

Ultrasound – Appendix

PURPOSE:

To evaluate for acute appendicitis in the setting of abdominal and right lower quadrant pain.

SCOPE:

Applies to all ultrasound appendix studies performed in Imaging Services / Radiology

INDICATIONS:

- Signs or symptoms including fever and right lower quadrant pain with a clinical suspicion for appendicitis
- Abnormal lab values indicating potential appendicitis

CONTRAINDICATIONS:

- No absolute contraindications

EQUIPMENT:

Linear array transducers: 9-15 Mhz

Curved array transducers: 2-9 Mhz

PATIENT PREPARATION:

- Optimally the patient should be NPO prior to study if able/applicable. However, non-fasting status should not delay performance of the ultrasound exam.

EXAMINATION:

GENERAL GUIDELINES:

A complete examination includes evaluation of the right lower quadrant, left lower quadrant, posterior right upper quadrant, periumbilical region, and deep pelvis.

EXAM INITIATION:

- Introduce yourself to the patient
- Verify patient identity using patient name and DOB
- Explain test
- Obtain patient history including symptoms. Enter and store data page
- Place patient in supine position

TECHNICAL CONSIDERATIONS:

- Review any prior imaging that could confirm appendix presence and localize its position.
- Use graded compression, looking for a blind-ended tubular structure in the right lower quadrant.
- Localize the iliac vessels in the right lower quadrant in the transverse plane. Often the appendix will lie just anterior to the right iliac artery, extending from the cecum to the medial aspect of the iliac vessels.
- Use constant downward pressure starting at the iliacs with movement cephalad. Use a “knead the dough” technique during compression to push the small bowel out of the way.

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- Work your way up from the iliac vessels to the cecum and ultimately to the lower pole of the kidney and lower liver edge.
- Asking the patient to localize the point of maximal tenderness may assist in localization.
- It may take 3-4 sweeps from the iliac vessels upward to the lower pole of the kidney/liver edge to ultimately visualize the appendix.
- If the appendix is not visualized using above maneuvers, search for a retrocecal appendix by taking a lateral approach just superior to the right iliac wing and pressing downward and medially. Label these images "lateral." Turning the patient left lateral decubitus may assist to get an adequate view into the retrocecal region.
- On compression images, use split screen image, labelled without and with compression. Label appendix and use arrows when needed.
- Label the appendix and regions of the appendix: **base** (by the cecum), **midportion**, and **distal (tip)** of appendix. Ensure that the entire appendix to its distal blind ended tip is seen as appendicitis may be localized only to the tip. Label the **cecum**.
- Take images with and without color and power Doppler, looking for hyperemia.
- Measure the **compressed** appendix at site of maximum diameter on **transverse** image, from **outer** to outer margins of wall. Normal appendix measures < 6 mm
- Evaluate for the presence of an appendicolith.
- Image the left lower quadrant, inferior right upper quadrant, periumbilical area, and pelvis. Document and label at least one image for each of these locations. More images may be necessary to document any additional pathology identified in these regions.
- Used curved transducer when needed to visualize the deeper regions, especially in the pelvis looking for fluid or in large patient for deeper penetration.
- Document any secondary findings including:
 - a) free fluid
 - b) loculated fluid collections
 - c) extraluminal air droplets
 - d) echogenic/hyperemic mesentery/inflammatory changes
- Entire scan should last a minimum of 15 minutes and include attempts with multiple probes before determining that the appendix is not visualized.

DOCUMENTATION:

- Right lower quadrant:
 - Transverse images: Right lower quadrant
 - Graded compression right lower quadrant: split screen without and with compression
 - Include with and without color and power Doppler images
 - Measure the **compressed** appendix at site of maximum diameter on **transverse** image, from **outer to outer** margins of wall.
 - Take multiple views from the level of the external iliac vessels upward to the lower pole of the right kidney and liver edge.
 - Evaluate for fecalith/appendicolith. Document and label appendicolith if present.
 - Document any secondary findings including:
 - a) free fluid
 - b) loculated fluid collections
 - c) extraluminal air droplets
 - d) echogenic/hyperemic mesentery/inflammatory changes

