Abdominal Trauma in Sports

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Disclosures

• No financial disclosures
You make the call!

• Insert Peter’s video of him getting struck outside goalie
Peter s/p reconnection of disrupted UPJ to L kidney at Johns Hopkins
Objectives

• Understand the mechanism of injury of abdominal trauma in sports
• Learn the evaluation and presentation of abdominal injury on the sidelines
• Understand the evaluation and management of sports-related abdominal trauma in the inpatient setting
• Be able to distinguish between intra-abdominal injury vs injury to the abdominal wall musculature
• Learn return to play guidelines for managing abdominal injury in athletes
Abdominal trauma
(not always penetrating)

• https://www.youtube.com/watch?v=QwyFDqs2Obw

Thank God, these are RARE!
Background of Abdominal Trauma in Sports

• **10% of abdominal injuries result from sports-related trauma**
  • Mechanism
  • Blunt impact
  • Penetration
  • Deceleration
  • Resulting pathologic process
  • Hemorrhage, hematoma
  • Organ laceration or crush injury
  • Chemical peritonitis
  • Infection
Organs that can be damaged

- Liver
- Spleen
- Intestines
- Stomach
- Pancreas
- Kidneys
- Abdominal wall
Sports

- **Contact from opponent**
  - Football*
  - Hockey
  - Soccer
  - Rugby
  - Boxing
  - MMA/Jui Jitsu

- **Object**
  - Baseball
  - Lacrosse
  - Bicycling*
  - Skiing
  - Snowboarding
  - Surfing
  - Motorized sports
Difficult Decision facing the Team Doctor

Return to the game?
• Take out, observe on sideline?
• Send to ER?
• When can resume sport after injury/hospitalization recovery?
• If suspect any intra-abdominal
Management of Abdominal Trauma in Athletes

High index of suspicion, delayed management is associated with worse outcomes

- **Serial examinations, observation, vitals**
- **Imaging decision-making:**
  - FAST (focused abdominal sonography for trauma): sensitive for intraperitoneal blood in adults, ?organ
  - DPL (diagnostic peritoneal lavage): sensitive but invasive, ?organ
  - CT scan
  - MRCP
  - Ultrasound
- **Labs:**
  - CMP: liver, kidney function, acidosis
  - CBC (H/H), elevated WBC not always infection
  - Amylase/lipase
  - Urinalysis
Signs and Symptoms

- Focal vs diffuse abdominal pain/tenderness
- **Cullens sign**: periumbilical bruise -> hemoperitoneum
- **Turner’s sign**: flank bruising -> hemoperitoneum
- Pain radiation to left shoulder (Kehr’s sign) from diaphragmatic irritation
- Guarding, rigidity, rebound tenderness
- Palpable hematoma or organ enlargement
- Fractured rib overlying an organ, or focal rib tenderness
- Pain with jumping, coughing
- Light-headed, high HR, low BP, pale sweaty skin, delayed capillary refill, dyspnea, anxiety, AMS/confusion, thready pulse
- Nausea, vomiting
Transient Diaphragmatic Spasm

- “Wind knocked out”
- Blow to the upper abdomen in epigastric region causes transient paralysis of the diaphragm muscle
- Athlete presents with difficulty breathing, dyspnea, that resolves spontaneously
- If doesn’t quickly resolve consider other diagnoses
Liver Injury

• The most commonly injured abdominal organ overall
• 2 possible mechanisms: deceleration vs direct blow
  • Deceleration -> laceration of liver capsule and underlying attached parenchyma as it continues to move
  • Direct blow -> crush injury to the liver... hematoma (subcapsular or intraparenchymal), while contusions are rare
Liver Trauma

May occur in combination with:
- right lower pneumothorax
- right rib fx
- right lung contusion
- right kidney trauma
- spleen injury

• Right lobe of the liver is more commonly injured than left (left is d/t epigastric blow)
Liver Trauma

- RUQ pain/tenderness
- Pain may radiate to shoulder (Kehr’s sign)
- Overlying ribs may be tender
- Nausea, vomiting
- +/- Abdominal guarding, peritoneal signs
- +/- Hemodynamic instability
Liver Trauma

