Abdominal Trauma in Children
KS CARE Training
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Kerri Weeks MD, FAAP
Associate Professor, Child Abuse Pediatrics
University of Kansas School of Medicine-Wichita

Disclosures
• I have nothing to disclose

Objectives
• Identify common presentations of accidental and abusive internal abdominal trauma
• Identify common causes of delayed presentation of significant internal abdominal trauma
• Obtain an appropriate medical evaluation to identify occult abdominal trauma
Case Presentation: Betty

11 month old female initially presented to the ED with her grandmother for medical evaluation after a reported short fall that morning.

What stands out to you about this case?

Duodenal transection and focal hemorrhage of the pancreas

Abdominal Trauma

- Epidemiology
  - 2-20% of abuse cases (under-recognized)
  - Rarely isolated injury = >60% have other injuries
    - Cutaneous injury
    - Fracture(s)
    - Cranial/intra-cranial injury
  - Unlikely from minor trauma (short falls, normal play)
Morbidity and Mortality

- 2nd most common cause of abuse-related death
- Severe and fatal cases peak at the toddler age
- Later than AHT
- Fatal abuse: 14% had intra-abdominal injuries
- Abusive abdominal trauma has higher morbidity & mortality
- High fatality (up to 50%)
  - Severity of injuries
  - Delayed presentation
  - Delayed diagnosis

Morbidity and Mortality

- Delayed Presentation
  - Subtle non-specific signs and symptoms initially
  - Injuries may “resolve” without intervention
    - Retroperitoneal small bowel perforation “walls off”
    - Small laceration/contusion to solid organ “self limiting”
- Delayed Diagnosis
  - Even severe trauma seldom leaves external bruising
  - Not part of abuse evaluation
  - Trauma history is absent, false or minimized
  - Distracting injuries

Most Common Abusive Injury Sites

- Midline fixed over spine on either side of Ligament of Treitz
  - Duodenum (1)
  - Left lobe of liver (2)
  - Pancreas (3)
  - Proximal jejunum
Less Common to be Abusive

- Kidney
- Mesenteric/vascular avulsion
- Spleen

Rarely Abusive
- Urinary Bladder
- Stomach
- Ileum and colon (more common in accidental)

Mechanisms of Injury

- Crushing of solid organs against vertebral column/thorax
- Compression, overdistention, and perforation of hollow organs against vertebral column
- Shearing forces due to acceleration/deceleration of mobile structures
- Penetrating trauma

Vulnerability of Young Children

- Flared ribs
- Protruberant organs
- Thin abdominal walls and small size of toddler abdomen
- Weaker musculature and skeletal structures
- Less protective fat surrounding pancreas and kidneys
- Increased pliability of bones and cartilage, transferring energy to intrathoracic organs
Mechanism of Injury

Accidental
- Bicycle handle bars
- MVC/seatbelts
- Hit by car
- Fall with focal intrusion (fall down stairs rarely causes)

Accidental vs Inflicted Abdominal Trauma
- Absence of external bruising is common in both
- Children with abusive abdominal trauma tend to be younger
- Delay in seeking care may be seen in either

Mechanisms of Injury
- “Shock” bowel
  - Cardiopulmonary arrest
    - Hypo-perfusion, hypoxia/ischemia, necrosis & perforation
  - Radiographic Findings
    - Intimal dilatation
    - Thickened bowel wall
    - Enhancement of bowel mucosa
    - Periportal edema
    - Free fluid
    - Combination shock bowel and mechanical injury
Question:
- What is the organ least likely to be injured in abusive abdominal trauma?
  - A. Liver
  - B. Pancreas
  - C. Kidney
  - D. Small Intestine

Solid Organ Injury
- Liver Injury
  - Most common abuse-related solid organ injury (nearly 2/3)
  - Left lobe contusion and/or laceration most common
  - Usually associated with other injuries
  - Most recover without surgical intervention
  - Can be severe with hemo-peritoneum and shock
  - Severe pain or delay in significant symptoms
Solid Organ Injury: Pancreas

- Pancreas Injury
  - Relatively “protected”
  - Contusion, laceration, hematoma
  - Often association duodenal and hepatic injury
  - Enzymes may be normal or elevated then to normal
  - Accidental: requires a focal intrusive force (i.e. handlebar)

Solid Organ Injury: Pancreas

- Traumatic pancreatitis
  - #1 cause is injury in children
  - Average age of children with pancreatitis due to abuse (27 months) is much lower than children with pancreatitis due to other mechanisms
  - Gradual development of symptoms
  - Complications: peritonitis, vomiting, dehydration, pseudocyst

