

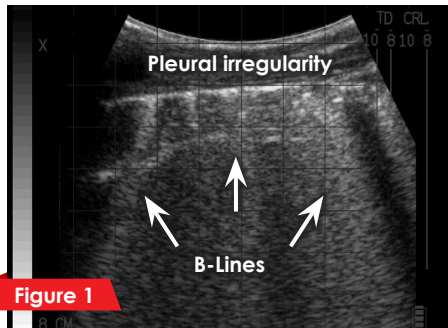
# The use of thoracic ultrasonography to aid diagnosis of pneumonia in calves

Written by:

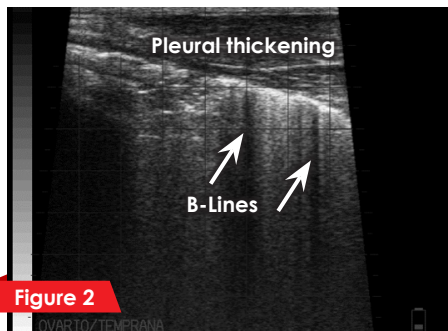
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## Part 3

Early abnormalities associated with pneumonia that can be visualised using thoracic ultrasound include the identification of B-lines and/or lung rockets disrupting the pleural line and thickening of the pleural line itself (**figures 1 and 2**). These lesions may also be observed in cases of lung oedema and in diffuse parenchymal disease.



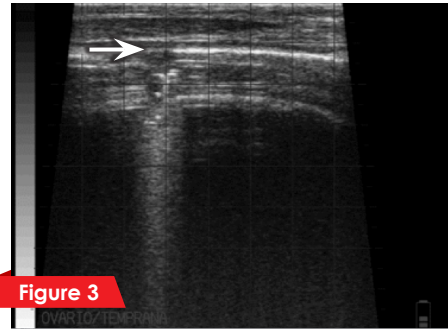
The pleural line is irregular with disruption of the normal reverberation artefact observed deep to the pleural line. B-lines are also visible (arrows).



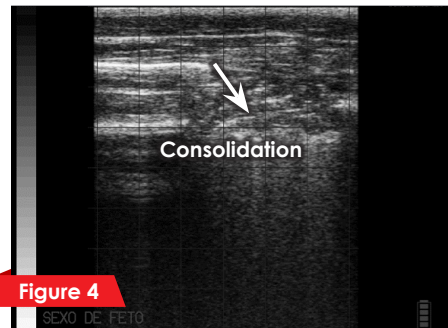
This image demonstrates thickening of the pleural line compared to normal, and the presence of multiple B-lines.

In the normal thorax, only the superficial surface of the lung is visible ultrasonographically. Reverberation artefact caused by healthy, aerated lung prevents visualisation of parenchyma beyond this level. In cases of inflammation of the lung and/or exudate or fluid within the lung parenchyma, the lung becomes consolidated and visualisation of the tissue is then possible.

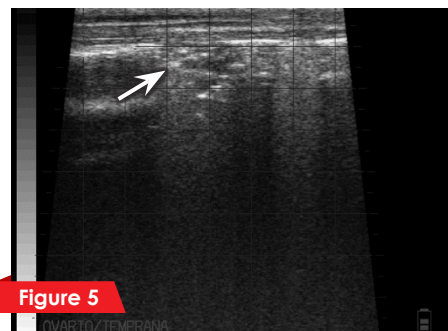
The following images (**figures 3 to 5**) provide examples of some abnormalities of the parenchyma that may be identified using transthoracic ultrasound.



**Figure 3**  
Lobular lesions (also called lobular consolidations or lobular pneumonia). This image shows a typical single lobular lesion (arrow), identified as an area of demarcated hypoechoogenicity disrupting the pleural line. This represents a small area of consolidation and it is associated with a B-line. The lung surface either side is otherwise normal (aerated). It is important to remember these will only be visible if they are at the peripheral surface of the lung.

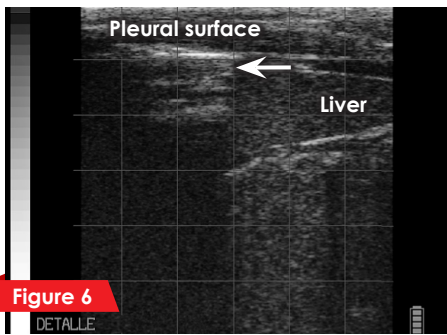


This area of consolidated lung has a hypochoic appearance and has a similar echotexture to the liver.

