Pediatric Blunt Abdominal Trauma

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Disclosure

- No pertinent financial conflicts.

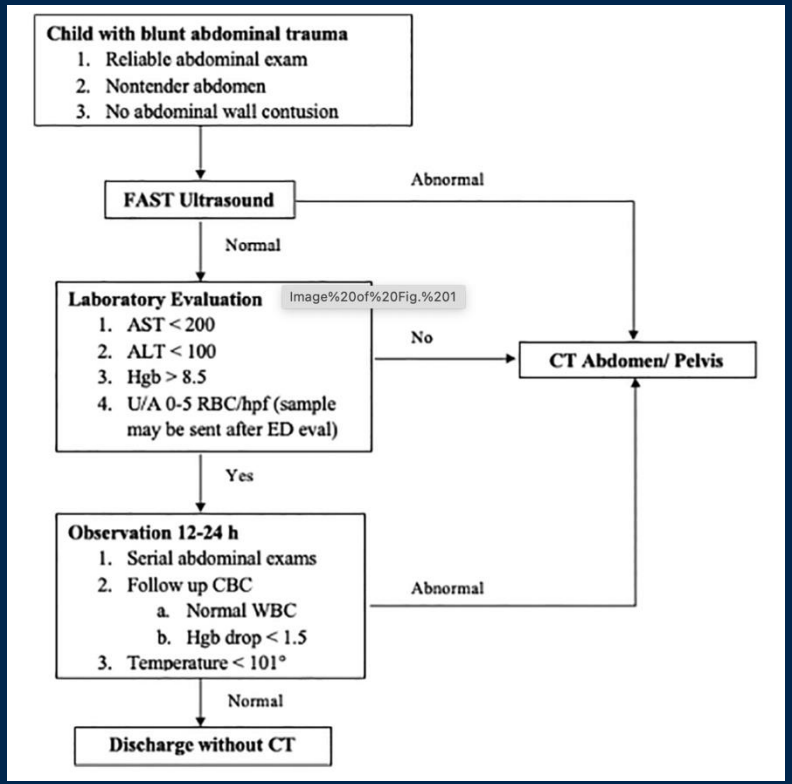
Pediatric Trauma

- Trauma is leading cause of death and disability in children and adolescents
- Accidental injuries and blunt trauma predominate
  - <10% of injuries involve chest and abdomen
- Anatomical differences
  - Organs larger/surface area smaller
  - Less fat and connective tissue
  - Ribs more compliant, less protective

Pediatric Blunt Abdominal Trauma

- CT remains exam of choice for suspected abdominal trauma
- Evidence-based guideline can safely reduce utilization and radiation exposure
  - Uses physical exam, lab values

Gaffley M. Journal of Pediatric Surgery 56(2021):297-301.



Blunt Abdominal Trauma in Children
Indications for CT

CT Indicated

- Tenderness, distention on physical exam
- Positive FAST, stable VS
- Lap belt/handlebar ecchymosis
- GCS < 14
- Hematuria (gross or micro)

Consider CT

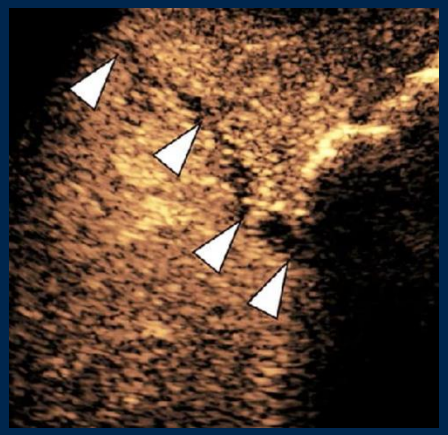
- Hypotension (SBP <70)
- Initial HCT < 30%
- Pelvic/femur/lower rib fx
- Suspected NAT

Abdominal CT

- IV contrast only
  - Oral not required
- Delayed phase
  - Severe renal injury
  - Suspected pseudoaneurysm
- ALARA principles

CEUS for Abdominal Trauma in Pediatrics

- **Advantages**
  - High accuracy
  - Low cost
  - No ionizing radiation
  - Portability



- **Drawbacks**
  - Operator dependent
  - Can be limited by lack of patient cooperation/respiratory motion
  - Limited evaluation of bowel, deep organs

Paltiel H. Pediatr Radiol 2021, 51: 2253-2269.

Intra-abdominal Fluid

- FAST exam (US)
  - Less sensitive in children
  - Variable reliability and accuracy
- Free fluid on CT
  - 68% solid organ injury
  - 11% intestinal injury
  - 10% no injury
    - Taylor, Sivit J Pediatr Surg 1995, 30:1644

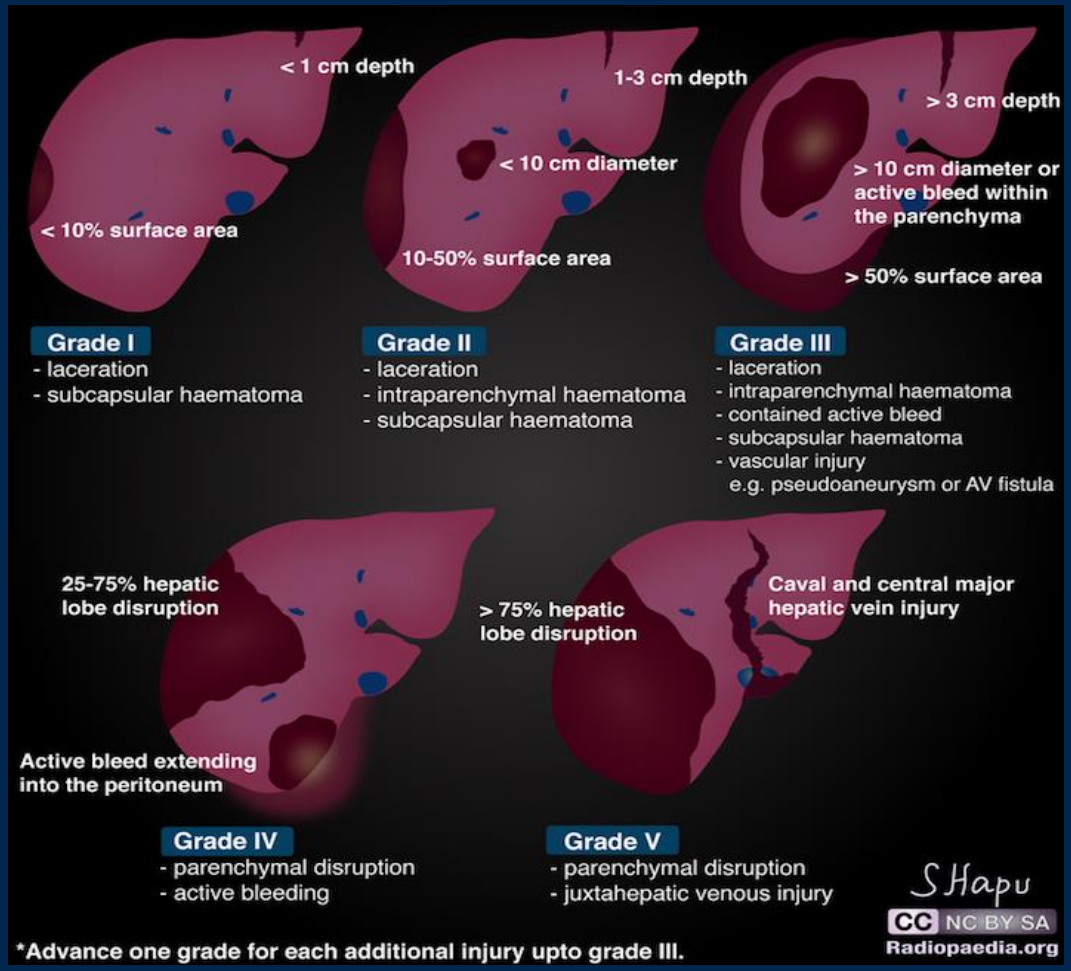
Liver and Spleen Injuries

- Usually caused by direct blow to upper quadrants
- Rib fractures uncommon
- Non-operative management successful in 85-95% of patients

