Pediatric Chest and Abdomen Trauma

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Pediatric Trauma

• Trauma is leading cause of death and disability in children and adolescents
• Causes and effects vary between age groups
• Blunt trauma predominates
  – <10% of injuries involve chest and abdomen
  – MVC
    • Passenger
    • Pedestrian
    • Driver
Pediatric Trauma

• Child abuse
  – 4 years and under
• Recreational trauma
  – School age
• Adolescence
  – Sport injuries
  – Violent injuries
  – Suicide
Why are children different?

- Constant growth and development
- Communication and cooperation
• Anatomical differences
  – Organs larger
  – Less fat and connective tissue
  – Bones more flexible
  – Tracheobronchial tree smaller and more compressible
  – Mediastinum more mobile
Thoracic Injuries

- Blunt trauma – 60-80% of cases
  - >50% - MVC
- Mortality of chest injuries
  - Isolated – 5%
  - Combined with abdominal or head injuries – 25-40%
- Lung, chest wall, airway most common sites of injury
Thoracic Cage

- Ribs more elastic
  - Incompletely ossified
  - Greater cartilage composition
Rib fractures in children are commonly associated with other injuries.

Accidental rib fractures tend to be few in number and unilateral.
Pulmonary Contusion

• Compression and shearing forces on lung parenchyma
  – 50% - no external chest wall evidence
  – CXR may be normal for first 4-6 hours
  – Consolidation – alveolar hemorrhage and interstitial edema
  – Most resolve in 7-10 days
• May be complicated by pneumonia or ARDS
Contusion, Aspiration, or Atelectasis?
Pulmonary Contusion
Pleural Fluid Collections

- Hemothorax
  - Low pressure pulmonary veins
  - Central pulmonary vessels
- Reactive effusion
- Chylothorax
- Malpositioned venous catheters
Pneumatoceles

- Fluid, blood, or air-filled cysts
  - Pulmonary laceration or broncial obstruction
- Post-traumatic pneumatoceles are seldom symptomatic
- Usually resolve within 2 weeks
- Can occur with any lung insult
  - Pneumonia
  - PPV
  - Airway obstruction
Thin walls, decreasing size typical
Tracheobronchial Injuries

• Pneumothorax – occurs in 1/3 children with blunt chest trauma
  – Other injuries common
• Tracheobronchial injury is rare
  – Distal trachea or mainstem bronchi
  – Mortality high and early (within 1 hour)
• Pneumomediastinum
  – More commonly associated with bronchospasm, penetrating pharyngeal injuries
Asthma
Great Vessel Injuries

• 1-7% of blunt chest injuries in children
  – Mean age = 12 years (<10% under 10)
  – More common in boys
  – Younger children
    • Improper child restraints
    • Ejection from vehicle

• Aorta most common
  – Isthmus distal to L subclavian artery
  – 80% die at scene or during transport
Radiologic Findings

- Radiographs
  - Mediastinal widening
  - Loss of normal aortic contour
  - Deviated NG tube
  - First rib fractures
  - Normal in 7%
Normal Thymus

6 month old infant
6 year old s/p MVC
Abdominal Aortic Injury
Lap Seatbelt Injuries

- 1% of children who are wearing seatbelt
- Most common between 5 – 9 years of age
- Improper position of belt
  - Small pelvis size
  - Short legs
Lap Belt Injury Mechanisms

- High center of gravity in young children
- Fulcrum of force at juncture of seatbelt and abdominal wall
- Torso free to move forward, leading to head impact
Seat Belt Syndrome

• Hip and abdominal contusions
• Ileal and pubic bone fractures
• Lumbar spine injuries
  – Chance fracture
  – Compression fracture
• Intrabdominal injuries
  – Small bowel mesenteric tears and perforation
  – Bladder rupture
Lap Belt Aortic Injury

- Helical CT
  - Periaortic hematoma
  - Irregular contour
  - Intimal flap
Chance Fracture

- Flexion distraction injury variant
- Up to 50% have abdominal injuries
Blunt Abdominal Trauma in Infants and Children

