Diseases of the Aorta
Overview

• Aortic Dissection
• Atypical Aortic Dissection
  – Intramural Hematoma
  – Penetrating Atherosclerotic Ulcer
• Aortic Aneurysm
• Aortic Atherosclerotic Disease
• Coarctation
• Aortic Trauma
  ▪ Transection
Aortic Dissection

• Deterioration of medial collagen and elastin
• A tear in the intimal layer allows blood to enter the intima-media space
• Blood then propagates down this new space creating a “true” and a “false” lumen
Factors Predisposing to Dissection

- Hypertension
- Marfan and Ehler-Danlos
- Coarctation and bicuspid aortic valve
- Pregnancy
- Trauma
- Perforation through an intimal atheromatous plaque
## TABLE 40–1. COMMONLY USED CLASSIFICATION SYSTEMS TO DESCRIBE AORTIC DISSECTION

<table>
<thead>
<tr>
<th>TYPE</th>
<th>SITE OF ORIGIN AND EXTENT OF AORTIC INVOLVEMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DeBakey</strong></td>
<td></td>
</tr>
<tr>
<td>Type I</td>
<td>Originates in the ascending aorta, propagates at least to the aortic arch and often beyond it distally</td>
</tr>
<tr>
<td>Type II</td>
<td>Originates in and is confined to the ascending aorta</td>
</tr>
<tr>
<td>Type III</td>
<td>Originates in the descending aorta and extends distally down the aorta or, rarely, retrograde into the aortic arch and ascending aorta</td>
</tr>
<tr>
<td><strong>Stanford</strong></td>
<td></td>
</tr>
<tr>
<td>Type A</td>
<td>All dissections involving the ascending aorta, regardless of the site of origin</td>
</tr>
<tr>
<td>Type B</td>
<td>All dissections not involving the ascending aorta</td>
</tr>
<tr>
<td><strong>Descriptive</strong></td>
<td></td>
</tr>
<tr>
<td>Proximal</td>
<td>Includes DeBakey types I and II or Stanford type A</td>
</tr>
<tr>
<td>Distal</td>
<td>Includes DeBakey type III or Stanford type B</td>
</tr>
</tbody>
</table>
Intimal flap and tear in a patient with acute type A aortic dissection

Predicting death in Patients with Acute Type A Aortic Dissection

- 547 pts; IRAD; Jan 96-Dec 99
- In hospital mortality 32.5%
- Age ≥ 70 years
- Abrupt onset of chest pain
- Hypotension, Shock, Tamponade
- Kidney failure
- Pulse deficit
- ECG abnormalities
Clinical Presentation

• Pain 85-96%
  - Sudden 85%
  - Severe 90%
  - Tearing/Ripping 50%

• Syncope
  - Pain, obstruction, barroreceptors

• Neurological
  - CVA 5%
  - Paraparesis or paraplegia

• CHF 7%
• MI rare
Physical Findings

• Pulse Deficits (50% prox; 15% distal)
• Aortic Regurgitation – 16-67% of cases
• Neurological Manifestations -6-19%
• CVA – 3-6%
• Altered consciousness or coma
• Spinal artery perfusion – paraplegia, paraparesis
Imaging Modality of Choice

GOALS

- Confirm the diagnosis
- Classify the dissection and determine extent
- Detect pericardial involvement
- Detect and grade AI

CHOICES

- TTE/TEE
- CT
- MRI
- Aortography
Procedure Used for the Diagnosis of Aortic Dissection

Am J Cardiology 2002
### Sensitivity of the Four Imaging Modalities

<table>
<thead>
<tr>
<th>Image Modality</th>
<th>Overall</th>
<th>Type A</th>
<th>Type B</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEE</td>
<td>88%</td>
<td>90%</td>
<td>80%</td>
</tr>
<tr>
<td>CT</td>
<td>93%</td>
<td>93%</td>
<td>93%</td>
</tr>
<tr>
<td>MRI</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Aortography</td>
<td>87%</td>
<td>87%</td>
<td>89%</td>
</tr>
</tbody>
</table>
TTE in Aortic Dissection
TEE in Aortic Dissection

- Hallmark: Dissection flap and entry site
- Dilated aorta
- Aortic insufficiency
- Pericardial and or pleural effusion
# TEE in Aortic Dissection: Pitfalls

<table>
<thead>
<tr>
<th>True Dissection Flap</th>
<th>Artifacts, Reverberations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distinct, well-visualized</td>
<td>Vague, blurry</td>
</tr>
<tr>
<td>Undulates with cardiac cycle</td>
<td>Crosses true anatomic barriers</td>
</tr>
<tr>
<td>Present in multiple views</td>
<td>Does not demonstrate typical undulation pattern</td>
</tr>
<tr>
<td>Separates true from false lumen</td>
<td>Does not separate true from false</td>
</tr>
</tbody>
</table>
Aortic Dissection on CT
Aortic dissection: Complications

• Rupture
• Tamponade
• Aortic Regurgitation
• Coronary Artery Involvement
• Other Branch Vessel Involvement
Aortic Dissection: Mechanism of AR

1. Dilatation of aortic root
2. Pressure from dissecting hematoma may depress one leaflet
3. Torn annular support of the leaflets
4. Intimal flap prolapse
Aortic Dissection – Pulse Loss

