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# WEBINAR

# Veterinary POCUS: Diagnosing Canine Pericardial Effusion in Seconds

February 2023

# Your Host

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

Emergency Physician & POCUS Educator
Chairman, Clarius Medical Advisory Board

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# Evaluation of a training course in focused echocardiography for non-cardiology house officers

> “Posttraining, most participants correctly identified pleural effusion (90%) and pericardial effusion (95%) and discriminated normal atrial size from atrial enlargement (86%) .”

Tse YC, Rush JE, Cunningham SM, Bulmer BJ, Freeman LM, Rozanski EA. Evaluation of a training course in focused echocardiography for noncardiology house officers. J Vet Emerg Crit Care (San Antonio). 2013 May-Jun;23(3):268-73. doi: 10.1111/vec.12056. Epub 2013 May 6. PMID: 23647602.

J Vet Emerg Crit Care (San Antonio). 2013 May-Jun;23(3):268-73. doi: 10.1111/vec.12056. Epub 2013 May 6.

## Evaluation of a training course in focused echocardiography for noncardiology house officers

Yuki C Tse [1], John E Rush, Suzanne M Cunningham, Barret J Bulmer, Lisa M Freeman, Elizabeth A Rozanski

Affiliations + expand

PMID: 23647602 DOI: 10.1111/vec.12056

### Abstract

**Objective:** To determine whether a training course in focused echocardiography can improve the proficiency of noncardiology house officers in accurately interpreting cardiovascular disease and echocardiography findings in dogs entering the emergency room setting.

**Design:** Prospective, blinded, educational study.

**Setting:** University veterinary teaching hospital.

**Study subjects:** House officers underwent training in focused echocardiography. Fifteen dogs, including normal dogs and dogs with stable congenital or acquired cardiac disease, were used as study subjects during the laboratory session.

**Interventions:** A 6-hour curriculum on focused echocardiography was developed that included didactic lectures, clinical cases, and hands-on echocardiography.

**Measurements and main results:** Pre- and postcourse written examinations were administered to participants. House officers attended didactic lectures that were subsequently followed by a hands-on laboratory session and practical examination, which involved performing transthoracic echocardiography on dogs with and without cardiovascular disease. Twenty-one house officers completed the focused echocardiography training course. Written examination scores were 57 ± 12% before and 75 ± 10% after training ($P < 0.001$). Following the course, 97% of participants in the practical examination were able to obtain the correct right parasternal short- or long-axis view. Posttraining, most participants correctly identified pleural effusion (90%) and pericardial effusion (95%) and discriminated normal atrial size from atrial enlargement (86%). However, successful identification of a cardiac mass, volume status, and ability to recognize a poor quality study as nondiagnostic remained relatively low. Most trainees responded that the length of hands-on laboratory training was too abbreviated and that the course should be > 6 hours.

**Conclusion:** A focused echocardiography training course improved knowledge and yielded acceptable proficiency in some echocardiographic findings commonly identified in the emergency room. This training course was not able to provide the skills needed for house officers to accurately

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# Echocardiographic and clinicopathologic characterization of pericardial effusion in dogs: 107 cases

> “Echocardiography had a high sensitivity and specificity for diagnosis and differentiation of RA and HB masses in dogs with pericardial effusion.”

MacDonald KA, Cagney O, Magne ML. Echocardiographic and clinicopathologic characterization of pericardial effusion in dogs: 107 cases (1985–2006). J Am Vet Med Assoc. 2009 Dec 15;235(12):1456–61. doi: 10.2460/javma.235.12.1456. PMID: 20001781.

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J Am Vet Med Assoc. 2009 Dec 15;235(12):1456-61. doi: 10.2460/javma.235.12.1456.

## Echocardiographic and clinicopathologic characterization of pericardial effusion in dogs: 107 cases (1985-2006)

Kristin A MacDonald [1], Orla Cagney, Michael L Magne

Affiliations + expand

PMID: 20001781 DOI: 10.2460/javma.235.12.1456

### Abstract

**Objective:** To evaluate sensitivity and specificity of echocardiography for diagnosis of cardiac masses in dogs with pericardial effusion.

**Design:** Retrospective case series.

**Animals:** 107 dogs with pericardial effusion.

**Procedures:** Records of dogs with pericardial effusion examined at the University of California-Davis Veterinary Medical Teaching Hospital from 1985 to 2006 were reviewed. Dogs were included when echocardiography and pericardectomy or necropsy were performed. Sensitivity, specificity, and metastatic rates were calculated for various causes of pericardial effusion.

**Results:** 107 dogs with pericardial effusion were evaluated by surgery (n = 48 dogs), necropsy (44), or both (15). Echocardiography revealed no mass (n = 41 dogs), a right atrial (RA) mass (38), a heart base (HB) mass (23), a pericardial mass (2), an HB and an RA mass (2), and a right ventricular mass (1). Sensitivity and specificity were 82% and 100%, respectively, for detection of a cardiac mass; 82% and 99%, respectively, for detection of an RA mass; and 74% and 98%, respectively, for detection of an HB mass. Most HB masses were neuroendocrine or ectopic thyroid gland tissue, but 3 were hemangiosarcomas and 4 were mesotheliomas. Most RA masses were hemangiosarcomas, but this group also included a neuroendocrine tumor, ectopic thyroid gland tissue, mesothelioma, lymphosarcoma, and sarcoma. Metastatic rates did not differ (50% to 66%) among neoplastic causes.

**Conclusions and clinical relevance:** Echocardiography had high sensitivity and specificity for diagnosis and differentiation of RA or HB masses in dogs with pericardial effusion. There was a high rate of metastasis for cardiac masses of all causes.

### Similar articles

Cardiac MRI findings in a dog with a diffuse pericardial mesothelioma and pericardial effusion.

Gallach RG, Mai W.

J Am Anim Hosp Assoc. 2013 Nov-Dec;49(6):398-402. doi: 10.5326/JAAHA-MS-5925. Epub 2013 Sep 19.

# The use of the diaphragmatico-hepatic (DH) views of the abdominal and thoracic focused assessment with sonography for triage (AFAST/TFAST) examinations

> “The DH view of FAST was found to be clinically helpful for the detection of PE.”

Bitar ZI, Shamsah M, Bamasood OM, Maadarani OS, Alfoudri H. Point-of-Care Ultrasound for COVID-19 Pneumonia Patients in the ICU. J Cardiovasc Imaging. 2021 Jan;29(1):60-68. doi: 10.4250/jcvi.2020.0138. PMID: 33511802; PMCID: PMC7847790.

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J Vet Emerg Crit Care (San Antonio). 2016 Jan-Feb;26(1):125-31. doi: 10.1111/vec.12374. Epub 2015 Oct 1.

## The use of the diaphragmatico-hepatic (DH) views of the abdominal and thoracic focused assessment with sonography for triage (AFAST/TFAST) examinations for the detection of pericardial effusion in 24 dogs (2011-2012)

Gregory R Lisciandro [1]

Affiliations + expand

PMID: 26426980 DOI: 10.1111/vec.12374

### Abstract

**Objective:** To evaluate the clinical usefulness of the diaphragmatico-hepatic (DH) view of the abdominal and thoracic focused assessment with sonography for triage (AFAST/TFAST) in detecting pericardial effusion (PE) in dogs.

**Design:** Retrospective case series from 2011 to 2012.

**Setting:** Private practice emergency and critical care hospital.

**Animals:** Twenty-four dogs with PE diagnosed by FAST.

**Interventions:** None.

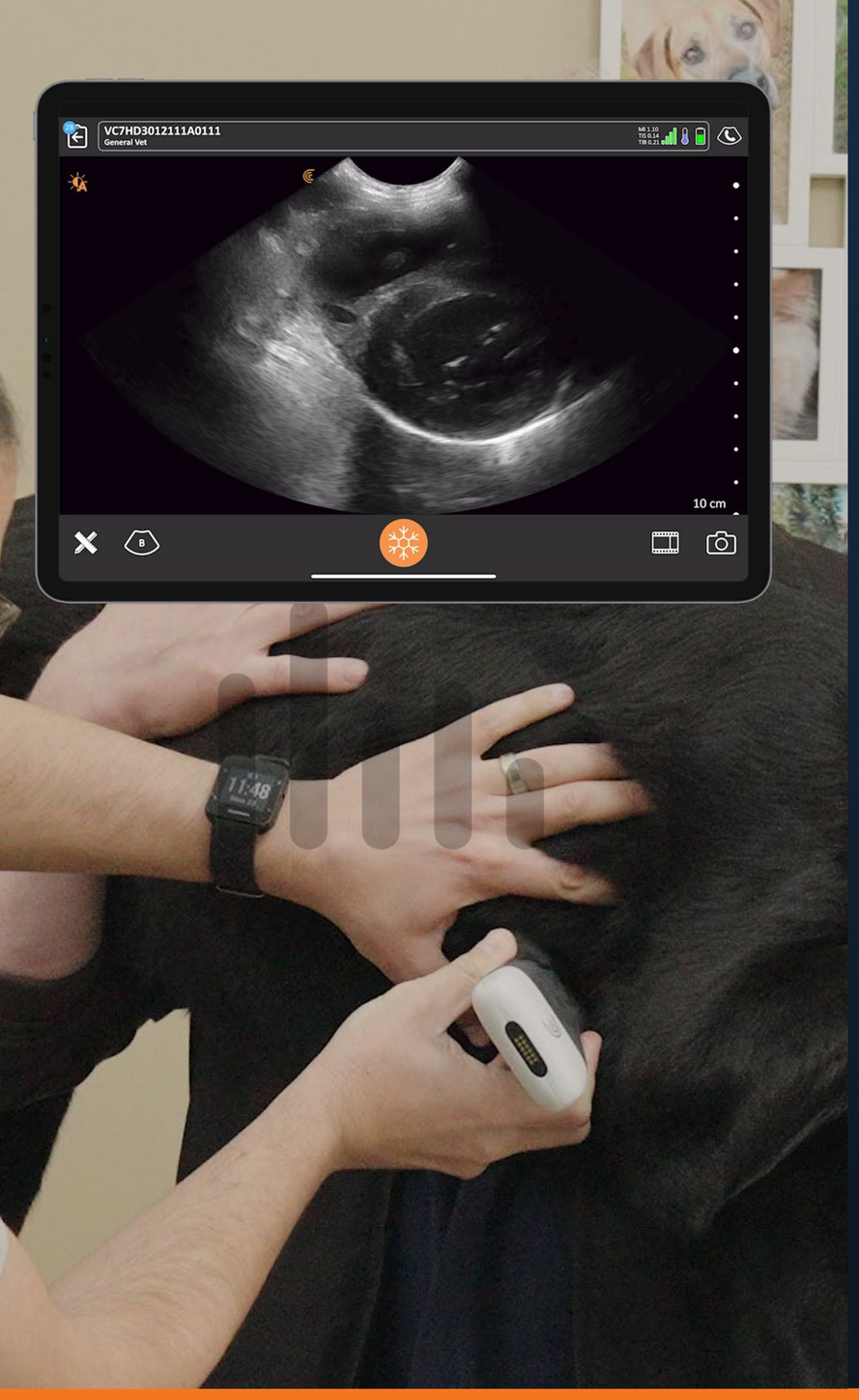
**Measurement and main results:** Fifty-two medical records from October 1, 2011 through September 30, 2012 had the terms "PE" within the medical record. Twenty-four dogs were diagnosed with PE by FAST with entries for the DH view. Of the 24 dogs, 7 had abdominal FAST, 6 had thoracic FAST (TFAST), and 11 had both exams performed. PE was noted on the DH view in 20 of 24 (83%) cases. Subjective PE volume assessment ranged from trivial (<5 mm) to severe. Of the 4 cases in which PE was absent via the DH view, PE was seen during the same exam at the TFAST pericardial views (n = 2) or detected on serial exam at the DH view (n = 2). The PE volume that was missed via the DH view was characterized as trivial (<5 mm; n = 1), mild (n = 1), and moderate (n = 2).

**Conclusions:** The DH view of FAST was found to be clinically helpful for the detection of PE. Veterinarians should make it routine practice and part of FAST training to look into the thorax via the DH view during both abdominal FAST and TFAST exams.

**Keywords:** AFAST; FAST; TFAST; cardiac tamponade; diagnostic imaging.

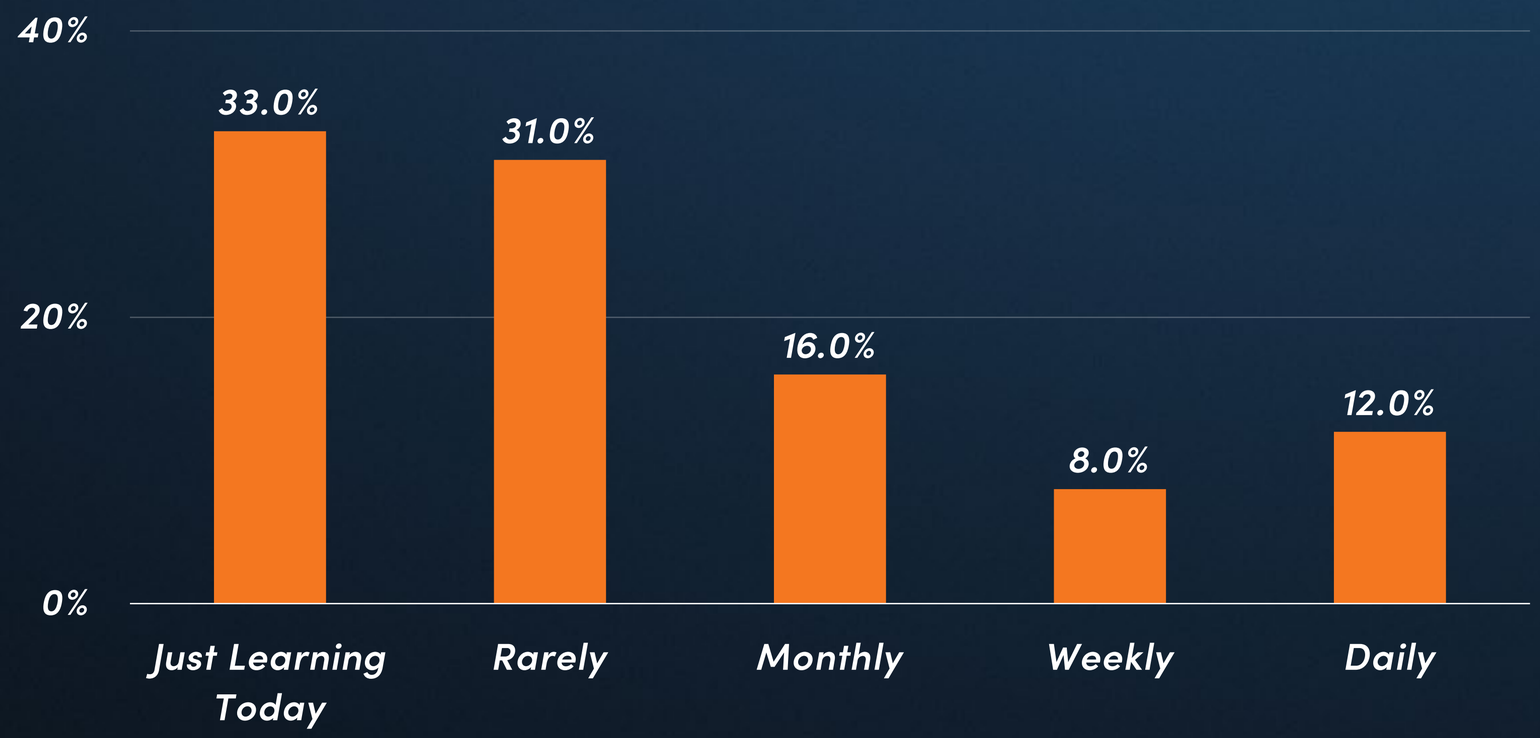


Similar articles




Interactive Poll

# How frequently do you use ultrasound to diagnose pericardial effusions?



# Your Host

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

Professor, Veterinary Clinical & Diagnostic Sciences, University of Calgary

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

Senior Instructor, Veterinary Clinical & Diagnostic Sciences, University of Calgary

