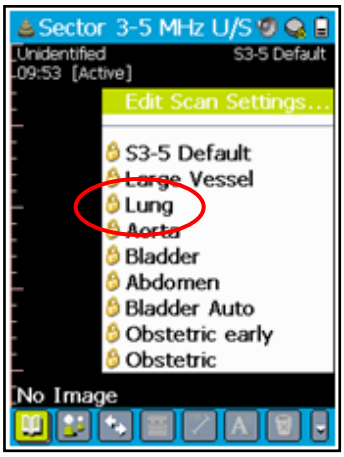
CLINICAL APPLICATIONS TRAINING SERIES

LUNG ULTRASOUND IMAGING

Signos RT can assist Emergency, Intensive Care, Rural and Pulmonary physicians in the assessment of Lungs and the Pleural cavity. Normal Lung Sliding, Consolidation, Pleural Effusions, Interstitial Syndrome, Pneumothorax, Lung Pulse, A-lines and B-lines can be assessed using Real-time and M-Mode imaging.

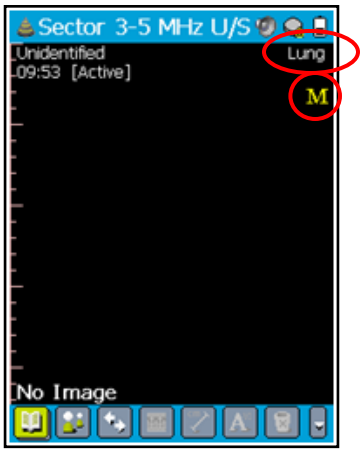
1. ***Turn Device on*** - button on top right
2. ***If you wish to enter patient details select***  **(User Manual Section 5)**
3. ***Select the Lung Preset*** **(User Manual Section 6)**



- Tap stylus on the preset icon (top right)
- Obtain drop down list
- Select **Lung**

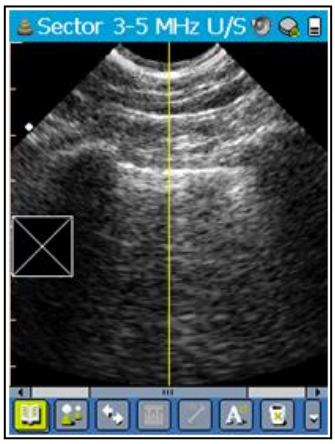
OR

- Scroll to Main Menu (book icon) – 'click'
- Select **Scan preset**
- Select **Select Preset**
- Select **Lung**

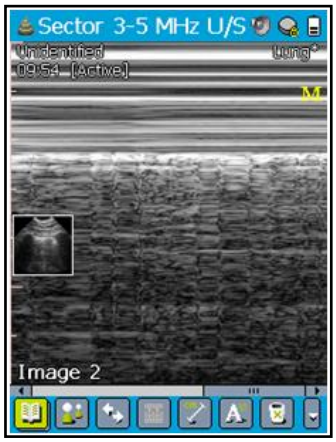


When the Lung preset is selected M-mode will automatically be selected.

This allows you to scan in B-mode and easily select M-mode by pressing the back button