Liver Injuries

- Most common solid organ injury
- Lacerations most common
- Can be asymptomatic

AAST Criteria



Management not based on these criteria alone in children

- Hemodynamic stability
- Other injuries

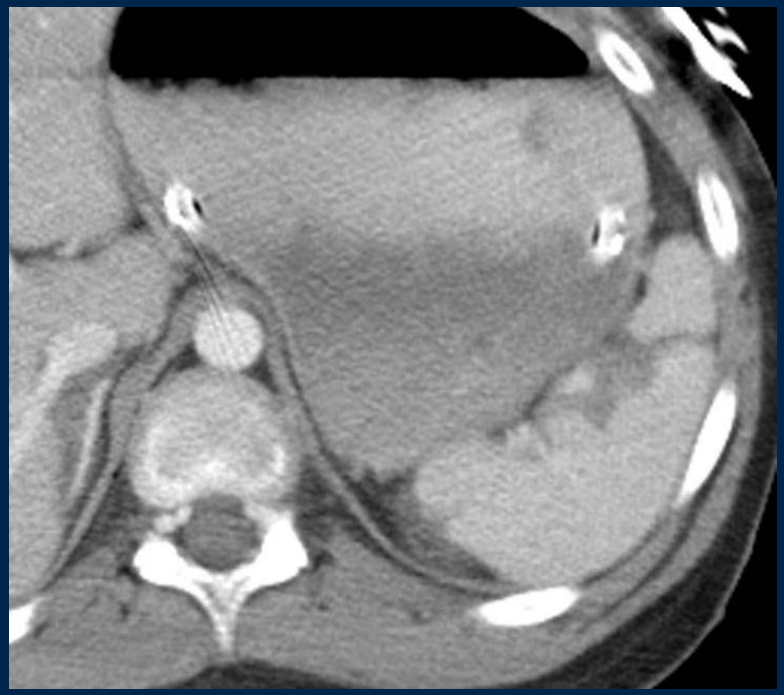
Grade may help determine when the child can return to normal activity

Injury grade plus 2 weeks

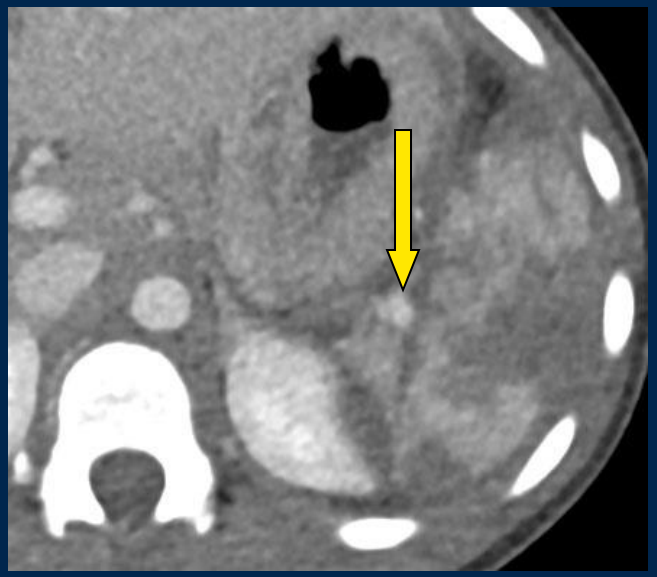
Splenic Trauma

- Lacerations most common
  - Differentiate from congenital clefts, uneven early enhancement
- Hemoperitoneum common if capsule disrupted
- Management largely determined by hemodynamic stability
- Non-operative management common for all injury grades
- Splenic artery embolization has high success rate (>98%)
  - Reserved for children needing immediate treatment or who fail at least 24 hours of NOM

Shinn K, et.al., J Vasc Interv Radiol (2021); 32(5): 692-702



Grade II splenic laceration



Shattered spleen with splenic artery pseudoaneurysm

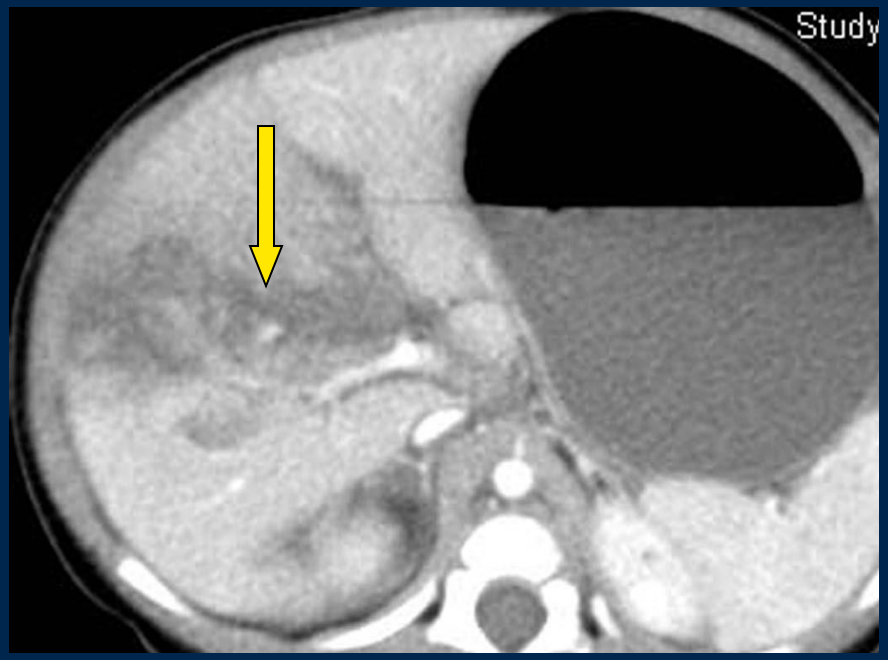
Complications of Hepatic and Splenic Injuries in Children

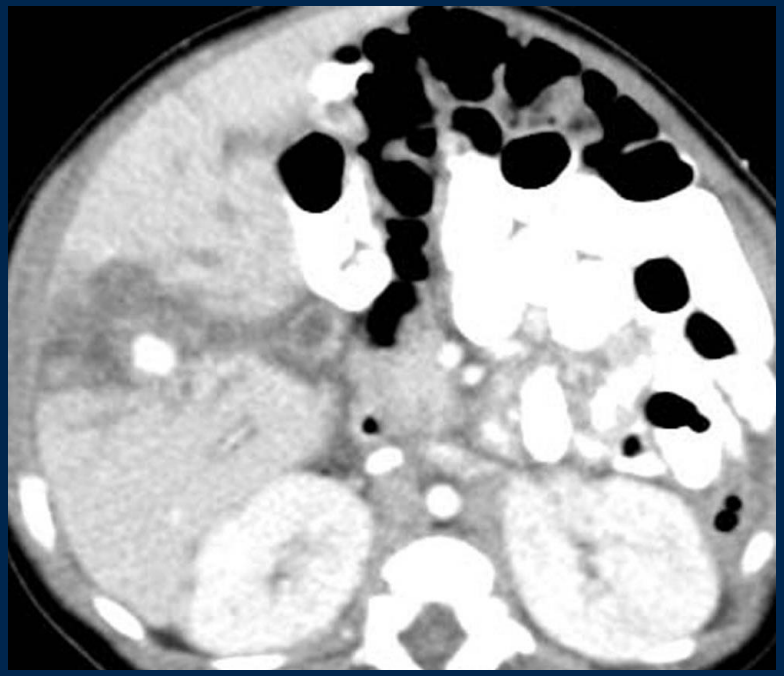
- Occur in 4-12%
  - Bile leaks
  - Arterial pseudoaneurysm
  - Necrotic gall bladder
- 57% managed non-operatively
  - Percutaneous or angiographic
    - J Trauma, 2006; 61:334.

