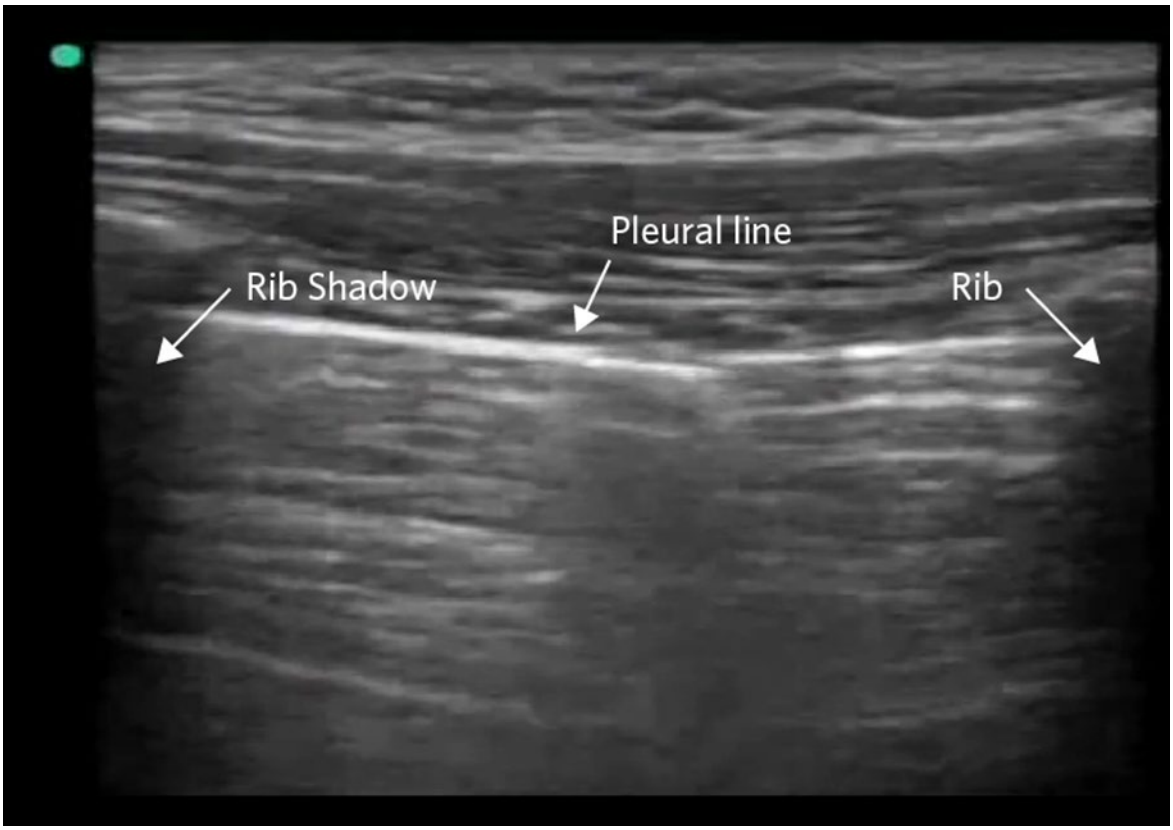
HOUSE
HANDS-ON ULTRASOUND EDUCATION

THE UNIVERSITY OF BRITISH COLUMBIA
Continuing Professional Development
Faculty of Medicine

# How-To Guide

## Lung Ultrasound




Lung Ultrasound: How to identify the most common lung pathologies, such as pneumothorax, pneumonia, CHF and pleural effusions.

## How to do it:

1. Select low frequency, or abdominal, probe.
2. Hold probe with thumb and 2 fingers.
3. Ensure depth is about 15cm.
4. Position probe on most superior aspect of chest, in a longitudinal orientation (marker towards patient's head). This will usually be in the 2nd or 3rd interspace, around the mid-clavicular line.
5. Find the area of interest: two rib shadows and the bright white pleural line between them.

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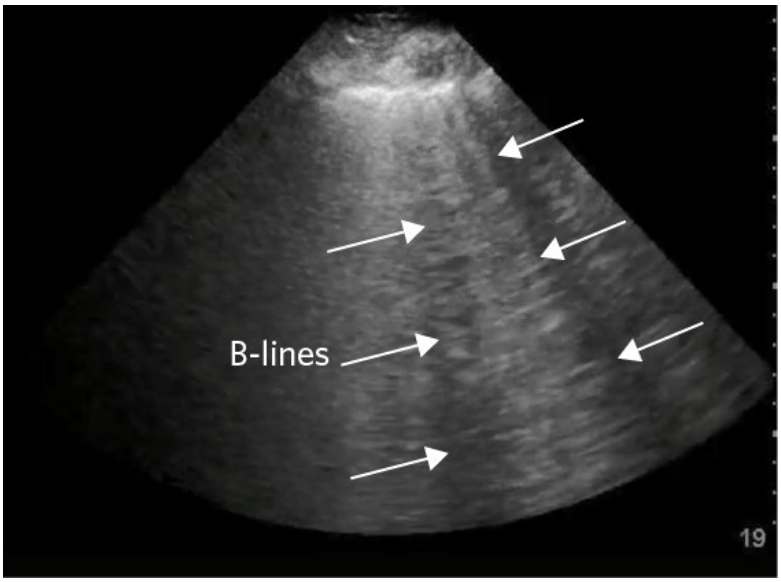
*The Hands-On Ultrasound Education (HOUSE) Program is offered in close collaboration with the Rural Coordination Centre of BC (RCCBc)*

