

# A case of acute appendicitis in a pediatric patient

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Diagnostic Radiology RAD 4001

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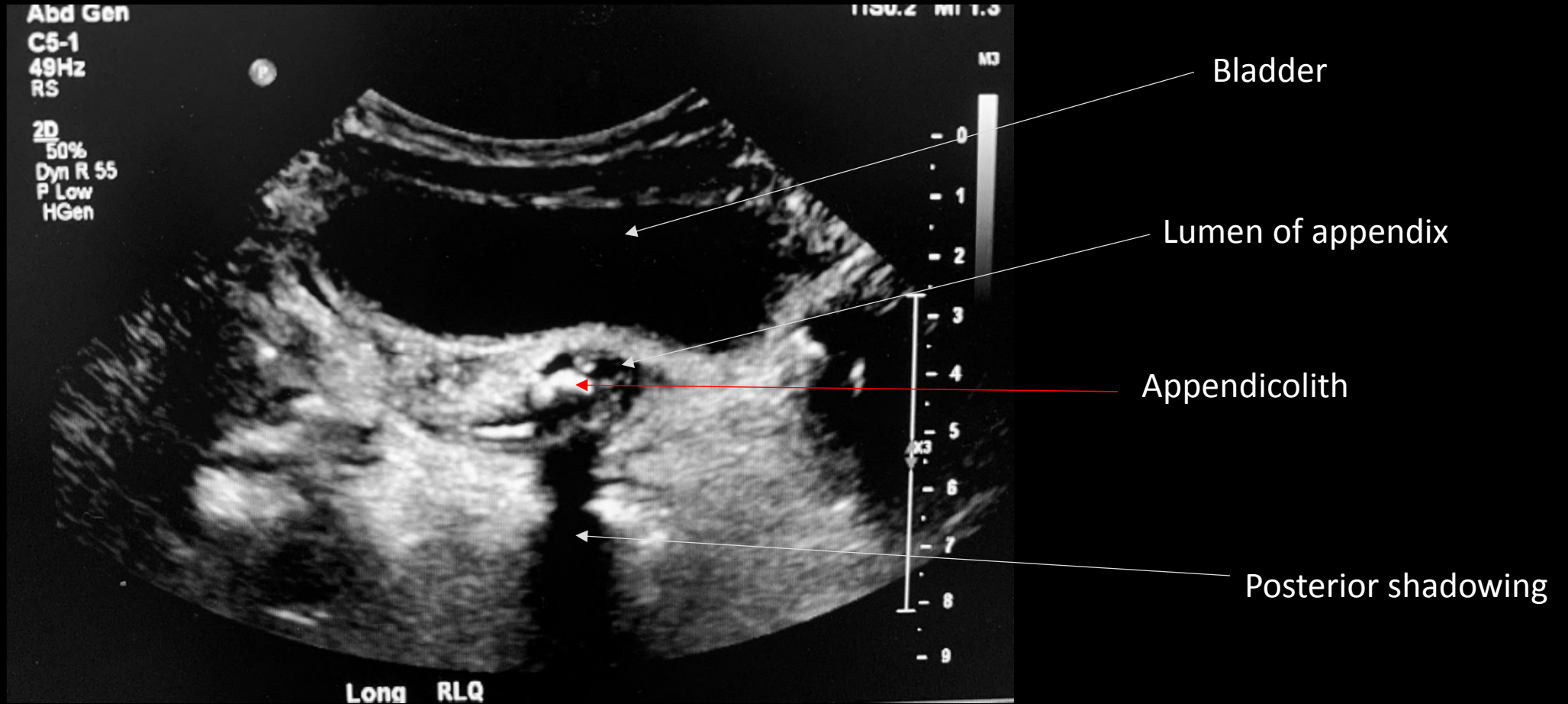


# Clinical History

- 6 y.o. male with no PMH/PSH presenting with approximately 1.5 days of abdominal pain
  - Pain began in right upper thigh, moved to umbilicus, then spread diffusely
  - Currently radiates to RLQ
- Current symptoms:
  - Endorses fever up to 103.1 F, anorexia
  - Denies nausea, vomiting, chills
- Physical exam findings:
  - Vitals: 100.7 F, HR: 129, RR: 22, BP: 113/68, SpO2: 96%
  - General: in significant pain?
  - Abdomen: soft, +pain on palpation, +pain with movement, +rebound, +guarding, - masses/hernias/scars/hepatosplenomegaly
- Work-up (notable labs):
  - CBC from OSH: WBC 15.2 with 73% PMNs

