Disclosure

• I have no financial disclosures

• I have spent the last 10 years of my life in training (general surgery, pediatric surgical critical care, and pediatric surgery) taking care of trauma and the last 4 years exclusively caring for children.
Objectives

• Review injury patterns and incidence of solid organ injuries in pediatric patients
• Understand age appropriate vital signs as one of the key factors in decision making for pediatric solid organ injuries
• Recognize and treat complications following solid organ injury
• Identify specific follow-up issues after solid organ injury in pediatric patients
Pediatric abdominal trauma

- Prehospital details
- Mechanism (MVA, fall, assault, ped v. car)
- External signs of injury (seatbelt sign, abrasions, contusions)
Blunt Trauma Patterns

• Waddell’s triad (Ped vs. Car)
  • Lower extremity fx, thoracic/upper abdominal trauma/head trauma

• Bike accident
  • Head/ortho
  • Handlebar injuries—shearing of abdominal wall away from skin (handlebar hernia), pancreas and duodenal injuries

• MVA with lap belt worn too high → seat belt injury
  • Duodenal hematoma, small bowel injury
  • Pancreas or liver injury
  • Chance fx of lumbar vertebrae
Liver and Splenic Injury

- Spleen—Most commonly injured organ with blunt abdominal trauma
- Symptoms abdominal pain, elevated LFTs
- Vast majority managed non-operatively
- ICU admission
  - Hemodynamic lability after resuscitation
  - Concomitant injuries (ie brain)
- If they’re going to fail, kids fail non-op management early, within 24 hours by hemodynamic lability
Liver Injury Grading

<table>
<thead>
<tr>
<th>Grade</th>
<th>Laceration</th>
<th>Hematoma</th>
<th>Vascular</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Capsular tear &lt; 1cm deep</td>
<td>Subcapsular hematoma &lt; 10% surface area</td>
<td>None</td>
</tr>
<tr>
<td>II</td>
<td>1.3 cm deep, &lt;10 cm long</td>
<td>Subcapsular hematoma: 10%-50% surface area, Intraparenchymal hematoma &lt; 10 cm</td>
<td>None</td>
</tr>
<tr>
<td>III</td>
<td>Parenchymal laceration more than 3 cm deep</td>
<td>Subcapsular hematoma &gt; 50% surface area, expanding or ruptured (regardless of size), Parenchymal hematoma &gt; 10 cm or expanding</td>
<td>None</td>
</tr>
</tbody>
</table>

**Hepatic CT Injury Grading Scale**

- **Grade I**
  - Laceration(s) < 1 cm deep
  - Subcapsular hematoma < 1 cm diameter

- **Grade II**
  - Laceration(s) 1-3 cm deep
  - Subcapsular or central hematoma 1-3 cm diam

- **Grade III**
  - Laceration(s) 3-10 cm deep
  - Subcapsular or central hematoma 3-10 cm diam

- **Grade IV**
  - Laceration(s) > 10 cm deep
  - Subcapsular or central hematoma > 10 cm diam
  - Lobar maceration or devascularization

- **Grade V**
  - Bilobar tissue maceration or devascularization
Splenic Injury Grading

Grade I: Laceration <1 cm
- Subcapsular hematoma <10% of surface area

Grade II: Laceration 1–3 cm
- Subcapsular hematoma 10%–50% of surface area

Grade III: Laceration >3 cm
- Ruptured subcapsular or parenchymal hematoma
- Subcapsular hematoma >50% of surface area

Grade IV: Segmental or hilar vascular injury
- Devascularization >25% of spleen

Grade V: Shattered spleen
- Hilar injury
- Devascularization >25% of spleen
Updated APSA Blunt Liver/Spleen Injury Guidelines 2019

**Admission**
- **ICU Admission Indicators**
  - Abnormal vital signs after initial volume resuscitation
- **ICU**
  - Activity - Bedrest until vitals normal
  - Labs – q6hour CBC until vitals normal
  - Diet – NPO until vital signs normal and hemoglobin stable
- **Ward**
  - Activity - No restrictions
  - Labs - CBC on admission and/or 6 hours after injury
  - Diet – Regular diet