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- Longitudinal images:
 - Obtain labelled compressed longitudinal appendix images throughout its course and measure point of maximal outer diameter
- Cine: Transverse and Longitudinal compression images: label as compression. Use arrows to point to appendix when needed.
- Left lower quadrant
- Inferior right upper quadrant
- Periumbilical area
- Pelvis

PROCESSING:

- Review examination images and data
- Export all images to PACS
- Document relevant history and any study limitations

REFERENCES:

Quigley, A.J. & Stafrace, S. Ultrasound assessment of acute appendicitis in paediatric patients: methodology and pictorial overview of findings seen. Insights Imaging (2013) 4: 741.
doi:10.1007/s13244-013-0275-3
<http://link.springer.com/article/10.1007/s13244-013-0275-3>

Seow, S. Appendicitis: a pictorial essay. AJUM 2011; 14 (1): 28-30. DOI: 10.1002/j.2205-0140.2011.tb00183.x
<http://onlinelibrary.wiley.com/doi/10.1002/j.2205-0140.2011.tb00183.x/full>

Gaitini D. Imaging Acute Appendicitis: State of the Art. Journal of Clinical Imaging Science. 2011;1:49.
doi:10.4103/2156-7514.85778.
<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3205519/>

APPENDIX:

- **Sonographic criteria for appendicitis:**
 - Tubular blind ending structure with size \geq 6 mm on compression images
 - Non-compressible
 - Secondary/ancillary findings:
 - Appendicolith
 - Hyperemia “ring of fire”
 - Peri-appendiceal fluid collections/perforation
 - Peri-appendiceal hyperechoic fat
 - Lacks peristalsis

NORMAL APPENDIX:	NORMAL APPENDIX:
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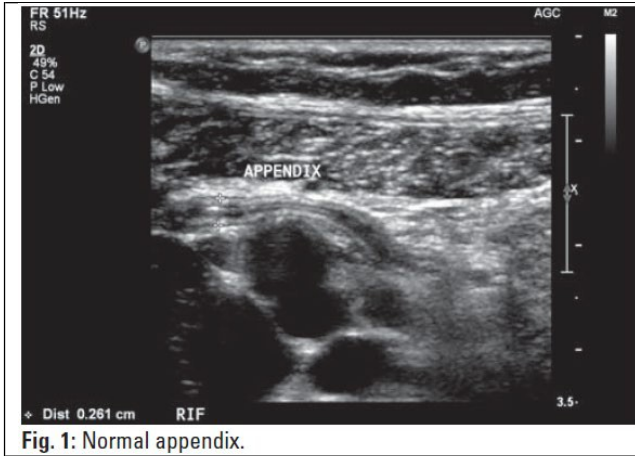


Fig. 1: Normal appendix.

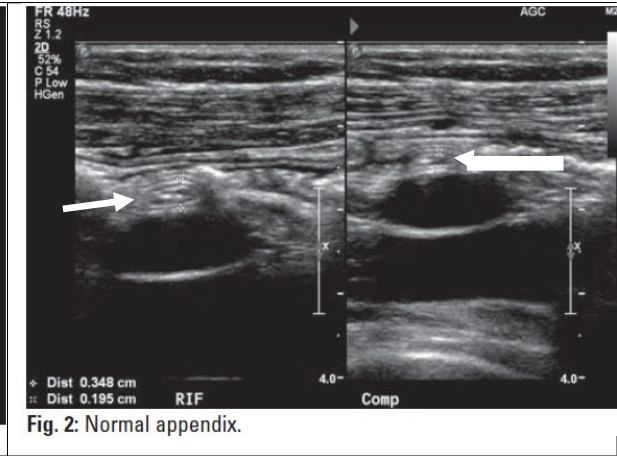


Fig. 2: Normal appendix.

