Beth Israel Deaconess Medical Center

Eduardo Hariton, HMSIII
Gillian Lieberman, MD

Nov-Dec 2012

In Depth Discussion of Aortic Dissection and its Radiological Manifestations

Eduardo Hariton, Harvard Medical School Year III
Gillian Lieberman, MD

Beth Israel Deaconess Medical Center
Eduardo Hariton, HMSIII
Gillian Lieberman, MD

Outline

- Intro to our Patient
- Review of Aortic Dissection
- Menu of Tests
- Images and Diagnosis
- Treatment and complications
- Take home points
- References
- Acknowledgements

Beth Israel Deaconess Medical Center
Eduardo Hariton, HMSIII
Gillian Lieberman, MD

Outline

- **Intro to our Patient**
- Review of Aortic Dissection
- Menu of Tests
- Images and Diagnosis
- Treatment and complications
- Take home points
- References
- Acknowledgements

Eduardo Hariton, HMSIII
Gillian Lieberman, MD

Our Patient: Presentation

- Our patient is an 81F who presented to OSH with sudden onset substernal chest pain radiating to her back at rest
- She presented to OSH within 30 minutes of symptoms onset and had a CT scan, which reported a PE and a type IIIa aortic dissection
- Transferred to BIDMC on labetalol drip
- Repeat CTA chest and abdomen was recommended to evaluate the patient's dissection

Eduardo Hariton, HMSIII
Gillian Lieberman, MD

Our Patient: Past Medical Hx

- Temporal arteritis
- Aortic insufficiency
- Aortic stenosis
- Mitral regurgitation
- Chronic back pain
- Compression of vertebrae
- Arthritis
- Osteoporosis
- COPD / Asthma
- GERD
- Macular degeneration

Eduardo Hariton, HMSIII
Gillian Lieberman, MD

Our Patient: Past Surgical Hx

- Bilateral knee replacements
- Bilateral carpal tunnel releases
- Right eye cataract surgery
- Trigger finger release

Eduardo Hariton, HMSIII
Gillian Lieberman, MD

Our Patient: Medications

- Plavix 75mg
- Simvastatin 20mg
- Metoprolol 12.5mg
- Diovan 40mg
- Levothyroxine 25 mcg
- Symbicort 2 puffs inh BID
- Albuterol inh Q4H prn
- Excedrin prn headache
- OTCs: Vitamin D, B12, and omega-3

Eduardo Hariton, HMSIII
Gillian Lieberman, MD

Our Patient: Other information

- SH: Quit smoking 10 years ago (~40 pack years). Occasional EtOH. Denies drug use. Retired church secretary
- FH: None pertinent
- Allergies: NKDA

Eduardo Hariton, HMSIII
Gillian Lieberman, MD

Our Patient: Physical Exam

- VS: BP R arm: 98/42 / L arm: 90/40
  HR: 64 RR: 18
- Pt Alert and Oriented in NAD
- Neck: Supple, trachea midline
- Chest: Clear to auscultation bilaterally
- Heart: RRR. **3/6 late peaking SEM**
- Abd: Soft / NT / ND
- Extremities: Bilat LE edema to just above knee
- Pulses: **Strong pulses in all extremities**

Eduardo Hariton, HMSIII
Gillian Lieberman, MD

Differential Diagnosis

- Acute Pancreatitis
- Aortic dissection
- Musculoskeletal pain
- Myocardial ischemia (ST or NST)
- Peptic ulcer disease
- Pericarditis
- Pleuritis
- Pulmonary embolus

Eduardo Hariton, HMSIII
Gillian Lieberman, MD

Outline

- Intro to our Patient ✔
- **Review of Aortic Dissection**
- Menu of Tests
- Images and Diagnosis
- Treatment and complications
- Take home points
- References
- Acknowledgements

Eduardo Hariton, HMSIII
Gillian Lieberman, MD

History of Aortic Dissection

- First well-documented case in 1760: King George II of England died while straining on the commode
- First pathologic description in 1761: Italian anatomist Giovanni Battista Morgagni
- Death sentence until 1955 (bypass invented): DeBakey performed first successful repair
- At 97, DeBakey was the oldest to survive the surgical procedure he pioneered

Eduardo Hariton, HMSIII
Gillian Lieberman, MD

Risk Factors for Aortic Dissection

- Aortic Coarctation
- Atherosclerosis
- Bicuspid Aortic valve
- Chronic or severe hypertension
- Collagen Disorders: Marfan's, Ehlers-Danlos syndrome
- Trauma
- Inflammatory Disease: Giant Cell arteritis and Takayasu arteritis

Eduardo Hariton, HMSIII
Gillian Lieberman, MD

Epidemiology of Aortic Dissection

- Evidence of aortic dissection is found in 1-3% of all autopsies (1 in 350 cadavers)
- 2000 cases/yr reported in the US
- More common in African Americans and less common in Asians than in Caucasians
- 75% of dissections occur in those 40-70, with a peak in 50-65YO range
- Patients with Marfan's syndrome present earlier in their 30s-40s

