VIDEOS INCLUDED

THE ESSENTIALS OF VETERINARY POINT OF CARE ULTRASOUND

Pleural Space and Lung

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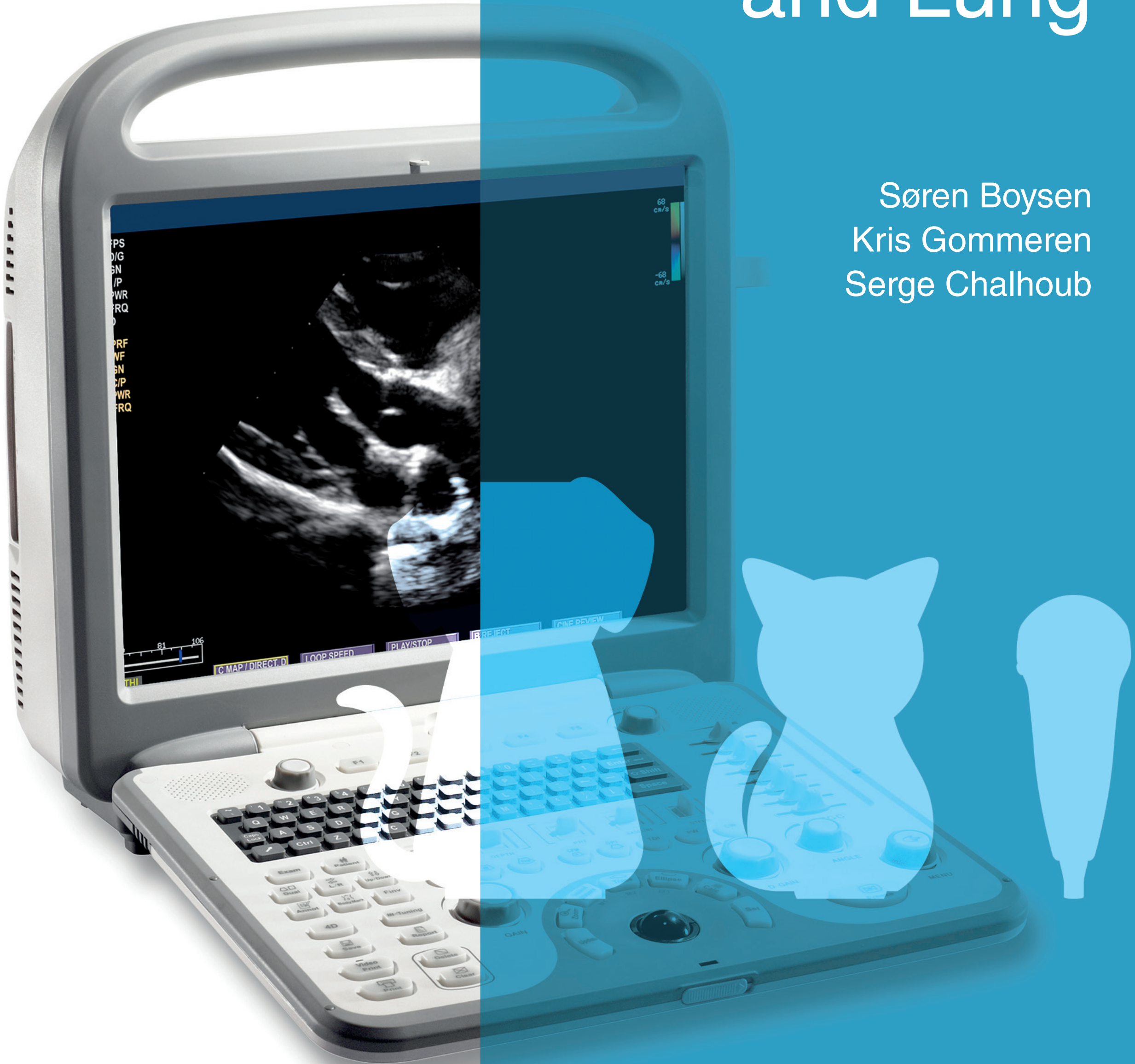

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INTRODUCTION

Pleural effusion appears as hypoechoic accumulations separating the parietal and visceral pleura, and its appearance can vary depending on the cellularity of the effusion, transducer location, patient positioning, the quantity of fluid, and the presence of adhesions.

The sonographic accuracy to detect pleural effusion is relatively good and effusion is easier to diagnose than pneumothorax, but small amounts of pleural effusion can be missed[1-3]. Finding pleural effusion with PLUS leads to further diagnostic and therapeutic considerations. For instance, ultrasound-guided thoracocentesis would lead to improved patient stability if the fluid is sufficient to cause respiratory compromise, and analysis of the fluid may lead to an etiologic diagnosis.

Pleural effusion separates the visceral pleura from the parietal pleura resulting in a loss of lung sliding, however the visceral pleura is still visible as a hyperechoic white line (depth may have to be increased) because fluid transmits ultrasound beams (vs. pneumothorax where air is an enemy of ultrasound and, therefore, the visceral pleura cannot be seen when the transducer is placed directly over a region of pneumothorax) (Fig. 1; video 5.1).

Due to the effects of gravity, pleural effusion will accumulate in gravity-dependent (lowest) regions of the pleural space, often forming sharp angles, and tracking along and outlining the diaphragm (Fig. 2; video 5.2).

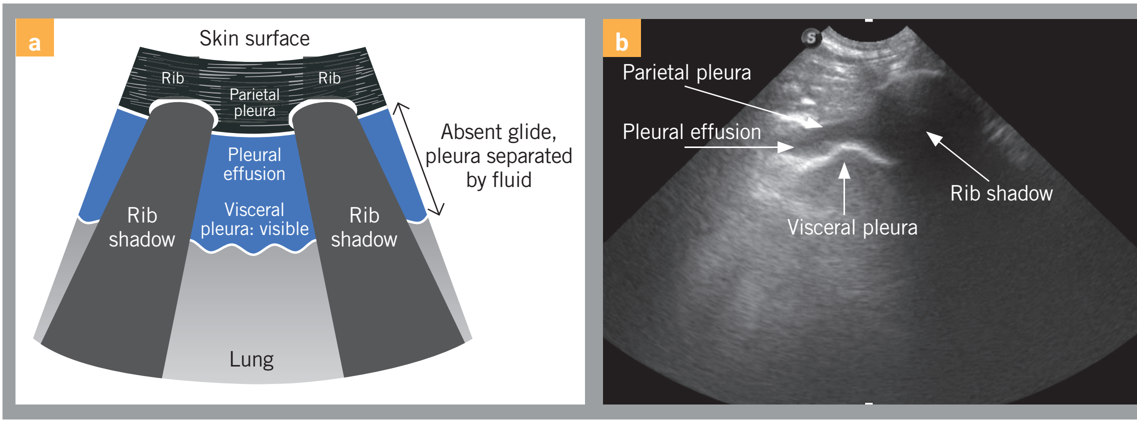

Figure 1. Schematic ultrasound image showing separation of the visceral pleura from the parietal pleura due to the presence of fluid in the pleural space (pleural effusion) with the transducer in perpendicular rib orientation. In this instance, the pleural line (solid white line) is composed of only the parietal pleura and, therefore, lung sliding is absent (i.e. the two pleura are not in contact). The lower curvilinear horizontal line represents the visceral pleura, which is separated from the parietal pleura by fluid. Fluid transmits ultrasound; therefore, the visceral pleura is visible (a). Ultrasound image of pleural effusion with the transducer in perpendicular orientation to the ribs. Both parietal and visceral pleura are visible because fluid is separating them. Fluid allows ultrasound beams to penetrate which allows the visualization of the visceral pleura. Although the visceral pleura is visible and will move with respirations, no lung sliding is present because the two pleura are separated (b).

