Pediatric Abdominal Emergencies

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PRESENTER FINANCIAL DISCLOSURE

I have no financial relationships relevant to this presentation

Objectives

- Describe imaging findings of common emergencies of the pediatric abdomen
- Recognize important anatomic landmarks
- Identify findings that affect management
- Recognize pitfalls that may lead to missed or incorrect diagnoses

CASE 1

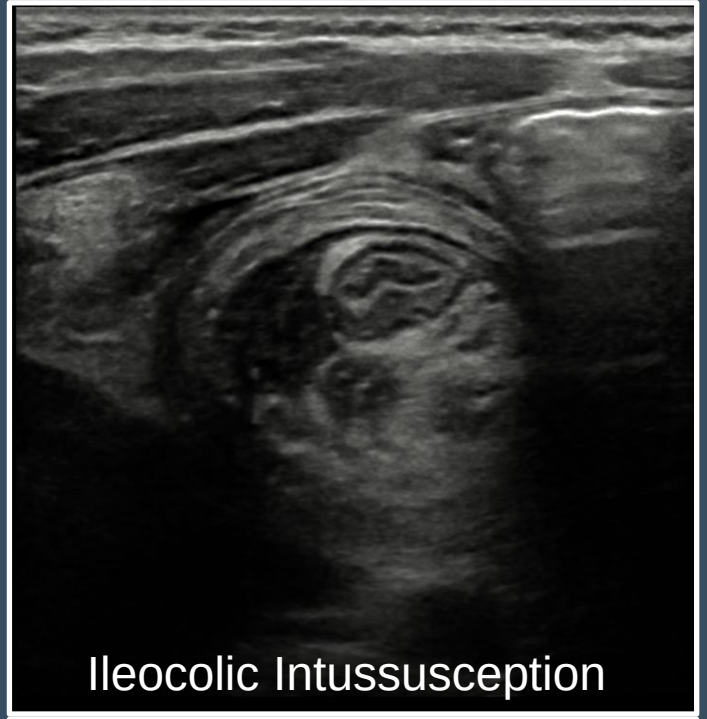
History: 10-month-old with abdominal pain

Findings:

- Target appearance of bowel at the right lower quadrant >2.5 cm in diameter
- Large fat component centrally
- Pseudokidney appearance on longitudinal images

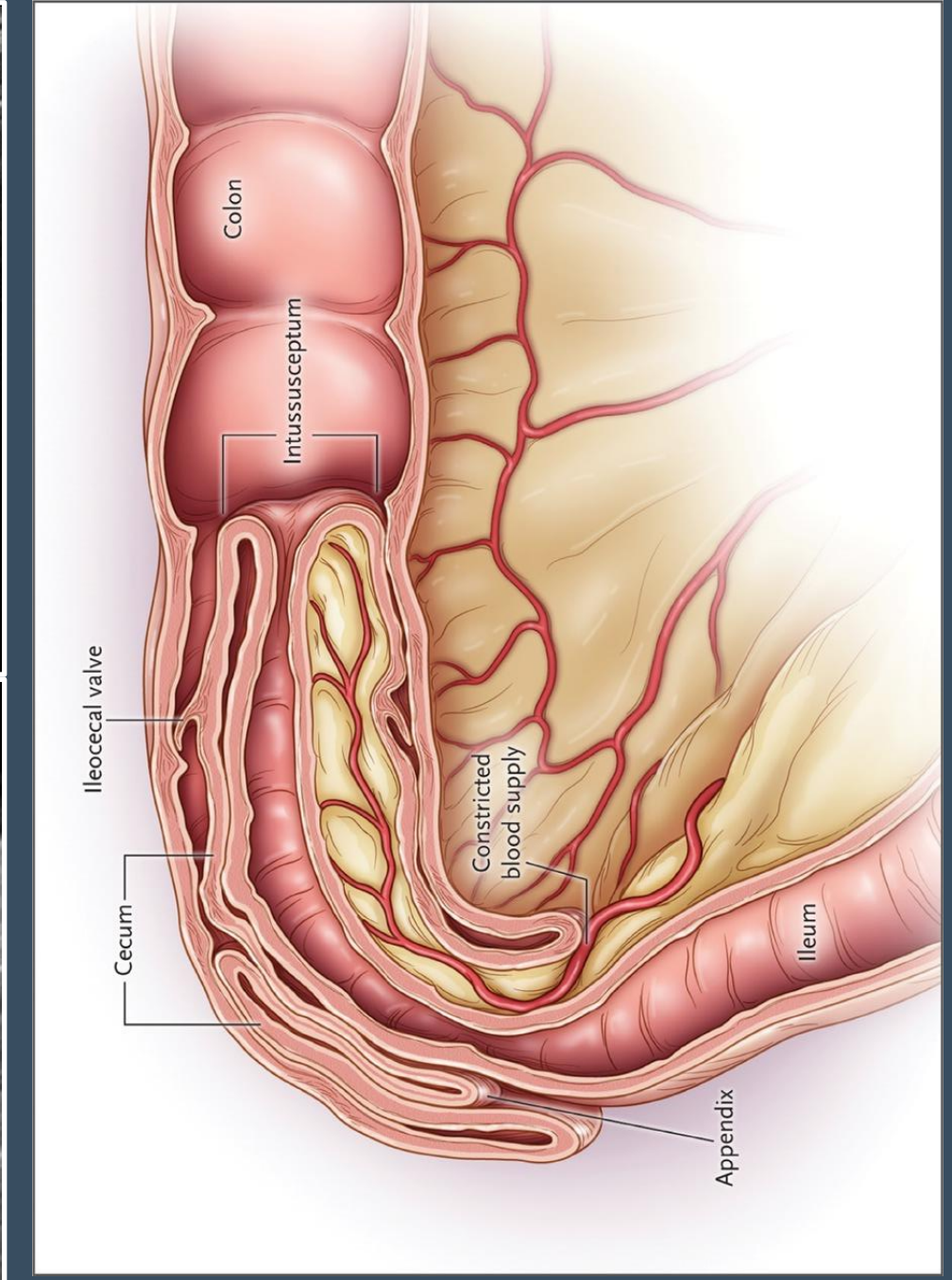
Diagnosis:

Ileocolic Intussusception



Ileocolic Intussusception

Small-bowel Intussusception



N Engl J Med 2012; 367:186-187
DOI: 10.1056/NEJMc1205522

Intussusception

Findings that favor ileocolic intussusception:

- RLQ
- Size (mean diameter >2.5 cm)
- Central fat core : Outer wall thickness >1.0

CASE 2

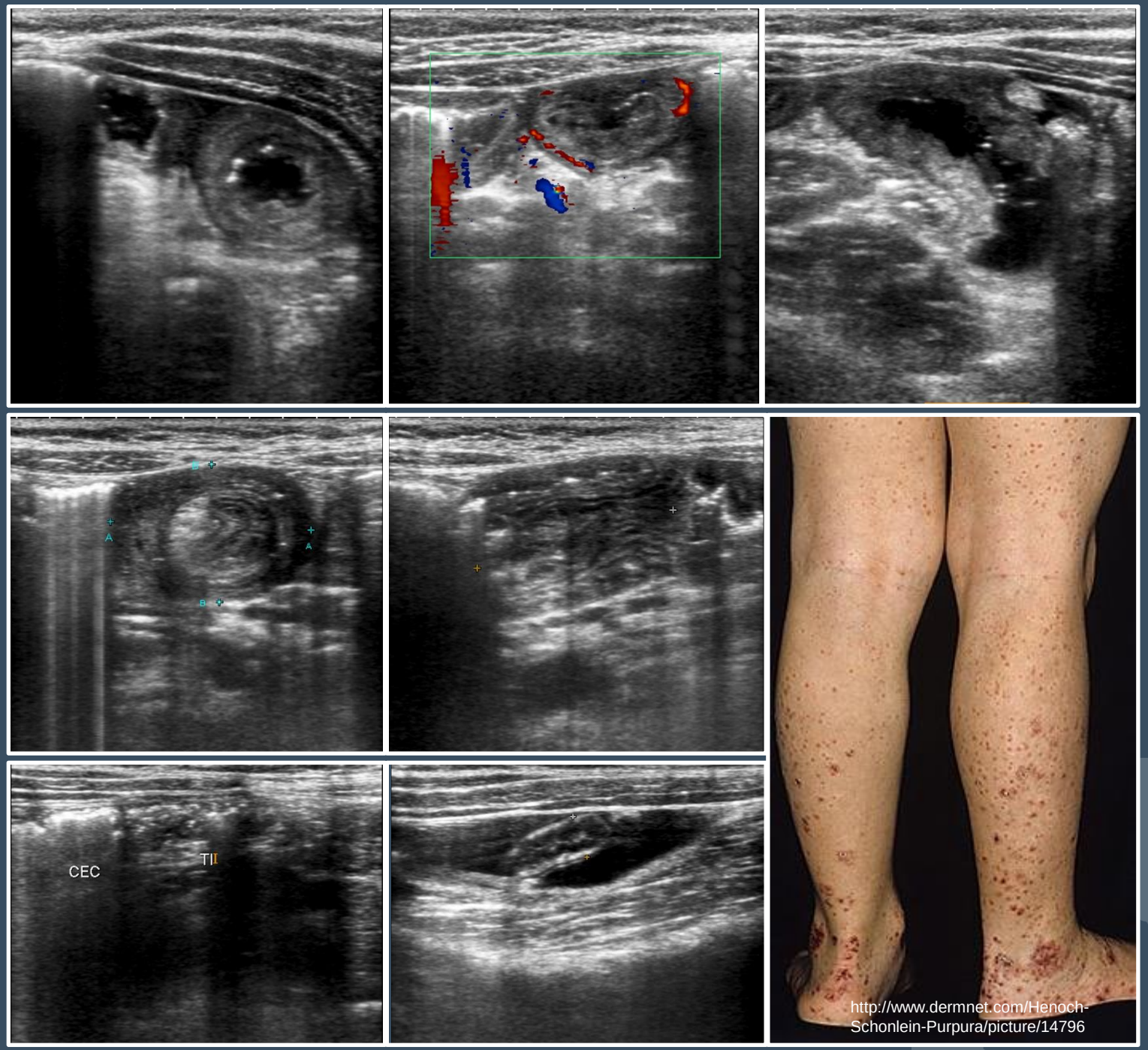
History: 4-year-old with abdominal pain

Findings:

- Discontinuous areas of circumferential bowel wall thickening and hyperemia
- Multiple areas of small bowel intussusception
- Lower extremity rash

Diagnosis:

