CT of Blunt Abdominal Trauma

Objectives
- Review several important CT signs in abdominal trauma
- Review the spectrum of abdominal injury which can be diagnosed with CT
- Discuss strengths/weaknesses of CT

CT of Blunt Abdominal Trauma

Objectives
- NOT going to review the AAST grading system for trauma of each organ in the abdomen!

CT of Blunt Abdominal Trauma

Clinical Impact
- Deciding operative vs non-operative management
- Guiding minimally invasive, transcatheater embolization
- “One stop shopping” for global assessment of head, MSK, visceral and many vascular injuries

CT of Blunt Abdominal Trauma

Limitations
- GI tract and pancreatic injuries
- CT staging based entirely on morphologic criteria are of limited value in management

CT of Blunt Abdominal Trauma

Selected Signs
- Abdominal signs of thoracic injury
- Signs of hemorrhage, shock and hypovolemia
- Challenges for CT: signs of bowel, pancreatic injury
**Ejected from Motor Vehicle**

- **Pneumothorax**
- "4 x 4 sign"

**Intra-abdominal Clues to Thoracic Injuries**

**Blunt trauma, normal CXR**

- Peri-aortic blood at the diaphragm

**Arch and Innominate Injury**

**Peri-aortic Blood at the Diaphragm**

- Only an abdominal CT may be ordered if CXR is interpreted as normal
- Relatively insensitive (70%) but fairly specific sign (94%) for aortic injury; re-scan chest with MDCT angio
- Vertebral fractures and ruptured diaphragm may also cause this finding

CT Signs of Diaphragmatic Rupture

- **Collar sign**: constriction of stomach or colon traversing the hernia
- **Dependent viscera sign**: upper portion of liver, spleen or bowel abuts ribs with no intervening diaphragm
- **Discontinuity of visualized diaphragm**
- **Blood dissecting along crus**
- **Outside sign**: abdominal viscera on wrong side of diaphragm on axial image
Diaphragmatic Rupture

Coronal Reconstruction

Diaphragmatic Rupture

What’s the blood coming from?

Sentinel Clot Sign

Signs of Hemorrhage

Sentinel Clot Sign

Blood closer to the site of injury has higher attenuation than blood further away.

s/p MVC

Sentinel Clot Sign
**Fall from Horse**

AAE into Paracolic Gutter

Spurting Vessel

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**Splenic Trauma**

Active Arterial Extrav

Must have IV contrast!

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**Splenic Trauma**

Proper bolus and scan delay are critical!

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**Splenic Injury**

AAE + Pseudoaneurysm

delay

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**Intrasplenic Pseudoaneurysm**

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**CT of Active Arterial Extravasation (AAE)**

Teaching Points

- AAE = High attenuation focus (100-150 HU) isodense with adjacent major arteries; surrounded by lower attenuation hematoma with adjacent mass effect
- AAE may be displaced by clot
- AAE often requires intervention
  - surgery vs embolization
**Hepatic Trauma, no AAE**
Successful non-operative management

**Hepatic AAE**
Intervention required...

**Minimally Invasive Therapy**
Transcatheter Embolization

**Lumbar Artery Lac, AAE**
Minimally Invasive Therapy

**Renal Trauma**
AAE and Traumatic Infarct

**Renal Trauma: AAE**
Renal Trauma: AAE?

Delayed images can confirm AAE

Mesenteric AAE

Pelvic Arterial Extravasation

Renal Pedicle Injury

Traumatic Renal Infarct

Renal Pedicle Injury

Traumatic Renal Infarct
Signs of Bowel Injury

Duodenal Perforation
Water Density Fluid

Jejunal Perforation
Interloop Fluid, No Free Air

Jejunal Perforation
Hyperdense bowel and FF

Small Bowel Injury
Interloop fluid, free air, dense bowel

Mesenteric Laceration
High Attenuation Interloop Fluid
**Small Bowel Laceration**
Abdominal wall contusion: Seatbelt injury

**Colonic Perforation**
Seatbelt Injury

**CT Findings in GI Tract Trauma: Stanford Experience** (n = 62)

<table>
<thead>
<tr>
<th>CT Finding</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Free Fluid</td>
<td>85</td>
</tr>
<tr>
<td>Interloop Fluid</td>
<td>72</td>
</tr>
<tr>
<td>Mesenteric Blood</td>
<td>39</td>
</tr>
<tr>
<td>Pneumoperitoneum</td>
<td>22</td>
</tr>
<tr>
<td>No CT findings</td>
<td>3</td>
</tr>
</tbody>
</table>

**CT Findings in Bowel Injury**

<table>
<thead>
<tr>
<th>Location</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stomach</td>
<td>• free air and fluid</td>
</tr>
<tr>
<td>Duodenum</td>
<td>• free air/fluid, often retroperitoneal</td>
</tr>
<tr>
<td>Small bowel</td>
<td>• free fluid, interloop</td>
</tr>
<tr>
<td></td>
<td>• little or no free air</td>
</tr>
<tr>
<td>Colon</td>
<td>• large free air</td>
</tr>
<tr>
<td></td>
<td>• ± free fluid or stool</td>
</tr>
</tbody>
</table>

**Intramural Hematoma**
High Attenuation in Bowel Wall

**Intra-abdominal water density fluid S/P Trauma**

- DDx
  - Pre-existing ascites
  - Luminal GI contents
  - Bile
  - Urine
  - Lymph
  - Succus pancreaticus
- Location of fluid hint to source
  - Interloop fluid = bowel perforation
**Gallbladder Rupture with Hemorrhage**

**Sentinel Clot Sign**

Known Cirrhosis

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**D5 s/p assault, abd distension**

**Intraperitoneal Bladder Rupture**

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**GSW to pelvis**

**Left ureteral transection**

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**Signs of Hypovolemia**

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**Shock/Hypovolemia**

**Caved-in Cava Sign**

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**Reperfusion Injury to Bowel**

**Hyperdense bowel wall**
**Pancreatic Injuries on CT**

**Teaching Points**

- **Location**
  - Body most common
  - Head/Tail rare
- **CT findings of pancreatic injury are time-dependent**
  - May be missed if scanned early
- **Retro-pancreatic fluid indicates pancreatic injury**

**Blunt Abdominal Trauma**

**Focused Abdominal Sonography for Trauma**

- Fast, portable, non-invasive
- Neither sensitive nor specific
- Inferior to CT for injury localization
- Cannot Dx active extravasation (and a bunch of other things)

**Negative FAST Exam**

**No Retroperitoneal FF**

**Pancreatic Transection**

**Infarcted Kidney**

**Negative FAST Scan**

**Pneumothorax and Splenic Laceration**

**Abdominal US Limitations**

“Technically Limited”
Aka “Can’t see Jack”

**Massive pneumoperitoneum**
**FAST**

**Clinical Impact**

- **FAST**
  - positive
  - negative

  **CT if stable**
  **OR if unstable**

**Pearls**

- FAST is fast, but very limited
- Look at bone and lung windows
- Look for AAE on all trauma cases
- Blood around the aorta on an abdominal CT should prompt a chest CTA to evaluate the aorta
- Keep diaphragmatic rupture in mind, easy to miss on axials

**Pearls**

- Interloop fluid, even without free air, should raise suspicion for small bowel injury
- Pancreatic and bowel trauma are challenging on CT, but there are some helpful signs
- Delayed images can be useful in many circumstances

Thank You!