Epidemiology

- 8000 occurrences/year in US
- 1000 reach hospital alive
- If untreated, 30% of those who are admitted to hospital will die within 24 hours
- Usually occurs after falls >30 feet, Motor Vehicle Collision(head-on or side impact), pedestrian struck by vehicle
Pathogenesis

1. Shearing caused by rapid deceleration of mobile aorta against fixed point (ligamentum arteriosum)
2. Compression of Aorta between bony structures
3. Sudden intraluminal hypertension during traumatic event
History

1557 – Vesalius, first to report on blunt aortic injury (traumatic aneurysm)

1958 – Parmley, et al first detailed description of Blunt Aortic Injury, suggested Aortography was most effective means to delineate extent of lesion

1958 – Klassen, first successful repair

1965 – Beta-Blockade therapy first shown to be effective for aortic dissection (non-traumatic)

1970 – Beta-Blockade therapy shown to be effective for Blunt Aortic Injury

1991 – Parodi, first use of endograft for management

2000 – Most recent EAST Practice Management Guidelines
Practice Management Guidelines (summarized)

1. Prompt (Open) repair of Aortic Injury
   “Once the diagnosis of BAI (Blunt Aortic Injury) is made, most authors agree that prompt surgical repair is the best approach.”

2. Medical control of blood pressure until repair can be performed

3. Spiral CT Scan can be used to rule out aortic injury (Aortography not mandatory)
“…during the last decade no other organ injury has seen more changes in diagnosis, treatment, and outcomes than thoracic aortic trauma.”

Demetriades, D. “Blunt Thoracic Aortic Injuries: Crossing the Rubicon” Scudder Oration on Trauma 2011
Diagnosis

- Physical Examination
- Chest Xray
- Helical or Spiral CT Scan
- Transesophageal Echocardiogram
- Aortography
Physical Examination Findings

- Hypotension
- Unequal Extremity Pulses
- Hypertension in the Upper Extremities
- Evidence of severe chest trauma
- Palpable sternal fracture
- Flail chest
Chest Xray Findings

1. Widened Mediastinum*
2. Obliteration of Aortic Knob
3. Opacified AP Window
4. Downward displacement of Left Mainstem Bronchus
5. Lateral Displacement of Trachea or NG tube
6. Sternal, Scapular, Clavicle Multiple Rib Fractures
Normal contour of aortic arch creating an “aortic knob”

Normal “AP Window” or angle between the aorta and pulmonary artery
Helical or Spiral CT Scan

- Fast
- Can examine for other injuries
- Does not require groin access
- Does not require special team (night)
- Does not require specialized suite
- Up to 100% Sensitivity
- *Occasional false positive due to ductus diverticulum
Ductus Diverticulum

1. Occurs in up to 9% of adults
2. Outpouching of Thoracic Aorta that occurs during development
3. Anatomically similar to pseudoaneurysm, however has smooth borders
Transesophageal Echocardiogram

- Sensitive and Specific
- Invasive
- May not be universally available
- A good test to use if in the OR for other reasons
Review of National Trauma Data Bank 1996-2003


**TABLE 3. Mortality According to the Type of Specific Severe Injury (n = 12,254)**

<table>
<thead>
<tr>
<th>Organ With Severe Injury</th>
<th>No. of Patients</th>
<th>Deaths (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isolated severe injuries*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Liver (grade IV/V)</td>
<td>3656</td>
<td>1074 (29.4%)</td>
</tr>
<tr>
<td>Complex pelvic fracture</td>
<td>2780</td>
<td>542 (19.5%)</td>
</tr>
<tr>
<td>Aorta</td>
<td>2502</td>
<td>880 (35.2%)</td>
</tr>
<tr>
<td>Penetrating cardiac</td>
<td>963</td>
<td>353 (36.7%)</td>
</tr>
<tr>
<td>Vena cava</td>
<td>819</td>
<td>392 (47.9%)</td>
</tr>
<tr>
<td>Iliac vessels</td>
<td>795</td>
<td>267 (33.6%)</td>
</tr>
<tr>
<td>Quadriplegia</td>
<td>1797</td>
<td>430 (23.9%)</td>
</tr>
<tr>
<td>Combined injuries†</td>
<td>1246</td>
<td>618 (49.6%)</td>
</tr>
<tr>
<td>Total</td>
<td>12,254</td>
<td>3345 (27.3%)</td>
</tr>
</tbody>
</table>

*Include patients with only 1 severe injury.
†Combined injuries include 2 or more of the injuries in the table.
2005 Review of Autopsies for 304 Blunt Traumatic Deaths

Patients with Thoracic Aortic Rupture had associated diaphragm rupture, intra-abdominal and cardiac injuries, and pelvic fracture than those without rupture

Patients with Thoracic Aortic Rupture were more likely to die at scene
Anatomic Location of Injuries

Figure 2. Anatomic location of the thoracic aortic injuries.