Henoch-Schonlein Purpura with small bowel intussusception



Case 2 Companion

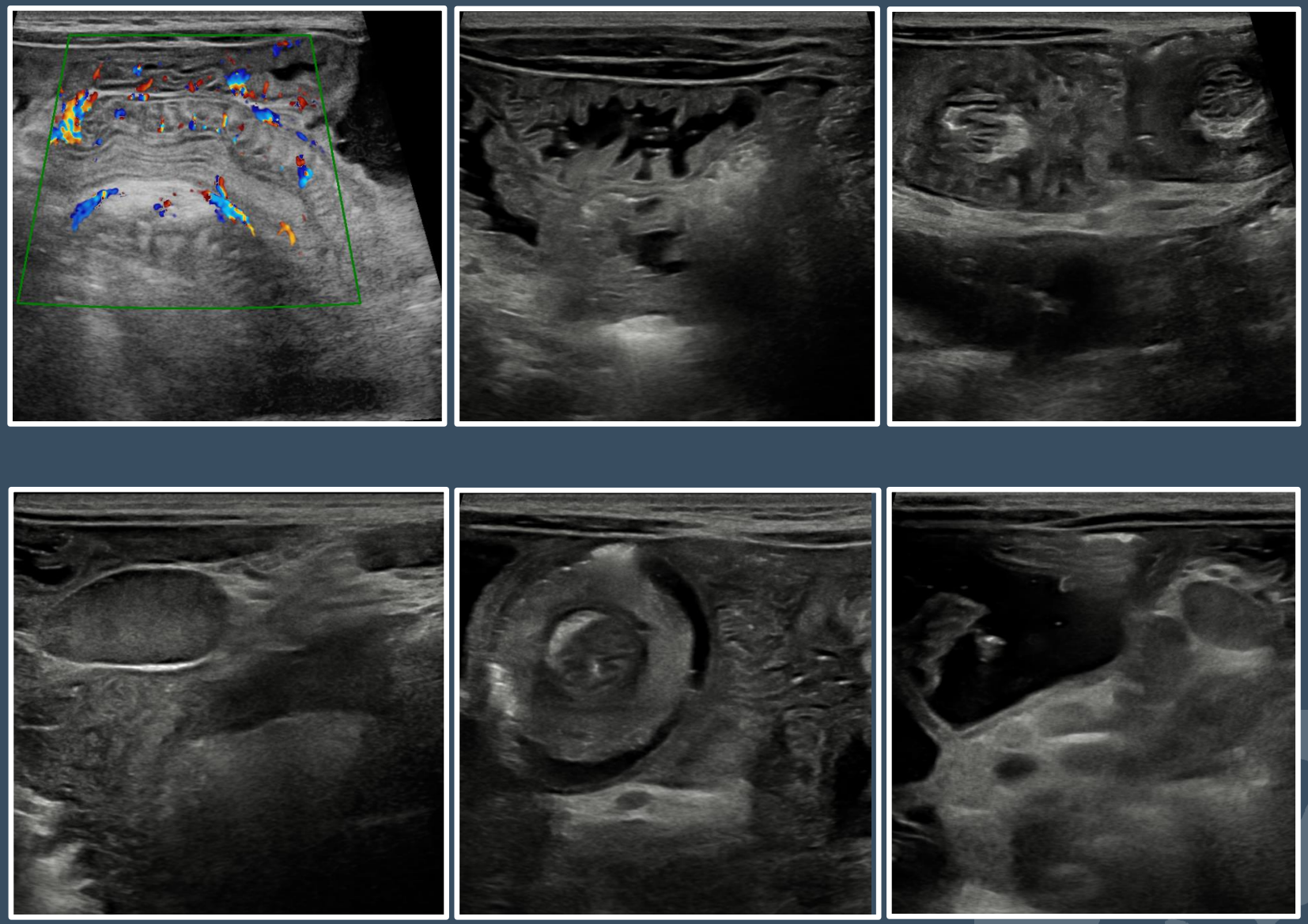
History: 3-year-old with chronic abdominal distention, pain, and steatorrhea

Findings:

- Numerous small-bowel intussusceptions
- Small-bowel wall thickening
- Hyperperistalsis
- Fluid-filled bowel loops
- Echogenic fat
- Lymphadenopathy

Diagnosis:

Celiac disease



Small-Bowel Intussusception

- Often transient
- Consider underlying pathologies
- Concerning features
  - Length >3 cm
  - Signs of obstruction
  - Lead point

CASE 3

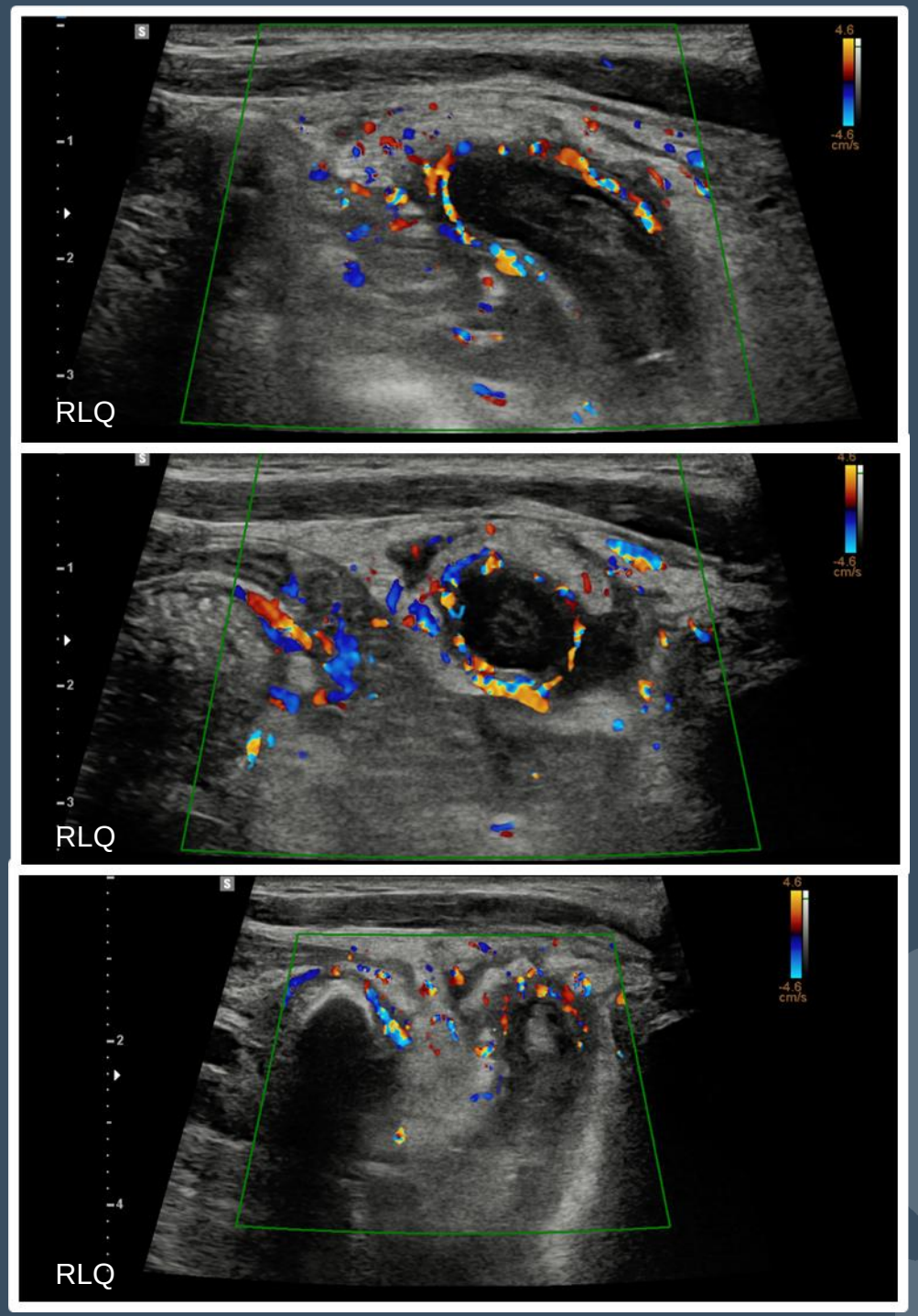
History: Pediatric patient with abdominal pain and emesis

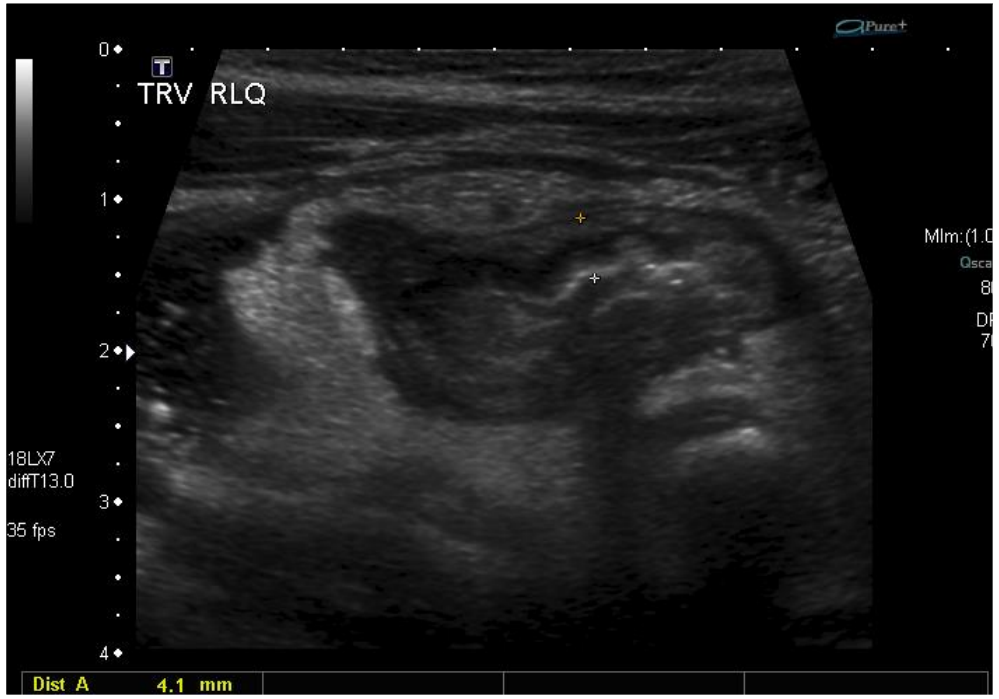
Findings:

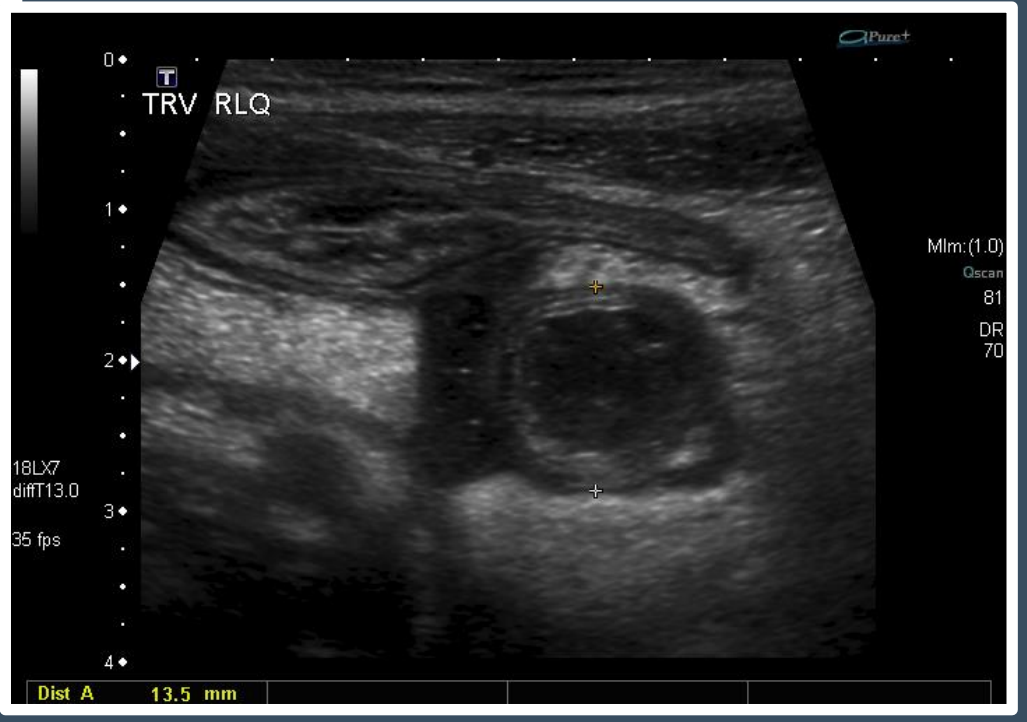
- Appendix
  - Enlarged, >6-7mm
  - Hyperemic
  - Noncompressible
- Appendicolith

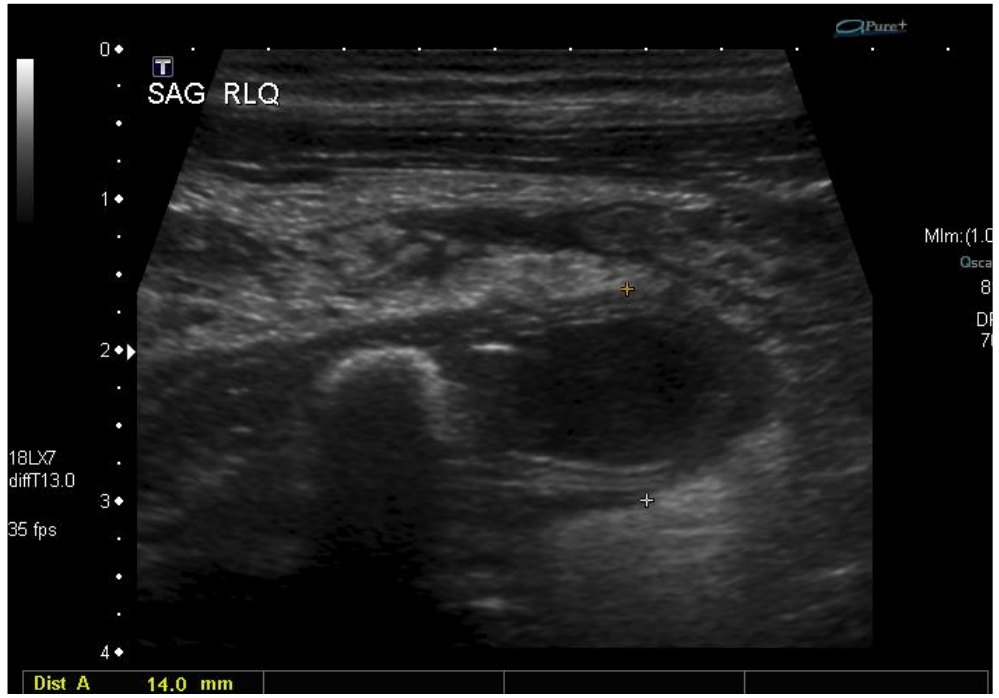
Diagnosis:

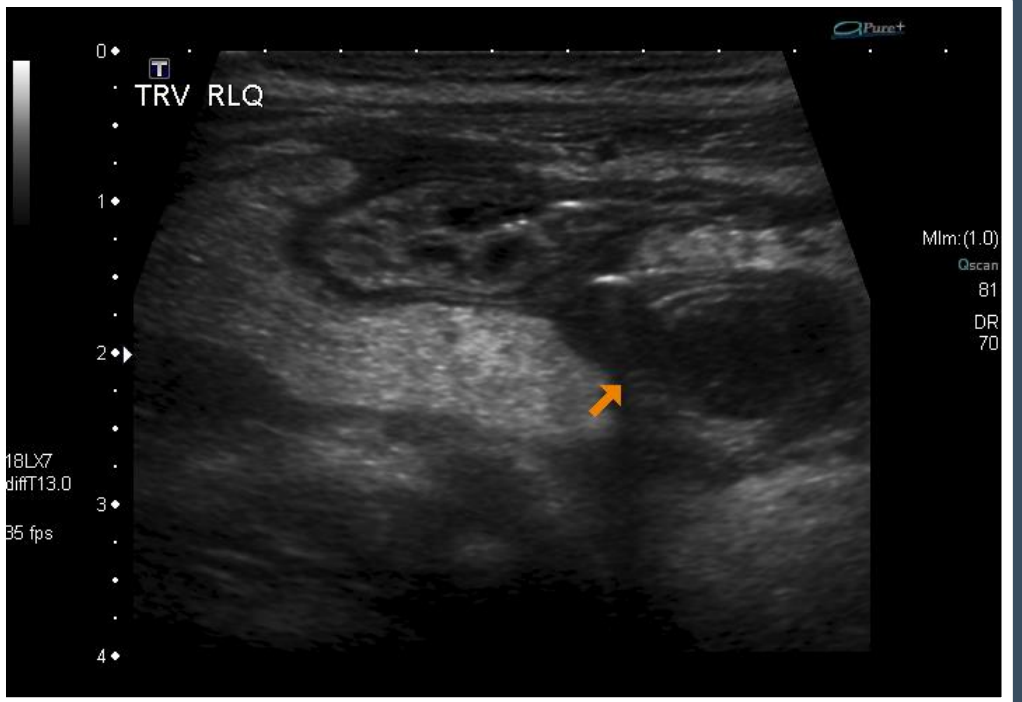
Acute appendicitis











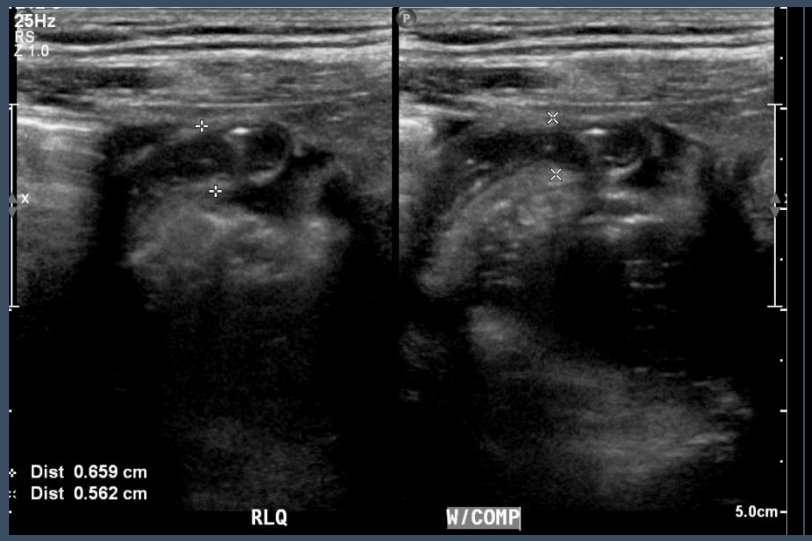
Appendicitis

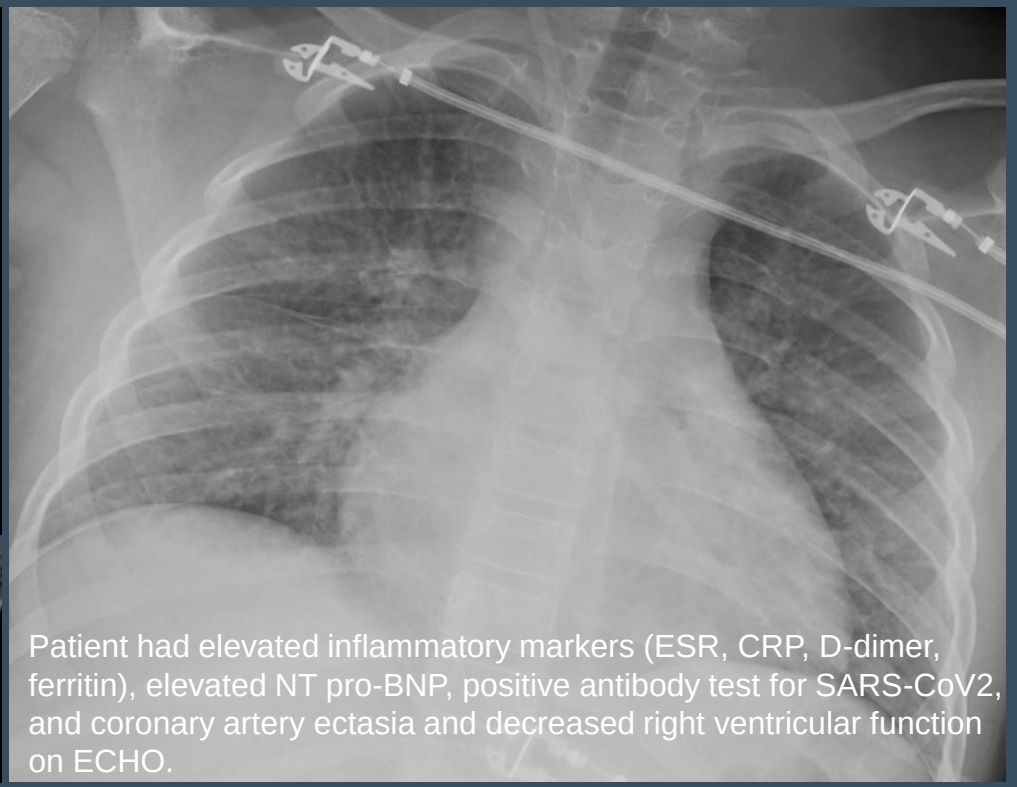
Appendicitis

- Size >6 mm
- Noncompressible
- Hyperemic
- Echogenic fat
- +/- Appendicolith

9% of studies are equivocal

Constellation of findings





Patient had elevated inflammatory markers (ESR, CRP, D-dimer, ferritin), elevated NT pro-BNP, positive antibody test for SARS-CoV2, and coronary artery ectasia and decreased right ventricular function on ECHO.

CASE 4

History: Child with fever, cough and right lower quadrant pain

Findings:

- Mildly prominent non-compressible appendix
- Right lower quadrant lymphadenopathy
- Pulmonary edema and pleural effusions

Diagnosis:

Multisystem Inflammatory Syndrome in Children (MIS-C) associated with COVID19 infection

Teaching Points

- MIS-C commonly presents with symptoms and findings that mimic appendicitis.
- Generalized inflammatory findings and/or inflammatory findings not centered at the appendix, cardiac abnormalities and/or dysfunction, and pulmonary edema are helpful clues that MIS-C should be considered.

