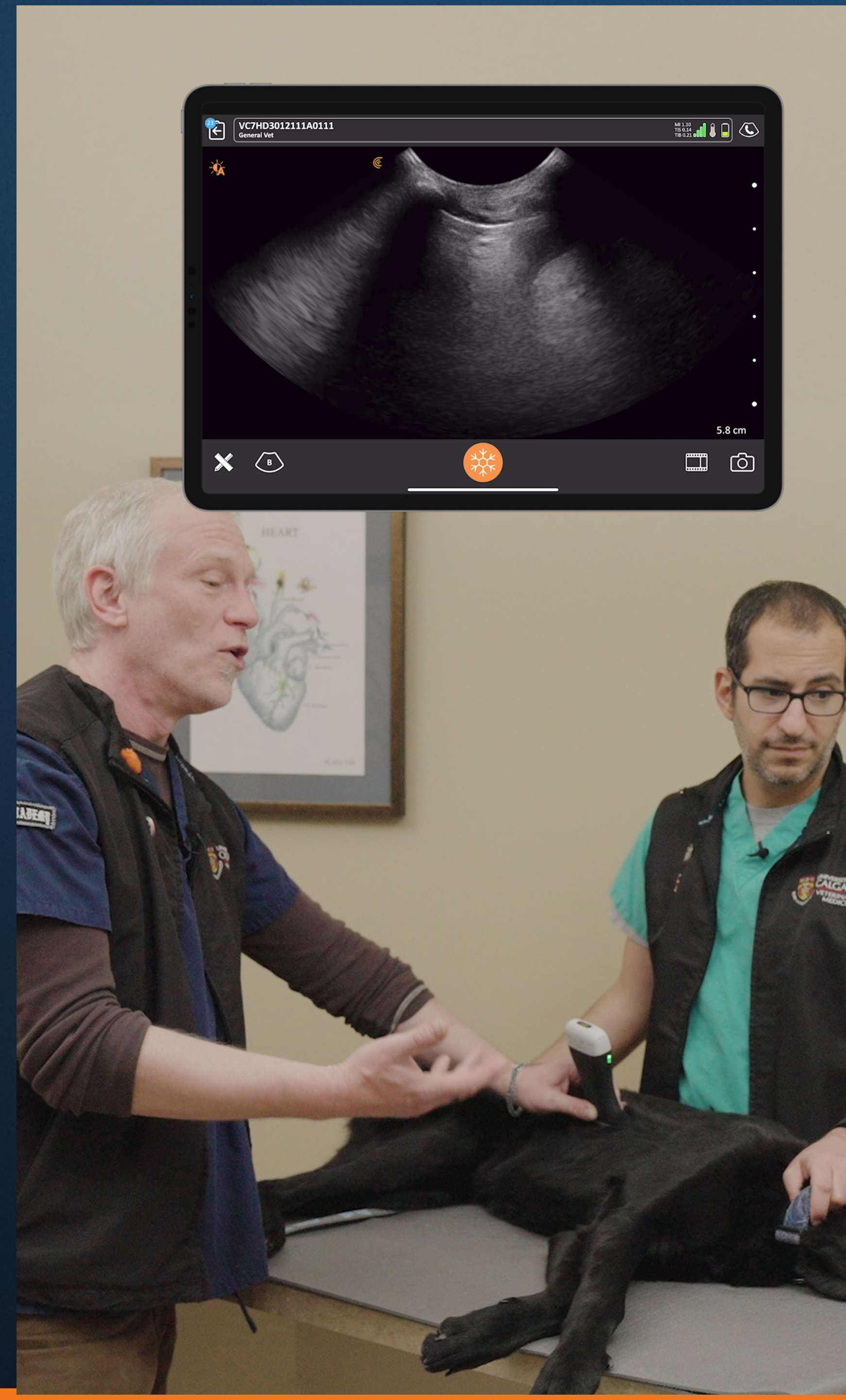




WEBINAR

Dog vs. Car! Veterinary POCUS in Canine Trauma: Navigating Respiratory Distress

March 2024



Your Host



Oron Frenkel, M.D., M.S.

Emergency Physician & POCUS Educator
Chairman, Clarius Medical Advisory Board

Diagnosis of pulmonary contusions with point-of-care lung ultrasonography and thoracic radiography compared to thoracic CT in dogs with motor vehicle trauma

“

Lung ultrasound provides a reliable diagnosis of pulmonary contusion after trauma”

Dicker SA, Lisciandro GR, Newell SM, Johnson JA. Diagnosis of pulmonary contusions with point-of-care lung ultrasonography and thoracic radiography compared to thoracic computed tomography in dogs with motor vehicle trauma: 29 cases (2017-2018). *J Vet Emerg Crit Care (San Antonio)*. 2020 Nov;30(6):638-646. doi: 10.1111/vec.13021. Epub 2020 Oct 21. PMID: 33085212.

Diagnosis of pulmonary contusions with point-of-care lung ultrasonography and thoracic radiography compared to thoracic computed tomography in dogs with motor vehicle trauma: 29 cases (2017-2018)

Samuel A Dicker¹, Gregory R Lisciandro², Susan M Newell¹, Justine A Johnson¹

Affiliations + expand

PMID: 33085212 DOI: 10.1111/vec.13021

Abstract

Objective: To determine the accuracy of lung ultrasound (LUS) using the Veterinary Bedside Lung Ultrasound Examination (VetBLUE) protocol and 3-view thoracic radiographs (TXR) compared to thoracic computed tomography (TCT) for diagnosing the presence and quantification of pulmonary contusions (PC).

Design: Prospective cohort study conducted from February 2017 to June 2018.

Setting: Private emergency and referral center.

Animals: Thirty-two dogs having sustained motor vehicle trauma were consecutively enrolled. Three dogs were excluded from statistical analysis. All dogs survived to hospital discharge.

Interventions: Within 24 hours of sustaining trauma, dogs had LUS, TXR, and TCT performed. Using the VetBLUE protocol, LUS PC were scored according to the presence and number of B-lines and C-lines, indicating extravascular lung water. Thoracic radiographs and TCT were scored for PC in a similar topographical pattern to the VetBLUE protocol. Lung ultrasound and TXR were compared to "gold standard" TCT for the presence and quantification of PC.

Measurements and main results: On TCT, 21 of 29 (72.4%) dogs were positive and 8 of 29 (27.6%) dogs were negative for PC. When LUS was compared to TCT, 19 of 21 dogs were positive for PC (90.5% sensitivity) and 7 of 8 dogs were negative (87.5% specificity) for PC. LUS PC score correlated strongly with TCT PC score ($R = 0.8$, $P < 0.001$). When TXR was compared to TCT, 14 of 21 dogs were positive for PC (66.7% sensitivity) and 7 of 8 dogs were negative (87.5% specificity) for PC. TXR PC score correlated strongly with TCT PC score ($R = 0.74$, $P < 0.001$).

Conclusions: In this population of dogs with motor vehicle trauma, LUS had high sensitivity for diagnosis of PC when compared to "gold standard" TCT. LUS provides reliable diagnosis of PC after trauma. More patients with PC were identified with LUS than with TXR, and additional studies are warranted to determine whether this increased sensitivity is statistically significant.

Keywords: blunt force trauma; canine; pneumothorax; ultrasound.

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[View Full Text](#)

Usefulness of transthoracic lung ultrasound for the mild pneumothorax

“...Lung ultrasonography is more sensitive than thoracic radiography for detecting mild pneumothorax in dogs”

Hwang TS, Yoon YM, Jung DI, Yeon SC, Lee HC. Usefulness of transthoracic lung ultrasound for the diagnosis of mild pneumothorax. *J Vet Sci.* 2018 Sep 30;19(5):660-666. doi: 10.4142/jvs.2018.19.5.660. PMID: 30041286; PMCID: PMC6167337.

Usefulness of transthoracic lung ultrasound for the diagnosis of mild pneumothorax

Tae Sung Hwang,¹ Young Min Yoon,¹ Dong In Jung,¹ Seong Chan Yeon,² and Hee Chun Lee ¹

[Author information](#)

[Author notes](#)

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Abstract

The aim of the present study was to investigate the diagnostic accuracy of ultrasonography in the detection of mild pneumothorax using computed tomography (CT) in dogs. Nine adult healthy beagles were included in the study. A thoracic tube was inserted into pleural space at the left thoracic wall, and each dog underwent the examinations in the order of CT, lung ultrasonography, and radiography before the infusion of room air into the pleural space. Two, 3, and 5 mL/kg infusions of room air were sequentially introduced into the pleural space and CT, lung ultrasound, and radiography examinations were performed. Sonographic signs included A-lines, stratosphere, lung sliding, lung point, lung pulse, and reverse sliding signs. Radiographs were evaluated for the absence or presence of a pneumothorax. Lung ultrasound results were more accurate than radiography results for the detection of mild pneumothorax. The overall sensitivity of the sonographic reverse sliding sign was higher than that of other sonographic signs, and its specificity was 100% for detection of mild pneumothorax. Thus, the reverse sliding sign is useful when using lung ultrasonography for diagnosis of mild pneumothorax.

Keywords

dogs; lung ultrasonography; pneumothorax; reverse sliding sign

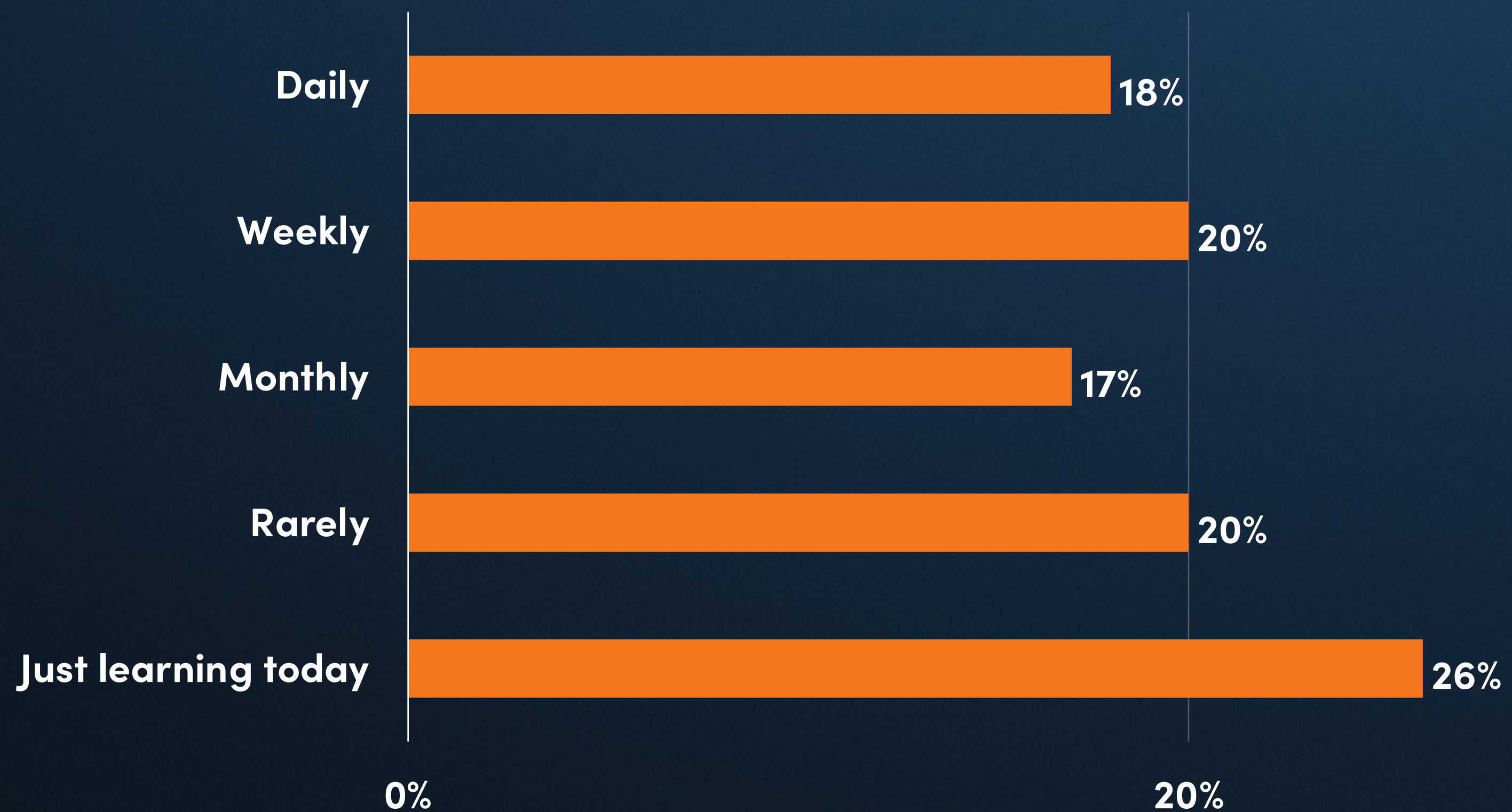
Introduction

Transthoracic lung ultrasonography is emerging as a diagnostic examination approach for a variety of lung diseases [18, 20, 22] and in the detection of pneumothorax [27, 31] in human. A mild pneumothorax is not usually life-threatening, but delayed diagnosis can cause disease associated with resultant circulatory and respiratory compromise in unstable patients [8]. Tension pneumothorax is an emergency condition, and because tension pneumothorax can lead to impairment of blood circulation and respiration, early diagnosis and treatment are required [12]. The diagnosis of pneumothorax is identified by using thoracic radiography, but thoracic radiography is a relatively insensitive and unreliable diagnostic tool [5]. In contrast, computed tomography (CT) scanning is deemed the gold standard for evaluation of pneumothorax [1, 8, 29].

Theoretically, air-filled lung parenchyma cannot be visualized by ultrasound [19]. The potential for ultrasound to examine the lung is classically thought to be limited since air is considered an insurmountable obstacle [17]. Ultrasonographic images are thus exclusively composed of artefacts. Recently, some ultrasonographic features have been confirmed in humans in the diagnosing of pneumothorax, such as the A-line sign [13], stratosphere sign [16], lung slide [16], lung point [14], and lung pulse [28] features. In normal lung, respiration-dependent motion of the lung surface is visualized via transthoracic lung ultrasound and is called lung gliding or lung sliding [21, 27, 30]. The presence of lung slide, a to-and-fro motion visible at the pleura that occurs with respiration, is an important feature in normal air-filled lungs [10, 13, 16, 21]. This is one of the dynamic signs of the lung and is identified by horizontal motion along the pleura in sonography [7]. A lung slide image can be objectified by using an M-mode as the superficial

Interactive Poll

How often do you use ultrasound to assess trauma patients?

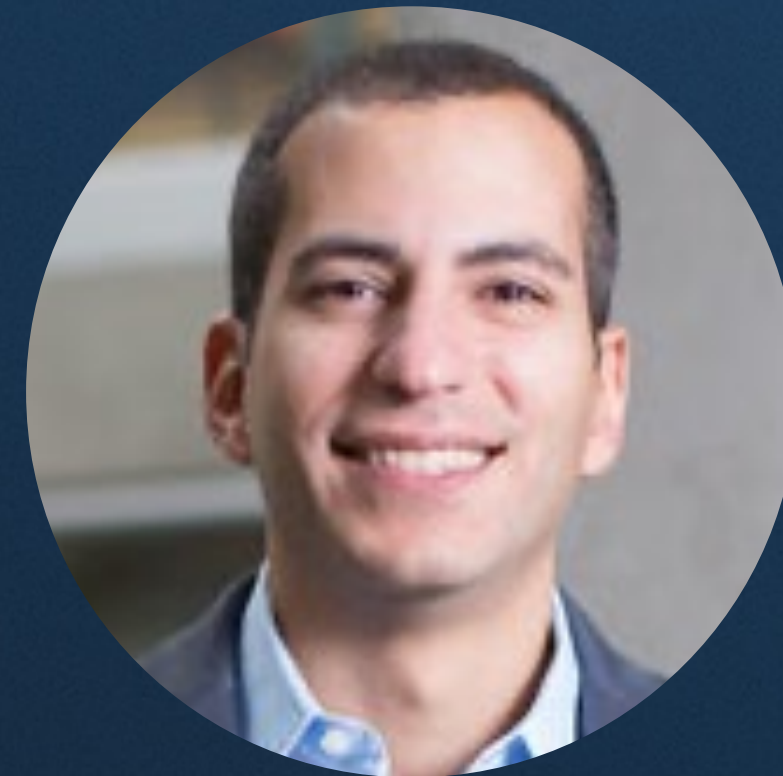


Your Host



**Dr. Soren Boysen, DVM,
DACVECC**

Professor, Faculty of Veterinary Medicine,
University of Calgary



**Dr. Serge Chalhoub, BSc, DVM,
DACVIM**

Associate Professor, Faculty of Veterinary
Medicine, University of Calgary

Dog vs. Car! Veterinary POCUS in Canine Trauma: Navigating Respiratory Distress

Review: *Clarius*, March 2021 *Veterinary Point-of-Care Pleural Space and Lung Ultrasound (PLUS) for Everyday Practice!*

**Veterinary Point-of-Care Pleural Space and Lung
Ultrasound (PLUS) for Everyday Practice!**



**Søren Boysen, DVM,
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Veterinary Clinical and Diagnostic Sciences

**Serge Chalhoub, DVM,
DACVIM**
schalhou@ucalgary.ca
Veterinary Clinical and Diagnostic Sciences



In relation to this presentation, we receive conference honorariums, but otherwise declare no conflicts of interest

TRIAAAAAGE!!!! Kira

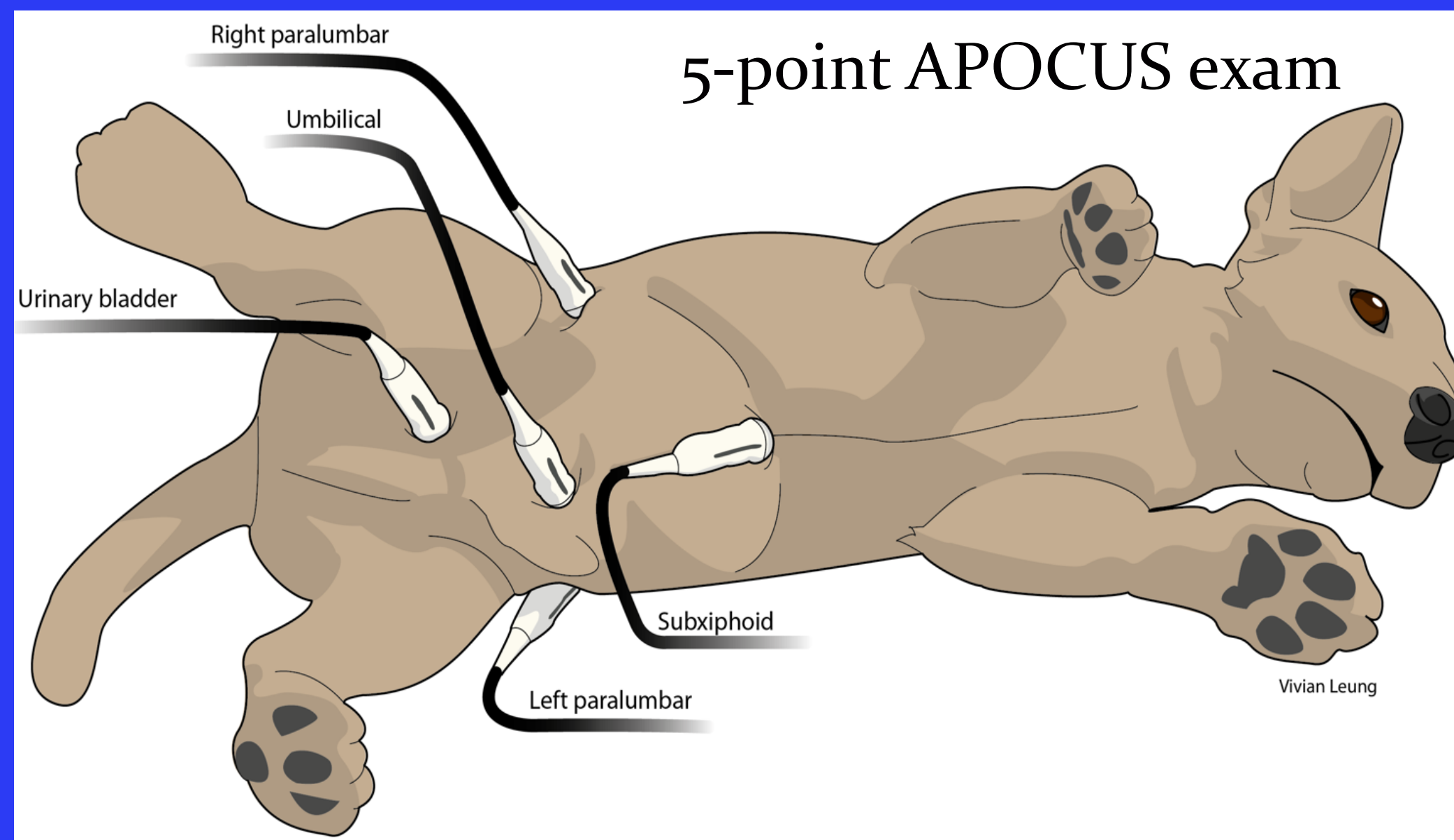
- 2 y.o. MN Husky: Hit by car!
- HR: 158 bpm, RR 44 rpm, T 38.6 C (101.5 F)
- Increased respiratory effort
 - Decreased right dorsal breath sounds
 - Crackles left thorax