- Management depends on stable vs non-stable
  - Unstable (unstable vitals, peritoneal signs) => surgery
  - Stable => observe
- Imaging:
  - CT is gold standard if pt is stable (high sens/spec for liver)
  - If unstable => emergent exploratory laparotomy
  - If equivocal => can consider DPL or FAST scan
Liver Trauma

50-80% of all liver injuries stop bleeding spontaneously, thus non-op management can be successful up to 94% of liver injuries
- Bowel rest, close observation/serial examinations, IVF
- Transcatheter embolization considered if slow persistent bleeding
- Surgery is to stop uncontrolled bleeding and/or repair/resect liver
  • Hematomas can grow before they regress
  • Contusions may resolve in 5-7 days
  • Lacerations can take weeks
Liver Trauma

Return to play when:
- Anatomic and functional healing
- Liver enzymes, H/H normalized
- Vitals stabilized
- Surgical scar healed
Splenic Injury

- The most commonly injured abdominal organ injured *in sports*
- & cause of death d/t sports-related abdominal trauma
- • Mechanism
  - Impact: direct blow to LUQ (most common mechanism)
  - Non-impact: sudden deceleration
  - Displacement of rib fractures
- • Injury can occur in the:
  - Subcapsular region
  - Capsule
  - Parenchyma
  - Hilar vasculature
Splenic Injury

- Very vascular structure (receives 5-6% of the C.O., filters 10-15% of total blood volume/min)
- B and T cells in parenchyma, produces IgM, involved in hematopoiesis & phagocytosis
- In adults spleen is protected under the ribs... unless enlarged from mononucleosis, infection, pregnancy, portal HTN (increased risk)
- In kids, rib cage does not fully cover the spleen and is more compliant/transmits more energy from trauma. However, pediatric spleen bleeds less b/c of thicker capsule, more elastic parenchyma.
- In other words... kids are more likely to injury the spleen than adults, but also have better chance of healing w/o surgery
Splenic Injury

MUST go to the ER for further eval

- Splenic injury can often be subtle clinically, need to repetitively reassess... b/c of risk for delayed rupture
- Physical exam: not sensitive nor specific (unremarkable exam does not exclude splenic trauma)
  - Generalized abdominal tenderness
  - Tenderness over 10th, 11th, 12th ribs
  - +/- Rebound, Guarding
  - Cullen or Turner signs
  - Vitals: high HR, low BP if hemodynamically unstable
- Eval for decreased H/H, elevated WBC (subcapsular hematoma)
- Ask for recent fevers/URIs or any h/o hematologic d/o
# Grading of Splenic Injury

**American Association for the Surgery of Trauma**

<table>
<thead>
<tr>
<th>Grade</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Hematoma</td>
<td>Subcapsular, nonexpanding, &lt;10% surface area</td>
</tr>
<tr>
<td></td>
<td>Laceration</td>
<td>Capsular tear, nonbleeding, &lt;1 cm parenchymal depth</td>
</tr>
<tr>
<td>II</td>
<td>Hematoma</td>
<td>Subcapsular, nonexpanding, 10%–50% surface area</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Intraparenchymal, nonexpanding, &lt;2 cm in diameter</td>
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<tr>
<td></td>
<td>Laceration</td>
<td>Capsular tear, active bleeding, 1–3 cm parenchymal depth that does not involve a trabecular vessel</td>
</tr>
<tr>
<td>III</td>
<td>Hematoma</td>
<td>Subcapsular, &gt;50% surface area or expanding</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ruptured subcapsular hematoma with active bleeding</td>
</tr>
<tr>
<td></td>
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<td>Hematoma</td>
<td>Ruptured intraparenchymal hematoma with active bleeding</td>
</tr>
<tr>
<td></td>
<td>Laceration</td>
<td>Laceration involving segmental or hilar vessels producing major devascularization (&gt;25% of spleen)</td>
</tr>
<tr>
<td>V</td>
<td>Laceration</td>
<td>Completely shattered spleen</td>
</tr>
<tr>
<td></td>
<td>Vascular</td>
<td>Hilar vascular injury that devascularizes spleen</td>
</tr>
</tbody>
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*Gannon & Howard, Curr Sports Med Rep, 2010*
Splenic Injury Evaluation

