Avoiding Pitfalls in Pediatric GI Emergencies

Susan D. John, MD

UTHealth® The University of Texas Health Science Center at Houston | McGovern Medical School

Nordic Trauma and Emergency Radiology
June 2025

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Trauma & Emergency Radiology

Initial Challenge – Which Exam to Use?

- Depends on patient age, clinical suspicion
- Ultrasound
  - Best initial screening examination in children for many types of gastrointestinal disease
    - Non-intimidating
    - Real time
    - No ionizing radiation

Abdominal Radiographs

- Can occasionally be diagnostic
- When not diagnostic, can provide useful information
  - Bowel obstruction
    - Presence
    - Location
  - Foreign bodies

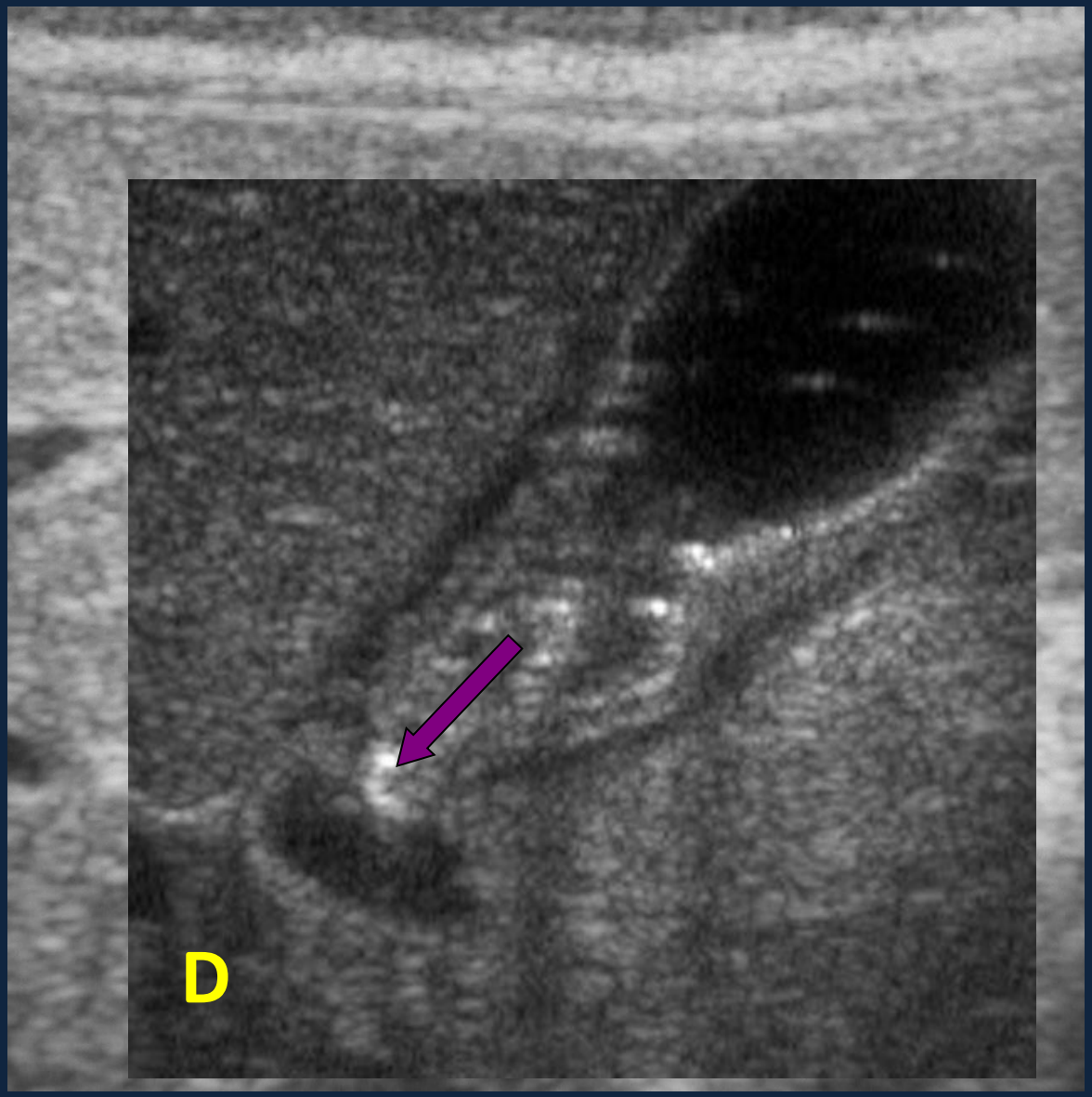
3 year old, choked while drinking milk

Hypertrophic Pyloric Stenosis vs GE Reflux

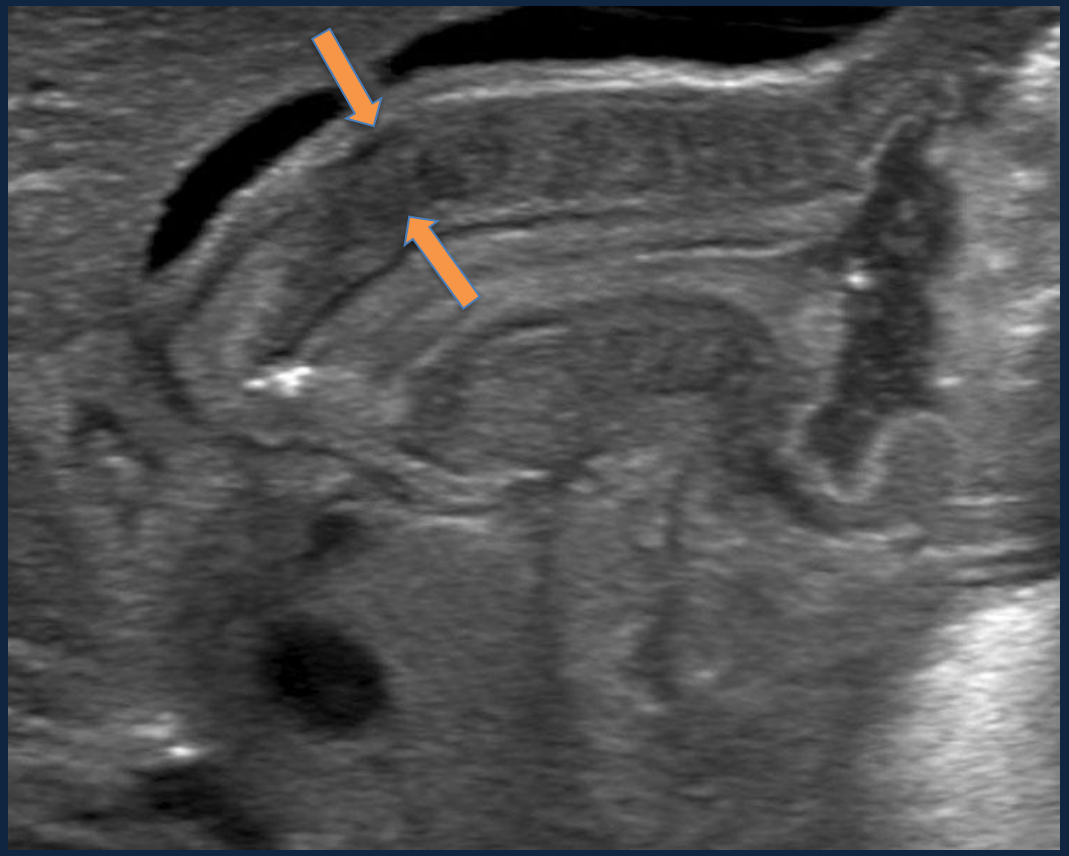
- Gastric US – Infants 2-8 weeks of age
- Technique critical
  - High frequency transducer
  - Assess first for adequate fluid distention of stomach
  - If little fluid is present, give oral liquid during the exam
  - Examine stomach with patient in right posterior oblique position

Normal Pylorus

- 1-2 mm muscle
- Length negligible
- Opens frequently
- Emptying usually evident



Hypertrophic Pyloric Stenosis

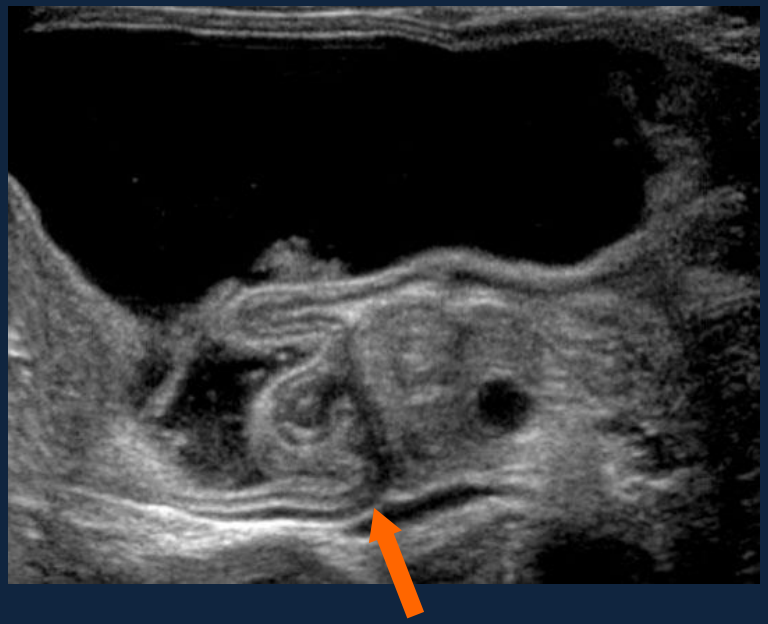


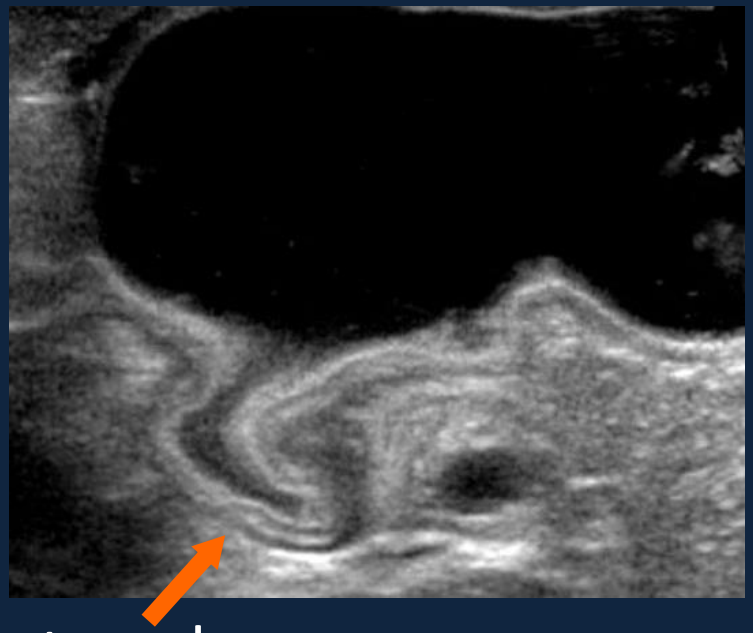
Longitudinal

Transverse

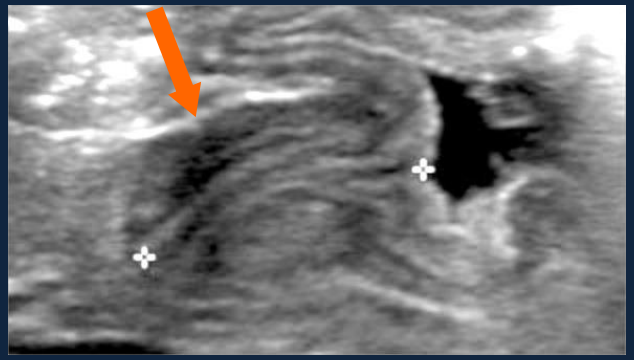
- 3 mm + muscle
- 1.5 cm + length
- Decreased emptying