Introduction: Small animal trauma

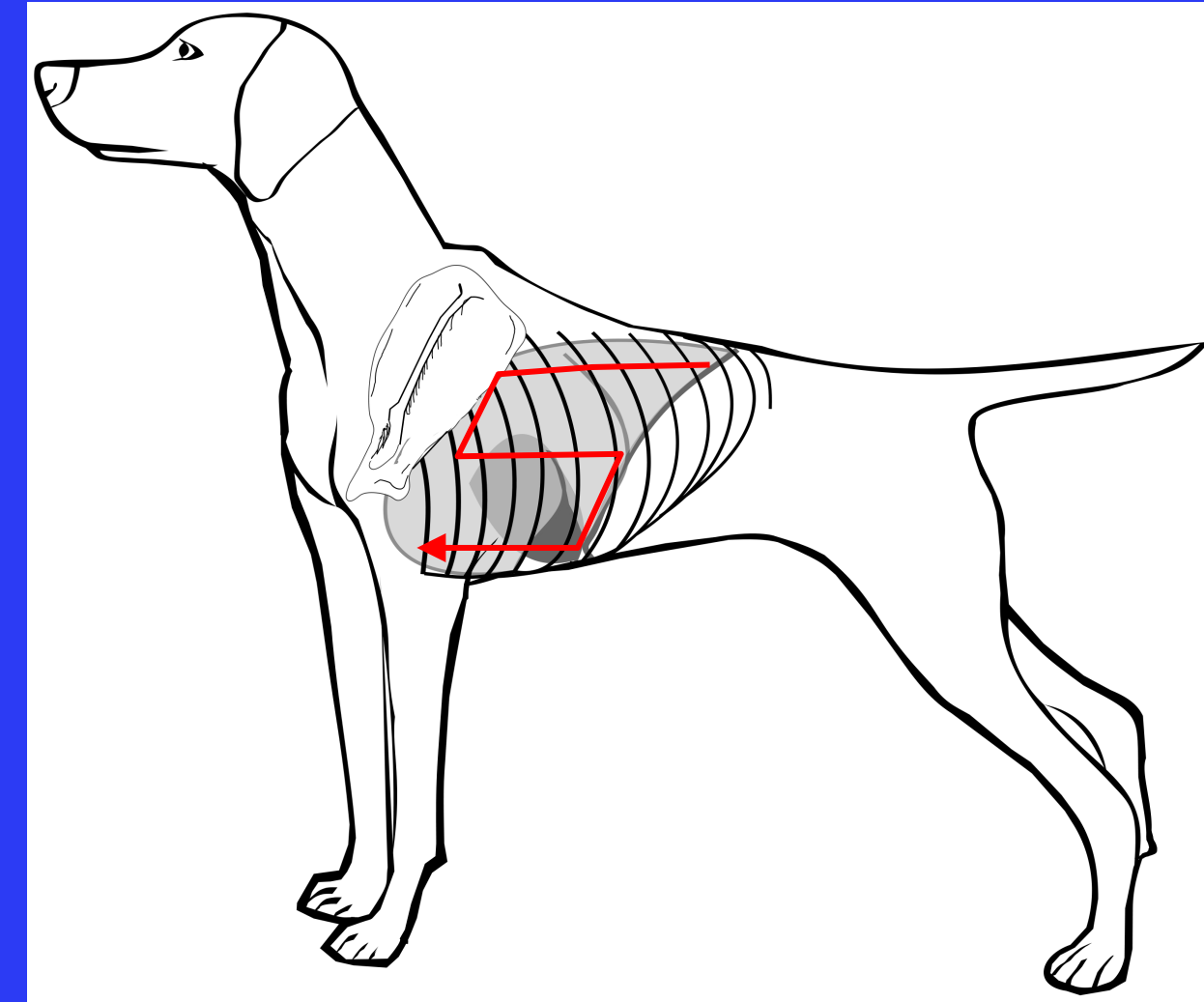
- Trauma is common (11% to 13% of cases urban ER cases)
 - Blunt abdominal injuries in up to 45% of dogs
 - Hemoperitoneum \approx 28-45 %
 - Urinary tract rupture \approx 3%
 - Other...

Kolata JAVMA 1975, Kolata JAVMA 1974, Boysen JAVMA 2004, Simpson JVECC 2009, Streeter JAVMA 2009



Introduction: Small animal trauma

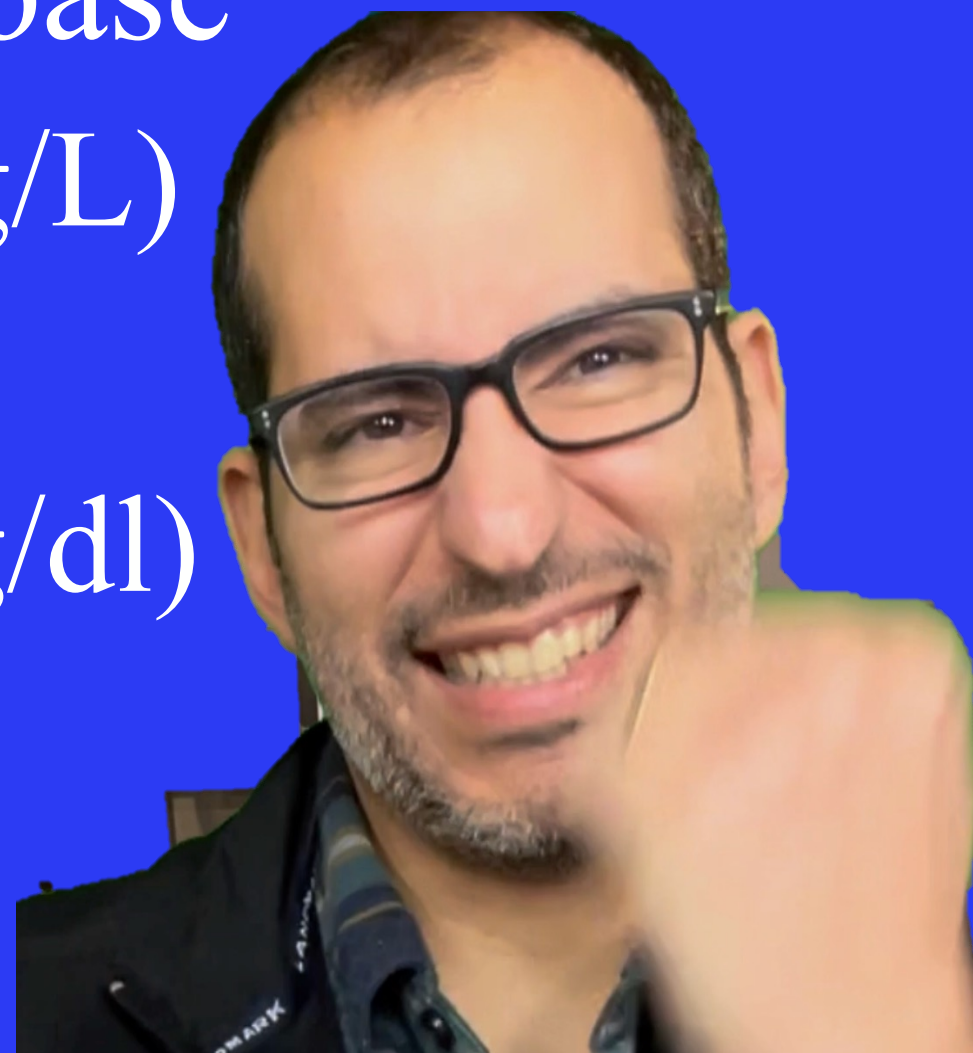
- Thoracic Injuries (up to 50% of trauma dogs)
 - Pulmonary contusions up to 58%
 - Pneumothorax up to 47%
 - Hemothorax up to 18%
 - Rib fractures up to 14%
 - Diaphragmatic hernia 6% (more often blunt abdominal)
 - Flail chest (more common with penetrating injury)
- Traumatic right atrial rupture (very rare < 0.01%)



What to do next?

Kira: Stabilization and point-of-care testing

- Oxygen
- Anxiolytics/analgesics
- Minimum emergency data base
 - Hct 41%, TS 5.8 g/dl (58 g/L)
 - BUN 15-26mg/dl
 - Glucose 4.9 mmol/l (89mg/dl)
 - Lactate 3.5 mmol/L
 - SpaO₂: 85% (room air)
 - ECG: Sinus tachycardia
 - Systolic blood pressure 90 mmHg

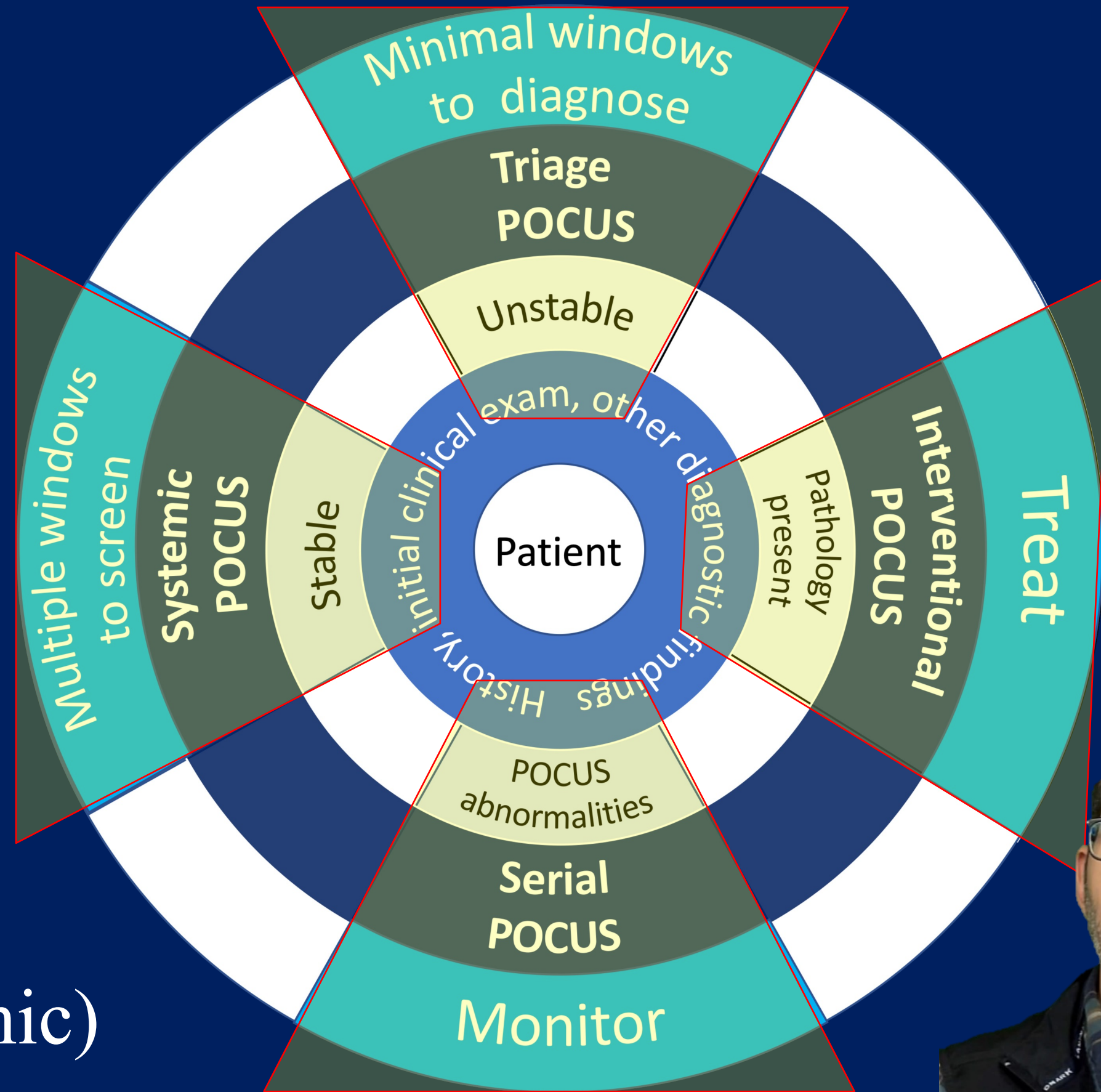


Point-of-care ultrasound as part of triage/MEDB?

The 3 T's of FAST have expanded to the six "T's" of POCUS:

Clarius, July 2022: Veterinary POCUS: Rapidly assessing acute abdominal conditions using the 5-point abdominal point-of-care ultrasound (POCUS) exam

- 1) Targeted
- 2) Trauma
- 3) Triage
- 4) Treatment
- 5) Tracking
- 6) Total (systemic)



- Minimum Emergency Data Base
 - Hct 41%, TS 5.8 g/dl (58 g/L)
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 - Glucose 4.9 mmol/l (89mg/dl)
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 - SpaO2: 85% (room air)
 - ECG: Sinus tachycardia
 - Systolic blood pressure 90 mmHg



JOURNAL OF Veterinary Emergency AND Critical Care
 Original Study
 Journal of Veterinary Emergency and Critical Care 26(1) 2016, pp 64-73
 doi: 10.1111/vec.12376

Focused assessment with sonography in nontraumatized dogs and cats in the emergency and critical care setting

Jantina McMurray, DVM; Søren Boysen, DVM, DACVECC and Serge Chalhoub, DVM, DACVIM

with renal pelvic dilation is not part of POCUS for t

J Am Vet Med Assoc. 2004 Oct 15;225(8):1198-204.

SMALL ANIMALS

Evaluation of a focused assessment with sonography for trauma protocol to detect free abdominal fluid in dogs involved in motor vehicle accidents

Søren R. Boysen, DVM; Elizabeth A. Rozanski, DVM, DACVECC, DACVIM; Amy S. Tidwell, DVM, DACVR; Jen L. Holm, DVM; Scott P. Shaw, DVM; John E. Rush, DVM, MS, DACVIM, DACVECC

Kira: POCUS and Trauma

Where do you want to start with Kira?

- Clinically relevant POCUS question(s)
 - Pleural and lung ultrasound (PLUS): incidence of injury in $\approx 50\%$ of blunt thoracic trauma
 - 5-point APOCUS: $\approx 45\%$ incidence in blunt trauma (hemoabdomen \gg uroabdomen)
 - Cardiovascular POCUS – volume status (rare blunt trauma induced pathology)

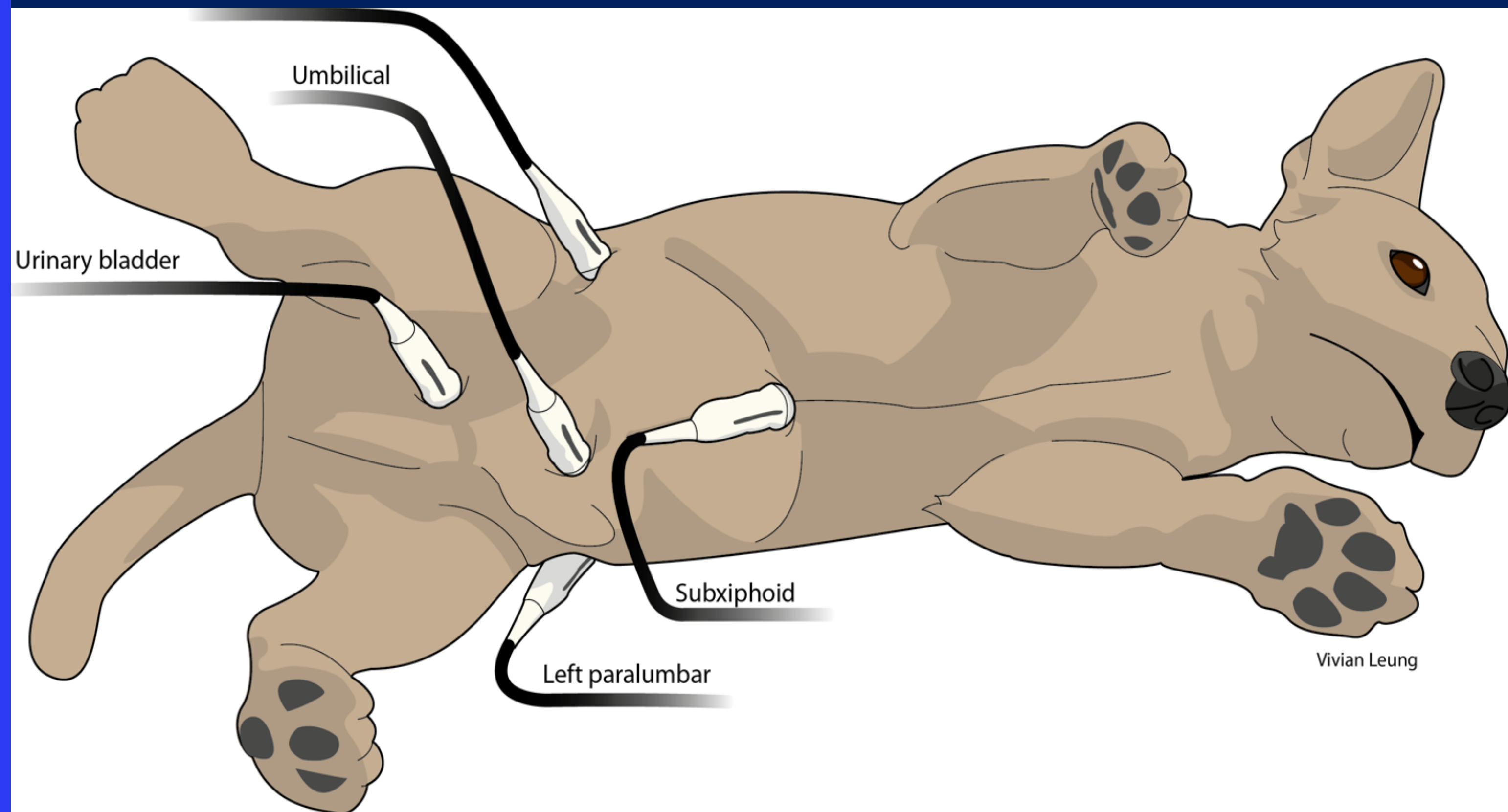
- 2 y.o male castrated Husky
- HR: 158 bpm, RR 44 rpm, T 38.6 C (101.5 F)
- Increased effort
 - Decreased breath sounds right dorsal
 - Crackles left side
- Minimum Emergency Data Base
 - Hct 41%, TS 5.8 g/dl (58 g/L)
 - BUN 15-26mg/dl
 - Glucose 4.9 mmol/l (89mg/dl)
 - Lactate 3.5 mmol/L
 - SpaO2: 85% (room air)



Kira: POCUS and Trauma

Where do you want to start with Kira?

