Abdominal Injuries in Sports that Send Your Athlete to the Emergency Room

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Objectives
• Define spectrum of sports related abdominal visceral injuries
• Recognize signs and symptoms of these injuries
• Describe initial management of these injuries
• Discuss post-injury restrictions and timing of return to sports

Epidemiology

20 – 30 million school aged children injured in organized sports every year in USA

Injury Rate = # injuries / 100 Athlete Exposures (AEs):
• Soccer: 2.1
• Baseball: 1.7
• Football: 1.5 *
• Injury rate higher in game vs. practice

Serious injury incidence up to 15%
High School Sports Injuries

National High School Sports-Related Injury Surveillance Study
• 2005 to 2010
• 100 schools throughout US

9 Sports Analyzed
• Football
• Basketball (boys/girls)
• Baseball
• Softball
• Soccer (boys/girls)
• Volleyball
• Wrestling

J Trauma 2011

Injuries requiring surgery
• 6.3% of all injuries
• Surgery Rate (SR): 1.45 / 10,000 AEs

Surgery Rate per High School Sport

<table>
<thead>
<tr>
<th></th>
<th>Boys</th>
<th>Girls</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Football</td>
<td>2.52</td>
<td>Soccer</td>
<td>1.48</td>
</tr>
<tr>
<td>Wrestling</td>
<td>1.64</td>
<td>Basketball</td>
<td>1.42</td>
</tr>
<tr>
<td>Soccer</td>
<td>1</td>
<td>Softball</td>
<td>.57</td>
</tr>
<tr>
<td>Basketball</td>
<td>.96</td>
<td>Volleyball</td>
<td>.4</td>
</tr>
<tr>
<td>Baseball</td>
<td>.86</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

J Trauma 2011

Cook Children’s Experience

Approximately 1,500 – 2,000 ED visits/yr for sports injuries
• 5 – 10% of all ED trauma visits

Jan 2008 – Dec 2015
• 1,110 potentially serious sports injuries
• 967 admissions (10% of trauma admissions)
• 82% male
• 57.8% transported by EMS (3% rotary/fixed-wing)
• 11% trauma team activation
• 67% required surgery
• 2% required PICU care
Cook Children’s Experience

Multiple Solid Organ Injury = 8 (16%)

\[ n = 50, 4.5% \]

Spectrum of Sports Injuries

1. Basketball: 11.2%
2. Soccer: 7.5%
3. Lacrosse: 5.4%
4. Baseball: 4.5%
5. Swimming: 3.5%
6. Field Hockey: 2.5%
7. Wrestling: 2.0%
8. Cheerleading: 2.0%
9. Track: 1.5%
10. Volleyball: 1.5%
11. Football: 1.0%
12. Wrestling: 0.5%
13. Rugby: 0.2%
14. Other: 0.2%

Cook Children’s Experience
Cook Children’s Experience

Spectrum of injuries requiring surgery

- Laceration
- Fracture/Dislocation
- Eye
- Hollow Viscus
- Hemo/Pneumothorax
- ICH
- Sprain/Strain
- Solid Organ

No Surgery
Surgery

Sports and Abdomen Injuries

CCMC Jan 2008 – Dec 2015
- 50 pts
- Male 96%

Sports and Abdomen Injuries

CCMC Jan 2008 – Dec 2015

Sports and Abdomen Injuries

CCMC Jan 2008 – Dec 2015
Sports and Abdomen Injuries
CCMC Jan 2008 – Dec 2015

96% < 72 hrs

16% Multiple Abdomen Injuries
Sports and Abdomen Injuries

CCMC Jan 2008 – Dec 2015

- 50 pts
- Male 96%
- Solid organ injury 94%
  - 0 required surgery
- Hollow viscus injury 6%
  - 1/3 required surgery
- PICU care 10%
- Hospital LOS 1 – 27 days

Case Discussion #1

13 year old male, Football collision
- Helmet to the lower abdomen
- Immediate abdomen pain
- Able to ambulate

Should he continue to play?

Case Discussion #1

13 year old male, Football collision
- Helmet to the lower abdomen
- Immediate abdomen pain
- Able to ambulate
- Gross hematuria in locker room

Should he have immediate MD evaluation?
Case Discussion #1

13 year old male, Football collision
- Helmet to the lower abdomen
- Immediate abdomen pain
- Able to ambulate
- Gross hematuria in locker room
- Past Medical History:
  - VACTERL Syndrome
  - Imperforate anus, repaired
  - Tethered spinal cord, released
  - Neurogenic bladder, bladder augmentation
  - Hypoplasia, repaired
  - Vesicoureteral reflux, ureteral reimplant

Does PMH influence need for immediate MD evaluation?

Case Discussion #1

13 year old male, Football collision
- Abdomen pain worsens at home
- Persistent gross hematuria
- Presents to ED 14 hours after injury
- Temp: 37.9 °C, RR 20, HR 115, BP 110/63
- Abdomen diffusely tender with guarding
- CBC & BMP normal
- Urinalysis: RBC 5-20, WBC 20-50

What is his injury?
Case Discussion #1

13 year old male, Football collision
- Helmet to the lower abdomen
- Immediate abdomen pain
- Able to ambulate
- Gross hematuria in locker room

❖ What is his injury?
- Bladder rupture

❖ Management?
- Surgical repair
- Hospital stay 12 days

❖ When can he return to football?