Unstable patient -> DPL/FAST or exploratory laparotomy
• Stable patient -> CT scan w/ IV contrast and observe/serial exams
• XR: not very useful, may show displaced stomach bubble or rib fx
• Imaging in stable pt: **CT scan w/ IV contrast** is best but does not predict need for laparotomy nor clinical outcome.... serial observation is necessary
  - Contrast CT looks for "blush sign" (pooling of contrast around or in an organ d/t active bleeding, indicates higher severity of injury)
Splenic Injury

- Non-op tx may work in stable pts with grade I-III injury, not in higher grades (IV-VI)
- Suggested duration of observation is [ASSI grade] + 1 - 5 days captures 95% of pts who will require intervention
- 75-93% of children are successfully managed with non-op tx (regardless of injury grade as long as hemodynamically stable) vs 35-65% of adults
- Increased morbidity in adults is d/t risk for delayed splenic rupture, which occurs in 1-8% of adults vs 0-7.5% in kids
- Often results from delayed hemorrhage or a slowly growing hematoma that develops into a pseudoaneurysm that can rupture
Spleen Injury: Return to Play

Faster return to play in post-splenectomy pts, but future risk for infection (will need to vaccinate against Haemophilus influenza B, Neisseria meningitides, Pneumococcus; higher risk for malaria and babesiosis)

- **Return to play**: 3 weeks to 3 months (the shorter timeframe seen in some post-splenectomy pts)
- According to one study, 84% of splenic injury pts had a fully healed spleen on imaging at 2-2.5 months
- Guidelines do not recommend repeating CT scan, as radiographic healing can lag behind functional healing, and risk of radiation exposure... unless there is a change in status (sudden worsening)
- No sports until symptoms, vitals, and exam have normalized; consider starting light activity starting at 3 months, then gradual return to play
Remember in Mononucleosis

Mononucleosis causes transient splenomegaly
• 0.1-0.2% incidence of splenic rupture in mono pts, often atraumatic/spontaneous but need to avoid sports during this time when the spleen is vulnerable to rupture
• Recommendation is to wait at least 3-4 weeks symptom onset in before returning to sport (assuming they are asymptomatic, afebrile, no e/o splenomegaly)
Injury to Bowel or Stomach

Mechanism: Direct impact to abdomen
- May see signs of chemical or bacterial peritonitis
- Diffuse abdominal pain/tenderness
- Rebound, guarding, rigid abdomen,
Injury to Bowels or Stomach

XR abdomen (KUB) to r/o free air under diaphragm (sign of perforation)...
can have false negatives
• Triage based on hemodynamic status
• CT findings may be subtle
• Most require exploratory laparotomy and surgical repair
Bowel Issues in Athletes

- Transient Ischemia of Bowels
  - Decreased Blood flow through the Superior Mesenteric Artery
  - Hematochezia, intense pain

- Cecal Slap Syndrome
  - Seen in distance runner, cecum “slaps” around peritoneum
  - Causes hematochezia, diarrhea, painful

- Runner’s Trots
  - Osmotic/secretory diarrhea associated with running
  - Cause: diarrhea, URGE, little to no abdominal

- Side Stitch
  - Diaphragmatic or intercostal muscle spasm
Pancreatic Injury

Very rare... pancreas is protected in retroperitoneal space and relatively immobile
- Pancreas injury is present in 3-12% of adult blunt abdominal trauma, and 2-10% of pediatric abd trauma
- MOI: pancreas gets compressed b/t spine and external force
  - Majority are d/t MVA or bicycle injury/handlebar
- Can get laceration of the pancreas, most commonly at head-neck junction
- Abdominal pain/tenderness e in 1st 2hrs, then e again over 6-8 hrs
  - Pain/TTP can be diffuse or focal (epigastric), rebound is rare (9%), +abdominal wall ecchymosis in 1/3 cases
Pancreatic Injury

