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
  - Chest and abdomen <10% of injuries
  - MVC
    - Passenger
    - Pedestrian
    - Driver
Pediatric Trauma

- Child abuse
  - 5 years and under
- Recreational trauma
  - School age
- Adolescence
  - Sport injuries
  - Violent injuries
  - Suicide

Objectives

- Be familiar with the more common injuries in infants and children and recognize the imaging findings
- Differentiate normal and abnormal findings that mimic accidental trauma
- Taylor imaging studies appropriately for pediatric patients
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.
Rib Fractures

- Rare in healthy infants and children
  - 82% - caused by abuse in infants
  - 8% - accidental (major trauma)
  - 7% - fragile bones
  - 3% - birth trauma

Bulloch, Pediatr 105:E48, 2000

- No accidental mechanism for bilateral rib fractures in infants
Bone scintigraphy is a useful adjunct to radiographic bone survey.
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 or Atelectasis?
Pneumatoceles

- Fluid, blood, or air-filled cysts
- 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
Differential Diagnosis

- Congenital cysts and masses
  - Bronchogenic cyst
  - Cystic adenomatoid malformation
  - Pulmonary sequestration
Unilocular CCAM with obstructive emphysema

Pulmonary Sequestration
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
Great Vessel Injuries

- 1-7% of blunt chest injuries in children
  - Mean age = 12 years (<10% under 10)
  - More common in boys (need for speed?)
  - 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%

• Helical CT
  – Periaortic hematoma
  – Irregular contour
  – Intimal flap

Normal Thymus
6 month old infant
6 year old s/p MVC
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 Injury
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
- FAST exams unreliable
  - Significant number of injuries in children have little free fluid
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 (2cc/kg)
  - Oral contrast vs water (10cc/kg)

Liver and Spleen Injuries

- Usually caused by direct blow to upper quadrants
- Rib fractures uncommon
- 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
Bowel and Mesenteric Injuries

- Common mechanisms
  - Blunt force or lap seatbelt injuries
  - Bicycle handlebars
  - Child abuse
- 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

[Imagery of medical scans with annotations indicating cecal perforation]
Sigmoid colon hematomawith active hemorrhage

8 month old withvomiting anddistended 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
Duodenal Hematoma
Combination Injuries
Delayed Images
Duodenal Perforation

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.