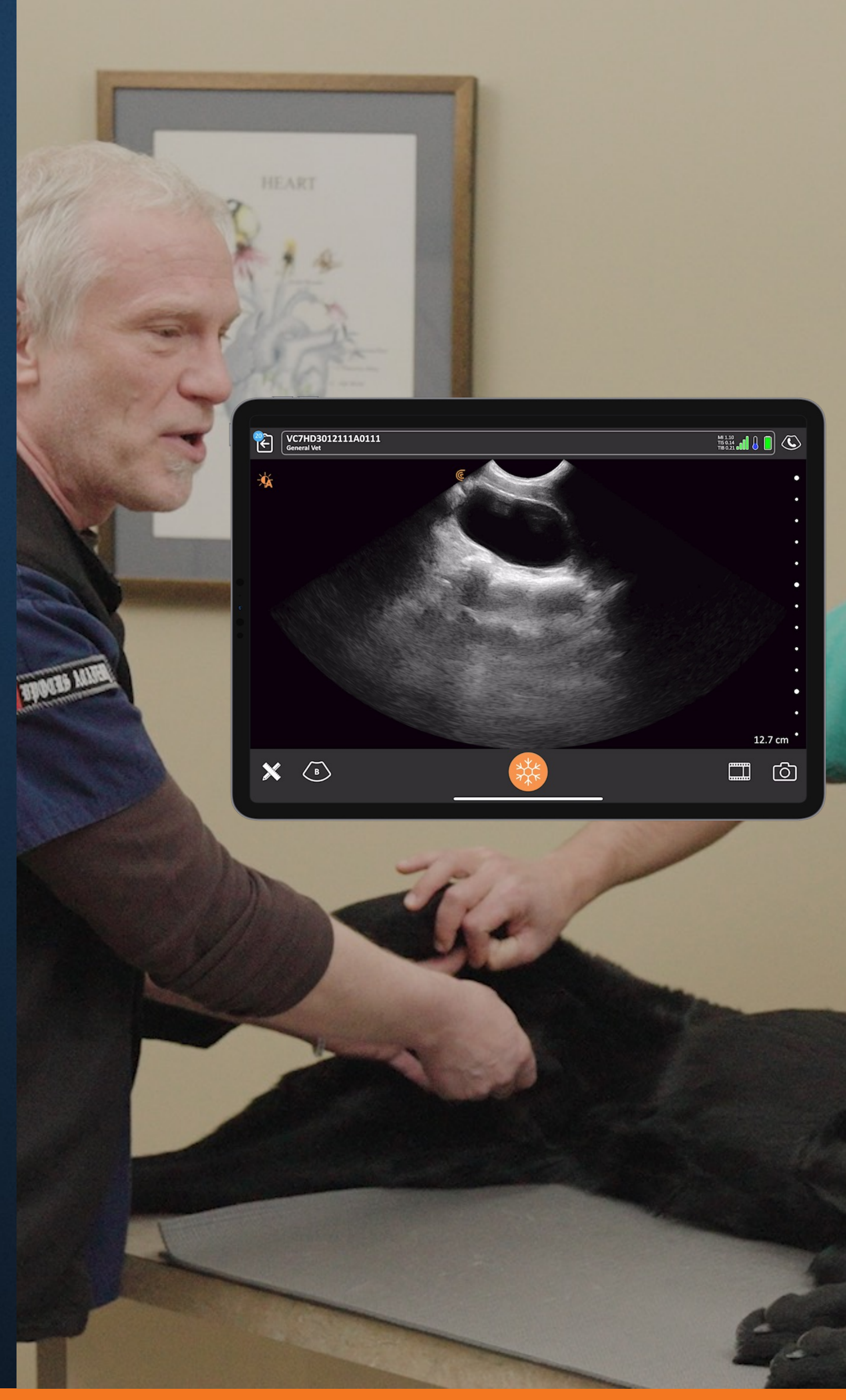




WEBINAR

Veterinary POCUS and Septic Peritonitis: Ultrasound Findings in the Septic Abdomen

January 2024



Your Host



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

Emergency Physician & POCUS Educator
Chairman, Clarius Medical Advisory Board

Ultrasonographic assessment of early leakage in intestinal sutures in dogs

“

Canine abdominal **ultrasound** seems to be a useful diagnostic technique allowing **early detection** of signs of a LIS, before the patient develops clinical signs of **septic peritonitis**

Costanzo G, Linta N, Auriemma E, Perfetti S, Del Magno S, Diana A. Ultrasonographic assessment of early leakage in intestinal sutures in dogs. *Front Vet Sci.* 2023 Mar 2;10:1094287. doi: 10.3389/fvets.2023.1094287. Erratum in: *Front Vet Sci.* 2023 Apr 13;10:1192801. PMID: 36937009; PMCID: PMC10018155.2.9.

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Search results

> [Front Vet Sci.](#) 2023 Mar 2;10:1094287. doi: 10.3389/fvets.2023.1094287. eCollection 2023.

Ultrasonographic assessment of early leakage in intestinal sutures in dogs

[Giulia Costanzo](#)¹, [Nikolina Linta](#)², [Edoardo Auriemma](#)¹, [Simone Perfetti](#)², [Sara Del Magno](#)², [Alessia Diana](#)²

Affiliations + expand
PMID: 36937009 PMCID: [PMC10018155](#) DOI: [10.3389/fvets.2023.1094287](#)
[Free PMC article](#)

Erratum in

[Corrigendum: Ultrasonographic assessment of early leakage in intestinal sutures in dogs.](#)
Costanzo G, Linta N, Auriemma E, Perfetti S, Del Magno S, Diana A.
Front Vet Sci. 2023 Apr 13;10:1192801. doi: 10.3389/fvets.2023.1192801. eCollection 2023.
PMID: 37124561 [Free PMC article.](#)

Abstract

Intestinal suture dehiscence is one of the most feared complications following gastrointestinal surgery in both human and veterinary medicine, increasing the morbidity and mortality of these patients. Clinical and laboratory early signs of septic peritonitis are not always easily identifiable while prompt treatment should help decrease postoperative morbidity and mortality. The aim of this study is to describe the ultrasonographic (US) features of confirmed leakage of intestinal sutures (LIS) and to evaluate if this imaging technique can be useful as noninvasive tool for the early diagnosis of LIS. Seven dogs developed LIS in a range of three-four days after gastrointestinal surgery and four of these developed a second dehiscence. On B-mode ultrasonography, all intestinal surgical sites were identified and characterized by a bowel focal thickening with reduced or absent wall layering and the presence of hyperechoic, double-walled foci at regular intervals (suture material). Furthermore, hyperechoic linear interfaces associated with dirty acoustic shadowing and comet-tail artifacts crossing the intestinal wall to free-float in peritoneal cavity or in a saccate collection have been documented. On the basis of these preliminary results, canine abdominal ultrasound seems to be a useful diagnostic technique for post-operative monitoring of patients undergoing intestinal surgery, allowing early detection of signs of a LIS, before the patient develops clinical signs of septic peritonitis.

