

## Emory EM US Section

### QA Guidelines

Revised: Jun 29, 2020

*Based on The ACEP Emergency Ultrasound Imaging Compendium and ACEP Standard Reporting Guidelines*

Ultrasound QA Requirements: To get credit for a scan you must do the following

#### Requirements for ALL Emergency Ultrasound Exams

- Patient Demographic Info
  - 2+ unique identifiers (e.g. name, MRN, or DOB)
- Use correct probe and preset
- Optimize gain/depth
- Record interpretation (in Q-path if at Grady).  
Resident exams will only be counted if listed under “operator” in QPATH  
Expect feedback email for interpretation discrepancies (unless the learner is in video review)

#### **AAA**

**Scanning:** Perform a preliminary survey of the entire aorta before taking measurements using curvilinear probe.

Start subxiphoid at the level of the celiac trunk in transverse. Slide towards umbilicus, visualize iliac bifurcation, then view aorta in sagittal.

**Images/clips to save:** Please label “Prox” “Mid” “Distal” Aorta

Labeling P/M/D also acceptable.

- 1) Record clip of preliminary survey of the entire aorta including bifurcation into iliacs.
- 2) Prox: Transverse view suprarenal (at or above SMA) cross-sectional diameter measurement (outside to outside)
- 3) Mid: Transverse view mid aorta with cross sectional diameter (outside to outside)
- 4) Distal: Transverse view at or above the bifurcation with measurement of aortic diameter with cross sectional diameter (outside to outside)
- 5) Sagittal/Longitudinal view(s) (if measurement taken, measure 90 degrees to the vessel)

**Interpretation:** Abnormal/positive if aorta >3 cm; if iliacs measured, abnormal if >1.5 cm

**Pitfalls:** not visualizing entire aorta from epigastrium to bifurcation  
Not looking at the longitudinal aorta at widest diameter

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**Biliary:**

**Scanning:** interrogate GB in 2 planes, scanning for stones, look closely at neck using phased array or curvilinear probe

**Images/clips to save:** Video preferred - make sure to interrogate entire GB during exam

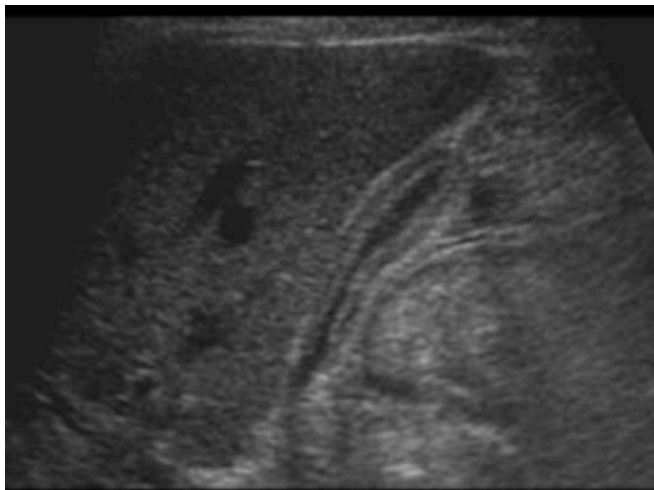
- 1) GB in transverse
- 2) GB in longitudinal
- 3) Measure anterior wall of GB in short axis - can zoom to be more precise
- 4) CBD inside to inside

**Interpretation:** Y/N gallstones, pericholecystic fluid, sonographic Murphy's, gallbladder wall thickening, dilated CBD. GB wall is abnormal > 3mm

There is a wide variation of what is reported as normal/abnormal CBD in the literature. Some authors suggest normal CBD width is <6 mm; older adults can have larger normal CBD diameters – allowed 1 mm for every decade of age.

