Tummy Trauma: Evaluation and Management of the Injured Child
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Pediatric Nurse Practitioner
Trauma Program/Division of Pediatric Surgery
Objectives

1. Discuss common mechanisms of injury in pediatric blunt abdominal trauma and likely subsequent injuries
2. Review common traumatic injuries and their management of both solid and hollow viscera
3. List 5 signs or symptoms that should warrant high index of suspicion for abdominal injury in a child
4. Describe return to sports guidelines for solid organ injury
Joy

- 4 year old
- Flipped over handlebars
- Abrasions to face
- Bruising on abdomen
Brittany

- 7 year old
- Auto vs. peds
- Deformity left femur
- Crying
Helen

- 15 year old
- Kicked in abdomen
- Continued playing
- Now nauseous and dizzy
- Bruise on abdomen
Isaac

- 4 year old
- Motor vehicle crash
- Altered mental status
Epidemiology - Abdominal Trauma

• 90% blunt
• 10% penetrating
  – Impalement
  – Gunshot
  – Stabbing
Pediatric Differences
Assessing the Pediatric Trauma Patient
In the Trauma Bay

History

Mechanism of injury
GCS/AVPU on scene
Any death on scene (MVA)
Illicit substances/ETOH involved
Interventions in field

ABCs
Mechanism of Injury

External Forces
Internal Forces
Blunt vs. Penetrating Forces
Waddell’s Triad

- Bumper vs femur and torso on same side
- Child is thrown, lands on opposite side of head
Restraint Devices & Injuries
In the Trauma Bay

History

Mechanism of injury
GCS/AVPU on scene
Any death on scene (MVA)
Illicit substances/ETOH involved
Interventions in field

ABCs
In the Trauma Bay
Pediatric Abdominal Exam

- Inspection
- Auscultation
- Percussion
- Palpation
Benign Abdominal Exam

- No outward signs
- Soft, NTND
Concerning Abdominal Exam

- Tenderness
- Ecchymosis
- Distension
- Rebound
- Guarding
- Kehr’s sign
- Blood urethral meatus or rectum
- Pelvic instability
Hemodynamics
Intra-Abdominal Injuries

Hollow Organs (<10%)
- Intraperitoneal Bladder
- Colon
- Small Intestine
- Stomach

Solid Organs (>90%)
- Pancreas?
- Spleen
- Liver
- Kidneys
Imaging the Belly

Ultrasound
- Able to identify fluid
- Unable to localize or identify solid organ injury
- Portable and Fast

CT Scan
- Excellent identification of solid organ injury
- Questionable sensitivity for hollow viscus injury
- Takes time

Plain Film
- Free Air
- Pelvic Fracture
- Portable and Fast

Also remember:
Serial abdominal exams...NPO...observation...
CAT scan
Not as friendly as the dog scan

With permission
To Scan or Not to Scan??

Streck et al 2012 - High-risk Clinical Variables

- Hypotension
- Abnormal abdominal exam
- AST > 200 U/L
- Microhematuria
- HCT < 30%
- Amylase > 100 U/L

CLINICAL PREDICTION MODEL

- Normal systolic
- Normal abdominal exam
- AST < 200 U/L
- HCT > 30%
- Normal CXR
Trauma Bay Study

- Multi-center study
- Data points collected from Trauma Bay
- Data points collected 1-2 months after injury
Re-imaging?

A Multicenter Study of the Risk of Intra-Abdominal Injury in Children After Normal Abdominal Computed Tomography Scan Results in the Emergency Department

Benjamin T. Kerrey, MD, MS; Alexander J. Rogers, MD; Lois K. Lee, MD, MPH; Kathleen Adelgais, MD; Michael Tunik, MD; Stephen M. Blumberg, MD; Kimberly S. Quayle, MD; Peter E. Sokolove, MD; David H. Wisner, MD; Michelle L. Miskin, MS; Nathan Kuppermann, MD, MPH; James F. Holmes, MD, MPH; for the Pediatric Emergency Care Applied Research Network*

• 3819 patients with normal CT scan results
• 16 (0.4%) subsequently diagnosed with intra-abdominal injury

