Diseases of the Aorta

Natesa G. Pandian

No disclosures
Pre-Lecture Question 1

A 69 year old woman with h/o HTN, hyperlipidemia and CAD presented to the ED with 3 days of back pain. Other than a BP of 168/96 mm Hg her physical exam was unremarkable. EKG revealed LVH and strain. CXR and TTE were normal. A TEE was performed to exclude dissection. Ascending aorta and arch were normal.

TEE shows:

1) Normal aorta
2) Intramural hematoma
3) Penetrating aortic ulcer
4) Clotted dissection
Pre-Lecture Question 2

This pulsed Doppler recording of distal thoracic aorta is seen in:

1) Normal aorta
2) Intramural hematoma
3) Penetrating aortic ulcer
4) Clotted dissection
Pre-Lecture Question 2

The most likely interpretation is:

1) Artefact
2) Dissection flap
3) Linear thrombus
4) A catheter in the aorta
Aortic Dissection
Aortic Aneurysm
Penetrating Ulcer
Aortic Trauma
Aortic Atheroma
Suprasternal View
<table>
<thead>
<tr>
<th></th>
<th>MEN</th>
<th>WOMEN</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Absolute cm</td>
<td>Index cm/m²</td>
</tr>
<tr>
<td>Aortic annulus</td>
<td>3.1</td>
<td>1.6</td>
</tr>
<tr>
<td></td>
<td>2.6±/-0.3</td>
<td>1.3±/-0.1</td>
</tr>
<tr>
<td>Sinus of Valsalva</td>
<td>4</td>
<td>2.1</td>
</tr>
<tr>
<td></td>
<td>3.4±/-0.3</td>
<td>1.7±/-0.2</td>
</tr>
<tr>
<td>Supra-aortic ridge</td>
<td>3.6</td>
<td>1.9</td>
</tr>
<tr>
<td></td>
<td>2.9±/-0.3</td>
<td>1.5±/-0.2</td>
</tr>
<tr>
<td>Prox Asc Ao</td>
<td>3.7-3.8</td>
<td>1.5±/-0.2</td>
</tr>
<tr>
<td></td>
<td>3.0±/-0.4</td>
<td></td>
</tr>
</tbody>
</table>

Case
Aortic Dissection
If
If aortic dissection is not diagnosed and treated promptly
If aortic dissection is not diagnosed and treated promptly, the mortality escalates every hr.
Aortic Dissection
Mortality Rates

21% within 24 hrs
49% at four days
74% at two weeks
93% at one year
Aortic Dissection

Type I

Type II

Type III

Type A or Proximal

Type B or Distal
Acute Aortic Dissection

- 2000 new cases reported in US per year
- True incidence possibly 10,000 per year
Clinical History

- Sudden severe pain: 74-90% cases
- May propagate or be localized
- 90% with antr pain only: Asc. Aorta
- 90% with intrascap pain: Desc. aorta
- Other symptoms: Branches compromised
  Rupture/Leakage
Aortic Dissection
Transthoracic Echo

Acoustic window not optimal in all pts.

Sensitivity: 59 - 85%
Specificity: 63 - 96%
## Aortic Dissection

### TEE

<table>
<thead>
<tr>
<th>Investigator</th>
<th>Pts</th>
<th>Sen %</th>
<th>Sp %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erbel ‘89</td>
<td>164</td>
<td>99</td>
<td>98</td>
</tr>
<tr>
<td>Nienabar ‘93</td>
<td>110</td>
<td>94</td>
<td>87*</td>
</tr>
<tr>
<td>Keren ‘96</td>
<td>112</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Sommer ‘96</td>
<td>49</td>
<td>96</td>
<td>96</td>
</tr>
</tbody>
</table>
Aortic Dissection

“All I need to know is the diagnosis and location”
TEE in Aortic Dissection

- Intimal flap, True/False lumen
- Entry sites, Prox extent, Type
- Patency or clot in false lumen
- Aortic regurgitation
- Coronary involvement
- LV wall motion, LV function
- Pericardial effusion
- Aortic ring sizing for surgery
- Assessment of surgery
Case
Cor Angio: Normal coronaries
Back pain in the cath lab
Cor Angio: Normal coronaries
Back pain in the cath lab
Aortic Dissection