Pylorospasm

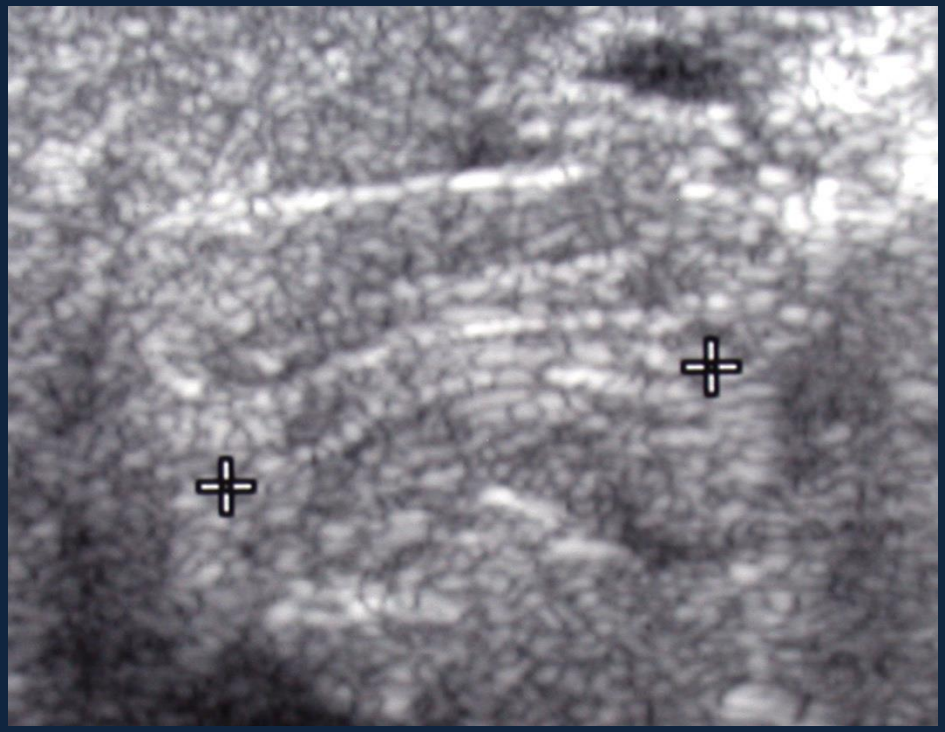




- Persistent contracton of the antropylorus
- Emptying may be absent
- Muscle can measure between
  2-2.9 mm
- Treat medically
  - Follow with US if symptoms increase

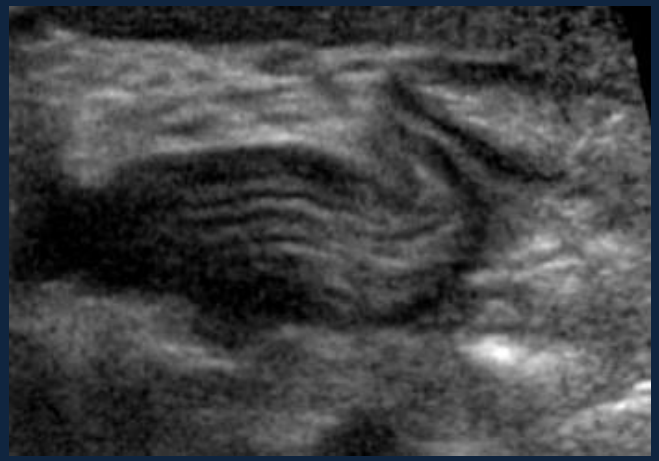


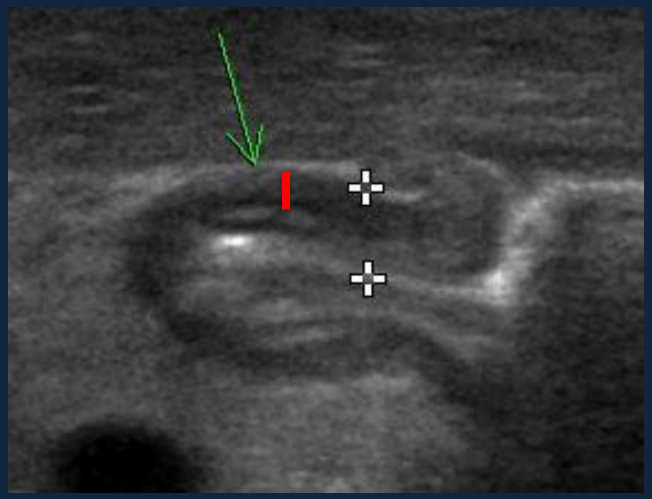
Pitfall – the empty stomach!

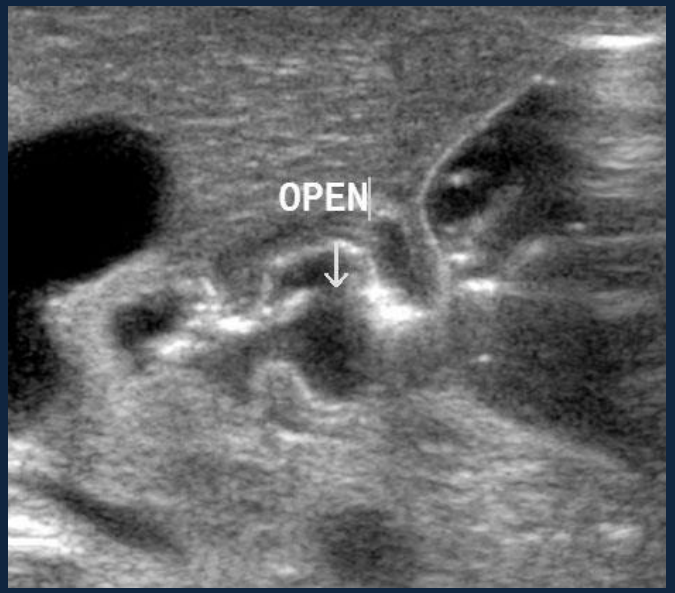


False Positives

- Contracted, elongated antrum secondary to spasm, inadequate fluid in antrum
- Incorrect measurements

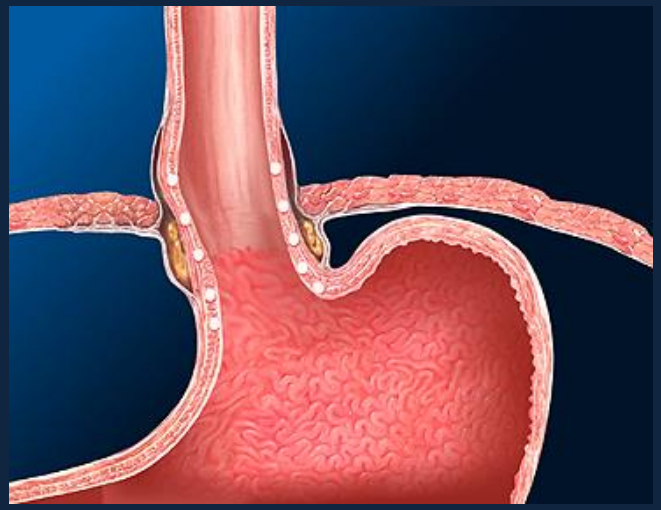




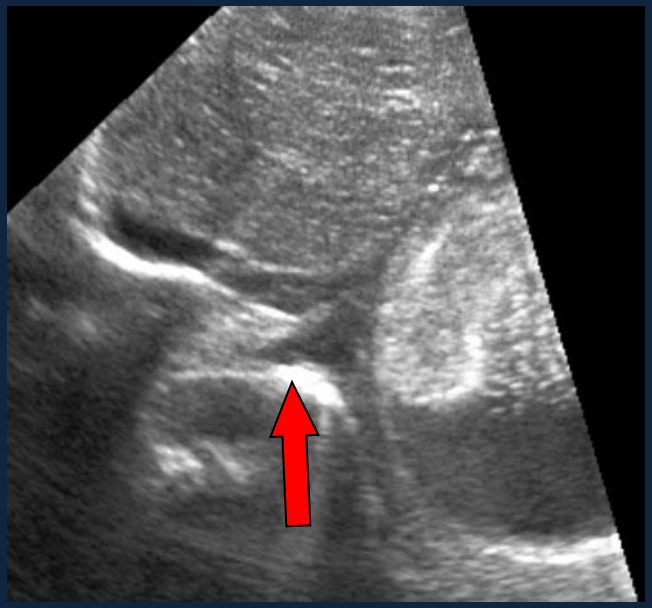


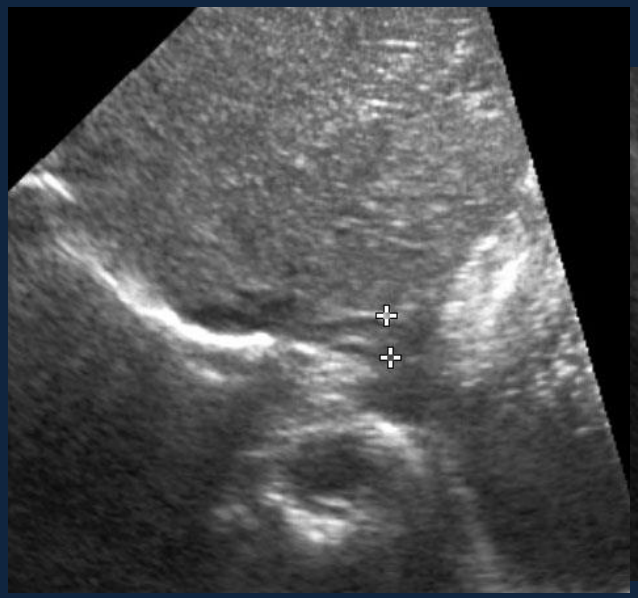
Gastroesophageal Junction – The Other Gastric Outlet