Assessment of a standing position during abdominal point-of-care ultrasound on abdominal fluid score in dogs

“...standing abdominal POCUS examination may be a valid option for identifying and quantifying peritoneal effusion in situations when a more traditional right lateral approach cannot be performed.

Buckley C, Seitz M, Wills RW, Lee AM. Assessment of a standing position during abdominal point-of-care ultrasound on abdominal fluid score in dogs. *J Vet Emerg Crit Care (San Antonio)*. 2023 Sep-Oct;33(5):559-566. doi: 10.1111/vec.13329. Epub 2023 Aug 12. PMID: 37573258.

> [J Vet Emerg Crit Care \(San Antonio\)](#). 2023 Sep-Oct;33(5):559-566. doi: 10.1111/vec.13329. Epub 2023 Aug 12.

Assessment of a standing position during abdominal point-of-care ultrasound on abdominal fluid score in dogs

[Christy Buckley](#)¹, [Marc Seitz](#)², [Robert W Wills](#)³, [Alison M Lee](#)²

Affiliations + expand

PMID: 37573258 DOI: [10.1111/vec.13329](#)

Abstract

Objective: To assess the use of a standing position during abdominal point-of-care ultrasound (POCUS) examination when evaluating dogs for peritoneal effusion.

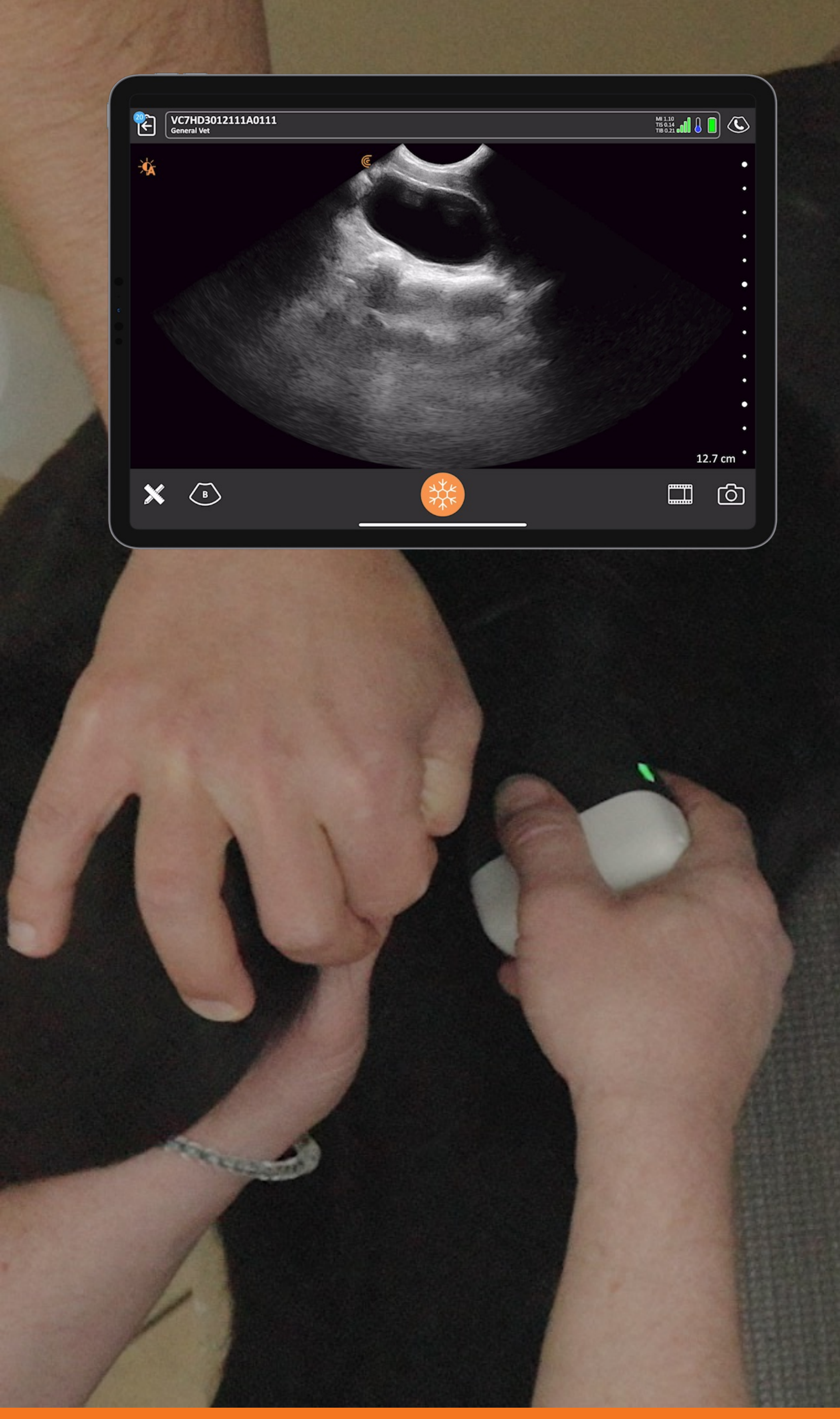
Design: Randomized prospective study over 17 months.

Setting: Single-center, university veterinary teaching hospital.

Animals: Thirty dogs presenting for acute abdominal disease. Eligibility included suspicion for free peritoneal effusion and the ability to stand.