# US Abdomen Limited – Right Lower Quadrant

- 10/29/2019 grayscale longitudinal ultrasound of RLQ



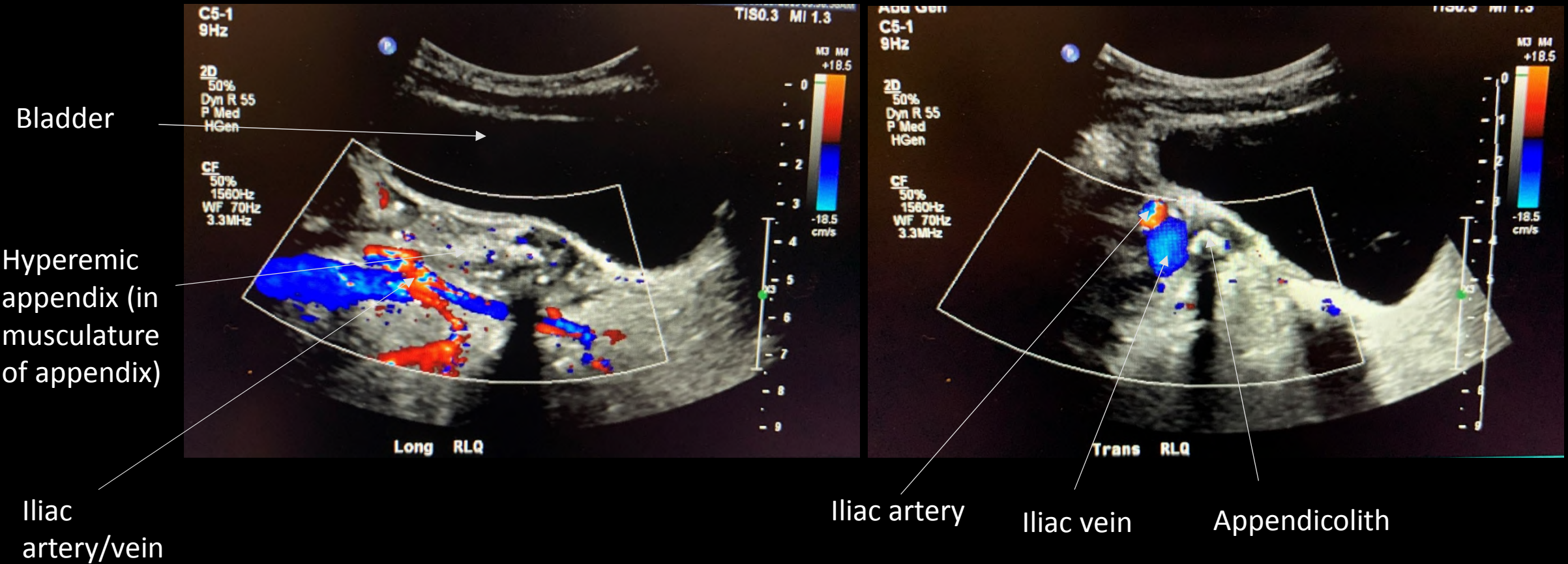
# More relevant imaging

- 10/29/2019 grayscale longitudinal ultrasound of RLQ



# More relevant imaging

- 10/29/2019 color Doppler longitudinal and trans ultrasound of RLQ



# More relevant imaging

- 10/29/2019 grayscale longitudinal ultrasound of RLQ and LLQ



FF = Free fluid, which is indicative of inflammation

# US – Abnormal Appendix<sup>1</sup>



Target sign on axial plane ultrasound  
with 9 mm diameter

# Summary of Key Imaging Findings

- CC: RLQ abdominal pain, fever, leukocytosis
- Imaging findings:
  - RLQ transducer tenderness with compression
  - Appendix visualized with diameter of 1.57 mm
  - No periappendiceal fat infiltration
  - Appendicolith present
  - Appendix hyperemic
  - Appendix non-compressible
  - Small amount of simple free fluid in bilateral lower quadrants