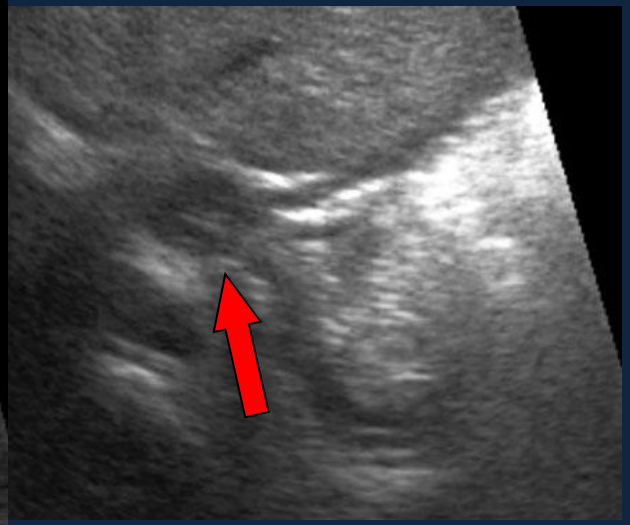
- Often clearly seen with a fluid-distended stomach
- Gastroesophageal reflux can be identified
  - May obviate the need for an UGI series
- Often imaged inadvertently



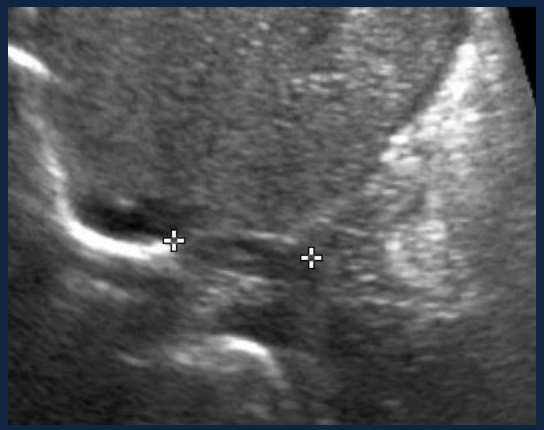
Transverse





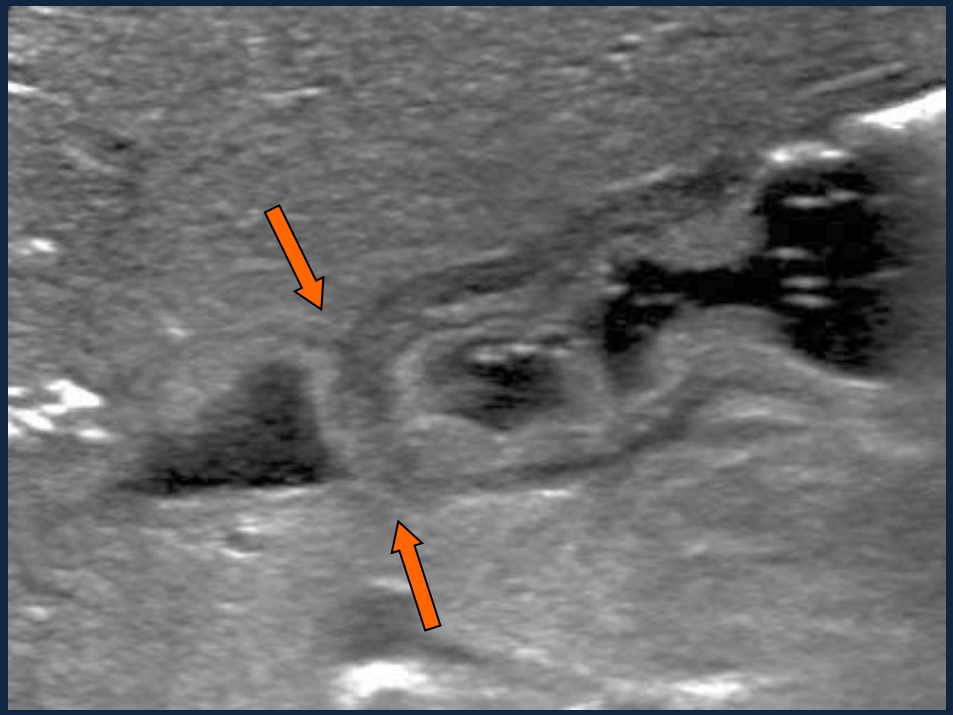


Longitudinal

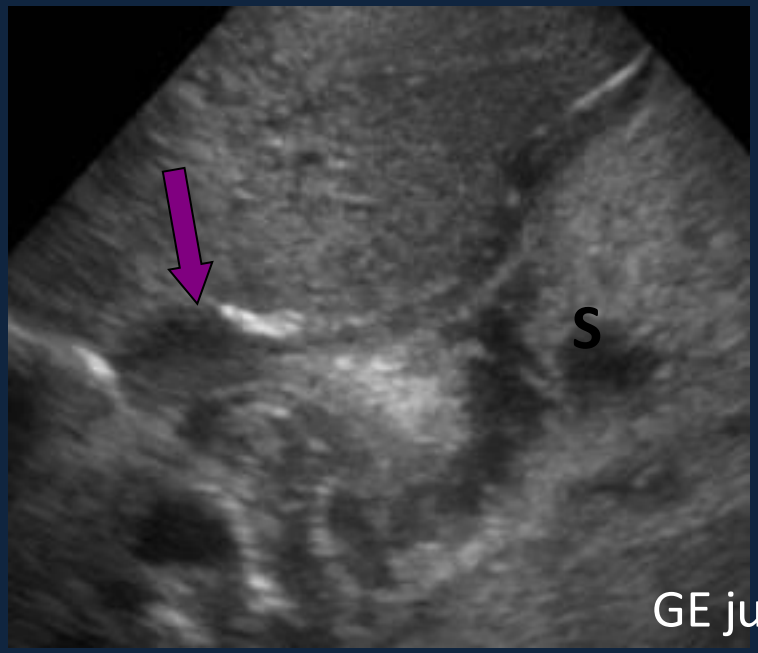


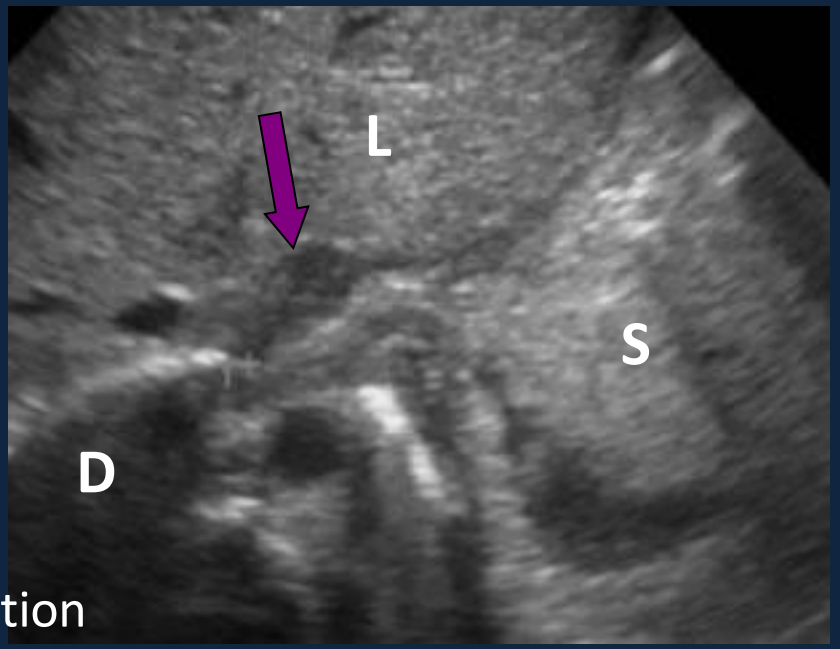
US of the GE Junction

GE Junction



Pylorus





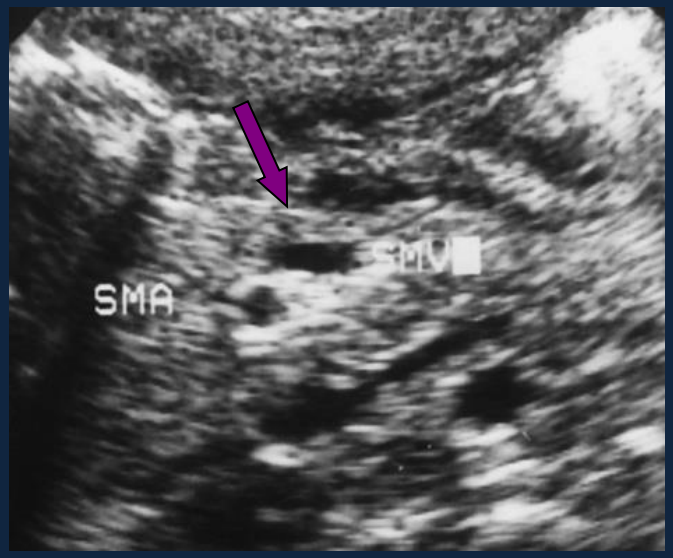
GE junction

Duodenal Web

US of Duodenum

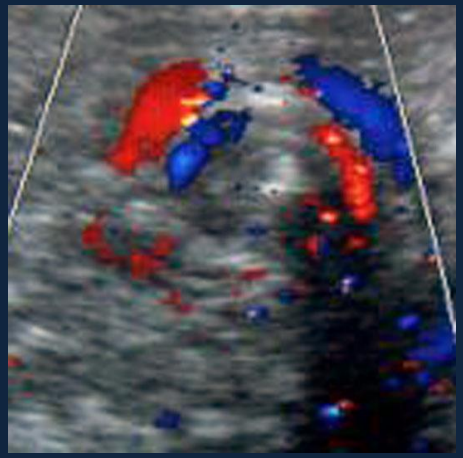
- May be accomplished if adequate fluid fills the lumen
  - May not be possible with severe GE reflux or poor gastric emptying
- Growing trend to use as screening in infants with bilious vomiting