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Video 5.1.
Perpendicular
pleural effusion.

QR
Video 5.2.
PCS pleural with
effusion consolidation.

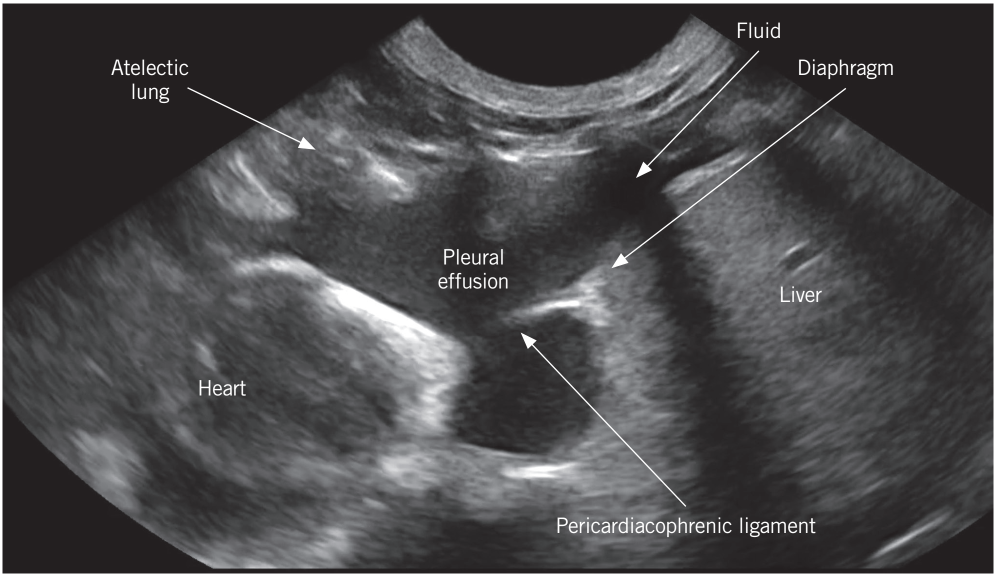

Figure 2. Pleural effusion in a sternal patient at the pericardiodiaphragmatic (PD) site, transducer in perpendicular rib orientation. Pleural effusion is affected by gravity and accumulates in the most gravity-dependent (lowest) sites of the pleural space. In this example, pleural effusion in a cat with feline infectious peritonitis (FIP) is seen at the PD site and the effusion forms angles with other structures. In addition, the pleural effusion is sufficient to track along (up and down) the diaphragm and fill the costophrenic recess. This ultrasound window is the key factor in determining if effusion is pericardial or pleural in nature, as pericardial effusion would be contained in the pericardial sac, curving away from the diaphragm and surrounding the heart.

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Video 5.3.
Pericardial effusion.

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Video 5.4.
Pericardiodiaphragmatic
(PD) pleural effusion.

This is in contrast to pericardial effusion where the fluid will be contained within the pericardial sac and will follow the circular contour of the heart (Fig. 3; video 5.3).

Large quantities of pleural effusion are easily identified in patients in sternal recumbency in the ventral third of the thorax outlining the diaphragm and lungs and separating the parietal and visceral pleura at the pericardiodiaphragmatic (PD) window (Fig. 2; video 5.4). For patients in lateral recumbency, large pleural effusions can be easily visualized at the widest gravity-dependent portion (lowest) of the thorax.

Small quantities of pleural effusion can be missed in the sternal or standing patient, particularly when the transducer is only placed over the heart or situated at the costochondral junctions in perpendicular orientation to the ribs, as recommended in thoracic FAST protocols[3-4]. To identify smaller effusions, the transducer should be rotated into parallel orientation (marker dorsally) at the PD window or level the costochondral junction in a sternal/standing patient. As pleural fluid accumulates the lungs may become atelectatic, appearing as tissue-like structures "floating" within pleural effusions (Fig. 4; video 5.5).

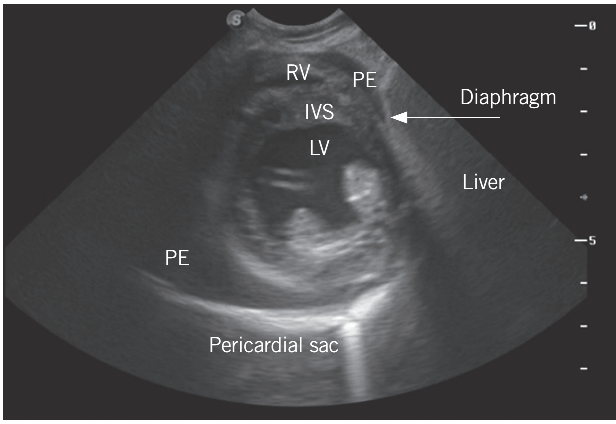

Figure 3. Pericardial effusion in a dog with transducer in perpendicular rib orientation at the pericardiodiaphragmatic (PD) window. The fluid is contained inside the pericardium and can be seen curving around the heart along the contours of the pericardial sac as well as curving away from the diaphragm. IVS: interventricular septum; LV: left ventricle; RV: right ventricle; PE: pericardial effusion.

Atelectatic lung in pleural effusion is termed the "jellyfish" sign in human medicine (Lichtenstein, 2005).

Healthy lung is not seen in normal patients (air is an enemy of ultrasound) but when pleural effusion causes the lung to collapse, the lung will have a soft tissue appearance due to the lack of aerated lung (see Chapter 7); hence, it is visible as tissue within pleural effusion because ultrasound beams can traverse the fluid and atelectic lung (video 5.2).

Pleural effusion can only be ruled in or out at the location the transducer is placed on the thorax. It is therefore essential to assess the most sensitive sites for pleural effusion to avoid missing smaller quantities of fluid.

