Acute Appendicitis: A Comparison Across Imaging Modalities

Matthew Young
Advocate Aurora Health, Matthew.young@aah.org

Luke Falesch
Advocate Aurora Health, luke.falesch@aah.org

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Acute Appendicitis: A Comparison Across Imaging Modalities

Presented 27 April 2023 by Dr. Matthew Young with Dr. Luke Falesch
Overview

- Brief overview of clinical appendicitis
- 4 major imaging modalities
- Interesting case
- Bit of research
- 1000 ft overview of graded compression technique for ultrasound
Clinical Overview

- Typically it is a disease of children and young adults. Peak incidence in the 2nd to 3rd decades of life.
- Usual symptoms of fever, leukocytosis and pain. Nausea and vomiting are also common.
- Most common cause is lymphoid hyperplasia (60%) followed by appendicolith (33%). More uncommon causes like Crohn’s make up the remainder.
- Chronic appendicitis is possible, although uncommon.
- Can get "stump appendicitis" even after an appendectomy.
- Numerous clinical grading systems such as APPEND and Alvarado score, beyond the scope of this presentation.
Location

- Typically in RLQ. Find the TI/Iliocecal valve and look just below it
- Within the pelvis (30%)
- Extraperitoneal (5%)
- Other: long appendix, intestinal malrotation, situs inversus, those with a mobile cecum
CT is highly sensitive (94-98%) and specific (up to 97%).

Also allows to evaluate for other sources of abdominal pain simultaneously.

**Appendiceal diameter**

- ≥8-9 mm outer-to-outer diameter has been suggested as a cut-off value (this may overlap with the upper limit of normal appendiceal diameter of up to 9.5 mm). Sources vary on this.

**Wall thickening (>3 mm) and enhancement**

**Intraluminal fluid depth >2.6 mm in a dilated (>6 mm) appendix without inflammation**

**Peri-appendiceal inflammation including fat stranding --> Abscess**

**Debate over use of oral contrast**
Interesting Case

23M Presents to ED with R hip pain

CT Shows a right psoas abscess which is subsequently drained and a pigtail is placed

Follow-up shows diffuse thickening of distal bowel loops, presumed reactive.

Multiple more follow-up CT to assess resolution of abscess. Has continued pain. Bowel has remained thickened. New vague soft tissue in RLQ.
Interesting Case Cont.

• Patient undergoes urgent colonoscopy
• Findings compatible with Crohn's Disease
• At most recent follow-up (early April 2023), patient has few remaining foci of gas in psoas and persistent TI/small bowel thickening.
Do we give contrast?

- Acute Appendicitis: Comparison of Helical CT Diagnosis—Focused Technique with Oral Contrast Material versus Nonfocused Technique with Oral and Intravenous Contrast Material (2001), Jacobs et al.

- After receiving oral contrast material, 228 patients with clinically suspected appendicitis underwent focused appendiceal CT (5-mm section thickness, 15-cm coverage in the right lower quadrant). Immediately thereafter, helical CT of the entire abdomen and pelvis was performed following intravenous administration of contrast material (abdomen, 7-mm section thickness; pelvis, 5-mm section thickness). Studies were separated and independently interpreted by three observers who were blinded to patient names. Diagnoses were established by means of surgical and/or clinical follow-up findings.

<table>
<thead>
<tr>
<th>TABLE 3</th>
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<tbody>
<tr>
<td>Evaluation of Acute Appendicitis: Comparison of Focused Nonenhanced and Nonfocused Enhanced CT Techniques</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Reader</th>
<th>Sensitivity (%)</th>
<th>Specificity (%)</th>
<th>Area under ROC Curve</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Focused Nonenhanced CT</td>
<td>Focused Nonenhanced CT</td>
<td>Focused Enhanced CT</td>
</tr>
<tr>
<td>1</td>
<td>83.3</td>
<td>93.0</td>
<td>0.951</td>
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<tr>
<td>2</td>
<td>73.8</td>
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<tr>
<td>3</td>
<td>71.4</td>
<td>97.9</td>
<td>0.901</td>
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<tr>
<td>Mean</td>
<td>76.2</td>
<td>94.4</td>
<td>0.916</td>
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</tbody>
</table>

* P value is for comparison of area under the ROC curve for use of focused nonenhanced CT technique with area under the ROC curve for use of nonfocused enhanced CT technique.
† The difference was not significant.
IV contrast was found to improve "ability to identify acute appendicitis vs alternate diagnoses. The study did not look at oral contrast benefit/cons. They did discuss other studies who advocated no oral or rectal contrast in order to improve wait times and decrease patient discomfort (Rao, 1997). This study's authors felt that their patients did not undergo undue discomfort from oral contrast.
• Almost exclusively used in pregnant patients where available

• Quick, multi-planar sequences. Workhorse are the T2 weighted sequences

• Inflamed appendix has high T2 signal due to edema

• T2 FS can be helpful to really make edematous appendix pop

• Looking for same thing as CT: Edema, thickening, dilation, fat stranding, abscess

• Varying degrees of sensitivity and specificity depending on the study being quoted
Diffusion for Appendicitis?

Recent article out of Brasil by Kulali

Looked at using DWI for diagnosing appendicitis in pregnancy and found it to be a sensitive tool

Study was limited by small sample size (due to DWI not being a standard or commonly used technique in MRI appendicitis protocols)
Ultrasound

• Modality of choice in young patients due to lack of ionizing radiation
• Non-compressible, rounded, fluid-filled, blind ending structure >6mm in outer dimension
• Appendicolith would have posterior shadowing
• Can have either distinct or indistinct layers. If distinct layers are lost, this implies gangrene/necrotic stage
• Detection is highly operator dependent (we almost never do them here at St. Luke's)
Graded Compression

3 Step Sequence for Imaging

Image Supine

Image LPO, parallel to psoas muscle (better for retrocecal app.)

Image Supine again in case of new acoustic window

Location determined by finding the most tender spot, and putting steady, gradually increasing pressure to move bowel aside and hopefully find appendix
Plain Film

- Plain radiography is infrequently used as there are better options.
- Can be useful for identifying free air. May show an appendicolith in 7-15% of cases.
- Finding an appendicolith makes the probability of acute appendicitis up to 90% with the right clinical presentation.
- If an inflammatory phlegmon is present, displacement of cecal gas with mural thickening may be evident.
- Small bowel obstruction pattern is present in ~40% of case of appendicitis with perforation.
Conclusion

All 4 major imaging modalities have a role in appendicitis imaging, though CT is far and away the workhorse.

IV contrast has been shown to improve sensitivity in diagnosis.

Oral contrast is a more contentious topic.

Specific techniques used for U/S evaluation require a lot of practice and make the evaluation operator dependent.
1. Radiopaedia.com


4. Rao PM, Rhea JT, Novelline RA, Mostafavi AA, Lawrason JN, McCabe CJ. Helical CT combined with contrast material administered only through the colon for imaging of suspected appendicitis. AJR Am J Roentgenology 1997; 169:1275–1280.

5. Hernia Ultrasound presentation by Dr. Luke Falesch/ 

6. EPIC/PACS case information, REDACTED for ePHI.

7. Case courtesy of Maulik S Patel, Radiopaedia.org, rID: 26853
Questions?