Traumatic Pseudoaneurysms

- Incidence low – 1-5% of liver and spleen injuries
- More common in high grade lacerations
  - Gr IV liver – 27%
  - Gr III spleen – 8%
  - Gr IV spleen – 17%

Safavi A, et.al., J Pediatric Surgery (2011) 46: 938-941





Hepatic Artery Pseudoaneurysm

- Management in children is controversial
- Close follow-up with US is a favored strategy

Yin-yang sign

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

Gastrointestinal Injuries

- Duodenal hematoma
- Perforation
  - 60% jejunum
  - 30% duodenum

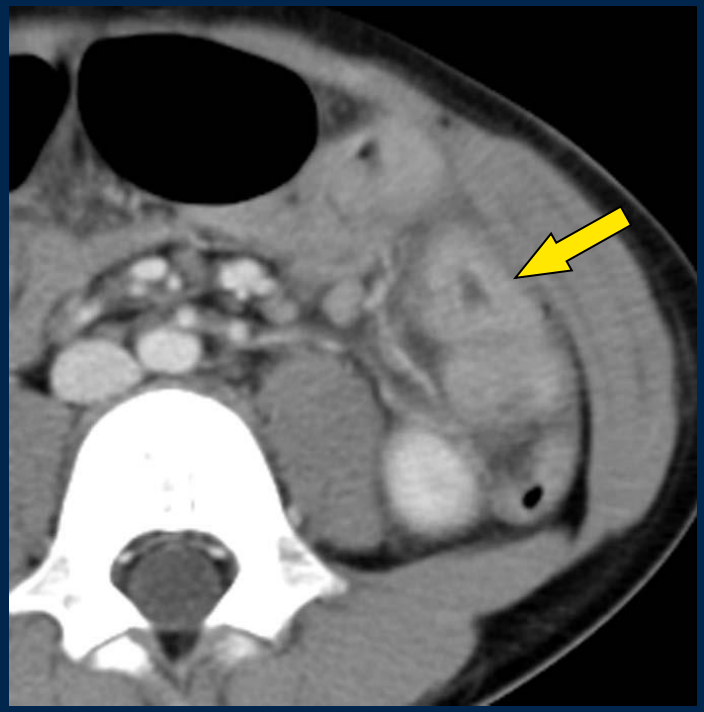
Colon hematoma

Free air or worsening clinical signs usually the indication for surgery

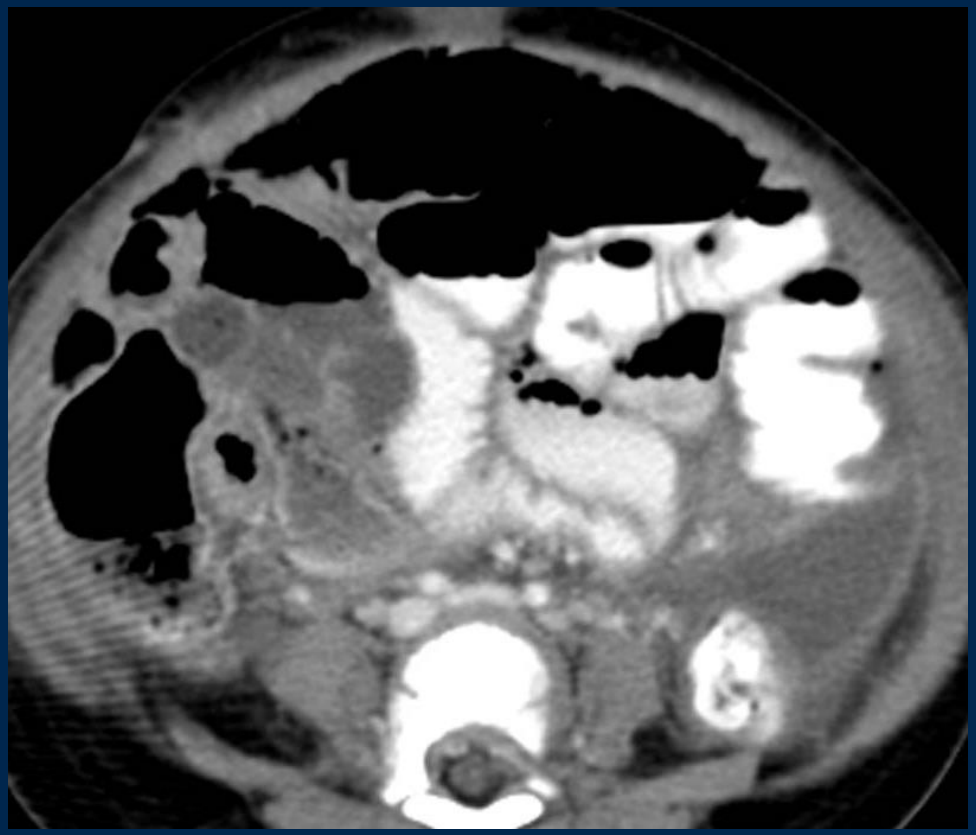
Child kicked by horse in left flank

Common CT findings:

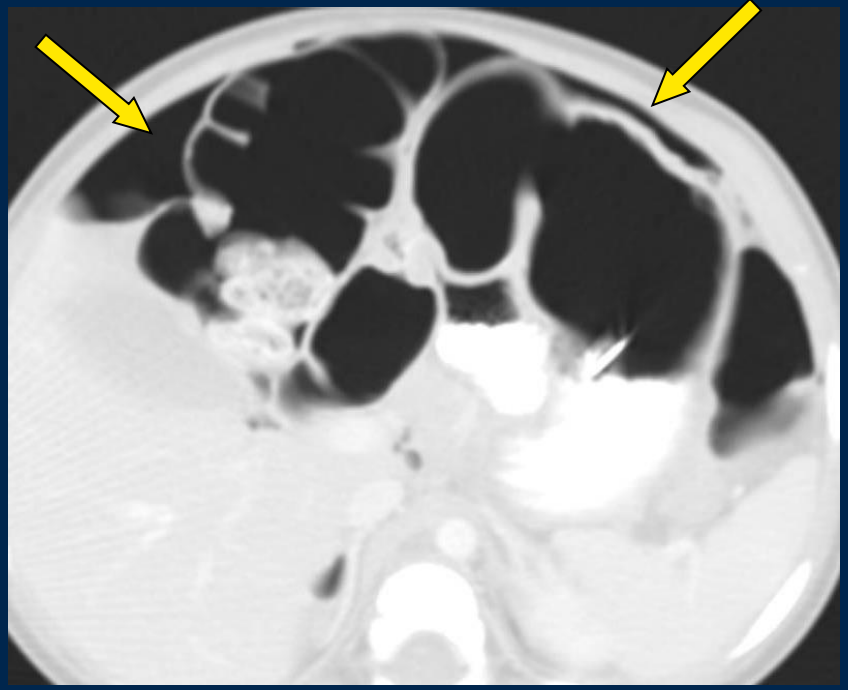
- Free fluid (71%)
- Bowel wall thickening (27%)
- Free air (27%)
- Mesenteric hematoma (6%)
- Contrast extravasation (4%)
- Abnormal wall enhancement, discontinuity