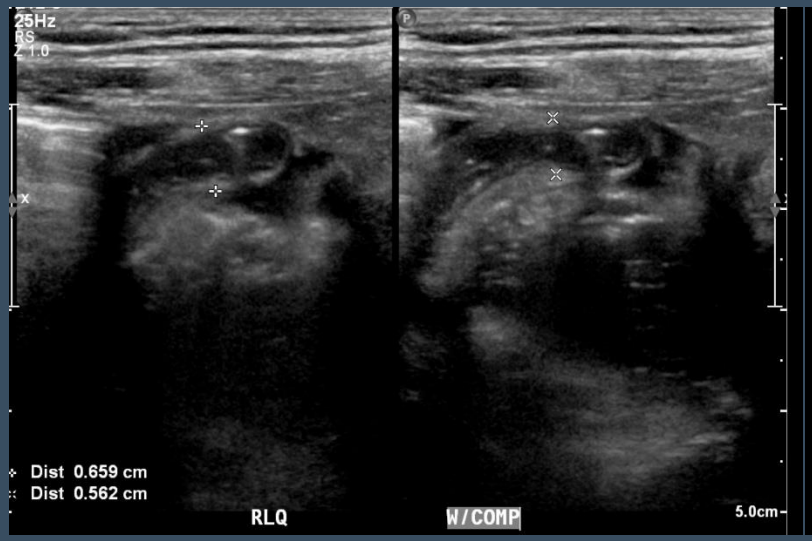
CDC MIS-C Case Definition

- Individual aged <21 years with fever, laboratory evidence of inflammation, and severe illness requiring hospitalization with multisystem organ involvement; AND
- Temporal association with COVID-19 evidenced by RT-PCR, serology, or antigen test, or by exposure to a suspected or confirmed COVID-19 case within the 4 weeks prior to the onset of symptoms; AND
- No other plausible diagnosis [3]

Clinical Findings

- MIS-C incidence is 2 per 100,000 in US
- Gastrointestinal symptoms in >90%, mostly abdominal pain and vomiting
- Work-up often includes CT and/or US
- Cardiovascular symptoms in >80%
- Differential diagnosis includes common abdominal pathologies and syndromes (Henoch-Schonlein purpura, hemophagocytic lymphohistiocytosis (HLH), Kawasaki disease (KD) etc.)

Imaging Findings	MIS-C Associated with Covid-19
Thoracic	Pulmonary edema, interstitial involvement, ARDS (asymmetrical), pleural effusion
Cardiovascular	Heart failure/Left ventricular systolic dysfunction, pericardial effusion, pulmonary embolism, coronary artery dilation, myocarditis
Abdominal	Hepatosplenomegaly, lymphadenopathy, gallbladder wall thickening, echogenic renal parenchyma, bladder wall thickening, ascites, bowel wall thickening
Other/Mucocutaneous	Rash, conjunctivitis, lip redness, headache,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Dist 0.562 cm
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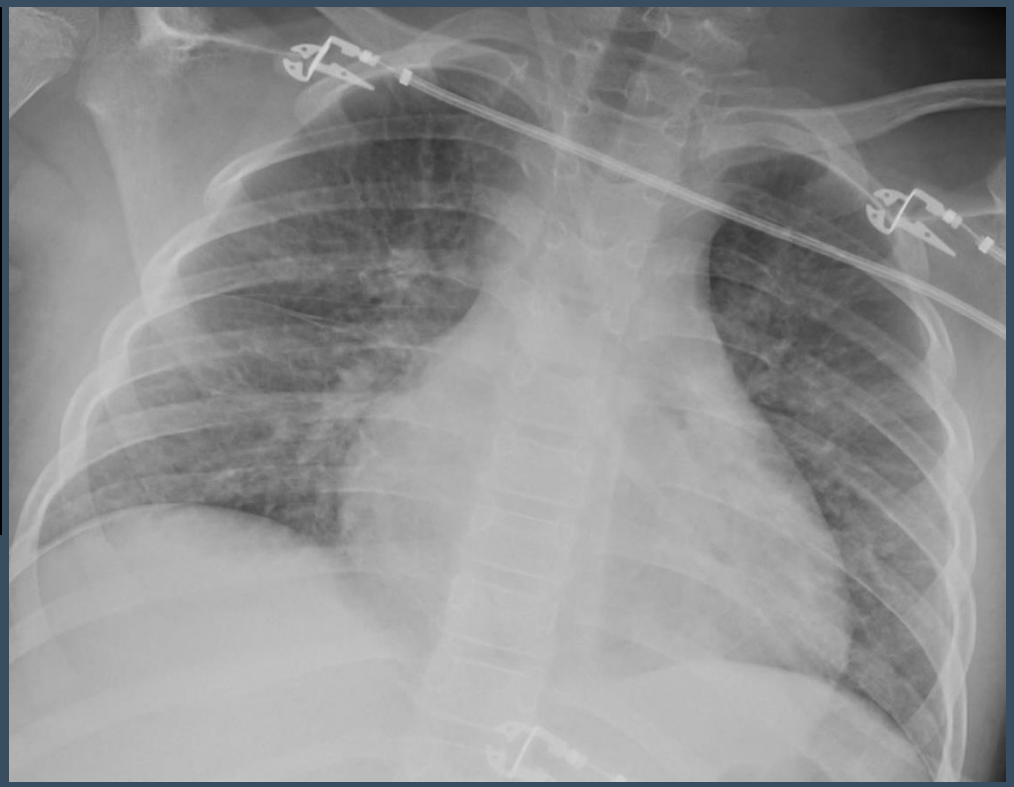
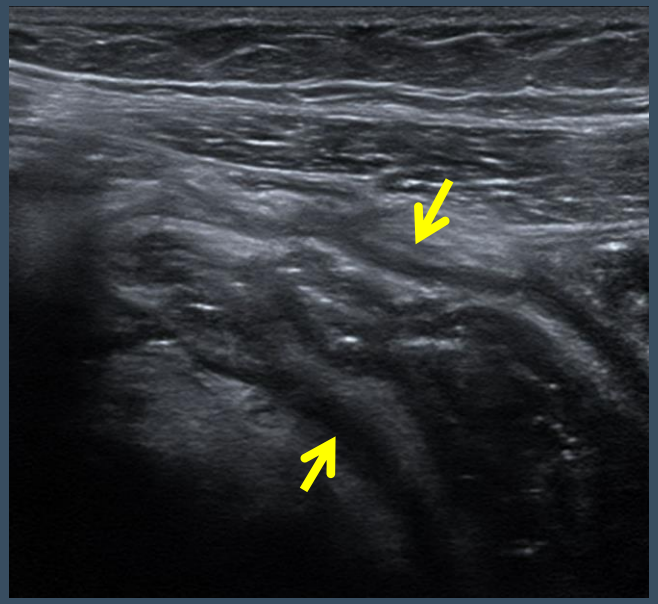
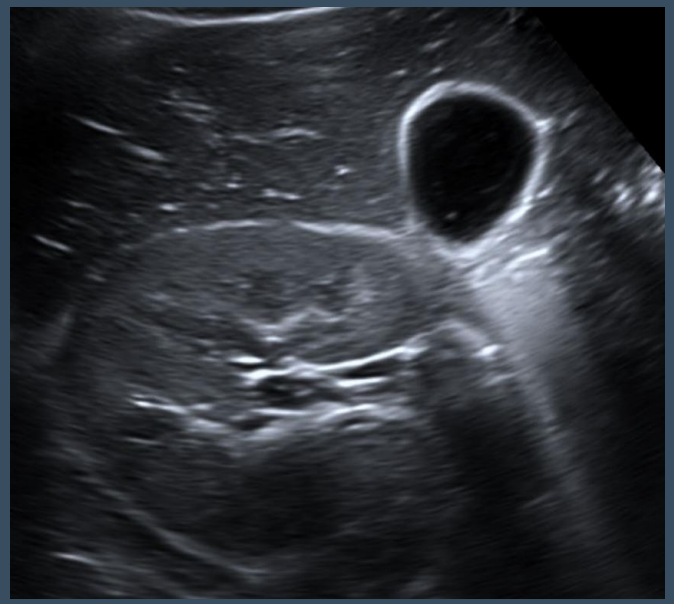
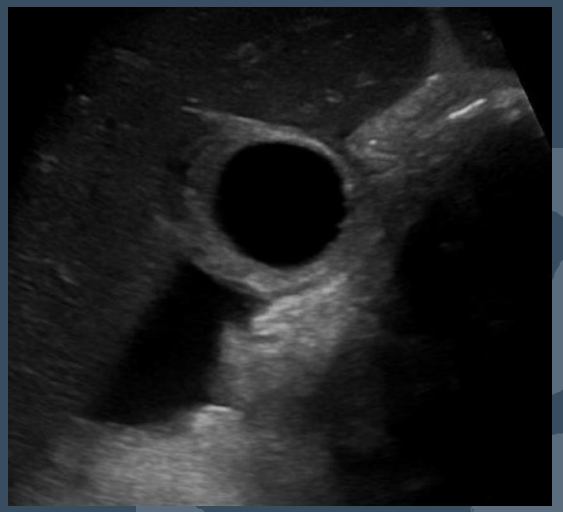







1 Spleen L 11.54 cm



CASE 5

History: 28-day-old with emesis after feeding

Findings:

- Thickened muscularis propria, >3 mm
- Elongated pyloric channel, >16 mm
- No fluid seen passing through pylorus

Diagnosis:

Hypertrophic pyloric stenosis

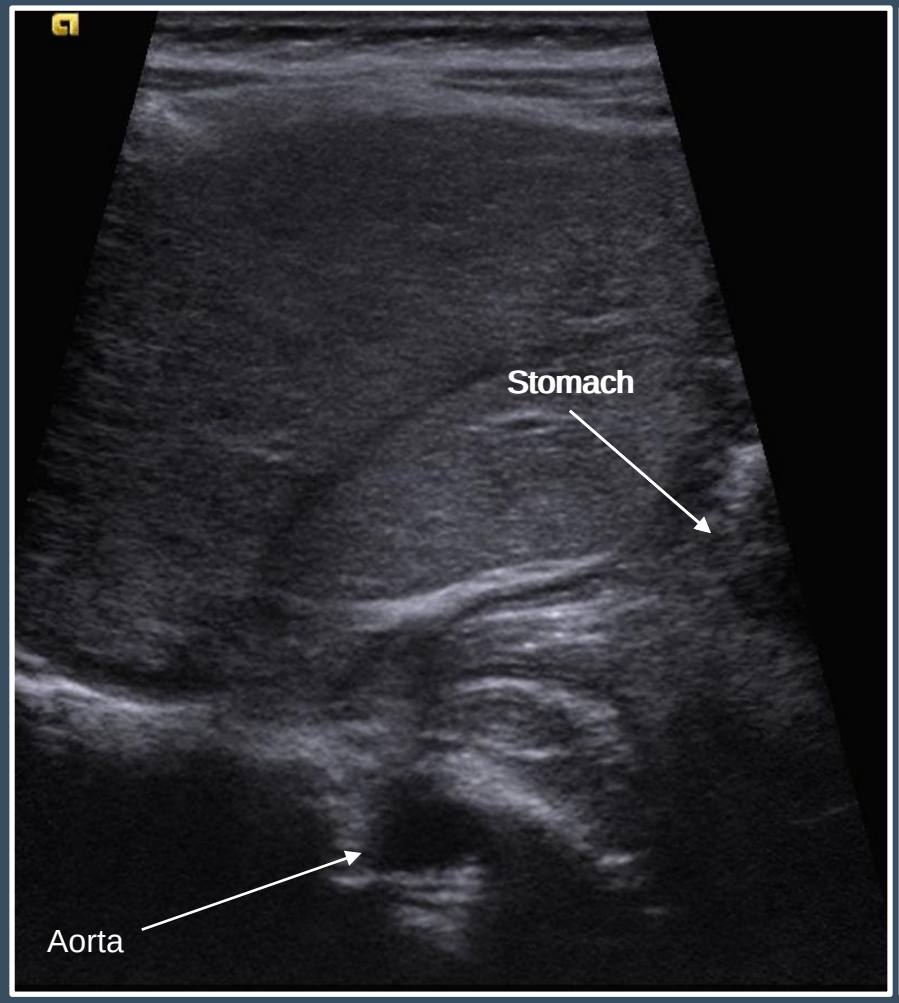
CASE 5
Companion Case

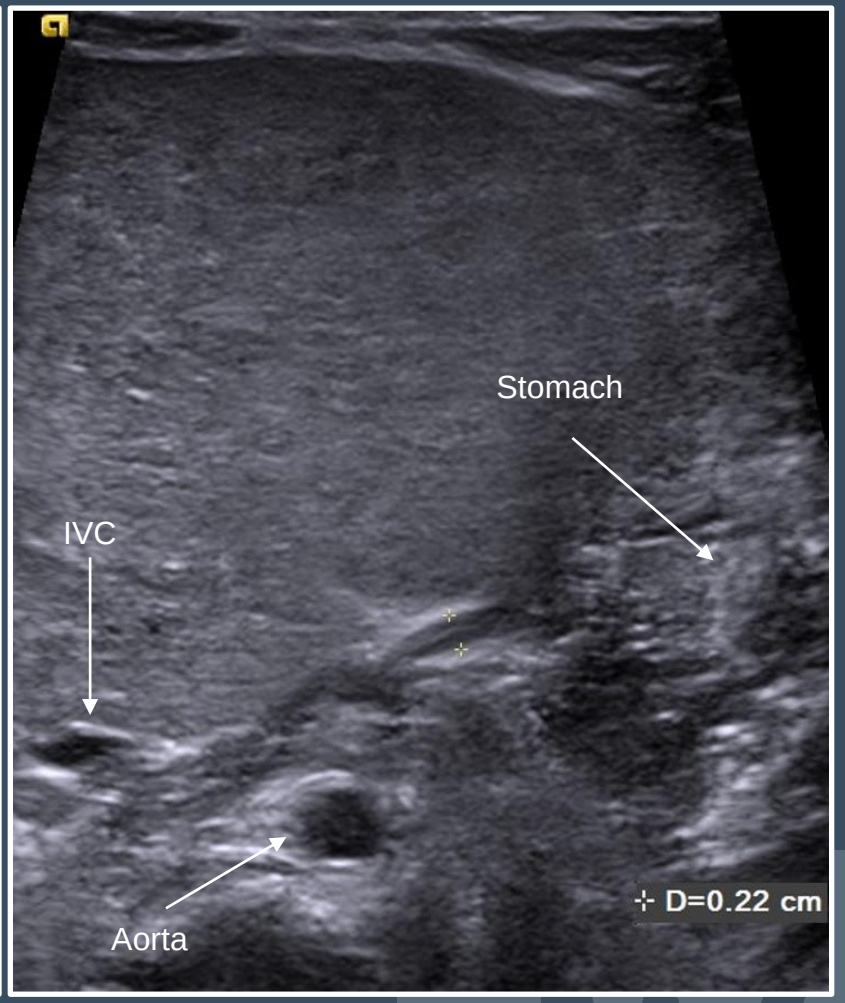
History: 4-month-old and 5-month-old with emesis being evaluated for pyloric stenosis

Findings:

- Sonographer reports normal thickness of the muscular wall of the pylorus and fluid seen passing through to duodenum

Diagnosis:
GE Junction





Hypertrophic Pyloric Stenosis Teaching Points

- Normal values
  - Single wall thickness <3 mm
  - Channel length <14 mm
- GE Junction is a common mimic – recognize surrounding anatomy
- Overdistended stomach pushes the pylorus posteriorly
- Find the pylorus before feeding to prevent obscuration by air

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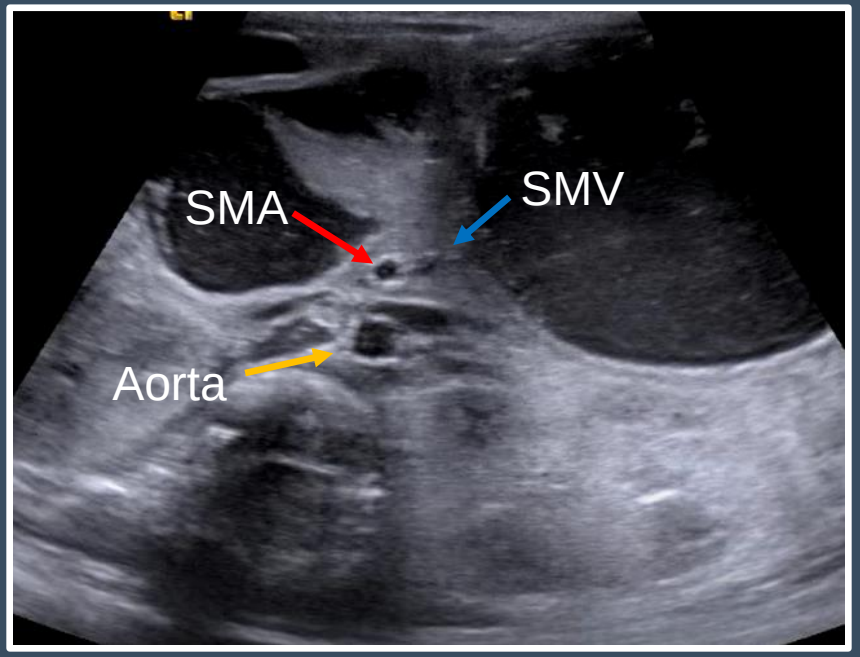
CASE 6

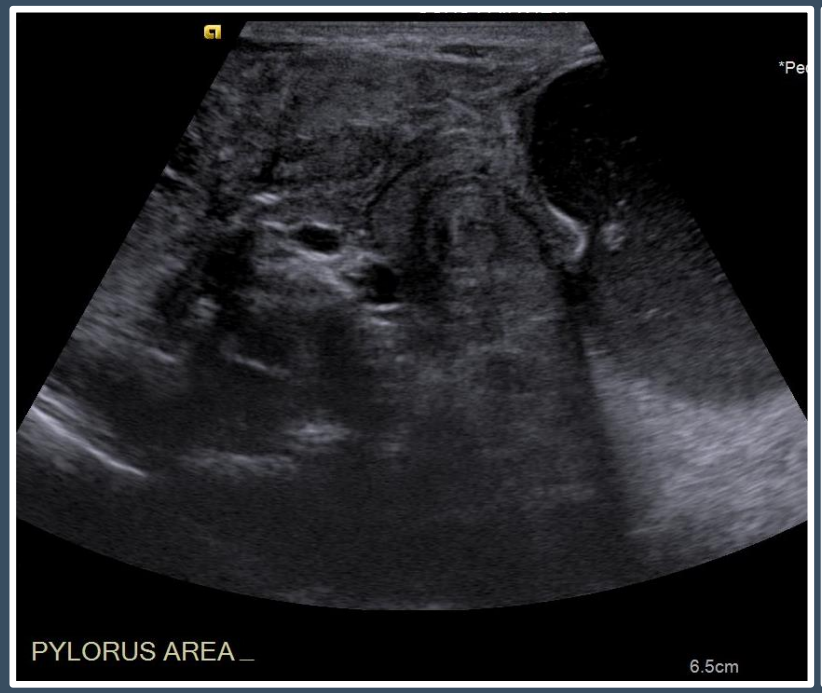
History: 5 week old with concern for pyloric stenosis

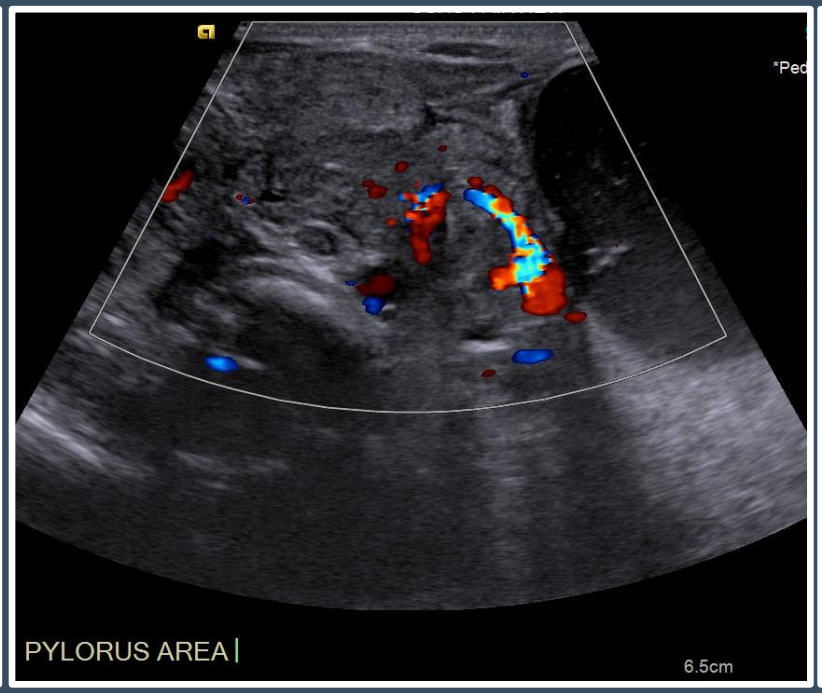
Findings:

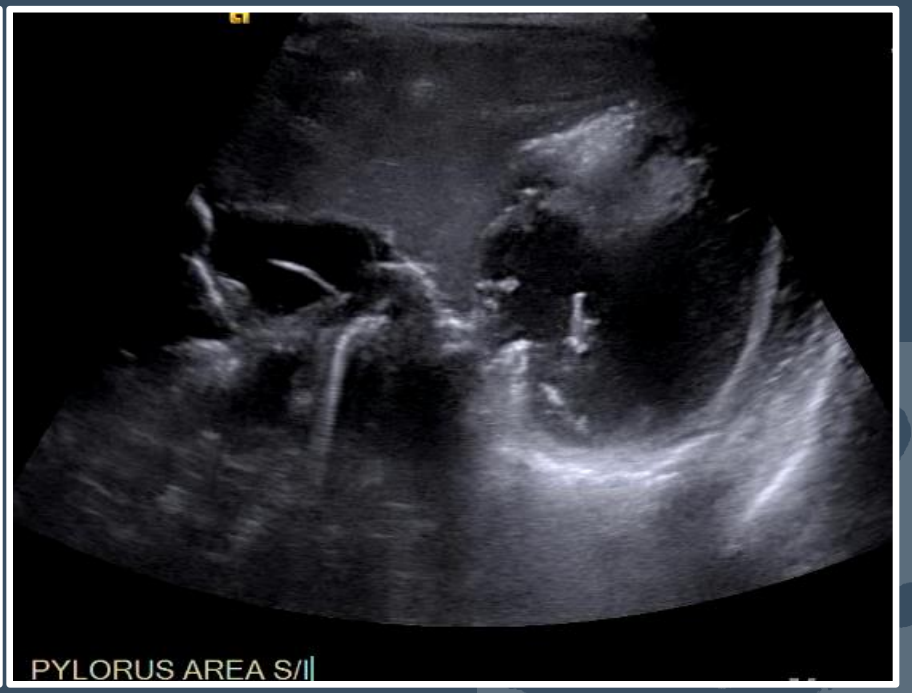
- Reversal of SMA-SMV relationship
- Whirlpool sign
- Beaked proximal duodenum

Diagnosis: Midgut malrotation and volvulus









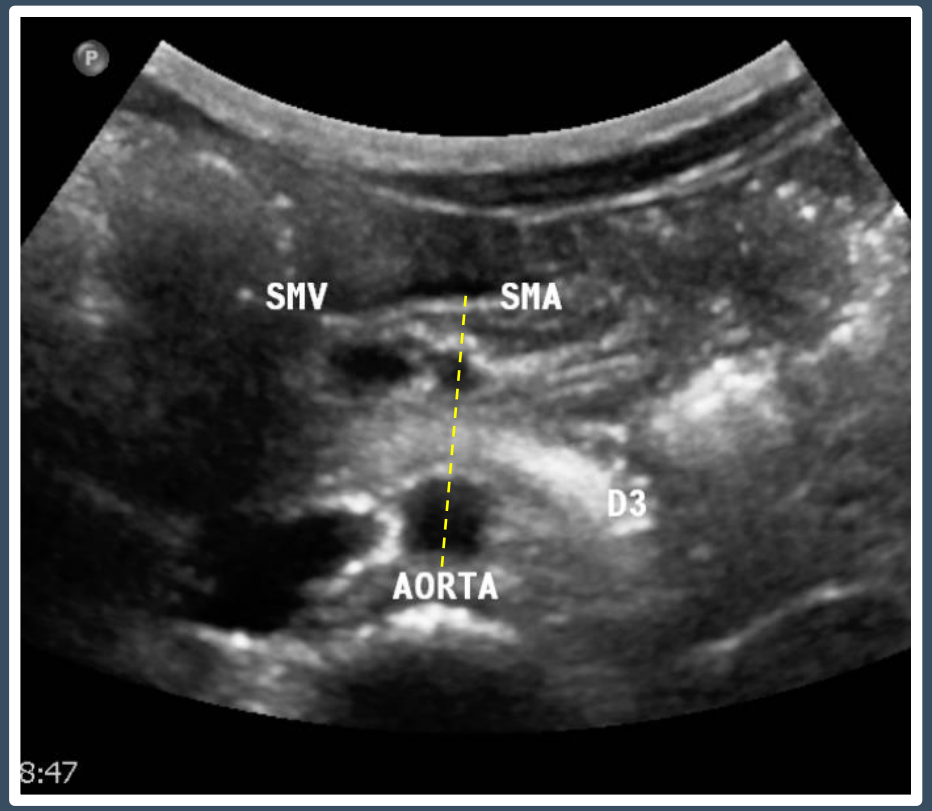
Malrotation with Midgut Volvulus

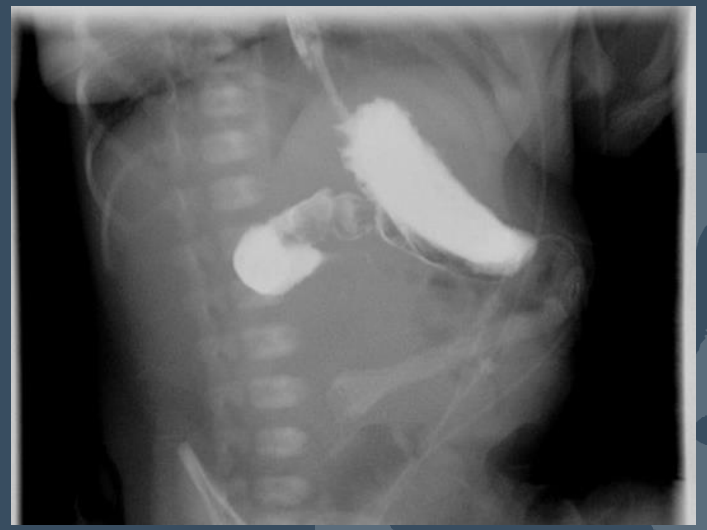
- Reversal of SMA-SMV relationship
  - SMA-aorta axis
    - Normal: SMV to right of SMA-aorta axis

- Intraperitoneal D3 anterior to SMA
  - Jejunal loops may mimic a normal retroperitoneal D3

- Whirlpool sign (greyscale and Doppler)
  - Clockwise swirl of SMV branches and bowel around SMA
  - Differentiate from normal counterclockwise swirl of jejunal SMV branches (no swirling bowel)

- Beaked or corkscrew appearance on UGI



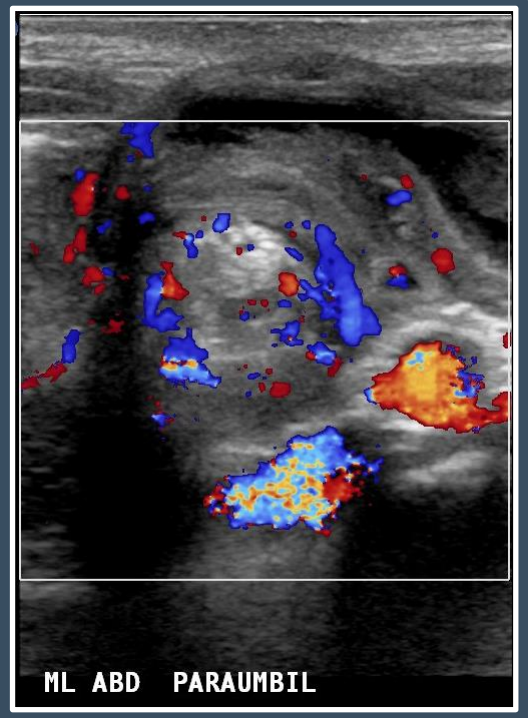


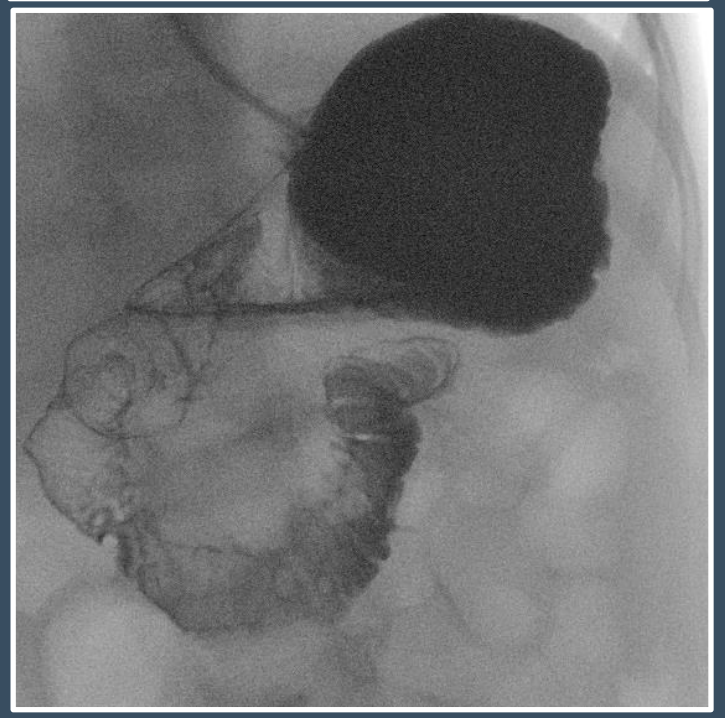
CASE 7

History: 2-year-old with abdominal pain

Findings:

- Abnormal bowel gas pattern
- Target sign vs whirlpool sign in paraumbilical region
- Normal SMA-SMV relationship
- Normal UGI



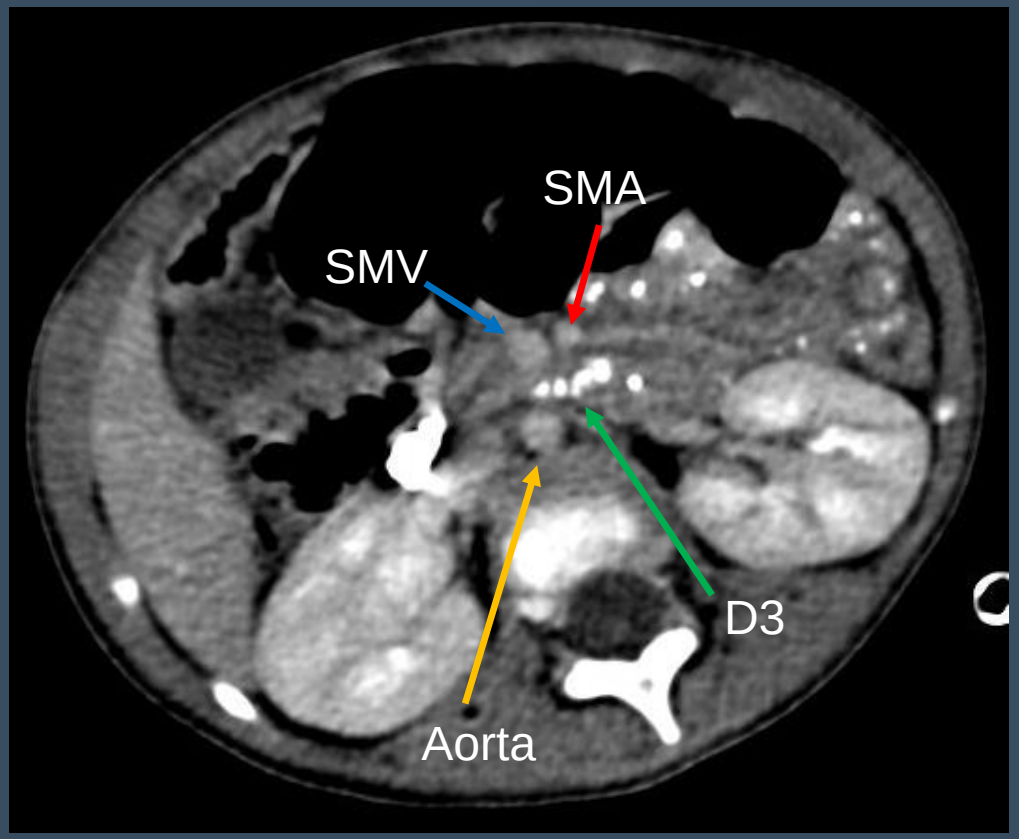


CASE 7

History: 2-year-old with abdominal pain

Findings:

- Normal SMA-SMV relationship
- Normal course of D3
- Dilated, beaked bowel loops and subtle swirling



CASE 7

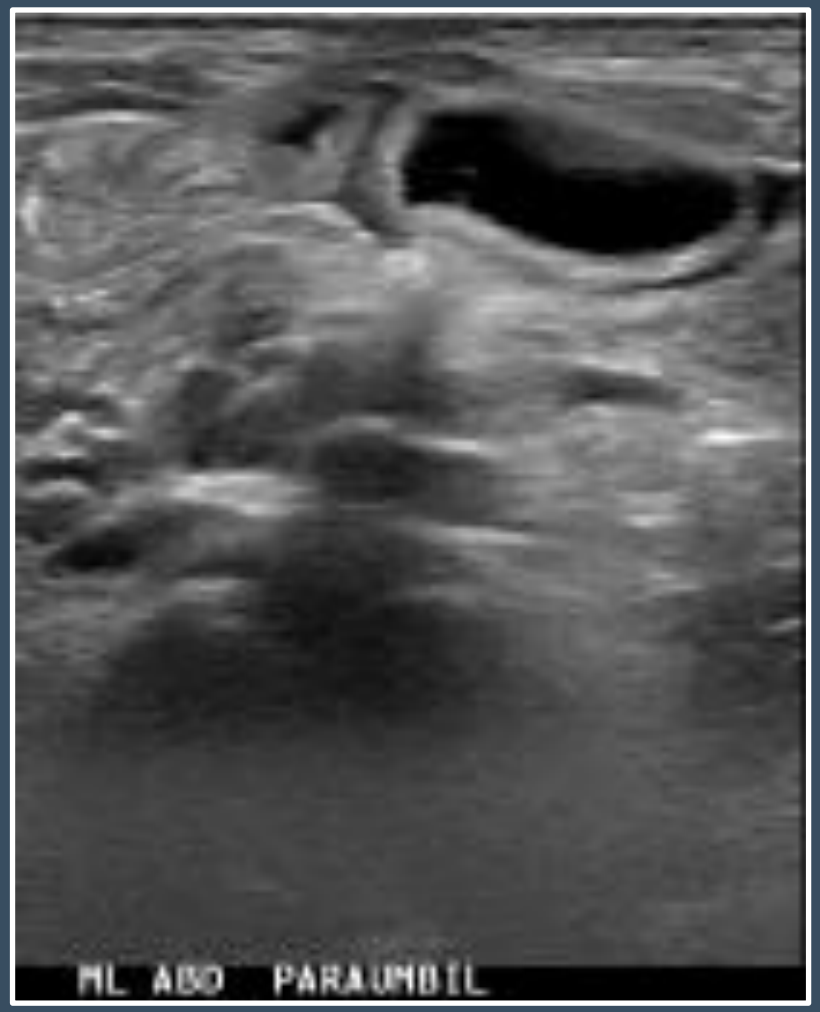
History: 2-year-old with abdominal pain

Findings:

- Swirling bowel and vessels in periumbilical region

Diagnosis:

Segmental volvulus



Segmental Volvulus

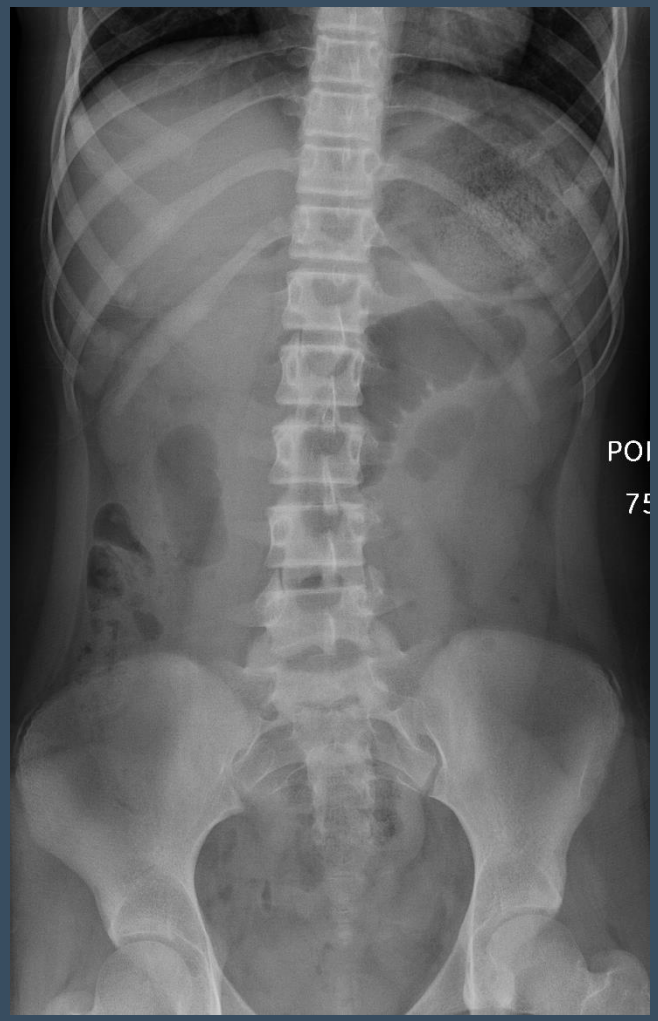
- Unrelated to malrotation
- Typically in neonates, but can occur in older children
- Whirlpool
  - Smaller/tighter twisting
  - Lower/deeper in abdomen
- Rapidly progress to ischemia

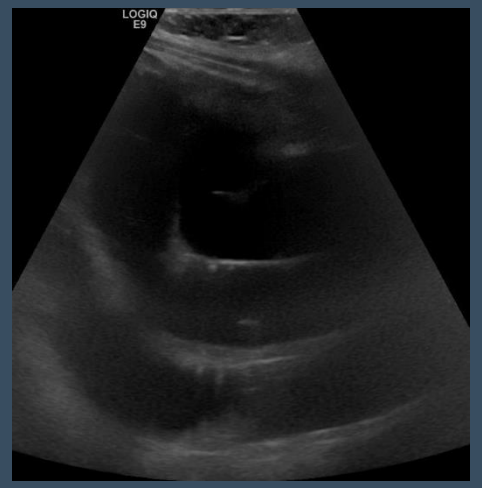
CASE 8

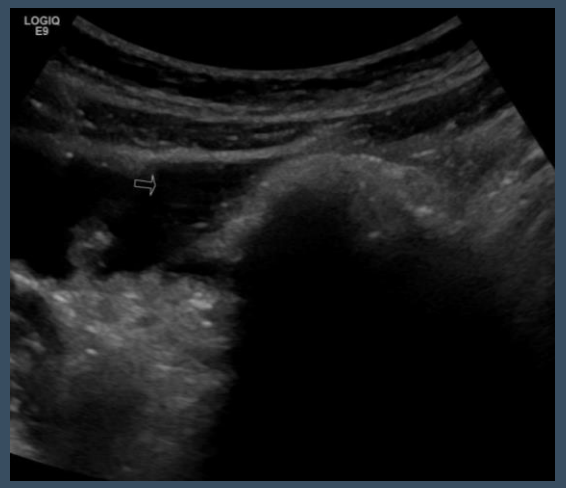
History: 12-year-old with abdominal pain and vomiting

Findings:

- Radiograph: mottled material in stomach and dilated small bowel
- US: dilated small bowel extending to shadowing arc-like echogenic structure
- CT: Material in stomach and distal small bowel with small bowel obstruction

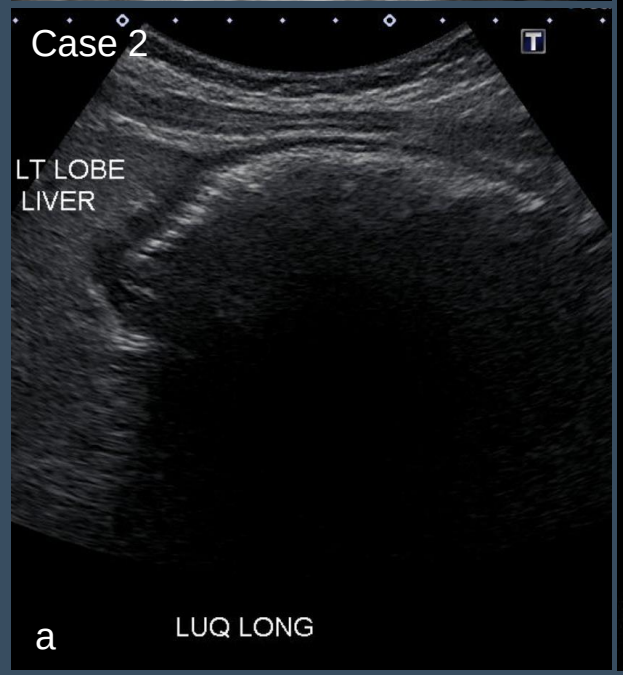






Diagnosis:

Small-bowel obstruction secondary to trichobezoar embolization



Trichobezoars Companion Cases

Case 1: 8-year-old female with trichotillomania

- Mass in stomach with peripheral mottling surrounded by crescent of air

Case 2 (figures a-d): 14-year-old with 14 pound weight loss and pain

- Shadowing echogenic arc in stomach
- Mottled mass in stomach extedning into proximal small bowel and bowel wall thickening
- “Rapunzel syndrome”