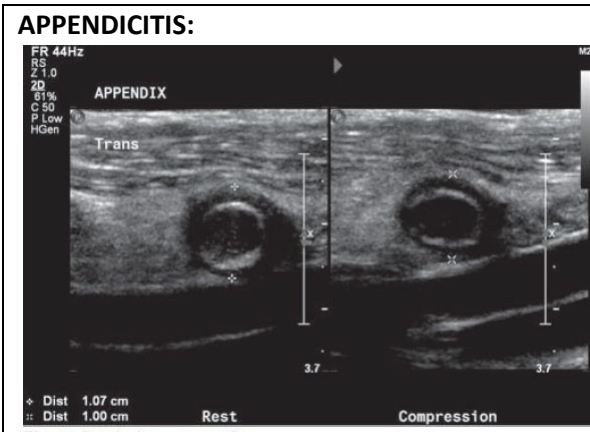


Fig. 8: Graded compression.



Fig. 4
Longitudinal view of a thickened, oedematous appendix measuring 10 mm in diameter with surrounding increased echogenic omentum in an 8-year-old boy with confirmed appendicitis. Absent intraluminal gas is noted

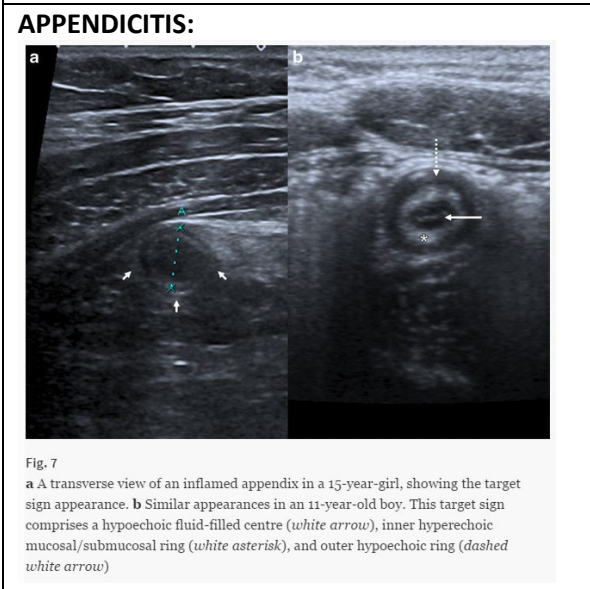


Fig. 7
a A transverse view of an inflamed appendix in a 15-year-old girl, showing the target sign appearance. b Similar appearances in an 11-year-old boy. This target sign comprises a hypochoic fluid-filled centre (white arrow), inner hyperechoic mucosal/submucosal ring (white asterisk), and outer hypochoic ring (dashed white arrow)

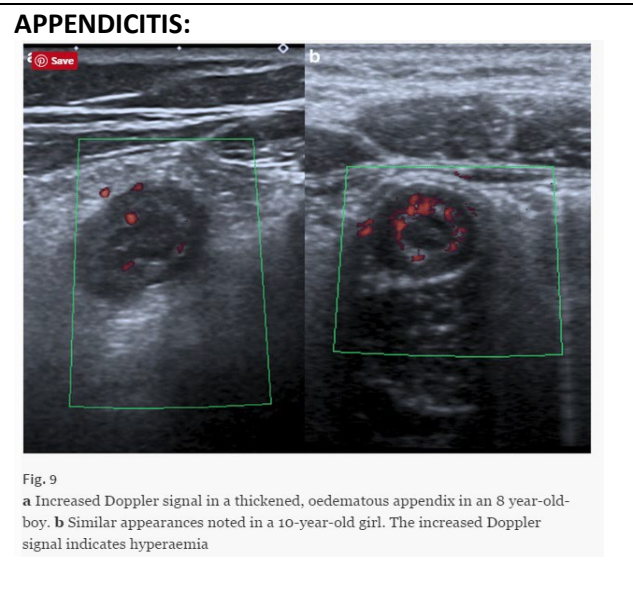


Fig. 9
a Increased Doppler signal in a thickened, oedematous appendix in an 8 year-old-boy. b Similar appearances noted in a 10-year-old girl. The increased Doppler signal indicates hyperaemia

APPENDICITIS:

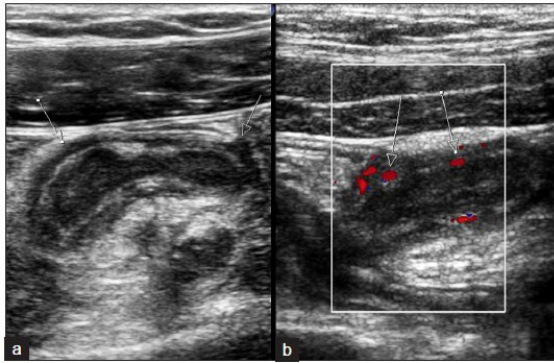


Figure 2: A 25-year-old-male with right lower quadrant pains and leukocytosis. Acute appendicitis on US. (a) Gray-scale longitudinal compression US. An incompressible, blind-ended, gut-pattern fluid-filled tubular structure, with thickened wall and diameter greater than 7 mm is seen in the right lower quadrant (arrows). (b) Power Doppler US. A hyperemic wall is demonstrated (arrows). Following diagnosis of acute appendicitis on US examination, patient proceeded to surgery, without further imaging tests.

APPENDICITIS:

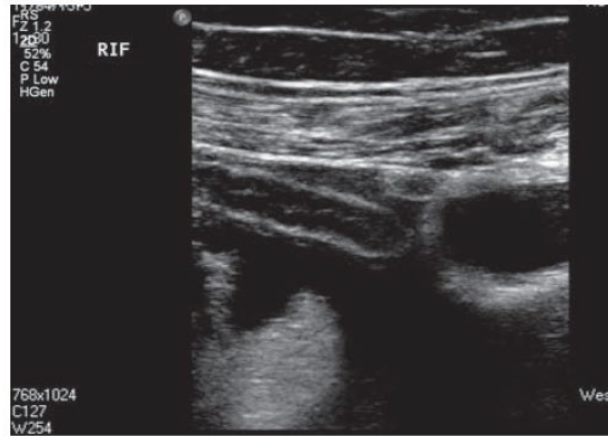


Fig. 10: Acute appendicitis – free fluid (right iliac fossa).

APPENDICITIS:

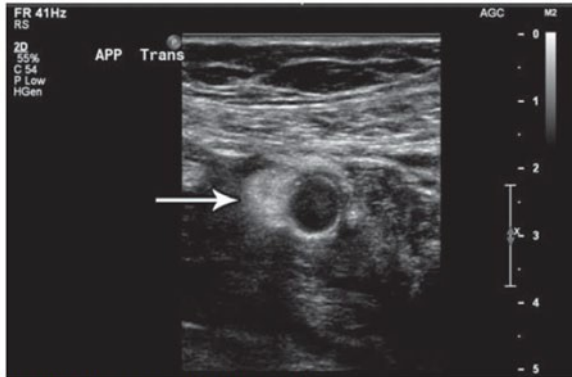
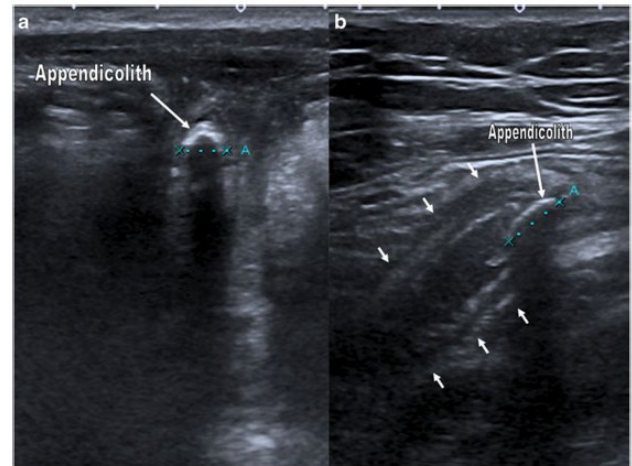


Fig. 9: Acute appendicitis fat oedema.

APPENDICITIS:



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CHANGE HISTORY:

STATUS	NAME & TITLE	DATE	BRIEF SUMMARY
Submission	Julie Champine, MD	09-23-2016	Submitted
Approval	David Fetzer, MD	10-03-2016	Approved
Review			Reviewed
Revisions	Kanupriya Vijay, MD	10-25-2018	Reviewed