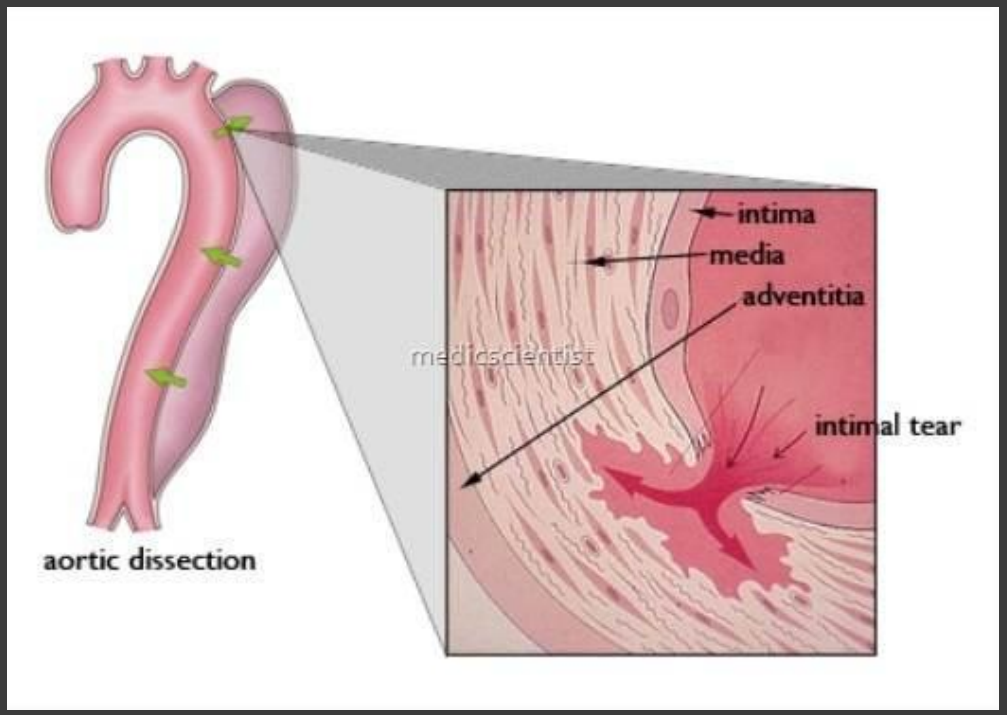
Eduardo Hariton, HMSIII
Gillian Lieberman, MD

Pathophysiology of Aortic Dissection

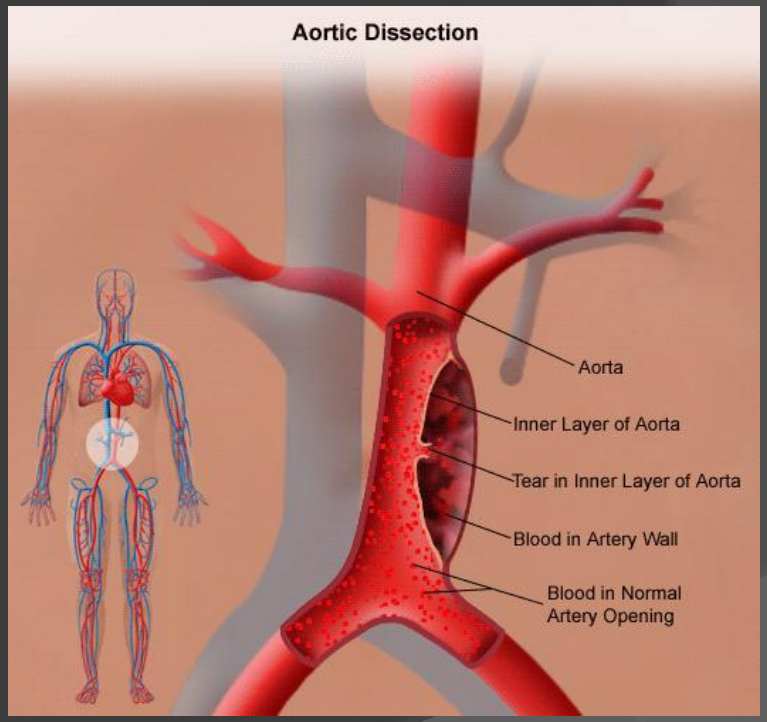
- Atherosclerosis: Inflammatory plaques have proteolytic factors that weaken the wall of vessels by destroying elastin and collagen
- Cystic medial degeneration: Accumulation of basophillic ground substance and loss of elastic and muscle fibers in the media
- Dissection is the result of a longitudinal separation of the aortic intima and adventitia caused by circulating blood gaining access to and splitting the media of the aortic wall, creating a false lumen

Beth Israel Deaconess Medical Center
Eduardo Hariton, HMSIII
Gillian Lieberman, MD

Pathophysiology of Aortic Dissection



http://medicscientist.com/aortic-dissection-treatment



http://www.yalemedicalgroup.org/stw/images/126150.jpg

Eduardo Hariton, HMSIII
Gillian Lieberman, MD

Presentation of Aortic Dissection

- Tearing chest pain radiating to the back
- Abdominal pain
- Clammy skin
- Dysphagia
- Hoarseness