CBD may be dilated up to 1 cm after cholecystectomy (ref: Senturk et al. Eur J Radiol. 2012)

**Pitfalls:** mistaking bowel for GB, not recognizing wall-echo (WES) sign, mistaking the hepatic artery for the CBD (color doppler can be used to identify CBD vs hepatic artery). Mistaking contracted GB for abnl (below is normal post-prandial GB: note anechoic center sandwiched in between two hyperechoic layers)



Ref:UCSF protocol

[https://edus.ucsf.edu/sites/edus.ucsf.edu/files/wysiwyg/UCSF%20ED%20US%20Protocol%20Biliary\\_Final.pdf](https://edus.ucsf.edu/sites/edus.ucsf.edu/files/wysiwyg/UCSF%20ED%20US%20Protocol%20Biliary_Final.pdf)

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**Cardiac:****Scanning:** Scan all 4 views using phased array probe**Images/clips to save:** Save clips

- 1) Parasternal Long (PSL) – show descending aorta
- 2) Parasternal Short (PSS)
- 3) Apical 4 Chamber (A4C)
- 4) Subxiphoid (SUBX)

**Interpretation:** Y/N effusion; if effusion, is there evidence of tamponade?

LV Function – normal, mild to moderately depressed, severely depressed, hyperdynamic, absent; RV dilation (RV/LV &gt;1:1), other signs of RV strain (e.g. septal bowing, TAPSE &lt;16 mm)

**Pitfalls:** mistaking pleural effusion for pericardial effusion, not including descending aorta in PSL view, commenting on RV size in PSL (cannot evaluate RV size in PSL)**FAST:** (in MTC please do an eFAST on all patients)**Scanning:** Phased array or curvilinear for abdominal component. In general start at a depth of 16cm in the normal sized adult. Please label R vs L (RUQ, LUQ)**Clips to save**

- 1) Cardiac view (subxiphoid or parasternal long view)
- 2) RUQ view (hepatorenal space, subphrenic space, right paracolic gutter/ liver tip, right thoracic cavity)
- 3) LUQ view (splenorenal space, subphrenic space, left paracolic gutter, left thoracic cavity)
- 4) Pelvic view (longitudinal and transverse view of the bladder)

If significant rib shadow, turn probe 45 degrees counterclockwise on patient's right and 45 degrees clockwise on patient's left to get in between rib spaces.

**eFAST:** consists of the above views along with the following anterior thoracic views – Please label R vs L lung

- 5) Right anterior lung field – evaluation for pleural sliding
- 6) Left anterior lung field – evaluation for pleural sliding

**Interpretation:** Y/N abdominal free fluid, Y/N pericardial effusion (if effusion, is there tamponade), Y/N fluid in the thoracic cavity, Y/N pneumothorax**Pitfalls:** In RUQ not demonstrating liver tip where FF can accumulate. In LUQ view not showing area under diaphragm where FF is likely to collect. In pelvic views not decreasing gain in bladder view which can obscure FF posterior to bladder, not showing pubic symphysis when bladder is decompressed, not looking cephalad of bladder in transverse view where FF can collect.

## **Thoracic:**

**Scanning:** A linear probe can be used anteriorly, but for evaluation of pleural effusions and interstitial fluid switch to phased array or curvilinear probe.

Label R vs L. Tailor scanning protocols to pathology of interest.

### **PTX: label R vs L, anterior/lateral/posterior**

Start in 2-3<sup>rd</sup> rib space, mid-clavicular line, with probe sagittal and marker cephalad.

Scan multiple intercostal spaces to the level of the diaphragm, anchoring scanning hand on chest to minimize chest wall motion (may scan more laterally on the left side in region of the heart).

Next examine the lateral chest at each interspace in the mid-axillary line.

Next examine the posterior thorax at each interspace. The patient is examined sitting upright if possible, with the patient grasping the contralateral shoulder so the scapula is abducted.

In critical situations (such as trauma) okay to limit eval to single location on each anterior hemithorax but for thoracic exam credit, more views required.

May use M-mode.

