Appendix Ultrasound

I. Patient Preparation

a. None due to the emergent nature of the exam.

II. Equipment

a. Performed with real-time scanner using a linear or curved transducer with frequencies ranging from 2.5 to 7.5 MHz for adults and adolescent patients. Frequency ranging from 5.0 to 12 MHz for pediatric patients.

III. Procedure Protocol

a. Imaging Technique

i. Ask the patient to identify the area of maximum pain (using one finger), trying to localize the area as much as possible. This may help to locate the aberrant appendix.
ii. Initiate the scan in a transverse plane, lateral right mid abdomen. Continue scanning caudally towards the right lower quadrant using a gradual graded compression technique (slide-scan-compress) inferiorly to the level of the right groin. Attempt to compress the bowl gas/fluid from the ascending colon and the cecum.
iii. Attempt to image the cecal tip in the transverse plane by scanning caudal to the approximate insertion of the terminal ileum.
iv. Assess the compressibility of normal bowel by gently reducing and increasing pressure with the transducer. The normal cecum and terminal ileum should be easily compressible with moderate pressure. If unable to compress, be careful to release pressure slowly so as not to induce rebound pain.
v. The inflamed appendix is most often seen at the base of the cecum during maximum graded compression.
vi. Continue the exam caudally with identification of the psoas and iliacus muscles, and the external iliac artery and vein, as the appendix may drape over these structures. Need to examine caudally to the level of the right groin as appendix can be in the deep pelvis or inguinal canal. The appendix can cross midline, so evaluation medially is important.
vii. Consider prone and/or right flank imaging in the right paracolic gutter to evaluate for a retrocecal appendix or fluid.
viii. Use both a curved AND linear transducer before assuming the appendix cannot be seen.

ix. Assess regional structures as well for pathology (e.g., ovary, kidney, urinary bladder, ureter, abdominal wall hernia, intussusception, mesenteric lymph nodes, small bowel, gallbladder, etc.). The bowel may be evaluated for wall thickening, dilatation, muscular hypertrophy, masses, and other abnormalities.

b. Diagnostic Criteria For Acute Appendicitis

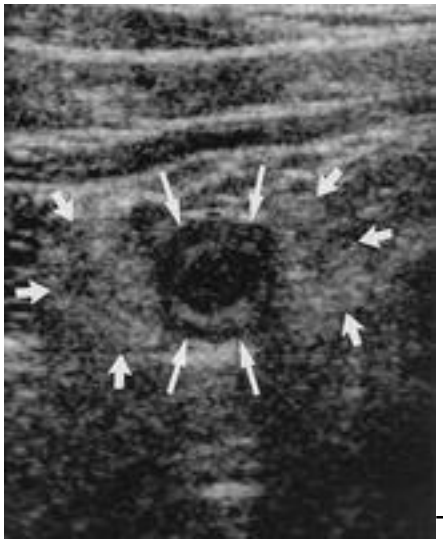
i. A diagnostic study is achieved if bowl gas can be expressed from the cecum, an appendix is identified (normal or abnormal), an abscess is seen, free fluid is seen or any other pathology is identified. Otherwise, it is a non-diagnostic study.
ii. If the appendix is visualized, evaluate the entire length of the appendix (including the tip).
iii. The outer appendiceal diameter is measured as the distance between the outer borders of the hypoechoic tunica muscularis (outer muscle coat). The number is rounded to the nearest whole number (i.e., 5.2 mm rounded to 5mm; 5.7mm rounded to 6mm). If several outer diameters are measured along the length of the appendix, the largest one is used. Use the smallest (anteroposterior) outer diameter as the relevant diameter in cases of an ovoid transverse appendiceal section.
iv. Sonographic Diagnosis of Acute Appendicitis:
    1. Visualization of a non-compressible appendix equal to or greater than 6mm maximum transverse diameter (dilated).
    2. Visualization of a non-compressible appendix less than or equal to 6mm maximum transverse diameter which contains appendicoliths and/or an association with a very strong clinical suspicion for acute appendicitis.
    3. Hypoechoic walls greater than or equal to 3mm (thick-walled).
    4. Peri-appendiceal abscess or abnormal fluid collection.
    5. Circumferential color on color Doppler evaluation (hyperemia).
    6. Increased echogenicity of the periappendiceal fat.

c. Required Images

i. Three long axis and three transverse views of the appendix/mass if located. If not located, then three long axis and transverse images of the area of pain and images marked as “area of pain”.
ii. Measurement of maximum transverse diameter of appendix and the wall thickness of the appendix.
iii. Transverse image of the right lower quadrant documenting the location of the right external iliac artery and vein.
iv. Sagittal midline pelvis to document presence or absence of fluid.

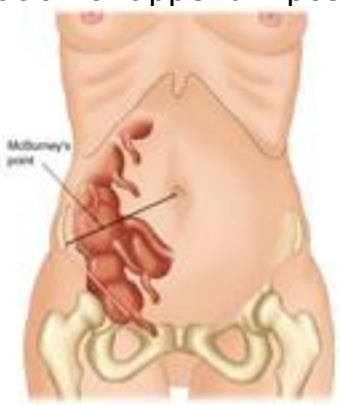
v. Image of Morrison's pouch and spleno-renal space to evaluate for free fluid.
vi. Image of the gallbladder.
vii. Cine clip of peristalsing bowel in area of pain.

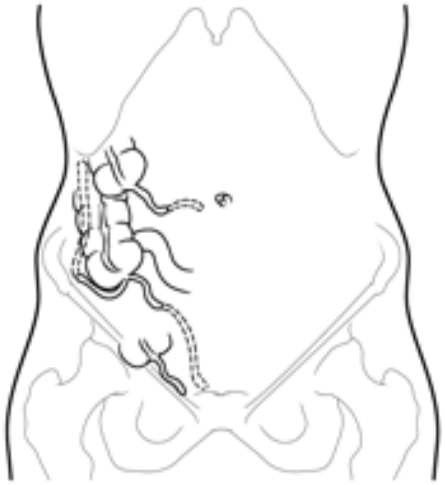
Transverse US image shows the proximal normal portion of a distally inflamed appendix. Image demonstrates an ovoid transverse section with an anteroposterior outer diameter of 5 mm (long arrows) and a transverse outer diameter of 11 mm (short arrows). Given the ovoid transverse appearance, the 5 mm diameter would be considered more accurate.

 Transverse US image of the distal portion of the same appendix as in a shows an acutely inflamed, round appendix with an 11-mm outer diameter (long arrows) and shows the surrounding hyperechoic inflamed fatty tissue (short arrows).

 US image shows the transverse section of a normal appendix with a 4-mm outer diameter

Variation of appendix position (A), Variation in pregnant patient (B)





Facts: Appendix can range from 2 cm to 20 cm in length. The base of the appendix arises at a fairly constant location, 2 cm below the ileocecal valve.

Reference(s):

1. Radiologic Diagnosis of Appendicitis. http://eradiology.bidmc.harvard.edu/LearningLab/gastro/Pani.pdf