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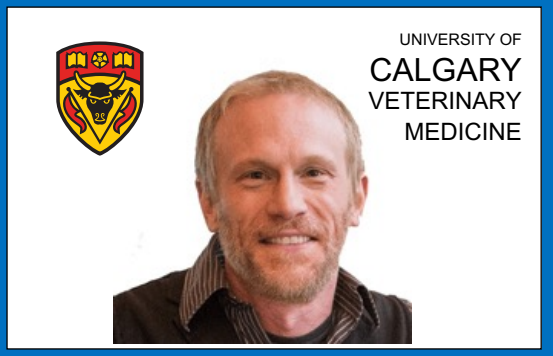
# Veterinary POCUS: Diagnosing Canine Pericardial Effusion in Seconds

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In relation to this presentation, we teach and lecture on POCUS at the University of Calgary and receive conference honorariums, but otherwise declare no conflicts of interest

# Shira: Initial history and triage…

- 10-year-old female Labrador Retriever
- Vomited 24 hours ago
- Lethargic and not eating past 24 hours
- Suddenly collapsed while in the back yard 20 minutes ago

# Shira: Triage – Stable or Unstable?

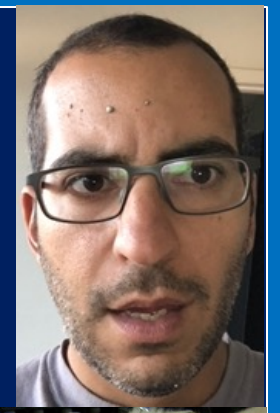
- HR 176, T 36.8C (98.2F)
- MM: pale, Capillary refill time > 2 seconds
- Weak irregular femoral pulses
- Respiratory rate 42 breaths per minute
  - Tachypneic not dyspneic
  - Lung sounds clear
- Unremarkable abdominal palpation
- Ok hydration

Thoughts at this point?
Call the criticalist and then run away!

# Differential diagnosis for Shira…unstable!

- Hemoabdomen 2$^{ndary}$ to neoplasia
- Sudden cardiac arrythmia
- Other acute hemorrhage (neoplasia)
- Addison's/hypovolemic shock
- Pericardial effusion
- Anaphylaxis
- GI perforation with sepsis
- Seizures
- Vomiting-induced vaso-vagal collapse
- Not sure, best ask the criticalist!

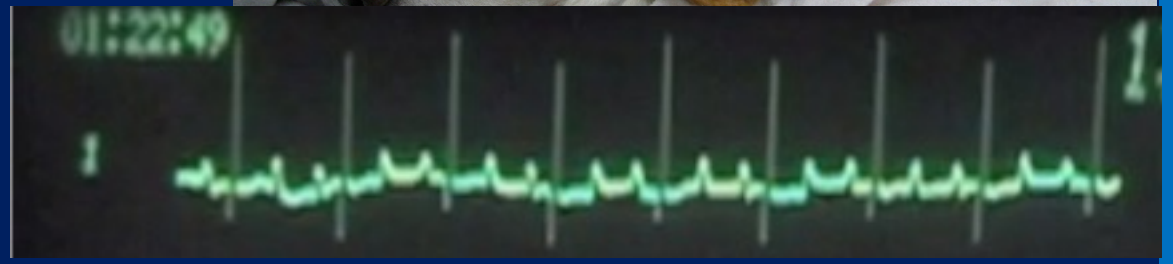
What's next?



# Minimum Emergency Data Base

- PCV: 46%
- TS: 60 g/L (6.0g/dl)
- Lactate: 6.7 mmol/l
- Glucose 8.2 mmol/L (148 g/dl)
- Azostix (BUN): 15-26mg/dl
- Systolic Doppler Blood pressure: 85 mmHg
- ECG…
- Revised differentials – do we have…
  - Hemoabdomen?
  - Septic abdomen?
  - Anaphylaxis?
  - Hypovolemia?
  - Pericardial effusion?

- 10-year-old female Labrador Retriever
- Vomited 24 hours ago
- Lethargic/anorexic 24 hours
- Collapse
- HR 176, RR 42, T 36.8C (98.2F)
- MM: pale, > CRT, weak pulses

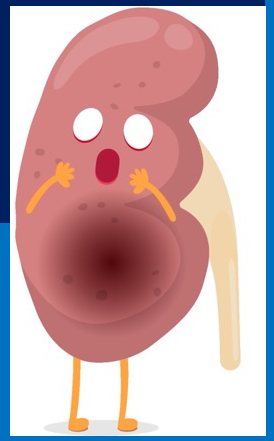



- POCUS:
  - Where do you start?
  - What is the question to answer?

Studies show POCUS is best applied when there is a high pre-test probability of a pathology being present:
Assess the patient and history to know what question(s) to answer!!!!!!

# On Today's Menu

- Pericardial effusion
  - Causes in cats and dogs*
  - Clinical findings
  - Diagnostic tests
  - Specific POCUS windows to diagnose
  - Differentiating pericardial from pleural effusion
  - Sonographic findings of tamponade
  - Emergency stabilization
  - And nothing about the kidneys.



# Pericardial effusion: Cats vs. Dogs

- Relatively common in dogs
  - Hemangiosarcoma (right atrial)
  - Heart base tumour (chemodectoma, mesothelioma)

  } (40-70%)
  - Idiopathic: 20 – 60 %
  - Coagulopathy
  - Left atrial rupture
  - Infectious
  - Occasional mild (clinically insignificant) effusion with cardiomyopathies
  - Other
- Rare in cats
  - Frequently associated with HCM and congestive heart failure (60-75%)
  - Lymphoma, FIP and bacterial infections also reported

*J Vet Intern Med* 2007;21:1002–1007

# Pericardial Effusion in Cats: A Retrospective Study of Clinical Findings and Outcome in 146 Cats

Daniel J. Hall, Frances Shofer, C. Kate Meier, and Meg M. Sleeper

| | | |
|---|---|---|
| Congestive heart failure (other causes ruled out) | 81 | 55.5 |
| Congestive heart failure versus other | 15 | 10.3 |
| Congestive heart failure/fluid overload | 14 | 9.6 |
| Open | 12 | 8.2 |
| Neoplasia | 8 | 5.4 |
| Idiopathic | 6 | 4.1 |
| Uremia versus fluid overload | 5 | 3.4 |
| Thyrotoxic cardiomyopathy | 3 | 2.1 |
| Idiopathic with FIP suspected | 1 | 0.7 |
| Pericardioperitoneal diaphragmatic hernia | 1 | 0.7 |
| Total | 146 | 100 |

# How do we diagnose it: History

JOURNAL OF
Veterinary Emergency
AND Critical Care

**Brief Clinical Communication**

*Journal of Veterinary Emergency and Critical Care* **27**(2) 2017, pp 250–252
doi: 10.1111/vec.12570

## Prevalence of vomiting in dogs with pericardial effusion

Rachel Fahey, DVM; Elizabeth Rozanski, DVM, DACVECC, DACVIM; April Paul, DVM, DACVECC and John E. Rush, DVM MS DACVIM, DACVECC

# How do we diagnose it: History

- Acute onset of pericardial effusion
  - Collapse
  - Vomiting within the previous 24 hours
    - 51% of dogs identified with PE had recently vomited

Not specific or sensitive

Not specific or sensitive

- Subacute to chronic onset
  - Owners may report a period of progressive weakness, exercise intolerance, lethargy, tachypnea, syncope, cough, abdominal enlargement, or muscle wasting

Not specific or sensitive

Signs are vague and non-specific in many cases…

# Triage: Acute cases

- Muffled to absent heart sounds
- Pulses paradoxes
  - Pulse is weaker on inspiration (which site is most sensitive to palpate)?

Specific but not sensitive

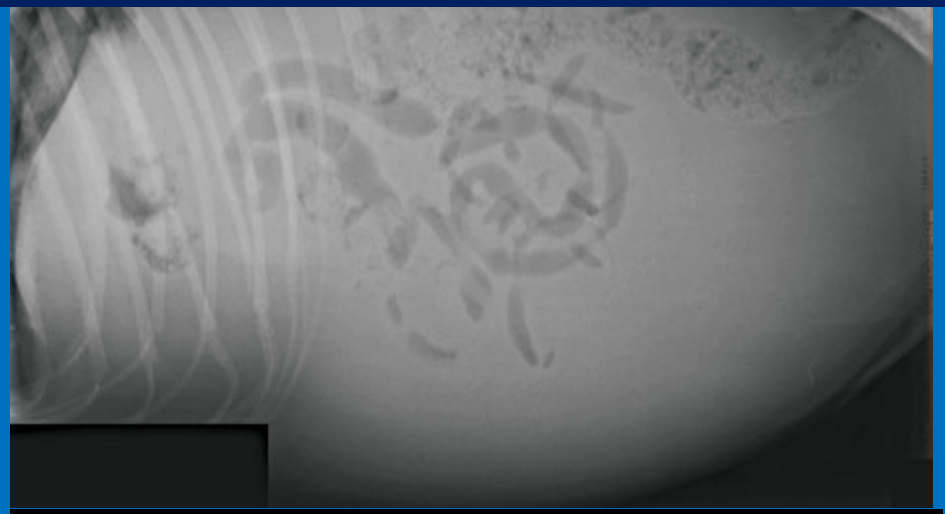
- Signs of cardiovascular shock
  - Hypotension, tachycardia
  - Low temperature
  - Pale mucous membranes
  - Prolonged capillary refill time

= tamponade

Not specific or sensitive

# Triage: Subacute cases

- 50% of dogs have evidence of right heart failure
  - Abdominal distention/fluid wave
    - 50% of cases with signs of right heart failure
  - Pleural effusion
    - 47% of cases with signs of right heart failure
    - Muffled heart sounds, dyspnea
  - Jugular vein distention/jugular pulse
- May present like acute cases
  - Shock, collapse, tamponade




Signs are vague and non-specific in many cases…

# Minimum emergency diagnostics

- ECG: may see electrical alternans — Specific but not sensitive
- Cage-side blood work (often have increased lactate)
- Blood pressure — Not specific or sensitive
  - Often decreased

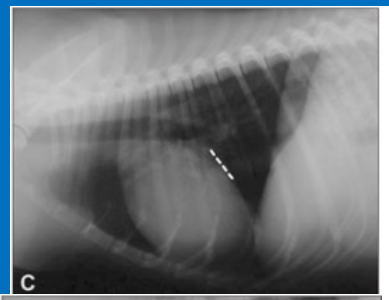

- Consider PT/PTT if warfarin ingestion

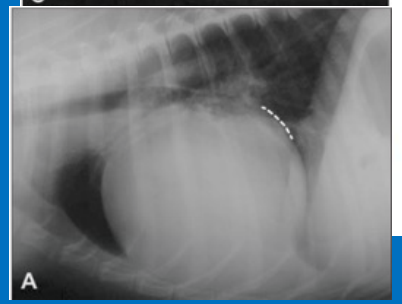
# Radiographs: Dogs with tamponade…

## What is our go-to test to look for pericardial effusion?

- 22% did not have an enlarged cardiac silhouette
- 42% did not have a globoid appearance of the cardiac silhouette
- The sensitivity and specificity of a VHS (≥ 10.7 vertebral bodies) for identification of dogs with cardiac tamponade was 77.6% and 47.8% respectively
- Pulmonary metastases reported in up to 1/3 of cases





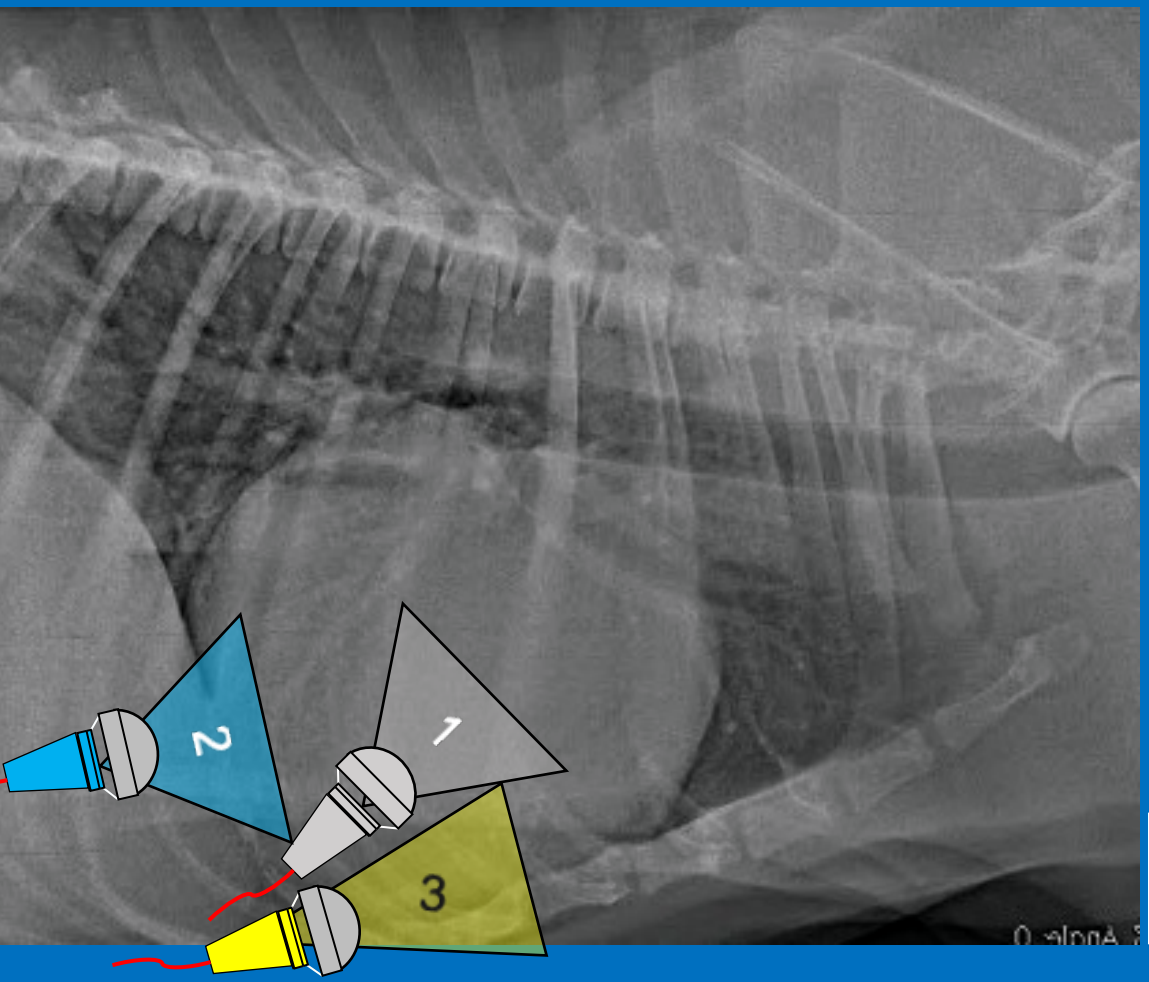




**Thoracic radiographic findings for dogs with cardiac tamponade attributable to pericardial effusion**

Etienne Côté, DVM, DACVIM; Leslie A. Schwarz, DVM, DACVR; Fortune Sithole, BVSc, PhD, DACVPM