Yes
No
Not sure
Case
Intramural Hematoma

About 6 - 20% of aortic dissection are intramural hematoma cases

(106/553 from pooled data)
**Intramural Hematoma**

- Thickening of aortic wall (>0.7 cm) with central displacement of intimal layer
- Displaced intimal calcium
- Absence of flap/fenestration
- May be echolucent but no flow
- Increased external aortic diameter
Intramural Hematoma

Acute Intramural Hematoma of the Aorta
A Mystery in Evolution

Arturo Evangelista, MD; Debabrata Mukherjee, MD; Rajendra H. Mehta, MD; Patrick T. O’Gara, MD; Rossella Fattori, MD; Jeanna V. Cooper, MS; Dean E. Smith, PhD; Jae K. Oh, MD; Stuart Hutchison, MD; Udo Sechtem, MD; Eric M. Isselbacher, MD; Christoph A. Nienaber, MD; Linda A. Pape, MD; Kim A. Eagle, MD; for the International Registry of Aortic Dissection (IRAD) Investigators*

Background—The definition, prevalence, outcomes, and appropriate treatment strategies for acute intramural hematoma (IMH) continue to be debated.

Methods and Results—We studied 1010 patients with acute aortic syndromes who were enrolled in the International Registry of Aortic Dissection (IRAD) to delineate the prevalence, presentation, management, and outcomes of acute IMH by comparing these patients with those with classic aortic dissection (AD). Fifty-eight (5.7%) patients had IMH, and this cohort tended to be older (68.7 versus 61.7 years; \( P<0.001 \)) and more likely to have distal aortic involvement (60.3% versus 35.3%; \( P<0.001 \)) compared with 952 patients with AD. Patients with IMH described more severe initial pain than did those with AD but were less likely to have ischemic leg pain, pulse deficits, or aortic valve insufficiency; moreover, they required a longer time to diagnosis and more diagnostic tests. Overall mortality of IMH was similar to that of classic AD (20.7% versus 23.0%; \( P=0.57 \)) as was mortality in patients with IMH of the descending aorta (8.3%.

Conclusions—The IRAD data demonstrate a 5.7% prevalence of IMH in patients with acute aortic syndromes. Like classic AD, IMH is a highly lethal condition when it involves the ascending aorta and surgical therapy should be considered, but this condition is less critical when limited to the arch or descending aorta. Fully 16% of patients have evidence of evolution to dissection on serial imaging. (Circulation. 2005;111:1063-1070.)

Treat like dissection
## Diagnosis of Intramural Hematoma

<table>
<thead>
<tr>
<th></th>
<th>Intramural Hematoma</th>
<th>Atheroma Plaque</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Intralum surface</strong></td>
<td>Usually smooth</td>
<td>Usually irregular</td>
</tr>
<tr>
<td><strong>Echodensity</strong></td>
<td>Hypoechoic</td>
<td>Hyperechoic</td>
</tr>
<tr>
<td><strong>Involvement</strong></td>
<td>Usually localized</td>
<td>Usually diffuse</td>
</tr>
<tr>
<td><strong>Peric effusion</strong></td>
<td>May be present</td>
<td>--</td>
</tr>
</tbody>
</table>
Aortic Dissection
Follow-Up

• Upto 29% of late deaths after surgery due to rupture of dissecting aneurysm or dissection at remote site
• Incidence of subsequent aneurysm at remote site is 17 - 25%
• In the majority, subsequent dissection develops within 2 years
Aortic Aneurysm
Types of aortic aneurysms

SACCULAR
Unilateral pouchlike bulge with a narrow neck

FUSIFORM
A spindle-shaped bulge encompassing the entire diameter of the vessel

DISSECTING
A hemorrhagic separation of the medial layer of the vessel wall, which creates a false lumen

FALSE ANEURYSM
A pulsating hematoma resulting from trauma and often mistaken for an abdominal aneurysm
Case
Bicuspid Aortic Valve
Aortic Root Enlargement

LV
LA
Aorta
Aortic Surgery in Dilated Aorta
AHA/ACC/ESC Guidelines

What diameter?
Aortic Surgery in Dilated Aorta
AHA/ACC/ESC Guidelines

What diameter?