<table>
<thead>
<tr>
<th></th>
<th>Total (n = 304)</th>
<th>TTA Injury (n = 102)</th>
<th>No TTA Injury (n = 202)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age ± SD</td>
<td>42.6 ± 21.0</td>
<td>43.5 ± 19.3</td>
<td>42.2 ± 21.9</td>
<td>0.63</td>
</tr>
<tr>
<td>Age ≥55 yr</td>
<td>29.2 (88/301)</td>
<td>30.0 (30/100)</td>
<td>28.9 (58/201)</td>
<td>0.83</td>
</tr>
<tr>
<td>Male</td>
<td>71.1 (216/304)</td>
<td>74.5 (76/102)</td>
<td>69.3 (140/202)</td>
<td>0.34</td>
</tr>
<tr>
<td>Mechanism</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MVC</td>
<td>49.7 (151/304)</td>
<td>52.0 (53/102)</td>
<td>48.5 (98/202)</td>
<td>0.88</td>
</tr>
<tr>
<td>AVP</td>
<td>36.8 (112/304)</td>
<td>37.3 (38/102)</td>
<td>36.6 (74/202)</td>
<td></td>
</tr>
<tr>
<td>MCC</td>
<td>7.9 (24/304)</td>
<td>6.9 (7/102)</td>
<td>8.4 (17/202)</td>
<td></td>
</tr>
<tr>
<td>Fall</td>
<td>3.3 (10/304)</td>
<td>2.9 (3/102)</td>
<td>3.5 (7/202)</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>2.0 (6/304)</td>
<td>1.0 (1/102)</td>
<td>2.5 (95/202)</td>
<td></td>
</tr>
<tr>
<td>Unknown</td>
<td>0.3 (1/304)</td>
<td>0.0 (0/102)</td>
<td>0.5 (1/202)</td>
<td></td>
</tr>
<tr>
<td>Death at the scene</td>
<td>69.1 (210/304)</td>
<td>80.4 (82/102)</td>
<td>63.4 (128/202)</td>
<td>0.002</td>
</tr>
<tr>
<td>Intoxication</td>
<td>42.2 (119/282)</td>
<td>44.9 (44/98)</td>
<td>40.8 (75/184)</td>
<td>0.50</td>
</tr>
<tr>
<td>Ethanol</td>
<td>28.7 (81/282)</td>
<td>32.7 (32/98)</td>
<td>26.6 (49/184)</td>
<td>0.28</td>
</tr>
<tr>
<td>Drugs</td>
<td>23.8 (67/282)</td>
<td>24.5 (24/98)</td>
<td>23.4 (43/184)</td>
<td>0.83</td>
</tr>
</tbody>
</table>

SD, standard deviation; AVP, auto vs. pedestrian; MCC, motorcycle collision.
The statistics in the table are percentages (No. cases/No. patients in group) unless stated otherwise. The p values for categorical variables were derived from χ² test; p values for continuous variables were derived from Student’s t test.
<table>
<thead>
<tr>
<th>Anatomic Location</th>
<th>MVC (53); % (n)</th>
<th>AVP (38); % (n)</th>
<th>MCC (7); % (n)</th>
<th>Fall (3); % (n)</th>
<th>Other (1); % (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Root</td>
<td>---</td>
<td>2.6 (1)</td>
<td>---</td>
<td>33.3 (1)</td>
<td>---</td>
</tr>
<tr>
<td>Ascending</td>
<td>1.9 (1)</td>
<td>2.6 (1)</td>
<td>14.3 (1)</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Arch</td>
<td>11.3 (6)</td>
<td>13.2 (5)</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Isthmus/descending</td>
<td>71.7 (38)</td>
<td>57.9 (22)</td>
<td>57.1 (4)</td>
<td>66.7 (2)</td>
<td>100 (1)</td>
</tr>
<tr>
<td>Multiple</td>
<td>15.1 (8)</td>
<td>23.7 (9)</td>
<td>28.6 (2)</td>
<td>---</td>
<td>---</td>
</tr>
</tbody>
</table>

AVP, auto vs. pedestrian; MCC, motorcycle collision.
CT Angiography has replaced x-rays in workup of blunt chest trauma
Change in resuscitation paradigm from aggressive field resuscitation to “scoop and run”
Use of beta-blockade with permissive hypotension
Emergence of endovascular repair as an adjunct to open repair
Shift from Immediate to Delayed Repair
Method of Diagnosis

Table 1. Changing Perspectives: Diagnostic Modalities for Blunt Thoracic Aortic Injury: American Association for the Surgery of Trauma 1 (1997) vs American Association for the Surgery of Trauma 2 (2007)

<table>
<thead>
<tr>
<th>Diagnostic modality</th>
<th>AAST 1 (n = 253)</th>
<th>AAST 2 (n = 193)</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>Aortogram</td>
<td>207</td>
<td>87.0%</td>
<td>16</td>
</tr>
<tr>
<td>CT scan</td>
<td>88</td>
<td>34.8%</td>
<td>180</td>
</tr>
<tr>
<td>TEE</td>
<td>30</td>
<td>11.9%</td>
<td>2</td>
</tr>
</tbody>
</table>

AAST, American Association for the Surgery of Trauma; TEE, transesophageal echocardiogram.
**Timing to Repair**

<table>
<thead>
<tr>
<th></th>
<th>Time to operation, h</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AAST 1 (1997)</strong></td>
<td></td>
</tr>
<tr>
<td>Open repair (n = 207)</td>
<td>16.5</td>
</tr>
<tr>
<td><strong>AAST 2 (2007)</strong></td>
<td></td>
</tr>
<tr>
<td>Open repair (n = 68)</td>
<td>67.6</td>
</tr>
<tr>
<td>Endovascular repair (n = 125)</td>
<td>48.1</td>
</tr>
</tbody>
</table>

*Crude Mortality was significantly lower in delayed repair*
Type of Repair
ERROR: stackunderflow
OFFENDING COMMAND: ~
ERROR: stackunderflow