5-point APOCUS:



Check serially with therapy: can have delayed findings

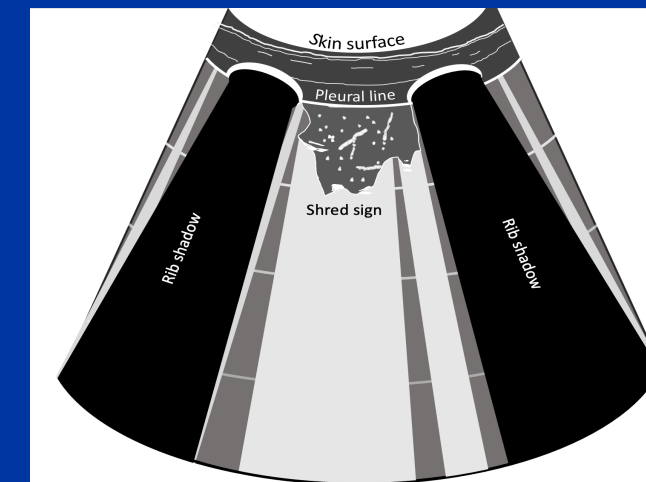
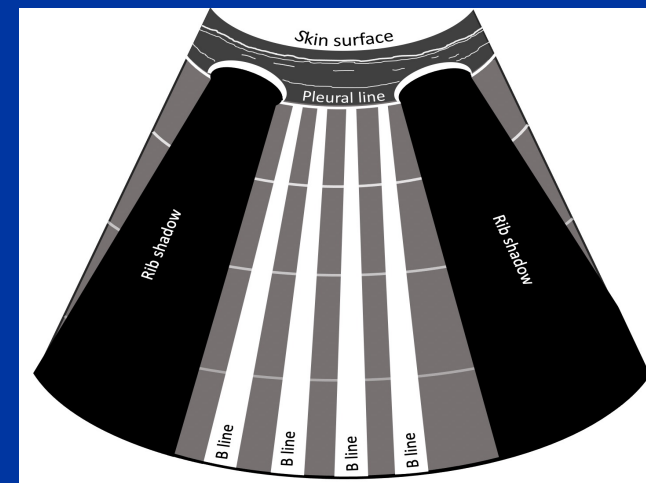
Dyspneic dog following blunt thoracic trauma

Pneumothorax 47%

Absent lung sliding, lung point, abnormal curtain signs

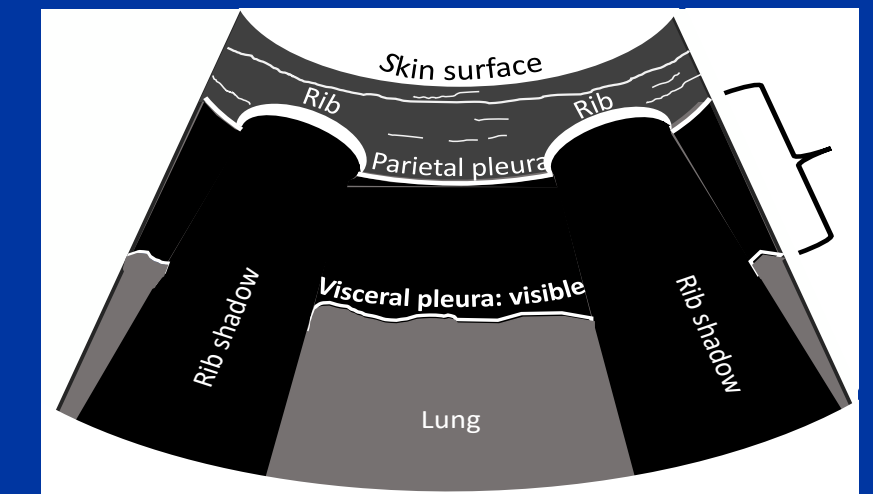
Pulmonary contusions 58%

Increased B lines
Possible lung consolidation



Hemothorax 18%

Pleural effusion

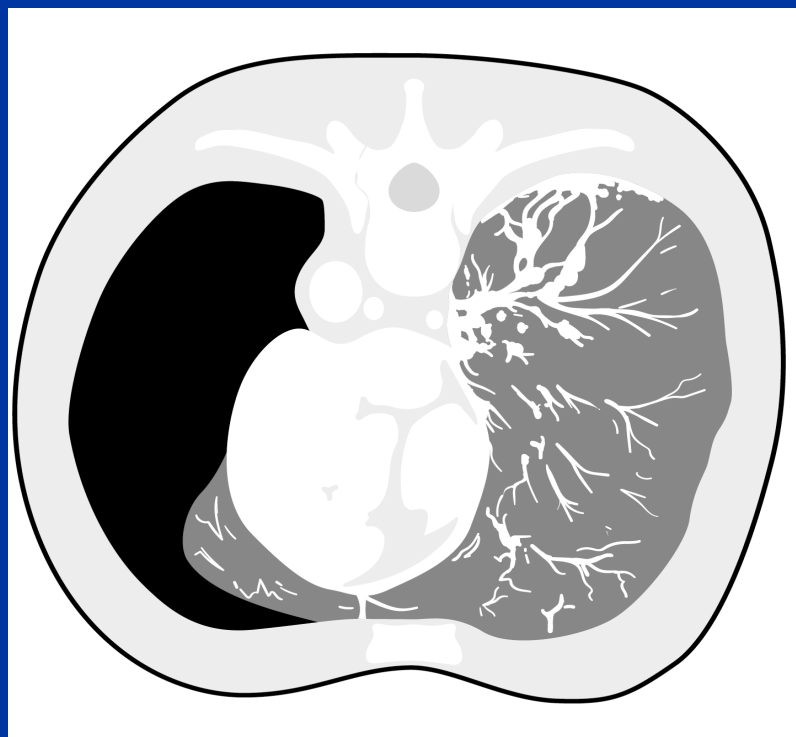


Rib fractures 14%
Physical exam/radiographs
Role for ultrasound?

Diaphragmatic hernia 6%

Abdominal organs, particularly the liver, cranial to the diaphragm

Flail chest: obvious on physical exam



Kira: Where to start on the thorax?

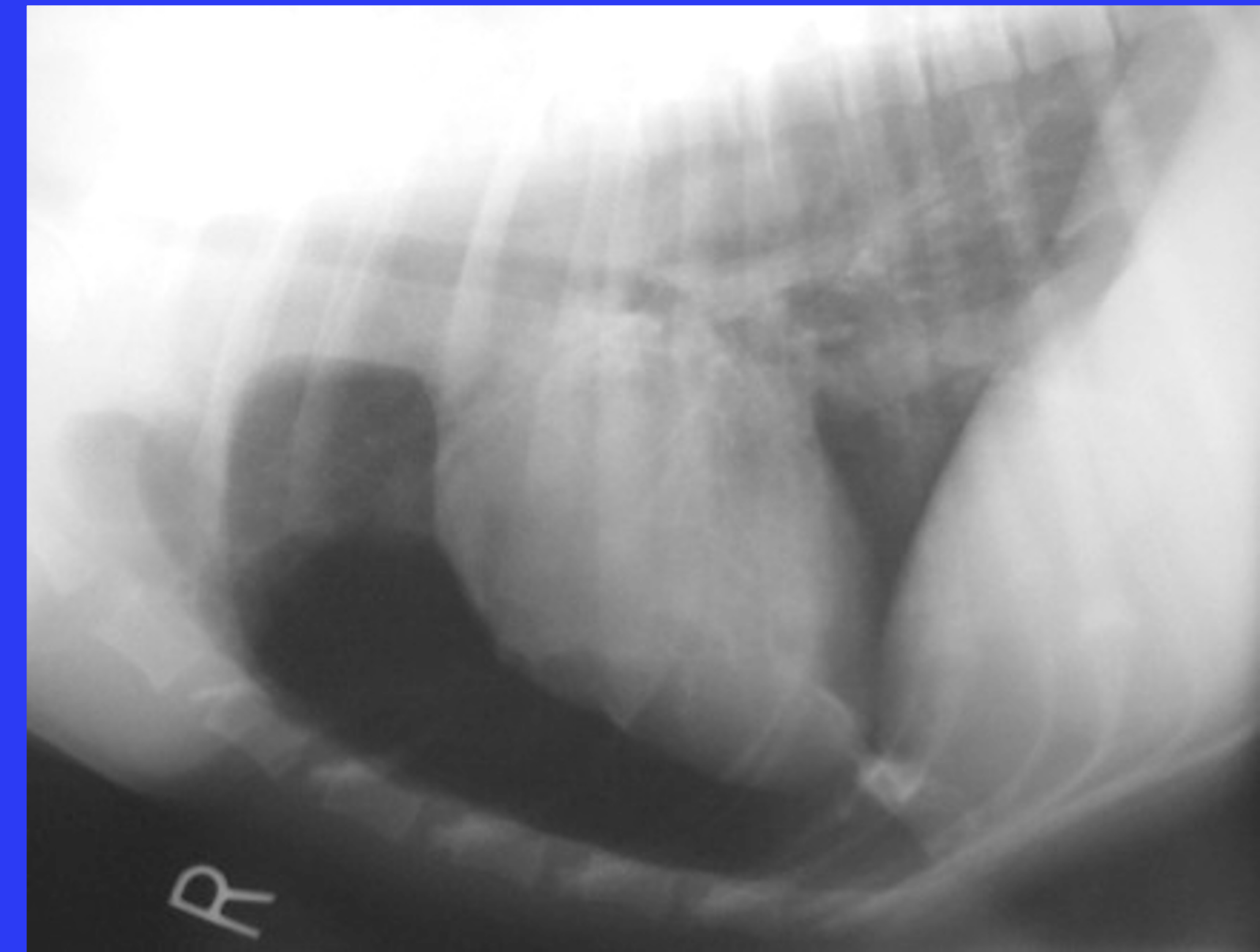
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 - SpaO₂: 85% (room air)



Interpreting PLUS for pneumothorax: Rule out findings

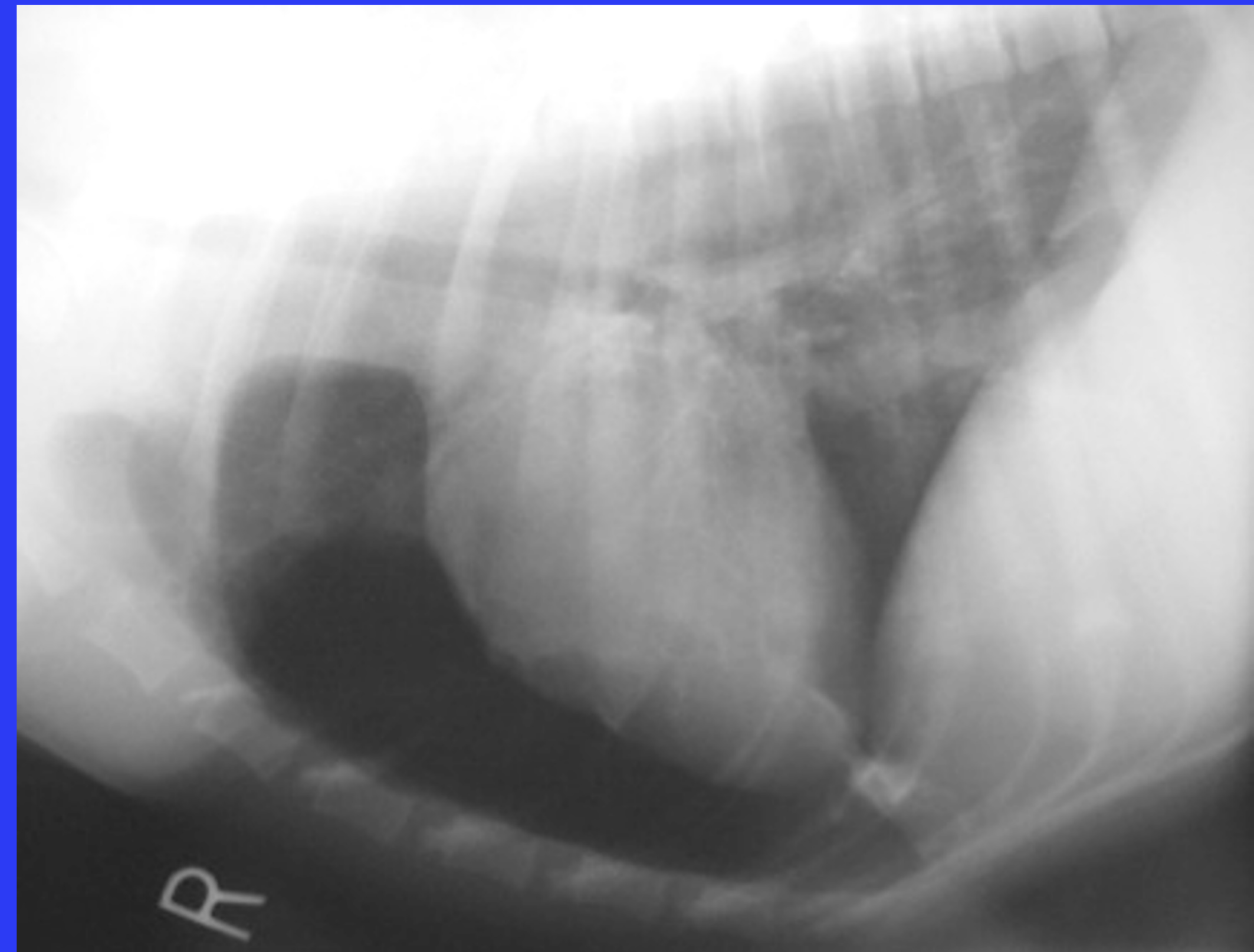
- There are two criteria that rule out pneumothorax at the probe location
 1. Lung sliding: **a rule out finding**
 - Lung sliding has a 95% sensitivity and 100% negative predictive value
 - Lung sliding confidently rules out pneumothorax (at that site)
 - *Absence of lung sliding is not accurate at diagnosing pneumothorax
 2. Search for B-lines: **a rule out finding**
 - Even a single B-line rules out pneumothorax at the probe location
 - Only present in 10-50 % of healthy animals!



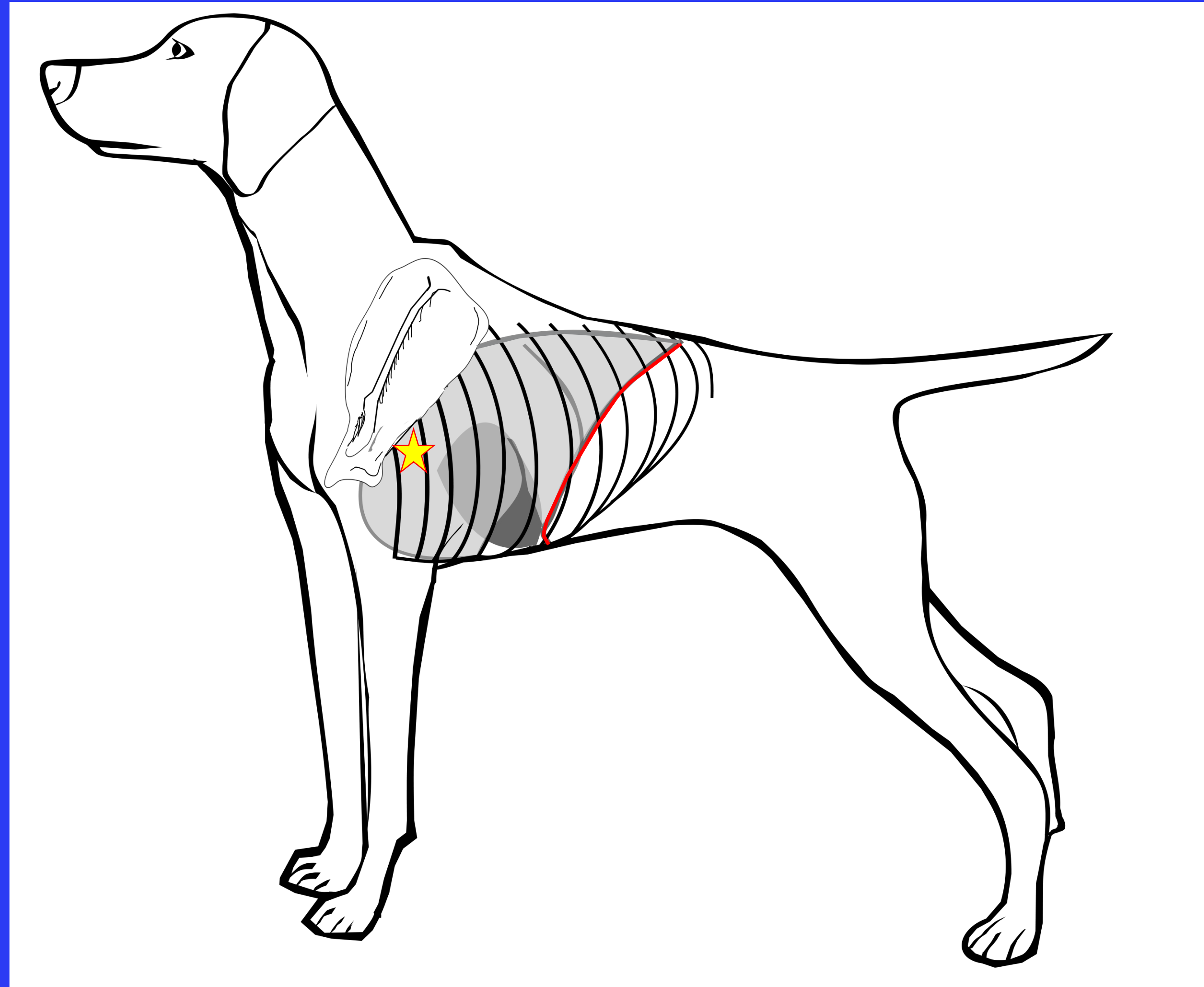
Interpreting PLUS for pneumothorax: Rule out findings

- If pneumothorax can't be ruled out with B-lines and absence of lung sliding, there are 2 criteria that confirm its presence
 1. The lung point: **Rules in** pneumothorax
 2. Abnormal curtain signs: there are 2 that help **rule in** pneumothorax
 - a) Double curtain sign
 - b) Asynchronous curtain sign

What is our preferred protocol to rule out/confirm pneumothorax?



Step 1: Start over lung





VC7HD3012111A0111
General Vet

MI 1.10
TS 0.14
TB 0.21

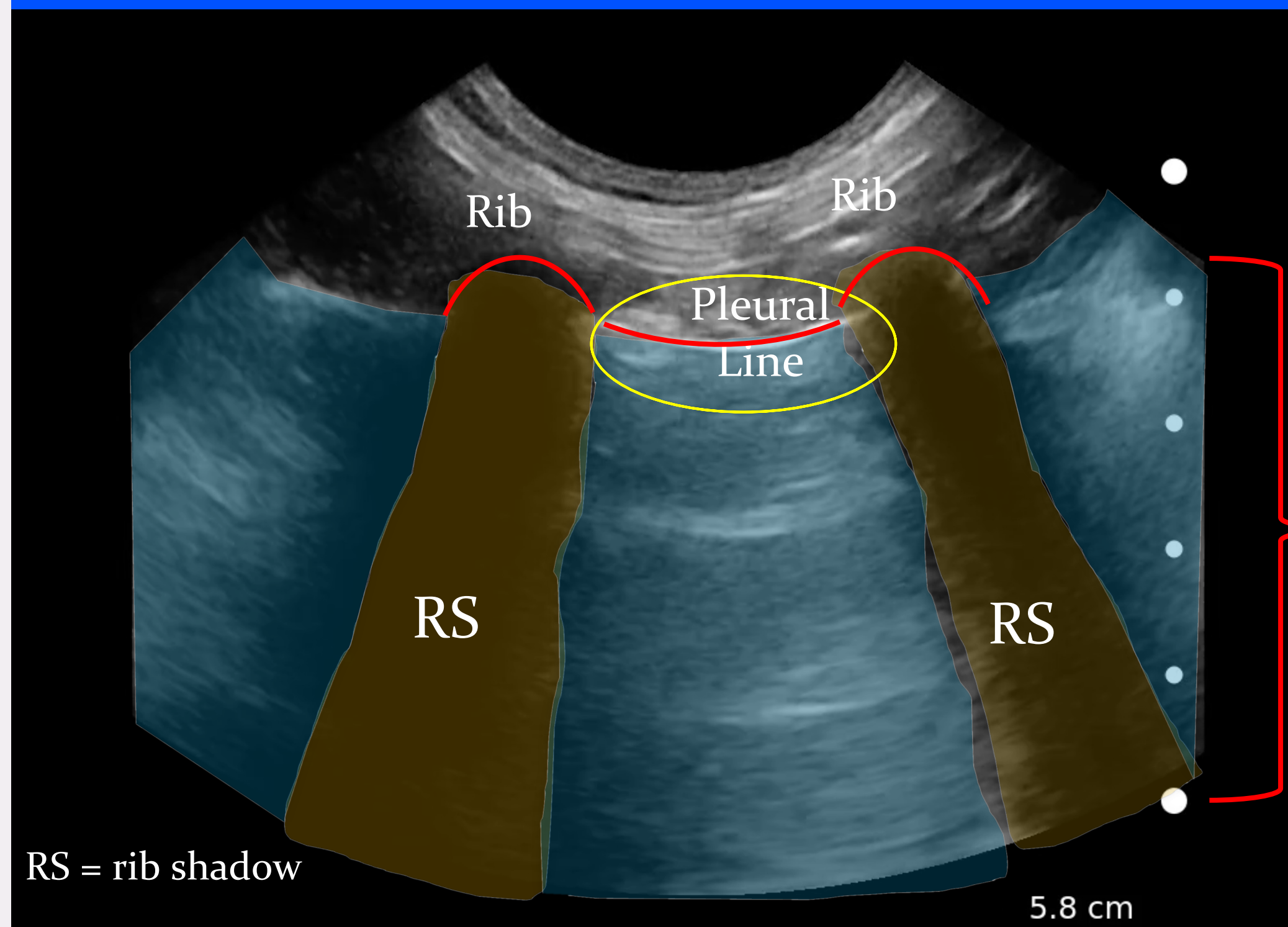
5.8 cm

The image shows a B-mode ultrasound scan of a dog's abdomen. The screen displays a grayscale image of internal organs. The UI includes a top status bar with a patient ID, a signal strength indicator, and battery level. A bottom toolbar contains icons for a pencil, a shield with 'B', a snowflake, a film strip, and a camera. A measurement of 5.8 cm is shown in the bottom right corner of the scan area.