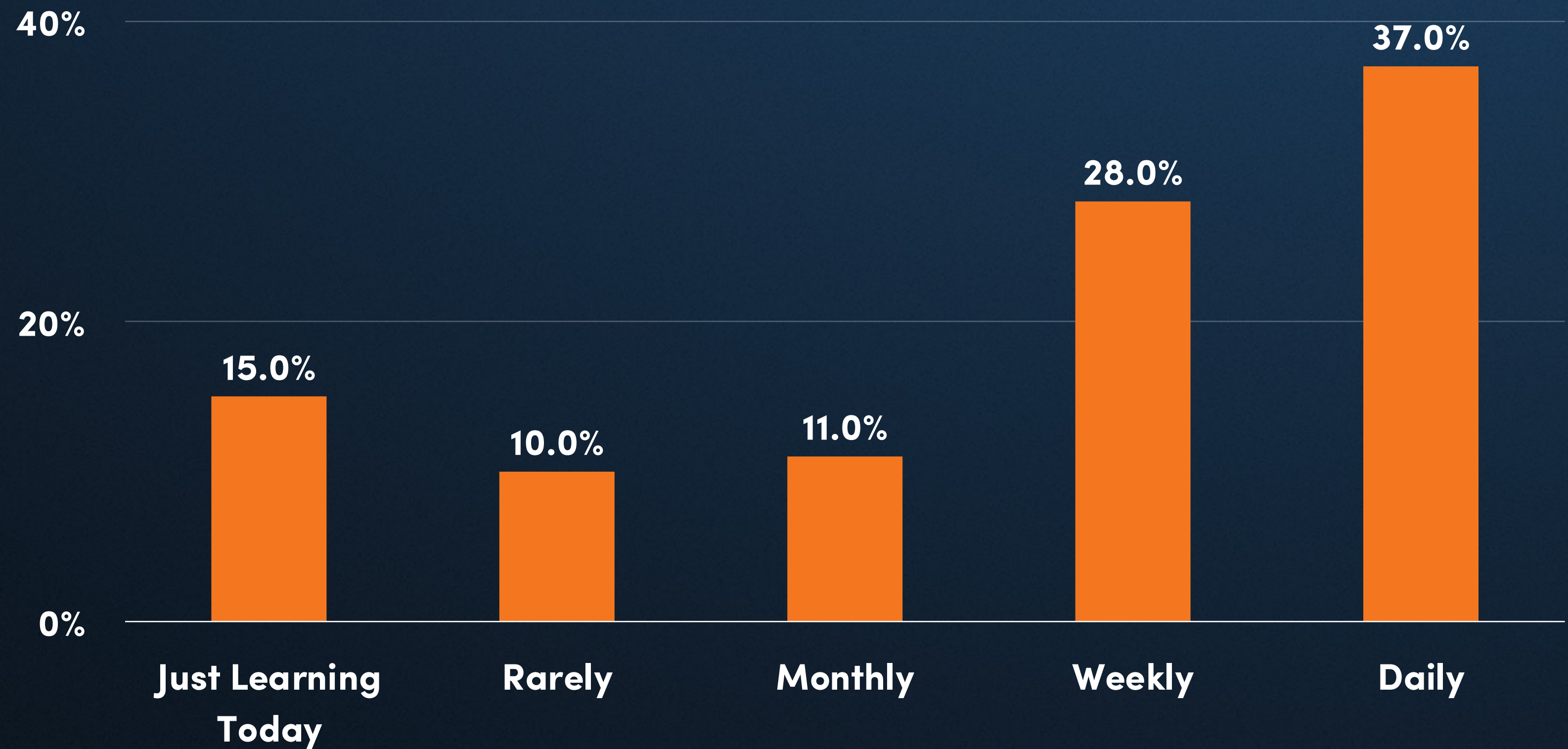
Interventions: Dogs underwent standing abdominal POCUS, right lateral abdominal POCUS, and a full abdominal ultrasound. We originally had nothing listed. It now includes all three ultrasound evaluations that were performed for each patient.

Measurements and main results: Patients underwent both a right lateral and standing abdominal POCUS via a previously described abdominal focused assessment with sonography for trauma (A-FASTr) and A-FASTs, respectively) technique in a randomized and sequential order followed by a full abdominal ultrasound (AUS-full). The A-FASTs examination included a right flank location in addition to the following standard views: subxiphoid, left flank, urinary bladder, and umbilicus. Five-second cine loops were obtained at each location for each examination and reviewed in the order they were obtained. Locations for both A-FAST exams were interrogated in the same order every time. The cine loops were scored for the degree of peritoneal effusion based on a previously published abdominal fluid scoring system by a board-certified radiologist, radiology resident, and radiology intern. The overall abdominal fluid score (AFS) was compared to a subjective full abdominal ultrasound score given by a board-certified radiologist. Six dogs had no peritoneal



Interactive Poll

How often to you use ultrasound to assess acutely ill patients?

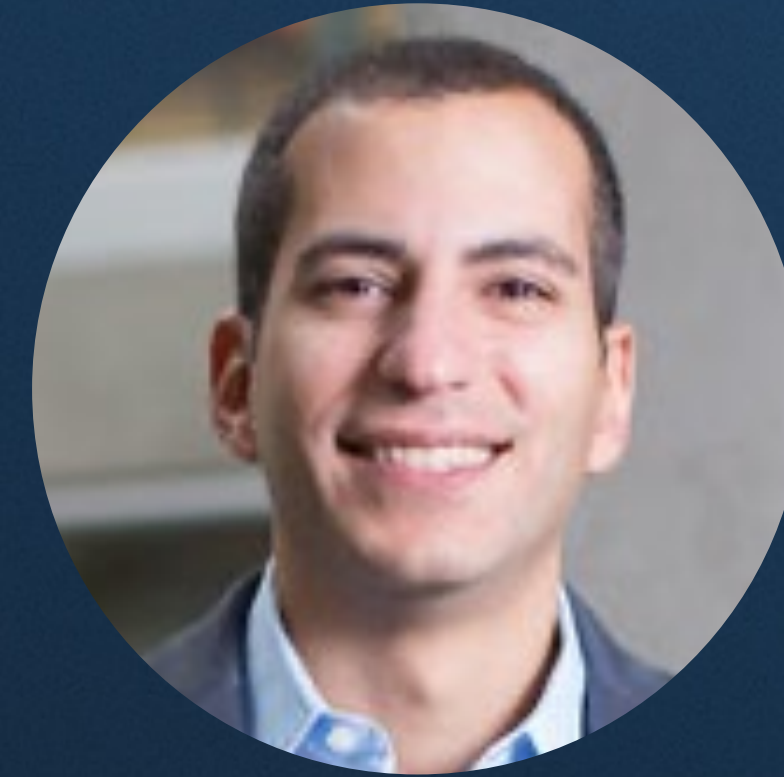


Your Host



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

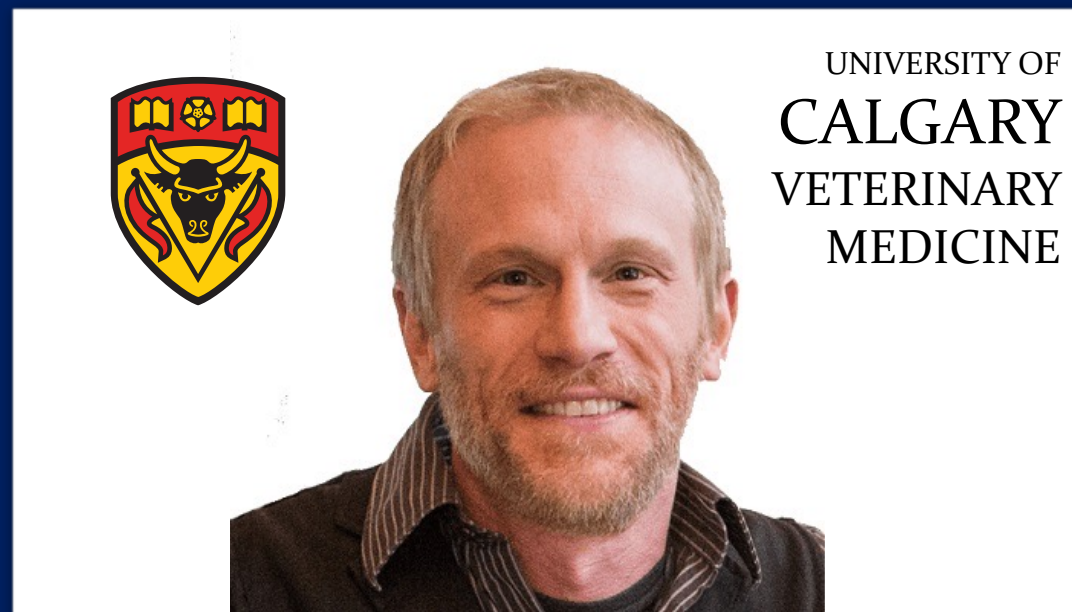
Professor, Faculty of Veterinary Medicine,
University of Calgary



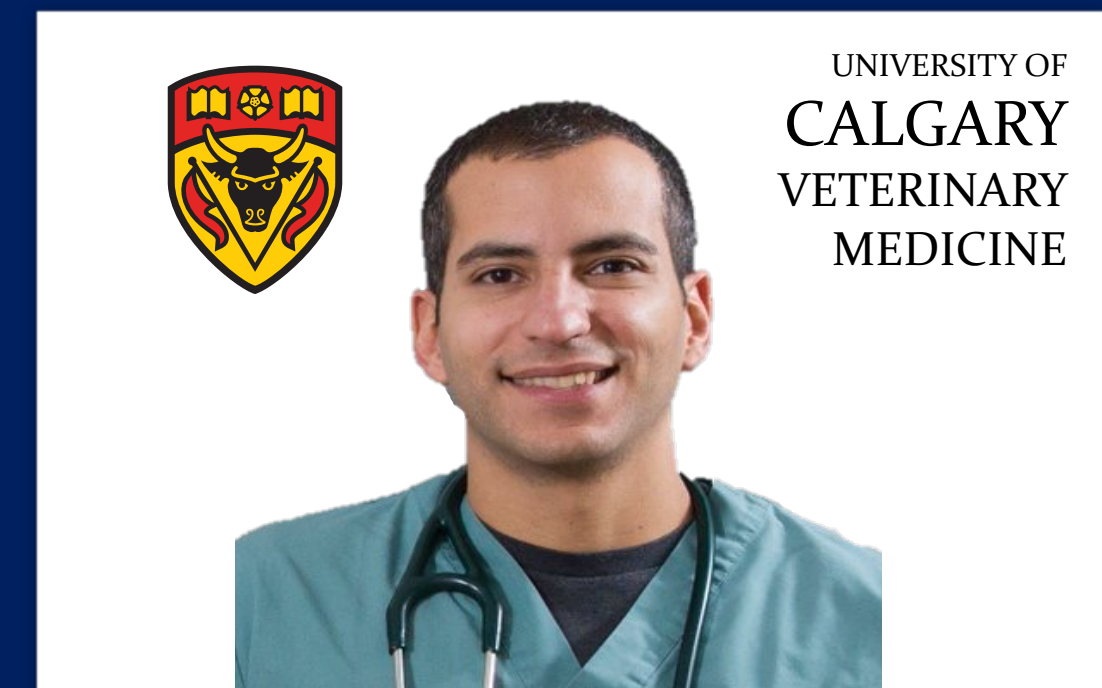
**Dr. Serge Chalhoub, BSc, DVM,
DACVIM**

Associate Professor, Faculty of Veterinary
Medicine, University of Calgary

Veterinary POCUS and Septic Peritonitis: Ultrasound Findings in the Septic Abdomen



**Søren Boysen, DVM,
DACVECC**
srboysen@ucalgary.ca



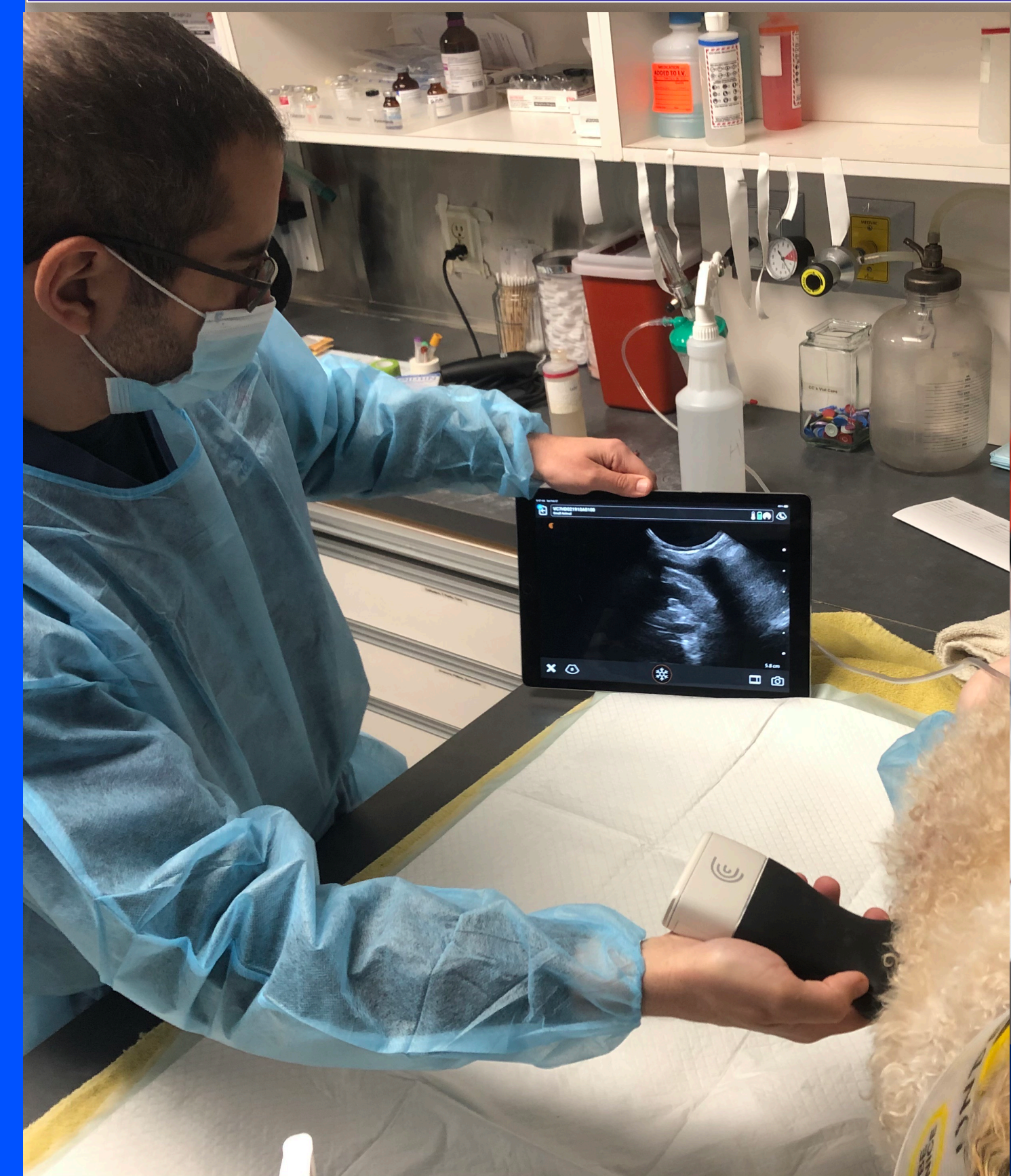
**Serge Chalhoub, DVM,
DACVIM**
schalhou@ucalgary.ca

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

Objectives for today

- Briefly describe the pathophysiology of septic peritonitis
- Demonstrate abdominal scanning for free fluid and air
- Image the gallbladder for gallbladder wall edema
- Use APOCUS to assess the caudal vena cava for hemodynamic status
- Showcase pathological examples and key treatment of the septic abdomen
- Demonstrate ultrasound-guided abdominocentesis to obtain samples for cytology

Once upon a time in the ER Dr. Chalhoub...



Dyson: History and presenting complaint

- 7-year-old male neutered Boxer cross
- 3-day history of progressive vomiting
- Anorexic x 2 days
- Lethargic
- No history of toxin ingestion but got into garbage
- Diet – Hill's canine maintenance and table food
- Fully vaccinated
- No travel history



Dyson



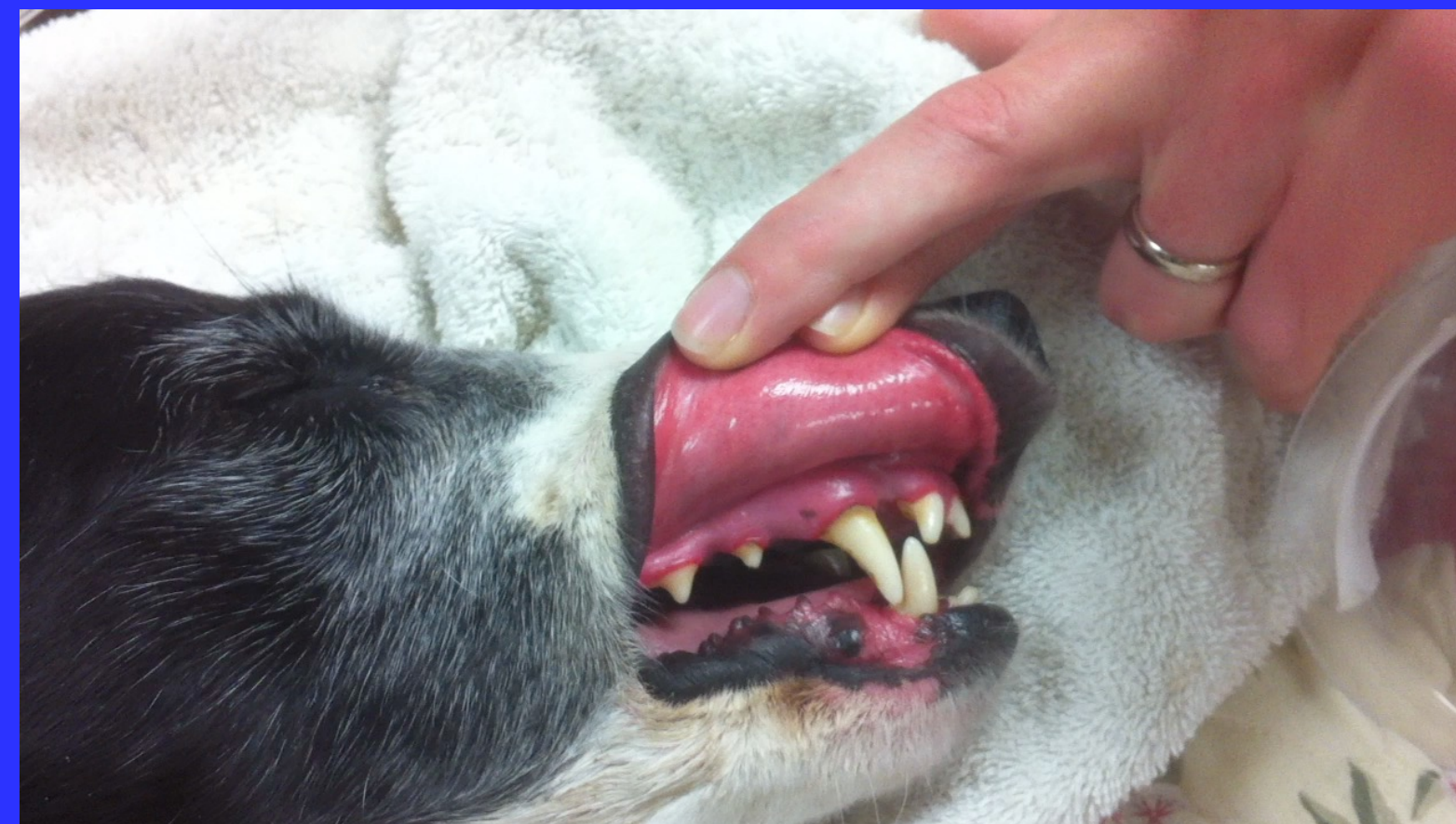
Pancreatitis – run a cPLI: Nailed it!! ...or not....let's start with stable or unstable...