### **Pleural effusion: Label R vs L**

R side: With patient supine, similar to evaluation of RUQ in FAST scan, place phased or curvilinear probe in an intercostal space around nipple line in coronal plane or plane parallel with ribs with orientation marker cephalad. Rock the probe to evaluate above diaphragm.

L side: Similar to evaluation of LUQ in FAST scan, place probe in coronal plane or plane parallel with ribs with orientation marker cephalad. Rock the probe to evaluate above diaphragm.

### **Interstitial Fluid/Parenchymal Disease: Label 1,2,3,4,5,6,7,8 +/- LP, RP**

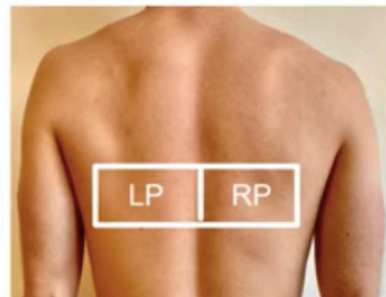
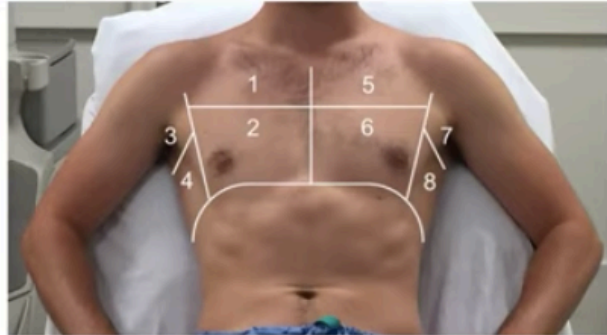
Orient either phased array or curvilinear transducer in sagittal plane. Scan in Volpicelli's 8 zones (4 zones for each hemithorax). Positive zone = > 3 B-lines visualized. The presence of 2+ positive zones bilaterally = interstitial syndrome. Minimum 12-15 cm depth. Turn off artifact-reducing technologies such as multibeam processing and tissue harmonic imaging if possible. If patient is stable and can tolerate sitting up or rolling, **scan left posterior and right posterior** lung fields

## 8-10 Zone Scan Protocol:

### Volpicelli lung zones plus left posterior, right posterior lung

reference: [https://www.youtube.com/watch?v=EQtzCVMC\\_Dk](https://www.youtube.com/watch?v=EQtzCVMC_Dk) (Elke Platz, Brigham) watch from 3:55

## Scanning technique: 8-10 zones



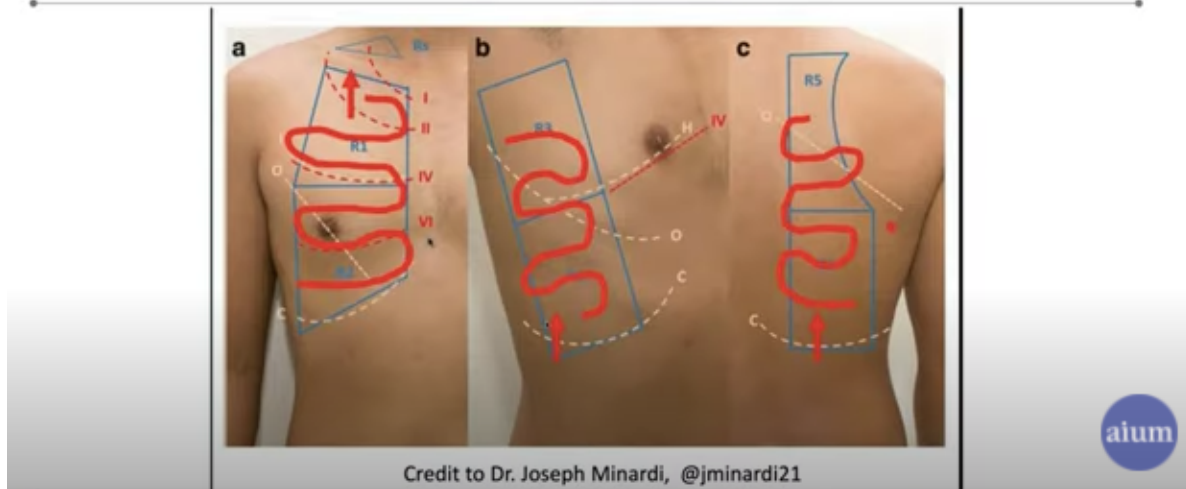
Exam duration: 2-5 min.