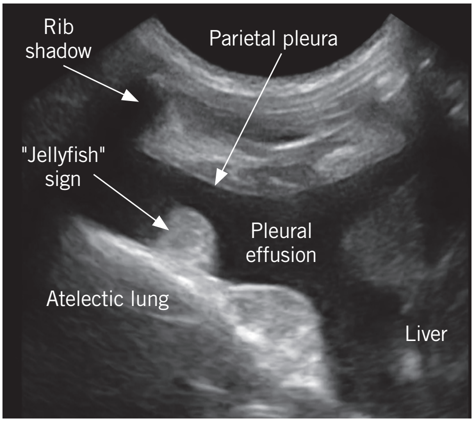

Figure 4. Image of an atelectatic lung ("jellyfish" sign) just dorsal to the pericardiodiaphragmatic (PD) window at the thoracoabdominal interface, transducer in perpendicular orientation to the ribs. When air is removed from lung, it adopts a tissue-like-pattern on ultrasound, meaning it becomes visible because ultrasound beams can now be transmitted through it (see Chapter 7, lung consolidation). Sometimes the atelectatic lung will move back and forth and have the appearance of a "jellyfish".

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Video 5.5.
"Jellyfish" sign.

Key concepts

- Pleural effusion accumulates in gravity-dependent (lowest) regions of the pleural space.
- When pleural effusion separates the two pleura, lung sliding is not present.
- The appearance of pleural effusion varies depending on transducer orientation, quantity of fluid, location of the fluid, cellularity and adhesions, and patient positioning.
- Atelectatic lung can create a “jellyfish” sign.
- Assessing the PD window allows differentiation of pleural from pericardial effusion.
- Large amounts of pleural effusion are easily identified in the gravity-dependent (lowest) regions of the thorax regardless of transducer orientation or patient position. Nevertheless, patient position must be accounted for to locate the gravity-dependent regions.
- Small amounts of pleural effusion are often missed ventrally and can be identified with the transducer in parallel orientation to the ribs.

CRITERIA TO DIAGNOSE PLEURAL EFFUSION

The presence of fluid between the parietal and visceral pleura eliminates lung sliding and confirms pleural effusion.

Although the visceral pleura (lung surface) may be visible deep to the effusion and may still move with respiration, one of the key criteria is that lung sliding* is lost; the pleura are not in contact, abolishing the shimmer created by the lung surface (visceral pleura) sliding across the inside of the thoracic wall (parietal pleura). With large amounts of pleural effusion, the visceral pleura may not be readily visible; this will depend on the depth settings of the ultrasound machine (e.g. the visceral pleura may be present beyond the visible far field of the ultrasound image).

Criteria to rule out pleural effusion

There are three sonographic findings that confirm the pleura are in contact, ruling out pleural effusion (and pneumothorax) at the transducer location:

1. Complete lung sliding across the entire pleural line at the transducer location.
2. The presence of lung pathology (B lines and/or consolidation) originating at the pleural line.
3. The presence of a lung pulse.

* Recall the definition of complete lung sliding: the two pleura must be in contact, and the animal must breathe.

In addition, mirror image artifact (such as seen at the subxiphoid window with the transducer angled to observe the thorax beyond the diaphragm) rules out pleural effusion immediately below the parietal pleura at the transducer location because it is an artifact created by large differences in acoustic impedance at soft tissue-to-air interfaces (Fig. 5; video 5.6). Similarly, the detection of A lines, because they are a type of air induced mirror image artifact, also rule out pleural effusion at that transducer location.

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Video 5.6.
Mirror image artifact.

Criteria to rule in pleural effusion

There are two primary criteria used to identify pleural effusion:

1. There is a loss of lung sliding because the two pleura are separated by effusion.
2. The effusion is uncontained within the pleural space. As such it tends to form sharp demarcated angles and irregular borders when located in more gravity-dependent (lowest) regions, and tracks along the diaphragm (i.e. not curving around the heart). This is in contrast to fluid contained within the pericardial sac.

Note: In cases with significant pneumothorax, the presence of air in the pleural space may prevent underlying pleural effusion from being visualized. In these cases, scanning ventrally below the area of pneumothorax in a standing patient or widest part of the thorax in a lateral patient (e.g. gravity-dependent regions) may reveal the presence of concurrent pleural effusion.

Criteria to differentiate pleural from pericardial effusion

Pleural effusion can sometimes be mistaken for pericardial effusion, and vice versa, and both may be present in the same patient. Consequently, it is important to carefully assess both the pericardial and pleural spaces for the presence of fluid.

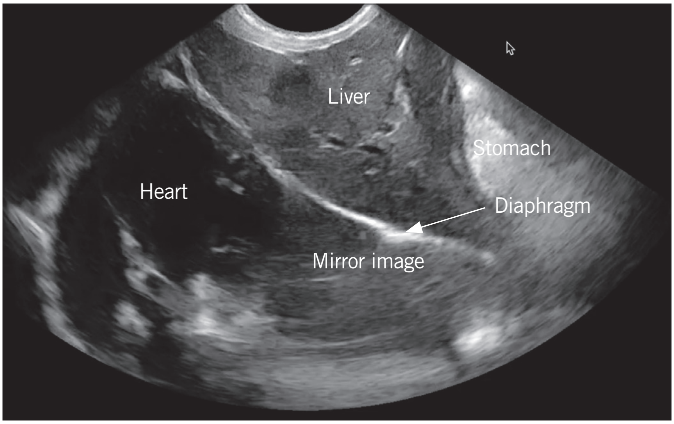

Figure 5. Mirror image artifact at the subxiphoid window, longitudinal axis.

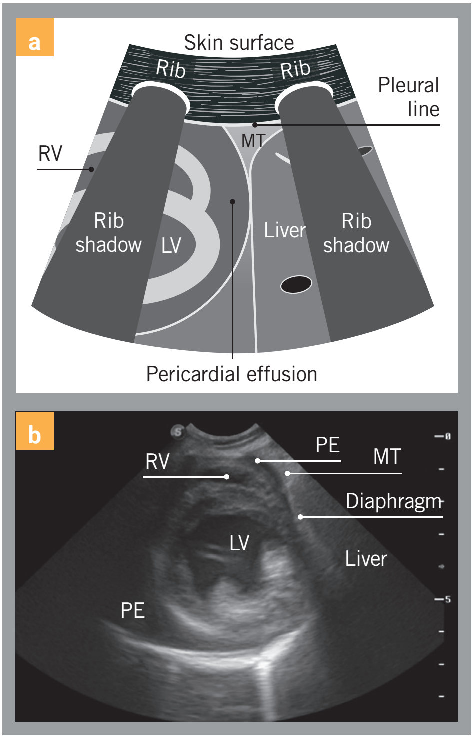

Figure 6. Schematic diagram (a) and ultrasound still image (b) at the pericardiodiaphragmatic (PD) window with the transducer in perpendicular orientation to the ribs in a dog with pericardial effusion (b). RV: right ventricle; LV: left ventricle; PE: pericardial effusion; IVS: interventricular septum.