Acute Duodenal Obstruction

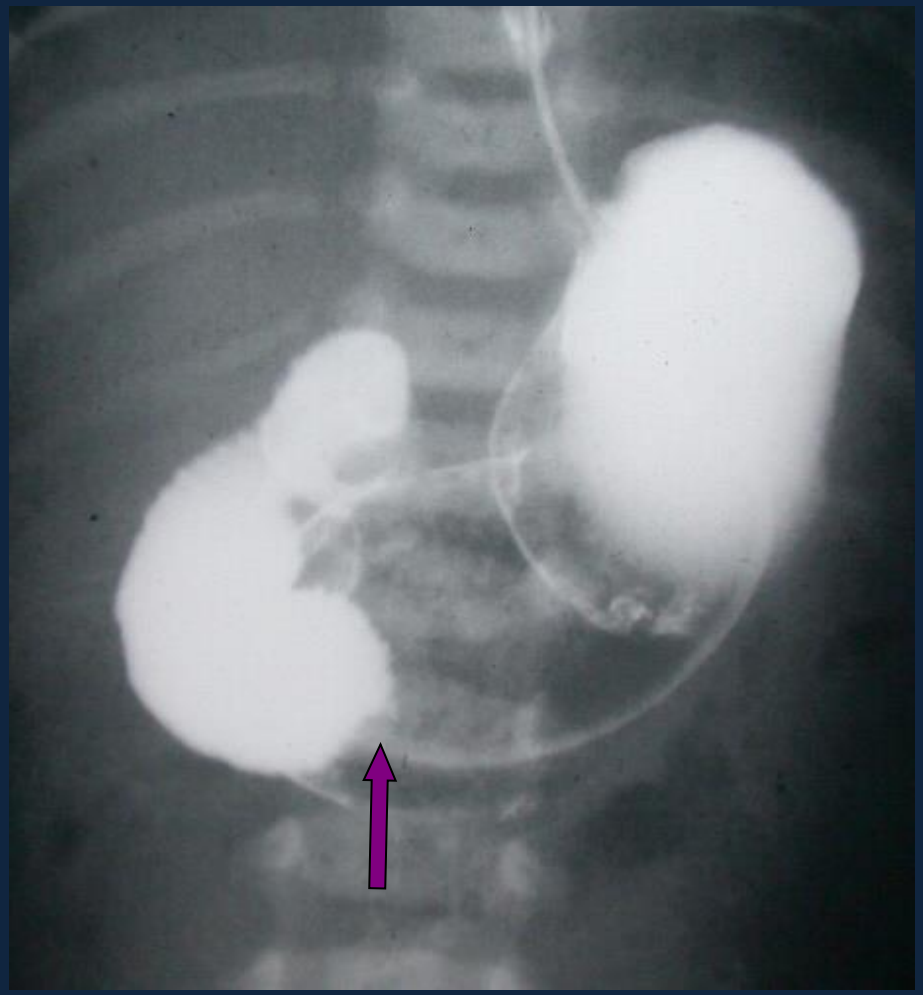


SMV to the Rt of SMA is abnormal, suggests malrotation

- Midgut volvulus
  - Bilious vomiting
  - Can occur at any age



Whirlpool sign



Signs of midgut volvulus

- Abnormal duodenojejunal junction position + swirling
- Complete obstruction in D3

9 month old with bilious vomiting and fever

Small bowel obstruction

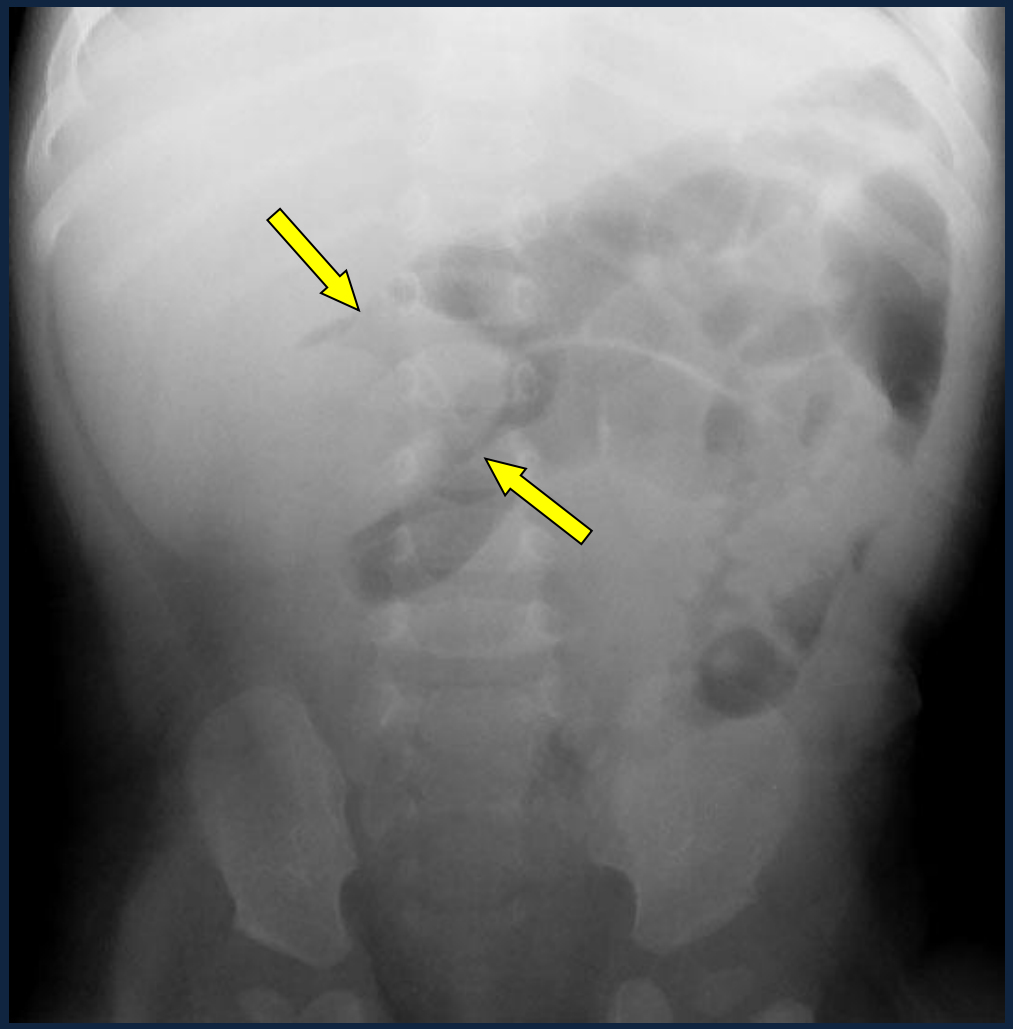
9 month old with bilious vomiting and fever

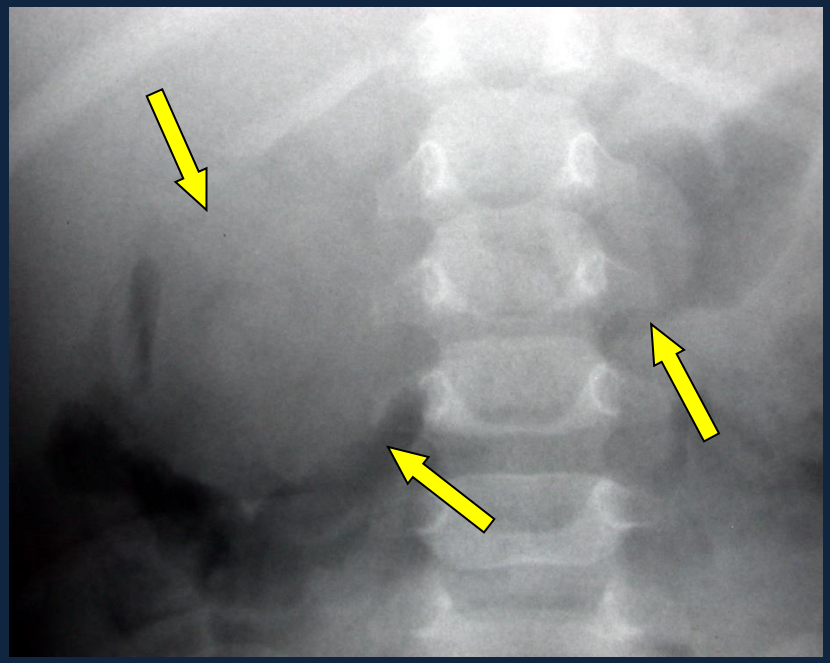
Ileocolic Intussusception

Intussusception

- Acute ileocolic obstruction (5months – 3 yrs age)
  - Often obstruction not evident on radiographs
  - Symptoms nonspecific
    - Vomiting
    - Intermittent crying episodes
    - Lethargy

- Early identification of intussusception makes non-surgical reduction more likely