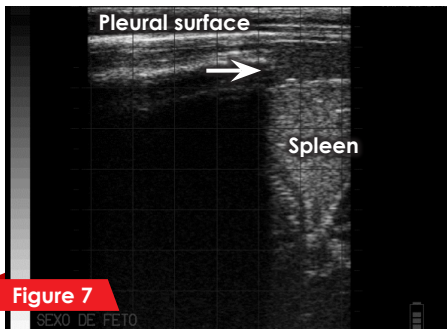


Area of consolidation identified as a well demarcated, focal area of hypoechoogenicity.

It is possible to mistake the liver or spleen for consolidated lung and vice versa. Hence, the thorax should be separated from the abdomen by locating the diaphragm (**figure 6 and 7**).

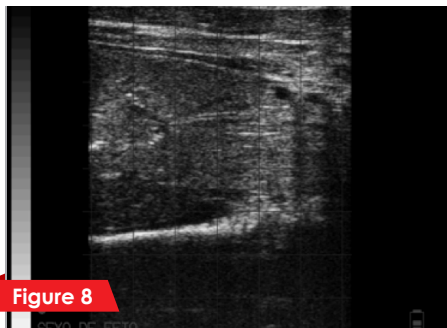


Normal image of the diaphragm (arrow) separating the abdomen from the thorax.

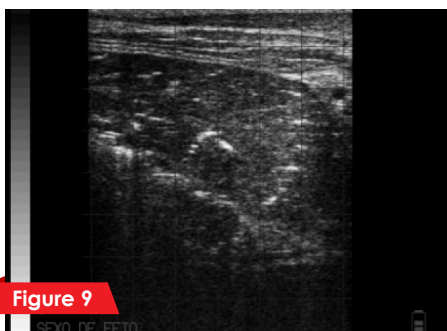


Normal image of the diaphragm (arrow) separating the abdomen from the thorax.

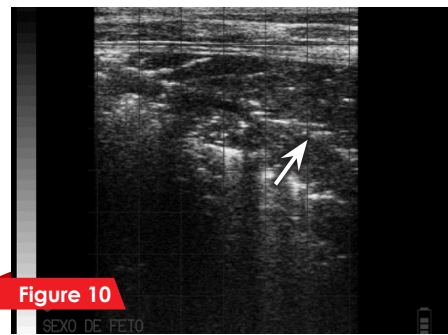
Consolidation can only be observed if adjacent to the pleural line (on the peripheral surface of the lung parenchyma). If the consolidation is deeper within the lung parenchyma, it cannot be observed using ultrasonography, due to the reverberation artefact caused by aerated lung tissue. **Figures 8, 9 and 10** demonstrate a lung lobe that is entirely consolidated and therefore visible in its entirety.



Full-thickness consolidation of the lung lobe is observed. The hypoechoic parenchyma of the entire distal lobe is visible; an aerated lung cannot be seen ventral to the lesion.

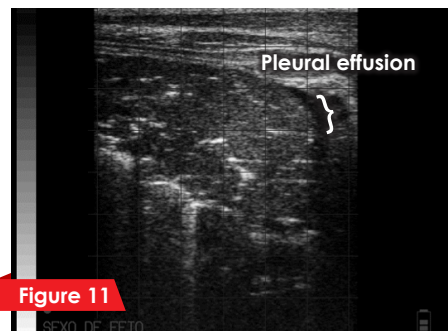


**Figure 9**  
The consolidated parenchyma is usually heterogenous due to two factors. Firstly, the appearance of gas filled bronchi, visualised as hyperechoic lines within the hypoechoic parenchyma representative of residual gas within the bronchi. Secondly, gas produced by the bacteria responsible for the pneumonia may cause small areas of hyperechogenicity; representative of the small pockets of gas produced.

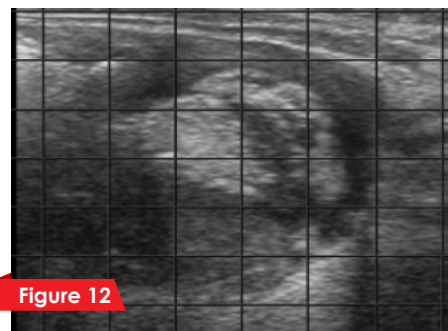


In more extreme cases an air bronchogram may progress to a fluid bronchogram seen here (arrow) as two parallel hyperechoic lines with the anechoic fluid filled lumen of the bronchi.

Other abnormalities that may be identified are illustrated in **figures 11 and 12**. These may be changes associated with pleuritis, bronchopneumonia and abscess formation.



Pleuritis and bronchopneumonia can be characterised by a ventral accumulation of varying quantities of hypoechoic to anechoic fluid which may or may not contain echogenic fibrin.



An abscess can also be observed with a thick capsule and heterogenous contents.

In conclusion, the use of thoracic ultrasonography substantially aids the diagnosis of pneumonia in young calves. In addition, ultrasonography will greatly improve our understanding of epidemiology, risk factors and the long-term effects associated with pneumonia

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