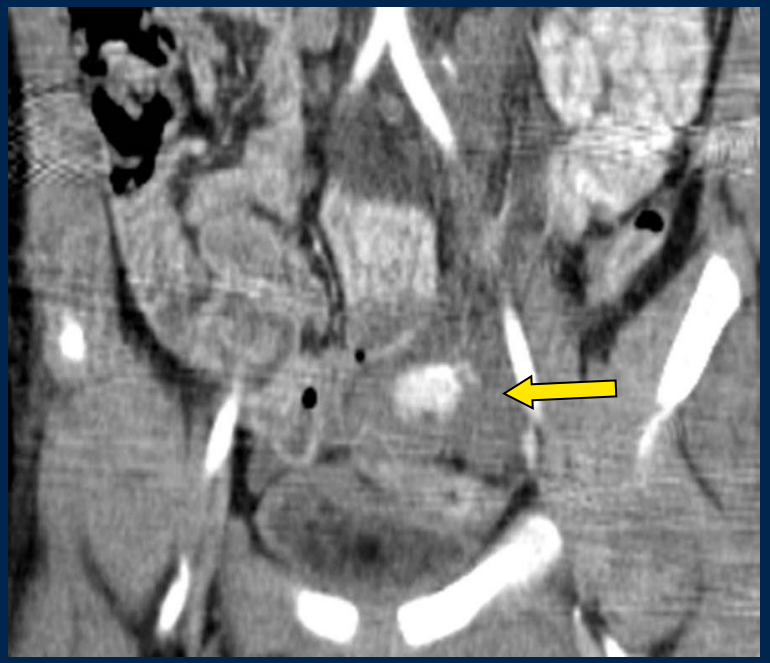
18 month old s/p MVC

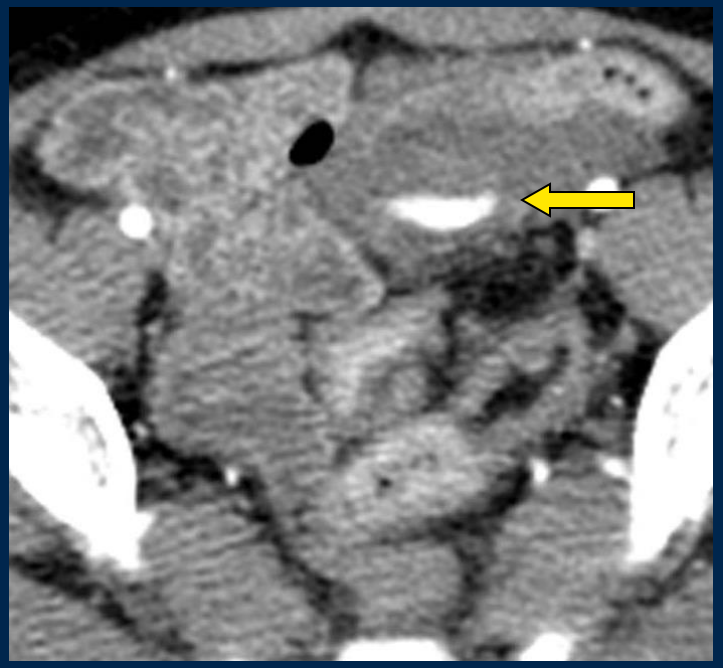


Cecal Perforation



Oral contrast does little to improve detection

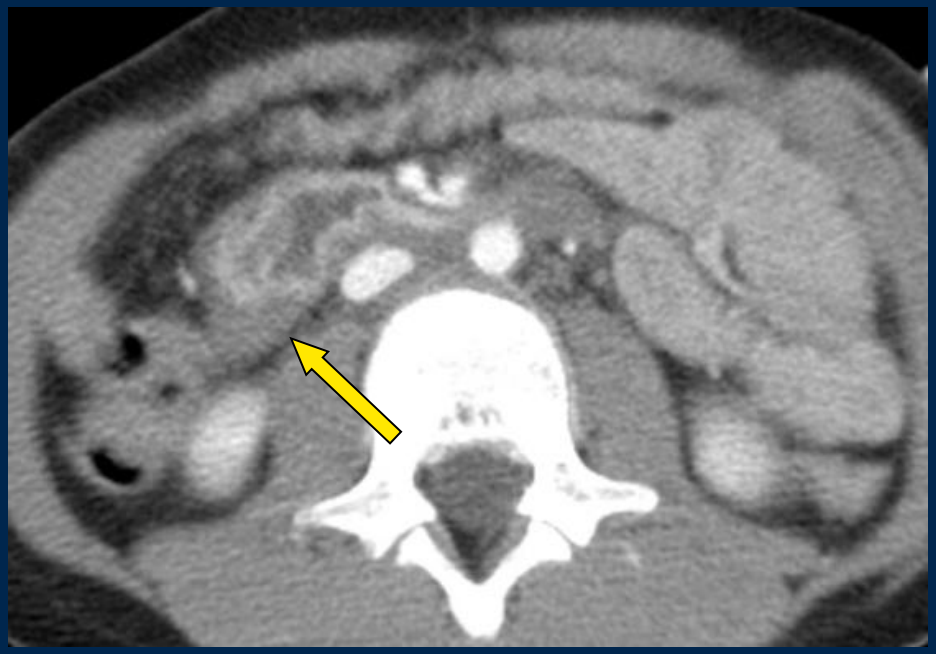




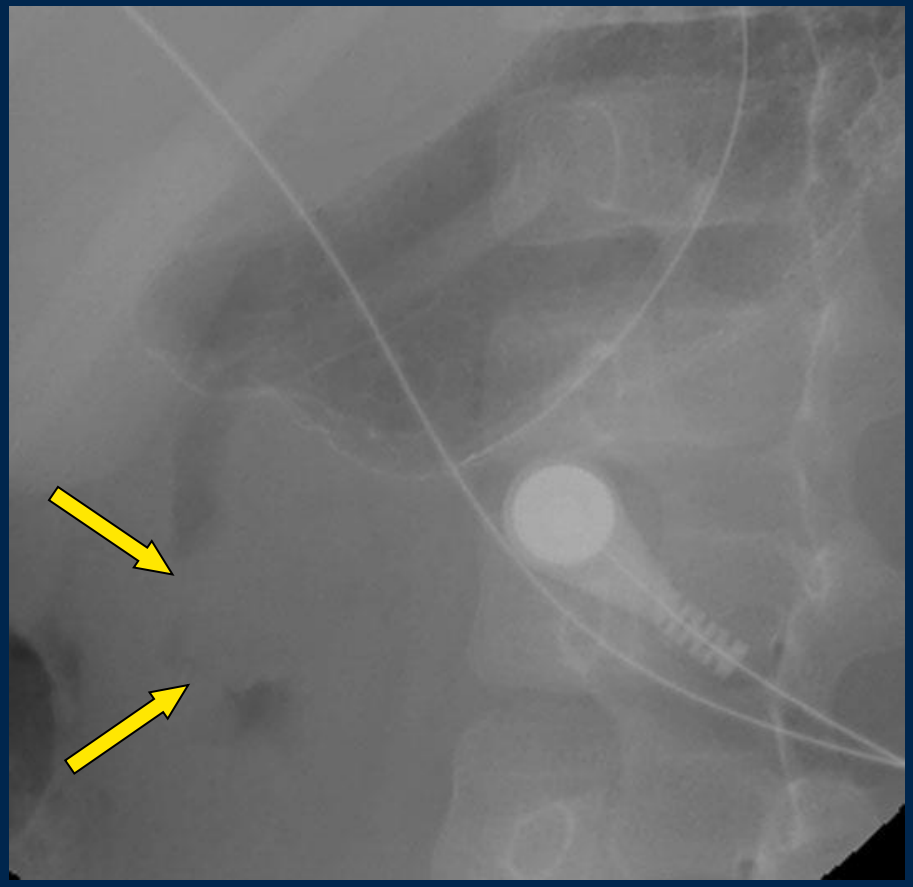
Sigmoid colon hematoma with active hemorrhage