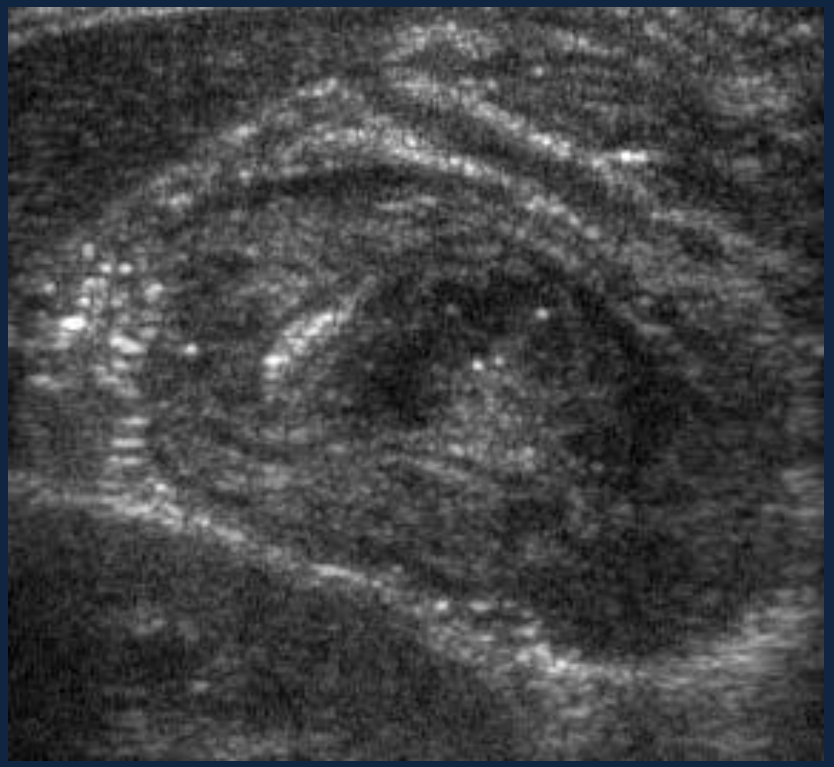


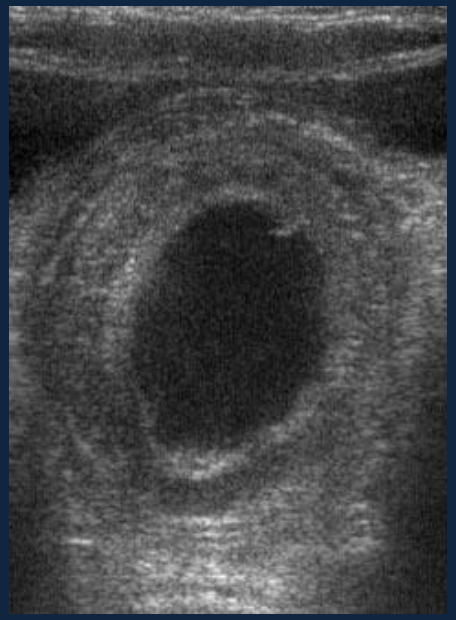


Intussusceptum visible on XR

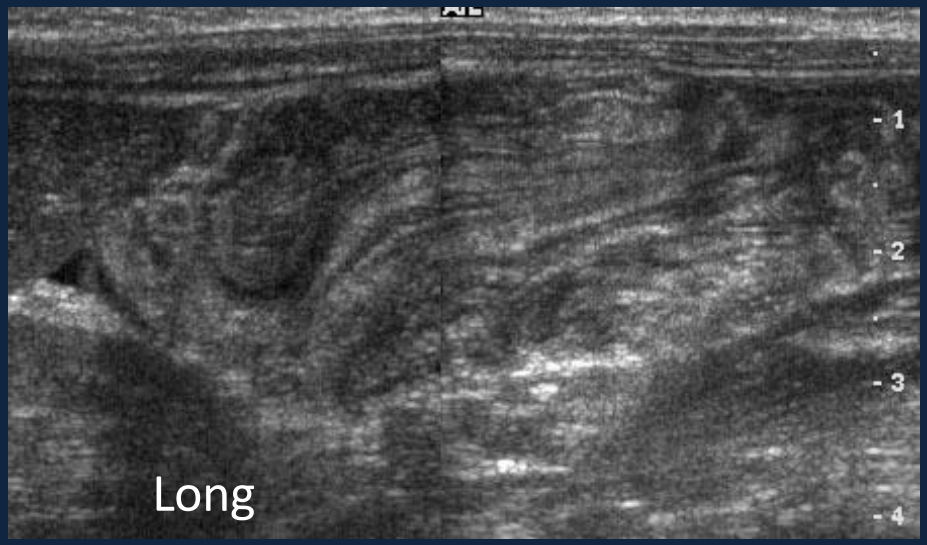
Ultrasound for Intussusception

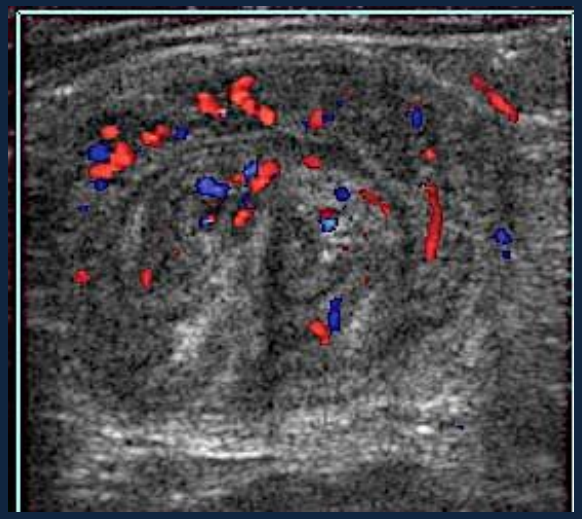
- High frequency (7-12 mHz) transducer
- Complex mass
  - Target, donut appearance





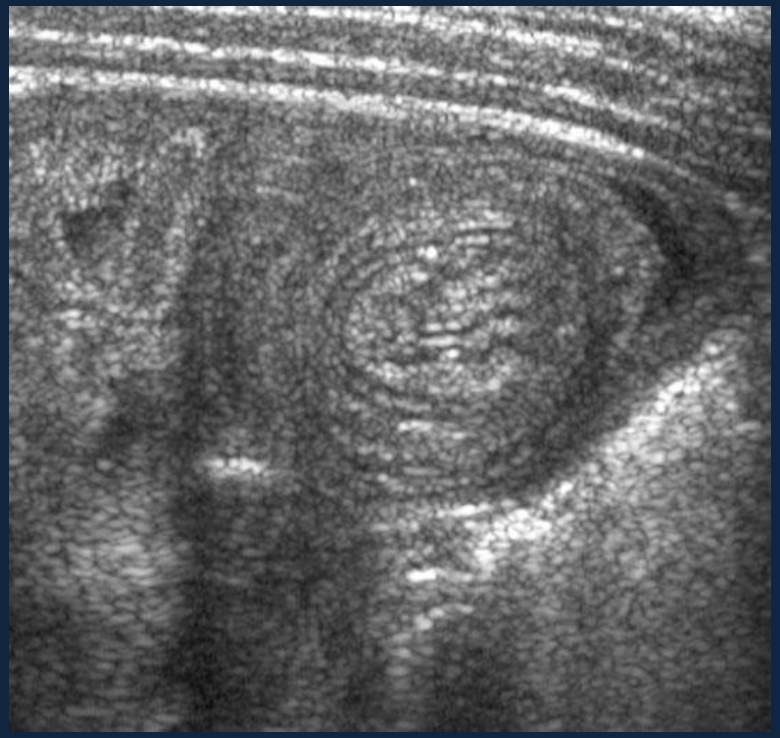
- High sensitivity and specificity
- If US negative, contrast enema not needed



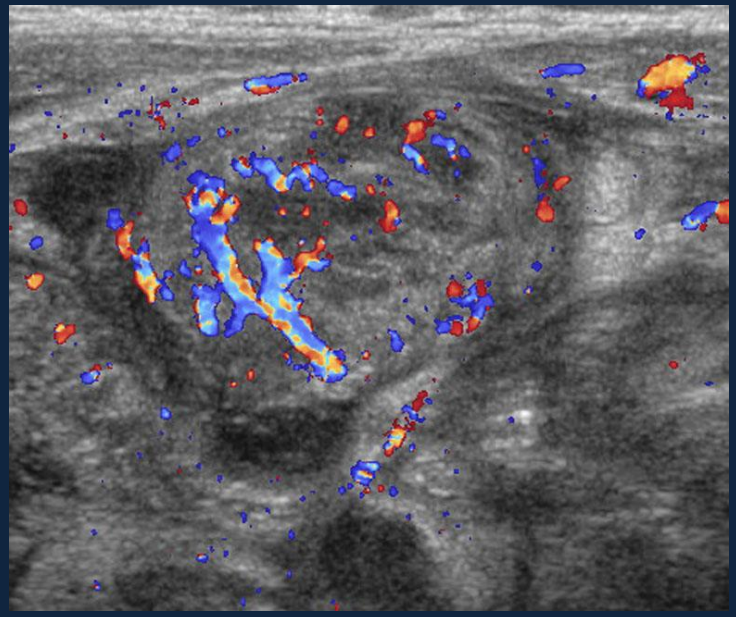


Small Bowel Intussusception

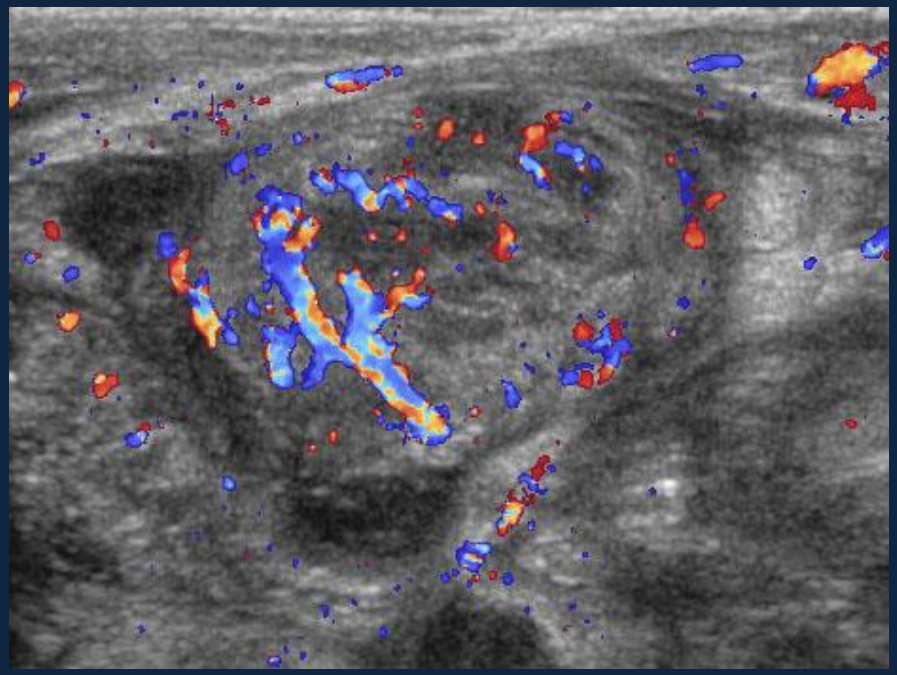
- Common in patients with hyperperistalsis
  - Smaller (<2.5 cm diameter), rim not hypoechoic, central abdomen
  - Only need surgery if persistent and longer than 3.5 cm in length Munden, AJR 2007;188:275-279

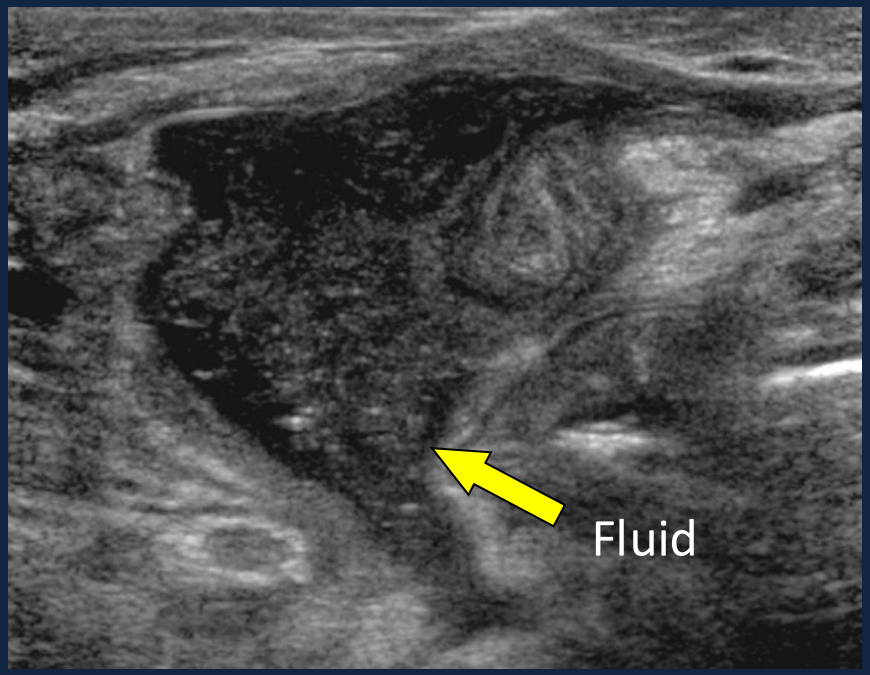


18 month old with abdominal pain and fever



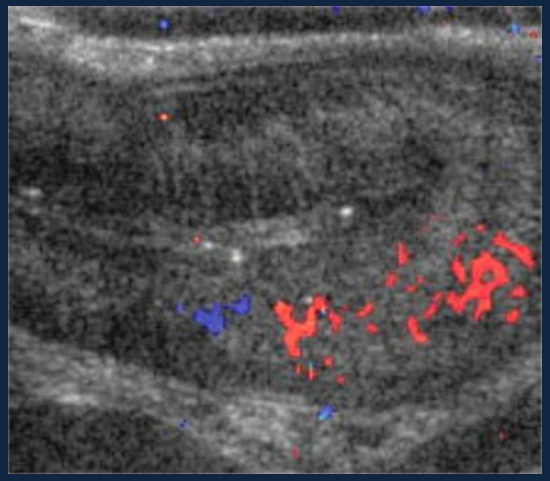
Perforated Appendicitis Mimics Intussusception