• Though pancreatic injury is rare, it can be deadly
• Can lead to chronic pancreatitis
• Injury to pancreatic duct indicates more severe injury grade
• If unstable, check DPL and consider laparotomy
• If stable, check CT scan and MRCP
  - CT is superior to U/S for evaluating pancreatic injury, but...
  - CT can miss the pancreatic duct (but often necessary to rule out other more common abdominal injuries)
  - ERCP is better for evaluating the pancreatic duct but is an invasive study... so MRCP is study of choice to evaluate the pancreatic duct
• Follow lipase and amylase
Renal Trauma and Hematuria

• Stay awake a little longer cause that will be in the next lecture!!
Abdominal Wall Anatomy

Abdominal wall consists of:

- **Rectus abdominus** w/ tendinous insertions (flex vertebral column & compress abdominal/pelvic cavities, downward pulling of ribs to help w/breathing)
- **External oblique muscles** (twisting/rotation & flexing of vertebral column, support abdomen/pelvis)
- **Internal oblique muscles** (twisting/rotation & flexing of vertebral column, support abdomen/pelvis)
- **Transverse abdominus muscle** (pelvic stabilizer for running & throwing)
Abdominal Wall Trauma

Result from:
- Direct trauma from opponent or object
- Sudden violent muscle contraction d/t abrupt torso movement (throwing or racquet sports)
- Repetitive activity from rotational sports (golf, racquet, throwing)

• Types of injury:
  - Rectus sheath: hematoma
  - EO, IO, and transverse abdominis muscles: strain or contusion

• Symptoms may resemble an acute abdomen, can be quite painful
  but are less serious
Rectus Sheath Hematoma

Caused by direct blow to abdominal wall, get bleeding into rectus muscle either d/t intramuscular vessel or epigastric artery, causing pooling into the rectus sheath

- Eventually get “self-tamponade” by the sheath
- Pain can be sudden or gradual in onset over several hours, rapid swelling
- May be able to palpate or see the hematoma... inferior to the umbilicus
- Passive flexion may alleviate the pain, pain is typically positional
- Check U/S or CT scan (helps r/o intra-abd injuries better)
Rectus Sheath Hematoma

According to one study, 60% are on right side, and greater than 80% occur in the lower quadrants (inferior to umbilicus)

- Majority will resolve with time, rest, close observation
- Eval for hemodynamic compromise
- **Type I**: unilateral focal, managed as outpatient, resolves in 1 month
- **Type II**: blood in muscle and fascia, hospitalized for 2-3 days, resolves 2-4 months, usually doesn’t need transfusion
- **Type III**: blood in fascia, peritoneum, & prevesical space; typically need transfusion, 4-5 days for hemodynamic stabilization, hospitalized 1 week, resolves 3+ months, rarely may need surgical evacuation or surgical ligation of epigastric artery
Other type of Abdominal Wall Trauma

EO, IO, and transverse abdominus muscle strains/contusions will have no obvious hematoma
- Rectus abdominis can be injured without a hematoma
- Abdominal wall pain will be *position*al
- Pain is typically *focal*, +TTP
- Sx’s vary & may or may not include: N/V, +/- rebound/guarding/rigidity
- **+Carnett’s sign:** when abd pain is same or increased while abd muscles are being tensed -> indicates abd wall injury accurately *if* there is also no N/V/rebound/guarding/rigidity
- Treatment: rest, ice, analgesics... rehab, gradual return to play when can resume sports activities effectively & w/o pain
Summary of Abdominal Trauma

- Exam doesn’t always correlate with severity of abdominal injury
- Presentation of abdominal injury often evolves, need to monitor/observe serial examination and re-check vitals
- Have high index of suspicion: if there is any concern for abdominal injury send to ER for workup, can decompensate suddenly
- Workup includes: CT abdomen if stable, ex lap or FAST scan if unstable, labwork.
- Return to play depends on symptom resolution, vitals and labs normalized, asymptomatic, scar healed, gradual transition to play
Thank You!!!