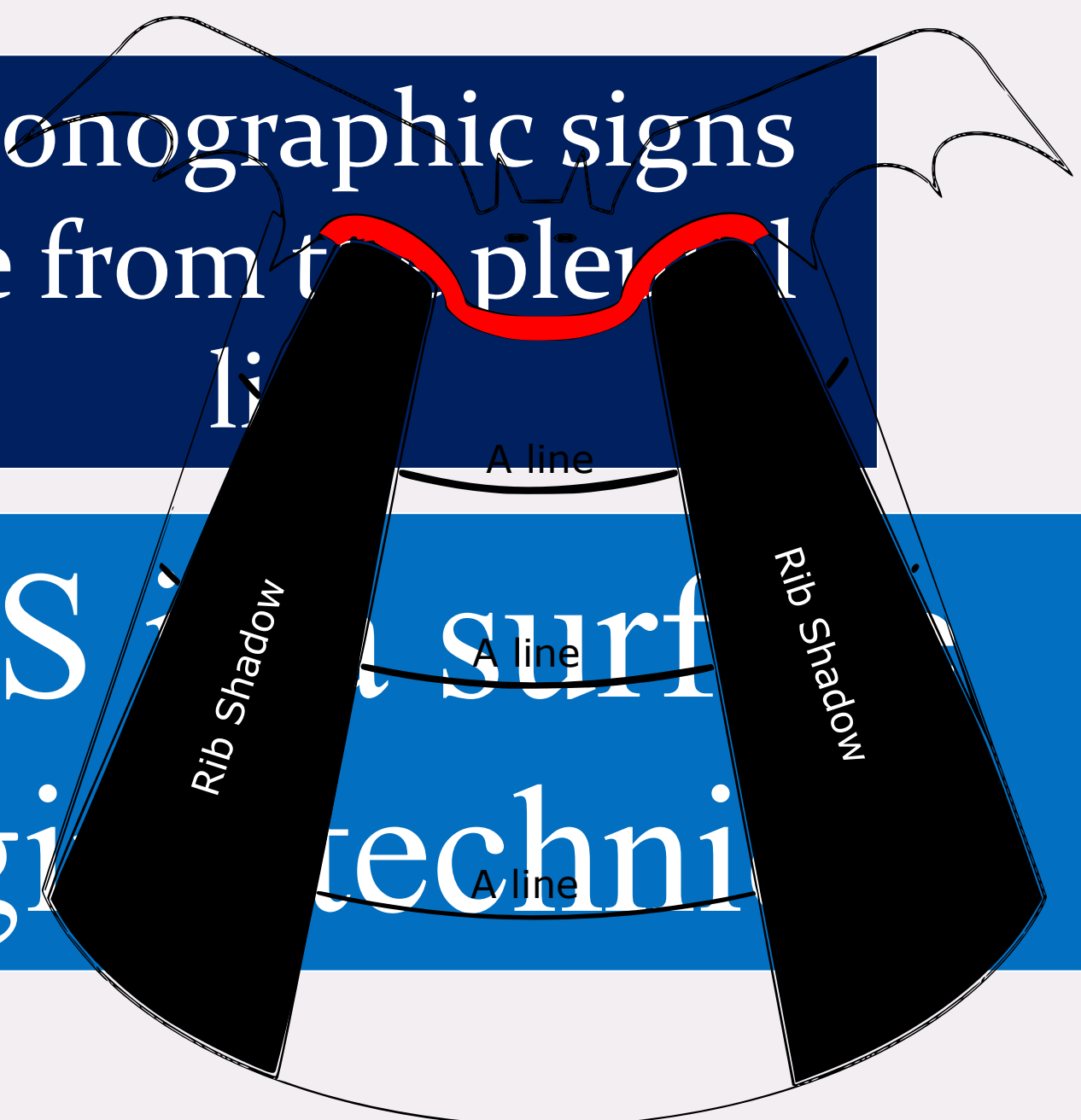
Bat sign to find the pleural line

- Pleural line: Bat Sign
 - Ultrasound waves can't go through bone!
 - Rib shadows
 - Ultrasound waves can't go through air!
 - 99.9% of the ultrasound beam is reflected at soft tissue air interface (e.g. at the pleural line), rendering aerated lung impenetrable to ultrasound



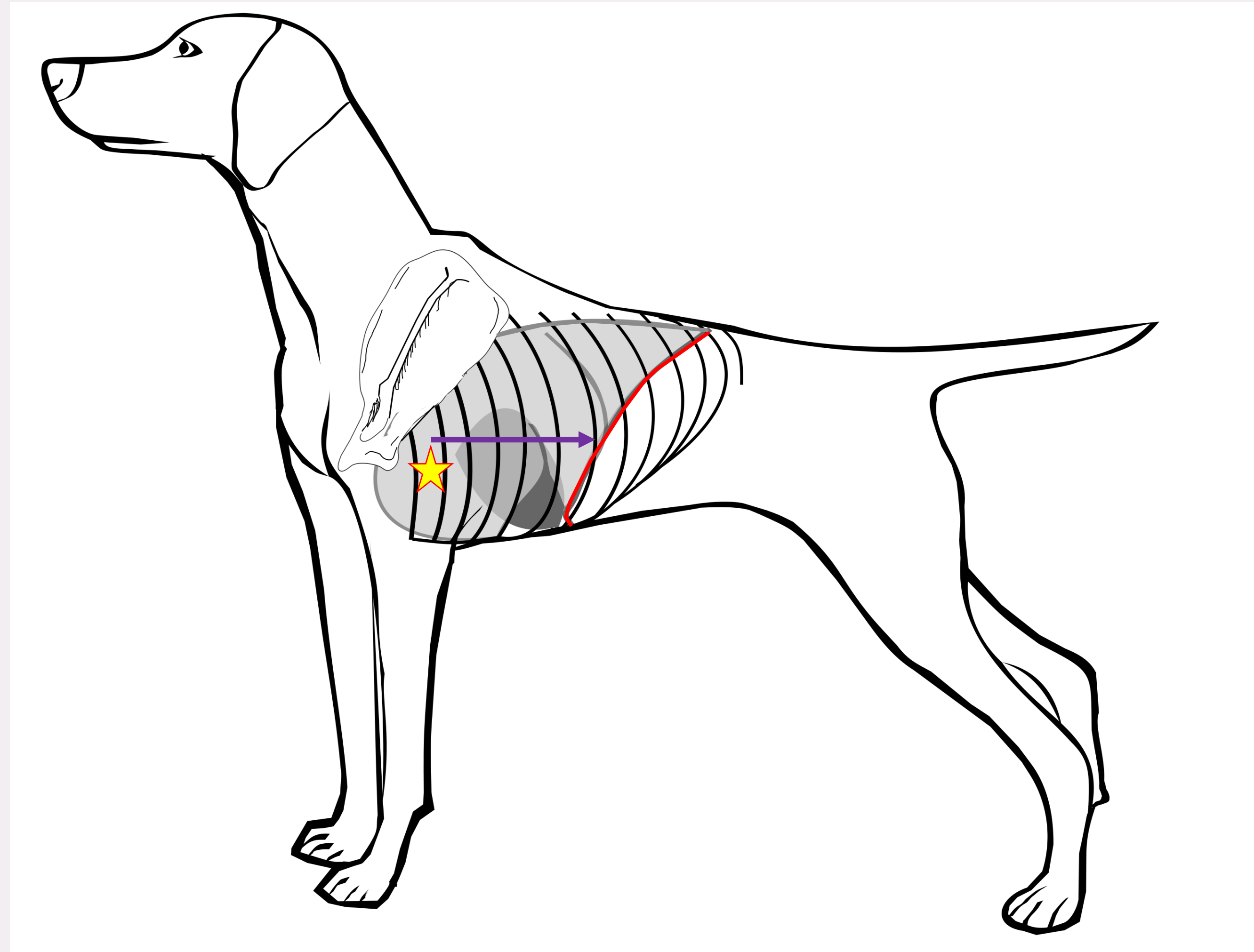
All sonographic signs
arise from the pleural
line

US of the surf
agitation techni



Step 1: Start over lung

Step 2: Find the caudal border (curtain sign)



**Slide caudal until the curtain sign
is found**



Abnormal curtain signs identified with a novel lung ultrasound protocol in 6 dogs with pneumothorax

Søren R. Boysen^{1*}, Jantina McMurray², Kris Gommerman³

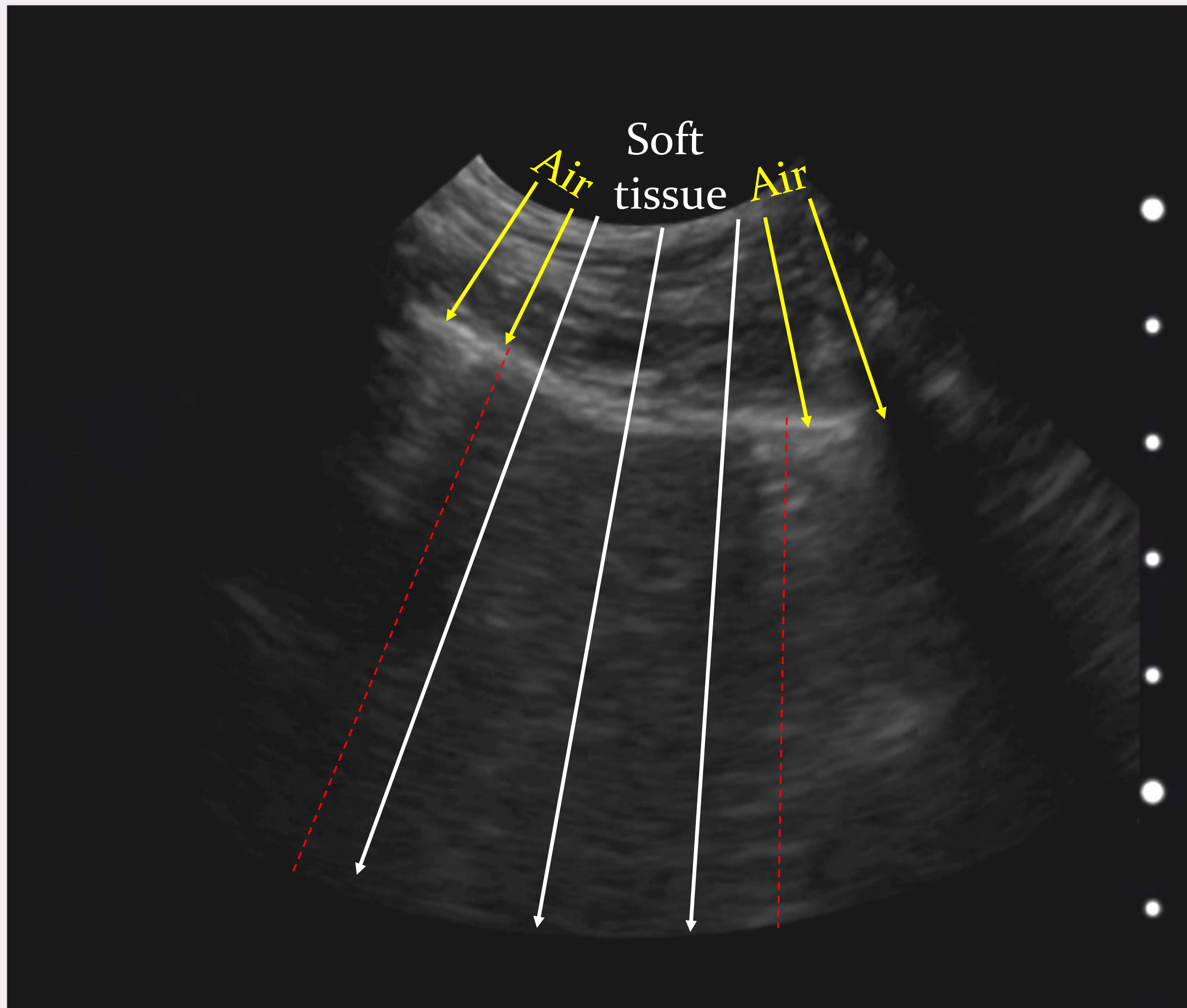


1. Abnormal Curtain Sign & Pneumothorax!

Normal



Double curtain sign



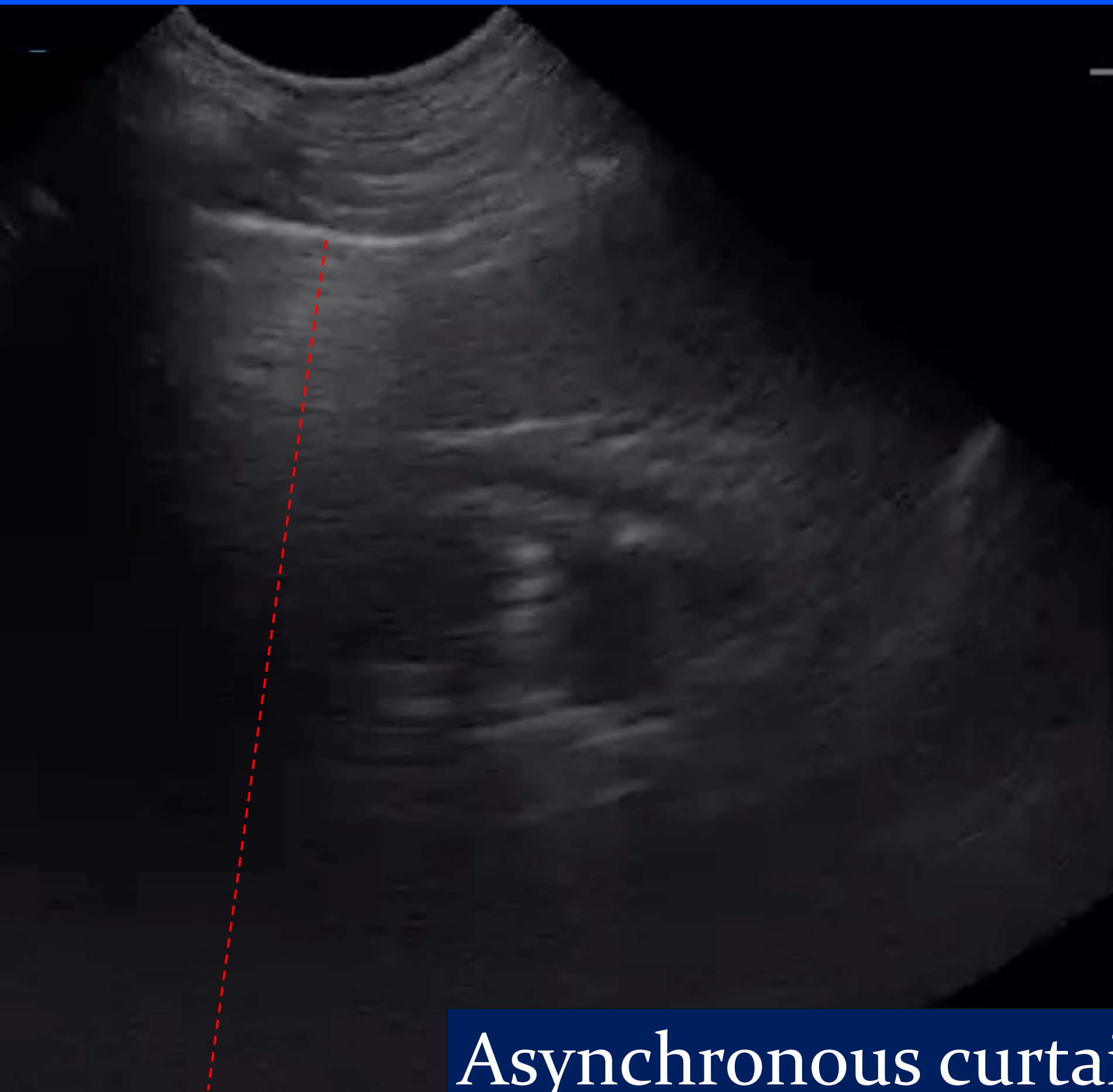
7 cm

5.8 cm

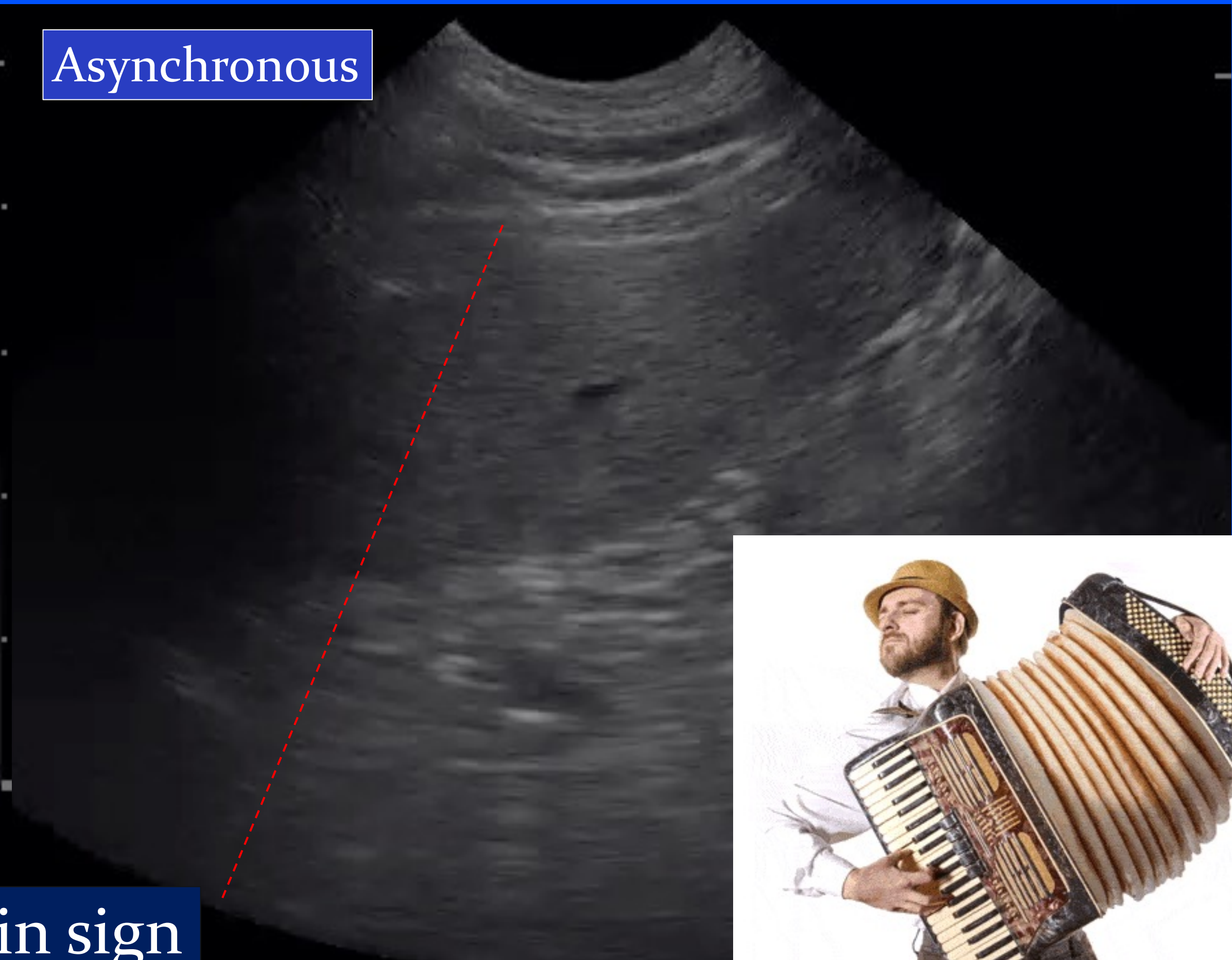


Abnormal curtain sign & pneumothorax!