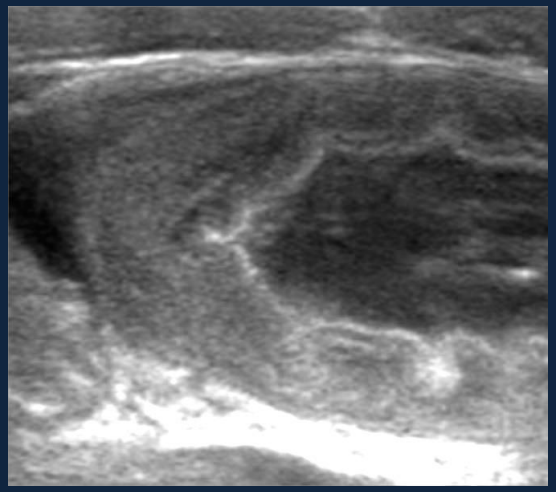


- Thickened bowel can resemble intussusceptum
- Complex free fluid is a clue

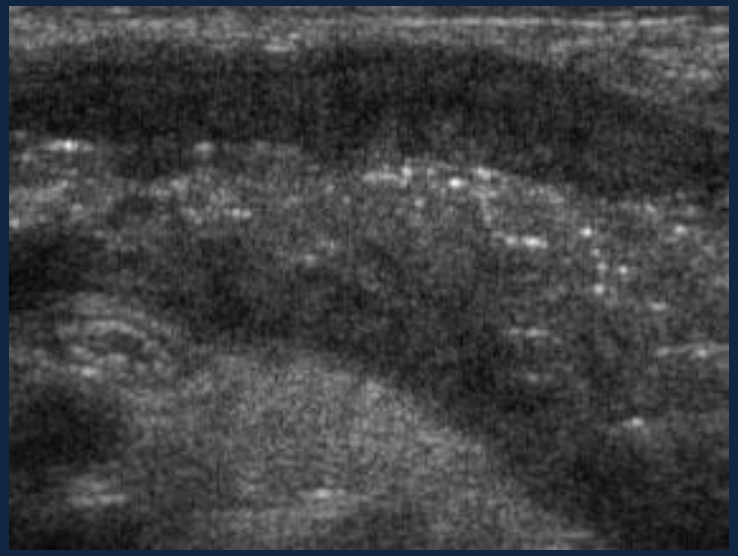
Pseudomembranous colitis

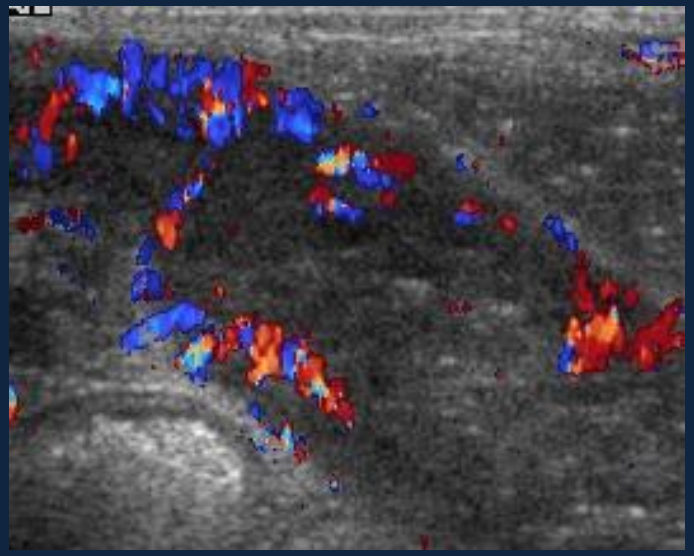


Shiga toxin positive colitis



Henoch Schoenlein purpura





Regional enteritis

Appendicitis

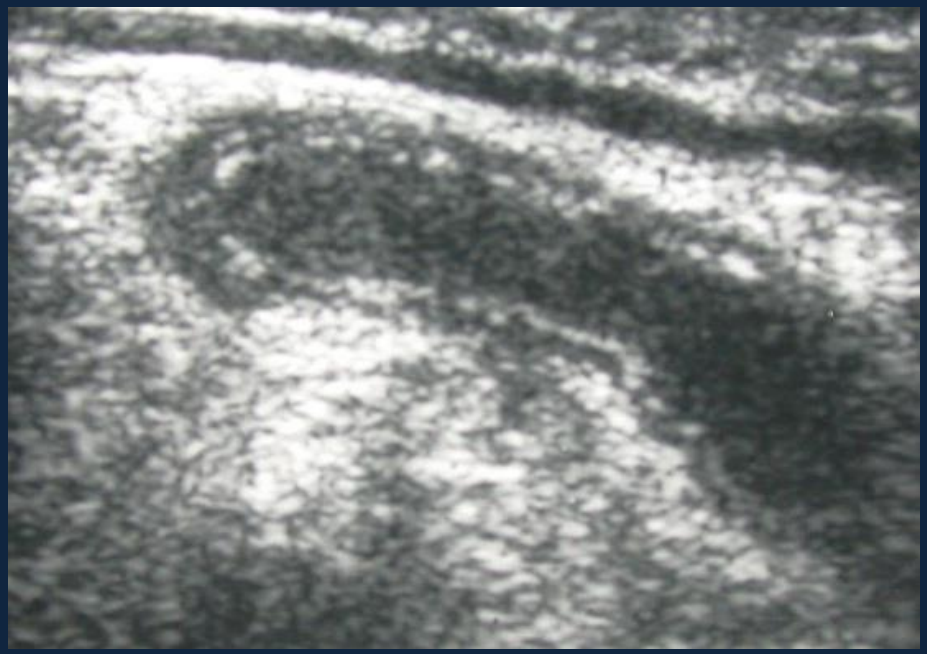
- Continues to be an elusive diagnosis in some patients
- Multimodality imaging is often performed, increasing cost and delaying diagnosis
- CT is the default imaging study for adults in most emergency departments

But children are different!

US for Appendicitis

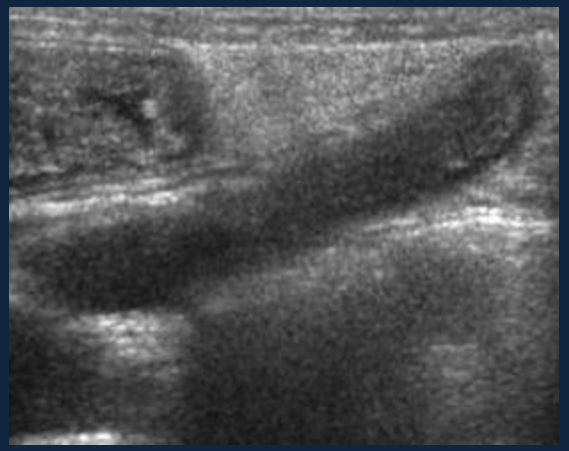
- Widely accepted as best first screening exam in children
- Staged approach using CT for equivocal cases highly accurate
  - Sensitivity 98.6%
  - Specificity 90.6%
  - CT avoided in 53%

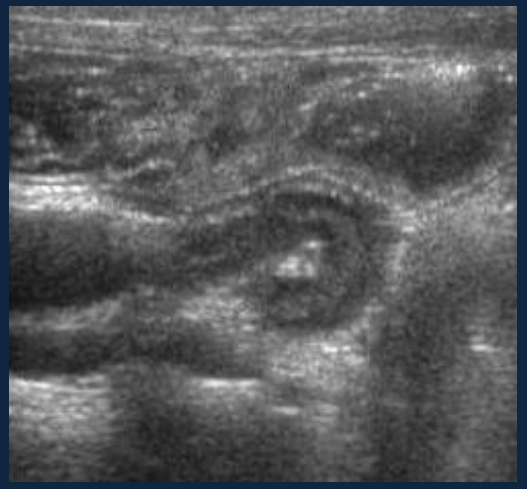
Krishnamoorthi, Radiol Jan. 2011



Normal Appendix

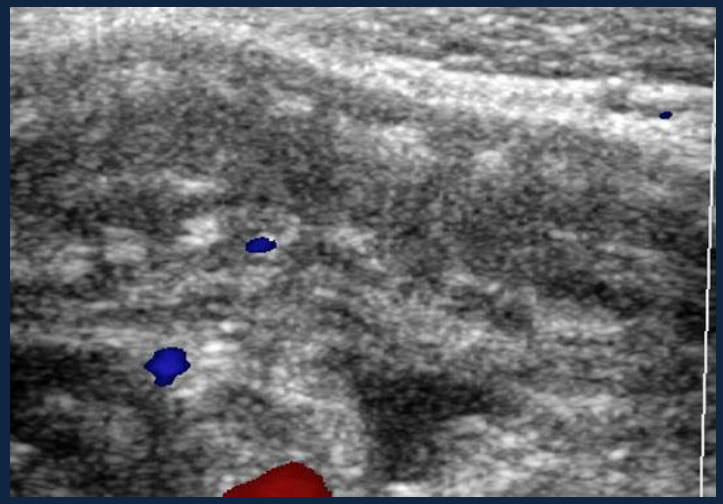
- More easily visible in children
  - Superficial
  - Less body fat
- Features
  - < 6-7 mm diameter (commonly)
  - Mobile
  - Active peristalsis in surrounding bowel
  - Little visible surrounding fat