Eduardo Hariton, HMSIII
Gillian Lieberman, MD

Classification of aortic dissections

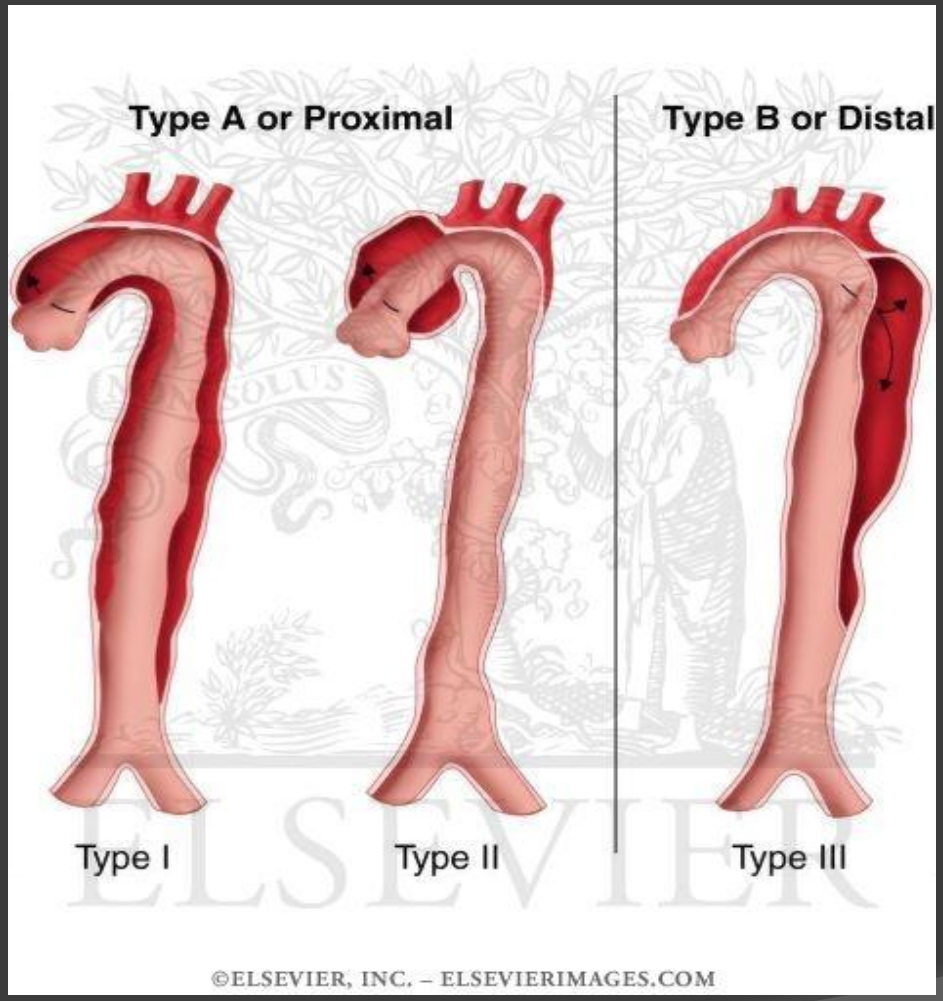
- Stanford (A / B)
  - Type A: Ascending aorta involved (60-70% of cases)
  - Type B: Descending aorta only involved (30-40% of cases)

- DeBakey (I / II / III)
  - Type I: Ascending and descending aorta involved
  - Type II: Ascending Only
  - Type III: Descending Only

Multidetector CT of Aortic Dissection: A Pictorial Review. McMahon, Michelle A. and Squirrell, Christopher A. RadioGraphics 2010; 30:445–460

Eduardo Hariton, HMSIII
Gillian Lieberman, MD

Classification of aortic dissections



- Image A represents a Stanford A or a DeBakey type 1 dissection.
- Image B represents a Stanford A or DeBakey type II dissection.
- Image C represents a Stanford type B or a DeBakey type III dissection.

http://www.elsevierimages.com/image/26036.htm

Eduardo Hariton, HMSIII
Gillian Lieberman, MD

Goals of Imaging

- Diagnose aortic dissection
- Classify the dissection
- Identify entry and reentry sites
- Ascertain vessel involvement
- Diagnose any complications from a dissection

Eduardo Hariton, HMSIII
Gillian Lieberman, MD

Outline

- Intro to our Patient ✔
- Review of Aortic Dissection ✔
- **Menu of Tests**
- Images and Diagnosis
- Treatment and complications
- Take home points
- References
- Acknowledgements

Eduardo Hariton, HMSIII
Gillian Lieberman, MD

Menu of Tests

- X-ray
- CT
- MRI
- TEE
- Angiography

Eduardo Hariton, HMSIII
Gillian Lieberman, MD

ACR Appropriateness Criteria

Last review date: 2011

American College of Radiology
ACR Appropriateness Criteria®

Clinical Condition: **Acute Chest Pain — Suspected Aortic Dissection**

Radiologic Procedure	Rating	Comments	RRL*
X-ray chest	9	Should be performed if readily available at the bedside and does not cause delay in obtaining a CT or MRI scan. Alternative causes of chest pain may be discovered. Not the definitive test for aortic dissection.	☢
CTA chest and abdomen with contrast	9	Recommended as the definitive test in most patients with suspicion of aortic dissection.	☢☢☢☢
MRA chest and abdomen without and with contrast	8	Alternative to CTA for: contraindication to CT (iodinated contrast), multiple prior chest CTA for similar symptoms, and in patients showing no signs of hemodynamic instability. Scanner availability and local expertise limit widespread use, as there is potential for delay in diagnosis. See statement regarding contrast in text under "Anticipated Exceptions."	O
US echocardiography transesophageal	8	If skilled operator readily available.	O
MRA chest and abdomen without contrast	7	Alternative to CTA for: contraindication to CT (iodinated contrast), multiple prior chest CTA for similar symptoms, and in patients showing no signs of hemodynamic instability. Scanner availability and local expertise limit widespread use, as there is potential for delay in diagnosis.	O
Aortography thoracic	5		☢☢☢
US echocardiography transthoracic resting	4		O
FDG-PET/CT skull base to mid-thigh	3	Not recommended as the initial test. May be useful for prognostication and for distinguishing acute from chronic dissection.	☢☢☢☢
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

American College of Radiology Appropriateness Criteria

Beth Israel Deaconess Medical Center
Eduardo Hariton, HMSIII
Gillian Lieberman, MD

Chest X-ray

- Can be initial study of choice if aortic dissection is suspected
- Subclinical dissections can be picked up incidentally
- Chest radiographic findings may be normal in 10%–40% of aortic dissections

Advantages

- Fast
- Available emergently
- Noninvasive
- Operator independent

Disadvantages

- Radiation
- Non specific for mediastinal widening
- Low sensitivy and specificity (~60%)

American College of Radiology Appropriateness Criteria

Multidetector CT of Aortic Dissection: A Pictorial Review. McMahon, Michelle A. and Squirrell, Christopher A. RadioGraphics 2010; 30:445–460

Eduardo Hariton, HMSIII
Gillian Lieberman, MD

CT Scan

- Most common initial study in acute setting
- CTA can identify double lumen and presence of an intimal flap only 70% of the time

Advantages

- Fast
- Available emergently
- Relatively noninvasive
- Operator independent
- Sensitivity of 100% and a specificity of 98%,

American College of Radiology Appropriateness Criteria

Disadvantages

- Requires IV contrast
- Difficult to assess site of intimal tear

Multidetector CT of Aortic Dissection: A Pictorial Review. McMahon, Michelle A. and Squirrell, Christopher A. RadioGraphics 2010; 30:445–460

Eduardo Hariton, HMSIII
Gillian Lieberman, MD

MRI

- Highest sensitivity and specificity
- Great for chronic aortic dissections when the patient is stable and for F/U

Advantages

- Noninvasive
- High quality images in several places
- Operator independent
- No radiation
- High sensitivity and specificity

Disadvantages

- Length of study
- Patient must be stable
- Not usually available emergently
- Contraindicated in many patients (old surgical clips, pacemakers, etc.)

American College of Radiology Appropriateness Criteria

Multidetector CT of Aortic Dissection: A Pictorial Review. McMahon, Michelle A. and Squirrell, Christopher A. RadioGraphics 2010; 30:445–460

Eduardo Hariton, HMSIII
Gillian Lieberman, MD

TEE

- Sensitivity of 94%–100% and a specificity of 77%–100% for identifying an intimal flap
- Good for assessing for complications: Aortic insufficiency (doppler) or pericardial effusions

Advantages

- Available at bedside
- Fast
- Can identify aortic insufficiency as well as entry and reentry sites

Disadvantages

- Invasive
- Operator dependent
- Poor images for surgical repair
- Contraindicated in patients with esophageal disease

American College of Radiology Appropriateness Criteria

Multidetector CT of Aortic Dissection: A Pictorial Review. McMahon, Michelle A. and Squirrell, Christopher A. RadioGraphics 2010; 30:445–460

Eduardo Hariton, HMSIII
Gillian Lieberman, MD

Angiography

- Previously gold standard but falling out of favor
- Only used in patients where definite coronary evaluation is required

Advantages

- High diagnostic accuracy (98% in digital subtraction angiography)

Disadvantages

- Invasive
- Iodinated contrast required
- Operator dependent

American College of Radiology Appropriateness Criteria

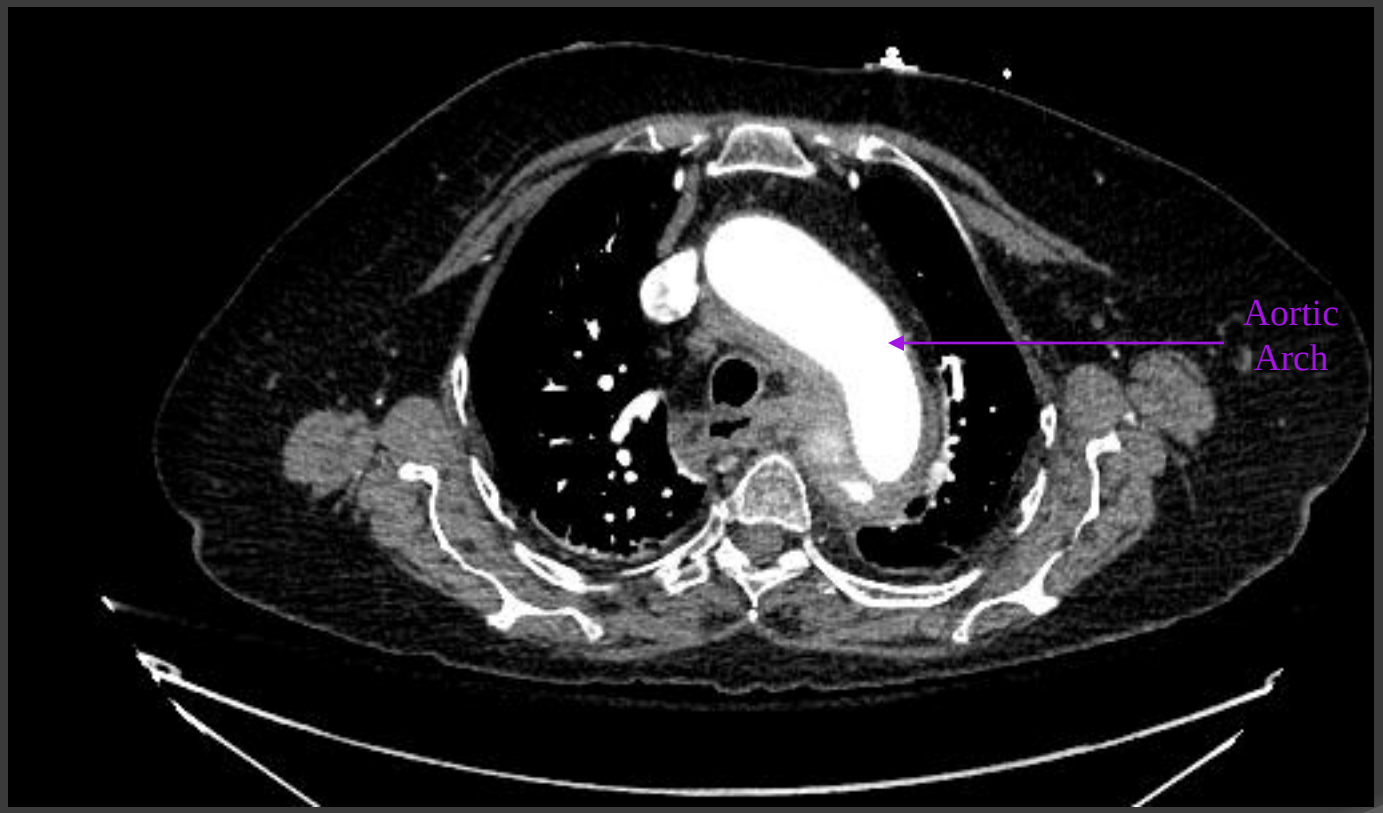
Eduardo Hariton, HMSIII
Gillian Lieberman, MD

