

Pulmonary edema or interstitial syndrome Supporting Literature:

Emergent Question (s): Is my patient in a fluid overload state? Are B lines with lung sliding present?

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

Clinical Scenario: In patients who present with severe dyspnea or acute respiratory failure requiring non-invasive ventilation or endotracheal intubation, evaluation for pulmonary edema can be performed. States such as hypertensive emergency, cardiogenic shock, or neurogenic pulmonary vasodilation can all cause similar lung patterns.

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]. A more rapid two region scan may be sufficient in some cases (anterior chest in the supine patient). B lines are vertical hyperechoic reverberation artifacts that arise from the pleural line and extend to the bottom of the ultrasound screen without fading. These lines can either be associated with lung sliding or not associated with lung sliding. The anatomic and physical basis of B lines is not clear at this time, and could be related to alveolar wall thickening. Multiples of these lines are the sonographic sign of lung interstitial syndrome. A positive region is defined by the presence of more than 3 B lines in a longitudinal plane between the ribs [Figure 2]. Focal B lines can be present in normal lung. In cardiogenic pulmonary edema, these B lines are associated with lung sliding, with homogenous distribution in anterior bilateral chest exam, and 'spared' areas are not observed, and the pleural line is rarely involved [1]. Pulmonary edema produces a transudate in this scenario, which is not supposed to generate inflammatory adherences (a factor that may affect lung sliding). In contrast, the findings in diffuse parenchymal lung disease include: pleural line abnormalities (irregular, fragmented pleural line), subpleural abnormalities (small echo poor areas), and nonhomogenous distribution of B lines. In acute respiratory distress syndrome (ARDS), anterior subpleural consolidations, absence of lung sliding, 'spared' areas of normal parenchyma, pleural line abnormalities (irregular fragmented pleural line), and nonhomogenous distribution of B lines can be found [2]. Evaluation of B lines allows monitoring of response to therapy in cardiogenic pulmonary edema.

Supporting Literature: Chest radiography can be used to diagnose pulmonary edema, but overall accuracy may be as low as 69% and findings of pulmonary edema can lag behind clinical changes [3, 4]. Many studies have now shown that lung ultrasound can be used to distinguish between cardiogenic and non-cardiogenic causes of dyspnea [5, 6]. Also B lines have been shown to correlate with more recognized methods of identifying pulmonary edema. Chest radiography [7], computed tomography [8], pulmonary capillary wedge pressure, quantitative measurements of extravascular lung water, and natriuretic peptide levels have all been correlated

to B lines using lung ultrasound [9, 10]. The presence of B lines has also been shown to be dynamic, disappearing in patients undergoing hemodialysis [11].

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Figure 1 - Areas of chest to examine

Figure 2 - B lines