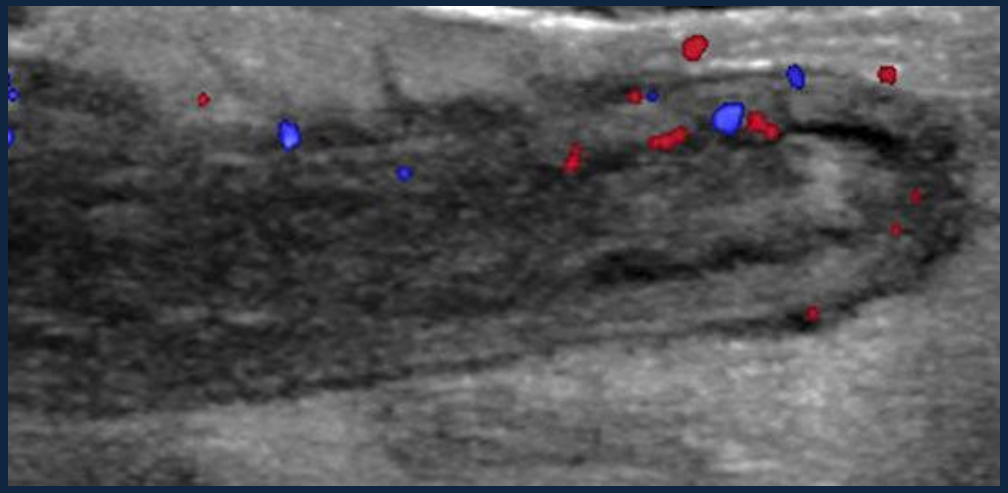




Problem Findings on Appendix US

- Large size (>7 mm)
- Compressibility
- Vascularity





Appendix Size in Appendicitis

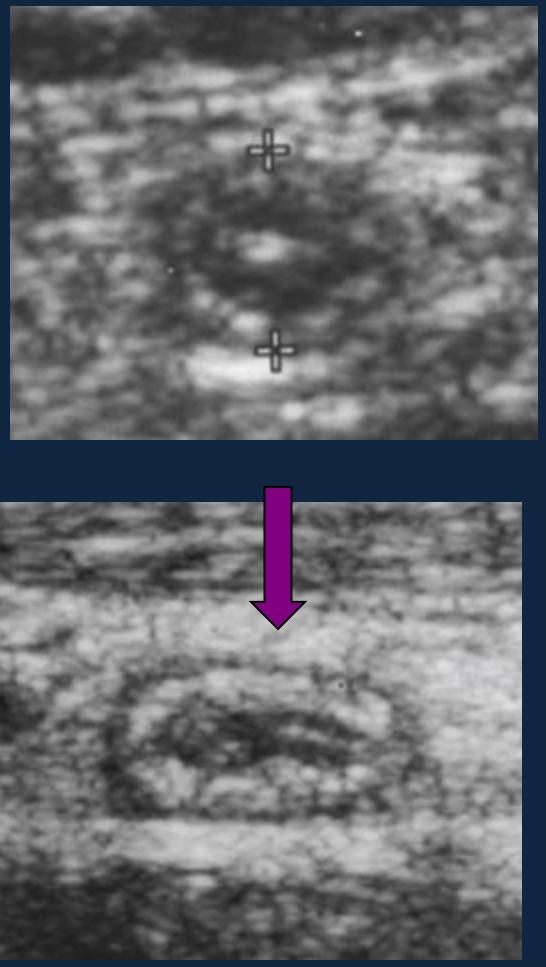
- 6 mm or > in diameter “abnormal”
  - PPV – 63%
  - NPV – 100%
  - More useful for excluding appendicitis

  Rettenbacher, Radiology 2011; 218: 757.
- 7 mm or >
  - Similar accuracy

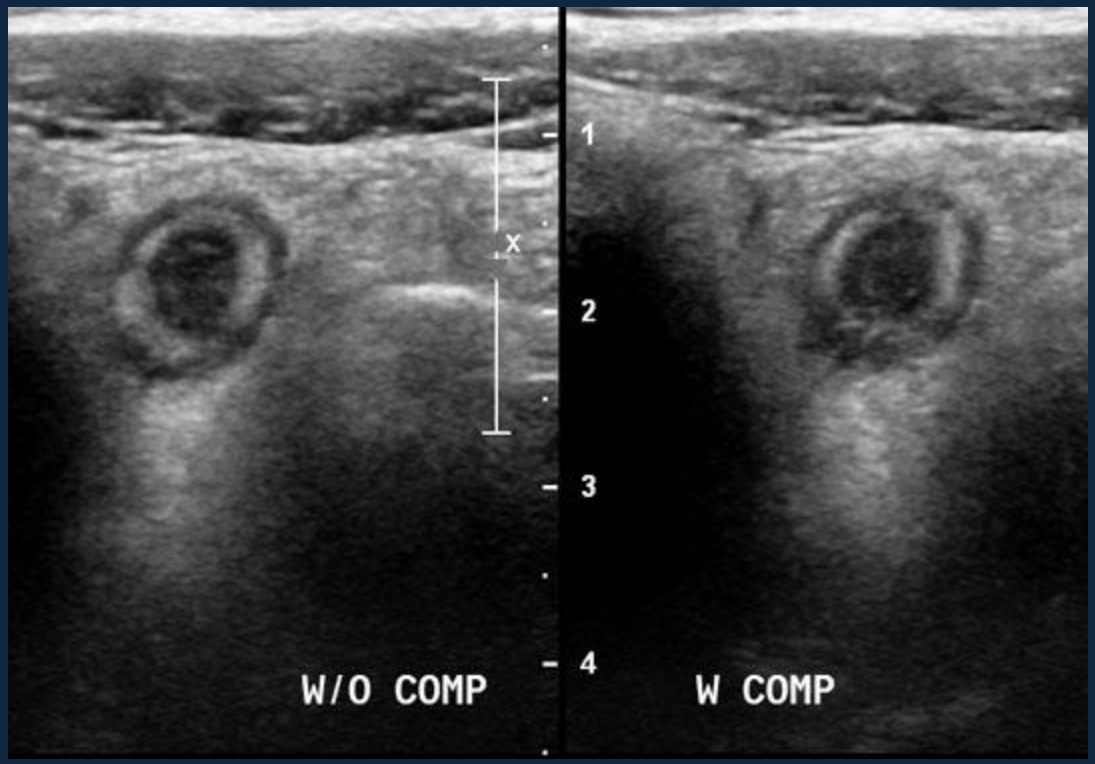
  Goldin, Pediatr Radiol 2011; 41: 993.
- CT – normal can be up to 8.7 mm
  - Grows in childhood

  Trout AT, AJR 2014; 202:936.

Compressibility – can be difficult to demonstrate with normal appendix



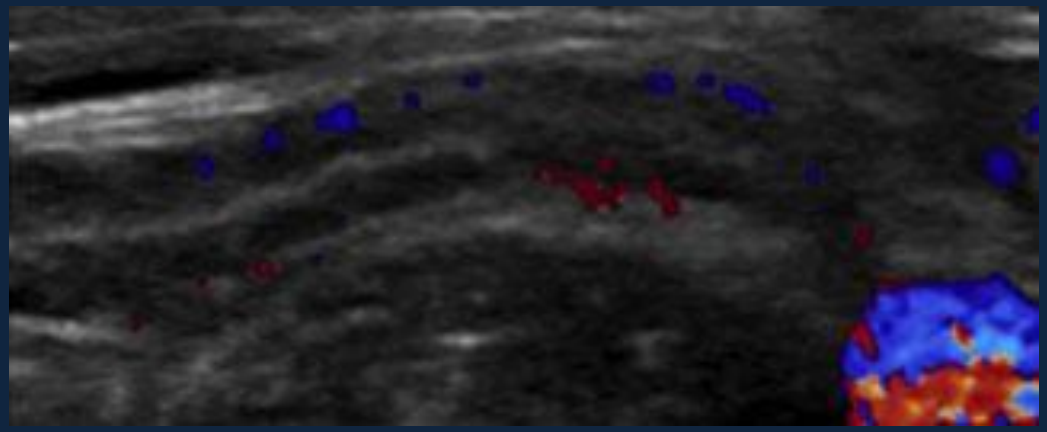
Normal



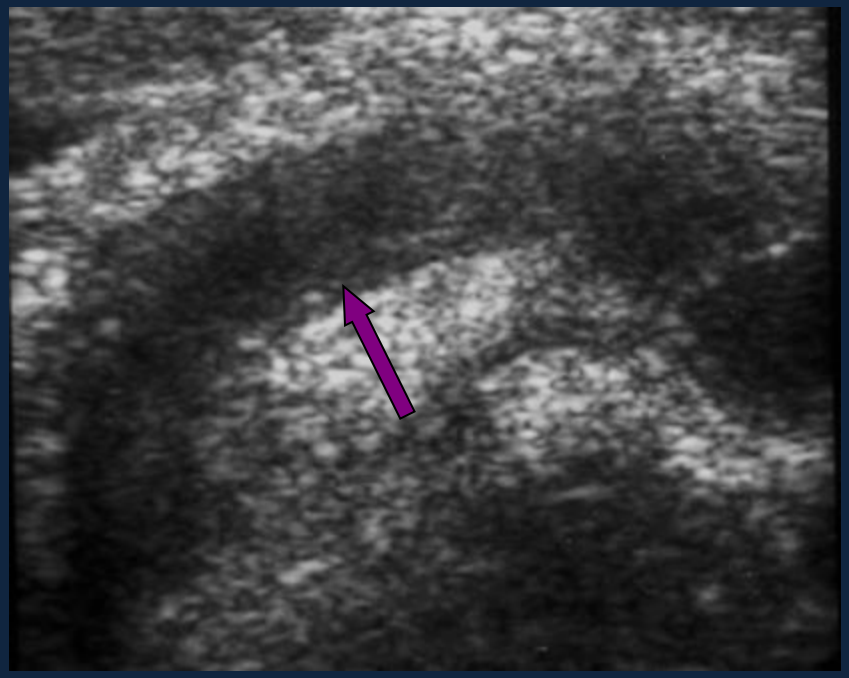
Appendicitis

Lymphoid Hyperplasia of the Appendix

- Enlarged lymphoid tissue in wall
  - Response to viral infection
- Can cause obstruction of the appendiceal lumen
  - May result in tip appendicitis

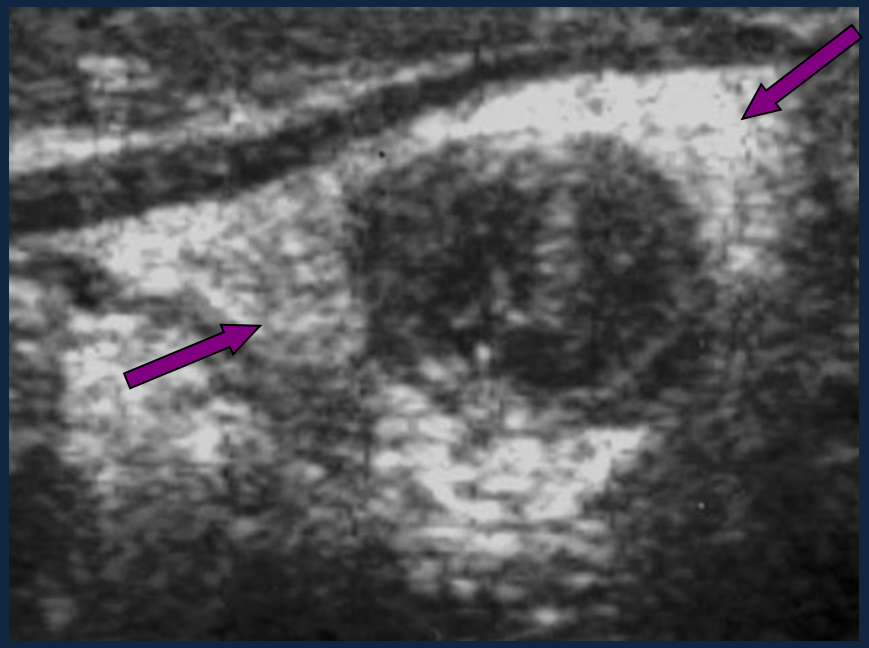


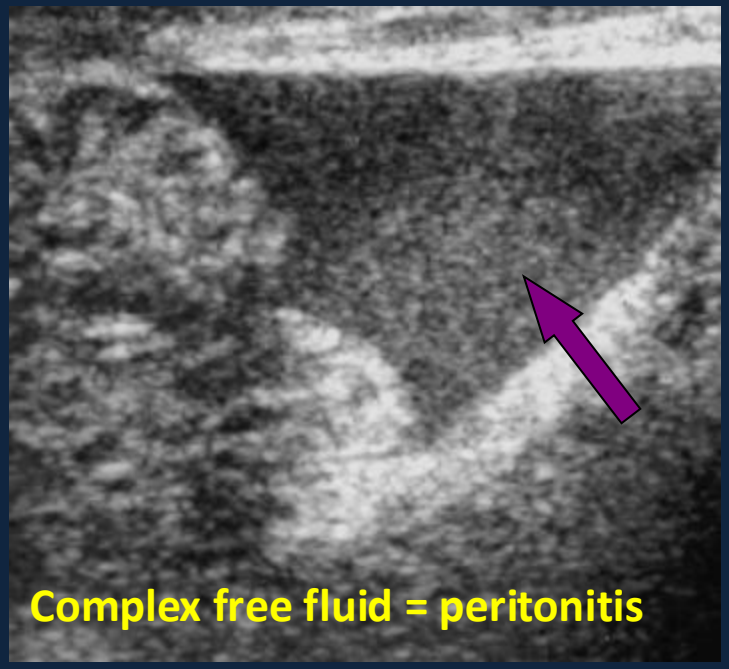
Swischuk, et al, Emergency Radiology (2015) 22:643-649

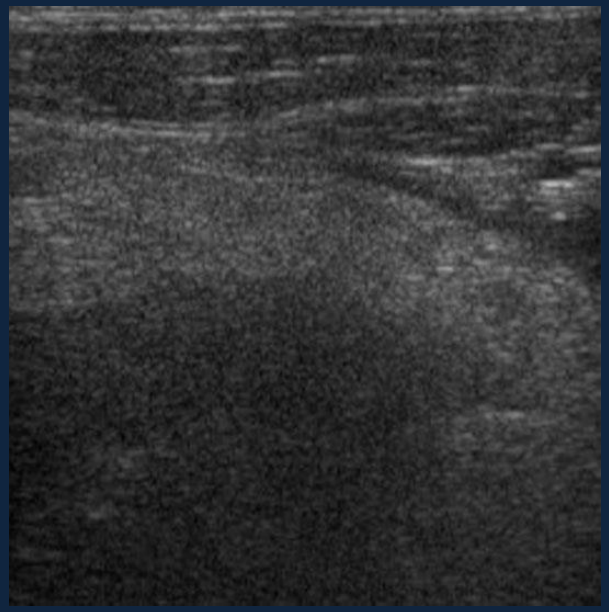


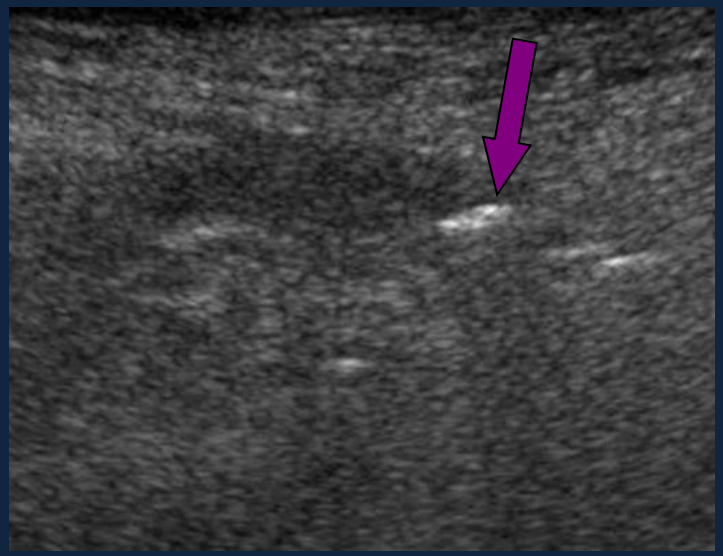
Signs of Active or Impending Perforation

- Loss of mucosal lining
- Edematous fat
- Adjacent fluid collections









Secondary findings can be strong indicators of appendicitis

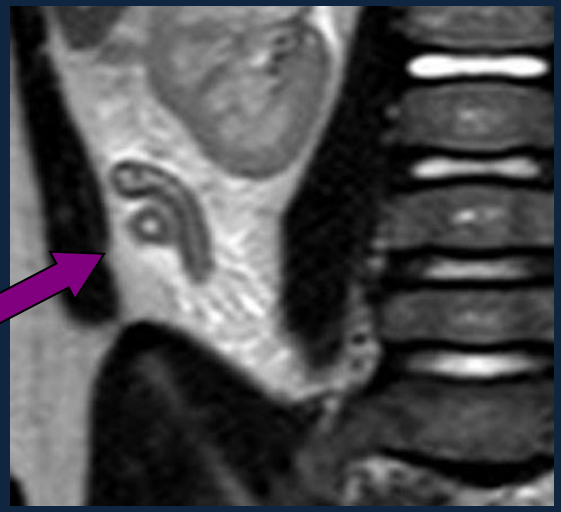
Wiersma, Eur Radiol 2009; 19: 455.

Thickened Echogenic Fat = Inflammation

Ultrafast MRI for Appendicitis

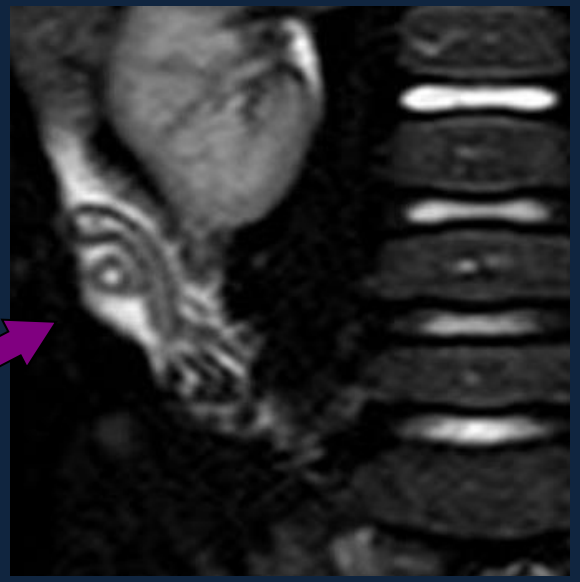
- Children of age 4-17 years
- No sedation or contrast
- Limited exam
  - Axial and coronal SSFSE w/wo fat sat
  - Axial DWI
- Scan times less than 9 minutes
- Normal appendix seen 43% of the time
- Sens/spec 100/99%
  - PPV 98%
  - NPV 100%

Johnson, AJR 2012, Jun 198:1424

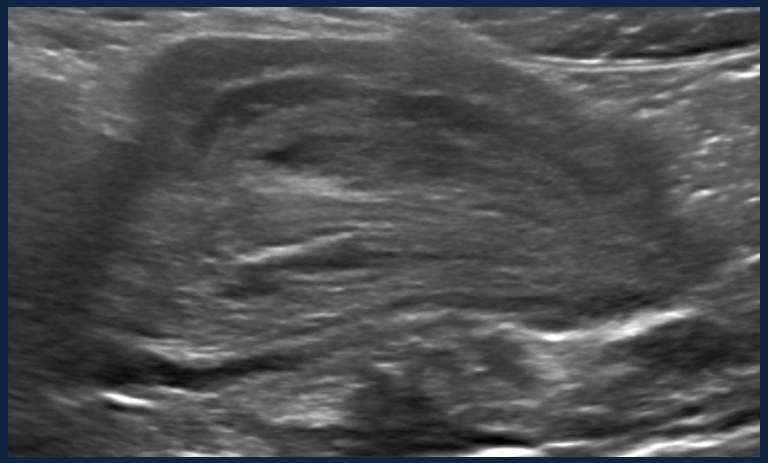


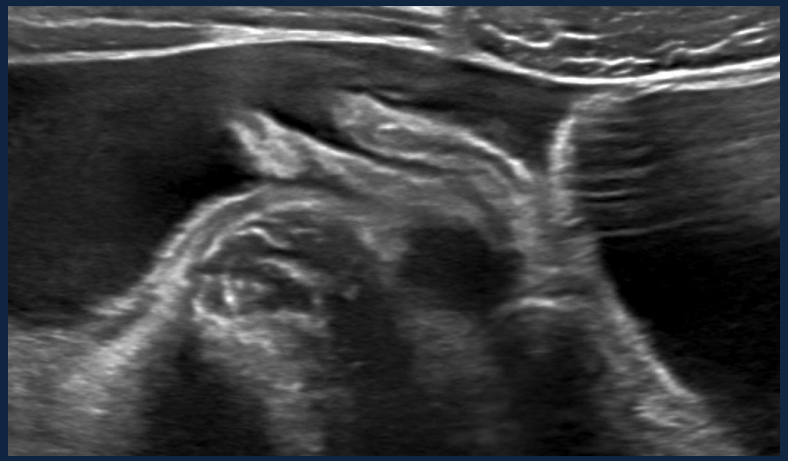
- No difference in time to antibiotics or surgery, negative appendectomy rate, perforation rate, or length of stay.

Gudrun A et al, Pediatrics 2014 ;133:586.



6 year old with abdominal pain and vomiting





Ingested magnetic beads with obstruction and perforation

Imaging GI Abnormalities in Children

- Use age and clinical signs to select best first exam
- Don’t ignore the xrays!
- US highly reliable when performed with proper technique
  - Proper fluid distension and positioning
  - Taking time to assess dynamic factors
  - Noting important secondary findings

susan.d.john@uth.tmc.edu