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Video 5.7. Pericardiodiaphragmatic (PD) window pericardial effusion.

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Video 5.8. Pericardiodiaphragmatic (PD) window pleural effusion.

Pericardiodiaphragmatic (PD) window

- At the PD window, pericardial effusion will appear as fluid contained within the pericardial sac curving around the heart and away from the diaphragm, often preserving the mediastinal triangle (Fig. 6). In contrast pleural effusion will track up and down the diaphragm, often obscuring the mediastinal triangle and permitting the diaphragm to be visible curving away from the thoracic wall, particularly when pleural effusion fills the costophrenic recess (Fig. 4; videos 5.7 and 5.8).

Right parasternal short axis views

- Becoming familiar with normal right parasternal short-axis views of the heart is key in differentiating pericardial effusion from normal cardiac chambers, such as the left and right ventricles. This will limit mistaking heart chambers for pericardial effusion. Scanning the heart from the apex, through “mushroom” and ‘fish mouth” to the “Mercedes and whale” views at the heart base will also aid in identifying pericardial effusion (cardiac POCUS is beyond the scope of this Chapter).
- In the right parasternal short axis view pericardial effusion will appear as fluid contained within the pericardial sac and curving around the heart (Fig. 7a; video 5.3), whilst pleural effusion will not curve around the heart. In contrast, in healthy animals, the pericardial sac is intimately associated with the ventricular walls with no effusion separating them (Fig. 7b; video 5.9).

In both these situations, it is important to change the depth to visualize the entire heart and pericardial sac. If doubt remains as to the origin of the fluid, the transducer can be slid caudally to locate the PD window to determine if the visible effusion tracks along the diaphragm or is only contained within the pericardial sac (sometimes, both are present).

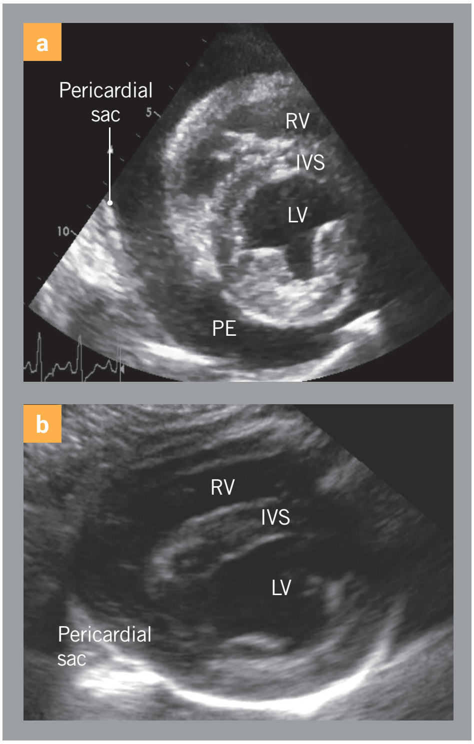

Figure 7. Ultrasound still images of the right parasternal short axis "mushroom" view in a dog with pericardial effusion (a), and a dog with a normal heart (b). RV: right ventricle; LV: left ventricle; MT: mediastinal triangle; PE: pericardial effusion; IVS: interventricular septum.

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Video 5.9.
Normal heart.

Subxiphoid view

Pleural and pericardial effusion can be diagnosed at the subxiphoid view in both longitudinal and transverse axis views (Fig. 8). The entire heart and pericardial sac do not need to be visualized in this window to differentiate pericardial from pleural effusion.

In most dogs and some cats, the apex of the heart contacts the diaphragm and as such the left ventricular free wall appears to blend with the diaphragm at this location (soft tissue-to-soft tissue transmission of ultrasound beams).

- If the heart is against the diaphragm with no hypoechoic fluid separating the two, then clinically significant pericardial effusion is very unlikely. The left ventricular free wall is in contact and appears to blend with the diaphragm when there is no clinically significant pericardial effusion (Fig. 8a–b; video 5.10).
- With pericardial effusion, the fluid is contained inside the pericardium and can be seen curving around the heart along the contours of the pericardial sac. The diaphragm and left ventricular free wall are separated by the pericardial effusion (Fig. 8c–d; video 5.11).
- With pleural effusion, the fluid will track along the diaphragm, and will not circle around the contours of the heart (video 5.12).

Note: in animals where the heart does not contact the diaphragm, the heart will not be visible at the subxiphoid window because lung (air) is superimposed between the diaphragm and heart, which does not transmit ultrasound beams. Cats will often have lung separating the diaphragm from the heart at the subxiphoid window.

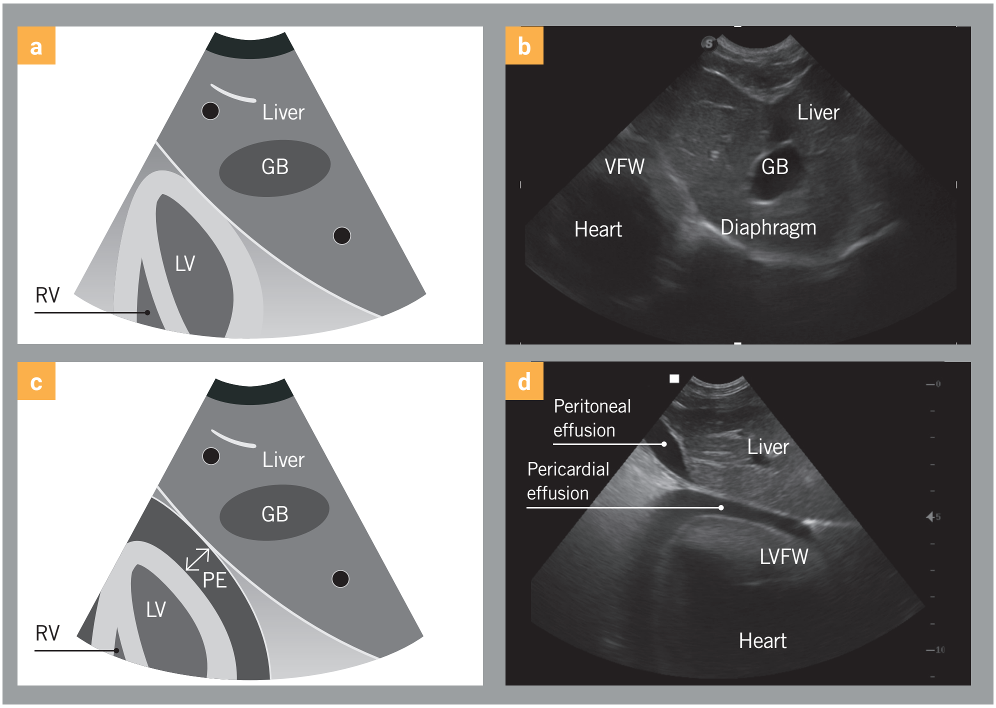

Figure 8. Schematic diagram (a) and subxiphoid long axis (ultrasound image) view (b) in a dog with a normal heart. Schematic diagram (c) and subxiphoid long axis (ultrasound image) view in a dog with a pericardial effusion (d). Note in the ultrasound image a small amount of peritoneal effusion is seen between the diaphragm and the liver. PE; pericardial effusion, LVFW; left ventricular free wall, GB; gallbladder, RV; right ventricle, LV; left ventricle.