Normal



Asynchronous

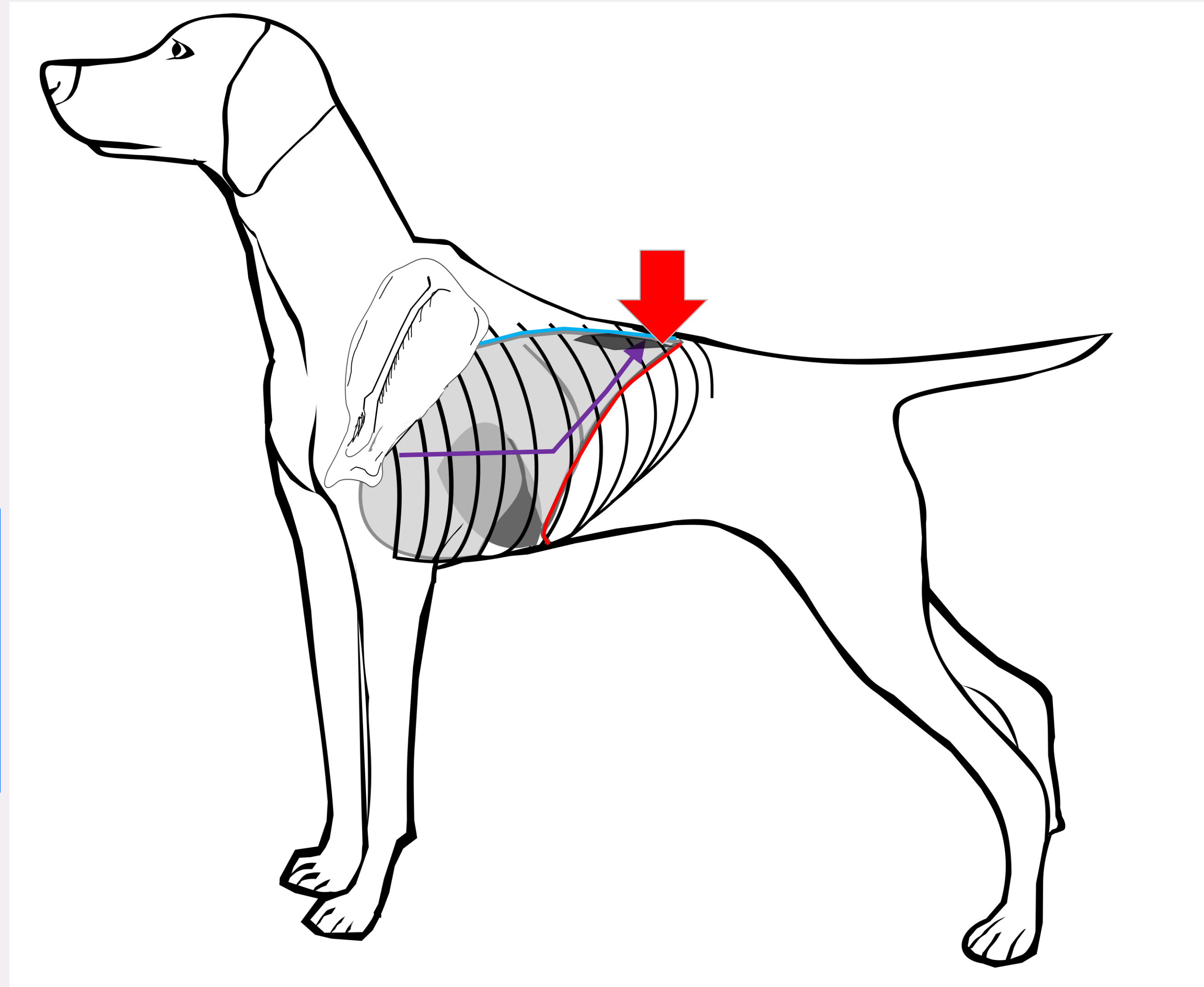


Asynchronous curtain sign

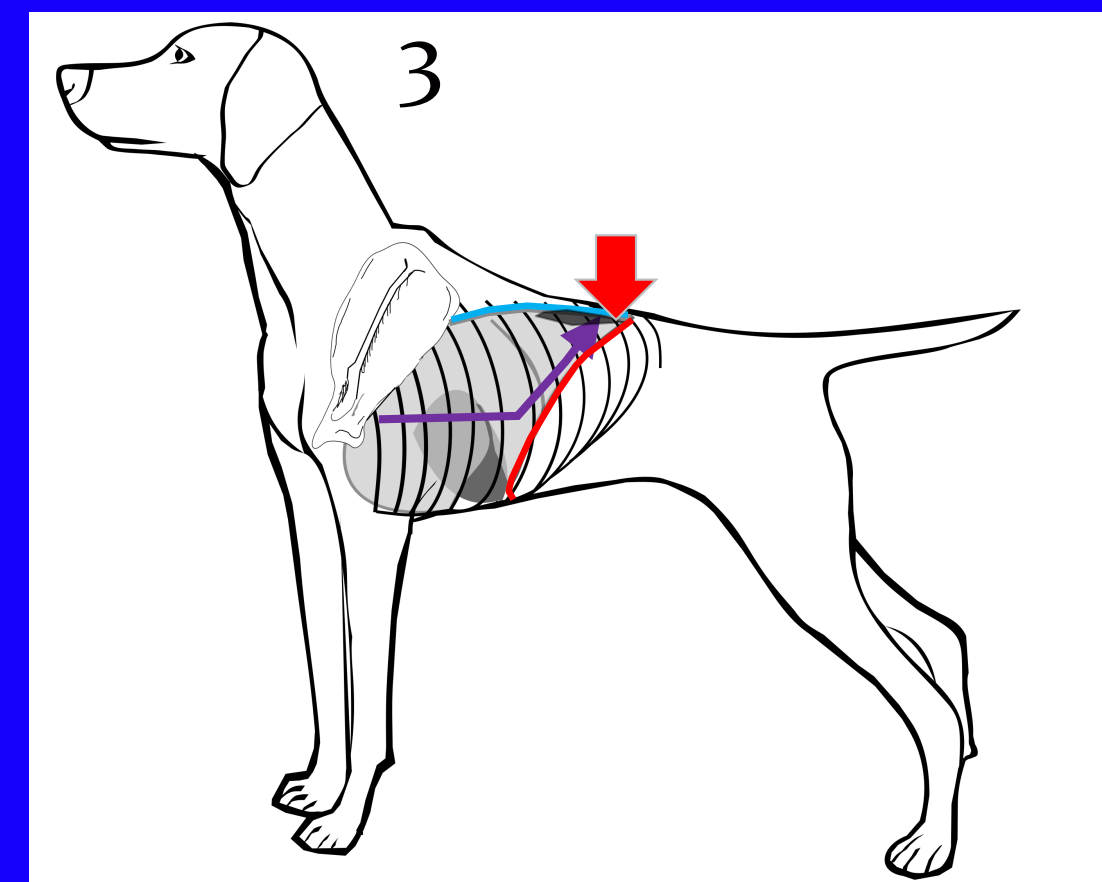
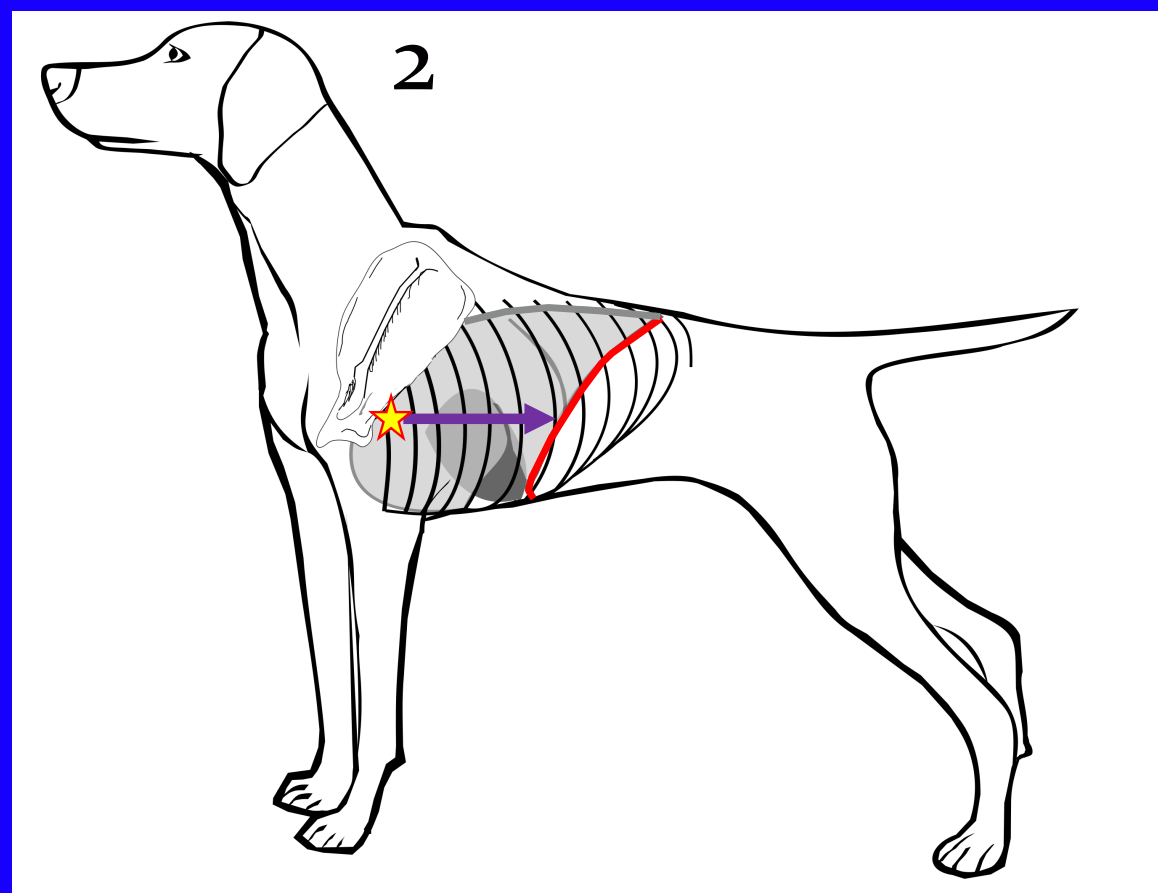
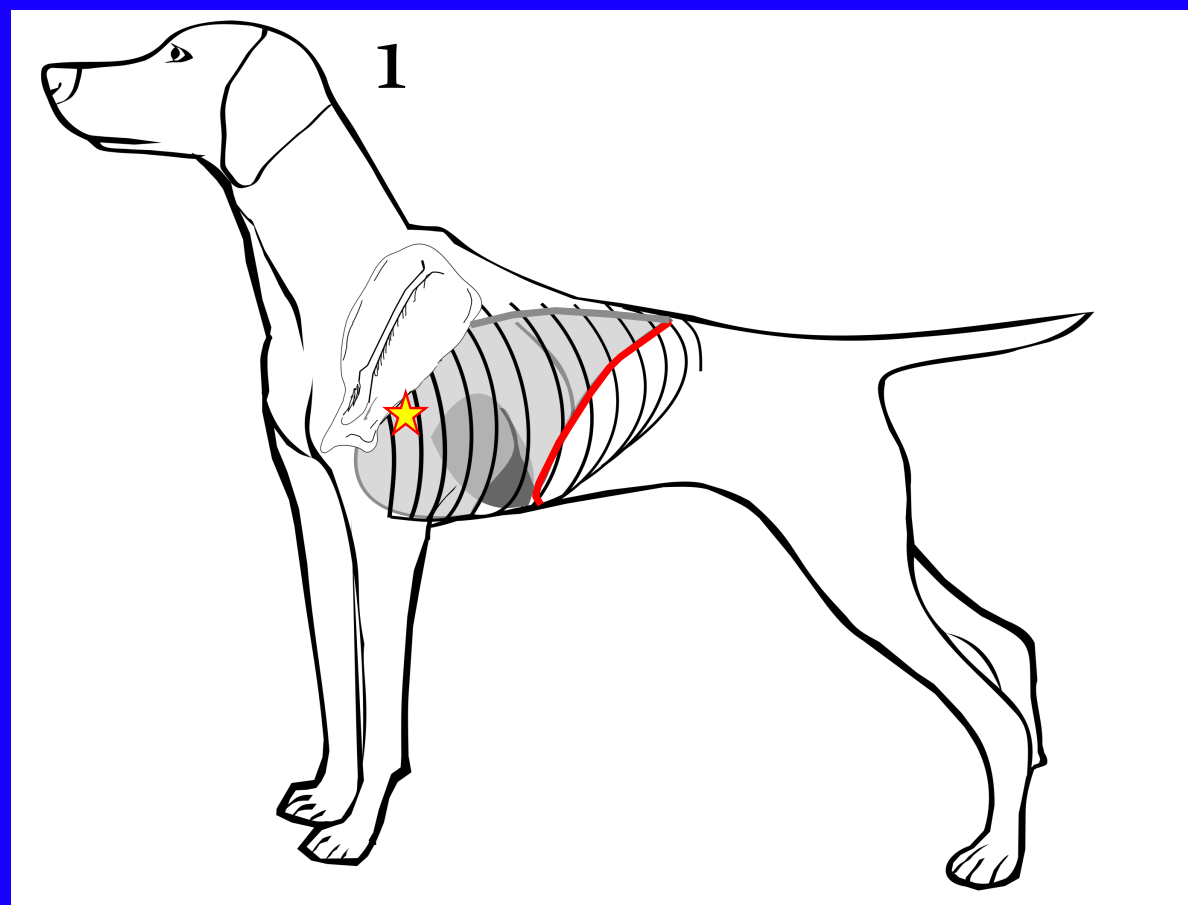


Step 3: Find the most caudo-dorsal border

Step 1: Start over lung
Step 2: Find the caudal border



Sweep dorsal along the curtain sign until the pleural line is lost in the sublumbar muscles



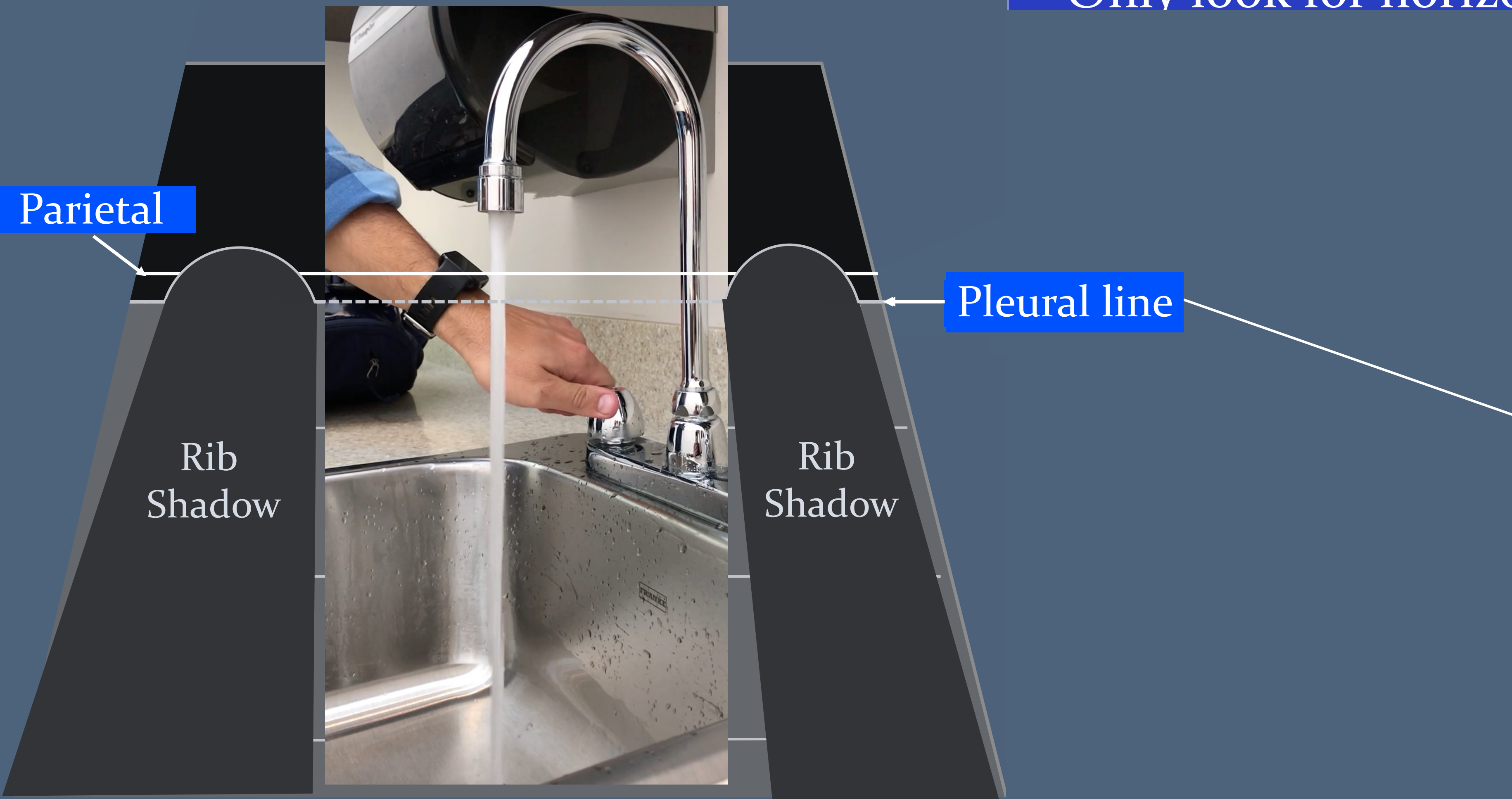
The bat sign, pleural line & lung sliding

Clarius, March 2021 Veterinary Point-of-Care Pleural Space and Lung Ultrasound (PLUS) for Everyday Practice!

Pleural line with lung sliding
(parietal and visceral pleura in contact)

Key points:

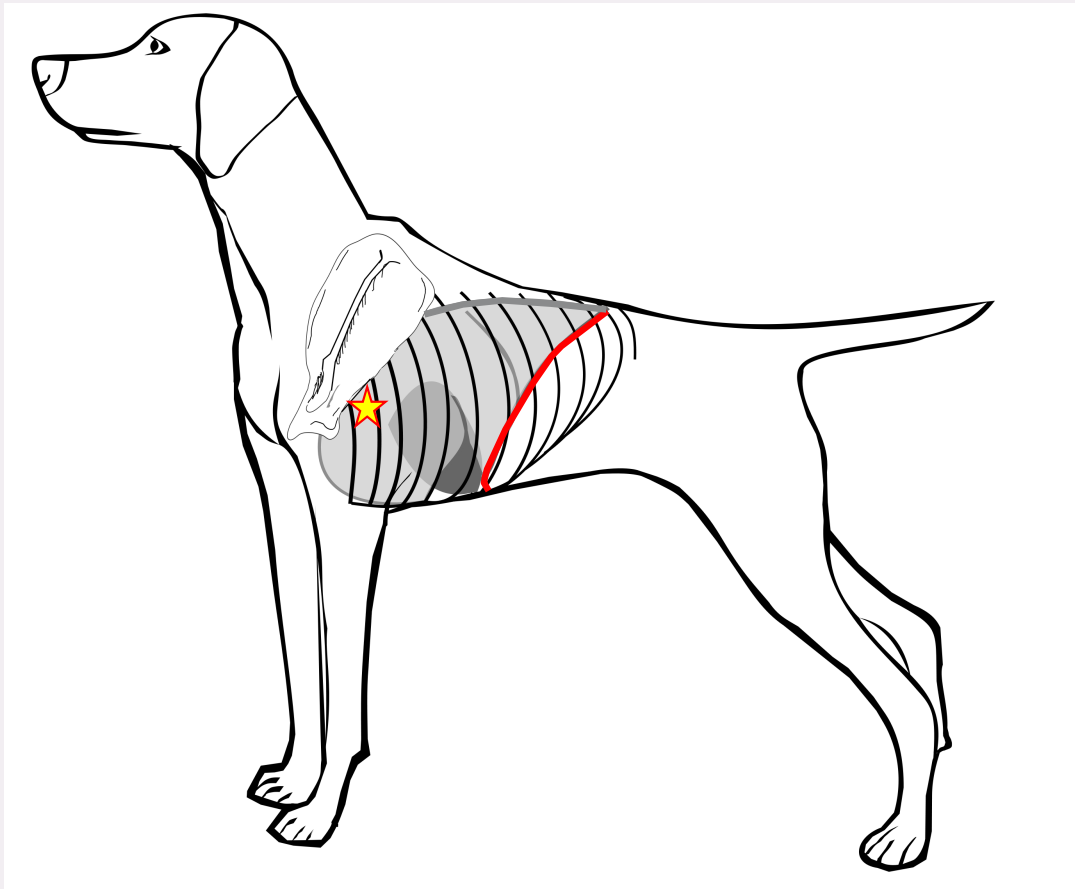
- Only look at the pleural line
- Only look for horizontal shimmering