Due to direct compression

Blockade due to flap of intima
Visualization of the left coronary ostium.
Visualization of the head and neck vessels
Mortality in Acute Aortic Dissection
Survival Curves: Mortality and Type A Dissection
By Age Group and Management Strategies

Days in Hospital

Survival

- Age 70+, Medical
- Age 70+, Surgical
- Age <70, Medical
- Age <70, Surgical
Atypical Aortic Dissection

- Intramural Hematoma
- Penetrating Atherosclerotic Ulcer
Intramural Hematoma: Diagnosis

- Contained hemorrhage within the medial layer of the aortic wall
- Crescentic area along the aortic wall
- Prevalence 10-15% in CT/MRI/TEE
- Normal size lumen
- False negative aortograms
Intramural Hematoma
Intramural Hematoma on CT
Atypical Aortic Dissection: IH Echo Features

- Localized thickening of Ao wall
  - Usually crescentic
  - Occasionally circumferential
  - Echo-lucent spaces common
- Relatively smooth luminal surface
- Absence of dissection flap
- Maintenance of circular lumen
Intramural haematoma

Intramural Hematoma of the Aorta

Predictors of Progression to Dissection and Rupture

- Location in the ascending aorta
- Initial hematoma thickness ≥ 11mm
- Moderately ectatic aortic diameter with progression

Circulation 2002
Circulation 2003
Penetrating Atherosclerotic Ulcer

- Almost exclusively in the descending Ao
- Usually remains localized
- Elderly HTN, evidence for other atherosclerotic CV disease
- Chest and back pain without associated AR or neurological deficits
AORTIC ATHEROSCLEROTIC ULCERS

Atheroma
Intima
Media
Adventitia

Aortic atheroma

Intimal ulcer

Plaque ulceration

Intimal plaque ulceration

Medial hematoma

Adventitial false aneurysm

Transmural rupture
Penetrating Atherosclerotic Ulcer

- Natural history is unclear
- No defined strategy
- Surgical repair for
  - Pseudoaneurysm
  - Transmural rupture
  - Continued pain
  - Distal embolization
  - Aneurysmal dilatation
Aortic aneurysm

• **Definition:** pathological dilatation of the normal aortic lumen involving one or several segments
• **Fusiform** (common), **saccular**
• **Pseudoaneurysm:** well-defined collection of blood and connective tissue outside the vessel wall
Thoracic aortic aneurysm

- Descending aorta > ascending aorta
- Cystic media degeneration: weakening aortic wall (elastic fiber degeneration)
- Marfan syndrome
- Atherosclerosis
- Syphilis: ascending aorta
- Infectious aortitis / mycotic aneurysm
Thoracic aortic aneurysm

• 40% asymptomatic
• pain
• Symptoms due to mass effect - superior vena cava syndrome, tracheal deviation

• CT, TEE > TTE
• Surgery: >5cm (mean expansion rate= 0.43 cm/year)
• Op risk: 5%
Aortic Atherosclerosis

- Atheroma
- Protruding Atheroma
- Complex plaque
  - 4mm or more thick and/or mobile component
Atherosclerotic lesions of the aorta detected by TEE have been recognized as an important cause of stroke and peripheral embolic disease.

Using TEE, the prevalence of thoracic aortic atheromas is 27% in patients who have experienced a previous embolic event.

When atheromas are present, the incidence of stroke is 12% in one year.

J Am Coll Cardiol 2000;35:545-54
• Plaque thickness and plaque composition as assessed by TEE have been identified as major risk factors for embolic complications.

• A strong association has been demonstrated between protruding non-calcified plaques ≥4mm in the aorta detected by TEE and the risk of ischemic stroke and peripheral embolism.

Circulation 1997;96:3838-41
• Atheromas in the aortic arch and ascending or descending aorta identified by TEE may be the cause of many otherwise unexplained strokes

• Role of Statins, ACEI, Anticoagulants and Antiplatelet agents uncertain
Trans-esophageal echocardiogram (horizontal, 0-degree view) of an aortic arch with large, multi-lobed, ulcerated protruding atheromas (arrows).

Kronzon I, Tunick P A Ann Intern Med 1997;126:629-637
Coarctation of Aorta

**Definition**

A congenital narrowing of upper descending thoracic aorta adjacent to the site of attachment of ductus arteriosus
Coarctation of Aorta

Morphology

1. Localized stenosis
   * Shelf, projection or infolding of aortic media into the lumen opposite the ductus arteriosus

2. Tubular hypoplasia
   * Severe with lesser narrowing
Coarctation on CT
Coarctation of Aorta

Pathophysiology

• Narrowed aorta produces increased left ventricular afterload and wall stress, left ventricular hypertrophy, and congestive heart failure

• Systemic perfusion is dependent on the ductal flow and collateralization in severe coarctation
Coarctation of Aorta

- **Indications for operation**

  1. Reduction of luminal diameter greater than 50% at any age
  2. Upper body hypertension over 150mmHg in young infant (not in heart failure)
  3. CoA with congestive heart failure at any age
Blunt Aortic-Brachiocephalic Trauma

Aortic isthmus mainly involved

Fisher et al, 1981 (n=510)

Vignon et al, 1998 (n=25)
Aortic Disruption: Anatomical types

Complete

Subtotal

Partial Tear

Intimal Tear

Circulation 1995
Thank You