

Emory EM US Section QA Guidelines

Revised: Jul 31, 2023

Requirements for ALL Emergency Ultrasound Exams

- Patient Demographic Info
 - 2+ unique identifiers (e.g. name, MRN, or DOB)
- Use the correct probe AND preset
- Optimize gain/depth
- Record images outline below for each exam
- Complete the worksheet for 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)

Guidelines based on The ACEP Emergency Ultrasound Imaging Compendium and ACEP Standard Reporting Guidelines.

Aorta

Scanning: The goal of an aorta exam is to survey the ENTIRE aorta in both longitudinal and transverse access. This can be done in a single sweep or multiple as long as the entire aorta is seen. Minimum of 2 videos (longitudinal and transverse)

- Perform a preliminary survey of the entire aorta.
- Start subxiphoid at the level of the celiac trunk in transverse (prox), visualize the SMA (mid), slide towards the umbilicus, and visualize the iliac bifurcation (dist).
- Then, view the aorta in the longitudinal plane.

Images/Clips to Save:

- 1) Record clip of a survey of the entire aorta including bifurcation into the iliacs in BOTH longitudinal and transverse view.
- 2) If more than one video is needed to obtain the entire aorta, label “Prox,” “Mid,” and “Dist”
- 3) IF the aorta approaches 3 cm or the iliac diameter approaches 1.5 cm, make sure to measure the anterior/posterior diameter (outside to outside) at the biggest diameter.

Interpretation:

- Aneurysm: Y/N (abnormal/positive if aorta >3 cm; if iliac >1.5 cm)
- Rules in AND rules out aneurysm
- Can rule in aortic dissection but CANNOT rule out

Pitfalls:

- Not visualizing the entire aorta from epigastrium to bifurcation
- Not looking at the longitudinal aorta at the widest diameter

Biliary:

Scanning: Evaluate the GB in 2 planes (2 videos) and obtain 2 measurements (AWT and CBDD)

Images/Clips to Save:

- 1) GB in transverse

- 2) GB in longitudinal
- 3) Measure the anterior wall of GB
- 4) Measure CBD with color flow on proving it is not the hepatic artery (inside to inside)

Interpretation:

- Stones or Sludge: Y/N
- Pericholecystic fluid: Y/N (by definition, any fluid around the GB)
- Sonographic Murphy's sign: Y/N
- Gallbladder wall thickening: abnormal if >3mm
- Dilated CBD: abnormal if >6mm
 - For post-cholecystectomy, abnormal if > 10mm
 - For the elderly, allow 1 mm for each decade over 60 (e.g. 70 y/o pt abnormal >7mm)

Pitfalls:

- Need to find a cystic structure with a portal triad that makes anatomical sense – Do not confuse for vasculature, bowel, renal cysts, etc.
- Missing the stone at the neck of the gallbladder
- Recognize wall-echo-shadow (WES) sign
- Must use color flow so as to not mistakenly measure the hepatic artery instead of the CBD
- Mistaking contracted GB for abnormal (below is normal post-prandial GB: note anechoic center sandwiched in between two hyperechoic layers)
- Mistaking a GB polyp for a stone

Cardiac:

Scanning: Scan all 4 views using the phased array probe (4 videos), can add on the longitudinal view of the IVC (1 additional video)

Images/Clips to Save:

- 1) Subxiphoid (Subx)
- 2) Parasternal Long (PSL) – show descending aorta
- 3) Parasternal Short (PSS)
- 4) Apical 4 Chamber (A4C or Apical)
- 5) IVC in long axis, caval-atrial junction must be in view

Interpretation:

- Pericardial effusion: Y/N
 - If effusion is present, is there evidence of tamponade?
- LV Function: normal, mild to moderately depressed, severely depressed, hyperdynamic, absent
 - Evaluated at the level of papillary muscles
- RV dilatation: Y/N
 - In A4C, RV should be 2/3 the size of LV
 - In PSL, the rule of 3rds (RV : aortic outflow : LA ratio)
 - In PSS: D sign is abnormal
 - Other signs of RV strain: septal bowing, McConnell's, TAPSE <16 mm, etc.
- IVC – signs suggestive of volume depletion vs not
 - Collapses > 50% if spontaneously breathing or distends >16-18% if intubated?

- o Is IVC small, collapsible, and flat or is it a large, plethoric vessel

Pitfalls:

- Mistaking pleural effusion for pericardial effusion
 - Evaluating EF in patients with valvulopathy, at the level of the mitral valve rather than mid-ventricle, in the setting of arrhythmia
 - Not including descending aorta in the PSL view
 - Commenting on RV size in PSS at the level of mitral valve
 - Comments on RV function, LV diastolic function, valve pathology, chamber dilatation, HOCM, LVH, etc. – These are all diagnosed with measurements and not a visual diagnosis.
 - Confusing the aorta with the IVC, evaluating the IVC at any point other than 2-3 cm from the caval atrial junction
 - Obtaining an IVC view without performing echo concurrently to help with interpretation
 - Evaluating IVC collapsibility in intubated patients
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EFAST:

Scanning: Obtain 7 total videos with adequate depth adjustments for each view. If significant rib shadow, can rotate probe 45 degrees counterclockwise on the patient's right and 45 degrees clockwise on the patient's left to get in between rib spaces.