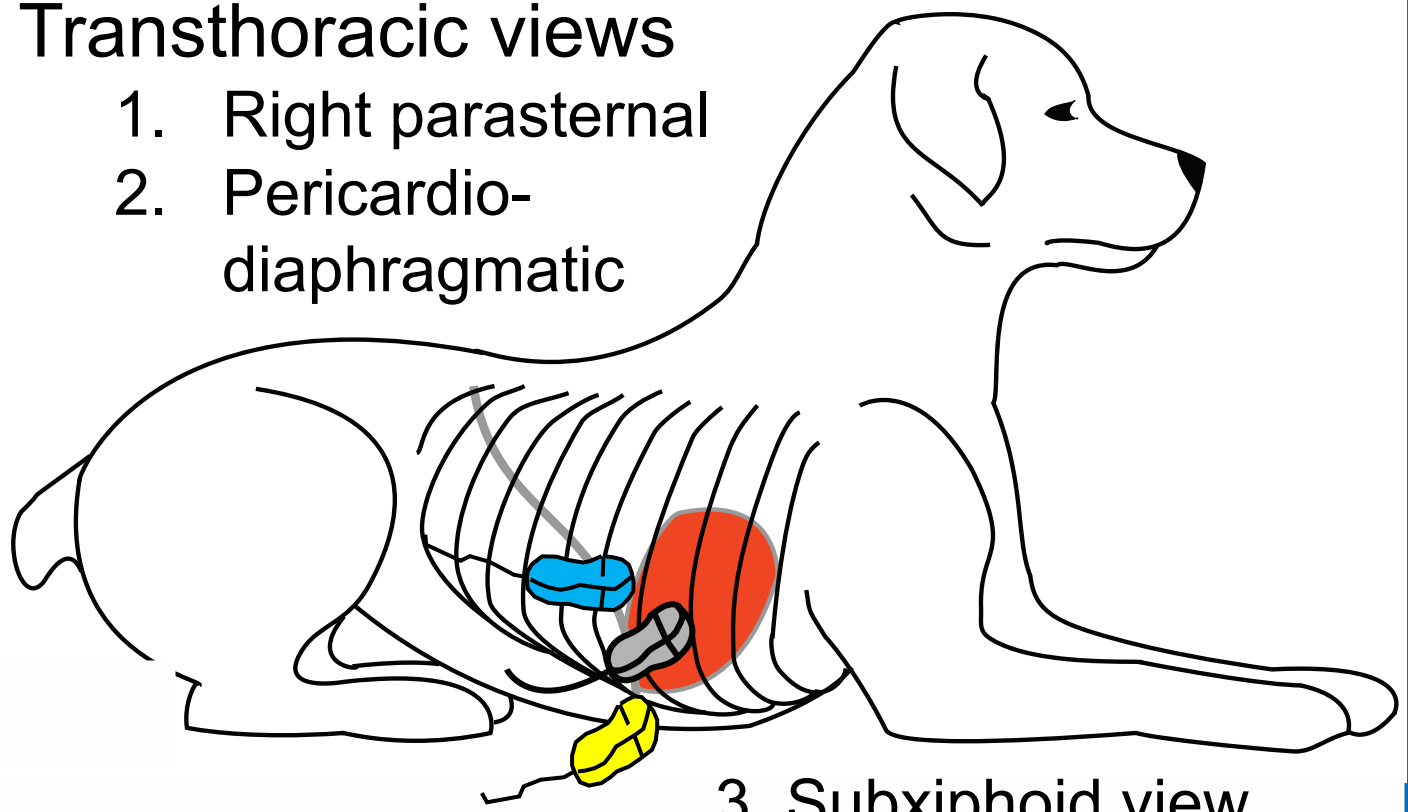
Côté E, Schwarz LA, Sithole F (2013) Thoracic radiographic findings for dogs with cardiac tamponade attributable to pericardial effusion. J Am Vet Med Assoc 243(2):232-5

# POCUS sites for pericardial effusion




Transthoracic views

1. Right parasternal
2. Pericardio-diaphragmatic

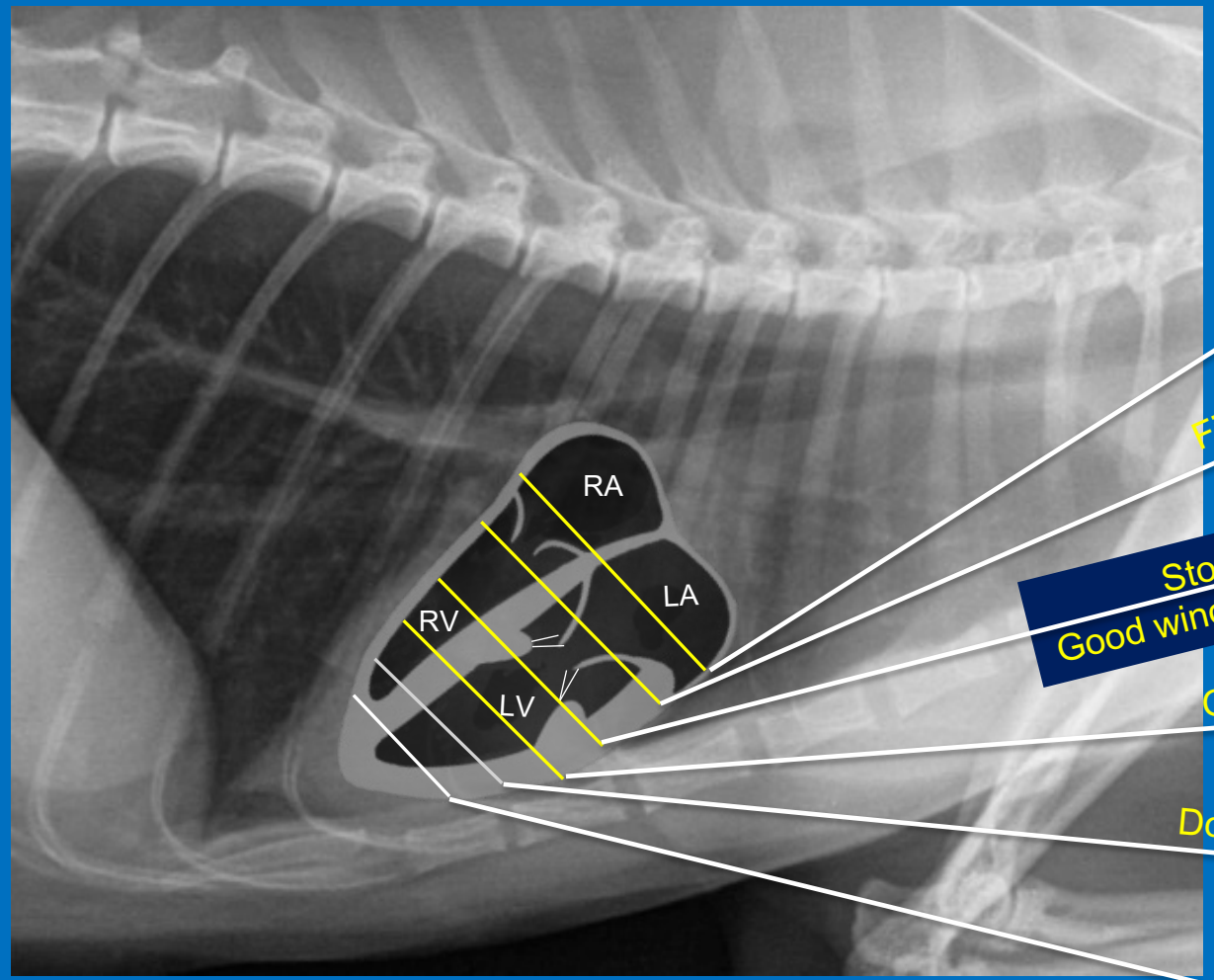


3. Subxiphoid view

3 key windows: right parasteranal, pericardio-diaphragmatic, and subxiphoid

# Site 1: Right parasternal short axis window

# RP short axis views




Mercedes and the whale

Fish mouth! Behlebelelbeluh

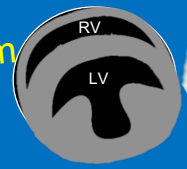
Stop sweeping and fan
Good window for volume assessmen

Good papillary = mushroom

Don't confuse for hypovolemia

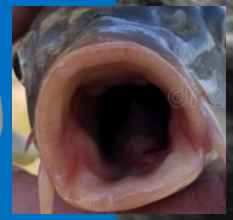
Left apex

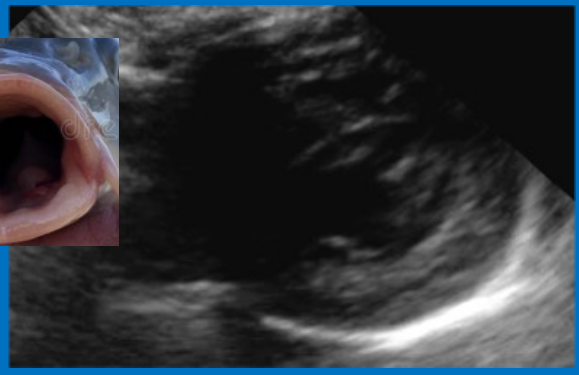


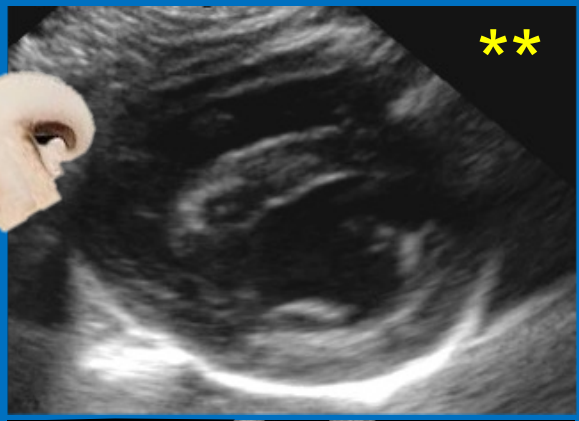



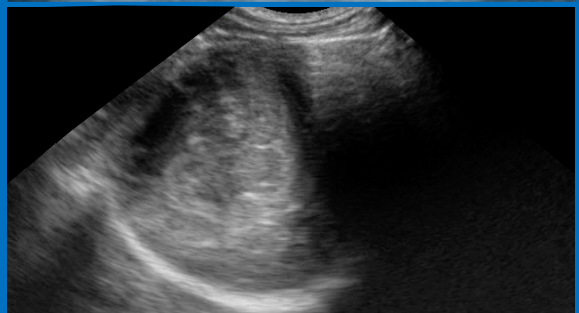


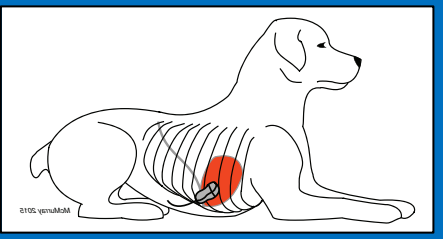








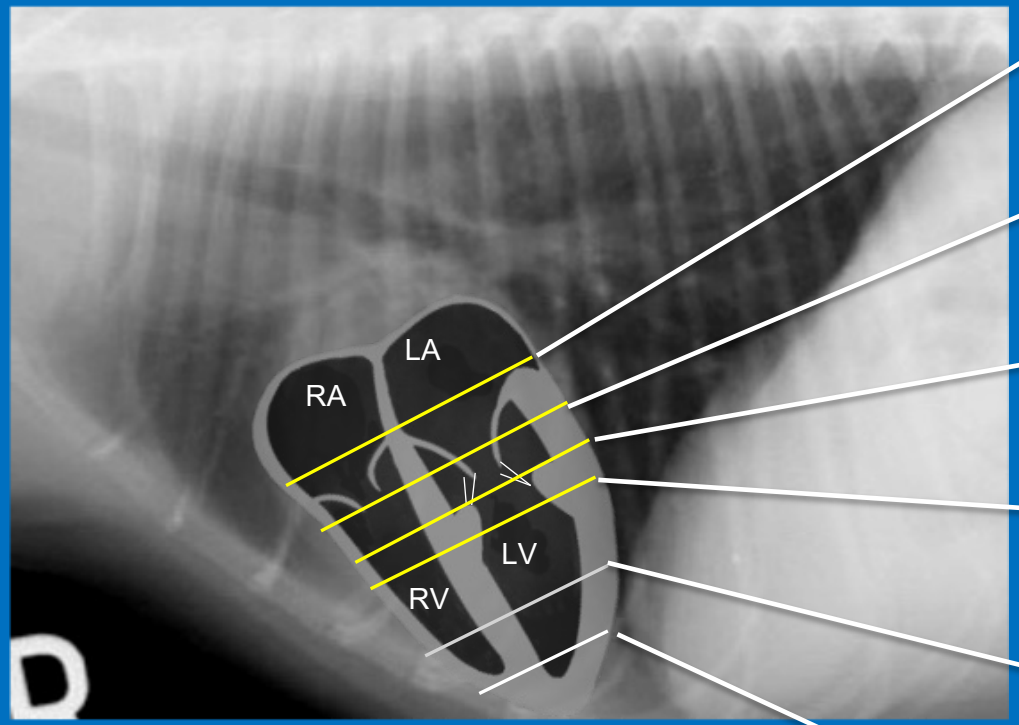



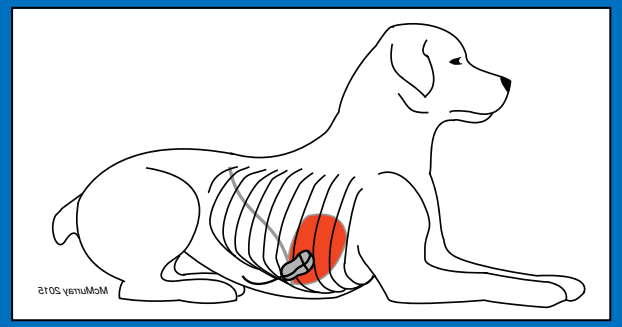


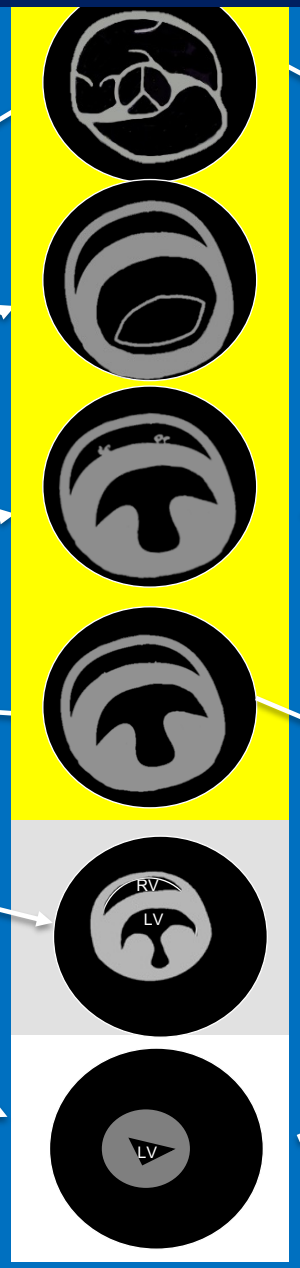
Need to know where you are to find the 2 key short axis views