6. Confirm the presence of lung sliding - yes or no. Lung sliding means no pneumothorax. Absence of sliding means pneumothorax is present.
7. Move on to look for the presence or absence of B-lines. If you don't see B lines, ensure that you can see the A lines consistent with normal lungs. If no A lines are seen, you are likely seeing an obliteration of lung tissue by fluid.




8. Also look at the subpleural area – the region just below the pleural line will be irregular and hyper-echoic in the setting of pneumonia, while it will be normal with CHF.
9. Slide caudally down the anterior chest to visualize a second region around the $4^{th}/5^{th}$ interspace and again look for lung sliding and B-lines, as above.
10. Slide the probe to the mid-axillary line and repeat the visualization steps a third time.
11. From the mid-axillary line, slide caudally, until you see the diaphragm, to check for pleural effusion (or hemothorax in trauma patients).
12. Repeat on the other lung, ensuring you scan all three zones on this side too.
13. Note which areas of lung have abnormal findings. It is the distribution of the lung findings that can help you determine the diagnosis.
14. Combine pulmonary POCUS with a quick point-of-care echo (parasternal long view) and view of the IVC to obtain a rapid and accurate assessment of the patient's hemodynamic status.

## How to interpret your findings:

If B-lines are:

- Unilateral: usually pneumonia, but consider contusion in trauma or old fibrotic changes

- Bilateral: decompensated heart failure, bilateral pneumonia, ARDS, interstitial lung disease

The absence of B-lines in a dyspneic patient suggests other etiologies such as COPD or pulmonary embolism or severe anemia.

Remember, small pneumonias are often missed by this simplified lung protocol, but hard to blame as the cause for significant dyspnea.

Bilateral B-lines with plump IVC and poor LV systolic function is the hallmark trinity for decompensated CHF

Heart failure with preserved systolic function (aka severe diastolic dysfunction) can also lead to bilateral B lines, but may have a near-normal appearing LV ejection fraction. In these cases, the IVC should be plump and the history should be consistent.

Bilateral B-lines with a flat IVC, is most likely NOT cardiogenic pulmonary edema. Consider other etiologies like ARDS, bilateral pneumonia, or interstitial fibrosis.

# How to do it better:

If you cannot, with certainty, identify normal lung sliding, the following steps should clarify normal lung or confirm pneumothorax:

a. Turning the gain way down to make the pleural line stand out.

b. Decreasing the depth to the minimal amount to magnify the “ants marching on a log”.

c. Switch to the linear probe for better resolution.

If pneumothorax is identified, slide your probe laterally to identify the lung point sign, which demarcates the limit of the pneumothorax. The lung point is the spot where you see the transition point between sliding lung and no sliding. This sign is pathognomonic for the presence of pneumothorax.

Be aware that consolidated lung can look like a solid organ (“hepatization”) and can often have air bronchograms (sparkling artifacts of air surrounded by fluid). These findings can obviously occur anywhere in the thorax and be unilateral or bilateral, depending on the disease process.

The above steps will identify major lung pathology. If you suspect your patient has a smaller process, like a localized pneumonia or pulmonary contusion, this requires a more focused scanning approach:

Rotate the probe so that the entire footprint lies in the intercostal space with the indicator towards the patient’s R shoulder. Start at the sternum and slide out towards the mid-axillary line keeping the probe’s footprint between the ribs. Repeat at each intercostal space working your way down the chest. This technique will cover most of the lung territory and ensure that you do not miss a small pneumonia if that is your goal.

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Be aware that ultrasound can help you determine the etiology of a pleural effusion. A simple transudative effusion or a fresh hemothorax appear black, while an empyema can appear grey and echogenic. More chronic effusions can even demonstrate echogenic fibrinous material.

## How to do it safely:

Ultrasound is far superior to CXR for diagnosing interstitial pulmonary edema, approaching the sensitivity and specificity of CT scan. However, the presence of B-lines, while very sensitive, is quite non-specific.

False negatives for pulmonary edema are fairly rare. If you believe that a patient is suffering from a CHF exacerbation, but you see no B-lines, reconsider your diagnosis.

False negatives for pneumonia are quite common, especially small areas of consolidation.

## How to use this in practice:

Do a lung scan on all patients with undifferentiated dyspnea. Combine this with a focused cardiac echo and an IVC scan to improve your diagnostic ability.

In a more stable patient, consider confirming your suspicions of focal pneumonia or lung contusion by doing a more focused lung scan. Especially in children, this may allow you to confirm a clinical suspicion without the need for CXR.

**Updated:** September 25, 2020