Outline

- Intro to our Patient ✔
- Review of Aortic Dissection ✔
- Menu of Tests ✔
- **Images and Diagnosis**
- Treatment and complications
- Take home points
- References
- Acknowledgements

Beth Israel Deaconess Medical Center
Eduardo Hariton, HMSIII
Gillian Lieberman, MD

Our Patient: Aortic Arch on Chest CT

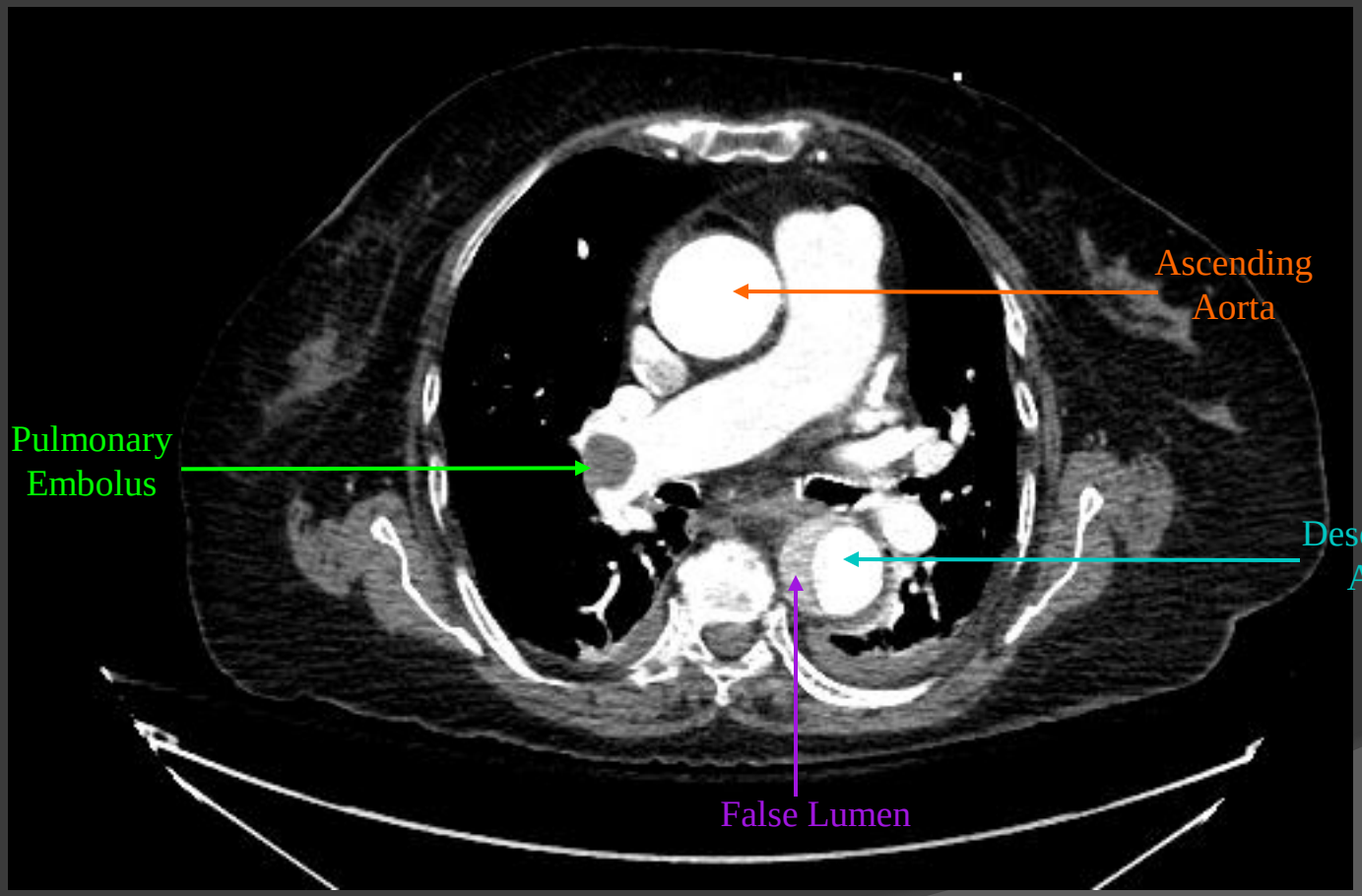


Axial C+ Chest CT

PACS BIDMC

Beth Israel Deaconess Medical Center
Eduardo Hariton, HMSIII
Gillian Lieberman, MD