Images/Clips to Save:

- 1) Cardiac view (subxiphoid preferred, can do PSL if unable to obtain subxiphoid)
- 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 view of the bladder)
- 5) Pelvic view (transverse view of the bladder)
- 6) Right lung
- 7) Left lung

Interpretation:

- Abdominal free fluid: Y/N
- Pericardial effusion: Y/N (if effusion, is there tamponade?)
- Pleural effusion: Y/N
- Pneumothorax: Y/N

Pitfalls:

- In RUQ view, not obtaining a perihepatic view including the liver tip
 - In LUQ view, not obtaining a perisplenic view, including suprasplenic/below the diaphragm
 - In pelvis views not decreasing gain to account for posterior acoustic enhancement
 - o Not showing pubic symphysis when the bladder is decompressed
 - o Not looking cephalad of the bladder in the transverse view
 - In thorax views, not keeping the probe hand still when evaluating for lung sliding or confusing cardiac motion or vascular pulsatility for lung sliding
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Thoracic:

Scanning: Obtain 8 total windows with a depth of 12-15 cm minimal. If you have high clinical suspicion for thoracic pathology, you can increase the sensitivity of this exam by adding on posterior lung fields (have the patient grasp their contralateral shoulder to abduct the scapula) or lawnmower technique to see more rib spaces. Consider patient positioning to increase sensitivity as well.

Images/Clips to Save:

- 1) R Anterior Superior – 2nd to 3rd rib space, mid-clavicular line, probe sagittal, marker cephalad
- 2) R Anterior Inferior – midclavicular line, at the level just above diaphragm, marker cephalad
- 3) R Lateral Superior – midaxillary line, 2nd to 3rd rib space, marker cephalad
- 4) R Lateral Inferior – mid axillary line, at the level of the diaphragm, marker cephalad
- 5) L Anterior Superior – 2nd to 3rd rib space, mid-clavicular line, probe sagittal, marker cephalad
- 6) L Anterior Inferior – midclavicular line, at the level just above diaphragm, marker cephalad
- 7) L Lateral Superior – midaxillary line, 2nd to 3rd rib space, marker cephalad
- 8) L Lateral Inferior – mid axillary line, at the level of the diaphragm, marker cephalad
- 9) Can add L & R posterior lung

Interpretation:

- Pneumothorax: Y/N (can decrease depth to better evaluate)
- Pleural effusion: Y/N
- Interstitial fluid / parenchymal disease: Y/N (presence of B lines)
 - If more than 3 B-lines in more than 2 fields bilaterally = pulmonary edema
- Other findings: A-lines, subpleural consolidation, pleural thickening, irregular pleural line, light beam sign, etc.

Pitfalls:

- Mistaking subcutaneous emphysema for lung pathology
- Misinterpreting probe motion, cardiac motion, or vascular pulsatility as lung sliding
- False positives for pneumothorax – apnea, pneumectomy, pleurodesis, right main stem intubation, etc.
- Not increasing depth to 12-15 cm and confusing comet tails for B-lines
- Not scanning more fields if high clinical suspicion of thoracic pathology

Pelvic Transabdominal US:

Scanning: Obtain views of the uterus in longitudinal and transverse, showing scans through bilateral adnexa. If pregnancy is detected, identify the location of pregnancy, gestation age, and movement. Imaging through a full bladder can help optimize views.

Images/clips to save:

- 1) Clips of the uterus in 2 planes
- 2) Clips of bilateral adnexa - label R and L
- 3) If a gestational sac is present, evaluate for the presence of a yolk sac and/or fetal pole.
- 4) If pregnancy is seen, obtain an estimate of gestational age (gestational sac diameter if no yolk sac/fetal pole present, CRL in 1st trimester, FL/HL in 2nd/3rd trimester preferred)

- 5) Comment on movement (fetal movement, cardiac movement). If cardiac activity is seen, measure FHR with M mode.
- 6) Consider FAST exam if no IUP and ectopic pregnancy is suspected

Interpretation:

- IUP: Y/N (gestational sac is not sufficient, must identify gestational sac + yolk sac and/or fetal pole
 - Identify centrally located v eccentric positioning, obtain myometrial mantle measurement if eccentrically located
 - Obtain gestational age and comment on the movement
 - Note if single or multiple gestational pregnancy and evaluate each fetus (can label A, B, etc)
- Ectopic pregnancy: Y/N (consider heterotopic pregnancies)
- Pelvic FF: Y/N

Pitfalls:

- Not interrogating the entire uterus (including cervix)
 - Mistaking a pseudogestational sac for a gestational sac.
 - Failure to "prove the stripe" (endometrial 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 and cornual pregnancies - myometrial mantle should be at least 5-8 mm
 - Not identifying heterotopic pregnancy - be sure to examine both adnexal areas even if an IUP is visualized.
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Renal:

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

Interpretation:

- Hydronephrosis: Y/N
- Degree of hydronephrosis: mild, moderate, severe
- Bladder distension: Y/N
- IF SEEN, comment on stones, cysts, masses, etc.