B-Mode



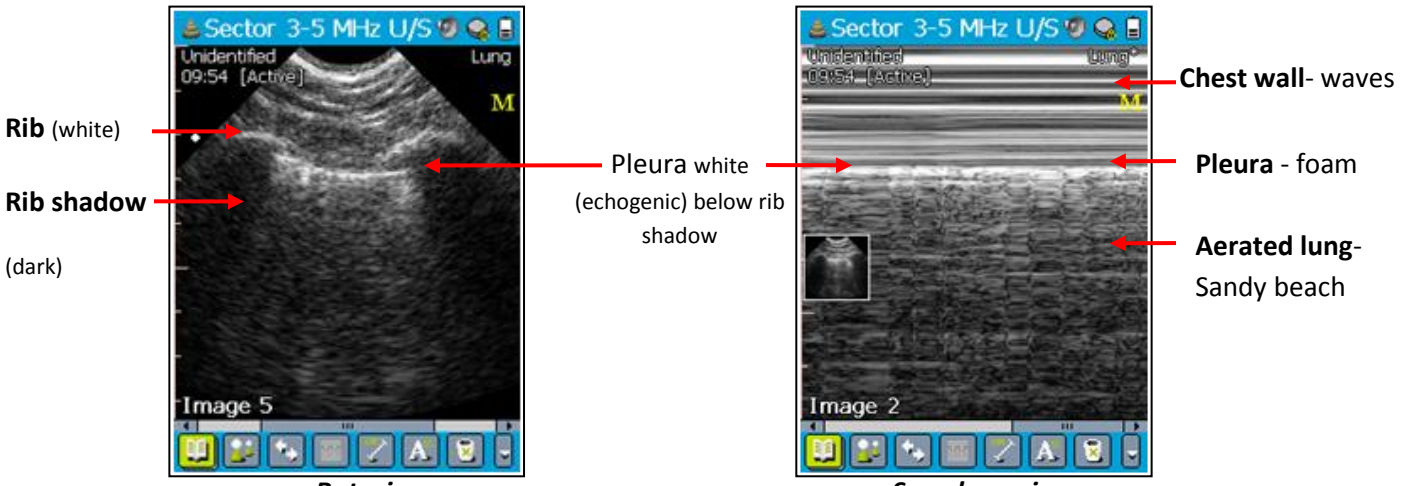
M-Mode

4. *Normal Lung Assessment*

The patient can be scanned supine or erect, anteriorly, posteriorly or in the mid axillary line intercostally (between the ribs) depending on the pathology being assessed. When scanning lungs it is recommended to scan in the longitudinal plane between the ribs to assist in identifying the level of the pleura between the rib artifacts (Lichtenstein 2010).

In B-Mode scanning the normal Pleura is seen as a white (echogenic) line which moves with respiration (lung sliding). The pleura is situated posterior (below) to the ribs which appear as white curved lines with a dark shadow behind. This is known as the **"Bat sign"** (Lichtenstein 2010).When scanning intercostally you may see the liver and diaphragm covered by lung during inspiration. This is known as the **"Curtain sign."**

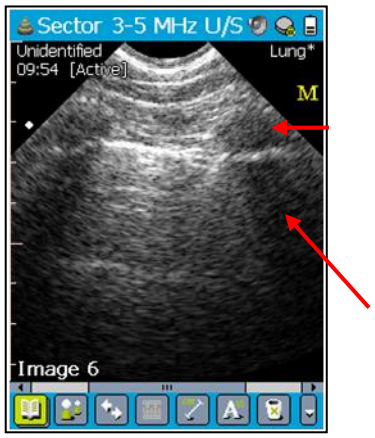
In M-Mode scanning (M-mode records tissue movement over time) the image of normal lung sliding with respiration is known as the **"Sea–shore sign".** The muscle of the chest wall, which doesn't move with respiration (in relation to the transducer), is depicted as linear lines and represents waves rolling toward the beach. The pleura is white and looks like the wave crashing onto the foreshore and the normal sliding lung looks like a sandy beach.



Bat- sign
B-Mode

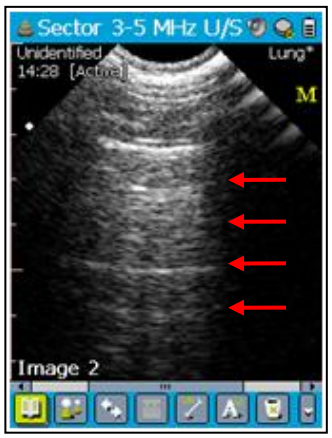
Sea-shore sign
M-Mode

Between the 'breath in' and 'breath out' there is a momentary loss of the sea-shore sign as the lung stops sliding.



When scanning anteriorly and medially the costalcartilage is not as echogenic as the rib and appears as a grey oval.

There is still some acoustic shadowing behind.



A normal lung image constists of A-lines which are reverberation artifacts.

They are equally distant apart and progressively become less echogenic.