Risk Factors for Injury

Anatomic / Developmental
- Organs large relative to body mass
- Bones flexible, transmit energy to adjacent organs before breaking
- Liver, spleen, kidneys lie below rib margin
- Bladder may occupy lower abdomen to umbilicus
- Muscle mass insufficient to protect organs
- Less intra-abdominal fat, less cushion for organs
- Poor coordination, muscle control, athletic skill

Medical
- Infiltrative diseases causing organomegaly
- Esterin Barr virus
- Hemolytic anemias
- Lymphoma
- Portal hypertension
- Previous abdomen surgery
Case Discussion #2

15 year old female, Soccer collision and pile-on

- Struck her head and chin on ground
- No loss of consciousness
- Completes the game without complaints

- ED evaluation that night for right shoulder and chest pain
  - Temp: 36.7 °C, RR 18, HR 95, BP 132/77
  - Mild tenderness right chest wall and posterior shoulder
  - Abdomen not tender
  - Hgb 10.3, Glucose 211, WBC 22.4
  - Chest, neck and shoulder Xray normal
  - Head CT shows frontal sinusitis

Does she have a serious injury?

Dismissed home on antibiotics and Motrin for sinusitis

Case Discussion #2

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Case Discussion #2

15 year old female, Soccer collision and pile-on

- Returns to ED 12 hours later:
  - Right upper quadrant pain
  - Right shoulder pain
  - Multiple episodes of emesis
  - Pallor
  - Temp: 36.3 °C, RR 26, HR 143, BP 82/34
  - Right chest and upper abdomen tenderness
  - Pallor
  - Cool extremities
  - Capillary refill sluggish

Does she have a serious injury?

YES! SHOCK!
Case Discussion #2

15 year old female, Soccer collision and pile-on
- Returns to ED 12 hours later:
  - Right upper quadrant pain
  - Right shoulder pain
  - Multiple episodes of emesis
  - Palor
- Temp: 36.3 °C, RR 26, HR 143, BP 82/34
  - Hgb 8.4, WBC 27.1
  - Glucose 270
  - AST 311, ALT 443
  - Creatinine 1.1

What is her injury?

- Grade IV Liver Laceration

Management?
- 5 units RBC, 2 units Platelets, 2 units Plasma
- ICU care 4 days, Hospital stay 9 days

When can she return to soccer?
Identifying Abdomen Injury

Previous cases highlight serious sequelae of abdominal organ injury:

- Bleeding (SHOCK)
- Acute abdomen (PERITONITIS)

What is Shock

Inadequate tissue perfusion to support aerobic metabolism

![Cellular metabolism diagram](image)

Physiology of Hemorrhage

Young subjects maintain normal systolic blood pressure up to 30 – 40% blood loss.

After 40% blood loss blood pressure rapidly declines until death.

- Recognize and correct blood loss early!
Signs of Shock

Altered mental status
Tachycardia (age specific)
Decreased capillary refill
Cool extremities
Peripheral mottling
Orthostasis

Normal Vital Signs in Children

<table>
<thead>
<tr>
<th>Age (yr)</th>
<th>Respiratory Rate (breaths/min)</th>
<th>Heart Rate (beats/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 1</td>
<td>30 – 60</td>
<td>100 – 160</td>
</tr>
<tr>
<td>1 – 2</td>
<td>24 – 40</td>
<td>90 – 150</td>
</tr>
<tr>
<td>2 – 5</td>
<td>22 – 34</td>
<td>80 – 140</td>
</tr>
<tr>
<td>6 – 12</td>
<td>18 – 30</td>
<td>70 – 120</td>
</tr>
<tr>
<td>&gt; 12</td>
<td>12 – 16</td>
<td>60 – 100</td>
</tr>
</tbody>
</table>

Lower Limits of Systolic Blood Pressure

1 – 10 years: 80 mmHg + (2 x age in years)

Shock Severity Classification

<table>
<thead>
<tr>
<th>Class I</th>
<th>Class II</th>
<th>Class III</th>
<th>Class IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood loss (%)</td>
<td>&lt; 15</td>
<td>15-30</td>
<td>30-40</td>
</tr>
<tr>
<td>Blood loss (ml)*</td>
<td>&lt; 360</td>
<td>360-720</td>
<td>720-960</td>
</tr>
<tr>
<td>Neurologic</td>
<td>Slight anxiety</td>
<td>Mild anxiety</td>
<td>Anxious, confused Confused, Obtunded</td>
</tr>
<tr>
<td>Heart rate</td>
<td>Normal</td>
<td>Tachycardia</td>
<td>Tachycardia  Bradycardia</td>
</tr>
<tr>
<td>Blood Pressure</td>
<td>Normal</td>
<td>Normal</td>
<td>Normal, Orthostatic Hypotensive</td>
</tr>
<tr>
<td>Respiratory rate</td>
<td>Normal</td>
<td>Mildly  increase</td>
<td>Moderately increased</td>
</tr>
</tbody>
</table>

* for 30 kg child (80 ml/kg blood volume)
Case Discussion #3

12 year old male, Football collision

- Knee to abdomen
- No pads during practice
- Immediate abdomen pain
- Completes practice with persistent pain

- ED evaluation 5 hours later for abdomen pain and emesis
  - Temp: 98.1 °F, RR 16, HR 142, BP 93/55
  - Tenderness LUQ abdomen
  - PAllor
  - Hgb 11.9, WBC 17.4

Does he have a serious injury?