### **Clips to save:** R vs L, anterior, lateral, posterior

- 1) R anterior superior lung
- 2) R anterior inferior lung
- 3) R lateral superior lung
- 4) R lateral inferior lung
- 5) L anterior superior lung
- 6) L anterior inferior lung
- 7) L lateral superior lung
- 8) L lateral inferior lung
- 9) L posterior lung \*if possible
- 10) R posterior lung \*if possible

**Alternative technique for general thoracic exam eval:  
Lawnmower technique (may scan either top to bottom or bottom to top)**

### How to scan – “Lawnmower” technique



Reference: [https://www.youtube.com/watch?v=Z-zY\\_YdGHpA&feature=youtu.be](https://www.youtube.com/watch?v=Z-zY_YdGHpA&feature=youtu.be) (Rachel Liu) watch 3:55-7:45

**Images/clips to save:** Video clips of lung sliding and artifacts, diaphragm/pleural cavity stills acceptable .

The following clips should be obtained (and labeled R vs L, anterior, lateral, posterior)

- 1) Lawnmower R anterior lung
- 2) Lawnmower R lateral lung (pt raises arm above head)
- 3) Lawnmower R posterior lung (pt gives self a hug)
- 4) Lawnmower L anterior lung
- 5) Lawnmower L lateral lung
- 6) Lawnmower L posterior lung

**Interpretation:** Y/N lung sliding, predominant A or B line pattern in bilateral lung fields, Y/N Pleural effusion, Consider PTX if no lung sliding and no B lines

**Pitfalls:** subcutaneous emphysema, absence of lung sliding does not always = PTX, not asking pt to take deep breath (splinting due to pain), waiting for inspiration if pt on vent

FYI: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7228287/pdf/JUM-9999-na.pdf>  
Italian paper recently proposed international standardization of 14 zones for patients with COVID-19; not required by Emory currently but interesting article

## Pelvic Transabdominal US

### Scanning:

Images are optimized when a patient has a full bladder. Place US probe on patient's pubic symphysis in sagittal orientation. Identify uterus using bladder as a landmark. To optimally image the uterus, align transducer with long axis of uterus which is often angled right or left of midline cervix. Visualize endometrial stripe and rectouterine pouch. Fan probe left to right and vice versa, visualizing entire bladder and uterus. Turn probe counterclockwise 90 degrees to obtain transverse view. Fan probe cephalad to caudad and vice versa.