• Physical exams, labs
Hollow Viscus Injury

**Diagnosis**
- Free air
- Unexplained free fluid on CT

**Peritonitis**

**Serial Exams**
- Fever
- Oliguria
- Tachycardia in absence of bleeding

**Management**
- Operate
# Grading of Splenic Injury

<table>
<thead>
<tr>
<th>Grade</th>
<th>Extent of Splenic Injury</th>
</tr>
</thead>
</table>
| 1     | Hematoma: subcapsular, non expanding, < 10% of surface area  
       | Laceration: capsular tear, non bleeding, < 1 cm of parenchymal depth |
| 2     | Hematoma: subcapsular, non expanding, 10-50% of surface area; intraparenchymal, non expanding, < 2 cm in diameter  
       | Laceration: capsular tear, active bleeding, 1-3 cm of parenchymal depth that does not involve a trabecular vessel |
| 3     | Hematoma: subcapsular, > 50% of surface area or expanding, ruptured subcapsular hematoma with active bleeding, intraparenchymal hematoma, > 2 cm or expanding  
       | Laceration: > 3 cm of parenchymal depth or involving trabecular vessels |
| 4     | Hematoma: ruptured intraparenchymal hematoma with active bleeding  
       | Laceration: laceration involving segmental or hilar vessel producing major devascularization (> 25% of spleen) |
| 5     | Hematoma: completely shattered spleen  
       | Laceration: hilar vascular injury that devascularizes spleen |

American Association for the Surgery of Trauma (AAST) 1994
# Grading of Liver Injuries

The American Association for the Surgery of Trauma (AAST) in 1994 established a grading system for liver injuries. The grading system is based on the extent of the liver injury, which includes both hematomas and lacerations.

## Grade 1
- **Hematoma:** subcapsular, non-expanding, < 10% of surface area
- **Laceration:** capsular tear, non-bleeding, with < 1 cm deep parenchymal disruption

## Grade 2
- **Hematoma:** subcapsular, non-expanding, hematoma 10-50%, intraparenchymal non-expanding, < 2 cm in diameter
- **Laceration:** < 3 cm of parenchymal depth, < 10 cm in length

## Grade 3
- **Hematoma:** subcapsular, > 50% of surface area or expanding, ruptured subcapsular hematoma with active bleeding, intraparenchymal hematoma > 2 cm
- **Laceration:** > 3 cm of parenchymal depth

## Grade 4
- **Hematoma:** ruptured central intraparenchymal hematoma
- **Laceration:** parenchymal disruption involving 25-75% of the hepatic lobe

## Grade 5
- **Hematoma:** parenchymal disruption > 75% of hepatic lobe
- **Vascular:** juxta-hepatic venous injury (retrohepatic cava/major hepatic veins)

## Grade 6
- **Vascular:** hepatic avulsion

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American Association for the Surgery of Trauma (AAST) 1994
Solid Organ Injury Management

Operative Management
- Refractory hemorrhagic shock
- Concomitant TBI

Non-Operative Management
- ICU, serial exams (bowel injury), serial Hct
- APSA Guidelines Grade plus 1 day
## APSA Guidelines - Isolated Spleen or Liver

<table>
<thead>
<tr>
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<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
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<tbody>
<tr>
<td>ICU stay (days)</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>1</td>
</tr>
<tr>
<td>Hospital stay (days)</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Pre-discharge imaging</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Post-discharge imaging</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Activity restriction (weeks)</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
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Protocol

- Grade I/II - One night bedrest
- Grade III-V - Two nights bedrest
- Ambulate after bedrest
- Hgb/Hct after 4 hours
- Discharge
Follow up of prospective validation of an abbreviated bedrest protocol in the management of blunt spleen and liver injury in children

Shawn D. St. Peter, Pablo Aguayo, David Juang, Susan W. Sharp, Charles L. Snyder, George W. Holcomb III, Daniel J. Ostlie*

- 249 patients
- 199 bedrest: mean grade of injury 2.7
- 28 required transfusion due to solid organ injury
- Mean bedrest 1.6 days vs 3.6 if had followed current guidelines

J Pediatric Surg, 2013
# APSA Guidelines - Activity Restriction

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