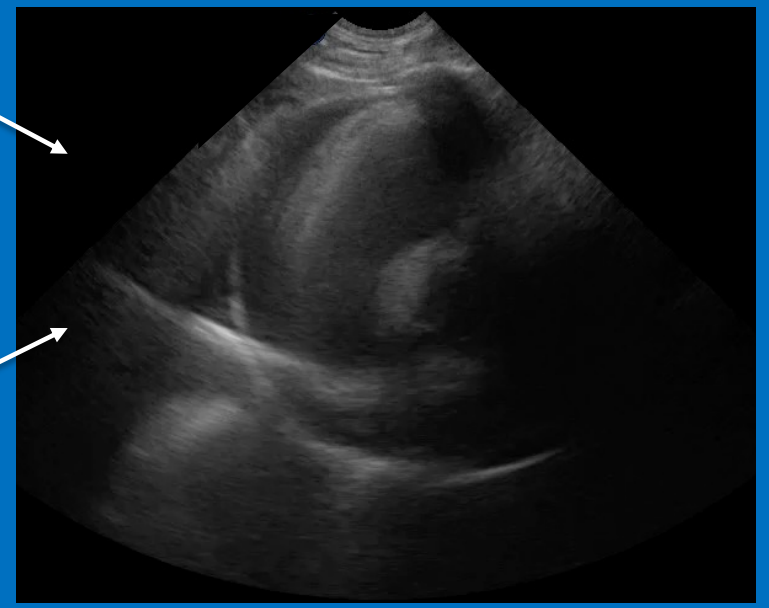
# Include multiple views and find the diaphragm

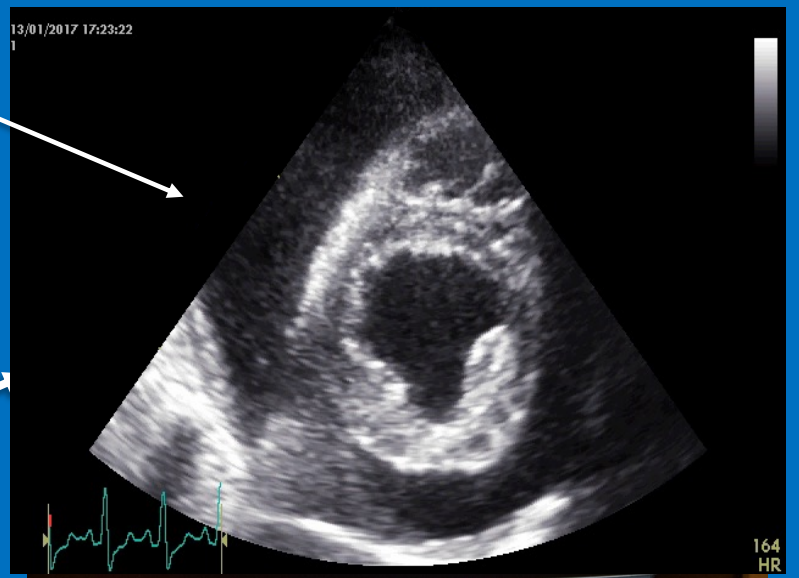
Ensure the entire heart and pericardium is visible: adjust your depth as needed!!!!



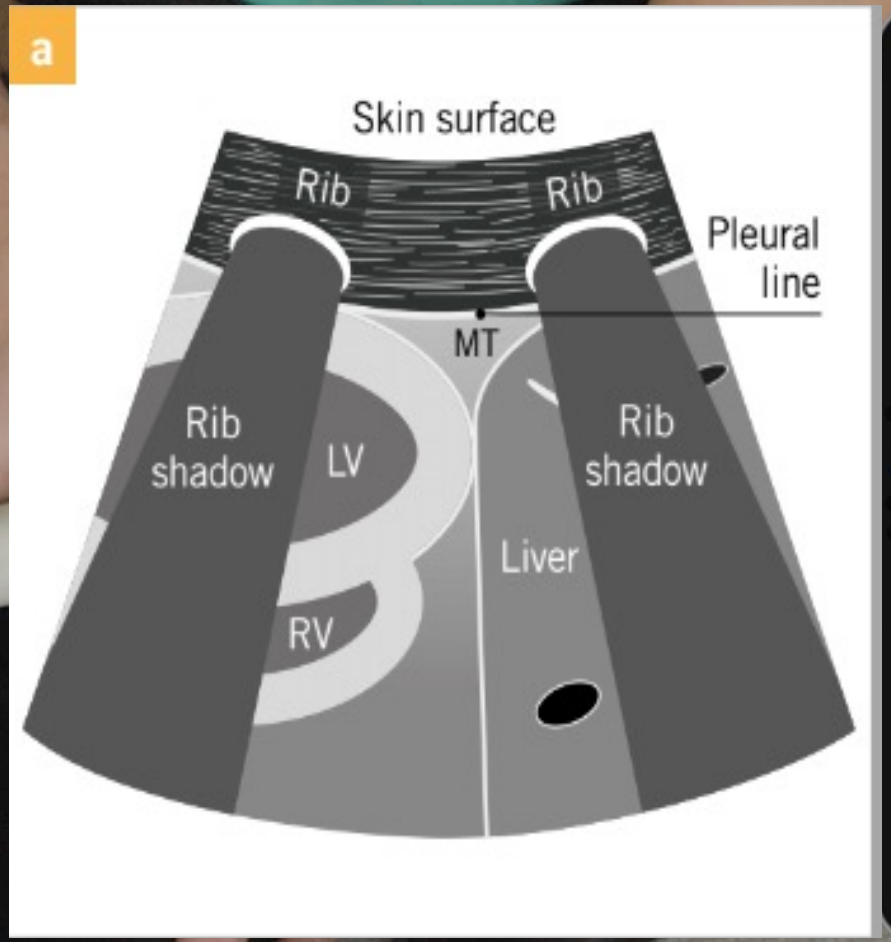



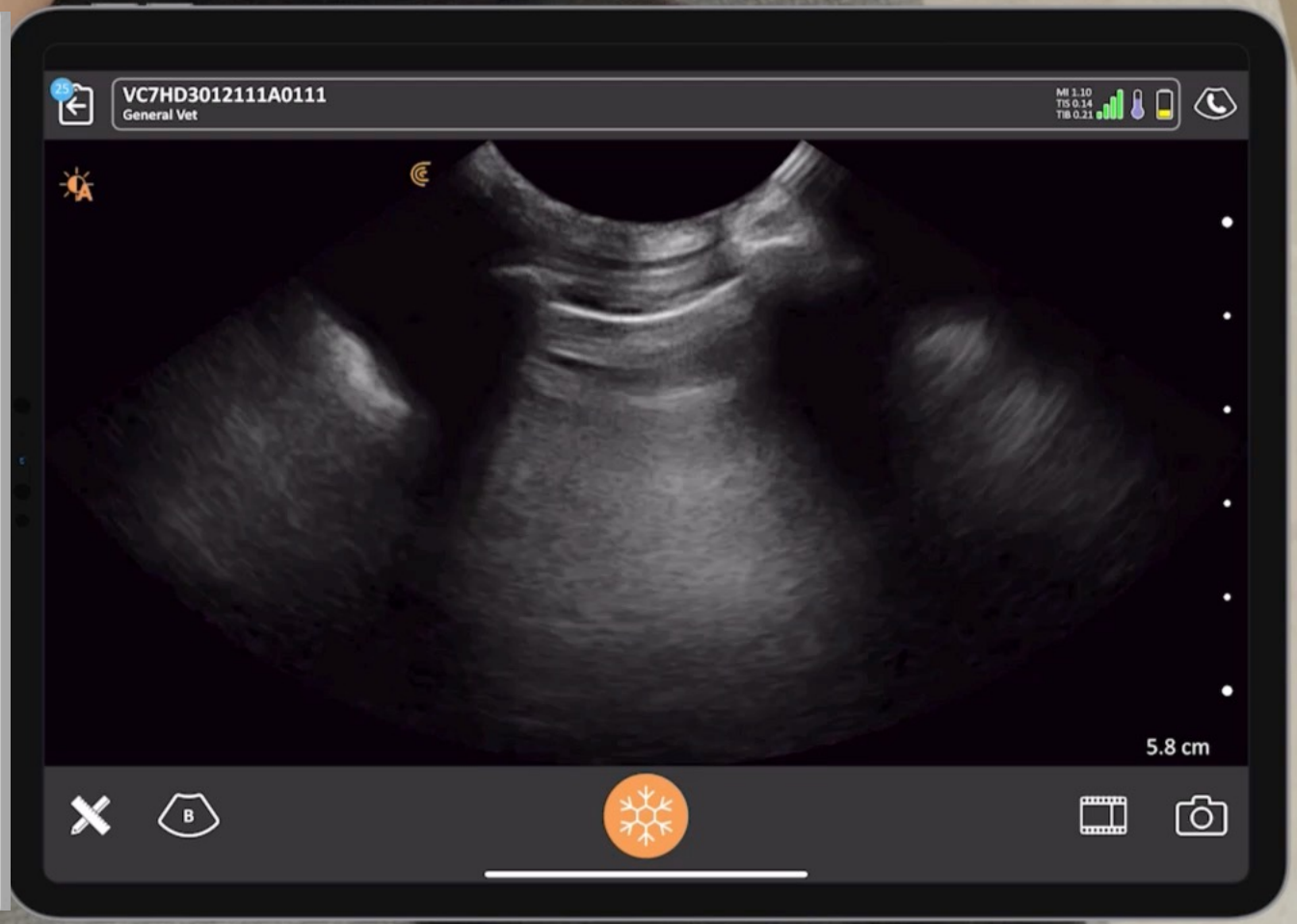


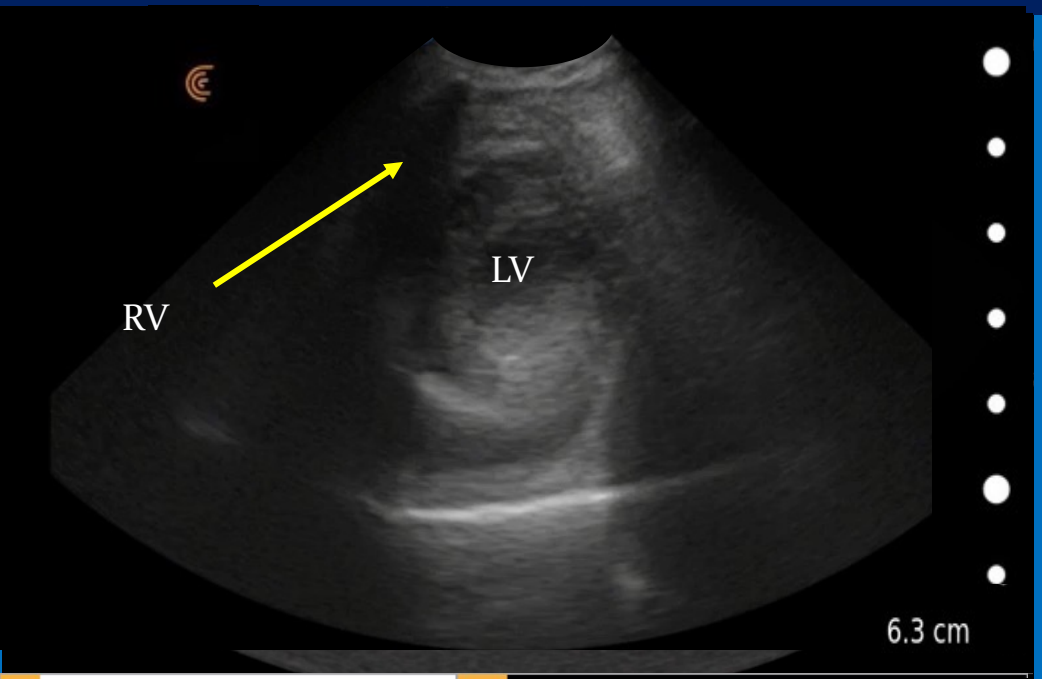


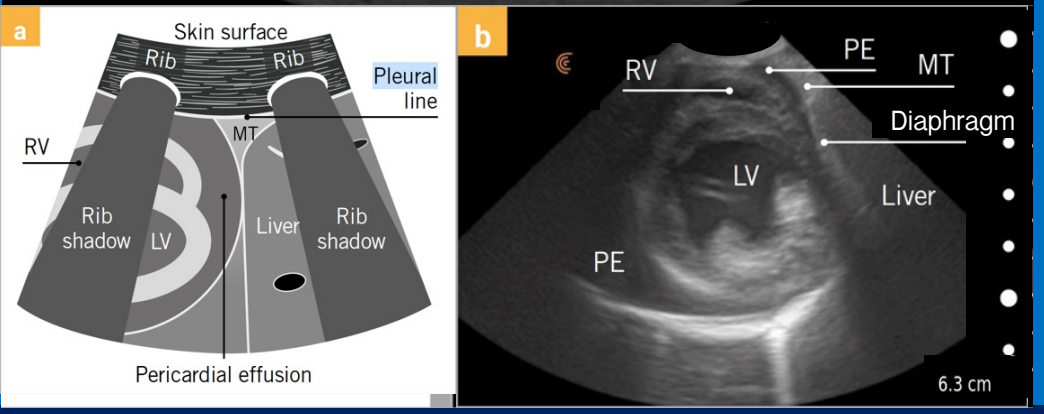
# Site 2: Pericardio-diaphragmatic window

