AIMS

Familiarize with the sonographic features of normal chest cavity to facilitate an understanding of the various patterns one may encounter when performing lung sonography.

SUMMARY

Traditionally, air has been considered the enemy of ultrasound and the lung has been considered an organ not amenable to ultrasonography examination, nevertheless, in the last 10 years, lung sonography has rapidly emerged as a reliable technique in the evaluation of various thoracic diseases.

Thoracic ultrasound (TUS) is made feasible by the interpretation of ultrasound artefacts that arise from the chest wall and pleural surface. A brief review of the relevant normal thoracic anatomy will provide the framework to facilitate an understanding of the various patterns one may encounter when performing lung sonography.

Thoracic ultrasound has several advantages over traditional radiographic imaging of the pleura including absence of radiation, real-time imaging, better portability and low cost but has the disadvantage to be an operator dependent technology. Focused, supervised training is needed to ensure that the operator correctly interprets the sonographic findings.

Equipment and Technique

For transthoracic examination of the pleura it is common to use two types of transducers.

First, a lower frequency transducer (3-5 MHz) with a convex probe is used, which has a wider and deeper image field, allowing easier detection of the anomalies of intra-thoracic structures.

After a pathological process is detected, a higher frequency transducer (7.5 to 13 MHz), with a linear probe can be used to obtain more detailed images of the superficial pathology. (Figure 1)

The lung and pleural structures are assessed using B-mode, while M-mode is used to assess pleural movement. The latter mode assesses the movement of structures over time. Doppler assessment is not required for examination of the thoracic cavity.

Lung ultrasound is best performed with the patient sitting up; however, this may not be possible in hospitalized patients where it is generally performed in supine or lateral positions.

Six regions, delineated by the anterior and posterior axillary lines should be systematically examined (upper and lower parts of the anterior, lateral and posterior chest wall) with the probe in transverse and parasagittal planes.

TUS of the Chest wall

Superficial structures (skin, subcutaneous fat, pectoral and intercostal muscles) conduct sound waves
well and do not generate artefacts.
The ribs appear as repeating curvilinear structures with deeper, hypoechoic, posterior acoustic shadow extending to the edge of the ultrasound screen. (Figure 2)

Normal Lung Findings

Normal lung parenchyma is not visualized because it is composed primarily of air, which scatters and impedes the transmission of sound waves.
The dramatic difference in the acoustic characteristics of soft tissues and the lung makes the lung surface a particularly strong reflector of ultrasound waves, and is responsible for creating a number of reverberation artifacts that provide valuable information about the lung’s current pathophysiology.

When an ultrasound transducer is laid on a normal chest wall with a normally aerated lung, the following is observed:

- **Pleural Line**: the parietal and visceral pleurae appear as a single bright hyperechoic line no wider than 2 mm “pleural line” just deep to the internal intercostal muscles. (Figure 3)
The pleural line “slides” with respiration. The sonographic effect of lung sliding (also known as lung gliding or lung sliding sign) is created by movement of the visceral pleura against the parietal pleura during respiration. Its amplitude is greater at the base than at the apex where it may be inappreciable. The presence of lung sliding excludes pneumothorax at the point of the probe with a negative predictive value of 100%. (Figure 4)
The image best seen in M mode as the superficial parietal layers are motionless and have a horizontal pattern of lines while the area deep to the pleural line appears “granular” as the motion of the pleural line is reflected all over this area. This is also known as the “seashore sign”. (Figure 5)

In B-Mode scanning the normal pleura is seen as a white (echogenic) line which moves with respiration (lung sliding). The pleura are situated posterior (below) to the ribs which appear as white curved lines with a dark shadow behind. This is known as the “Bat sign”. (Figure 6)

- **A-Lines**: Horizontal, regularly spaced hyperechogenic lines representing reverberations of the pleural line. These are motionless and are artifacts of repetition. (Figure 7)

- **B-lines**: B-lines occur when sound waves pass through the superficial soft tissues and cross the pleural line encountering a mixture of air and water. They appear as vertical lines extending from the pleural line to the lower edge of the screen without fading. B lines move synchronously with lung during respiration and tend to erase A lines. It is common to see a few B lines at the base of a normal lung, the presence of more than three B lines in a single ultrasound field is considered significant e suggests alveolar interstitial syndrome. (Figure 8)

- **Z lines**: are short, broad, ill defined, vertical comet tail artifacts arising from the pleural line but not reaching the distal edge of the screen and are not B lines. These are found in normal persons as well as in those with pneumothorax.

- **Diaphragm**: diaphragm typically appears as an echoic line approximately 1 mm thick; downward movement of the diaphragm should be seen with inspiration and the location of the splenorenal and hepatorenal recesses must be research in each patients. When scanning intercostally you may see the liver and diaphragm covered by lung during inspiration. And this is known as the “Curtain sign”.

Conclusion

Ultrasonographic assessment of the lung and pleura provides rapid, noninvasive and essential information in the diagnosis and management of various pulmonary condition but in order to do that the physician need to have clear knowledge of basic normal chest ultrasound. A brief review of the relevant normal thoracic anatomy will provide the background to facilitate the recognised of the various patterns one may encounter when performing lung sonography.
REFERENCES


EVALUATION

1. Which transducer provides wider and deeper image field:
   a. Cardiac transducer
   b. Linear probe higher frequency transducer (7.5 to 13 MHz)
   c. Curvilinear low frequency transducer (3-5 Mhz)

2. Which of the following images represents the “seashore sign”:

   a)
   ![Image of seashore sign]
3. Which images represents the “bat sign”: