Pleural Effusion Supporting Literature:

Emergent Question: Do I have a moderate or large pleural effusion that the patient might benefit from acute drainage, either improving oxygenation, alleviating dyspnea, or improving ventilation?

Probe Type: Cardiac (phased array) or Abdominal (curvilinear) probe; 2-5 MhZ

Clinical Scenario: Patients who have acute respiratory failure, hypoxia, or increased work of breathing on the ventilator may benefit from evacuation of pleural fluid. Patients in the acute trauma bay also can benefit from this by using as part of the extended FAST exam to identify hemothorax.

Scanning Technique: Small effusions may be better visualized with patient sitting in the upright position, but of interest to us in the emergent setting are the moderate to large effusions. Most of these patients will be limited to the supine position. The probe marker is positioned towards the patient's right and placed in the mid-axillary line. The diaphragm is a very important structure to identify and so the exam is best to start with identification of the renal and liver interface, since this is an easily identifiable structure in most patients. Once this location is identified, the probe is moved towards the patient's head along the mid-axillary line and the liver/diaphragm interface should be noted and recorded. This is very important in that many patients with pleural effusions may also have ascites. The diaphragm must be visualized in relationship in order to correctly identify pleural fluid [Figure 1]. Once the area visualized is confirmed to be above the diaphragm, the probe can be angled slightly towards to bed to better visualize the whole lung field. An anechoic space between the parietal and visceral pleura and respiratory movement of the lung within the effusion (sinusoid sign) is present in almost all free effusions [Figure 2]. This sign is a dynamic sign showing variation of interpleural distance during respiration. This can be visualized in M-mode as a sine wave when the M-mode line is positioned over the visceral pleura through the effusion [6, 7]. If the lung is not freely moving, the lung is sometimes referred to as 'trapped'. This might be a indicator that removal of fluid may 'un-trap' the lung so that oxygenation can be improved. An effusion with internal echoes (mobile particles or septa) suggest an exudate or hemorrhage. While most transudates are anechoic, some exudates can also be anechoic and therefore thoracentesis may be needed to further classify [8, 9]. This technique can be done on the side of interest to the clinician, or in part of an acute respiratory failure algorithm done on both sides.

Supporting Literature: In the evaluation of pleural effusion, ultrasound is more accurate than supine radiography and is as accurate as computed tomography. Also, in opacifications seen on chest radiography, lung ultrasound should be used to distinguish between effusions and consolidations [1]. Balik et al has shown that you can estimate the drainage that can be done with a formula, although it is not used frequently due to underestimation of volume [2, 3]. Also if one is attempting to reduce the work of breathing and increase respiratory muscle efficiency, the consideration of removal of pleural fluid should be made even though there have not been

validated criteria for decision making process [4]. Many times the decision to drain can be made on clinical parameters such as reduced chest wall compliance, difficulty weaning, refractory hypotension or when ultrasound suggests and infectious effusion (homogenous echogenecity, septation, fibrin strands, nodular pleural changes) [5].

[1]. Volpicelli G, Elbarbary M, Blaivas M, Lichtenstein DA, Mathis G, Kirkpatrick AW, Melniker L, Gargani L, Noble VE, Via G, Dean A, Tsung JW, Soldati G, Copetti R, Bouhemad B, Reissig A, Agricola E, Rouby JJ, Arbelot C, Liteplo A, Sargsyan A, Silva F, Hoppmann R, Breitkreutz R, Seibel A, Neri L, Storti E, Petrovic T, International Liaison Committee on Lung Ultrasound for International Consensus Conference on Lung Ultrasound (2012) International evidence-based recommendations for point-of-care lung ultrasound. Intensive Care Med 38:577–591
[2]. Balik M, Plasil P, Waldauf P, Pazout J, Fric M, Otahal M, Pachl J: Ultrasound estimation of volume of pleural fluid in me- chanically ventilated patients. Intensive Care Med 2006; 32: 318 – 2
[3]. Reme´rand F, Dellamonica J, Mao Z, Ferrari F, Bouhemad B, Jianxin Y, Arbelot C, Lu Q, Ichaï C, Rouby JJ: Multiplane ultrasound approach to quantify pleural effusion at the bed- side. Intensive Care Med 2010; 36:656–4
[4]. Doelken P, Abreu R, Sahn SA, Mayo PH: Effect of thoracen- tesis on respiratory mechanics and gas exchange in the patient receiving mechanical ventilation. Chest 2006; 130: 1354 – 61
[5]. Kopterides P, Lignos M, Papanikolaou S, Papadomichelakis E, Mentzelopoulos S, Armaganidis A, Panou F: Pleural effusion causing cardiac tamponade: Report of two cases and review of literature. Heart Lung 2006; 35:66–7
[6]. Kocijancic I, Vidmar K, Ivanovi- Herceg Z (2003) Chest sonography versus lateral decubitus radiography in the diagnosis of small pleural effusions. J Clin Ultrasound 31:69–74
[7]. Lichtenstein D, Hulot JS, Rabiller A, Tostivint I, Meziere G (1999) Feasibility and safety of ultrasound- aided thoracentesis in mechanically ventilated patients. Intensive Care Med 25:955–958
[8]. Brooks A, Davies B, Smethhurst M, Connolly J (2004) Emergency ultrasound in the acute assessment of haemothorax. Emerg Med J 21:44–46
[9]. Chen HJ, Tu CY, Ling SJ, Chen W, Chiu KL, Hsia TC, Shih CM, Hsu WH (2008) Sonographic appearances in transudative pleural effusions: not always an anechoic pattern. Ultrasound Med Biol 34:362–369

Figure 1 - diaphragm with ascites and pleural fluid
Figure 2a - moderate to large effusion ; with split screen showing sine wave “sinusoid” sign;
Figure2b - moderate to large effusion with no sinusoid sign