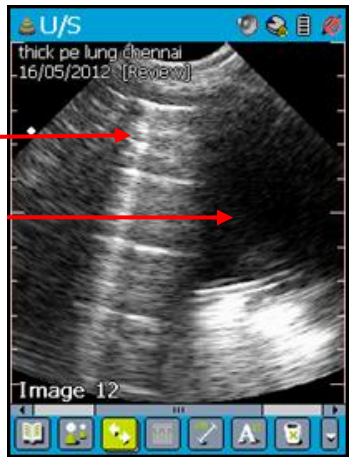
5. *Pleural Effusion Assessment*

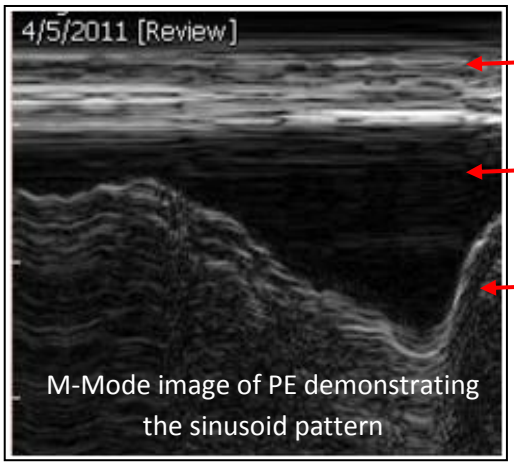
Fluid (Black) will collect in the dependent area of the chest cavity. The patient can be scanned supine or erect,depending on the condition of the patient, in the mid axillary line or slightly posterior to the mid axilliary line. Methodical survelliance of the chest cavity in the longitudinal plane from medial to lateral and superior to inferior will assist in locating the largest pool of fluid in the erect patient. The largest pool of fluid can be marked for thoracentesis. **(Refer to Clinical Applications Training Series – Thoracentesis)**

- ***M-Mode will demonstrate the lung moving with respiration within the Pleural effusion. This is refered to as the 'Sinusoid' pattern.*** This pattern is also an indicator of the viscosity of the PE and may not occur with a thick PE.
- ***A haemothorax or pyothorax will appear more echogenic.***

B-Mode
Normal lung
with A-lines

Pleural effusion
(Black)





Chest wall
(straight lines)

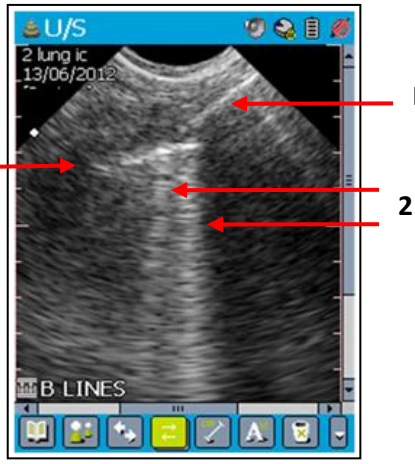
Pleural effusion
(Black)

Lung movement
(wavy line)

6. *Interstitial Syndrome (Pulmonary odema)*

The presence of B-Lines (or comet tails) are an artifact that occurs with odema and can aid in the management of Interstitial Lung Disease. B-Lines are well defined white lines which arise from the pleura, extend to the bottom of the image and move with respiration. As the severity of odema increases the number of B-Lines seen increases.

Pleura

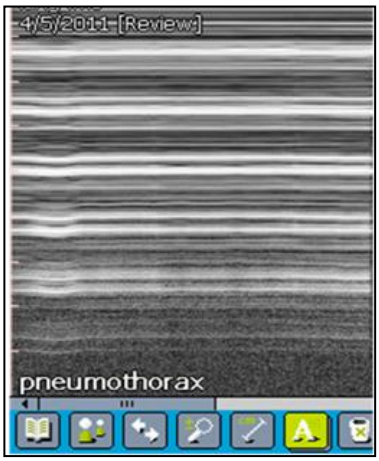


Rib and rib shadow

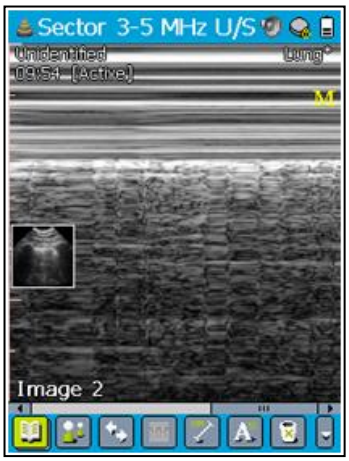
2 white B-lines

7. *Pneumothorax*

In M-mode the presence of a pneumothorax results in the absence of a ***'Sea-shore sign'*** and creates a '***Barcode'*** sign.The sound wave is reflected entirely by the free air in the chest cavity.The sound travels back to the transducer is also refelected by the transducer back into the chest cavity resulting in the soundwave ossilating between the air in the chest cavity and the transducer creating a reverberation artifact resulting in the Barcode sign. The patient is usually scanned supine as air rises. Begin scanning at the most anterior region of the supine patients chest.