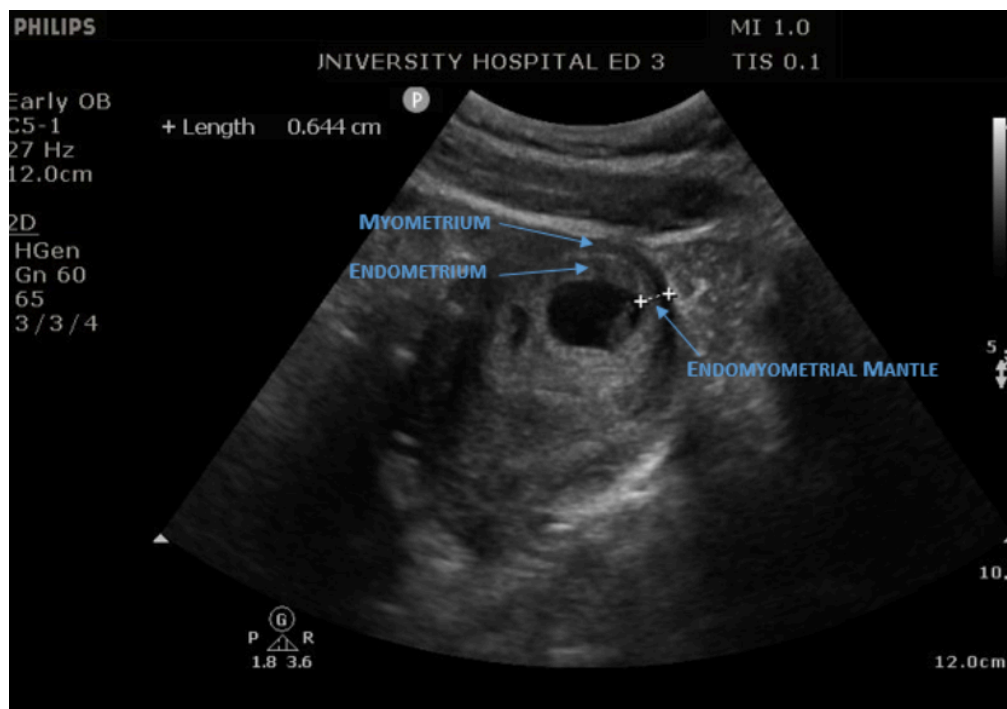
Slide the probe to right adnexal area, fan cephalad to caudad and vice versa. Turn probe clockwise to obtain sagittal view of r adnexa, fan left to right. Turn probe counterclockwise 90 degrees to return to transverse and slide probe to left adnexal area. Fan probe cephalad to caudad and vice versa. Turn probe clockwise 90 degrees to obtain a sagittal view of left adnexa. Fan from left to right and vice versa.

### Images/clips to save:

- 1) Clips of uterus in 2 planes; clips of bilateral adnexa in 2 planes - label R and L. If gestational sac present, zoom/adjust focus to examine for presence of yolk sac and/or fetal pole.
- 2) If cardiac activity seen, measure FHR with M mode.
- 3) Obtain estimate of gestational age with relevant measurements (gestational sac diameter if no yolk sac/fetal pole present, CRL in 1st trimester, FL/BPD in 2nd/3rd trimester)
- 4) Consider FAST if no IUP and patient is hypotensive or ruptured ectopic pregnancy is suspected

**Interpretation:** IUP or no definitive IUP. Can only determine IUP if gestational sac + yolk sac and/or fetal pole. If IUP, note if single, twin or multiple gestational pregnancy and examine/take measurements of each fetus (can label A, B, etc). Other possible interpretations- findings suspicious for ectopic, or abnormal pregnancy.

**Pitfalls:** Not interrogating entire uterus (including cervix). Mistaking a pseudosac for gestational sac. Failure to "prove the stripe" (best done in sagittal view) - dangerously making an assumption that what appears to be a gestational sac is in the uterus when it is not. Failure to identify interstitial ectopic pregnancy - endomyometrial mantle should be at least 8 mm (see figure below). Take measurement and send patient for confirmatory study if eccentrically placed gestational sac. Not identifying heterotopic pregnancy - be sure to examine both adnexal areas even if an IUP is visualized.



