

Pneumonia or lung consolidation Supporting Literature:

Emergent Question: Do I see a lung consolidation with air bronchograms?

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

Clinical Scenario: Patients who are in respiratory failure with unknown etiology and unstable for transfer to radiological suite might benefit from evaluation of the lung fields for large consolidations that might be the etiology. This examination can also be helpful in differentiating consolidation from pleural effusions in the acutely hypoxic patient.

Scanning Technique: The acutely ill patient is usually in the supine position. The probe marker is towards the patient's head and the operator should start the exam with the probe on the sternum. The image obtained will be a shadow artifact from bony sternum. First move towards the right anterior chest and then move laterally towards the posterior thorax. Multiple areas can be studied and the various types of pneumonias produce abnormalities at many locations on the chest wall [Figure 1]. The sonographic sign we are looking for is a subpleural echo poor region or one with a tissue like echo texture ("tissue like sign") [Figure 2]. Also, one of the most important criteria is a positive air bronchogram within the tissue like sign, and has been shown to be found in 70-97% of cases [8-10] [Figure 3a]. Atelectasis has to be differentiated from pneumonia. Atelectasis is normal due to large pleural effusion and moves within an effusion, it is moderately echoic, and sharply demarcated. Air bronchograms indicating pneumonia can sometimes be seen as moving to and fro with respirations or ventilator breaths, and are referred to as 'dynamic' air bronchograms, and means bronchial patency and rules out obstructive atelectasis [11]. Pneumonia appears as a hypoechogenic area with poorly defined borders and presence of B lines with lung sliding reduced or absent. Multiple lenticular echoes, representing air trapped in the smaller airways are also frequently observed [Figure 3b].

Supporting Literature: Lung ultrasound should be considered an accurate tool in ruling in lung consolidations when compared to chest radiography. In mechanically ventilated patients, lung ultrasound should be considered because it is more accurate than chest radiography in differential diagnosis of consolidation which include pneumonia, atelectasis, or pulmonary embolism [1]. In many recent studies it has been shown that lung ultrasound can be highly effective in evaluating pulmonary conditions such as pneumonia [2, 3]. High diagnostic accuracy was found in multiple studies where CT scan alone was the gold standard [4-6]. Bedetti et al have shown that clinicians are able to detect presence of pulmonary interstitial syndrome after fewer than 10 examinations and total training time of 30 minutes [7].

[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, Breikreutz 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]. Cortellaro F, Colombo S, Coen D, Duca PG: Lung ultrasound is an accurate diagnostic tool for the diagnosis of pneumonia in the emergency department. *Emerg Med J* 2012, 29:19–23.
- [3]. Reissig A, Copetti R, Mathis G, Mempel C, Schuler A, Zechner P, Aliberti S, Neumann R, Kroegel C, Hoyer H: Lung ultrasound in the diagnosis and follow-up of community-acquired pneumonia: a prospective, multicenter, diagnostic accuracy study. *Chest* 2012, 142:965–972.
- [4]. Lichtenstein D, Goldstein I, Mourgeon E, Cluzel P, Grenier P, Rouby JJ: Comparative diagnostic performances of auscultation, chest radiography, and lung ultrasonography in acute respiratory distress syndrome. *Anesthesiology* 2004, 100:9–15.
- [5]. Lichtenstein DA, Lascols N, Meziere G, Gepner A: Ultrasound diagnosis of alveolar consolidation in the critically ill. *Intensive Care Med* 2004, 30:276–281.
- [6]. Xirouchaki N, Magkanas E, Vaporidi K, Kondili E, Plataki M, Patrianakos A, Akoumianaki E, Georgopoulos D: Lung ultrasound in critically ill patients: comparison with bedside chest radiography. *Intensive Care Med* 2011, 37:1488–1493.
- [7]. Bedetti G, Gargani L, Corbisiero A, Frassi F, Poggianti E, Mottola G: Evaluation of ultrasound lung comets by hand-held echocardiography. *Cardiovasc Ultrasound* 2006;4:34.
- [8]. Gehmacher O, Mathis G, Kopf A, Scheier M: Ultrasound imaging of pneumonia. *Ultrasound Med Biol* 1995;21:1119–1122.
- [9]. Sperandio M, Carnevale V, Muscarella S, Sperandio G, Varriale A, Filabozzi P, Piattelli ML, D'Alessandro V, Copetti M, Pellegrini F, Dimitri L, Vendemiale G: Clinical application of transthoracic ultrasonography in in-patients with pneumonia. *Eur J Clin Invest* 2011;41:1–7.
- [10]. Parlamento S, Copetti R, Di Bartolomeo S: Evaluation of lung ultrasound for the diagnosis of pneumonia in the ED. *Am J Emerg Med* 2009;27:379–384.
- [11]. Lichtenstein D, Meziere G, Seitz J: The dynamic air bronchogram. A lung ultrasound sign of alveolar consolidation ruling out atelectasis. *Chest* 2009;135:1421–1425.

Figure [1]. Chest zones for evaluation of pneumonia

Figure [2]. Tissue like sign

Figure [3]. 3a Air bronchogram; 3b lenticular echoes with abscess

Figure [4]. Shredded Lung sign