Dyson: Physical exam

- T = 40.7C (105.3F), heart rate 168, respiratory rate 24, bounding pulses
- Mucous membranes: brick red, capillary refill time ~1 second
- No murmurs or arrhythmias, lung auscultation – unremarkable
- Extremely lethargic & appears nauseous
- Abdominal palpation – grunts when you palpate the cranial abdomen and tenses; arched back

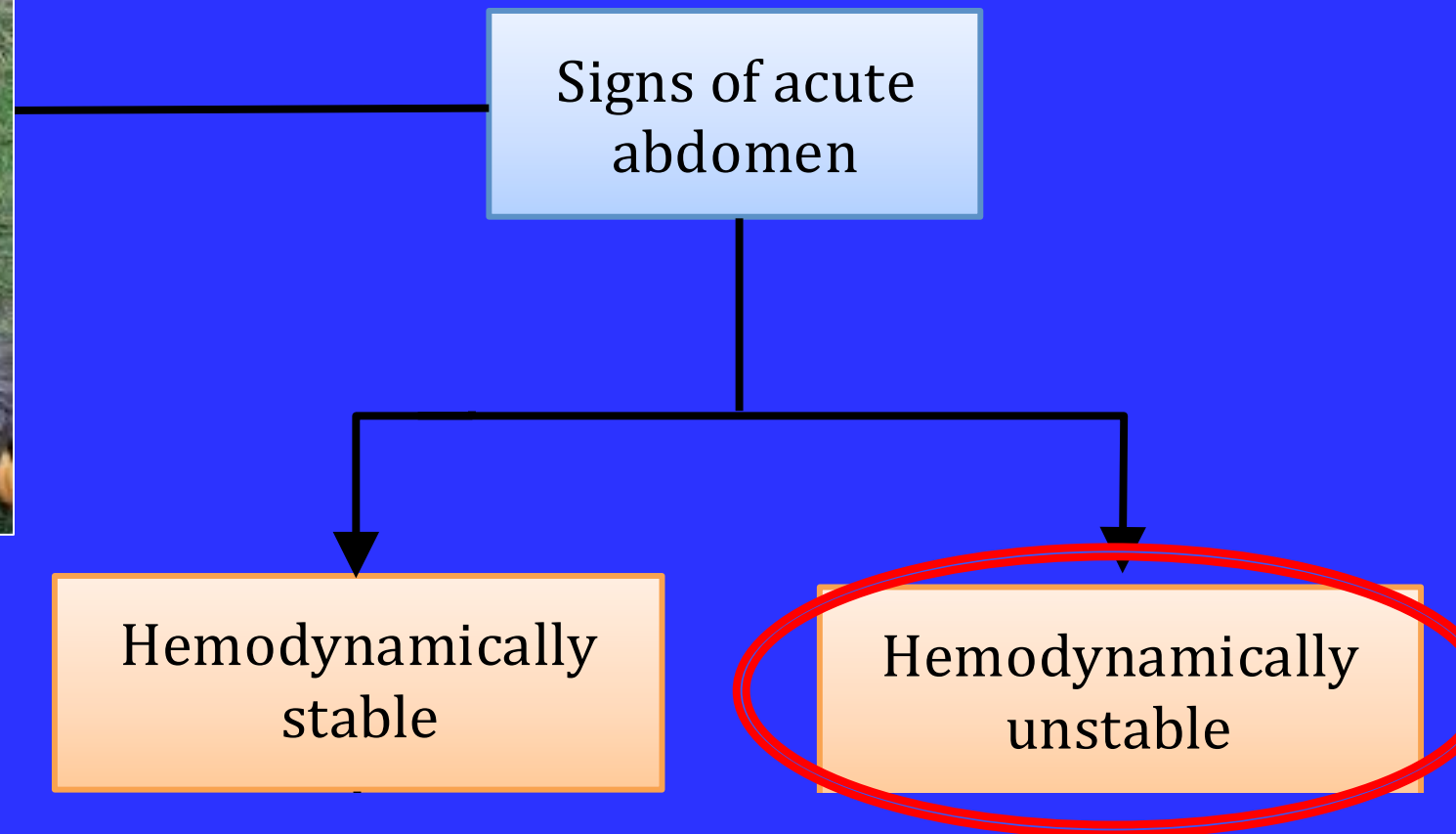
Stable or unstable?

(Not Dyson FYI)



Dyson: First 5 minutes...

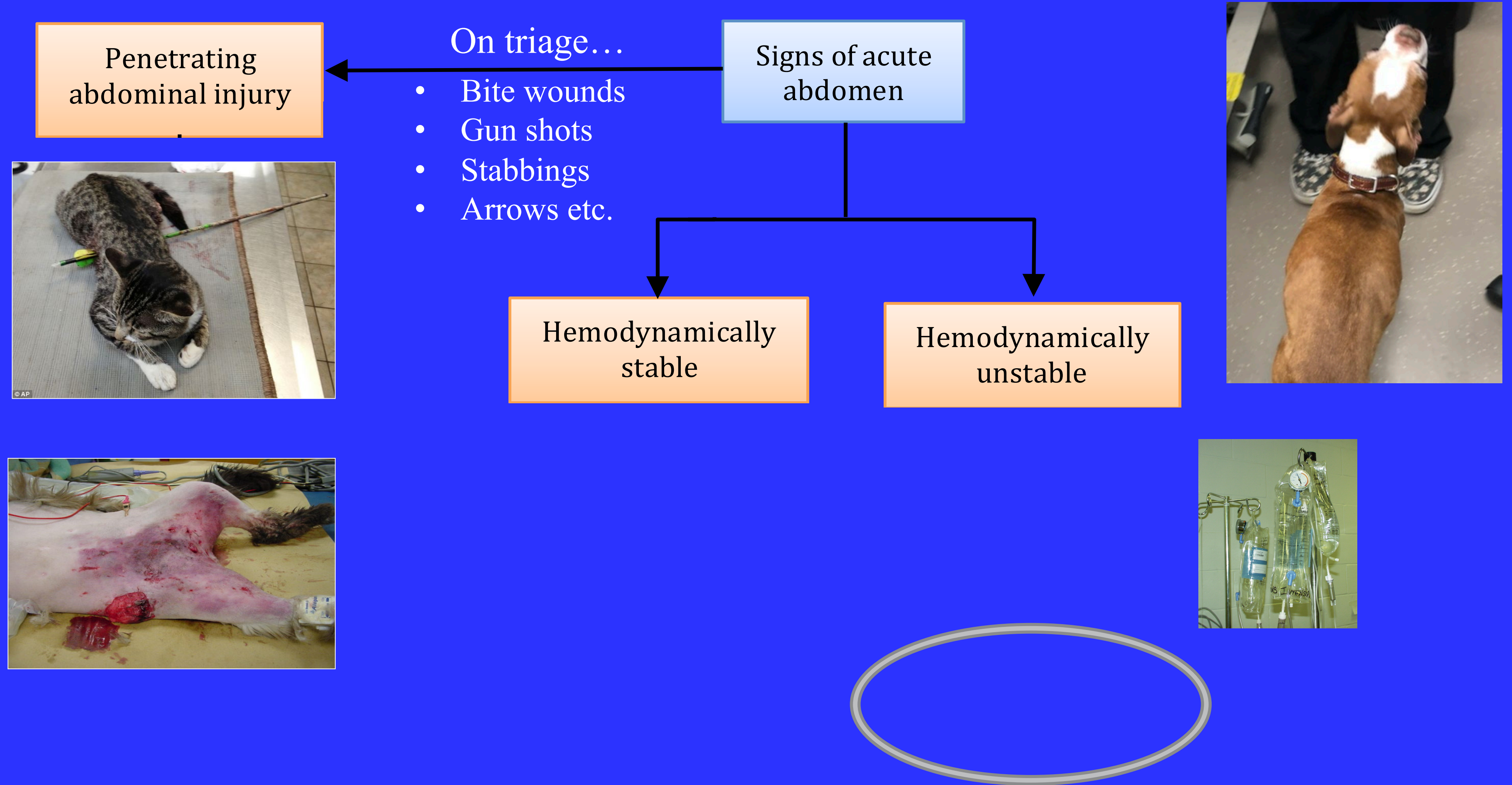
T = 40.7° C, Heart rate 168, Respiratory rate 24
Bounding pulses, mucous membranes brick red
Rapid capillary refill time: ~1 second
Lung auscultation – unremarkable
Abdominal palpation – painful
Appears nauseous
Extremely lethargic