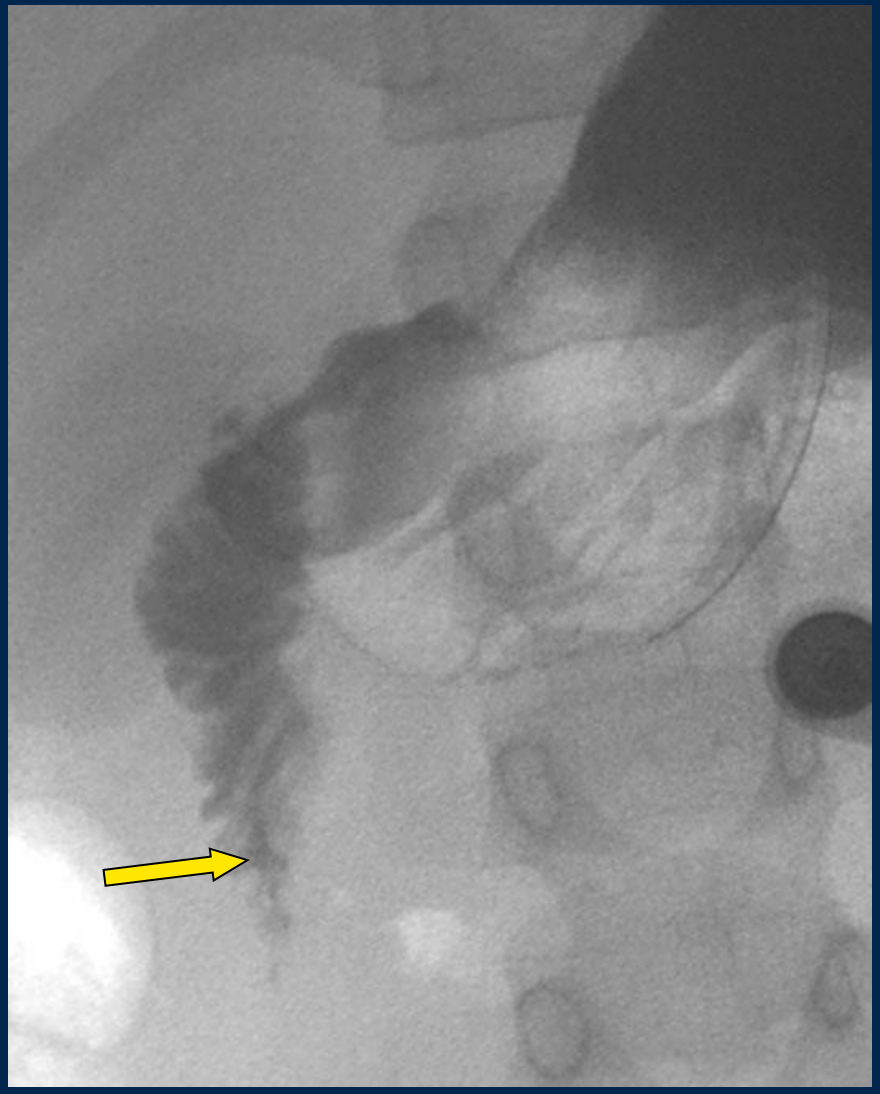
Lap Seatbelt Injuries

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



9 year old rear seat minivan passenger, lap belt



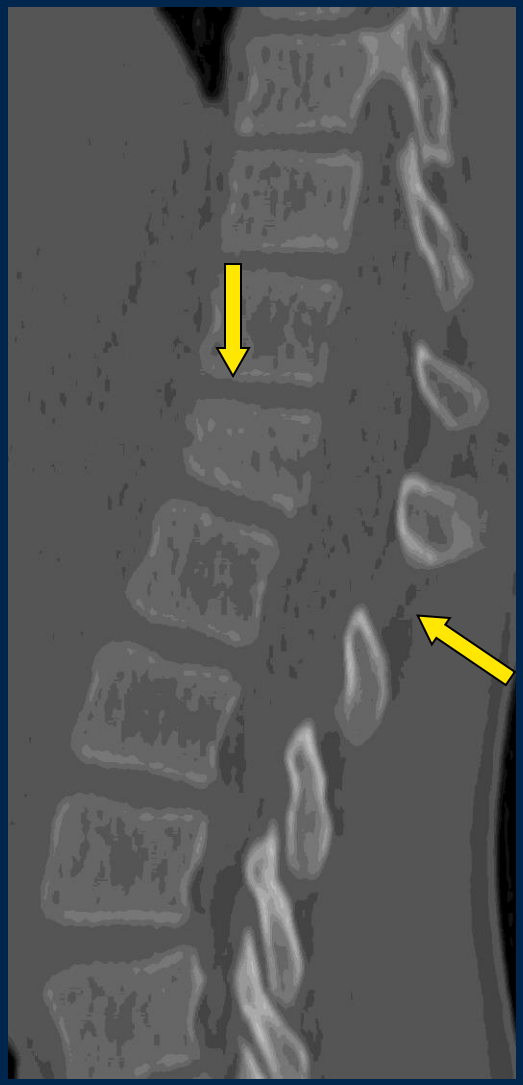


Duodenal Hematoma

Chance Fracture

- Flexion distraction injury variant
- Up to 50% have abdominal injuries

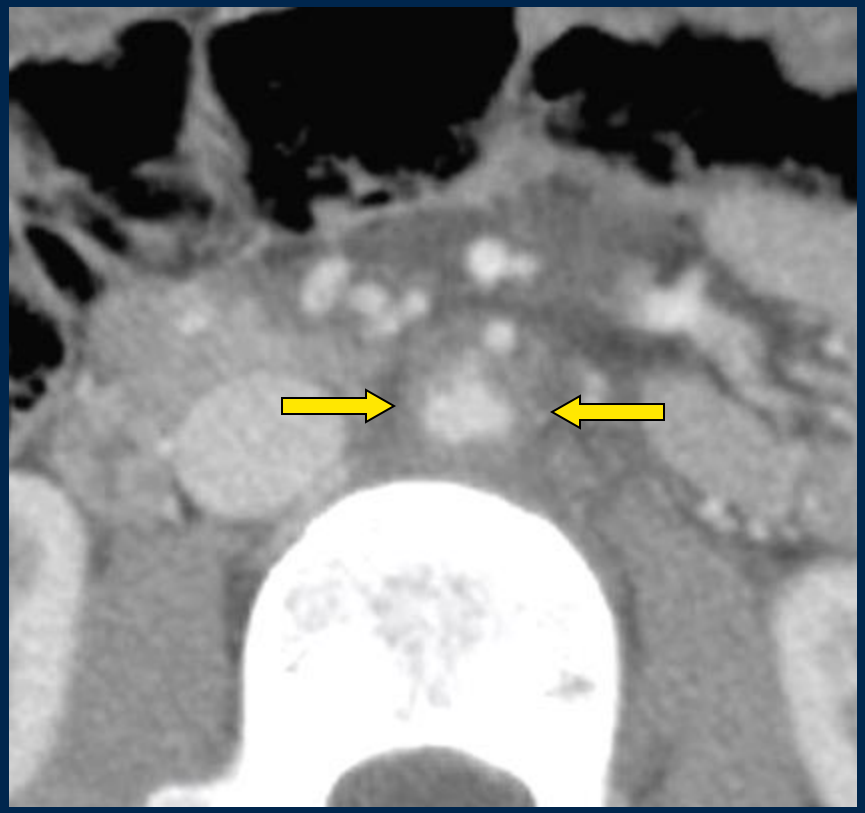
Duodenal Hematoma and Perforation

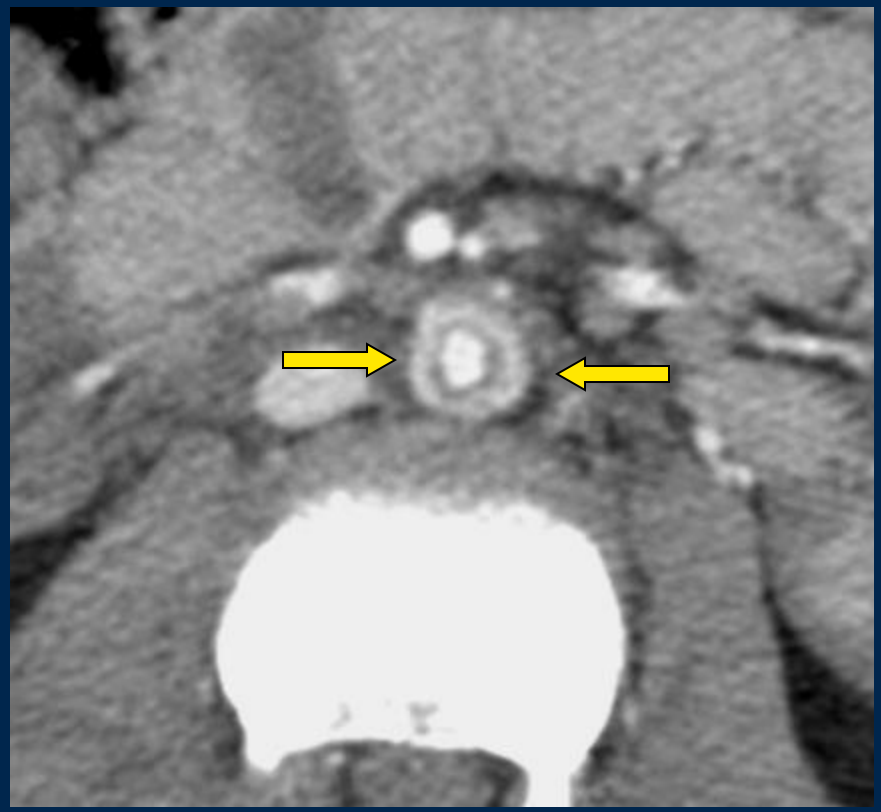


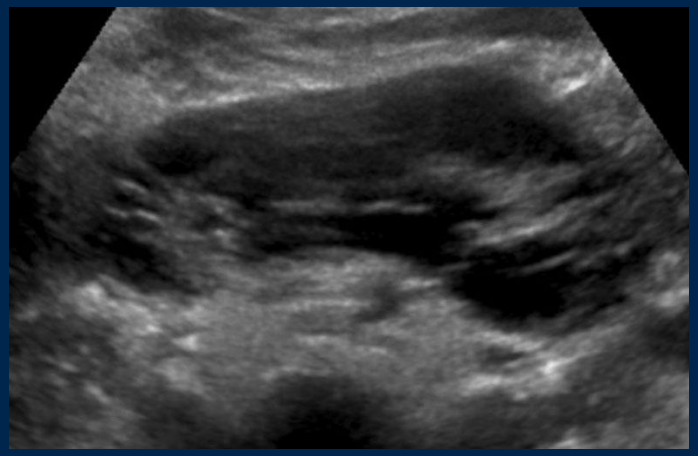
Abdominal Aortic Injury

Lap Belt Aortic Injury - CT

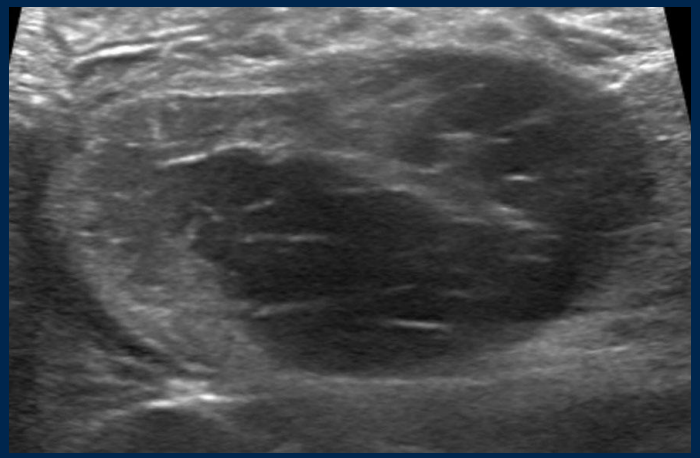
- Periaortic hematoma
- Irregular contour
- Intimal flap