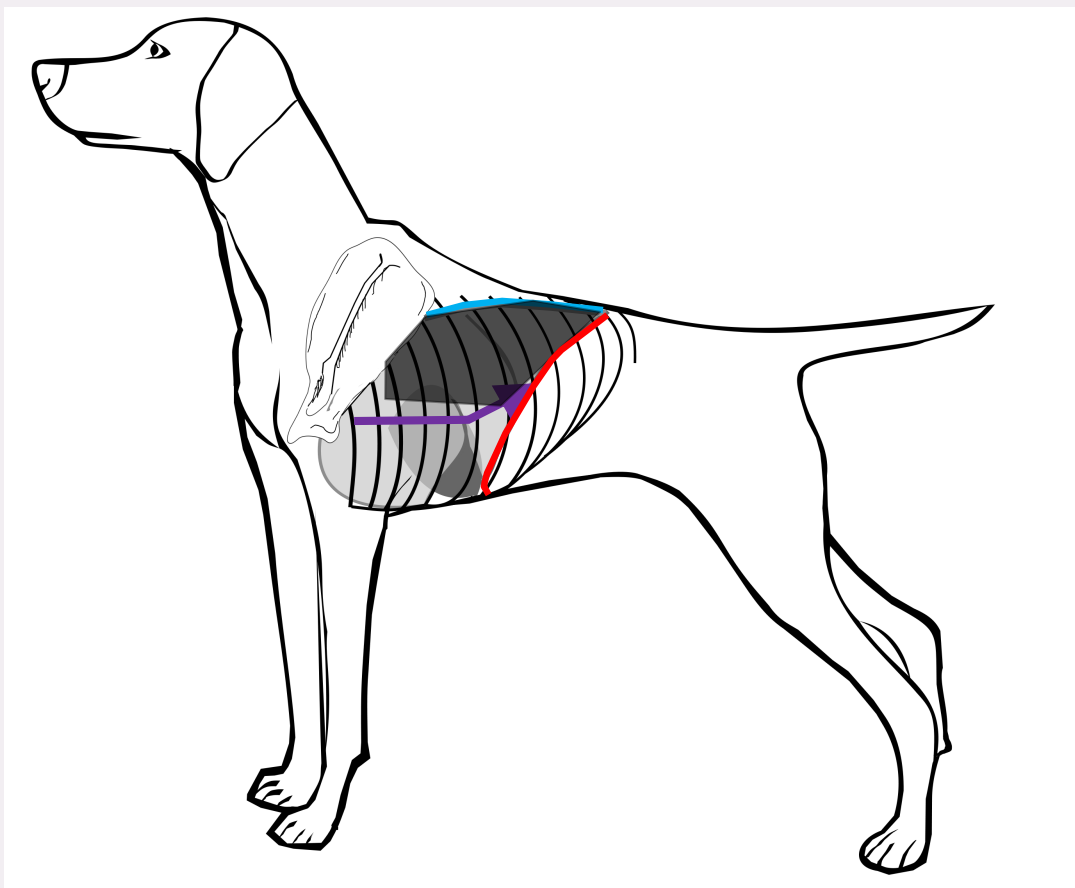
Kira



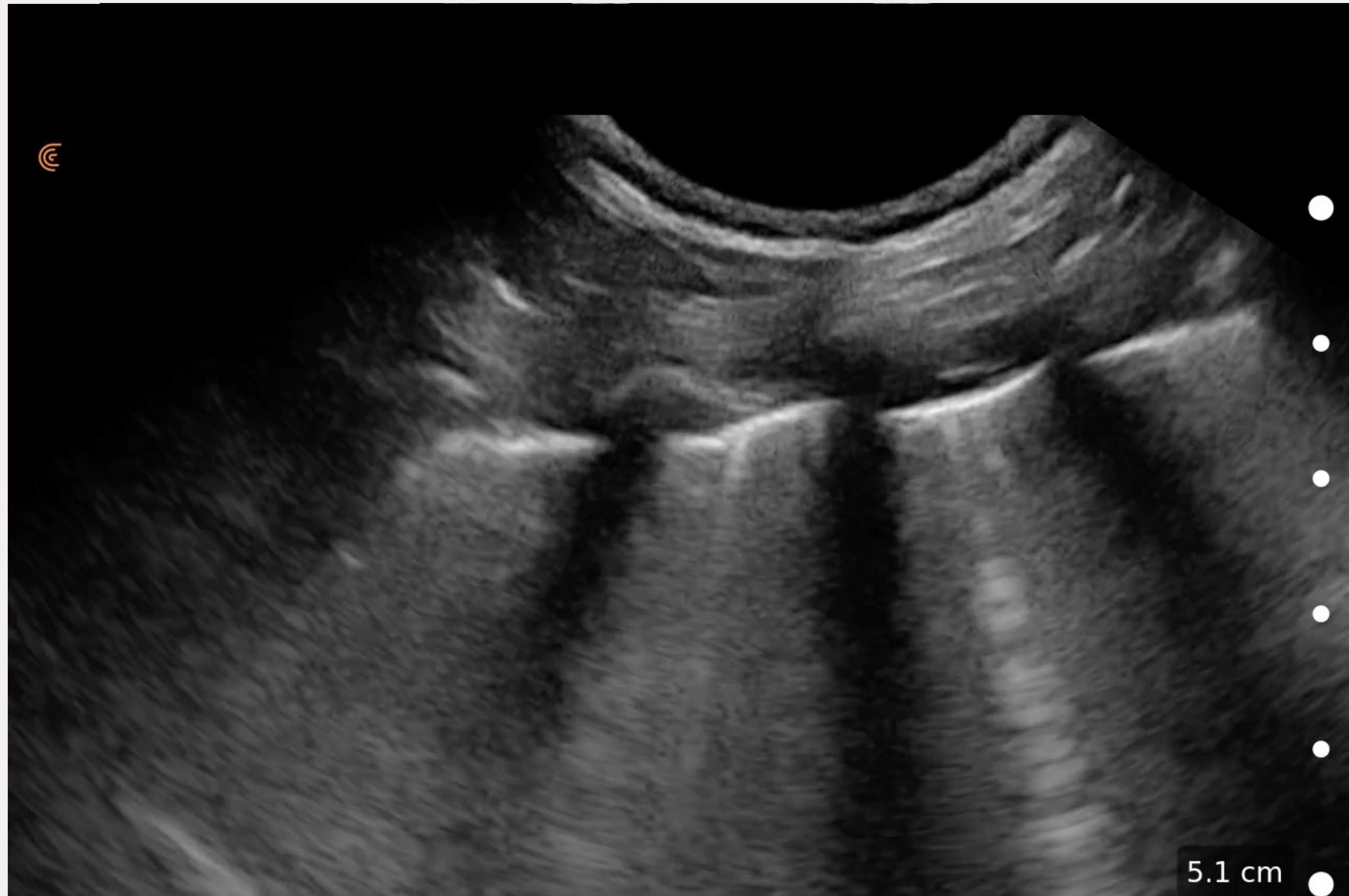
Lung sliding & B-lines present at starting point...



Double curtain sign present with loss of B-lines & lung sliding at the caudal border...



Assessment of the curtain sign?



Kira Treatment: Thoracocentesis



Dyspneic dog following blunt thoracic trauma

Pneumothorax %

Absent lung sliding, lung point, abnormal breath sounds

Pulmonary contusions 58%

Increased B lines
Possible lung consolidation

Hemothorax 18%

Pleural effusion

Rib fractures 14%

Physical exam/radiographs
Role for ultrasound?

Diaphragmatic hernia 6%

Abdominal organs, particularly the liver, cranial to the diaphragm

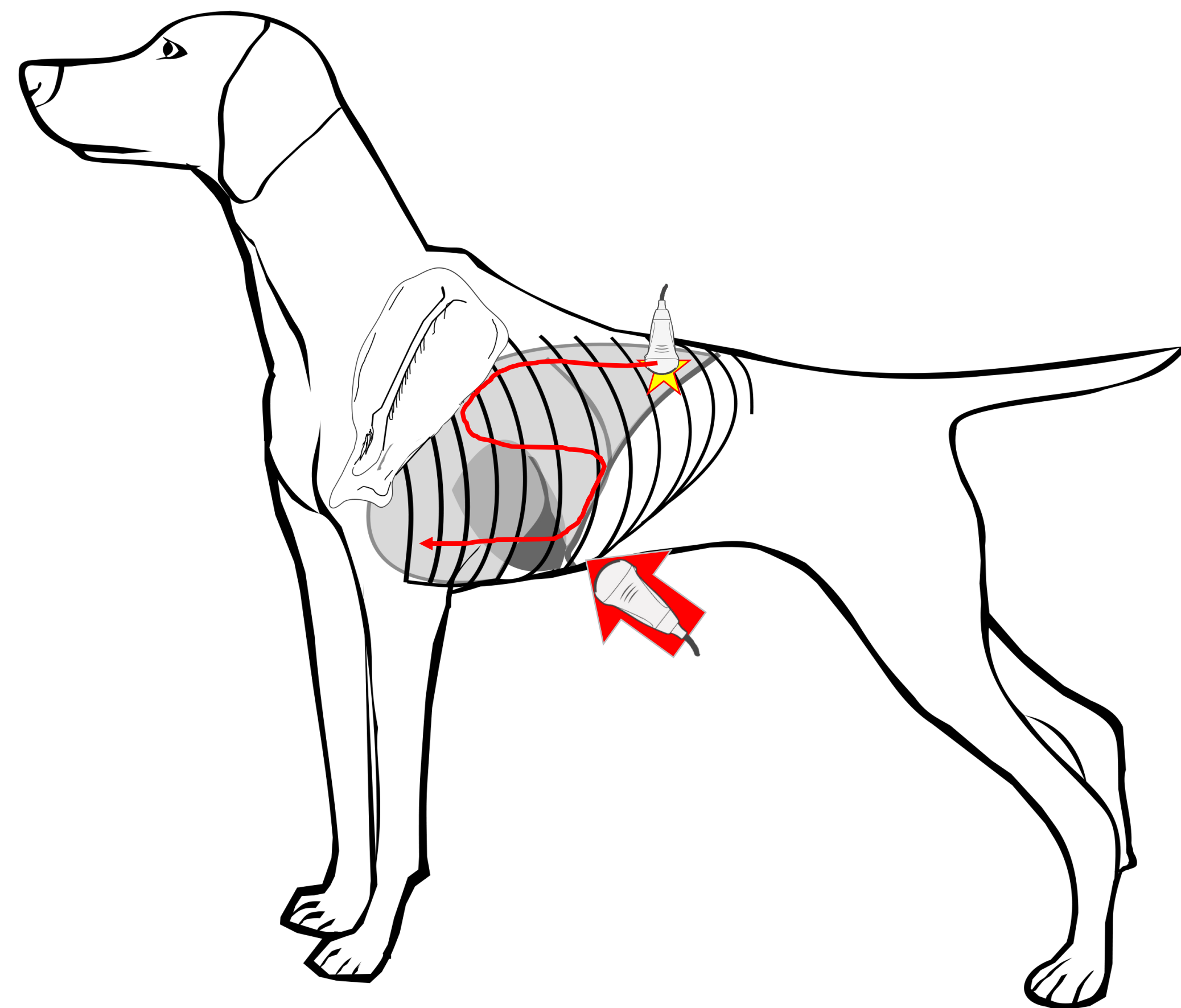
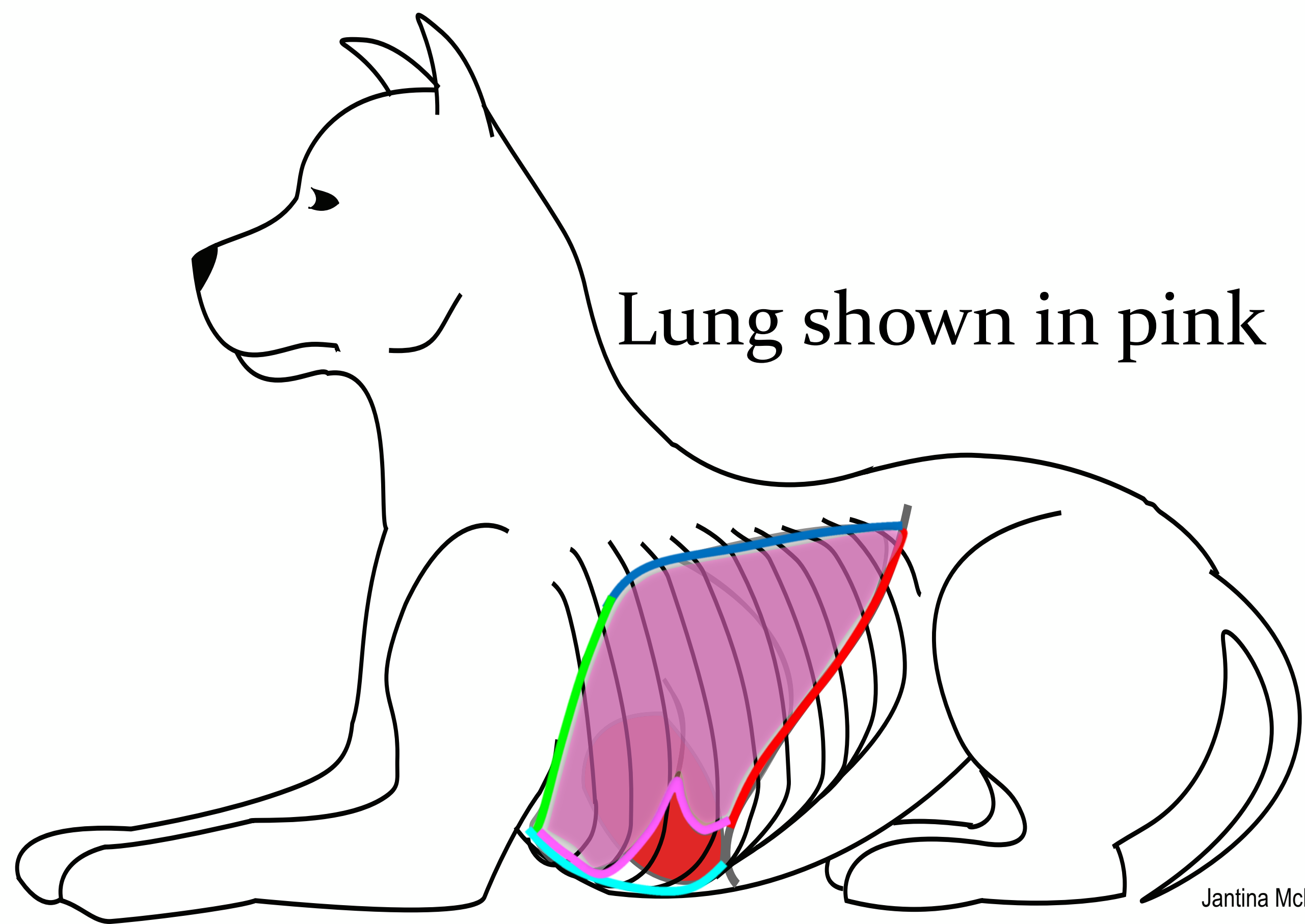
Flail chest: obvious on physical exam

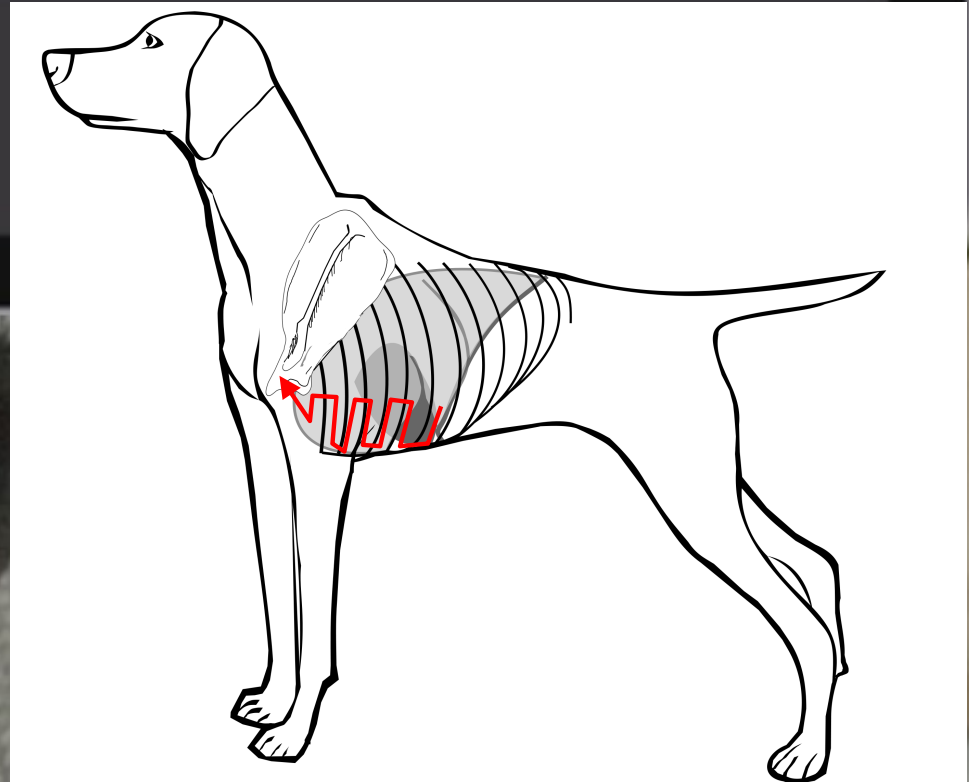
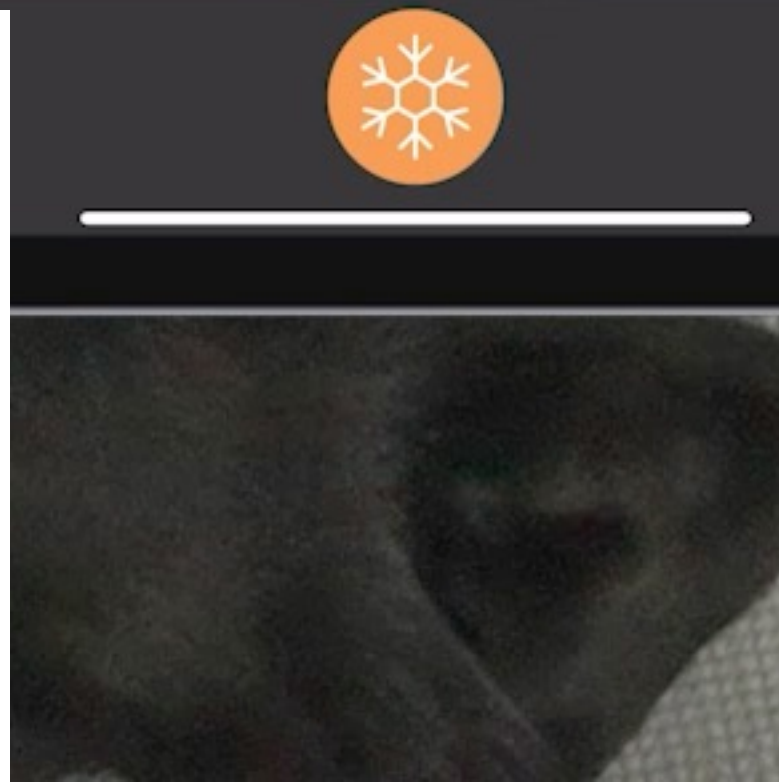
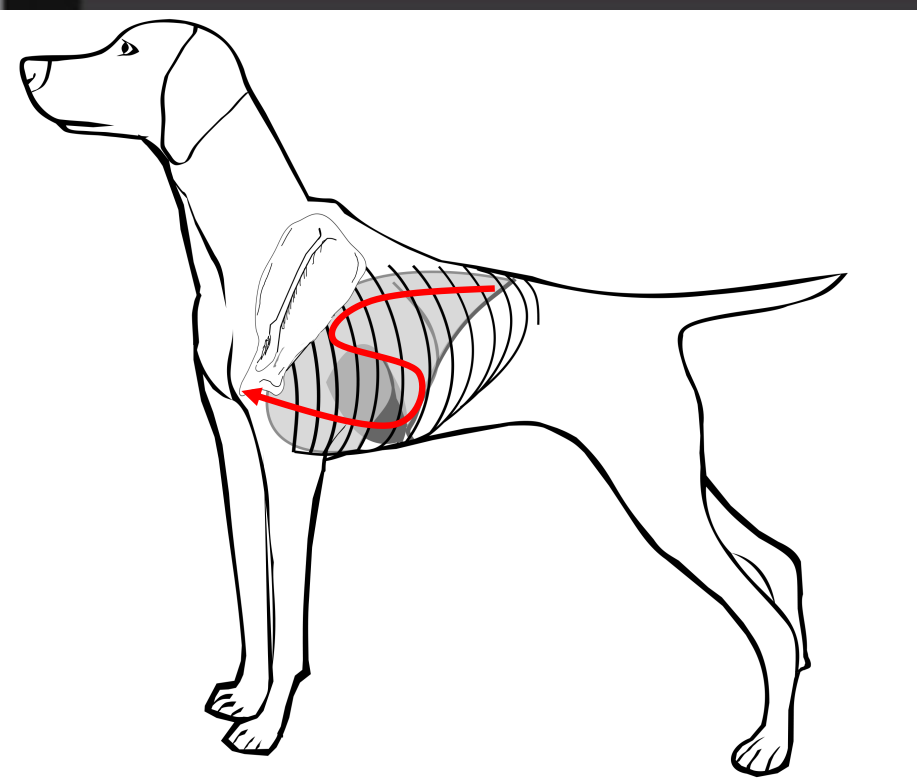
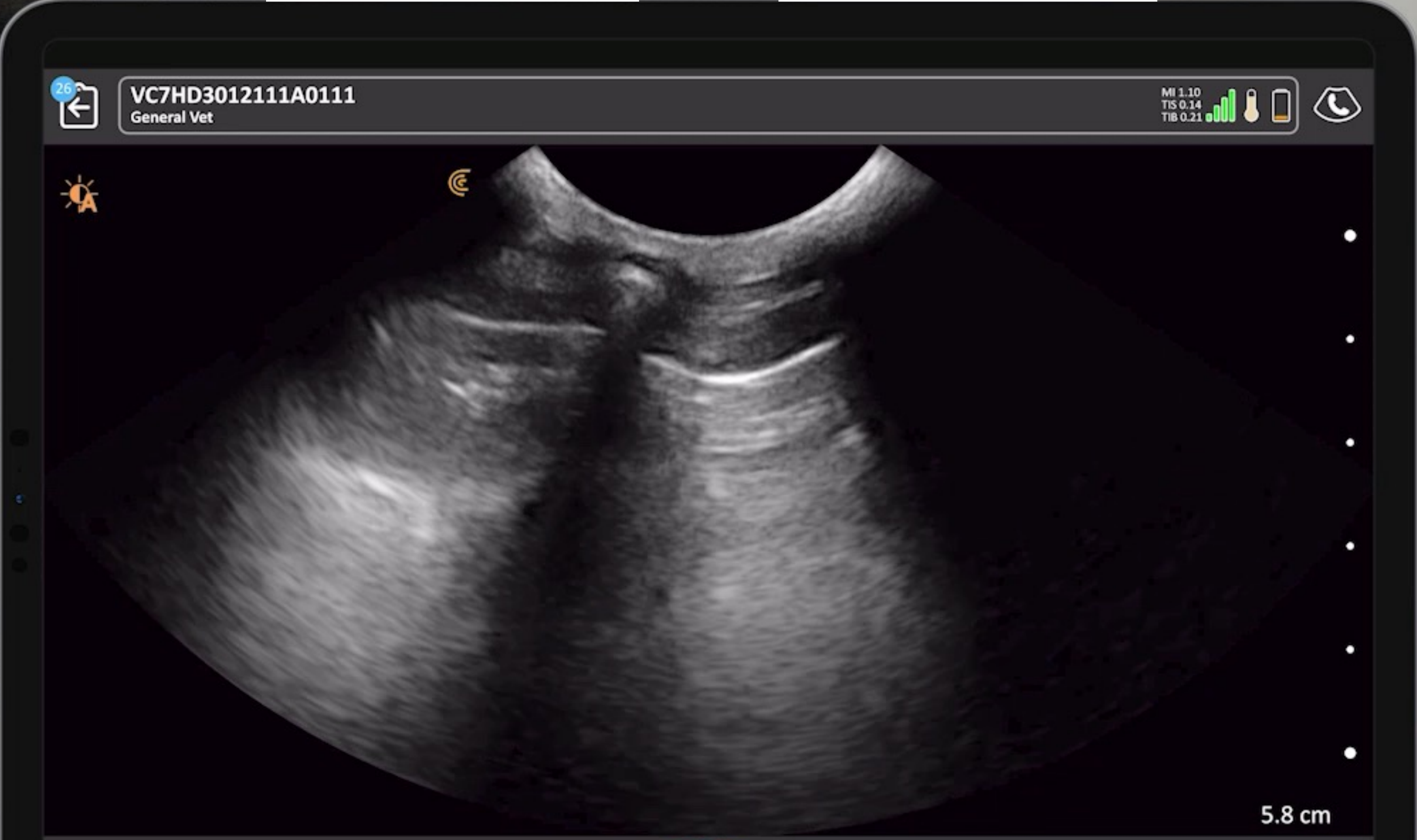
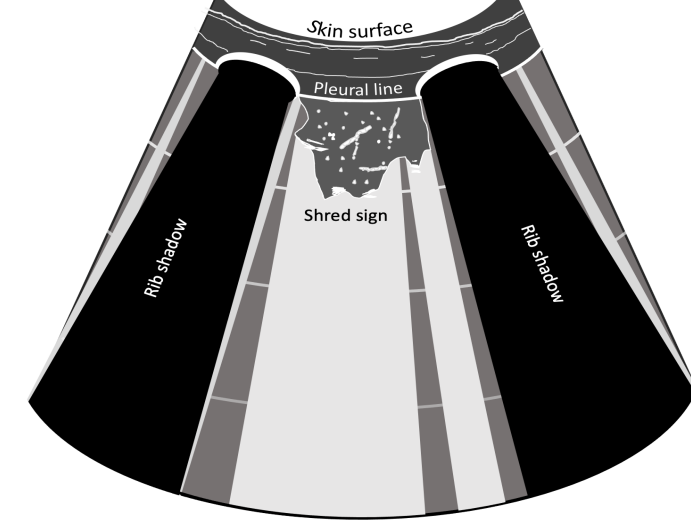
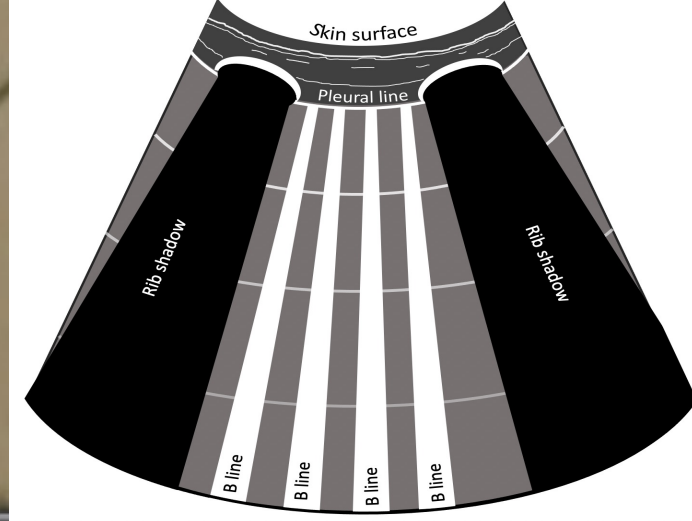
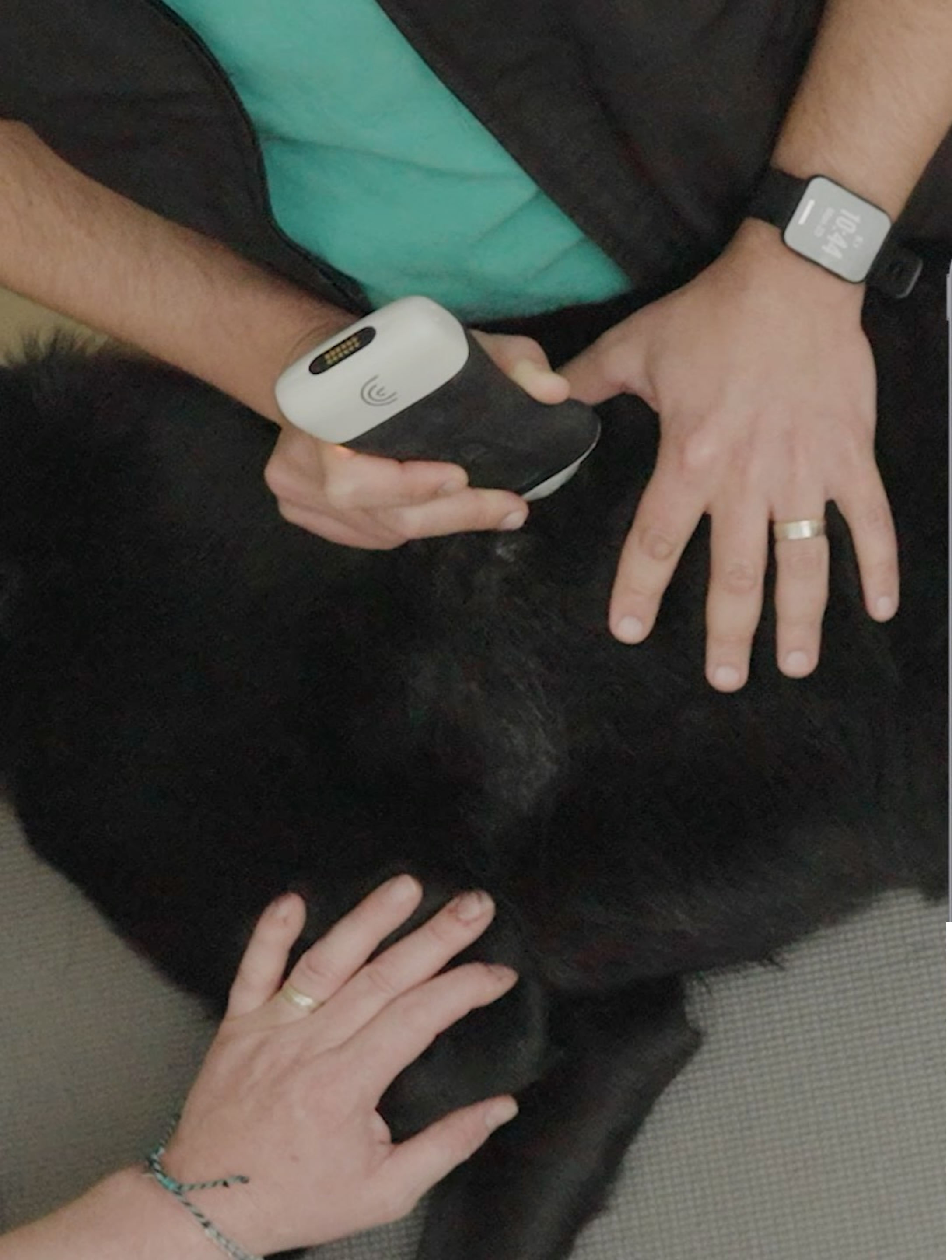