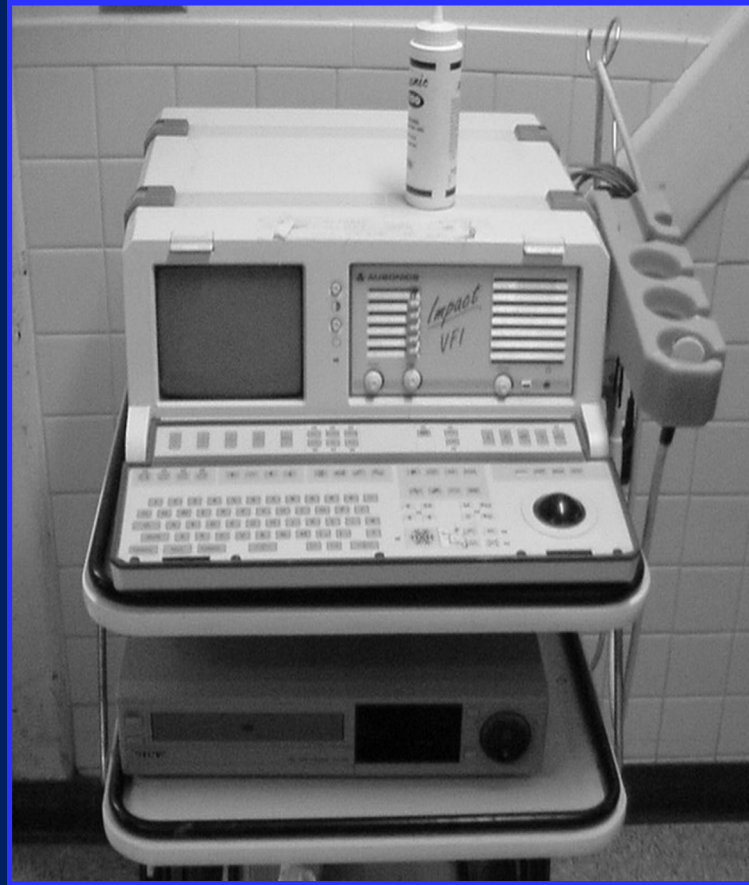
- 1. Rapidly assess cardiopulmonary status
 - Stable or unstable? Triage exam
 - Unstable: should we call a surgeon? **Maybe, but not yet...**
 - Minimum emergency data base (MEDB): **YES!**



Dyson: First 5 minutes...



Dyson: Minimum emergency data base



Then.....



Now.....

ECG

All in 5-10 minutes of presentation!!

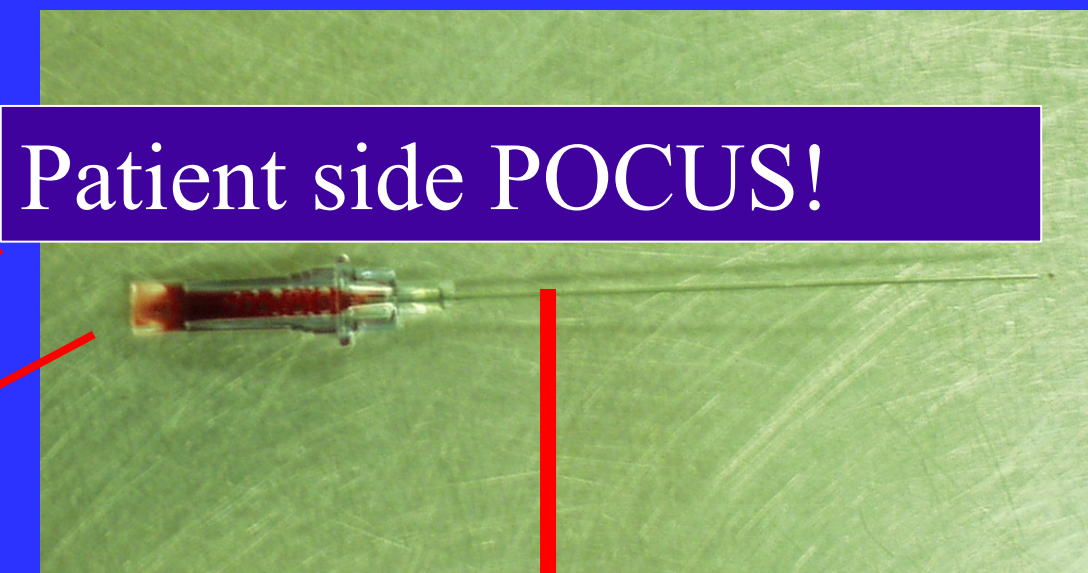


Don't flush the stylet before placing IV catheter

Big 4/5

PCV, Total Solids, Glucose, BUN, Lactate

Patient side POCUS!