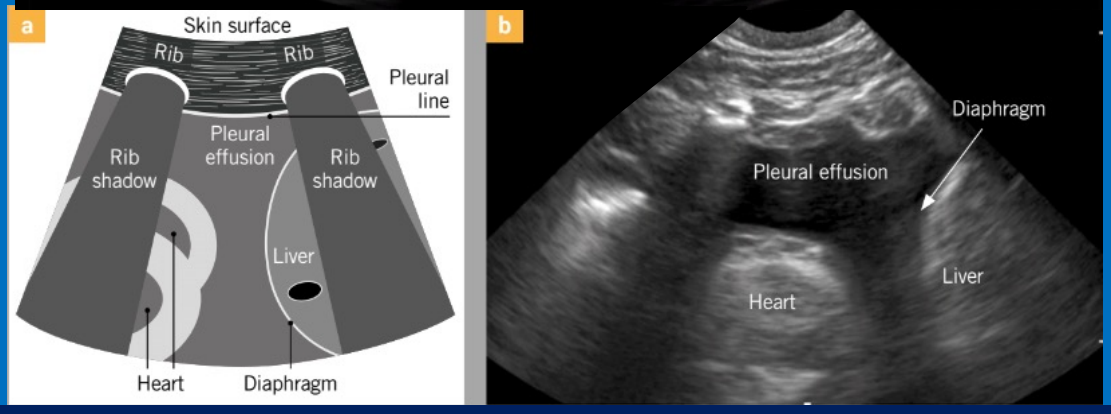


# PD window differentiates pleural and pericardial effusion



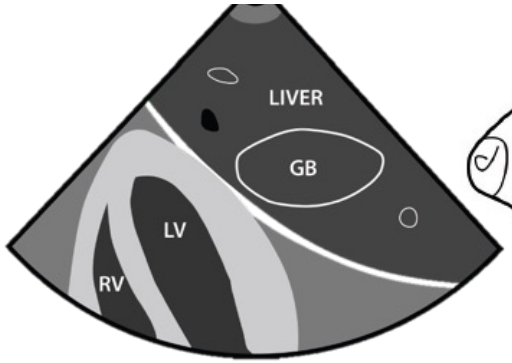



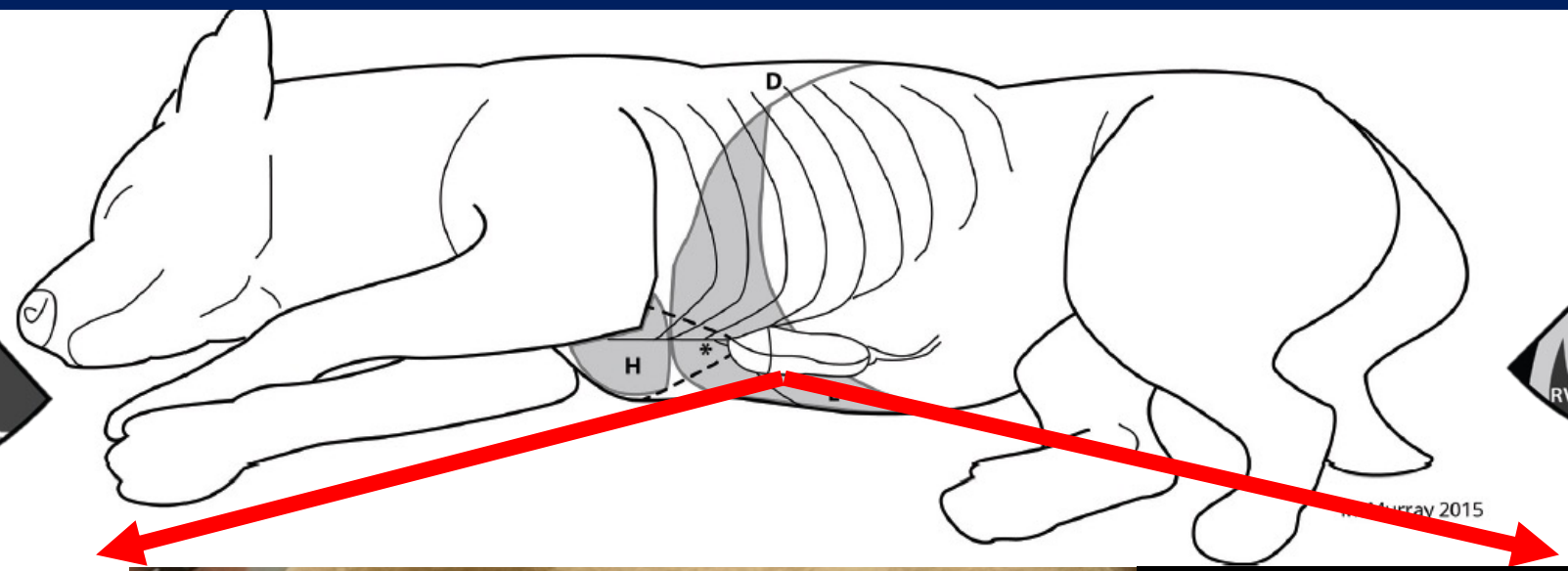

## Key findings at the PD window:

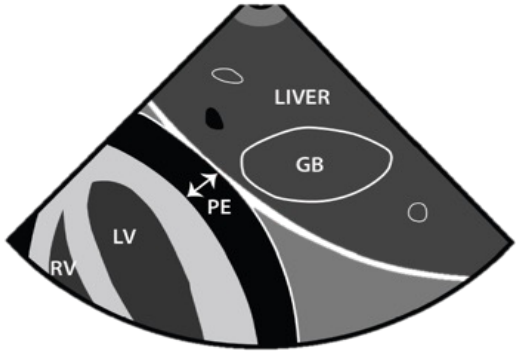
- Fluid that tracks along and outlines the diaphragm is pleural effusion
- Fluid that curves around and parallels the outline of the heart is pericardial effusion