\( \geq 55 \text{ mm} \)
Surgery to repair the aortic root or replace the ascending aorta is indicated in patients with bicuspid aortic valves if the diameter of the aortic root or ascending aorta is $> 5.0 \text{ cm}^*$ or if the rate of increase in diameter is $0.5 \text{ cm/yr}$ or more

(Level of Evidence: C)

In patients with bicuspid valves undergoing AVR because of severe AS or AR, repair of the aortic root or replacement of the ascending aorta is indicated if the diameter of the aortic root or ascending aorta is greater than $4.5 \text{ cm}$

(Level of Evidence: C)
CLASS I

Operative intervention to repair the aortic sinuses or replace the ascending aorta is indicated in patients with a bicuspid aortic valve if the diameter of the aortic sinuses or ascending aorta is $> 5.5 \text{ cm}$

Level of evidence: B
CLASS IIa

Operative intervention to repair the aortic sinuses or replace the ascending aorta is reasonable in patients with bicuspid aortic valves if the diameter of the aortic sinuses or ascending aorta is greater than 5.0 cm and a risk factor for dissection is present (family history of aortic dissection or if the rate of increase in diameter is $\geq 0.5$ cm per year).

Level of evidence: C
CLASS IIa

Replacement of the ascending aorta is reasonable in patients with a bicuspid aortic valve who are undergoing aortic valve surgery because of severe AS/AR if the ascending aorta diameter is > 4.5 cm. Level of evidence: C

Replacement of the sinuses of Valsalva is not necessary in all cases and should be individualized.
Disorders associated with Aortic Aneurysms

- Marfan Syndrome
- Ehlers-Danlos Syndrome
- Ankylosing Spondylitis
- Behcet disease
- Reiter Syndrome
- Williams Syndrome
Case
Case
Penetrating Aortic Ulcer

Courtesy: Mankad, MD
Penetrating Aortic Ulcer

Courtesy: Mankad, MD
Penetrating Aortic Ulcer

- Atherosclerotic disease $\rightarrow$ superficial ulceration of plaque confined to intima

- Ulcer may penetrate into internal elastic lamina and into media
Penetrating Aortic Ulcer - Sequele

- Benign
- Deep ulcer (true saccular aneurysm)
- Medial hematoma
- Pseudoaneurysm
- Transmural rupture
Penetrating Aortic Ulcer

- More common in descending aorta
- Elderly, hypertensive patients
- Symptoms: chest pain, back pain
- Symptomatic involvement of ascending aorta or arch has high risk for rupture → surgery
- Surgery for descending P.A.U. if:
  - Hemodynamic instability
  - Pseudoaneurysm
  - Pericardial effusion
  - Bloody pleural effusion
  - Expanding intramural hematoma
Aortic Masses

• Atheromas
• Thrombotic masses
• Tumors (sarcoma, histiocytoma, angiosarcoma)
• Mysteriomas
Case
Aortic Atheroma
Aortic Atheroma

- Association with systemic embolic events
- > 3 or >4 mm atheroma: a higher risk
- Besides Rx of dyslipidemia, other forms of therapy unproven/controversial
- Has intraoperative implications in patients undergoing aortic cannulation
Case
Case
What next?

1. Thrombus - Anticoagulate
2. Thrombus - Surgery
3. Tumor – Do more work-up
4. Tumor - Operate
What next?

1. Thrombus - Anticoagulate
2. Thrombus - Surgery
3. Tumor – Do more work-up
4. Tumor - Operate
5. Just talk
Case
Aortic Trauma

- High Mortality (20% survival to hospital)
- Horizontal deceleration injury (MVA)
- Vertical decel injury (falling from height)
- Most common sites:
  - Aortic isthmus tethered by ligamentum arteriosum
  - Ascending aorta above sinus of valsalva
  - Origin of the innominate artery
Diagnosis of Aortic Trauma

Angiography—transport of patient, risk of worsening vascular trauma

CT—requires transport of patient

TEE

Cannot be performed in severe facial injury or cervical spine injury

May not see distal ascending aorta or great vessels
Echo Findings in Aortic Trauma

- “thick stripe” due to deep laceration
- Pseudoaneurysm
- Fusiform dilation
- Intramural hematoma
- Intraluminal thrombi
- Mediastinal hematoma
Case
Coarctation of the Aorta

- Pre-ductal, Ductal or Post-ductal
- If hypertensive/symptomatic, Angioplasty/stent or surgery
Pseudo-coarctation of the Aorta

Thank You