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Video 5.10.
Subxiphoid cardiac blend.

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Video 5.11.
Subxiphoid pleural and pericardial effusion.

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Video 5.12.
Subxiphoid pleural effusion.

Table 1. Ruling in or out pleural effusion at the transducer location.

Rule in	Rule out
Loss of lung sliding	Complete lung sliding
Fluid tracking along the diaphragm forming angles	Lung pathology (B lines and/or consolidation) originating from the pleural line
	Lung pulse
	Mirror image artifact beyond the diaphragm or pleural line

Table 2. Ruling in or out pericardial effusion.

Transducer location	Rule in	Rule out
Pericardiodiaphragmatic (PD) window.	Effusion contained within pericardial sac encircling the heart.	No effusion present with mediastinal triangle fat most often visible. If pleural effusion: effusion outlining and tracking along the diaphragm but not encircling the heart, mediastinal triangle often replace by fluid.
Subxiphoid window.	Effusion contained within pericardial sac encircling the heart and separating the left ventricular free wall from the diaphragm.	Ventricular free wall touching and blending with the diaphragm; no separation between the two.
Parasternal (short or long axis) cardiac window.	Effusion contained within pericardial sac encircling the heart (important to correctly identify normal heart chambers).	Pericardial sac intimately associated with heart walls with no fluid separating the two (important to scan the heart from apex to base to rule out small pericardial effusions).

The shape of pleural effusion

The appearance or shape of pleural effusion varies based on its location, interaction with the heart, lungs, thoracic cage, diaphragm, presence of adhesions, quantity and the orientation of the transducer.

Perpendicular transducer orientation to the ribs:

- With small quantities of pleural fluid, fluid often appears as a hypoechoic (black) stripe, of varying thickness, separating the two pleural sheets (Fig. 1b; video 5.13).
- With larger quantities of effusion, fluid amounts may be substantial, and depth may have to be increased to visualize the visceral pleura and/or atelectatic lung.

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Video 5.13.
PD Deep fluid.

Parallel transducer orientation to the ribs, marker dorsally and transducer positioned ventrally (gravity-dependent region):

- When no effusion is present, the pleural line is comprised of both pleura which curves along the ventral sternal border comprised of the sternal/pectoral muscles. This image has been termed the "ski jump" sign by the authors (Fig. 9a; see video 3.13).
- When scant to small quantities of fluid accumulate between the parietal pleural lining the sternal/pectoral muscles and the visceral pleura/lung surface, the two pleural sheets will be separated, often forming hypoechoic "spinnaker sail" shaped lesions (Fig. 9b; video 5.14). Hence, the authors have termed this a "sail sign" to identify positive pleural effusion when the transducer is parallel to the ribs.
- Locating scant amounts of fluid may not have therapeutic considerations but can have important diagnostic benefits. For instance,

with a patient presenting non-specific clinical signs, finding a scant amount of pleural effusion, and possibly sampling it, may provide a diagnosis for the patient's ailment.

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Video 5.14.
"Sail sign".

Assessing the pericardiodiaphragmatic window and the heart via the subxiphoid window often allows pleural and pericardial effusion to easily be differentiated from each other (Fig. 2). Knowing the difference in how fluid appears at different locations is important to ensure pleural effusion is accurately identified.

DIAGNOSTIC APPROACH

Transducer orientation and selection

A microconvex curvilinear transducer is used to search for pleural effusion. In general, the depth is set at 2–6 cm, depending on the patient's body condition score (obese patients require deeper settings, thin patients' shallower settings). To visualize the pleural line and lung sliding, a good rule of thumb is to place the pleural line at approximately the 1/3 to 1/2 mark of the ultrasound image (Fig. 10; see video 3.1).

Transducer settings are adjusted to make the pleural line appear grainy; the grainier the pleural line, the easier it is to identify lung sliding. See normal lung sliding (Chapter 3) for general tricks regarding transducer manipulation to make the pleural line grainier and lung sliding easier to visualize.

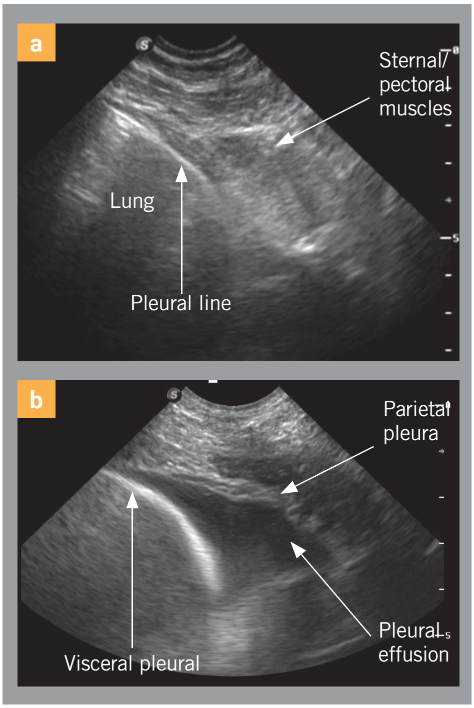


Figure 9. The "ski jump" sign; the transducer is parallel to the ribs ventrally with the transducer marker directed dorsally on the thorax in this sternal patient. The image produced when no pleural effusion is present is that of a "ski jump"; in other words, the two pleural sheets are in contact and lung sliding is seen, and the pleural line curves along the pectoral/ sternal muscles (a). The "sail sign"; the transducer is parallel to the ribs with the transducer marker directed dorsally and the transducer positioned ventrally on the thorax in this sternal patient. The image produced when pleural effusion is present is that of a "sail sign"; in other words, the two pleural sheets are separated by fluid forming a triangle shape and lung sliding is absent. In a live patient, the triangle of fluid changes shape with respiration and lung expansion, giving the impression of a sail flapping in the wind (b).