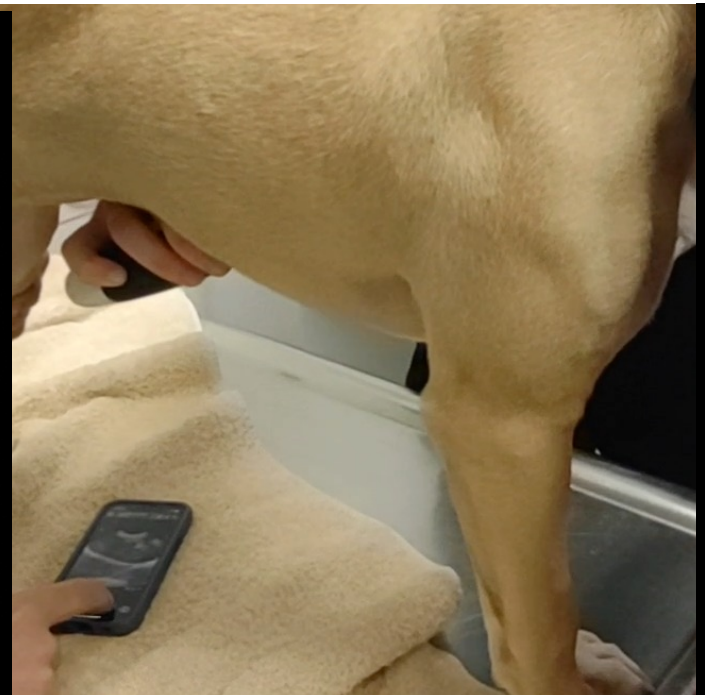
# Site 3: Subxiphoid

# Subxiphoid: Pericardial Effusion Y/N?

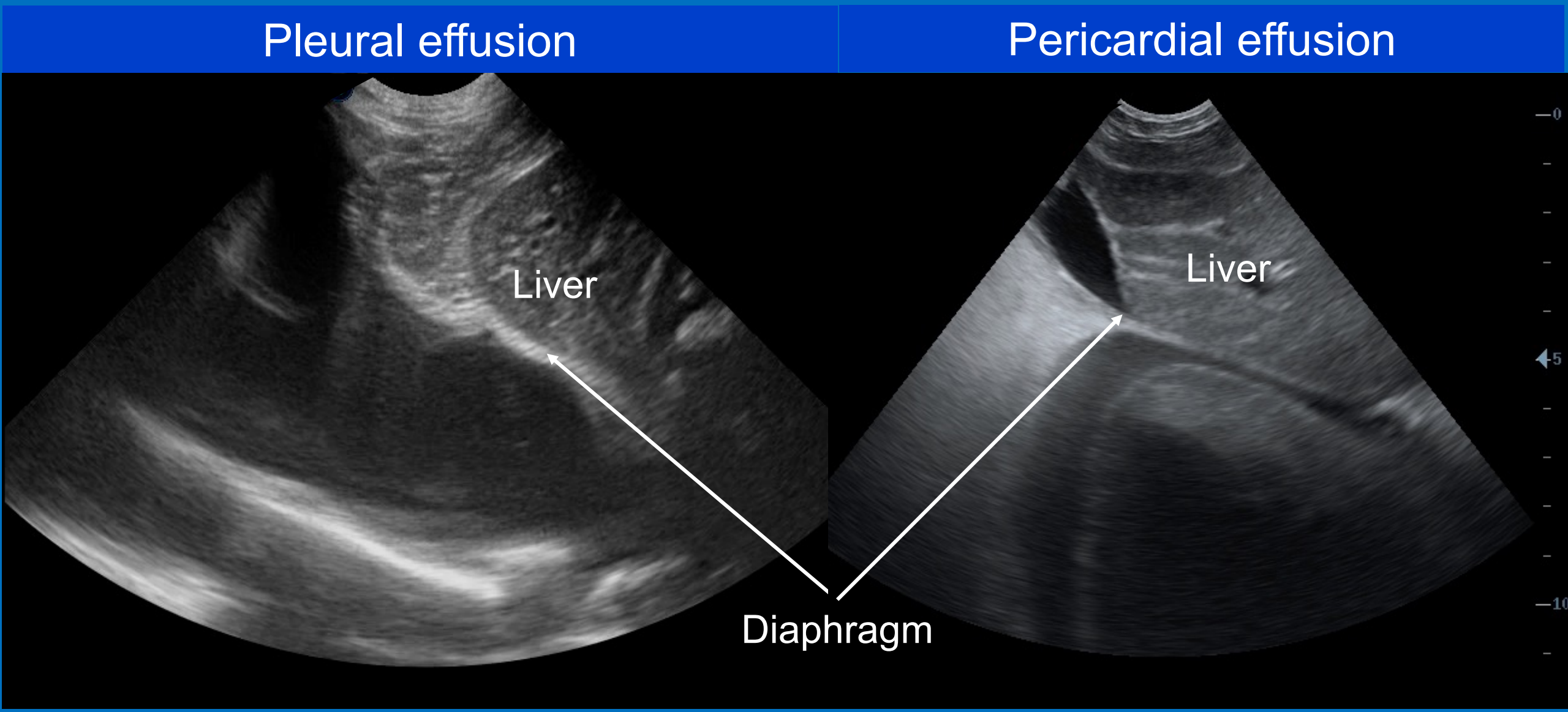


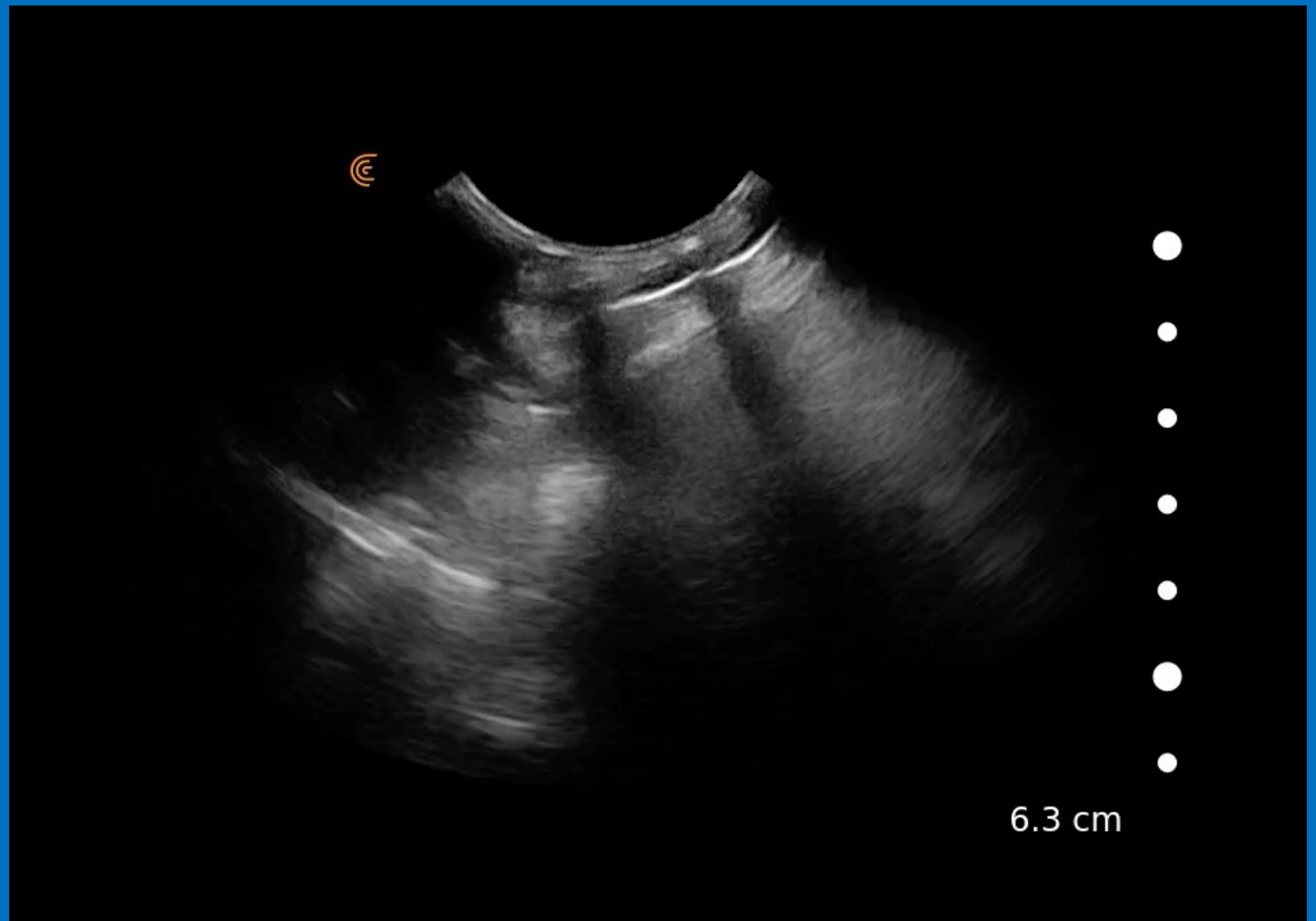



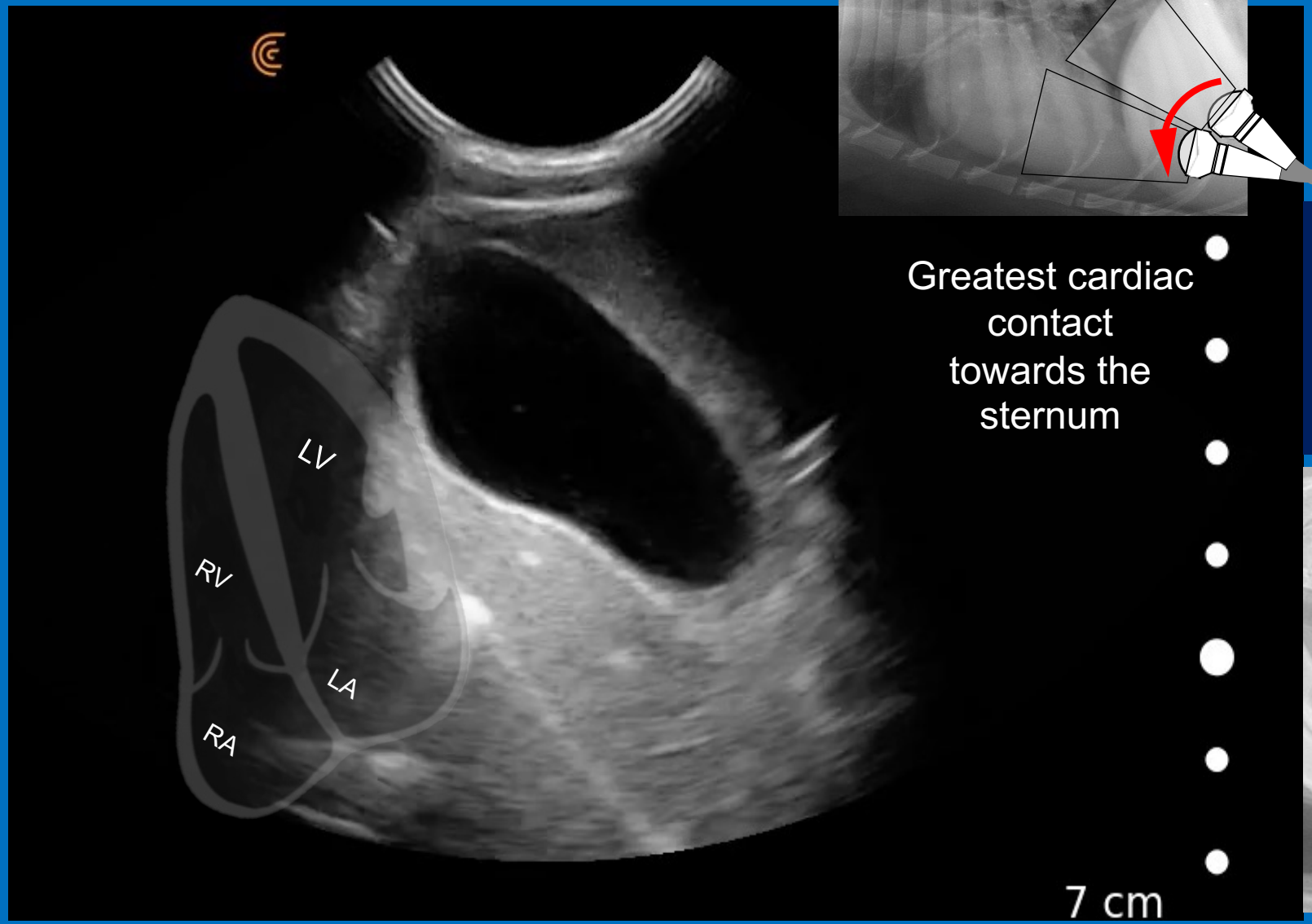
# Subxiphoid: Differentiates pleural and pericardial

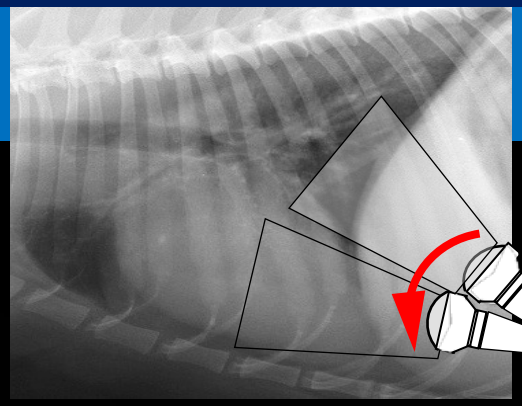


# Quiz: Pleural or pericardial….

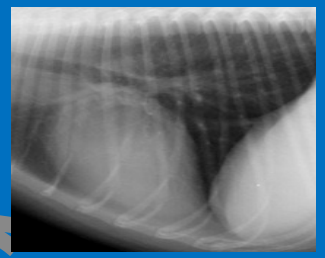


# Quiz: Pericardial effusion – Y/N?

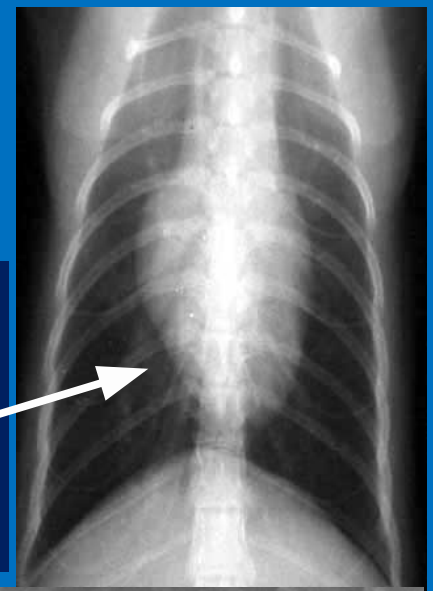


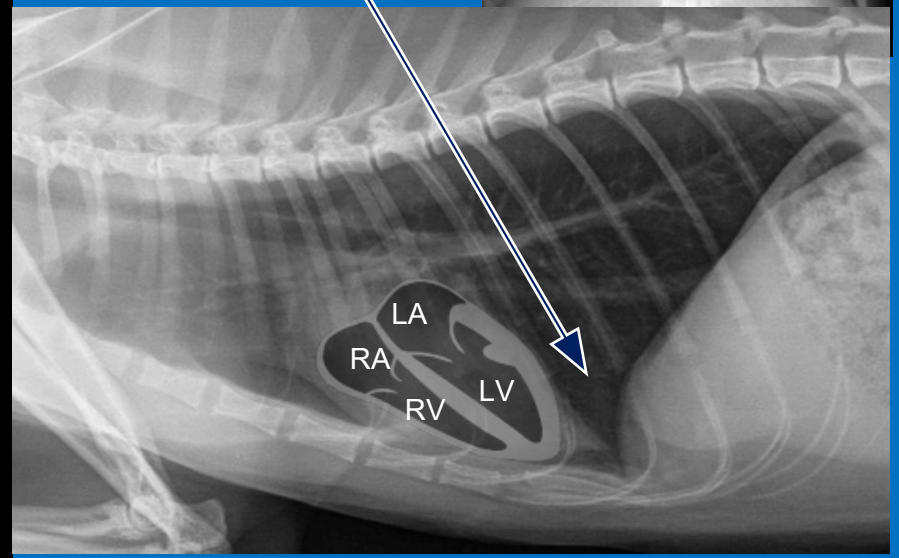



Greatest cardiac contact towards the sternum



Air between heart and diaphragm prevents heart being seen, particularly in cats

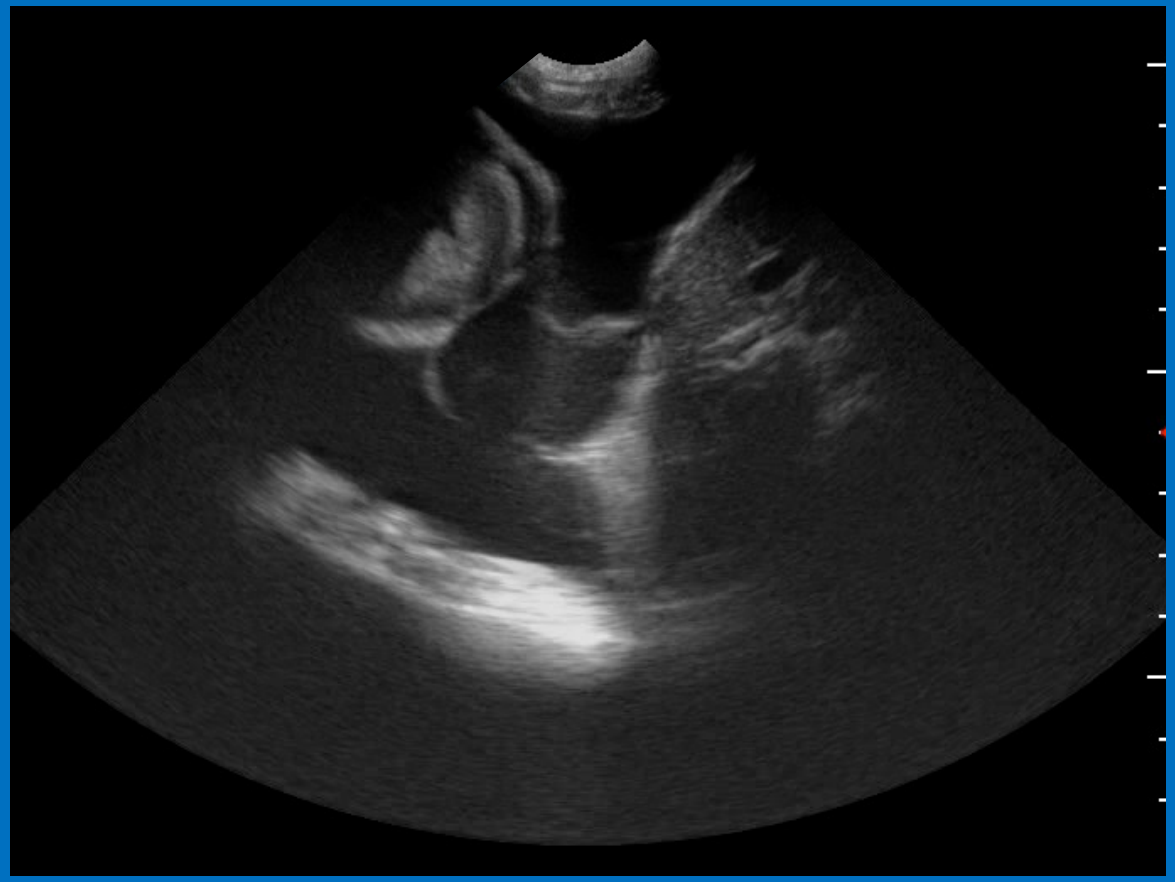




# Quiz: Pleural or pericardial….

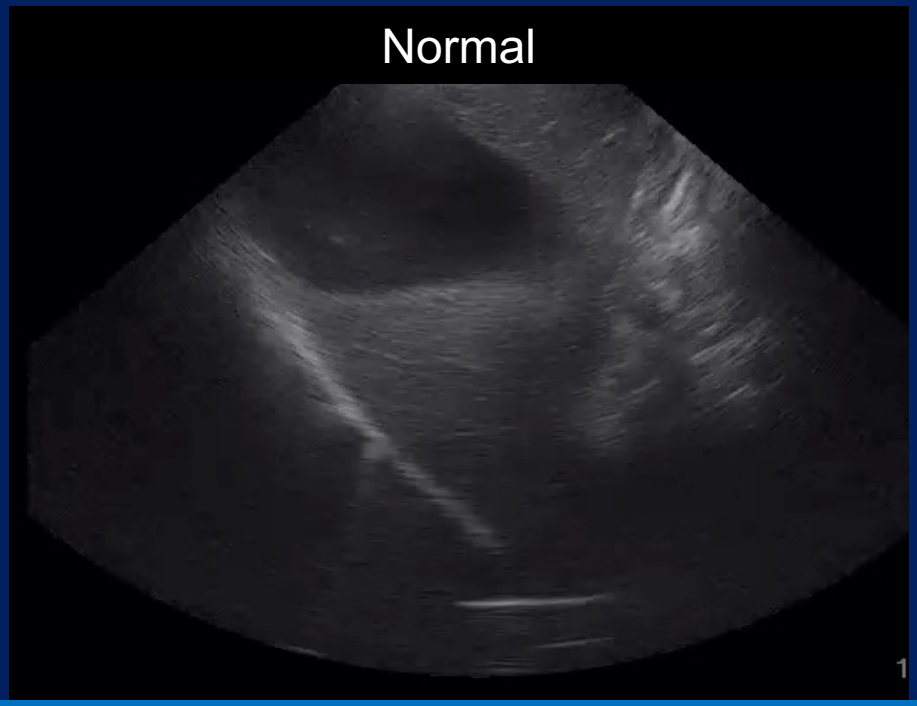
Slide caudally off the heart until the diaphragm is visible in the same window:
Does the fluid curve up and around the diaphragm or around the heart, or both?

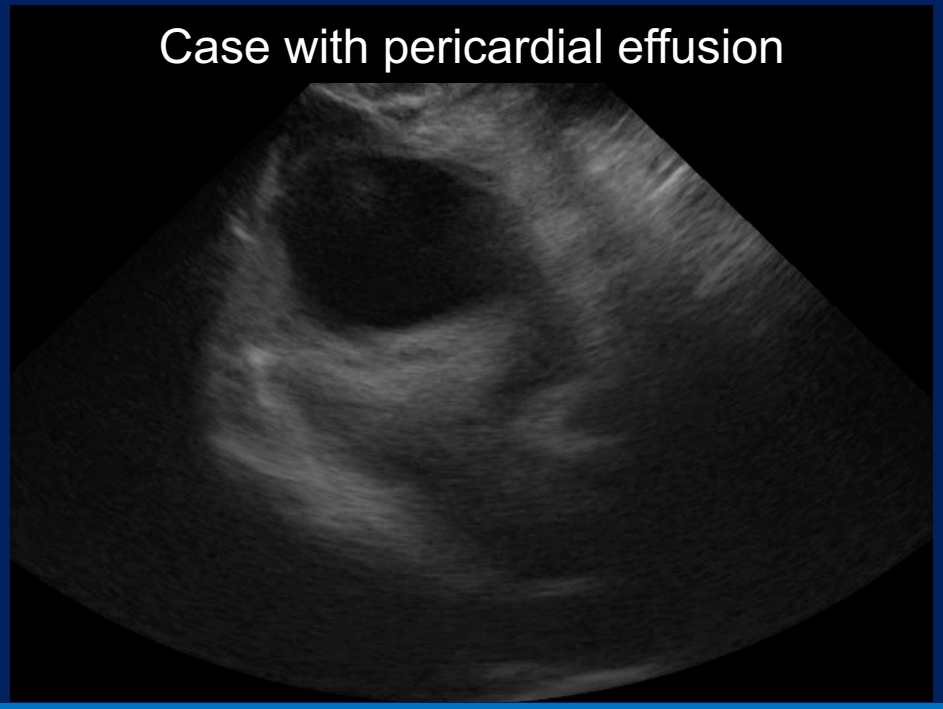
# Quiz: Pleural or pericardial?