- 2 y.o male castrated Husky: Hit by car!
- HR: 158 bpm, RR 44 rpm, T 38.6 C (101.5 F)
- Increased effort
 - Decreased breath sounds right dorsal
 - Crackles left side

How to scan the lung (vs. the pleural space)

- Step 1: Start at the caudal dorsal site
- Step 2: Scan multiple lung regions (S shaped pattern)
- Step 3: Include the subxiphoid site







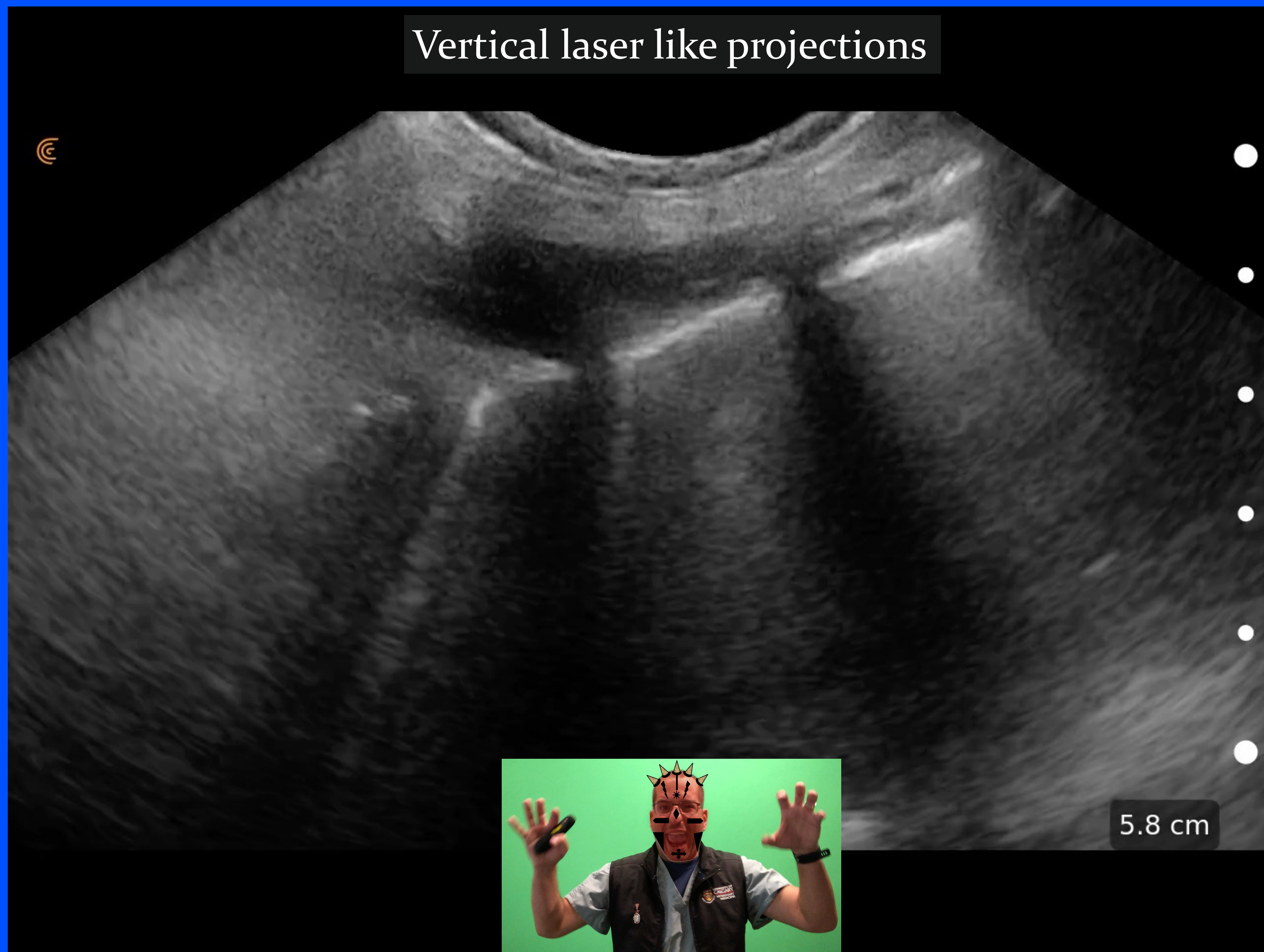
B-line criteria for identification



**STAY
ON
TARGET**

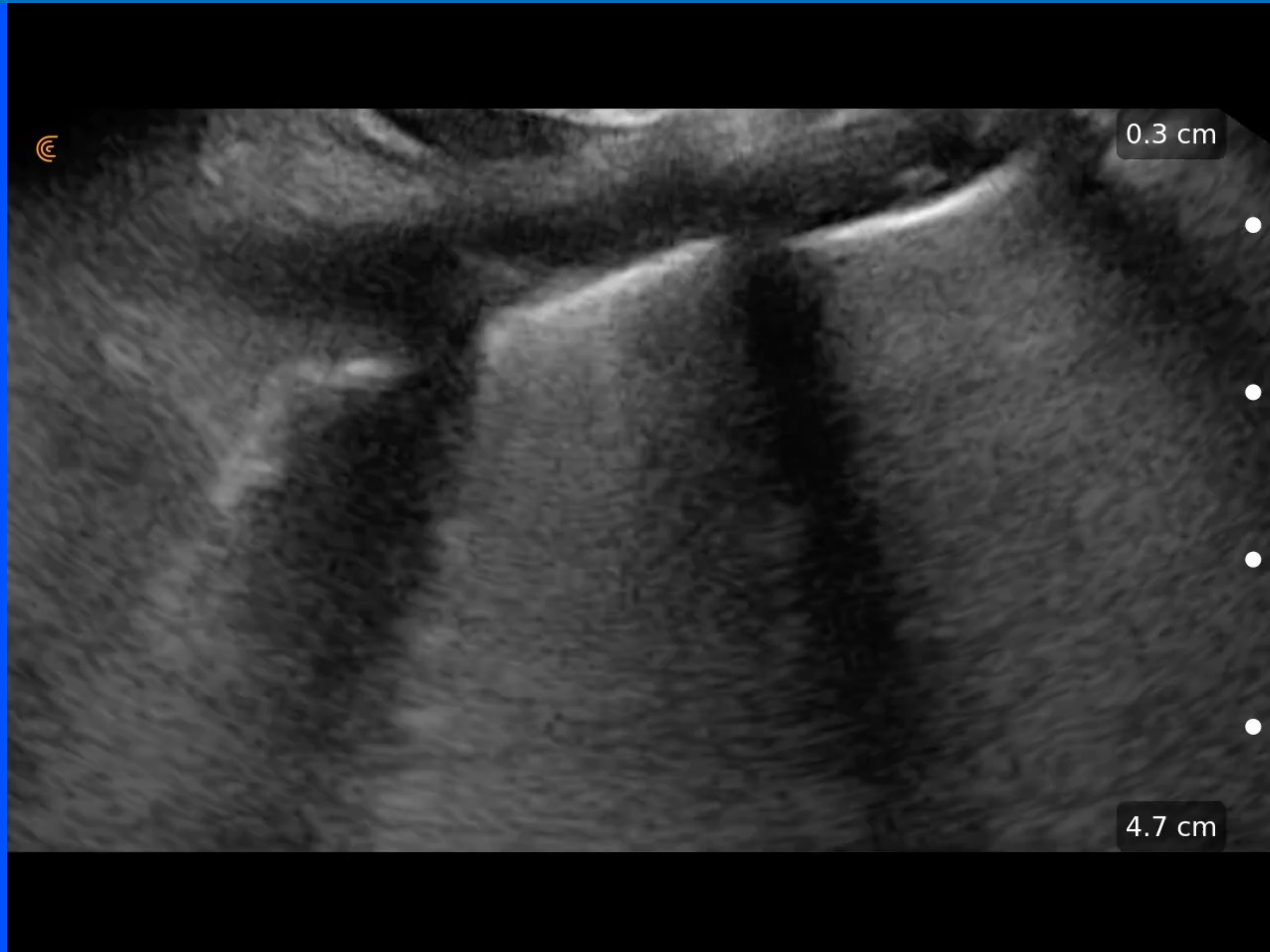
location!!!

Vertical laser like projections



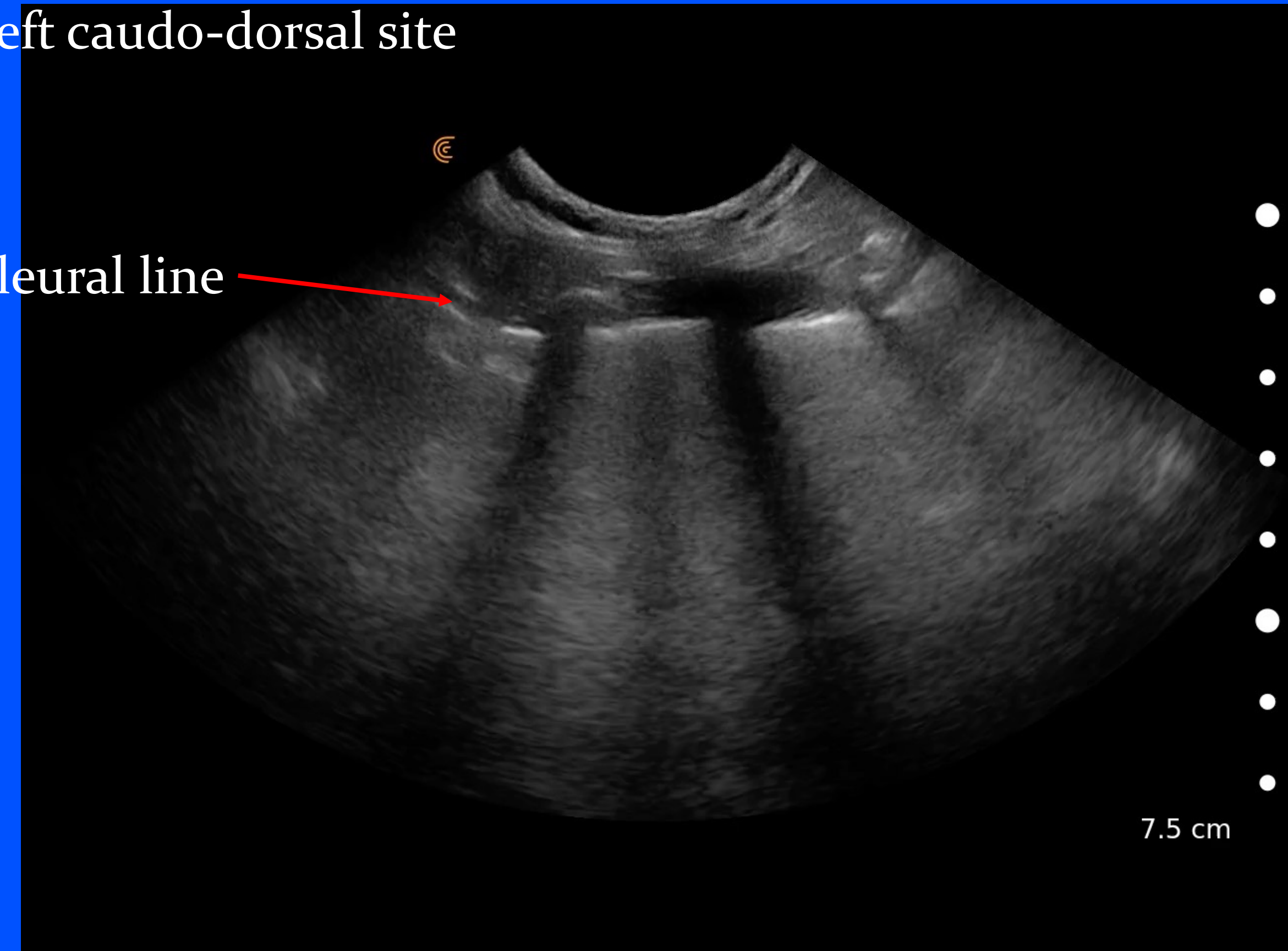
Kira lung ultrasound: Left hemithorax - crackles

Do you have lung sliding Y/N?
Do you have a pneumothorax Y/N?
Is the lung surface normal Y/N?