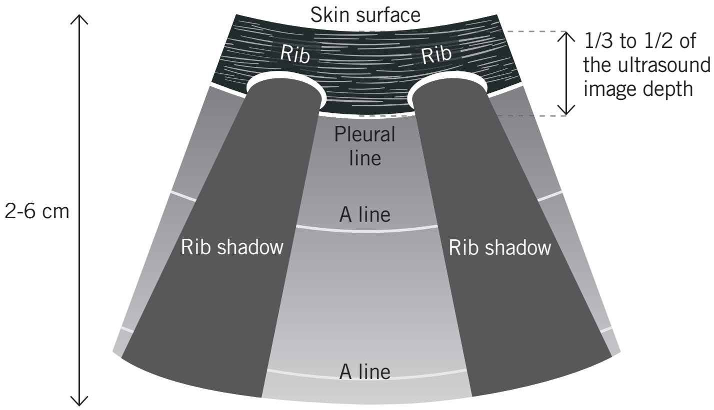


Figure 10. Schematic ultrasound image showing the recommended starting depth to initially assess the pleural line for lung sliding. The depth setting is adjusted to approximately 2–6 centimeters and the pleural line is located at approximately 1/3 to 1/2 of the depth of the ultrasound image (red arrow).

The transducer can be placed perpendicular or parallel to the ribs. The authors recommend starting with the transducer perpendicular to the ribs for beginners.

Patient Positioning

Patient positioning affects where pleural effusion accumulates in the thorax and, therefore, where it can be sonographically visualized. In standing or sternal position, fluid will accumulate in the ventral aspects of the thorax. In lateral recumbency, fluid will accumulate at the widest gravity-dependent part of the thorax. Therefore, the scanning technique should take into account the patient position (See Chapter 1; Fig. 2).

Sonographic techniques to identify pleural effusion

In general, two PLUS approaches are used to identify pleural effusion; the subxiphoid approach and the transthoracic approach.

Subxiphoid window

The subxiphoid area should be palpated and the transducer placed at this site (see Chapter 2). The transducer should be fanned and rocked in both long and short axis to increase the chance of finding smaller accumulations of pleural fluid:

- In standing position, the subxiphoid is accessed by palpating the “V” of the subxiphoid region and placing the transducer in this location.
- In sternal position, the subxiphoid region can be reached by placing two tables in an “L” fashion and laying the patient’s subxiphoid region in the gap formed by the two tables, or by using a cardiac table.
- In lateral recumbency, the subxiphoid “V” can be easily reached and palpated.

The transducer needs to be more parallel relative to the spine in orientation and the depth setting adjusted (set deeper) compared to the angle and depth used for POCUS of the abdomen. This will allow the ultrasound beams to extend into the more ventral regions of the thorax using the liver as an acoustic window into the thorax.

At the subxiphoid window, pleural effusion will appear to track along (up and down) the diaphragm, forming angles (Fig. 11).

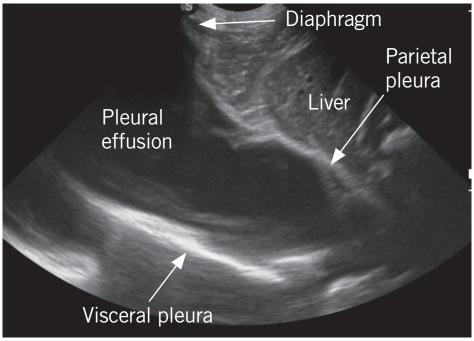


Figure 11. Pleural effusion seen from the subxiphoid view. Pleural effusion will track dorsally and ventrally along the diaphragm and the parietal pleura, outlining the diaphragm and forming angles with other structures.

Transthoracic window

Patient in lateral recumbency

Although sternal or standing is preferred when scanning the pleural space, particularly in patients with respiratory distress, some patients may require lateral positioning (e.g. fractures). The most sensitive transthoracic window to identify pleural effusion with the patient in lateral recumbency is the widest, most gravity-dependent point of the thorax (see Chapter 1). This is often the heart-base region.

- Use of a cardiac table is an easy way to access the gravity-dependent regions of the thorax.
- If a cardiac table is not available, two tables placed in an "L" shape can be used and the widest gravity-dependent portion of the thorax placed in the gap created by the "L". The transducer can then be placed in this region to identify pleural effusion.
- Alternatively, an assistant can help by gently rolling the patient into a slightly more dorsal orientation (limbs up), ensuring that the patient is not in respiratory compromise. If the patient is in respiratory distress, it should be scanned in a sternal or standing position.

Patient in sternal or standing recumbency

In sternal recumbency, the most sensitive regions to detect pleural effusion will be the ventral (gravity-dependent) portions of the thorax, including the most caudoventral thoracic border (PD window; Figs. 11 and 12), which is helpful in differentiating pleural effusion from pericardial effusion. Identifying borders (see Chapter 1), specifically the caudal (curtain) and ventral (ventral pleural border), is extremely valuable to find the region where the heart and diaphragm can be visualized in the same ultrasound image*. In brief, to reach the PD window:

- Place the transducer over lung perpendicular to the ribs and identify lung sliding. To ensure lung is scanned, initial transducer placement can be 1/3 to 2/3 the way up the thorax behind the forelimb (cranial thoracic border). When the goal is to look for pleural effusion the transducer is usually placed 1/3 of the way up the thorax. If pleural effusion is identified in this region, slide the transducer dorsally to estimate the extent of the effusion.

*Please refer to Chapter 2 for detailed technique descriptions.

- If pleural effusion is not identified, slide the transducer caudally and identify the abdominal curtain sign (caudal thoracic border).
- Once the abdominal curtain sign is identified, follow it ventrally until the heart or costochondral junction is reached. At this point the heart and diaphragm can usually be visualized in the same ultrasonographic window (PD window, see Chapter 3).
  - In healthy dogs and a few cats, the heart and diaphragm are in contact with each other and a small triangle of mediastinal fat can be visualized between them (Fig. 12).
  - In most healthy cats and a few dogs the heart may not contact the diaphragm and the mediastinal triangle is obscured by overlying lung (see Chapter 3).
  - With pleural effusion, fluid will track along the diaphragm outlining it and filling the costophrenic recess (allowing it to be seen curving away from the thoracic wall). Pleural effusion will also form angles between lung lobes and between the lung and surrounding structures. When there is significant pleural effusion present it will separate the heart from the diaphragm (Fig. 13).
- Another method to find the PD window is to identify the heart in perpendicular transducer rib orientation, and then slide the transducer caudally until the diaphragm is seen. If lung is superimposed between the heart and the diaphragm sweep the transducer ventrally along the abdominal curtain sign to try and identify the mediastinal triangle. In some patients lung will always be superimposed between the diaphragm and the heart at the PD window.
- The area cranial to the heart should also be evaluated for the presence of pleural effusion.
- At the most ventral (gravity-dependent) areas of the thorax, including the PD sites, if pleural effusion is not identified with the transducer perpendicular to the ribs, the transducer can be turned parallel to the ribs to try and identify smaller accumulations of fluid between the lung or heart and ventral body wall.
  - When the transducer is parallel to the ribs and there is no pleural effusion, the pleura will be in contact with each other and the “ski jump” sign is identified (Fig. 8a).
  - When pleural effusion is present, it will separate the pleura and the “sail sign” will be visible (Fig. 9b).
- The ventral portions of the thorax, from the caudal border (curtain) to the cranial border (thoracic inlet/forelimb), can be examined for pleural effusion with the transducer in parallel or perpendicular orientation to the ribs (see Chapter 2).
- In parallel position, the transducer can be slid a few centimeters dorsally and then back down ventrally to examine the ventral lung border for pathology as well as the ventral pleural border for pathology.