**Procedures**
- **Transfusion**
  - Unstable vitals after 20 cc/kg bolus of isotonic IVF
  - Hemoglobin < 7
  - Signs of ongoing or recent bleeding
- **Angioembolization**
  - Signs of ongoing bleeding despite pRBC transfusion
  - Not indicated for contrast blush on admission CT without unstable vitals
- **Operative exploration with Control of Bleeding**
  - Unstable vitals despite pRBC transfusion
  - Consider massive transfusion protocol

**Set Free**
- Based on clinical condition **NOT** injury severity (grade)
- Tolerating a diet
- Minimal abdominal pain
- Normal vital signs

**Aftercare**
- **Activity Restriction**
  - Restricting activity to grade plus 2 weeks is safe
  - Shorter restrictions may be safe but there is inadequate data to support decreasing these recommendations
- **Follow up Imaging**
  - Risk of delayed complications following spleen and liver injuries is low
  - Consider imaging for **symptomatic** patients with prior high grade injuries
Blunt Abdominal Trauma- Complications

• Complications from non-operative management
  • Splenic or hepatic cysts

• Complications following blunt liver injury
  • Hemobilia
    • IR embolization
  • Bile leak
    • IR drainage and ERCP
Pancreatic injury

• 1-4% of children with intra-abdominal injuries
• Mechanism-fixed in retroperitoneum so vulnerable to injuries by crush or rapid change in energy
• Also direct trauma from bike handle etc
• Most commonly injured at the midbody
• 90% of pancreatic injuries are associated with OTHER INJURIES

• ***Level of amylase and lipase elevation does NOT correlate with severity of injury****
Blunt Abdominal Trauma - Pancreatic Injury
Complications from Blunt Pancreatic Injury

- Persistent peripancreatic fluid collection
- Traumatic Pancreatitis
- Pancreatic fistula
- Intraabdominal abscess
- Delayed bleed
- Delayed ductal strictures
- **Up to 60% of pancreas injuries will have a complication**
Blunt Pancreatic Injury Pathway

Figure 5. Proposed clinical pathway for NOM of blunt pancreatic injury in pediatric patients.
Blunt Abdominal Trauma-Kidney injury

• **Initial management:**
  - All renal blunt traumas to be managed by observation initially unless **UPJ disruption or hemodynamic instability secondary to renal injury**
  - Do not need to place a catheter because of renal trauma unless hemodynamically unstable
  - Renal Injuries of Grade \( \geq 2 \) or with perinephric fluid collection (hematoma vs urinoma) should all get delayed initial images
  - Time of delayed images to be decided by radiology (delayed images need to be adequate enough to visualize renal pelvis and ureters down to bladder), do not need fine cuts
Blunt Abdominal Trauma-Kidney Injury Grading
Blunt Renal Trauma Guidelines 2019

• Non-operative management
  • Greater renal salvage
  • Less transfusion

• Ongoing or delayed bleeding in a HD stable patient, recommend angioembolization

• BP checks should be performed as outpatient
  • 4.7% chance of developing renovascular hypertension
Blunt Abdominal Trauma-Kidney injury

• **Inpatient management:**
  • Discharge criteria:
    • pain controlled
    • hemodynamically stable
    • return of bowel function
    • good oral intake and afebrile

• **Outpatient f/u:**
  • Need BP checks for reno-vascular hypertension
Pediatric Blunt Solid Organ Injury Take-Aways

• Management based on hemodynamics
  • Pay attention to examination and vital signs

• Non-operative management unless clinical decline or other indications for intervention

• Follow-up
  • Spleen/Liver-reimage if symptomatic
  • Pancreas-management based on tolerance of PO
  • Renal-follow-up BP checks as up to 5% will develop reno-vascular hypertension
References

• AAST injury grading scales http://www.aast.org/Library/TraumaTools/InjuryScoringScales.aspx
• APSA NaT “Not a Textbook”
  • https://www.pedsurglibrary.com/apsa