Imaging Credit: Taming the Sru <http://www.tamingthesru.com/blog/ultrasound/case-of-the-month>

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### Renal:

**Scanning:** Using phased array or curvilinear probe, record clips of both kidneys in short, long and bladder in 2 views

**Images/clips to save:** Label clips R vs L

- 1) Visualize long axis of bilateral kidneys - make sure there is clear view of renal sinus and consider use of color doppler for mild hydro to exclude visualization of renal hilum
- 2) Visualize short axis/transverse view of bilateral kidneys
- 3) Bladder view (sagittal and transverse)

**Interpretation:** Y/N hydronephrosis. Comment on stones, cysts, masses if seen.  
Bladder distension?

**Pitfalls:** mistaking renal vasculature for hydro, overestimating degree of hydronephrosis, overdistended bladder or mass causing BL hydro

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**DVT:**

**Scanning:** Scan in inguinal fossa. Find common femoral artery and vein, then find the junction of the common femoral and greater saphenous vein. Follow common femoral vein to bifurcation into femoral and deep femoral vein. In popliteal fossa find artery and vein and follow to trifurcation 7 cm below popliteal crease. Ensure that you are scanning and compressing in 1 cm increments within each region.

**Images/clips to save: (Please label R vs L)**

- 1) Clip of compression of common femoral vein
- 2) Clip of compression of greater saphenous-common femoral junction
- 3) Clip of compression of femoral vein (formerly superficial femoral vein)
- 4) Clip of compression of popliteal vein
- 5) Clip of compression of trifurcation

**Interpretation:** Y/N complete compressibility. Full compression is defined as complete compression of vein where anterior and posterior walls touch.

**Pitfalls:** Not compressing hard enough in obese patients, mistaking superficial veins for deep veins, mistaking lymph nodes for blood clots (LN are spherical when investigated in two planes)

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**Ocular:**

**Scanning:** Supine or 20 degree HOB elevation. Tegaderm over eye or use sterile gel. Rest examining hand on patient's forehead or face to avoid pressure on globe. Interrogate eye in transverse and sagittal planes, asking the patient to move eyes in all 4 directions. Increase gain to show abnormalities in the vitreous chamber. Scan both eyes; label R vs L

**Images/clips to save:** Video clips preferable

- 1) Transverse globe showing optic nerve, dynamic exam in all 4 quadrants (look up, down, left, right)
- 2) Sagittal globe showing optic nerve, dynamic exam in all 4 quadrants
- 3) If clinically indicated, may consider measuring optic nerve sheath diameter, though this is not required. Measurement should be taken 3mm from globe.

**Interpretation:** Y/N Retinal detachment (RD). Comment on vitreous detachment (VD) or vitreous hemorrhage (VH) if seen. Abnormal ONSD is >5 mm in adults.

**Pitfalls:** Not increasing gain enough to see RD/VD/VH, not visualizing the optic nerve when interpreting RD, not using kinetic echography – pathologies such as RD and VH are easier to see with eye movement, interpreting “RD vs VD” (make a decision),

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**Bladder Volume:**

**Scanning:** Transabdominal transverse and sagittal. Can use dual mode on Mindrays to capture single image that includes both longitudinal and transverse views.

**Images/clips to save:**

- 1) Transverse: measure AP and lateral diameter
- 2) Longitudinal: measure length
- 3) Use volume measurement calculation on ultrasound to determine bladder volume

**Interpretation:** Report bladder volume. If post void, Y/N urinary retention

**Pitfalls:** Duplicating the AP diameter during volume measurement. Make sure to use the bladder volume calculation/formula.

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**Vascular:**

**Scanning:** Use Linear probe

**Central Line:**

**Images/clips to save:** (Please label R vs L)

- 1) Still of vein OR
  - 2) Video of vein compressibility OR
  - 3) Still/video of vessel cannulation OR
  - 4) Image of guidewire in longitudinal
- Optional: Clip of rapid atrial swirl sign (RASS)

**Interpretation:** Successful or Unsuccessful

**Pitfalls:** Too much head turn when placing IJ (overlaps IJ over carotid), not confirming guidewire placement prior to dilation, ignoring thrombus in vein

**Peripheral IV:**

**Images to save:**

- 1) Still of vein OR
- 2) Video of vein compressibility OR
- 3) Still/video of vessel cannulation OR
- 4) Video of vessel demonstrating proximal flow after saline flush