# Differential Diagnosis: Acute Abdominal Pain in Children<sub>2</sub>

- Gastroenteritis
  - Most common cause of abdominal pain in children
  - Viral: Rotavirus, Norwalk virus, adenovirus, enterovirus
  - Bacterial: E. coli, Yersinia, Campylobacter, Salmonella, Shigella
- Mesenteric lymphadenitis
  - Associated with Adenovirus infection
  - Mimics appendicitis
  - No signs of peritonitis, less localized
  - +/- generalized lymphadenopathy
- Urinary tract infection
  - Urinary frequency, dysuria, urgency, malodorous urine

# Final Diagnosis: Simple Acute Appendicitis

- Most common surgical condition in children with abdominal pain
- Definition: inflammation of the vermiform appendix
  - Subtypes: simple vs complicated (presence of gangrene/perforation)<sup>3</sup>
- Pathophysiology: obstruction of appendiceal lumen by lymphoid tissue or fecalith leads to distension, ischemia, necrosis<sup>4</sup>
- Presenting signs: visceral pain = vague, poorly localized, periumbilical
  - 6-48 hours: parietal pain (peritoneum inflamed) = well localized and constant in right iliac fossa
- PAS score for our patient: 9/10

# Discussion: Samuel's Pediatric Appendicitis Score (PAS)

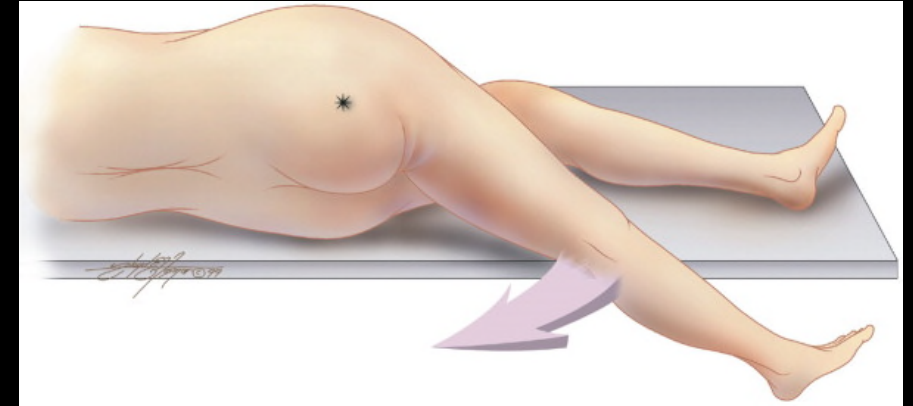
- For use in patients age 3-18 with abdominal pain less than/equal to 4 days' duration
- Do NOT use if known GI disease, pregnancy, previous abdominal surgery
- Stratifies to: Low Risk PAS (<4), Equivocal PAS (4-6), High Risk PAS (>6)
  - Low Risk → consider other causes
  - Equivocal → imaging helpful, surgical consult warranted
  - High Risk → surgical consult
- Found to be 98.6% sensitive, 94.4% specific
  - Helped decrease need for CT from 75.4% to 24.2%<sup>5</sup>

# PAS Variables<sup>5</sup>

<a href="#">.RLQ</a> tenderness to cough, percussion, or hopping	No 0	Yes +2
Anorexia	No 0	Yes +1
Fever Temp $\geq 38.0^{\circ}\text{C}/100.4^{\circ}\text{F}$	No 0	Yes +1
Nausea or vomiting	No 0	Yes +1
Tenderness over right iliac fossa	No 0	Yes +2
Leukocytosis <a href="#">.WBC</a> >10,000	No 0	Yes +1
Left shift <a href="#">.ANC</a> >7,500	No 0	Yes +1
Migration of pain to <a href="#">.RLQ</a>	No 0	Yes +1

# Discussion: Appendiceal Signs<sub>6</sub>

- Most reliable signs in children:
  - Absent or decreased bowel sounds (LR+ = 3.1)
  - Psoas sign (LR+ = 3.2)
    - Pain on passive extension of right thigh
  - Obturator sign (LR+ = 3.5)
    - Pain on passive internal rotation of femur
  - Rovsing sign (LR+ = 3.5)
    - Palpation of LLQ causes pain in RLQ