Our Patient: Pulmonary Embolus on Chest CT

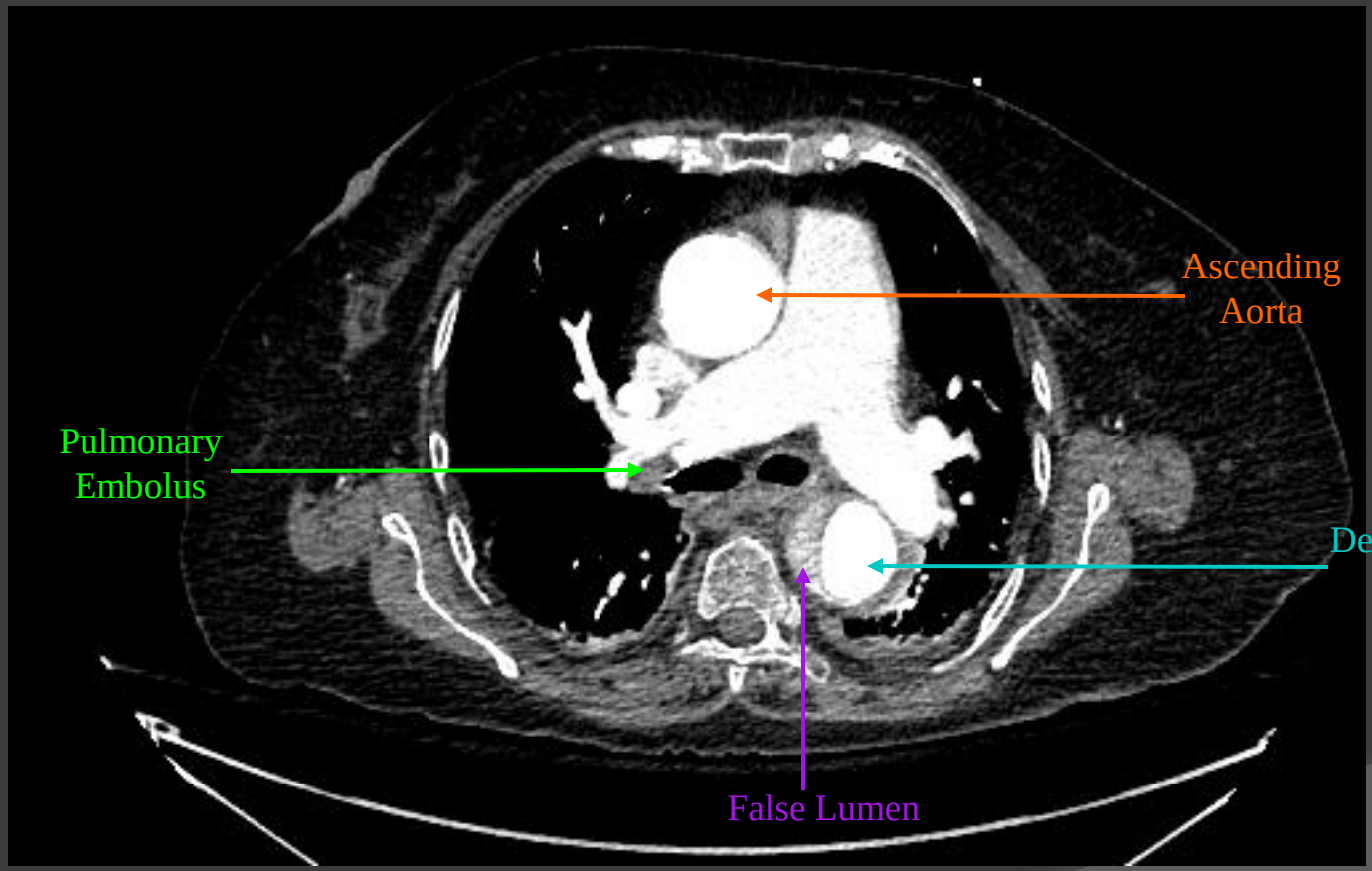


Axial C+ Chest CT

PACS BIDMC

Beth Israel Deaconess Medical Center
Eduardo Hariton, HMSIII
Gillian Lieberman, MD

Our Patient: Aortic Dissection on Chest CT



Axial C+ Chest CT

PACS BIDMC

Eduardo Hariton, HMSIII
Gillian Lieberman, MD

Our Patient: Findings

- Typical presentation of aortic dissection
- Type B aortic dissection beginning at the level of the take-off of the left subclavian artery and ending at the diaphragmatic hiatus shortly above the level of the celiac trunk.
- Large pulmonary embolism in the right main pulmonary artery
- Patient was managed with hypertensive control and her symptoms resolved