CASE 9

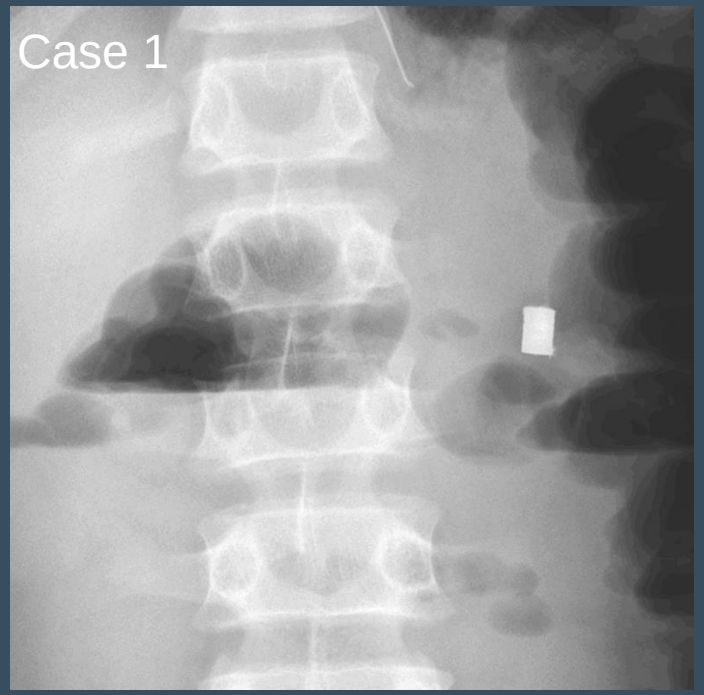
History: (a) 2-year-old, and (b) 6-year-old after foreign body ingestion

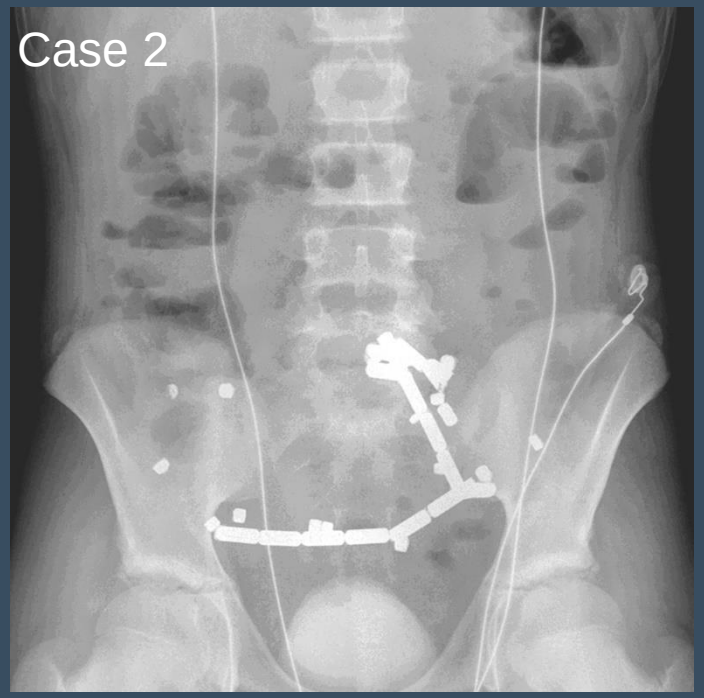
Findings:

- Multiple foreign bodies abutting each other
- Dilated bowel loops

Diagnosis:

Multiple magnet ingestion with small-bowel fistulas





Ingested Magnet Companion Cases

Case 1: 12-year-old
- Stacked magnets in the left upper abdomen
- Jejunal and colonic perforation at surgery

Case 2: 13-year-old
- Numerous stacked magnets in lower abdomen and pelvis
- Multiple small-bowel perforations and fistulas at surgery

Teaching Points

- Ingested magnets may attract across bowel wall and cause fistula, perforation, obstruction, volvulus
- Abnormal bowel gas pattern should raise suspicion for complications
- Gap between magnets may not be visualized even with intervening bowel wall
- Attached magnets may simulate a necklace or solid cylindrical object

Kramer RE, Lerner DG, Lin T, Manfredi M, Shah M, Stephen TC, Gibbons TE, Pall H, Sahn B, McOmber M, Zacur G. Management of ingested foreign bodies in children: a clinical report of the NASPGHAN Endoscopy Committee. Journal of pediatric gastroenterology and nutrition. 2015 Apr 1;60(4):562-74.

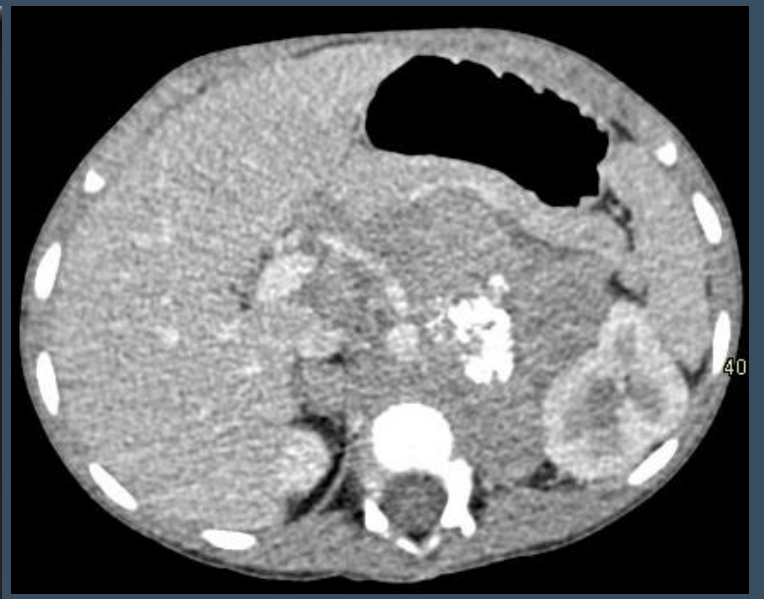
CASE 10

History: 3-year-old with abdominal pain

Findings:

- Radiograph: irregular left paraspinal calcifications
- CECT: left paraspinal mass with calcifications

Diagnosis:
Neuroblastoma



CASE 11

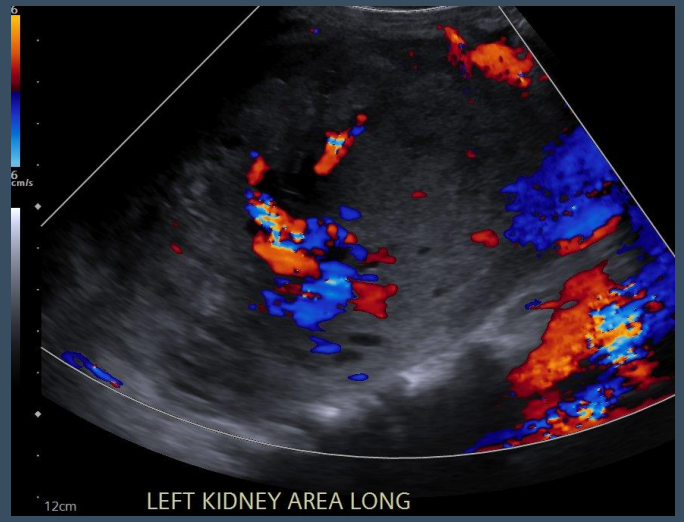
History: 5-year-old with abdominal pain

Findings:

- Radiograph: space occupying mass in left abdomen
- US and CT: left renal mass with solid components and hemorrhage

Diagnosis:

Wilm’s tumor



Neuroblastoma

- Most common extracranial solid neoplasm in children
- Majority <5 years old, median age 2 years old
- Malignant, arises from sympathetic neural crest cells, most often at adrenal gland
- Can be syndromic (Beckwith-Wiedemann, neurofibromatosis)
- Extrarenal heterogeneous mass
- Calcifications common
- ↑ Urine catecholames

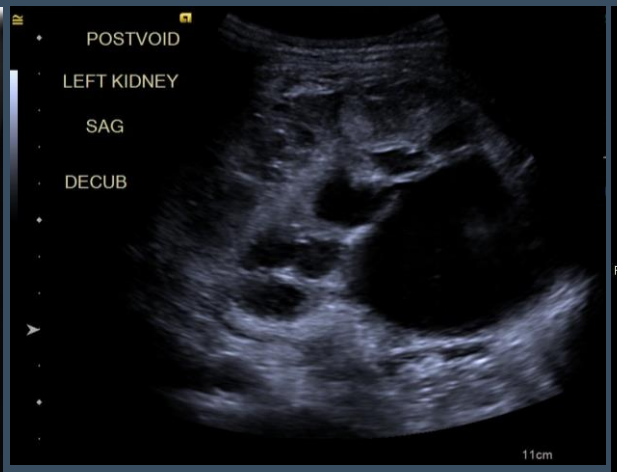
Wilms Tumor

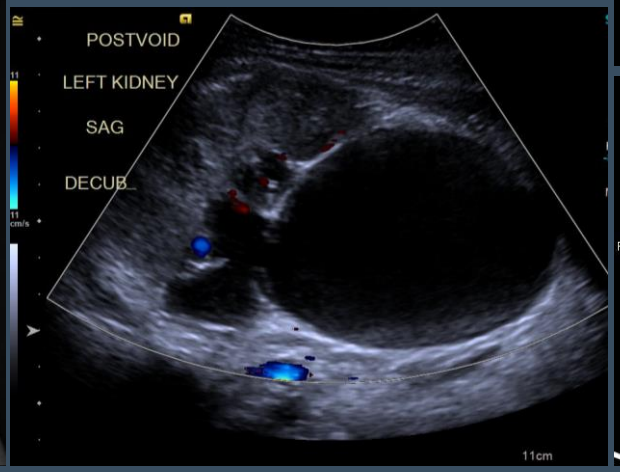
- 80% <5 years old, peak incidence 3-4 years old
- Malignant, arises from nephrogenic rests of metanephric blastema tissue
- Can be syndromic (Beckwith-Wiedemann, WAGR syndrome)
- Heterogeneous mass arising from kidney
- Calcifications less common

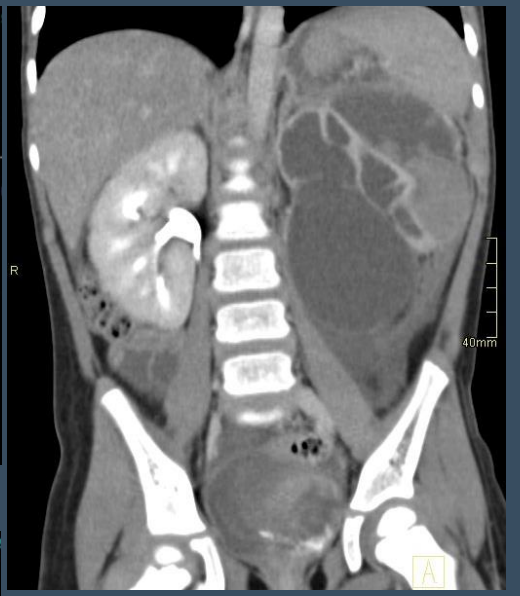
CASE 12

History:
3-year-old with abdominal pain and hematuria

Findings:
- Radiograph: space occupying mass in left abdomen
- US: severe pelvocaliectasis and heterogeneous mass-like area at the left kidney with solid and fluid components







Diagnosis:
Ureteropelvic junction obstruction with subcapsular renal hematoma

Summary

- Age helps narrow differential
  - Pyloric stenosis 3 weeks – 3 months
  - Ileocolic intussusception 3 months – 3 years
- Consider images in context of clinical presentation
- Anatomic landmarks
  - Pylorus vs GE junction
  - SMV-SMA relationship
- Risks of foreign body ingestion
- Look for mass-effect on radiographs

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