# Other POCUS findings often seen with pericardial effusion

- Distended fat CVC with no ”bounce”
- Gallbladder halo sign
- Hepatic vein distention

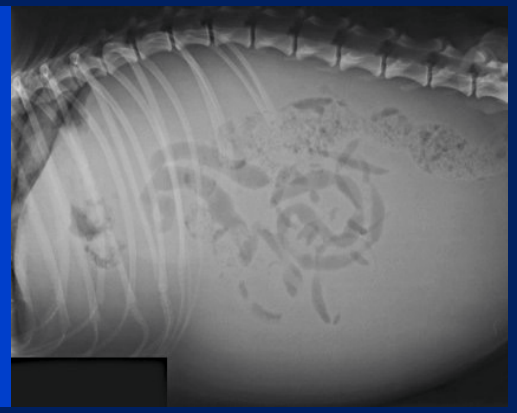



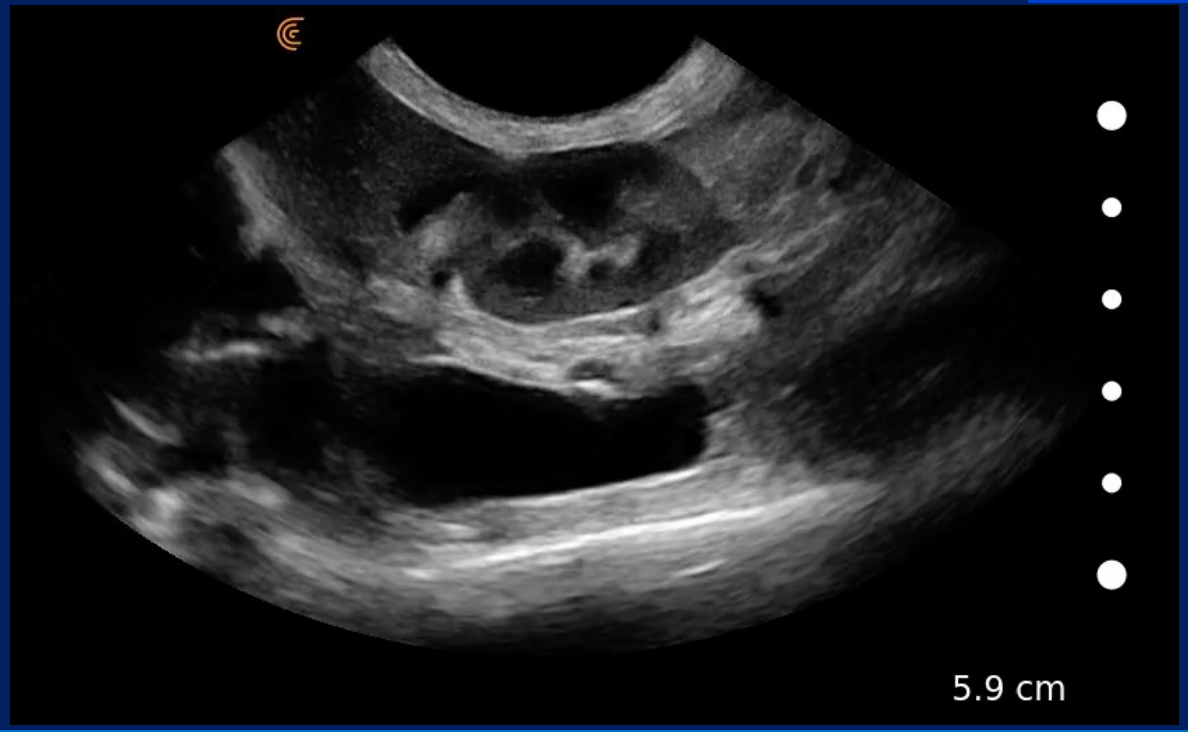



# We have confirmed pericardial effusion, can we diagnose tamponade on ultrasound?

- Abdominal effusion
- Pleural effusion

- Recall: 50% of dogs have evidence RCHF
  - Abdominal distention/fluid wave
    - 50% of cases with signs of right heart failure
  - Pleural effusion
    - 47% of cases with signs of right heart failure
    - Muffled heart sounds, dyspnea
  - Jugular vein distention/jugular pulse

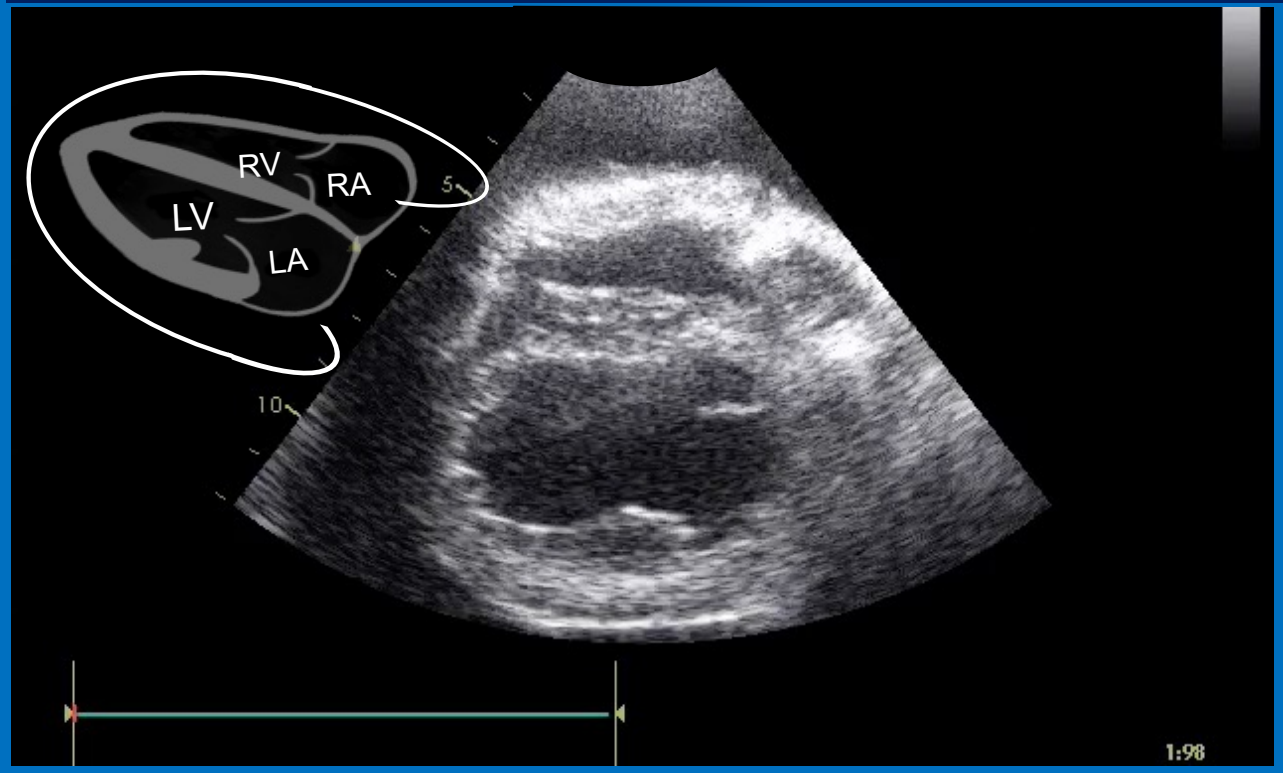


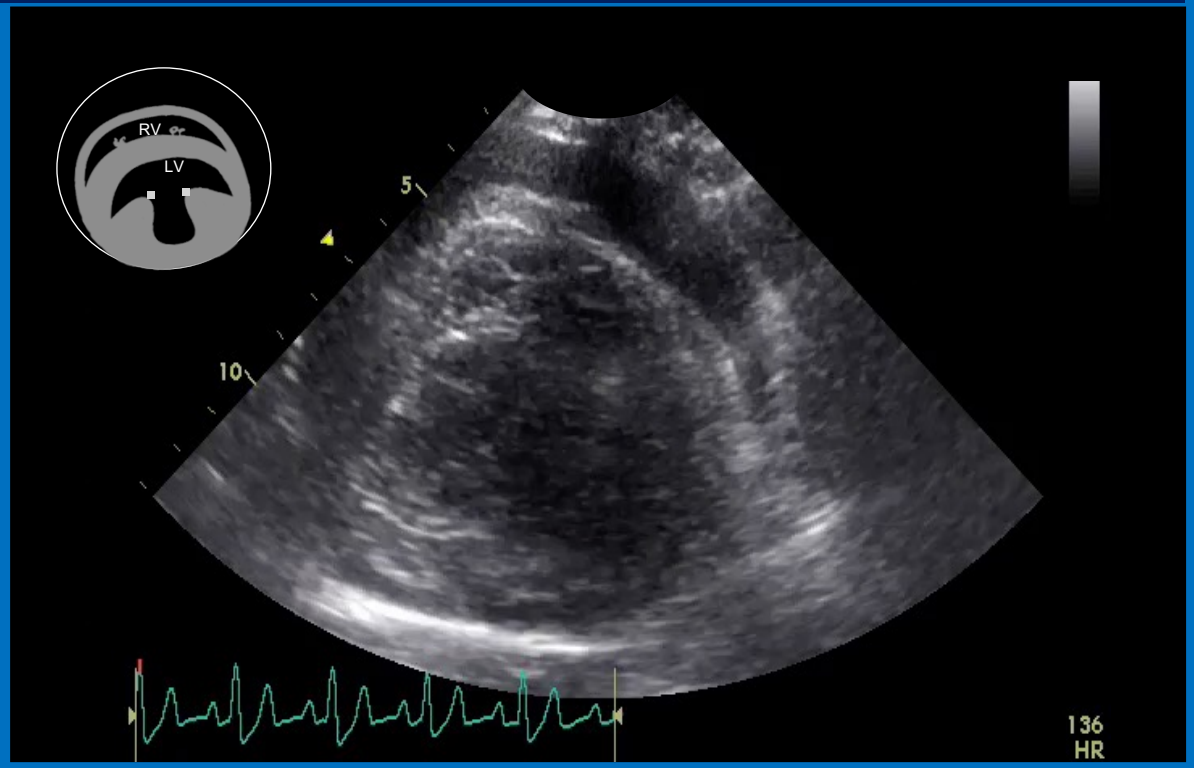



# We have confirmed pericardial effusion exists; how do we treat it?

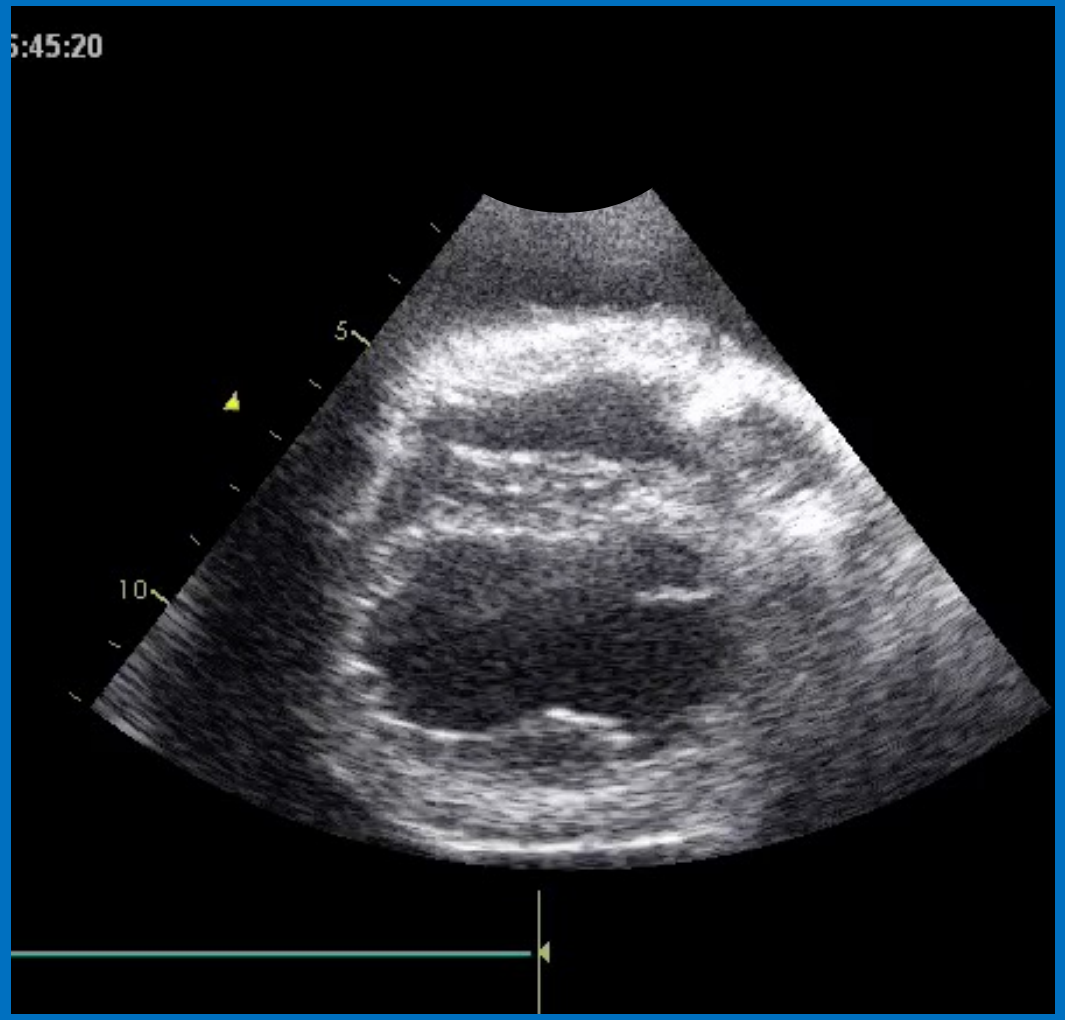
There are occasional reports of pleural effusion causing tamponade

Should increase depth to see pericardial sac in the far image!



# Therapy: IV fluid bolus?




- Pericardial effusion is a diastolic filling problem
- A bolus of IV isotonic crystalloids (20 ml/kg over 10 minutes) may help stabilize our patient while preparing for pericardiocentesis

# When to tap?

- ASAP if cardiovascularly unstable

- If cardiovascularly stable without tamponade
  - May be easier to identify a mass with fluid in the pericardial space
  - Don’t compromise patient safety though!!
  - Even small residual pericardial effusion will allow easier mass identification
  - Stabilization may be achieved with removing small amounts of fluid

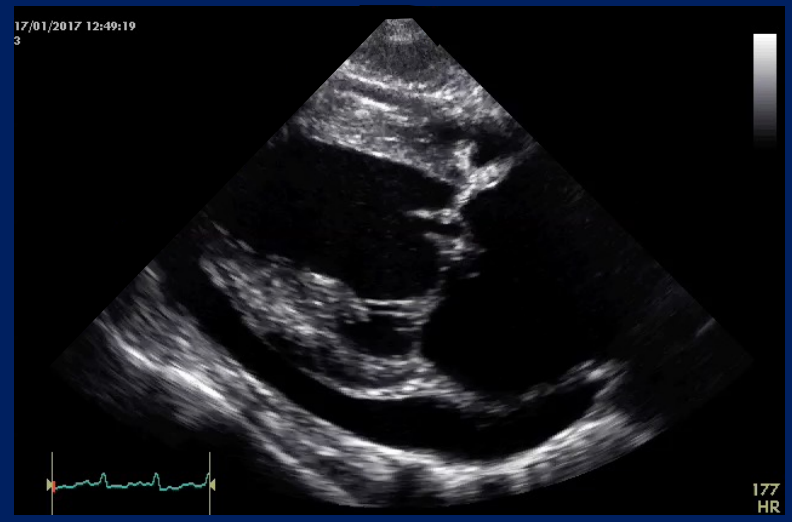
Any situations where tapping could make the patient worse?

