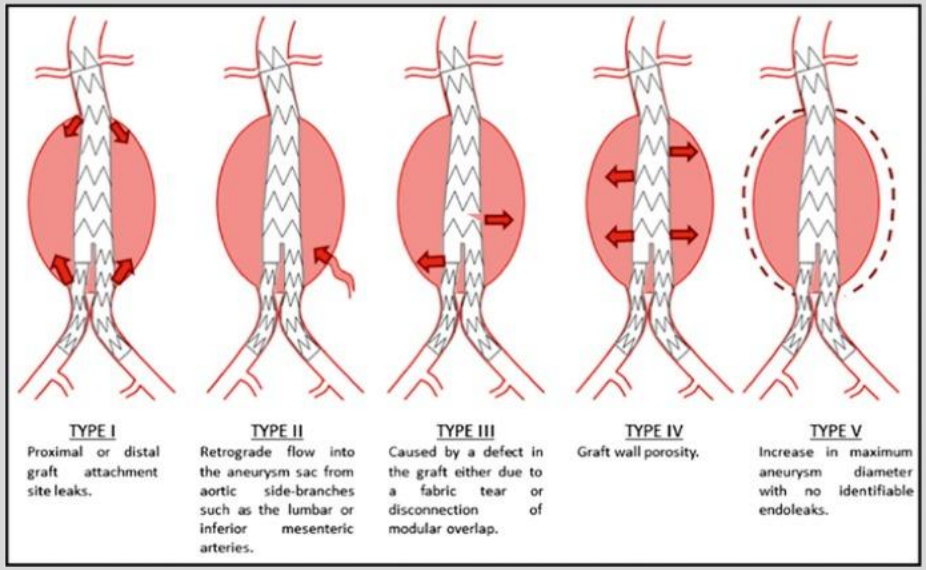


Endograft Leak



Endograft Leak

- Problem is re-pressurization of the original problem
- Use that as a guide for management
- Err on the side of managing an aortic syndrome

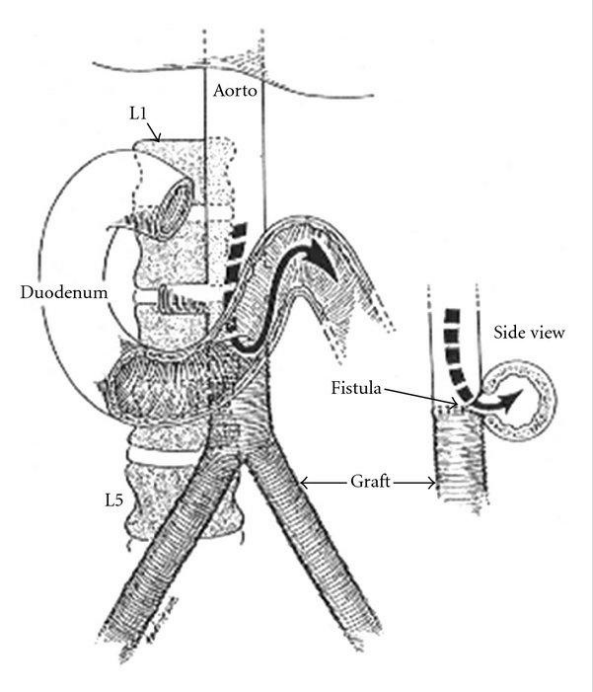


Other Endograft Complications

- Limb Ischemia: up to 40% of cases
- Renal Artery Occlusion: < 5%
- Colonic Ischemia: up to 3%
- Graft Infection: approx. 1%
- Spinal Cord Ischemia: 0.21 %

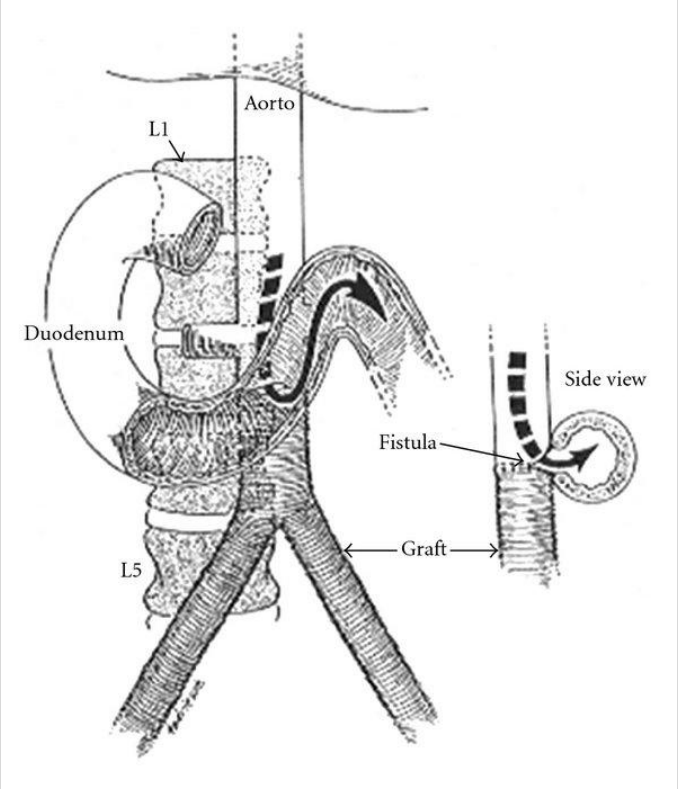
Aortoenteric Fistula

- Connection between duodenum and aorta
  - Friction between graft and enteral tract if not protected by soft tissue
  - Aortic wall erodes into GI tract
  - Up to 1.6% of patients
- Mortality after intervention nearly 50%



Aortoenteric Fistula

- Suspect in all patients with GIB and history of aortic graft
- Herald bleed
  - 70% of patients
  - Bleeding limited by thrombus and vasospasm



Today's Talk

- Language
  - Aortic syndrome
  - Aneurysm
  - Endograft
  - Aorto-enteric fistula
- Anatomy
  - Thoracic
  - Abdominal
  - Arch
- Physiology
- Treatment
  - Physiology
  - Location

Questions

Thank You