• Liver, spleen, kidneys most commonly injured
  – Usually managed non-operatively
• Pancreas, duodenum, small bowel uncommon
  – Often require surgery
CT of Abdomen and Pelvis in Children

- Use size-based dose reduction protocols (lower mA)
  - Larger dose per size of organs
  - Longer life span for radiation effects
- Contrast
  - IV contrast important (2 cc/kg)
  - Power inject with 22 g or larger IV
  - Oral contrast vs water (10 cc/kg)
Liver and Spleen Injuries

- Usually caused by direct blow to upper quadrants
- Non-operative management successful in 85-95% of patients
- Grade may help determine when the child can return to normal activity
  - Injury grade plus 2 weeks
Grade II Splenic Laceration
Complications of Hepatic Injuries in Children

- Occur in 4-12%
  - Bile leaks
  - Hepatic artery pseudoaneurysm
  - Necrotic gall bladder
- 57% managed non-operatively
  - Percutaneous or angiographic
  - J Trauma, 2006; 61:334.
Hepatic Artery Pseudoaneurysm
Intra-abdominal Fluid

- US less commonly used in children

- 94.7% of children had true negative FAST exam

- Free fluid on CT
  - 68% solid organ injury
  - 11% intestinal injury
  - 10% no injury
Bowel and Mesenteric Injuries

• Common mechanisms (Canty TG, JTrauma, 1999)
  – Blunt force or lap seatbelt injuries (19%)
  – Bicycle handlebars (13%)
  – Child abuse (9%)

• Causes
  – Compression against spine
  – Sudden increase in intraluminal pressure

• Abdominal wall ecchymoses
  – Common with seatbelt injury, but often absent with other mechanisms
Child kicked by horse in left flank

Colon hematoma
18 month old s/p MVC
Cecal Perforation

Oral contrast does not improve detection
Sigmoid colon hematoma with active hemorrhage
8 month old with vomiting and distended abdomen
Perforated jejunum in a battered child
Abdominal Trauma in the Battered Child

- 4 -15% of abdominal trauma in children in U.S. is inflicted.
- Usually in children 3 years old or less
- > 50% of these children are in critical condition when they present
  - Delay in bringing for care
  - Complication rate high
Rectal perforation

Usually seen with sexual abuse
Pancreas and Duodenum Injuries

• Less than 5% of abdominal injuries

• Blows to upper abdomen
  – Handlebars
  – Child abuse

• Duodenal injuries
  – Hematoma
  – Laceration

• Pancreas injuries
  – Contusion
  – Laceration
  – Pancreatitis
Pancreas Injuries

• Subtle in early post-trauma period

• Findings
  – Free fluid in lesser sac or anterior pararenal space
  – Defect in pancreas (less common)

• Transection
  – Early operative therapy warranted
Two days later
MRI of pancreatic transection
Duodenal Obstruction (Hematoma)
9 year old rear seat minivan passenger, lap belt
Duodenal Perforation
Rupture of Cisterna Chyli and Minor Duodenal Hematoma
Renal Injuries

- More common in children and tend to be more severe
  - Less well-protected by ribs
  - Less fat and abdominal muscle
- Can occur with simple falls at home
- Microhematuria or gross hematuria virtually always present
  - Amount of blood doesn’t correlate with injury severity
Renal Ultrasound – fairly sensitive for detecting injuries but tends to underestimate severity
CT better depicts severity... but most still treated non-operatively.
Complication - Urinoma
7 year old after bicycle accident

Horseshoe kidney injury

- Low position in abdomen
- Isthmus anterior to spine
Adrenal Hemorrhage

- **Mechanisms**
  - Direct trauma
  - Acutely increased venous pressure
  - Infants – fragile venous sinuses in medulla
Adrenal hemorrhage – usually central in gland and low attenuation
Intraperitoneal Bladder Rupture
2 ½ year old s/p MVA with lap belt ecchymosis
Points to Remember

• Keep blunt injury in mind, even when there is no clear history of trauma.

• Routine follow-up imaging not usually warranted but may be needed for patients with equivocal or non-specific findings.

• CT is valuable but radiation dose must be minimized.