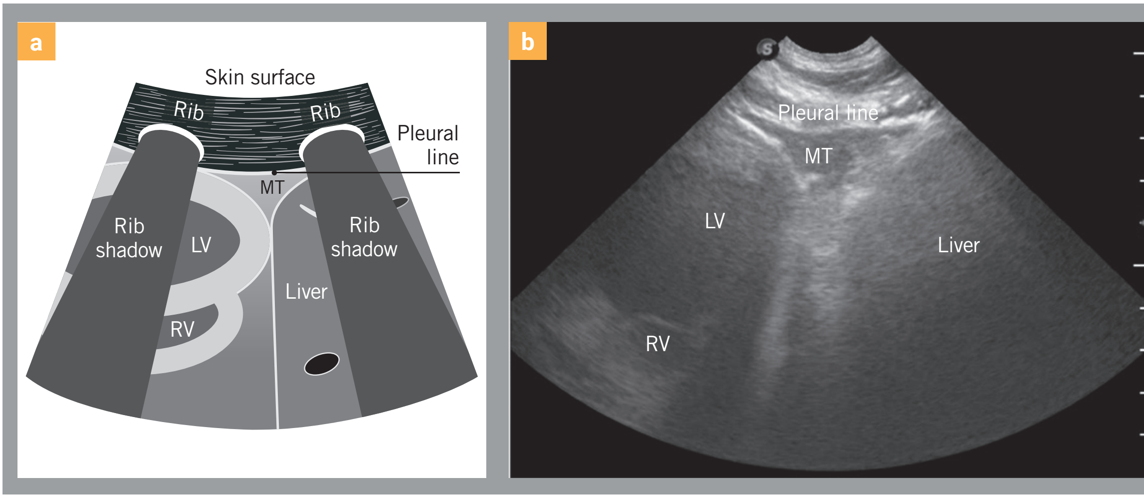


Figure 12. Schematic diagram (a) and ultrasound image (b) of the PD window with the transducer in perpendicular orientation to the ribs in a heathy cat or dog where the mediastinal triangle of fat is visible. At this window, the left ventricular free wall seen contacting the diaphragm below the mediastinal triangle of fat, because ultrasound beams travel through fat. RS; rib shadow, RV; right ventricle, LV; left ventricle, MT; mediastinal triangle.