**Interpretation:** Successful vs Unsuccessful

**Pitfalls:** Misidentifying artery as vein, attempting to cannulate a vein that is too deep or not wide enough, going through a nerve, ignoring thrombus in vein

**Arterial Line:**

**Images to save** (Please label R vs L):

- 1) Still/Video of artery OR
- 2) Still/video of cannulation

**Interpretation:** Successful vs Unsuccessful

**Pitfalls:** Misidentifying vein as artery attempting to cannulate artery that is too deep or not wide enough, going through a nerve

**IVC**

**Scanning:** Transabdominal subxiphoid

**Images/clips to save:**

- 1) Video of IVC in a long axis demonstrating the IVC draining to the RA

**Interpretation:** Signs suggestive of volume depletion vs not. Is IVC small, collapsible, and flat or is it a large, plethoric vessel?

**Pitfalls:** Confusing the aorta with the IVC. Not performing echo concurrently.

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## **Soft Tissue/MSK**

**Scanning:** Linear probe. Use standoff pads/waterbath/other techniques as needed.

### **Images/clips to save:**

1) Imaging of the area of interest in 2 planes.

**Interpretation:** +/- cobblestoning (representing edema or cellulitis), +/- abscess, +/- foreign body, fracture, joint effusion, dislocation, tendon rupture (partial v complete) +/- air in soft tissue

**Pitfalls:** Confusing lymph node for abscess, failure to consider necrotizing fasciitis. Confusing pseudoaneurysms/vasculature as abscess (turn on color flow if this is a question).

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## **Bowel: SBO**

**Scanning:** Curvilinear probe. Make sure you look at dependent areas of abdomen. Video clip preferable to assess peristalsis. Scan entire abdomen using lawnmower technique to find largest loop of bowel.

### **Images/clips to save:**

1) Still image with diameter measurement of largest loop of bowel

2) Video clip demonstrating peristalsis

**Interpretation:** Dilatation > 2.5 cm, associated free fluid, abnormal peristalsis

**Pitfalls:** Do not confuse large bowel for small bowel, find a longitudinal segment of bowel to measure (not oblique)

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## **Bowel: Appendicitis**

**Scanning:** Linear probe placed at point of maximal tenderness. Include at least 2 views. Use gradual pressure to displace overlying bowel gas.

### **Images/clips to save:**

1) Long and short axis of appendix

2) Video clip scanning the entire length of appendix

3) Measurement of diameter (outer wall to outer wall)

4) Compressibility

**Interpretation:** Tubular non-vascular structure, non-compressible, diameter > 6mm. Aperistaltic. Associated free fluid or fat stranding. Fecalith.

**Pitfalls:** Not scanning the entire length of appendix and missing areas of dilation. Misinterpreting appendix for the terminal ileum or a lymph node.

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## **Testicular:**

**Scanning:** Place patient in frog-leg position and place towel under the scrotum as a support. Scan unaffected side first to allow for comparison of size, texture, echogenicity, as well as to adjust Doppler settings.

### **Imaging/clips to save:**

1) Transverse and sagittal clips of testicle in B mode with attention to the epididymis as well

2) Coronal views bilaterally to view epididymis in entirety

- 3) Transverse comparative view of both testicles across the median raphe in B mode (probe at diagonal b/c left testicle hangs lower)
- 4) Color or power doppler of each testicle in short/long.
- 5) Transverse comparative view of both testicles using color or power doppler.

Optional: Spectral doppler waveform analysis to distinguish venous vs arterial flow

**Interpretation:**

Testicle +/- homogenous, +/- flow, +/- venous and arterial waveforms

Scrotum +/- hydrocele, +/- hernia, +/- varicocele +/- scrotal skin changes (i.e. Fournier's, abscess, cobblestoning)

**Pitfalls:** When using color doppler, minimize wall filter and PRF, pulse repetition frequency.