Eduardo Hariton, HMSIII
Gillian Lieberman, MD

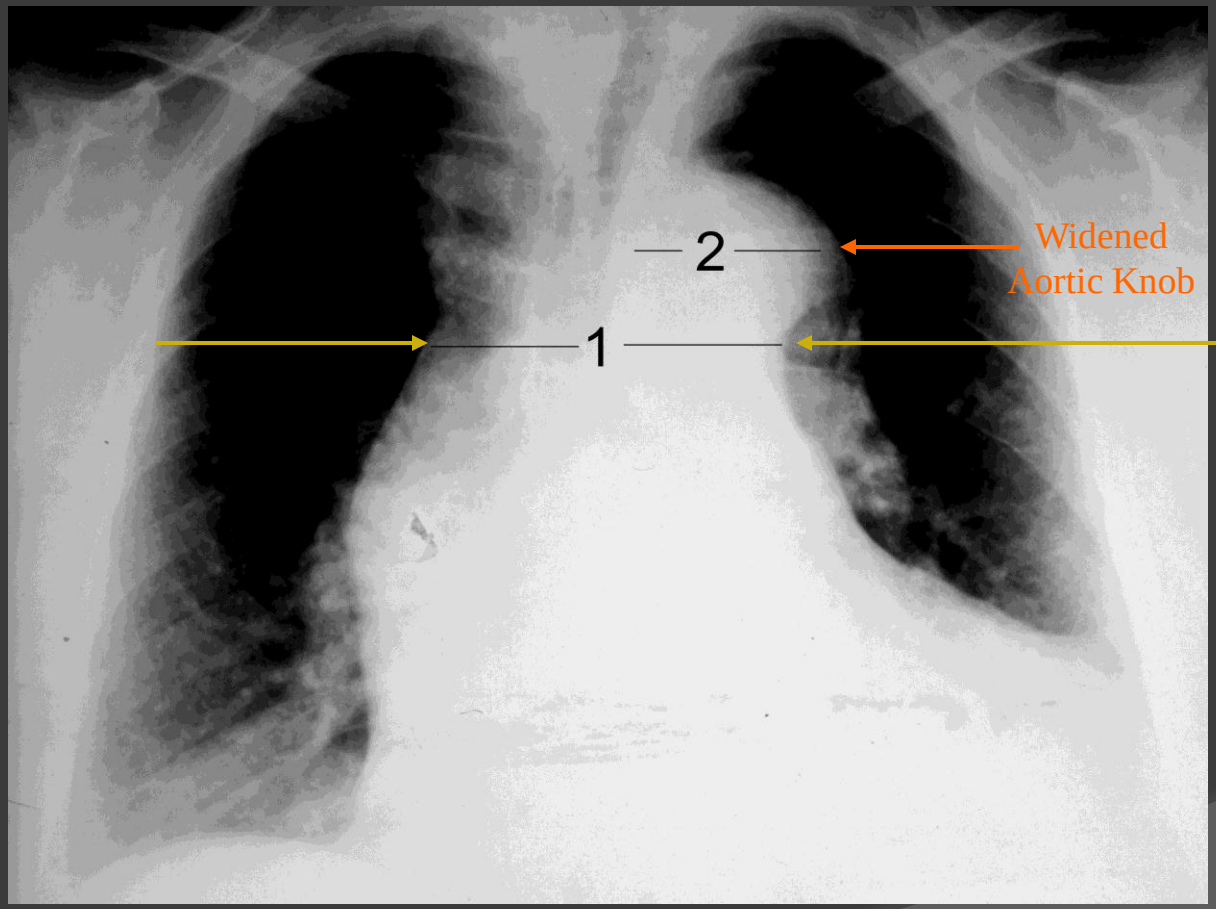
Aortic Dissection on X-Ray and MRI

We just saw radiological evidence of aortic dissection on Axial C+ Chest CT

Lets continue to view how aortic dissection manifests itself in other imaging modalities

Beth Israel Deaconess Medical Center
Eduardo Hariton, HMSIII
Gillian Lieberman, MD

Companion Patient #1: Aortic Dissection on Chest X-Ray

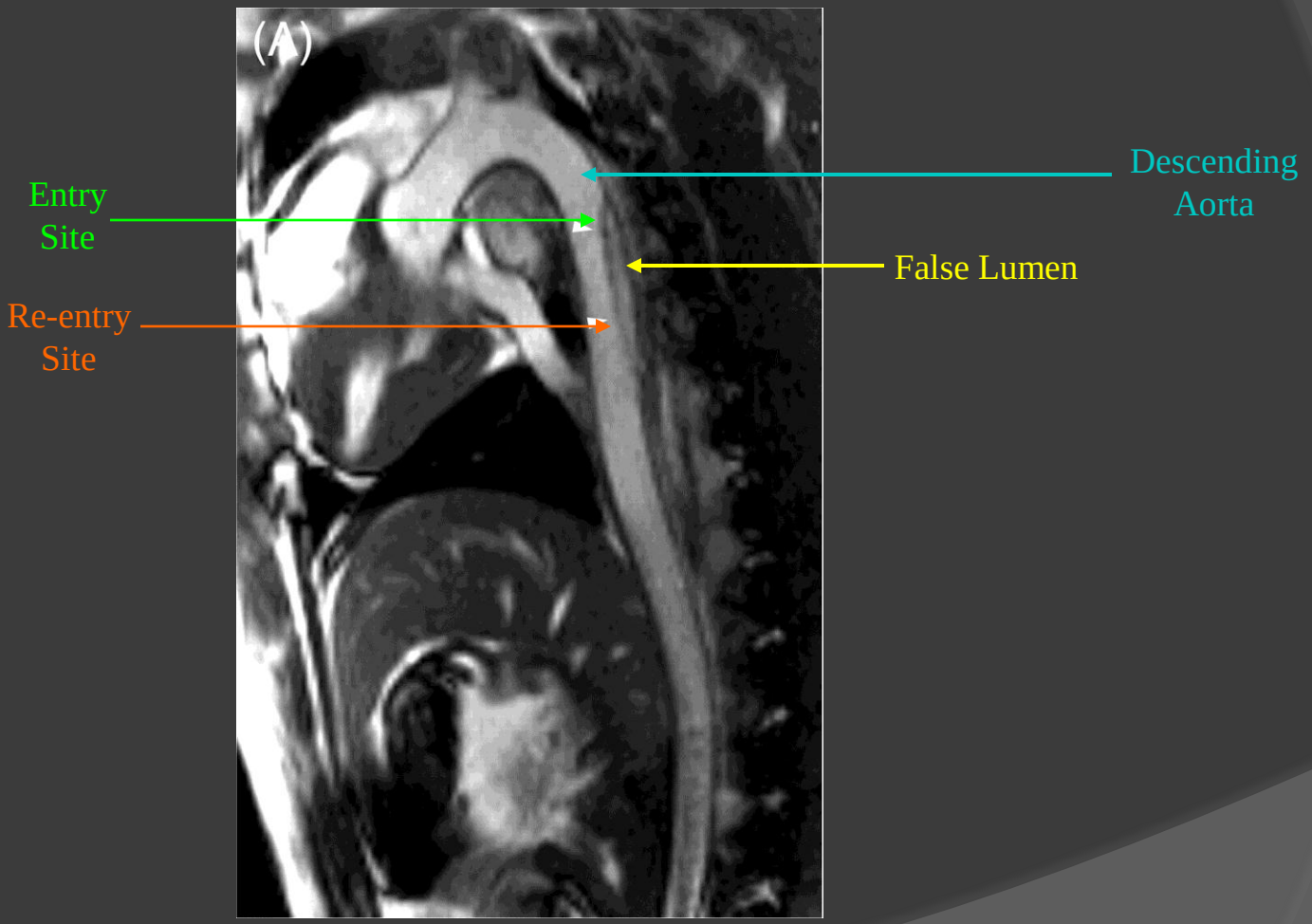


Frontal PA Chest Radiograph

http://www.acutemed.co.uk/diseases/Aortic+Dissection

Beth Israel Deaconess Medical Center
Eduardo Hariton, HMSIII
Gillian Lieberman, MD