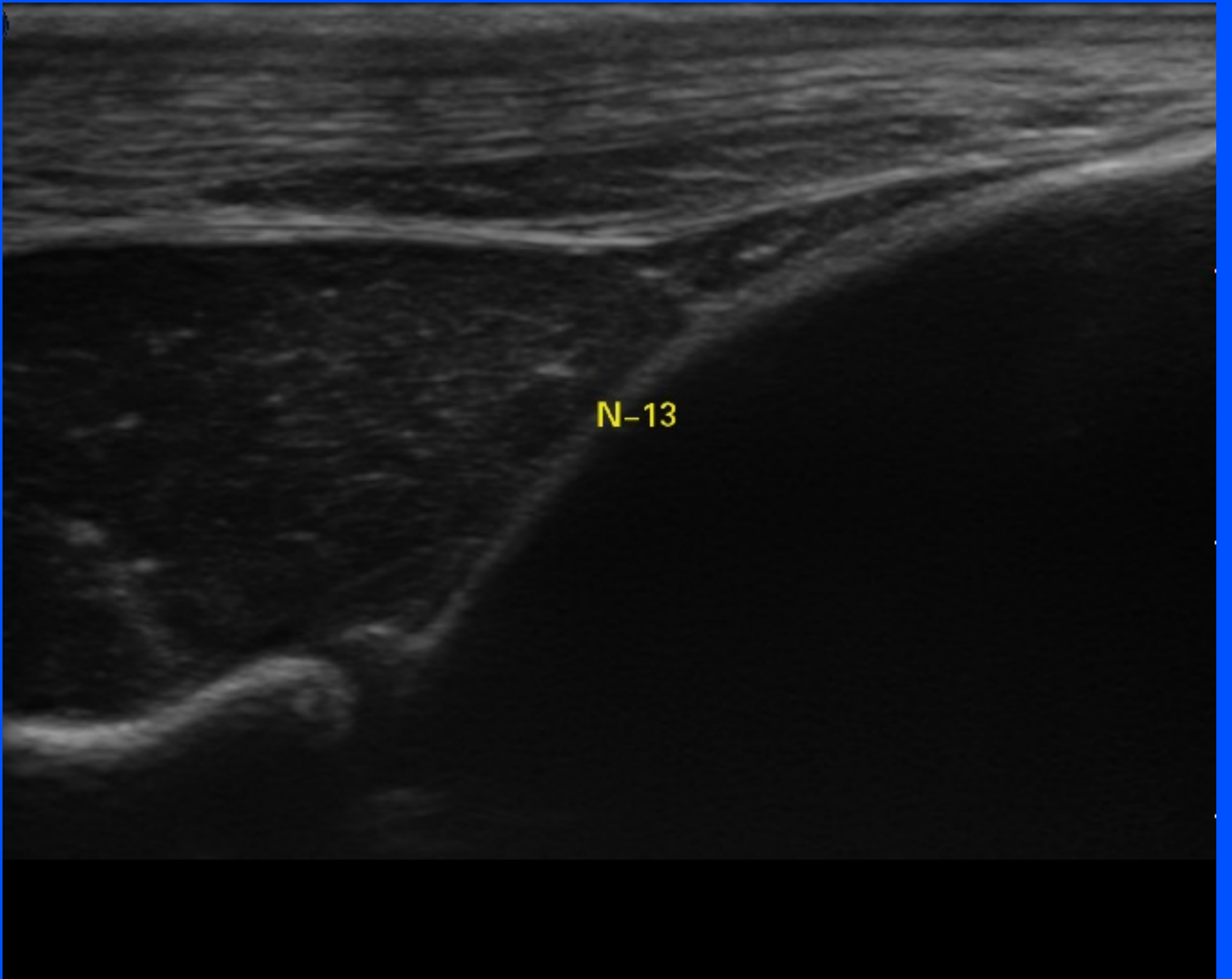


Left caudo-dorsal site

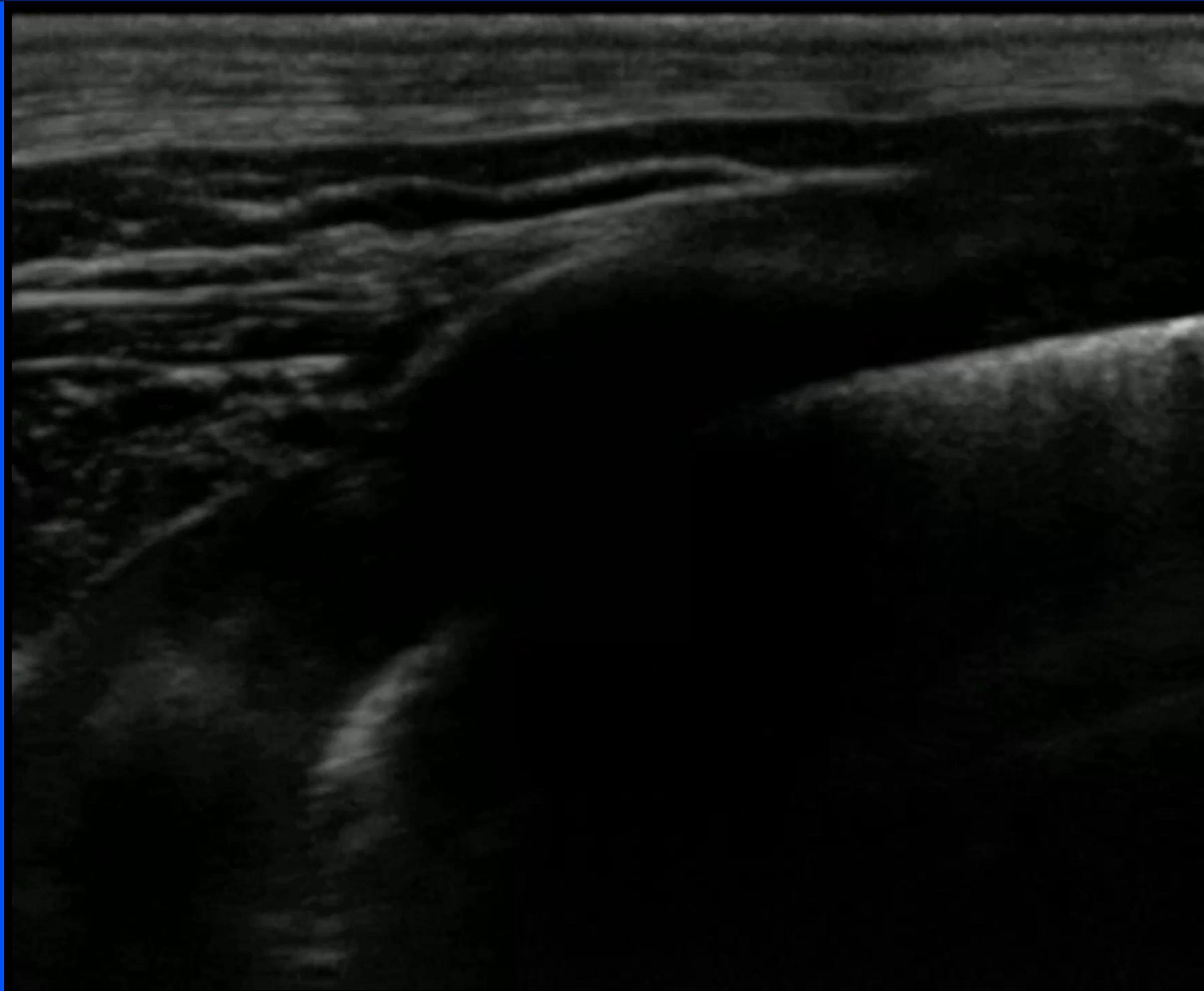
Pleural line



Kira Rib Fractures



Kira Rib Fractures



Overall sensitivity and specificity for rib fractures on ultrasound and radiographs were 83%, 99.74%, and 82%, 99.22% respectively, with no statistical difference between group comparisons

Summary of PLUS

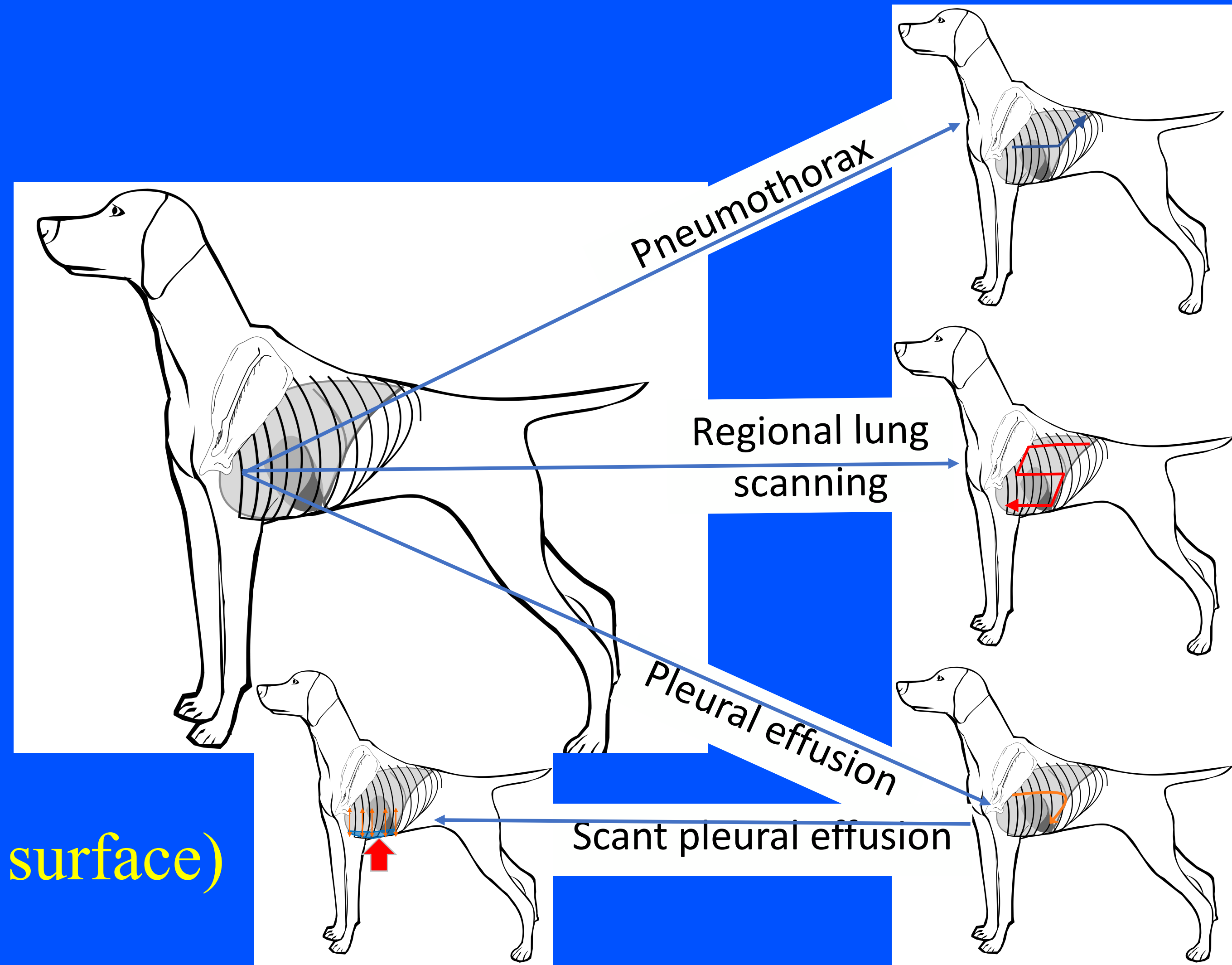
- Pleural space

1. Pleural effusion
2. Pneumothorax

- Rib fractures?

- Lung

3. Increased B-lines (vs. normal surface)
4. Consolidations



Kira

- 2 y.o. MN Husky: Hit by car!
- Pulmonary contusions and rib fractures
 - Analgesia, oxygen, supportive care (do not give steroids or antibiotics!)
- Pneumothorax
 - Thoracocentesis x 3
- Discharged to owner

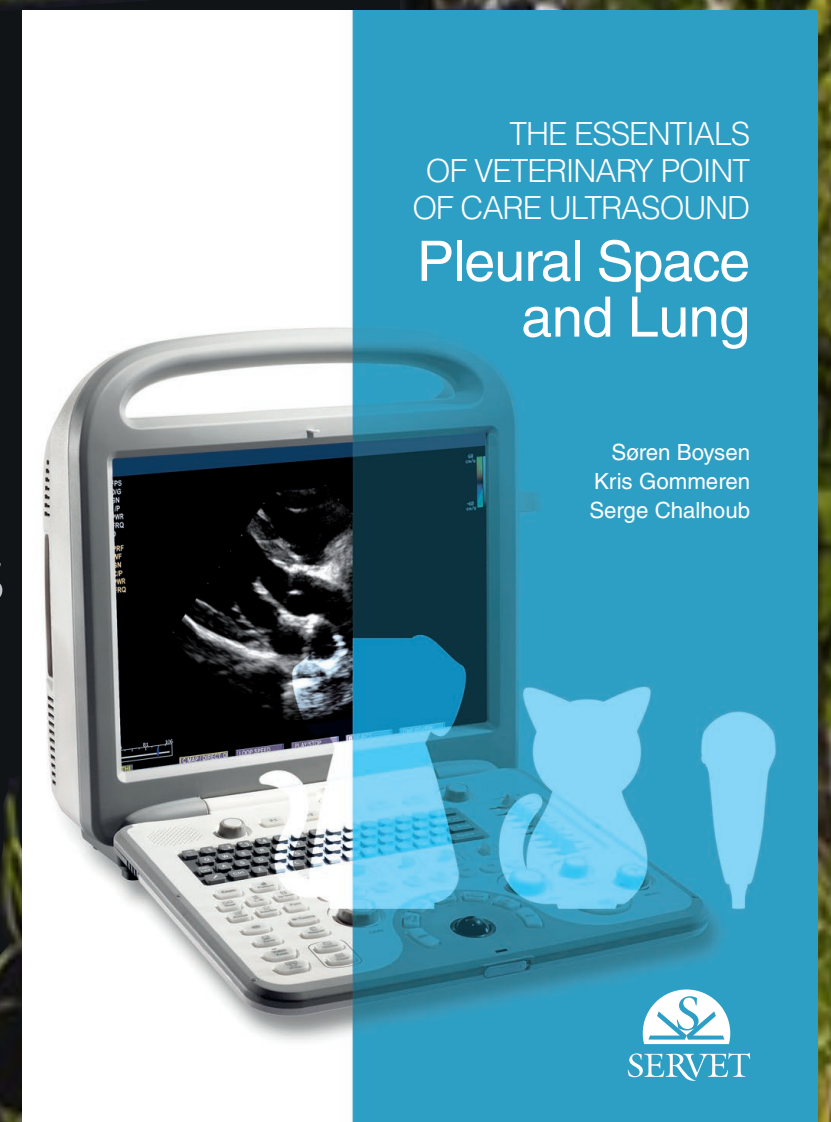




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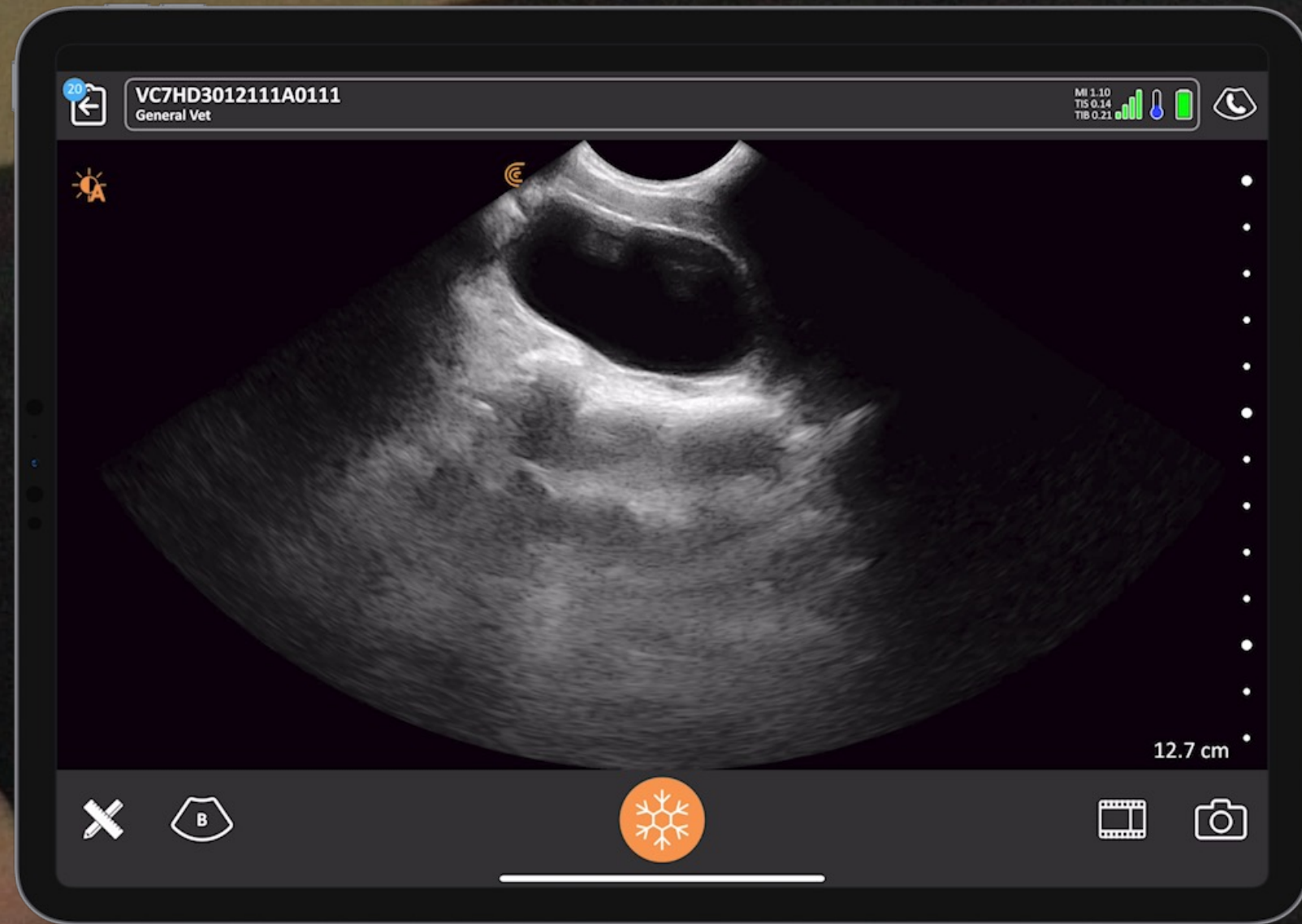


Live Demonstration



Shelley Guenther, CRGS, CRCS

Sonographer | Clinical Marketing Manager



What additional information would you like?

Interactive Poll

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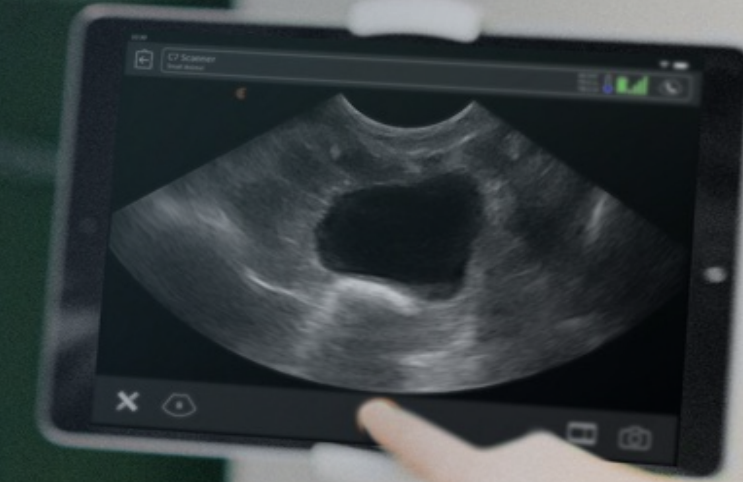

C7 Vet HD3
Small Animals




L7 Vet HD3
MSK/Ocular



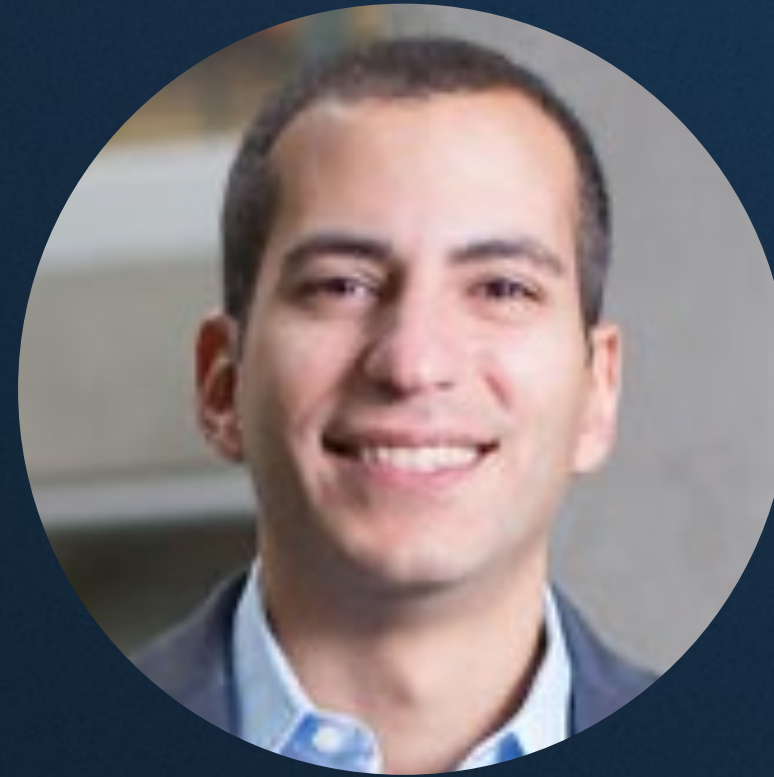

C3 Vet HD3
Large Animals



Questions



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Dr. Serge Chalhoub
Veterinary Internal Medicine,
University of Calgary



Dr. Oron Frenkel
Emergency Physician



Thank you!