# Discussion: Prognosis

- Prognosis:
  - Unknown prognosis of untreated appendicitis (unethical)
    - Spontaneous resolution ranges 4% - 20%
    - “The grumbling appendix” recurrence risk
- Risk factors for perforation in children:
  - Fever, vomiting, longer duration of symptoms (delay in surgery > 48 hours), elevated CRP/WBC, ultrasound with free fluid, visualized perforation, mean appendix diameter > 11 mm<sup>6</sup>

# Treatment

- **Laparoscopic appendectomy**
  - Current standard to prevent potential complications
  - Increasing evidence on use of antibiotics
- **Open vs laparoscopic appendectomy**
  - Laparoscopic with less wound infection (odds ratio: 0.43)
  - Laparoscopic with more intra-abdominal abscess formation (odds ratio: 1.87)<sup>3</sup>
- **IV antibiotics vs appendectomy**
  - For patients with uncomplicated appendicitis 73% resolution rate
  - Ertapenem 1 g per day IV x3 days, levofloxacin 500 mg per day + metronidazole 500mg TID x7 days
  - Antibiotic treatment with decreased complications and need for pain medications
  - 40% with antibiotic therapy require appendectomy within 1 year<sup>6</sup>

# ACR Appropriateness Criteria - Pediatrics

- RLQ abdominal pain, fever, leukocytosis with suspected appendicitis, uncertain if ruptured
- US **appropriate** according to ACR appropriateness criteria<sup>7</sup>

**Variant 2:**

**Child. Suspected acute appendicitis, intermediate clinical risk. Initial imaging.**

Procedure	Appropriateness Category	Relative Radiation Level
US abdomen RLQ	Usually Appropriate	○
US abdomen	Usually Appropriate	○
CT abdomen and pelvis with IV contrast	May Be Appropriate (Disagreement)	⊗⊗⊗⊗
CT abdomen and pelvis without IV contrast	May Be Appropriate (Disagreement)	⊗⊗⊗⊗
MRI abdomen and pelvis without and with IV contrast	May Be Appropriate (Disagreement)	○
MRI abdomen and pelvis without IV contrast	May Be Appropriate (Disagreement)	○
Radiography abdomen	May Be Appropriate (Disagreement)	⊗⊗
CT abdomen and pelvis without and with IV contrast	Usually Not Appropriate	⊗⊗⊗⊗⊗
US pelvis	Usually Not Appropriate	○



# Imaging Cost

- US Abdomen Limited at Memorial Hermann-Texas Medical Center<sup>8</sup>
  - Insured: total cost \$1493, out-of-pocket \$262
  - Uninsured: \$537

# Take Home Points

- Utilize the prediction scores and physical exam signs to stratify risk and help determine next steps
- Ultrasound is imaging of choice for children and pregnant patients
- Either appendectomy or antibiotics are viable options for uncomplicated appendicitis, but surgical management is necessary for complicated appendicitis

# References

- 1) Acute appendicitis on ultrasound. Website URL: <https://radiopaedia.org/cases/acute-appendicitis-on-ultrasound-1?lang=us>
- 2) Acute Abdominal Pain in Children. Website URL: <https://www.aafp.org/afp/2003/0601/p2321.html>
- 3) Appendicitis. Website URL: <https://www.aafp.org/afp/2016/0115/p142.html>
- 4) Acute Abdominal Pain in Children. Website URL: <https://www.aafp.org/afp/2003/0601/p2321.html>
- 5) Pediatric Appendicitis Score (PAS). Website URL: <https://www.mdcalc.com/pediatric-appendicitis-score-pas#evidence>
- 6) Acute Appendicitis: Efficient Diagnosis and Management. Website URL: <https://www.aafp.org/afp/2018/0701/p25.html>
- 7) ACR Appropriateness Criteria, Pediatrics Suspected Appendicitis. Website URL: <https://acsearch.acr.org/docs/3105874/Narrative/>
- 8) Cost of imaging at Memorial Hermann. Website URL: <https://www.memorialhermann.org/patients-caregivers/pricing-estimates-and-information/>



Questions?