Ultrasound in Critical Care Medicine

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Objectives

• Discuss what is required to perform whole body ultrasound
• Discuss utility of general whole body ultrasound in critical care
• Review questions that can be answered with goal directed echocardiography (GDE)
• Apply these concepts in case studies
What does it require?

• Trained staff
  – Training should include general critical care ultrasound, basic critical care echo, and advanced critical care echo

• Ultrasound
  – Doppler is not necessary
  – Cardiac probe and vascular probe
  – Curvilinear probe unnecessary
Why is it useful?

• Rapid assessment and interpretation leads to earlier treatment
• No radiation exposure
• No need to travel off unit. Readily available
• Goal directed exam can be used to track evolution or resolution of illness
• Procedural guidance
Lung/Pleural ultrasound

• normal aeration pattern
• r/o PTX
• focal/diffuse consolidation
• interstitial edema
• pleural effusion
• procedural guidance
Thoracic Ultrasonography for the Pulmonary Specialist

Seth J. Koenig, MD; Mangala Narasimhan, DO, FCCP; and Paul H. Mayo, MD, FCCP

Relevance of Lung Ultrasound in the Diagnosis of Acute Respiratory Failure*

The BLUE Protocol

Daniel A. Lichtenstein, MD, FCCP; and Gilbert A. Mezière, MD
Background

- Observational study that assessed potential of lung ultrasound to diagnose acute respiratory failure
- Compared initial ultrasound findings to final diagnosis
- N=260
- Assessed for lung artifact, lung sliding, alveolar consolidation, pleural effusion
- Combined with venous u/s to create profiles
Results

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Sensitivity</th>
<th>Specificity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asthma/ COPD</td>
<td>89%</td>
<td>97%</td>
</tr>
<tr>
<td>Pulmonary edema</td>
<td>97%</td>
<td>95%</td>
</tr>
<tr>
<td>PE</td>
<td>81%</td>
<td>99%</td>
</tr>
<tr>
<td>PTX</td>
<td>81%</td>
<td>100%</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>89%</td>
<td>94%</td>
</tr>
</tbody>
</table>
Vascular ultrasound

- Rule out proximal lower extremity DVT
- Vascular access
  - Internal jugular
  - Femoral
  - Subclavian
Assessed accuracy and timeliness of compression ultrasonography for proximal lower extremity DVT by Intensivist vs. traditional ultrasonographer with interpretation by radiologist

- Multi-center study at 3 university hospitals
- n=128
- Overall prevalence of DVT was 20%
- Discordance in 9 patients (6 false positives and 3 false negatives)
- Final interpretation resulted in 88% sensitivity, 98% specificity, and diagnostic accuracy of 86%
Abdominal ultrasound

• FAST exam
• Evaluation of kidneys and bladder in oliguric/anuric patient
• AAA
• Ascites and guidance for paracentesis
Application of critical care echocardiography

• Is there a life-threatening cause for shock?
  – Pericardial tamponade, PE, catastrophic valve failure, acute cor pulmonale, etc

• Is it likely to be fluid responsive?
  – IVC measurement

• Is there pump failure?

• Are there confounders?
Billing

• CPT codes available
  – Require documented indication, note, and captured image
• OR include in critical care billing time
Case Study #1

- 56 yo F with triple negative breast CA with metastatic disease to pleura, bone, and liver
- Admitted to Oncology service for new distal left PE and femoral DVT.
- Started on heparin gtt
- Platelet count 85K
Hospital day #2

• Pulmonary team consulted for consideration of pleurex catheter
• Diagnostic thoracentesis performed- 950 cc of serosanguinuous fluid removed
• Follow-up CXR: negative PTX, persistent right pleural effusion
• Rapid response called 2 hours after thoracentesis for “hypotension”
• HR 113, SBP 70, pt weak but AAO x3
• NS bolus initiated, but BP refractory
• Transferred to MICU for further care
• BP remained refractory to IVF and pressers
• Differential diagnoses: PTX, septic shock, distributive shock from PE, hemorrhagic shock
• Limited ultrasound performed
Lung sliding
Case Study #2

- Pt is 48 yo male with new ESRD and HD initiation, as well as HTN, DM, and osteo of right foot
- RRT called to dialysis unit for hypoxia and decreased LOC
- On arrival, CPR and BMV in progress
- Pt intubated and received 2 rounds of epinephrine before ROSC
• Transferred to MICU once stabilized
• Differential diagnoses: PE, volume overload, cardiac failure
• Whole body ultrasound completed
• Korey, et al. Accuracy of Ultrasonography Performed by Critical Care Physicians for the Diagnosis of DVT. *CHEST 2011;139;538-542*


