RADY 401 Case Presentation

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Focused patient history

• 18 year old female who presents with abdominal pain, nausea and vomiting. She began experiencing dull abdominal pain a few hours before going to sleep. She awoke in the middle of the night with extreme right lower abdominal pain and began to vomit.

• LMP reported around 2 weeks ago

• No past medical history

• No surgical history
Notable findings on workup

• Vitals: HR 100 BP 130/82 RR 20 T 100.5
• Physical exam: young female in acute distress due to pain. Clutching her abdomen
  • Pain on palpation of RLQ (McBurney’s point)
• Labs: WBC 15,000
Differential

- Appendicitis
- Ovarian cyst rupture
- Adnexal torsion
- Ectopic pregnancy
- Tuboovarian abscess
- PID
- Endometriosis
- Chrohns disease
- Acute cholecystitis

What imaging?
Does imaging change if 10yo vs 60yo? How about BMI?
**American College of Radiology**  
**ACR Appropriateness Criteria®**  
**Right Lower Quadrant Pain-Suspected Appendicitis**

**Variant 1:**  
Right lower quadrant pain, fever, leukocytosis. Suspected appendicitis. Initial imaging.

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Appropriateness Category</th>
<th>Relative Radiation Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT abdomen and pelvis with IV contrast</td>
<td>Usually Appropriate</td>
<td>⭐⭐⭐⭐⭐</td>
</tr>
<tr>
<td>CT abdomen and pelvis without IV contrast</td>
<td>May Be Appropriate</td>
<td>⭐⭐⭐⭐⭐</td>
</tr>
<tr>
<td>US abdomen</td>
<td>May Be Appropriate</td>
<td>0</td>
</tr>
<tr>
<td>MRI abdomen and pelvis without and with IV contrast</td>
<td>May Be Appropriate</td>
<td>0</td>
</tr>
<tr>
<td>US pelvis</td>
<td>May Be Appropriate</td>
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<tr>
<td>CT abdomen and pelvis without and with IV contrast</td>
<td>Usually Not Appropriate</td>
<td>⭐⭐⭐⭐⭐⭐</td>
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<tr>
<td>Radiography abdomen</td>
<td>Usually Not Appropriate</td>
<td>⭐⭐⭐⭐⭐</td>
</tr>
<tr>
<td>Fluoroscopy contrast enema</td>
<td>Usually Not Appropriate</td>
<td>⭐⭐⭐⭐⭐</td>
</tr>
<tr>
<td>Tc-99m WBC scan abdomen and pelvis</td>
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<td>⭐⭐⭐⭐⭐⭐</td>
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</table>
# ACR Appropriateness Criteria®
## Suspected Appendicitis—Child

### Variant 1:
Child. Suspected acute appendicitis, low clinical risk. Initial imaging.

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<tr>
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</tr>
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<td>O</td>
</tr>
<tr>
<td>US abdomen</td>
<td>Usually Not Appropriate</td>
<td>O</td>
</tr>
<tr>
<td>US abdomen RLQ</td>
<td>Usually Not Appropriate</td>
<td>O</td>
</tr>
<tr>
<td>US pelvis</td>
<td>Usually Not Appropriate</td>
<td>O</td>
</tr>
<tr>
<td>Radiography abdomen</td>
<td>Usually Not Appropriate</td>
<td>★★</td>
</tr>
</tbody>
</table>

### Variant 2:
Child. Suspected acute appendicitis, intermediate clinical risk. Initial imaging.

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</thead>
<tbody>
<tr>
<td>US abdomen RLQ</td>
<td>Usually Appropriate</td>
<td>O</td>
</tr>
<tr>
<td>US abdomen</td>
<td>Usually Appropriate</td>
<td>O</td>
</tr>
<tr>
<td>CT abdomen and pelvis with IV contrast</td>
<td>May Be Appropriate (Disagreement)</td>
<td>★★★★</td>
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<tr>
<td>CT abdomen and pelvis without IV contrast</td>
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<td>Radiography abdomen</td>
<td>May Be Appropriate (Disagreement)</td>
<td>★★</td>
</tr>
<tr>
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</tr>
<tr>
<td>US pelvis</td>
<td>Usually Not Appropriate</td>
<td>O</td>
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</table>
US findings supporting appendicitis:

- >6mm outer diameter - non compressible, dilated appendix
- Thickened walls >3mm (unless ruptured)
- Appendicolith - hyperechoic with posterior shadowing
- Increased echogenic prominent periappendiceal fat
- Periappendiceal fluid collection
- Mural hyperemia with Doppler demonstrating increased vascular flow (prior to necrosis)
- Target appearance (axial section)
- Periappendiceal reactive nodal prominence/enlargement
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• Target appearance (axial section)
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- Thickened walls >3mm (unless ruptured)
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- Increased echogenic prominent periappendiceal fat
- Periappendiceal fluid collection
- Mural hyperemia with Doppler demonstrating increased vascular flow (prior to necrosis)
- Target appearance (axial section)
- Periappendiceal reactive nodal prominence/enlargement
CT findings:
- dilated appendix with distended lumen (>6 mm diameter)
- thickened and enhancing wall
- thickening of the cecal apex (up to 80%): cecal bar sign, arrowhead sign
- periappendiceal inflammation, including stranding of the adjacent fat and thickening of the lateroconal fascia or mesoappendix
- extraluminal fluid inflammatory phlegmon abscess formation
- appendicolith may be identified
- periappendiceal reactive nodal prominence/enlargement
- non-enhancement of the mucosa representing necrosis and a precursor to perforation
Imaging Studies

CT findings:

- dilated appendix with distended lumen (>6 mm diameter)³
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Treatment of Appendicitis

• Laparoscopic appendectomy
  • Definitive treatment
  • Risks of anesthesia
  • Small risk of surgical site infection, adhesions, incisional hernias

• Conservative management
  • Antibiotics and supportive care
  • Success rate ~95-98%
  • Recurrent appendicitis ranging from 14-28% at 1 year
Imaging Choice Discussion

• Ultrasound
  • Widely ranging sensitivity/specificity due to operator dependent
  • Body habitus plays a role
  • Estimated sensitivity and specificity at 86% and 81% respectively

• CT is highly sensitive, 94 - 98%, and specific, ~97%  

• NB: diagnosis of a perforated appendix is still only 69-71% sensitive (2,3). Patients with a visualized fecalith on CT are also reported to have an up to 40% increased rate of complicated appendicitis
Imaging Choice Discussion for Special Populations

- **Children**
  - Ultrasound first line
  - Easier to detect (less likely to have abdominal fat)
  - If unequivocal US then CT or MRI
- **MRI for pregnant patients**
  - MRI sensitivities and specificities 80–100% and 93–98% \(^5\)
MRI for pregnant patients
MRI sensitivities and specificities 80–100% and 93–98%\textsuperscript{5}

Fetus in breech presentation
Arrows and arrowhead denote an abnormal appendix
Do we always need imaging and labs?

Alvarado score

• Score of $\leq 5$: good for 'ruling out'
  • sensitivity 99% overall, 96% men, 99% woman, 99% children

• Score of $\geq 7$: plan for surgery
  • Poor score performance
  • Specificity $\sim 81\%$ average$^6$
  • Similar to studies demonstrating strict clinical judgement
<table>
<thead>
<tr>
<th>Symptoms</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Migratory right iliac fossa pain</td>
<td>1</td>
</tr>
<tr>
<td>Anorexia</td>
<td>1</td>
</tr>
<tr>
<td>Nausea/Vomiting</td>
<td>1</td>
</tr>
</tbody>
</table>

**Signs**

<table>
<thead>
<tr>
<th>Symptoms</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tenderness in right iliac fossa</td>
<td>2</td>
</tr>
<tr>
<td>Rebound tenderness</td>
<td>1</td>
</tr>
<tr>
<td>Elevated temperature</td>
<td>1</td>
</tr>
</tbody>
</table>

**Laboratory Findings**

<table>
<thead>
<tr>
<th>Symptoms</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leucocytosis</td>
<td>2</td>
</tr>
<tr>
<td>Shift to the left of neutrophils</td>
<td>1</td>
</tr>
</tbody>
</table>

**Total score** 10
Complicated Appendicitis

- Definition: perforation, abscess or fecal peritonitis
  - Perforation occurs in about 13-30%\(^2\)
  - Abscess about 2%
- Risk factors: age (bimodal), duration of pain
- Management: more difficult operation, sicker patients, length of antibiotics differs, percutaneous drainage with interval appendectomy
- Outcomes: increased risk for infection, sepsis, prolonged hospital stay
Complicated Appendicitis Diagnosis

• Ultrasound ~40% sensitive for perforation
  • Sensitivity for appendicolith 58% 
• CT is 69-71% sensitive for perforation ¹,²
• Patients with fecalith 40% increased rate of complicated appendicitis
  • Recommend operative management for these patients ⁴
CT findings:

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- thickened and enhancing wall
- thickening of the cecal apex (up to 80%): *cecal bar sign*, *arrowhead sign*
- periappendiceal inflammation, including stranding of the adjacent fat and thickening of the *lateral fascia* or *mesoappendix*
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- *appendicolith* may be identified
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- appendicolith may be identified
- periappendiceal reactive nodal prominence/enlargement
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Wrap Up

- Diagnosis of appendicitis is both clinical and radiographic
- Alvarado score good for ruling out
- Different imaging in children and pregnant patients
- Surgery vs conservative management based on patient and setting
- Increased risk of morbidity with complicated appendicitis
- Complicated appendicitis is harder to differentiate on imaging
References