Trans

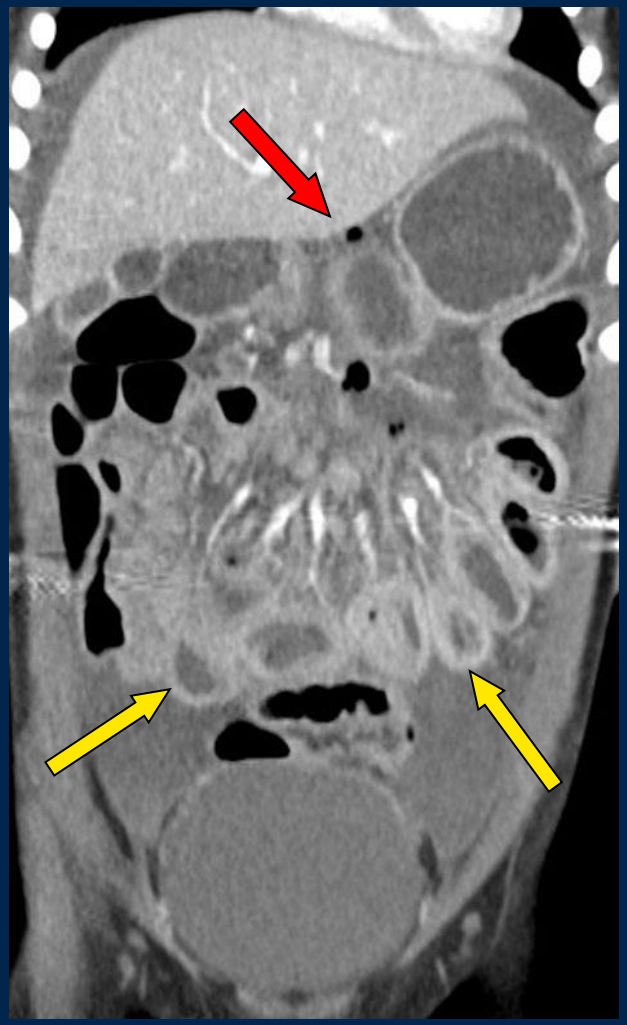


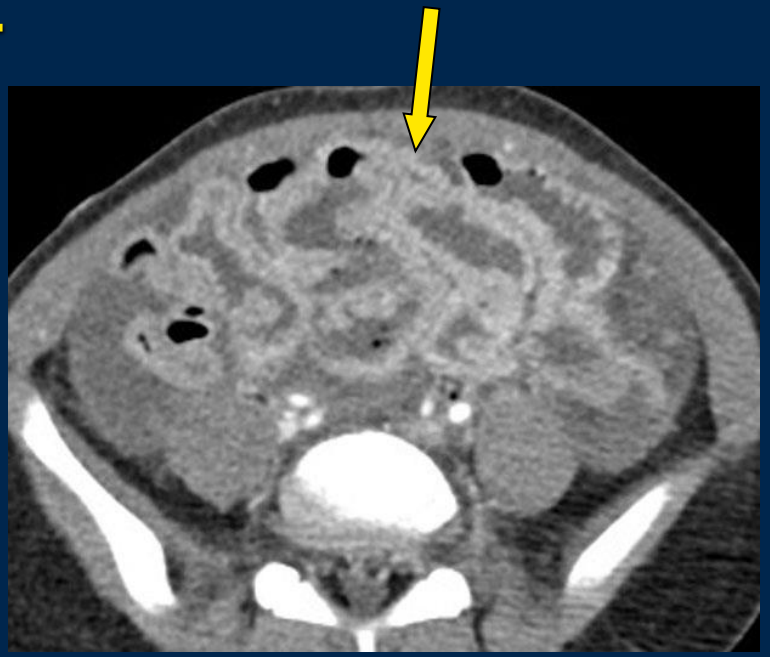
Long

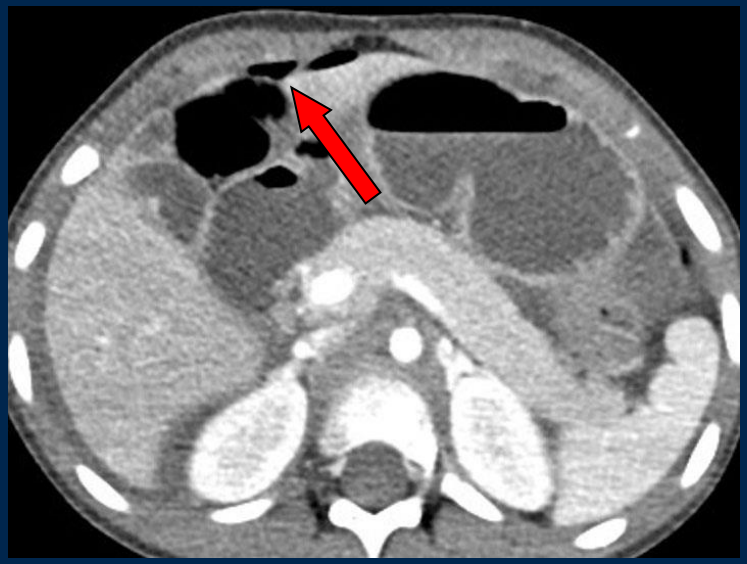
2 yo with new onset vomiting

Large duodenal hematoma caused by inflicted blunt trauma

Small bowel perforation and mesenteric root avulsion - NAT

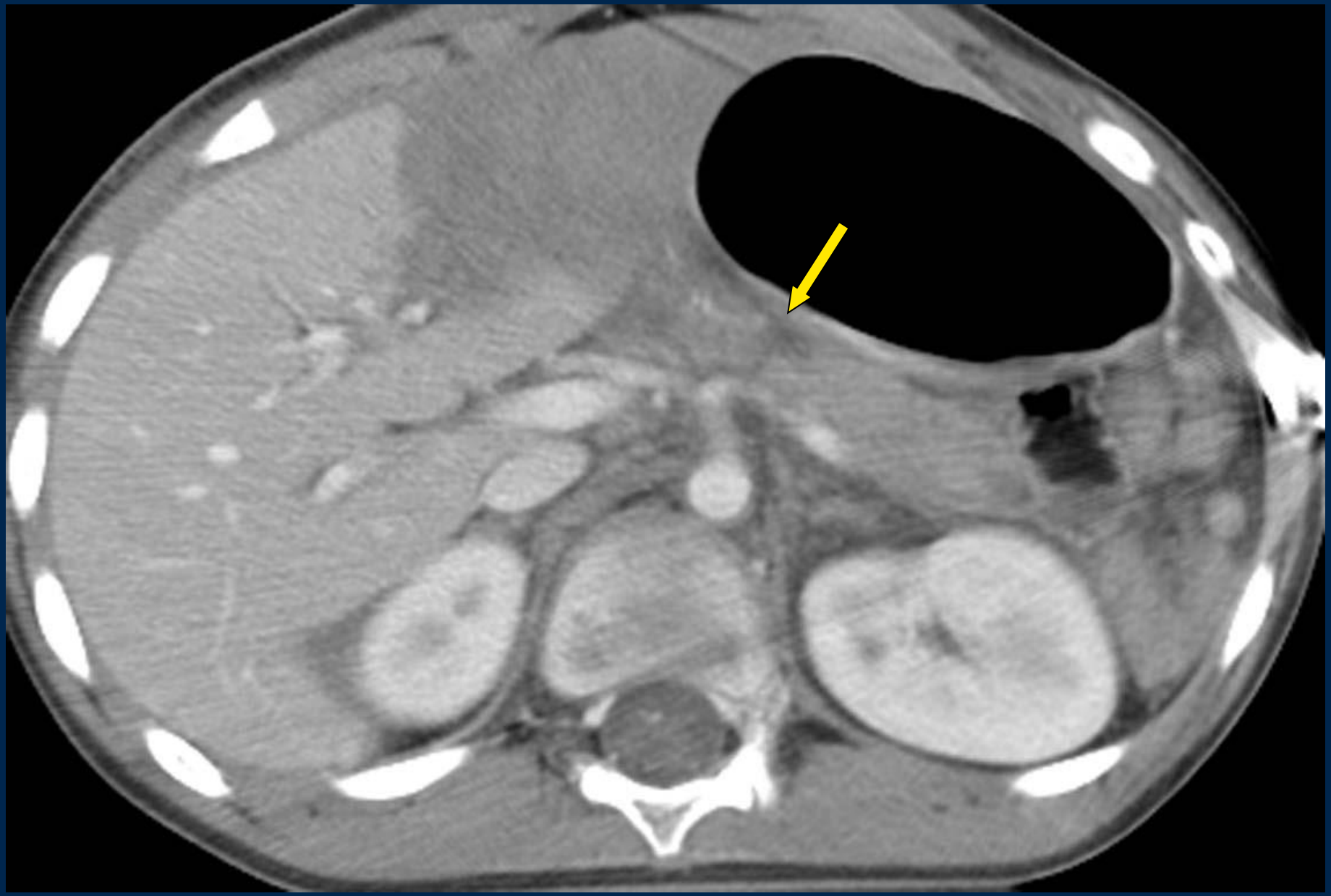


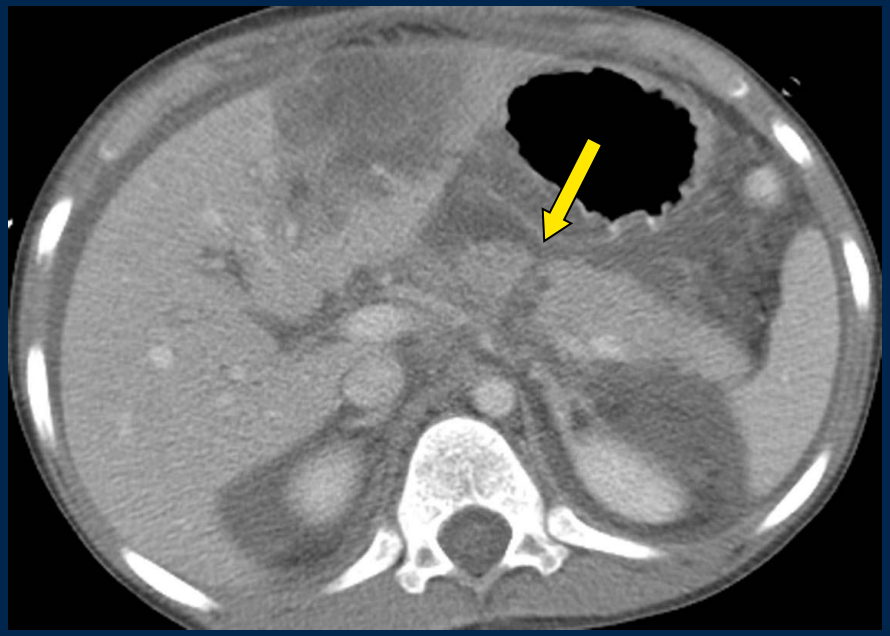