# Initial history and triage…

- Coumadine toxicity: transfuse and tap unless…
  - Unless agonal
    - Tap
    - Transfuse
  - If unstable but not on the verge of an arrest
    - Plasma bolus 10 ml/kg over 10 minutes
    - Tap
    - Remaining plasma over 2 hours
    - (Monitor for volume overload)

# Pericardial effusion: When **NOT** to tap??

- Left atrial rupture
  - Often a clot in the pericardial space
  - Minimal hemodynamic compromise
    - Postpone tap
      - Risk of further/worsened bleeding when tapped
      - May resolve with medical management
  - Tamponade and unstable
    - May need to tap
    - Very poor prognosis



# Pericardiocentesis: technique

- Dogs
  - life-saving  and necessary for initial stabilization
- Cats

- Under sedation
- Sternal or left lateral recumbency
- Ultrasound assisted
- Lidocaine prepared
- 14 gauge 5” IV catheter (fenestrated)?

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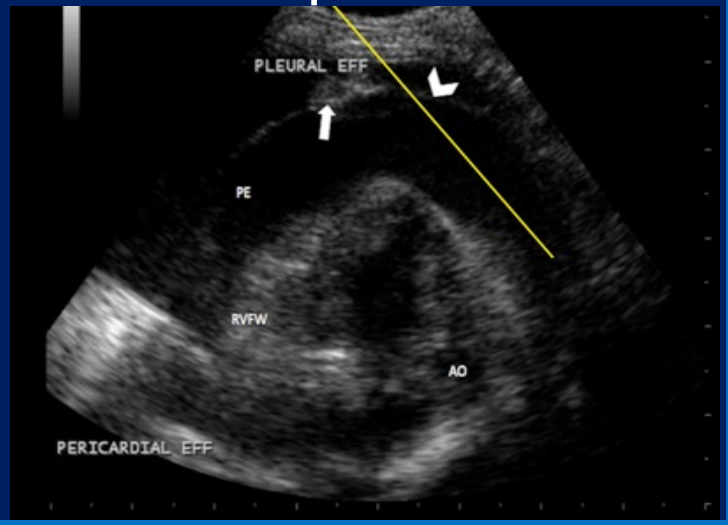
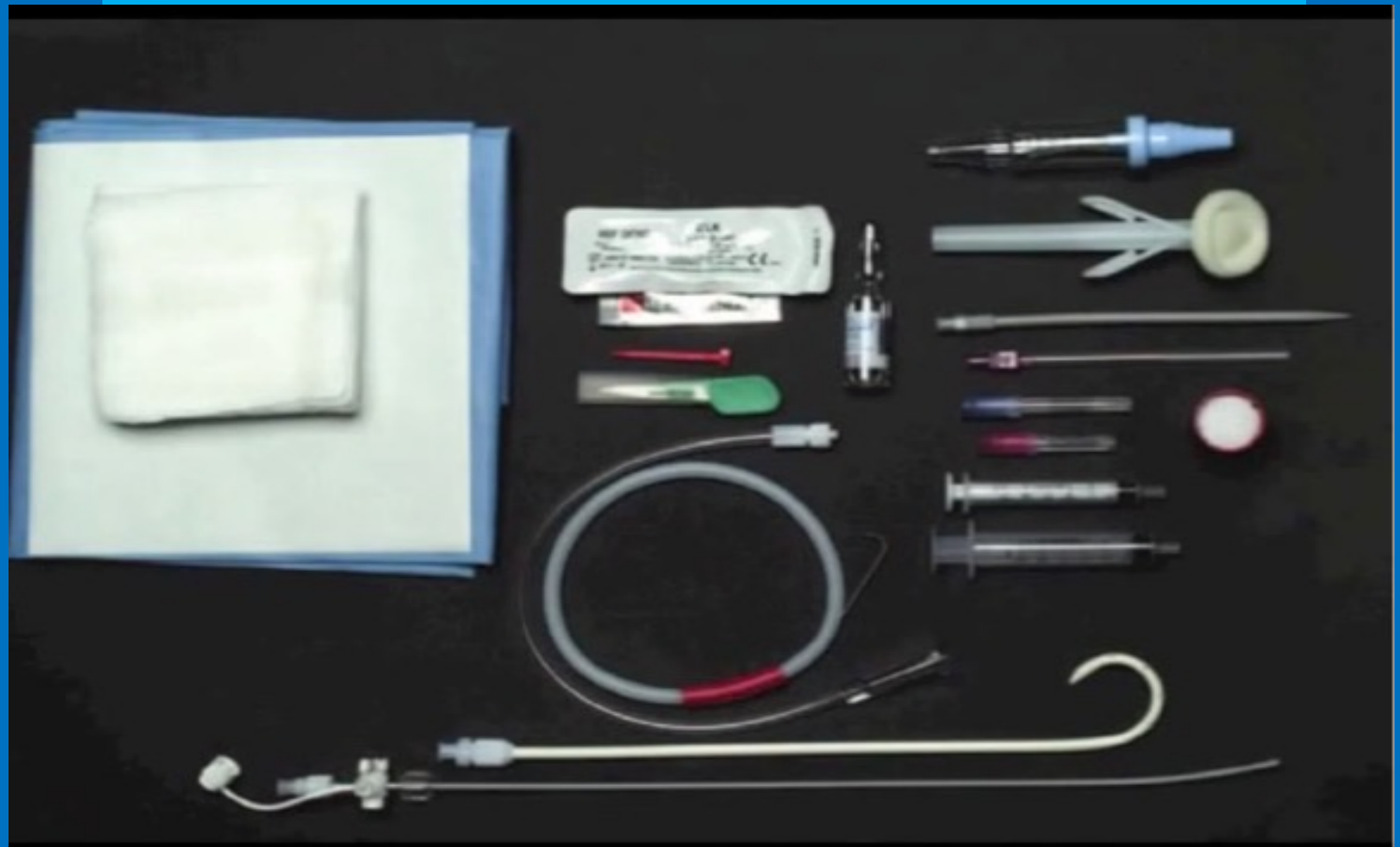
nce of cardiac tamponade



# Indwelling pericardial catheters?

Recurrence of bleeding reported in 29% of dogs

Mila chest tube catheter?



# Prognosis

- 100% mortality with severe clinical signs if the pericardial effusion is not promptly removed
- Dogs with hemangiosarcoma have a guarded prognosis
  - Median survival 1-4 months
- Heart base tumors
  - Median survival with pericardectomy (730 days), without pericardectomy (42 days)
- Dogs with idiopathic pericardial effusion have a good prognosis
  - Survival time of up to 4 years

# Summary

- Cats most often develop nonclinical pericardial effusion secondary to congestive heart failure (often HCM)
- Dogs require pericardiocentesis most often due to tumors and idiopathic causes
- Confirm with POCUS using multiple windows with the depth extended to see the entire heart and pericardium
- Pericardiocentesis can easily be performed by non specialists – consider small bore indwelling pericardial catheters
- Prognosis varies with underlying cause

# Questions? Thanks for joining us!!!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# Live Demonstration

**Shelley Guenther, CRGS, CRCS**

Sonographer | Clinical Marketing Manager

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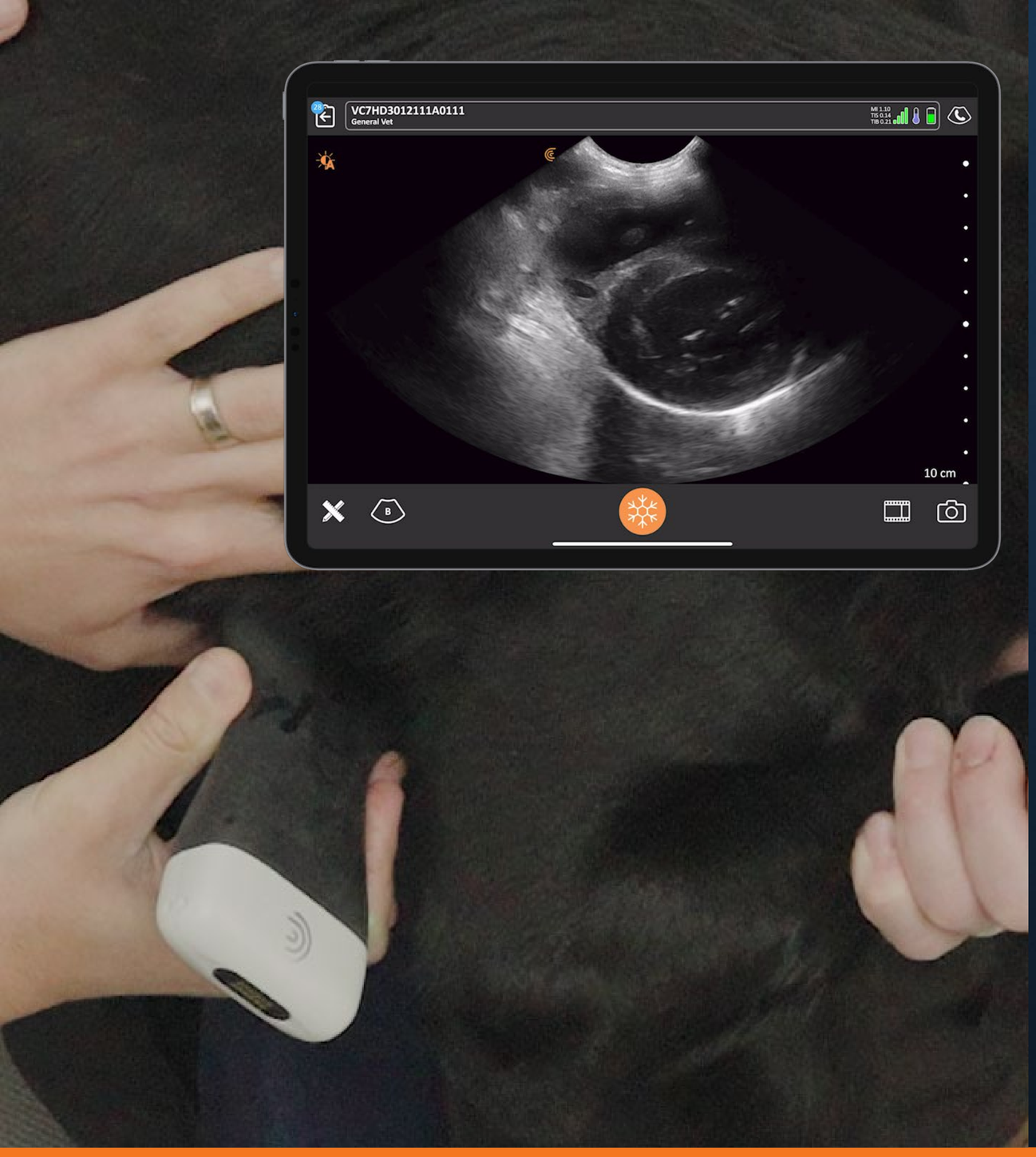


# What additional information would you like?

*Interactive Poll*

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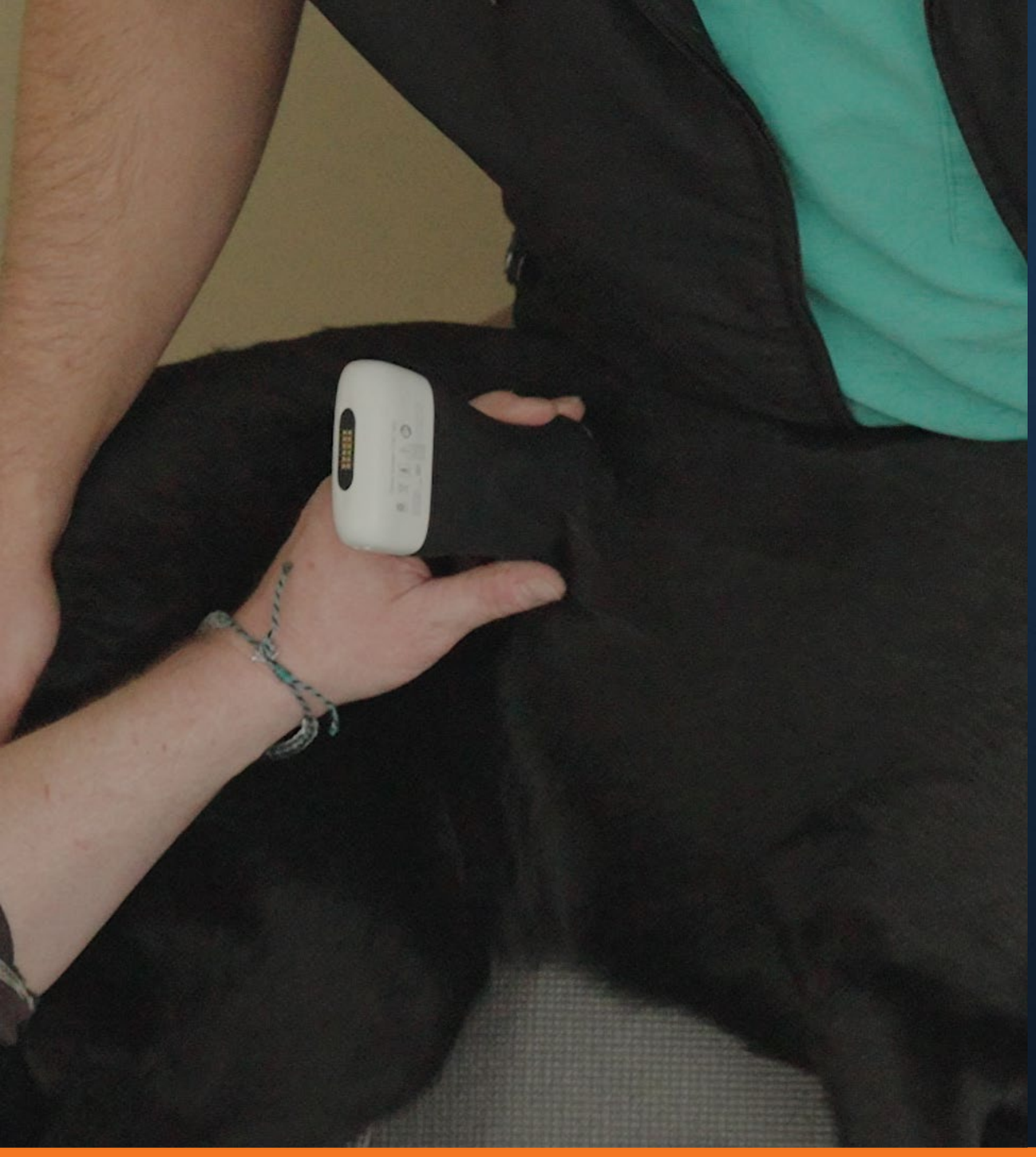

# Pre-Register

*Poll*

# Veterinary POCUS: Renal Pelvic Dilation, it's Not the Kidney's Fault!!!

Tuesday, May 9th 2023
2PM Pacific | 5PM Eastern

www.clarius.com/ultrasound-webinars

# Questions

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*Veterinary Critical Care,*
*University of Calgary*

**Dr. Serge Chalhoub**

*Veterinary Internal Medicine,*
*University of Calgary*

**Dr. Oron Frenkel**

*Emergency Physician*

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# Thank you!