Companion Patient #2: Aortic Dissection on MRI



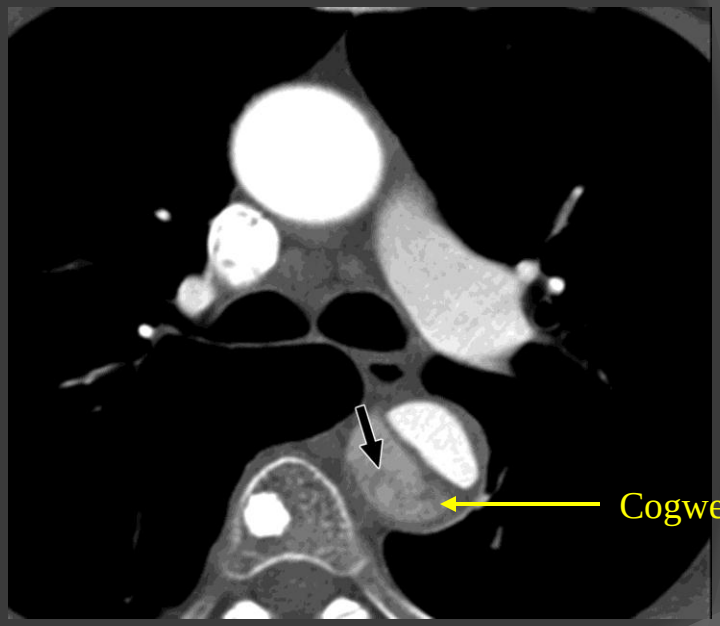
High-resolution MRI (TrueFISP retro) in parasagittal orientation

http://eurheartj.oxfordjournals.org/content/27/5/613/F5.expansion

Beth Israel Deaconess Medical Center
Eduardo Hariton, HMSIII
Gillian Lieberman, MD

True Vs. False Lumen in Aortic Dissection

- False lumen is most often posterior to true lumen
- Cobwebs in false lumen: These are residual ribbons of media that have been incompletely sheared from the aortic wall during the dissection process



Magnified Axial C+ Chest CT

Aortic cobwebs: an anatomic marker identifying the false lumen in aortic dissection--imaging and pathologic correlation. Williams et al., Radiology 1994 Jan;190(1):167-74

http://www.ajronline.org/content/193/4/928/F15.large.jpg

Eduardo Hariton, HMSIII
Gillian Lieberman, MD

Outline

- Intro to our Patient ✔
- Review of Aortic Dissection ✔
- Menu of Tests ✔
- Images and Diagnosis ✔
- **Treatment and complications**
- Take home points
- References
- Acknowledgements

Eduardo Hariton, HMSIII
Gillian Lieberman, MD

Treatment of Aortic Dissection

- Type A dissection typically requires urgent surgical intervention
- Type B dissection can often be treated medically with blood pressure control, unless there are complications due to extension of dissection (ie: end organ ischemia or persistent pain)

Multidetector CT of Aortic Dissection: A Pictorial Review. McMahon, Michelle A. and Squirrell, Christopher A. RadioGraphics 2010; 30:445–460

Eduardo Hariton, HMSIII
Gillian Lieberman, MD

Complications of Aortic Dissection

- Rupture is almost universally fatal due to cardiovascular collapse
- Dissection can lead to stroke, infarct, paralysis, renal failure, and other manifestations of end organ ischemia

Eduardo Hariton, HMSIII
Gillian Lieberman, MD

Our Patient: Outcome and Follow-up

- Our patient was discharged 9 days after admission on anticoagulation and strict BP control
- She did well for two months and then presented with a large PE, syncope, and complete heart block
- She had a pacemaker implanted and was discharged soon after
- Has done well since. Will have F/U MRI

Eduardo Hariton, HMSIII
Gillian Lieberman, MD

Outline

- Intro to our Patient ✔
- Review of Aortic Dissection ✔
- Menu of Tests ✔
- Images and Diagnosis ✔
- Treatment and complications ✔
- **Take home points**
- References
- Acknowledgements

Eduardo Hariton, HMSIII
Gillian Lieberman, MD

Take Home Points

- Aortic dissection is life threatening and must be diagnosed and managed promptly
- CT W&WO contrast is good initial study of choice in the acute setting
- MRI is excellent in non acute setting
- CXR is often not diagnostic
- TEE is good for assessing complications

Eduardo Hariton, HMSIII
Gillian Lieberman, MD

References

- American College of Radiology Appropriateness Criteria
- Aortic cobwebs: an anatomic marker identifying the false lumen in aortic dissection--imaging and pathologic correlation. Williams et al., Radiology. 1994 Jan;190(1):167-74
- Multidetector CT of Aortic Dissection: A Pictorial Review. McMahon, Michelle A. and Squirrell, Christopher A. RadioGraphics 2010; 30:445–460
- http://www.acutemed.co.uk/diseases/Aortic+Dissection
- http://www.ajronline.org/content/193/4/928/F15.large.jpg
- http://www.elsevierimages.com/image/26036.htmhttp://eurheartj.oxfordjournals.org/content/27/5/613/F5.expansion
- http://medicscientist.com/aortic-dissection-treatment
- http://www.yalemedicalgroup.org/stw/images/126150.jpg

Acknowledgments

- Dr. Gillian Lieberman
- Dr. Mark Masciocchi
- Claire Odom
- Daniel Kim
- Matthew Torre
- Hayley Walker