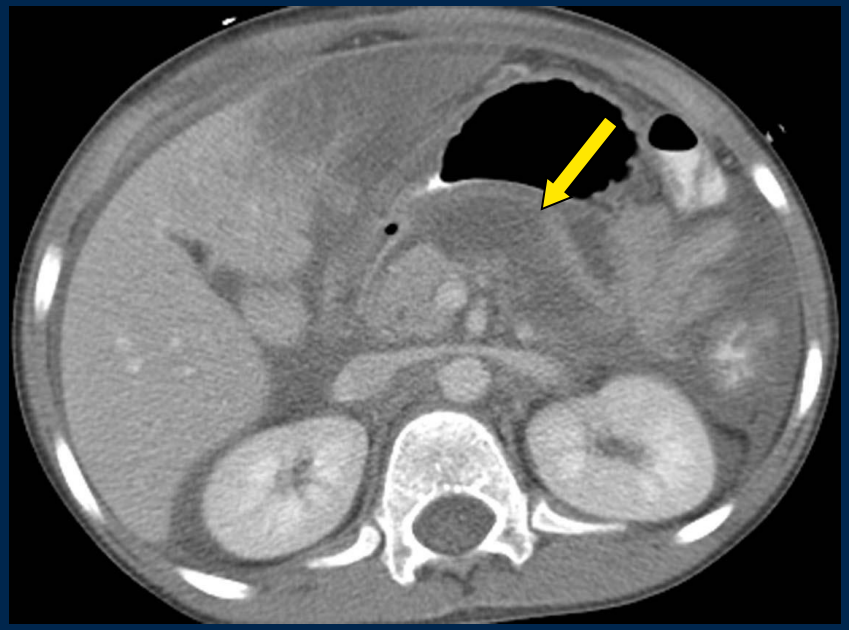


Pancreas Injuries

- Most common causes:
  - MVC/Auto-ped accidents
  - Handlebar impact –high grade duct injuries
- Findings subtle in early post-trauma period
  - Free fluid in lesser sac or anterior pararenal space
  - Defect in pancreas
- Transection
  - Early operative therapy warranted
  - Management depends on dx of duct injury