Solid Organ Injury: Kidney

- Kidney Injury
  - Uncommon abusive injury
  - Relatively “protected”
  - Blunt force impact to flank, lower lateral chest
  - Frequently seen with other intra-abdominal injuries
  - Hematoma, contusion and infarction; vascular injuries
Hollow Viscus Injury

- Small Bowel Injury
  - Much more common in abuse than accidental
  - Small bowel is most common hollow viscus injured in abuse
  - Duodenum and proximal jejunum are at particular risk in NAT because of their fixation at the ligament of Treitz and the concentration of force from a punch or kick to the epigastrium
- Severity range:
  - Intramural hematoma (most common) < Perforation < Transection

Mesenteric Injury

- Uncommon
  - Lesser severity may be missed
- Avulsion
  - Disruption of blood supply to solid and hollow viscus
  - Ischemic/shock bowel

History/Presentation

- Abdominal trauma history absent
- Minimized or falsified history
  - Short fall, dropped, fall down stairs
- History is inconsistent with type and severity of injury
- Delayed presentation
- Presents for extra-abdominal injury
- Presents for non-specific illness
  - Irritable, pain, vomiting, fever, decreased intake, respiratory distress
Physical Examination

- General: altered mental status, tachycardia, pallor, poor perfusion, shock, respiratory distress, fever
- Extra-abdominal injury: bruises, burns, fracture(s), intracranial injury
- Abdominal Wall Bruising
  - Always concerning for abuse
  - Absent in most cases >80%
  - Small, disproportionate to intra-abdominal injury
  - Blunt focal impact
  - Requires laboratory and radiographic evaluation

Abdominal Examination

- Physical Signs:
  - Distension in 39%
  - Absent, decreased, "tinkling" bowel sounds
  - Diffuse or localized pain on palpation in 50%
  - Rebound pain

Laboratory Evaluation

- Trauma Lab Indications
  - ALL children evaluated for inflicted trauma
  - ALL children with bruising of abdominal wall
    - Concurrent CT or subsequent CT if enzymes elevated
  - ALL children with abnormal abdominal exam
    - Concurrent CT scan
Trauma Labs

- Liver enzymes (CMP including ALT and AST)
- Pancreatic enzymes (lipase)
- CBC followed by serial Hct/Hgb
- PT, aPTT
- Non-catheter UA (hematuria)
- +/- Stools for occult and observation for gross blood
- +/- serum myoglobin, creatine kinase

**Question:**

What level ALT/AST would indicate that you should order an abdominal CT scan?

- A. 80
- B. 100
- C. 150
- D. 200
Trauma Labs

- Liver enzymes
  - All suspected physical abuse victims
  - AST/ALT >80 warrant abdominal CT
  - May be normal or elevated depending on timing

- Pancreatic enzymes
  - All suspected abuse victims
  - Lipase, no CT threshold available
  - May be normal or elevated; may normalize rapidly

Radiology

- Abdominal CT is gold standard.
- Indications:
  - Peritoneal signs
  - Liver and/or pancreatic enzyme elevation and/or hematuria
  - Abdominal and lower thoracic wall bruises
  - Encephalopathy
  - Hemodynamic instability of unknown etiology

Radiology

- Abdominal CT
  - Include CT lower thorax and pelvis
  - IV contrast for solid organs, bladder and vascular injury
  - PO contrast for hollow viscus injury
  - May not detect:
    - Small lacerations of solid organs, liver and pancreas
    - Bowel wall hematoma
    - Bowel strictures with partial obstruction
Radiology

- Plain films
  - NOT the definitive study. May see free air, bowel wall edema, obstruction
- Focused Assessment with Sonography for Trauma (FAST)
  - Advantages: fast, no radiation.
  - Can show bowel wall hematoma, intra-abdominal fluid, pancreatic injury, pancreatic pseudocyst, appendicitis
  - Disadvantages: Minimal data on use in suspected child abuse cases, insensitive, Operator dependent, Non-specific
- Upper GI study with Contrast
  - Indications: Abdominal CT negative with peritoneal signs and symptoms
  - May see bowel wall hematoma, bowel strictures, partial obstruction

Practical Approach

Consider CT
- Signs of shock
- Drop in Hct
- Abdominal wall bruising
- Abdominal signs (abnormal exam)
- AST/ALT >80
- Plain films or FAST indicate concern

Follow Clinically
- Hemodynamically stable and well appearing
- No abdominal bruising
- Normal abdominal exam
- AST/ALT < 80
- FAST negative

Key Points

- Abusive abdominal trauma is
  - Most often caused by focal, intrusive blunt force trauma to the abdomen
  - Underrecognized
  - High mortality due to delay in diagnosis

- Do not forget to screen for abdominal trauma on all suspected physical abuse patients!
References

- Anderst, J. Kellogg N. "Mechanisms of Injury in Childhood" 3D Modeling and Animation (Medical Version).

Questions?