

Case: 12-year-old girl who is crying hysterically

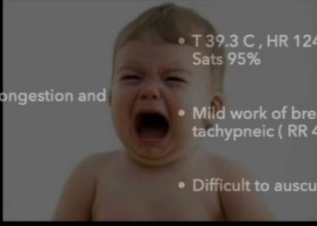
Basic Science and Literature: (important one liners from literature)

Comparing POCUS to CT scans and CXR – POCUS has high sensitivity and specificity for dx of pneumonia. One meta-analysis from 2015: Sens 96% Spec 93% Putting into practice: Reduction in CXR use: 38.8%, Novice 30% and Experienced 60%, NNT was 2.5 scans, 1 spared a CXR, increased use of antibiotics (10.6% due to higher sensitivity of picking up small consolidations)

Cut-off of 1 cm for determining bacterial pneumonia – yet controversy continues – POCUS findings do fall on a spectrum of disease.

Quantifying pleural effusions – 79% accuracy

Case

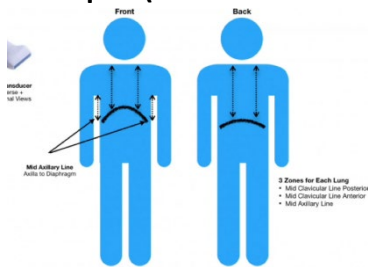


- 12 month old girl
- T 39.3 C, HR 124, BP 92/64, RR 45, Sats 95%
- Rhinorrhea, nasal congestion and cough x 1 week
- Mild work of breathing and tachypneic (RR 45)
- Fever x 3 days
- Difficult to auscultate

Table 1 Summary of Lung Ultrasound Findings in Pediatric Infectious Pulmonary Pathology

	Bacterial Pneumonia	Viral Pneumonia	COVID-19	Bronchiolitis
Distribution	Posterior	Diffuse	Posterior/Lateral	Diffuse
Pleural Line	Irregular near consolidations	Irregular Thickened	Irregular Thickened	Irregular Thickened
Lung Parenchyma	Discrete B-lines Air-bronchograms	Scattered B-lines Confluent B-lines	Scattered B-lines Confluent B-lines	A-line pattern Scattered B-lines Confluent B-lines Air-bronchograms
Consolidations	Focal consolidations Hepatization	Sub-centimeter consolidations	Subpleural consolidations	Subpleural consolidations
Pleural Effusion	Common	Rare	Rare	Rare

Technique: (describe how to find structure)



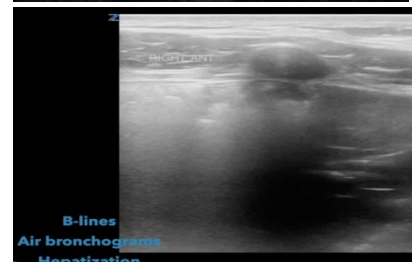
Use the hi frequency linear transducer.

6 Zones – scan from clavicles to the diaphragms – anteriorly mid clavicular, axillary, then opposite side, then posterior mid scapular to diaphragm. Initial recs are to use only longitudinal view, but zig zag covers more area of the lungs Engage child, have them apply gel or have parent and child hug which moves scapula out of way.

Focused ?'s: and Patholgy (List the focused questions to answer Yes or No)

Is this a Normal Lung or Abnormal Lung

- Are there A line's and Is there shimmering, (Lung sliding) of the pleura or is there pleural shredding. Comet tails are normal.
- Is there a Pneumothorax: Was there a lung point. Use M-Mode: No movement or not.
 - Movement is Sandy Beach: No sliding and c.w a Pneumothorax with Bar Code sign.
- Are there B Lines: Signify Interstitial edema c/w edema or infiltrate and is the pleural thickened.
- Pleural Shred? Are there sub-centimeter consolidations at pleura (Bite Marks)
- Are there air bronchograms and Hepatizations?
- Atelectasis without signs of inflammation is more c/w Atelectasis. If with signs of consolidation more c/w dynamic air broncho



Signs of Pneumonia are:

- Plueral Shred
- Confluent B Lines
- Subpleural Hypoechoic Areas > 1 cm deep. Sub-centimeter consolidation
- Air or fluid bronchograms
- Hepatization

Pleural Effusions can be small in children with viral infections. Larger ones are associated with bacterial pneumonia or an empyema. Look for Spine Sign and cardiac view.

Pathology, Pearls and Pitfalls



Make Child Comfortable, Holding Parent moves scapula out of the way

Scan whole thorax in children.

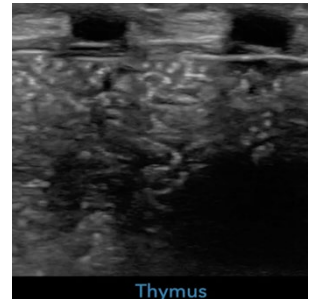
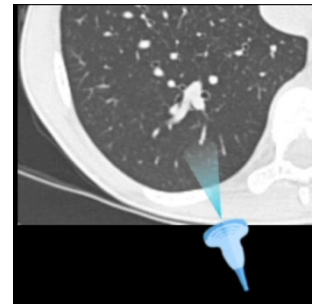
More sensitive than specific and all findings are on a spectrum, clinical context is important. Just like wheezes and crackles.

Get behind ribs by rotating and place probe perpendicular to the pleural and tilt probe to achieve that.

Thymus gives a picture like a bunch of worms or starry sky. and be quite large and is typically anterior to the heart.

Diaphragm detection to note presence if in abdomen or chest.

POCUS cannot detect central pneumonia if the infiltration does not extend to the pleura. Get a CXR



Troubleshooting and Pearls

- **Position to spread scapula** – patient sitting in parent/adult's lap, reaching up to hug their parent/adult
- **Context/Spectrum** – the sonographic findings for lung pathologies exist on a spectrum and must be put into clinical context to differentiate the diagnosis. Just as wheezes and crackles can be found in both bronchiolitis and pneumonia, so can the sonographic appearance of viral and bacterial pathologies overlap.
- **Rotating the transducer** – can rotate the transducer 90 degrees from longitudinal to transverse to get the ribs out of the way and get a better look at pathology

Pitfalls:

- **Angle of transducer** – the rib cage is round! Keep the transducer perpendicular to get a crisp pleural line – and to avoid mistaking normal pleura for shredding.
- **Thymus** – well demarcated clean edges, "starry sky" appearance in the anterior chest of younger children, anterior to the heart. A thymus can be mistaken for pathology or hide pathology behind/beside it.
- **Diaphragm** – identify the diaphragm. Easy to mistake the stomach bubble for lung pathology. Hepatized lung and liver can look very similar.
- **Central Pneumonia** – Lung ultrasound can only see pneumonias that touch the pleural surface. 1.5% of pneumonias do not abut the chest wall. Get further workup if no lung pathology is identified but clinical picture is concerning for pulmonary disease.
- **Atelectasis** – Just as in x-ray, atelectasis and pneumonia can look similar. Differentiate the hepatization of atelectasis from the hepatization of pneumonia by the lack of inflammation. Lack of pleural thickening, pleural shredding, lack of (or few) B lines, lack of effusion, lack of DYNAMIC (moving, worm-like) air/fluid bronchograms all point to atelectasis.
 - Be wary of overtreating for bacterial pneumonia when ultrasounding patients with asthma. Given the likelihood of false positives, scanning unless they are not responding to asthma treatments.