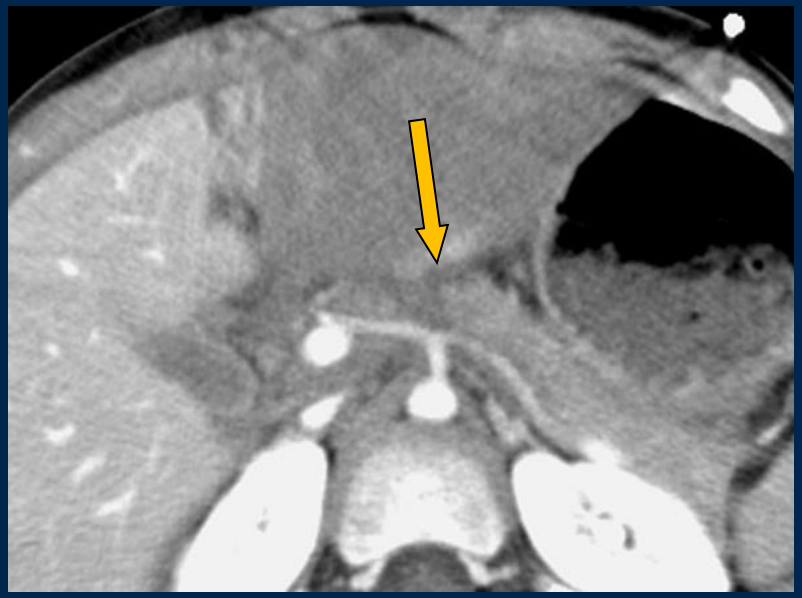


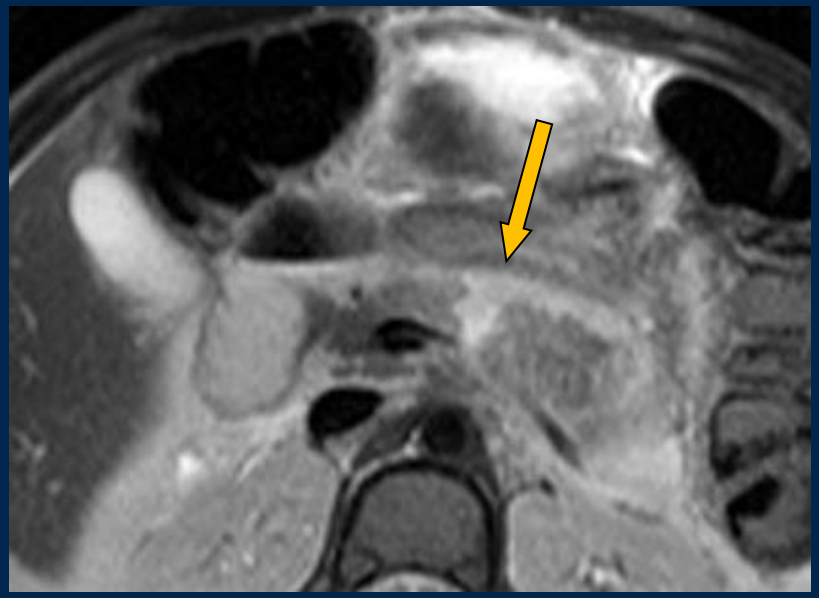


Two days later

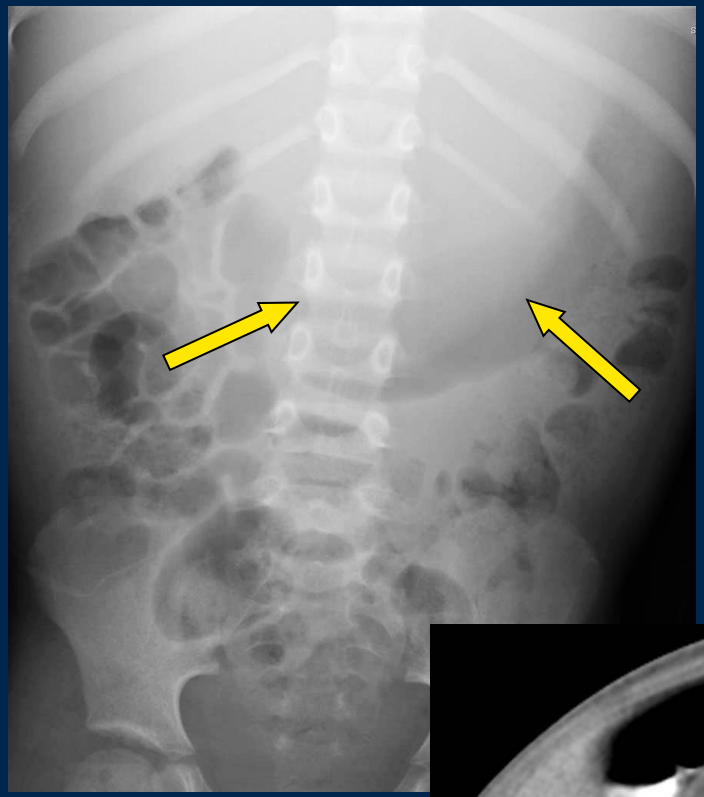
MRI for Pediatric Abdominal Trauma

- Availability, need for sedation, cost limit use
- Beneficial for problem-solving, follow-up

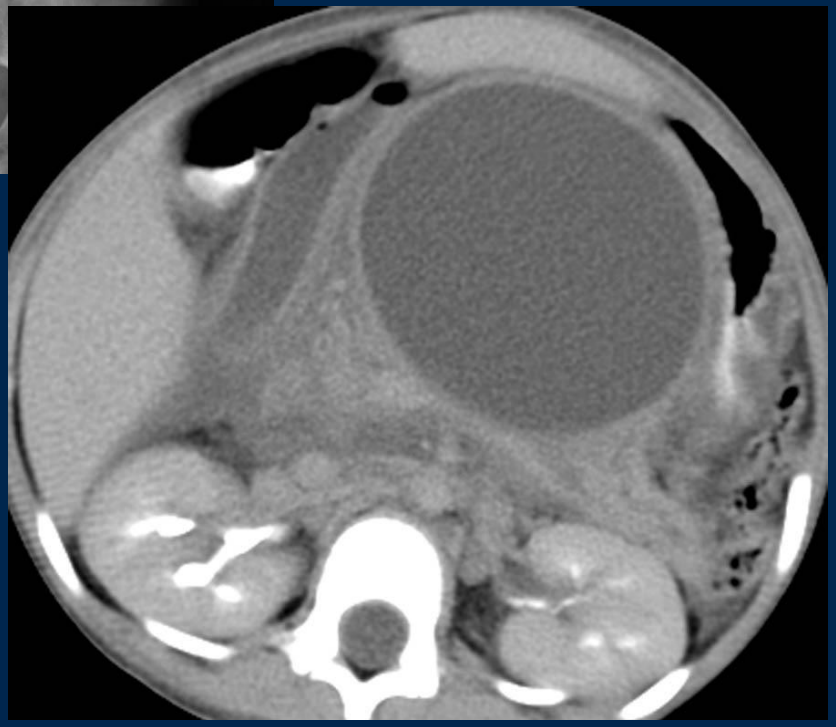




18 month old with abdominal pain after minor fall



Posttraumatic pancreatitis and pseudocyst after kick to abdomen



Absence of history of MVC or handlebar injury in child with pancreatic injury should be evaluated for NAT.

Points to Remember

- Keep blunt injury in mind, even when there is no clear history of trauma.
- CT is valuable but radiation dose must be minimized.
  - Use only when indicated
  - Single phase exams
  - Avoid follow-up exams