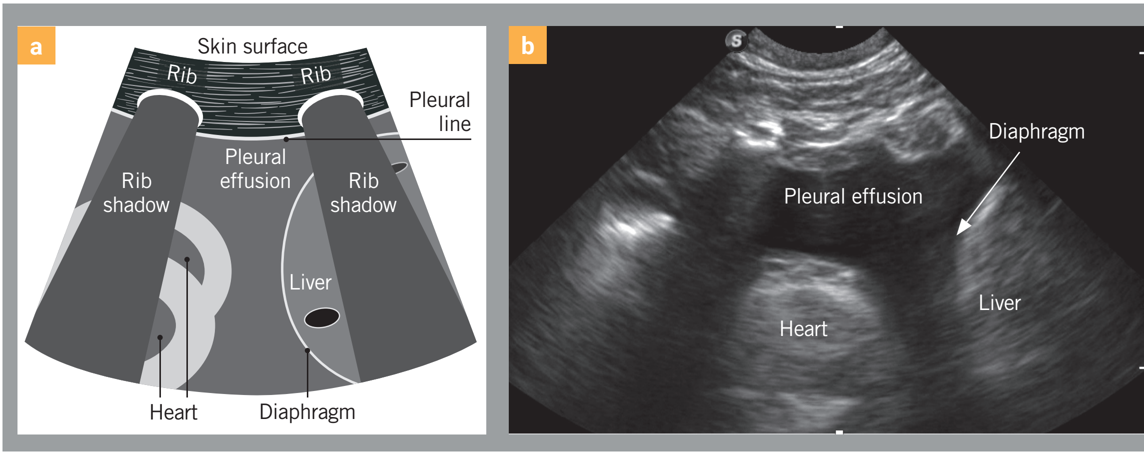
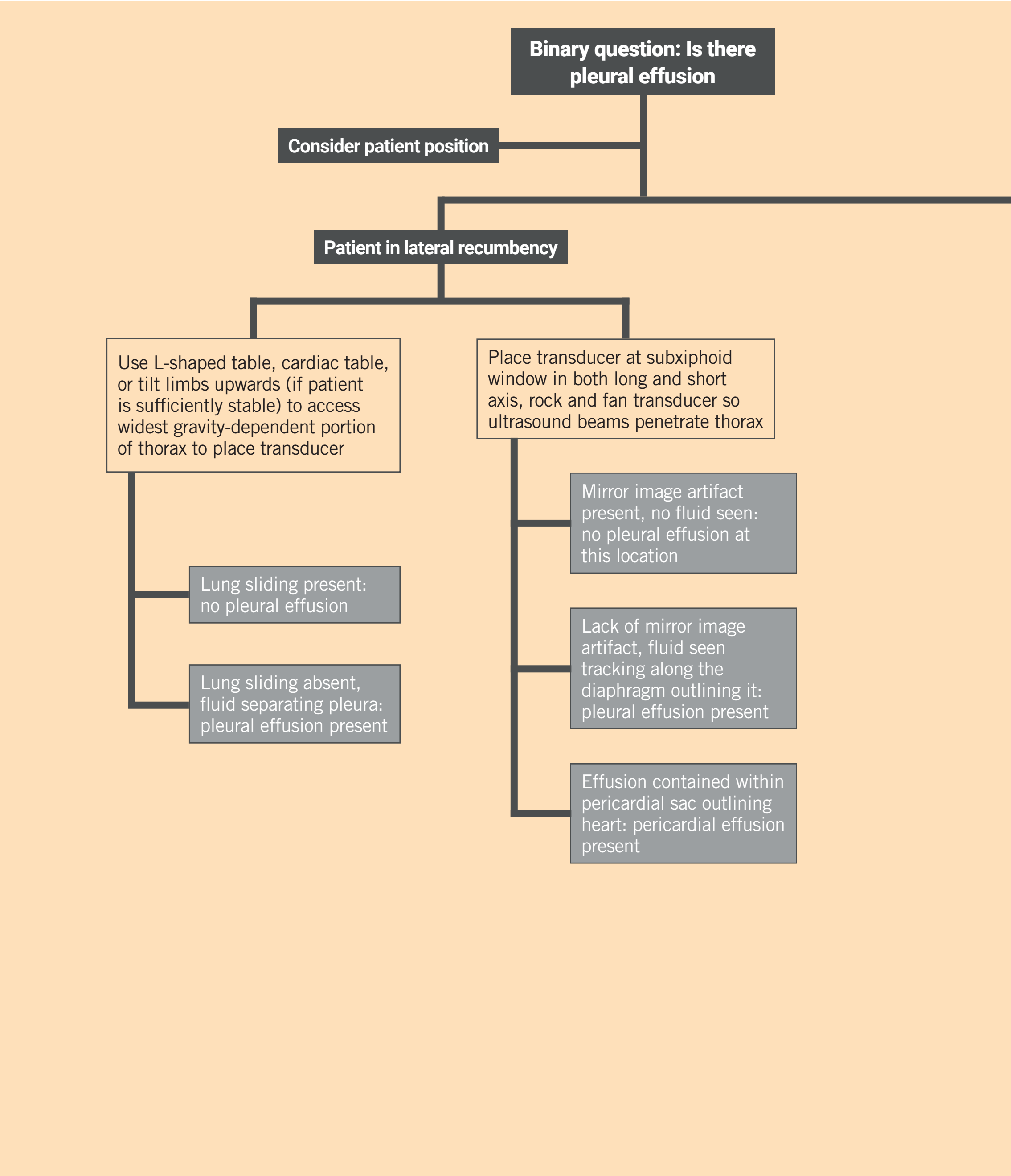
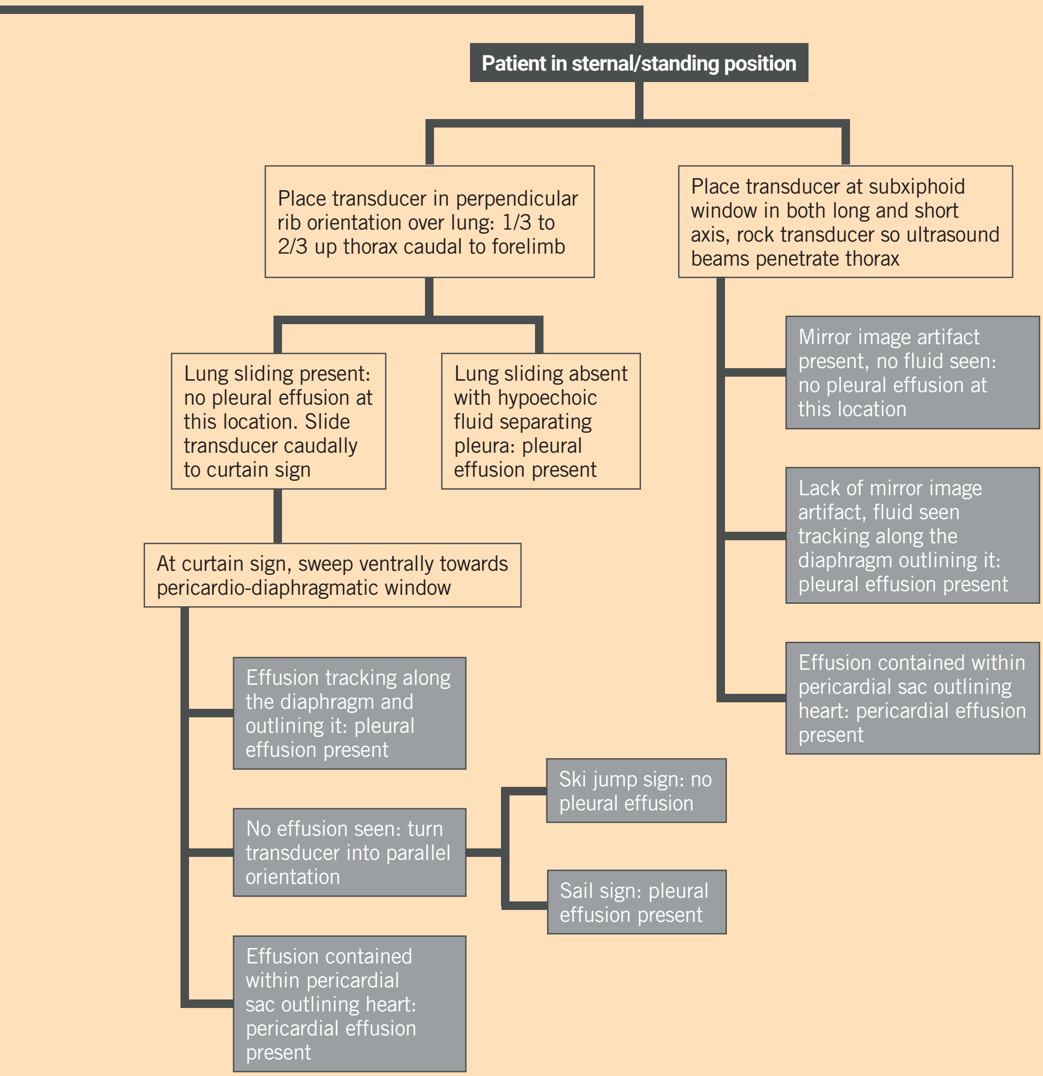


Figure 13. Schematic diagram (a) and ultrasound image (b) of the pericardiodiaphragmatic (PD) window with the transducer in perpendicular orientation to the ribs in a dog with pleural effusion. Pleural effusion tracks along the diaphragm outlining it and forms angles with other tissues/organs. The diaphragm is visible curving away from the chest wall because pleural effusion conducts ultrasound beams and fills the costophrenic recess.

BINARY QUESTIONS

In asking binary questions concerning pleural effusion, the following algorithm can be considered.




Patient in sternal/standing position
Place transducer in perpendicular rib orientation over lung: 1/3 to 2/3 up thorax caudal to forelimb
Place transducer at subxiphoid window in both long and short axis, rock transducer so ultrasound beams penetrate thorax
Lung sliding present: no pleural effusion at this location. Slide transducer caudally to curtain sign
Lung sliding absent with hypoechoic fluid separating pleura: pleural effusion present
Mirror image artifact present, no fluid seen: no pleural effusion at this location
Lack of mirror image artifact, fluid seen tracking along the diaphragm outlining it: pleural effusion present
Effusion contained within pericardial sac outlining heart: pericardial effusion present
At curtain sign, sweep ventrally towards pericardio-diaphragmatic window
Effusion tracking along the diaphragm and outlining it: pleural effusion present
No effusion seen: turn transducer into parallel orientation
Ski jump sign: no pleural effusion
Sail sign: pleural effusion present
Effusion contained within pericardial sac outlining heart: pericardial effusion present