Barcode sign



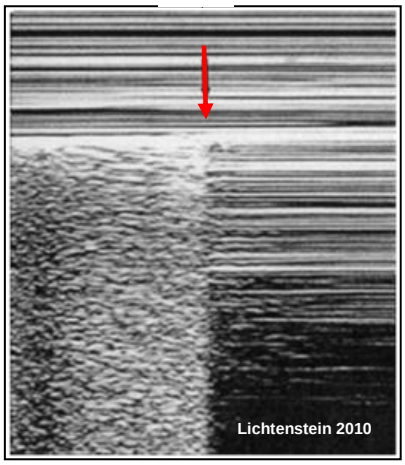
Sea-shore sign

8. *Lung Point*

This is the point at which you can see normal lung in M-mode (Sea-shore sign) and the pneumothorax (Barcode sign) occur with respiration.

'Lung point has a sensitivity of 66% and a specificity of 100%' (Lichtenstein 2010)

Sea-shore sign



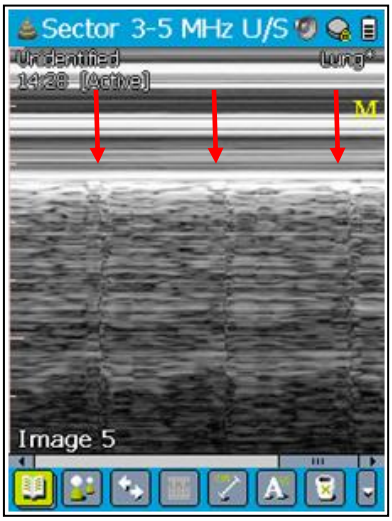
Barcode sign

Lung Point

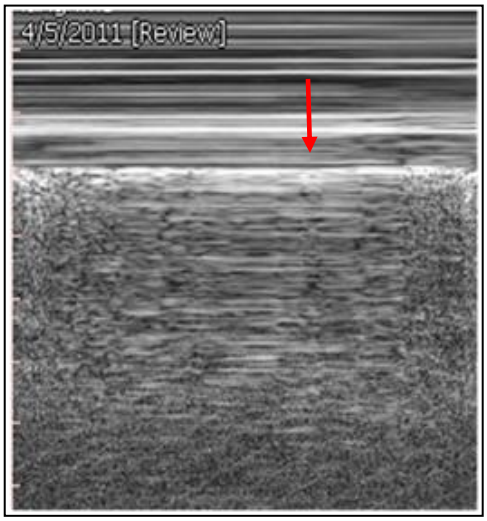
9. ***Lung Pulse***

As the heart beats the movement of the heart is transmitted through the medium of the lung which is demonstrated in M-mode as a regular motion artifact through the seashore pattern to the level of the pleura. The Lung Pulse is easily identified when the patient holds their breath. If there was a pneumothorax present the motion of the heart beat could not be identified within the Barcode.

"Lung Pulse rules out Pneumothorax" (Lichtenstein 2010)



Lung pulse extending from the bottom of the screen, where the heart is positioned behind the lung, to the pleura.



Pause in respiration on a ventilator causing loss of sea-shore sign *but* demonstrates a lung pulse hence excluding a pneumothorax.

10. ***Remember to Optimize the Gain and Depth settings***

While scanning press the scroll wheel once to access the Gain (brightness) control. Press the scroll wheel again to access the Depth control. Roll the scroll wheel to change the Gain and Depth settings.
(Refer to User Manual section 3 and Clinical Applications Training Series – Gain).

Scanning supine for pneumothorax

Scanning erect for pleural effusion

Reference list : Lichtenstein, DA 2010, *Whole Body Ultrasonography in the Critically Ill*, Springer,