Pitfalls:

- Mistaking renal vasculature for hydronephrosis – make sure to turn on color flow and keep the probe still to evaluate for vasculature v minor hydronephrosis
 - Failure to visualize the entire kidney (pole to pole, anterior to posterior) – make sure to move away from rib shadows to evaluate the entire kidney
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DVT:

Scanning: Scan in inguinal fossa. Find the common femoral artery and vein, then find the junction of the common femoral and greater saphenous vein. Follow the common femoral vein to bifurcation into the femoral and deep femoral vein. In popliteal fossa find artery and vein and follow to bifurcation/trifurcation. 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 with 2 compressions at the common femoral vein
- 2) Clip with 2 compressions at greater saphenous-common femoral junction
- 3) Clip with 2 compressions at femoral vein (formerly superficial femoral vein)
- 4) Clip with 2 compressions at the popliteal vein
- 5) Clip with 2 compressions at trifurcation

Interpretation: Fully compresses: Y/N (Full compression is defined as complete compression of the vein where anterior and posterior walls touch.)

Pitfalls:

- Incomplete compression – not compressing hard enough or compressing at an angle that is not perpendicular to the vessel
 - Mistaking superficial veins for deep veins
 - Mistaking lymph nodes for blood clots
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Ocular:

Scanning: Supine or 20-degree HOB elevation. MUST use sterile gel. Rest examining hand on the patient's forehead or face to avoid pressure on the globe. Interrogate the eye in transverse and sagittal planes, asking the patient to move their 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:

- 1) Video of fanning through transverse globe showing optic nerve
- 2) Video of fanning through sagittal globe showing optic nerve
- 3) Dynamic exam in all 4 quadrants (look up, down, left, right)

Interpretation:

- Retinal detachment (RD): Y/N
- Vitreous detachment (VD): Y/N
- Vitreous hemorrhage (VH): Y/N
- Technically, ONSD is abnormal if > 5 mm in adults (measured 3 mm posterior to the globe)

Pitfalls:

- Not increasing gain enough to see RD/VD/VH
 - Not visualizing the optic nerve when interpreting RD (RD anchors to the optic nerve whereas VD does not)
 - Not using kinetic echography – pathologies such as RD and VH are easier to see with eye movement
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Bladder Volume:

Scanning: Transverse and longitudinal view of the bladder. Can use dual view on machines to

capture both images on the same screen.

Images/clips to save:

- 1) Transverse: measure in AP and RL plane
- 2) Longitudinal: measure cephalad/caudad plane
- 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.

Vascular Procedures:

Scanning: Use the linear probe

Central Line:

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

- 1) Video of vein compressibility OR
- 2) Still/video of vessel cannulation OR
- 3) Image of the guidewire in longitudinal

Optional: Clip of rapid atrial swirl sign (RASS)

Interpretation: Successful or Unsuccessful

Pitfalls: Not identifying vein v artery, ignoring thrombus in the vein

Peripheral IV:

Images to save:

- 1) Video of vein compressibility OR
- 2) Still/video of vessel cannulation OR
- 3) 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 the vein

Arterial Line:

Images to save (Please label R vs L):

- 1) 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

Soft Tissue/MSK:

Scanning: Linear probe. Use standoff pads/water bath/other techniques as needed.

Images/clips to save: Imaging of the area of interest in 2 planes.

Interpretation:

- Cobblestoning: Y/N (representing edema or cellulitis)
- Fluid collection: Y/N (cyst or abscess)

- Foreign body: Y/N
- Other potential findings: 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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SBO:

Scanning: Curvilinear probe. Start the exam at the point of maximum tenderness. If pathology is not seen, at minimum evaluate in all four quadrants. Using the lawnmower technique to increase sensitivity is preferred

Images/clips to save:

- 1) If SBO is found, a video of the largest loop of bowel
 - a. Obtain a still image with a diameter measurement of the largest loop of the bowel
- 2) If no SBO is found, obtain 4 videos: subxiphoid, bilateral gutters, and suprapubic region
 - a. No need to measure the diameter of the loop if not dilated

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

Pitfalls:

- Do not confuse large bowel for small bowel
 - Measuring an oblique loop or multiple loops rather than a true diameter of the bowel
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Appendicitis:

Scanning: Linear probe placed at the 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 the appendix
- 2) Video clip scanning the entire length of the appendix
- 3) Measurement of diameter (outer wall to outer wall)
- 4) Evaluate 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 the appendix and missing areas of dilation.
 - Misinterpreting appendix for the terminal ileum or a lymph node.
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Testicular:

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

Imaging/clips to save:

- 1) Transverse and sagittal clips of the 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.