- YES! SHOCK!

What is his injury?

- Liver
- Blood
- Spleen
- Grade 4 Injury
- Bladder
Case Discussion #3

12 year old male, Football collision
• Knee to abdomen
• No pads during practice
• Abdomen pain and emesis
• Shock

📍 What is his injury?
• Grade IV Spleen Laceration

📍 Management?
• Observation only
• ICU care 1 day, Hospital stay 6 days

📍 When can he return to football?

What is Acute Abdomen

Peritoneal irritation in response to intra-abdominal process
• Infection
• Inflammation
• Injury

Injury leads to acute abdomen usually by hollow viscus perforation

Common peritoneal irritants
• Intestinal juice
• Bile
• Pancreatic juice
• Urine

📍 Blood alone does not cause acute abdomen

Recognizing Acute Abdomen

Pain can be focal, diffuse, and referred
• Abdomen
• Back
• Flank
• Shoulder

Pain worse with movement
Patient often lays very still to minimize pain
Recognizing Acute Abdomen

*Peritonitis* is the hallmark of acute abdomen

- Tenderness
- Guarding
- Rebound tenderness
- Muscle spasm \(\rightarrow\) rigid abdomen

Early parasympathetic nervous system response

- Nausea / Vomiting
- Diaphoresis
- Pallor
- Orthostasis

Delayed sympathetic nervous system response

- Tachycardia
- Tachypnea
- Hypertension
- Anxiety

Initial Management

*High index of suspicion*

- Remove player from sport activity
- Immobilize
- Initiate fluid resuscitation if possible
- Avoid NSAID pain medication

\(\checkmark\) Refer to ED evaluation RAPIDLY!
Trauma Management

Advanced Trauma Life Support protocol
• Rapid assessment Airway, Breathing, Circulation, Disability, Exposure
• Fluid resuscitation
• Blood product transfusion
• Imaging to determine severity of injury
• Rapid operative intervention to control hemorrhage

Imaging of the injury
• Focused abdominal sonogram in trauma (FAST)
• CT scan with IV contrast

Definitive operative management
• Hemorrhage stops with proper resuscitation in 95% solid organ injury
• Hollow viscus perforation = surgery

Sequelae of Splenectomy

Spleen assists immune system for encapsulated bacteria clearance
• Meningococcus
• Streptococcus pneumoniae
• Haemophilus influenza

Risk of Post-splenectomy Sepsis
• Need 50% spleen substance with intact native blood supply for immune function
• 0.7% risk of sepsis (splenectomy for trauma highest risk)
• 50% fatal

Management after splenectomy
• Vaccinations
• Penicillin daily prophylaxis until 18 years of age, possibly life long

Case Discussion #4

13 year old male, Football collision
• Hit in right flank with helmet
• Immediate pain
• Becomes pale and diaphoretic
• Has to leave the field last quarter to lay down

Should he have immediate MD evaluation?
Case Discussion #4

13 year old male, Football collision
- Hit in right flank with helmet
- Immediate pain
- Becomes pale and diaphoretic
- Has to leave the field last quarter to lay down
- ED evaluation 1.5 hours later for abdomen pain, emesis, unsteady gait
  - Temp: 36°C, RR 18, HR 94, BP 139/89
  - Firm and tender right abdomen
  - Pain bearing down to void
  - Gross hematuria on catheterization
  - Hgb 14.4, WBC 27.7

❖ Does he have a serious injury?

- Liver
- Blood
- Kidney
- Spleen

Grade 4 Injury

❖ What is his injury?
- Grade IV Kidney Laceration

❖ Management?
- 1 unit RBCs
- Hospital stay 21 days for pancreatitis and ileus

❖ When can he return to football?
Return to Sports

Post-injury period of light activity:
- Solid organ injury = grade of injury + 2 weeks
- Solid organ injury with surgery = 6 weeks
- Hollow viscus injury = surgery = 6 weeks

Return to contact sports
- Recommend 3 months for high grade solid organ injury
- May consider 6 week return for low grade solid organ injury
- Surgery = 3 months

What if athlete has a solitary kidney?
- Multiple studies indicate risk of kidney loss in sports injury is extremely low
- Not an absolute contraindication to return to contact sports

Summary

Serious abdomen injury in sports is rare

High index of suspicion important to recognize signs of visceral injury
- Signs of shock
- Signs of acute abdomen

Vast majority of solid organ injuries can be treated nonoperatively with proper resuscitation

Solitary kidney no longer absolute contraindication to contact sports