Total solids

Oxygenation SPO₂

Glucose

IV access secured

Blood pressure



Oxygen Lactate

- Sample collection (ideally before therapy)
- Other emergency diagnostics (case specific)

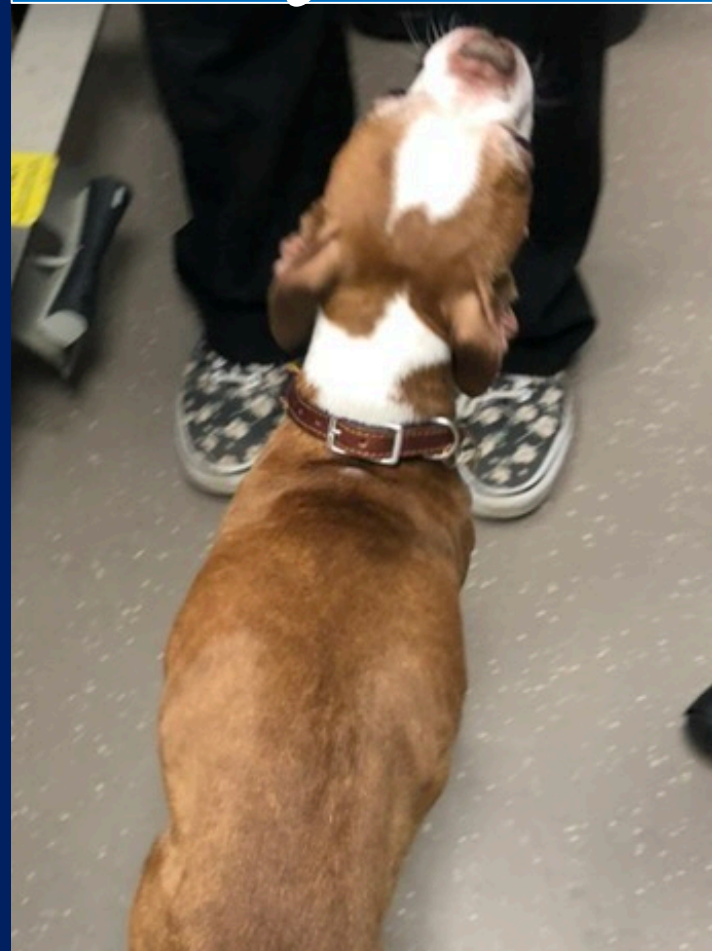
And for Dyson...

Methadone 0.2 mg/kg, IV once IV catheter placed

What POCUS binary response question(s) do you want to rapidly rule in/out considering the clinical information?

I do love the urinary tract...let's start with the urinary bladder!!!

Dyson



Emergency cage side diagnostics

PCV 37%, TS 56 g/dl
Glucose 4.5 mmol/L (94 mg/dl)
BUN 63.3, mmol/L USG 1.039
Hyperlactatemic (6.4 mmol/l)
Doppler blood pressure 110 mmHg
ECG: Sinus tachycardia

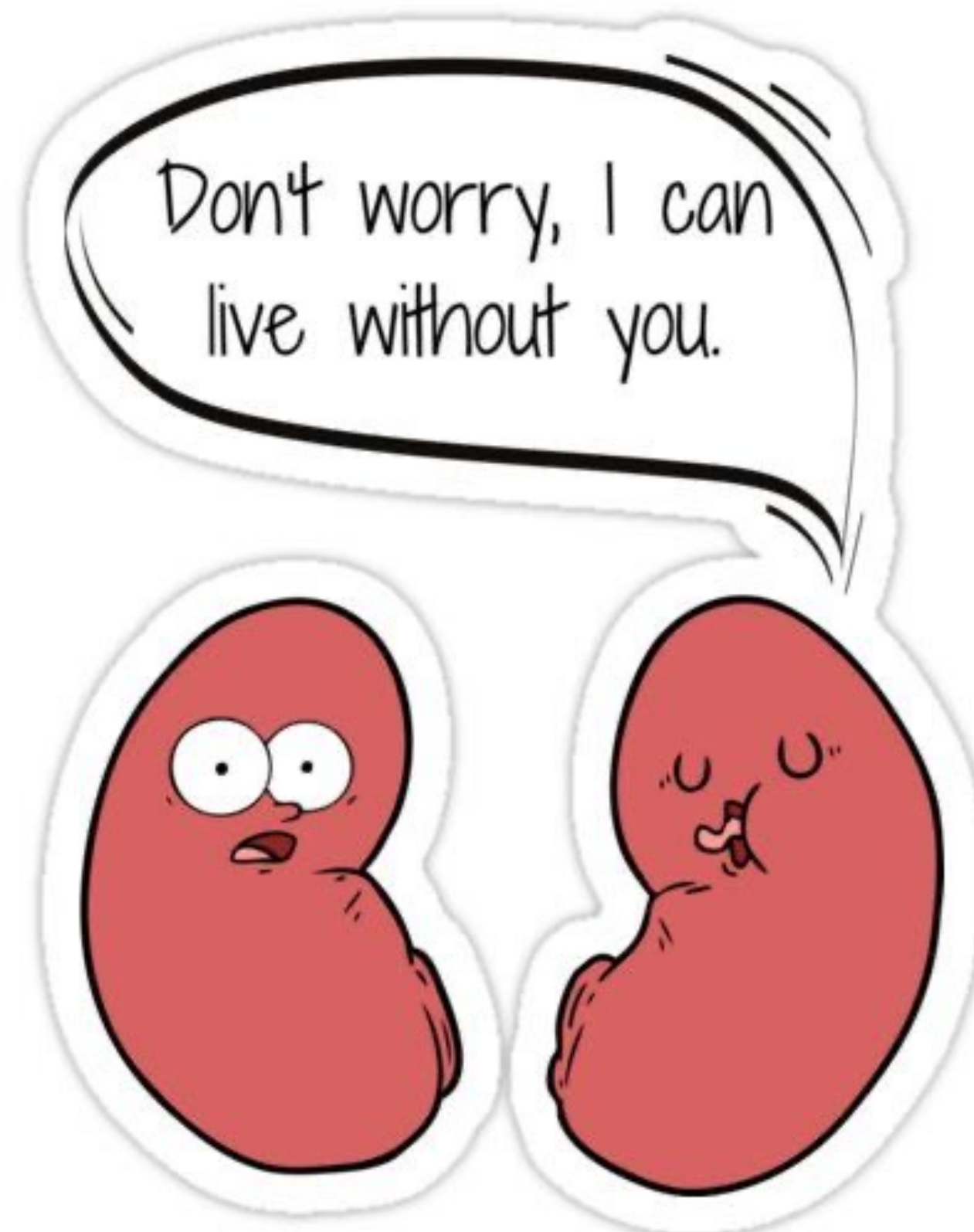
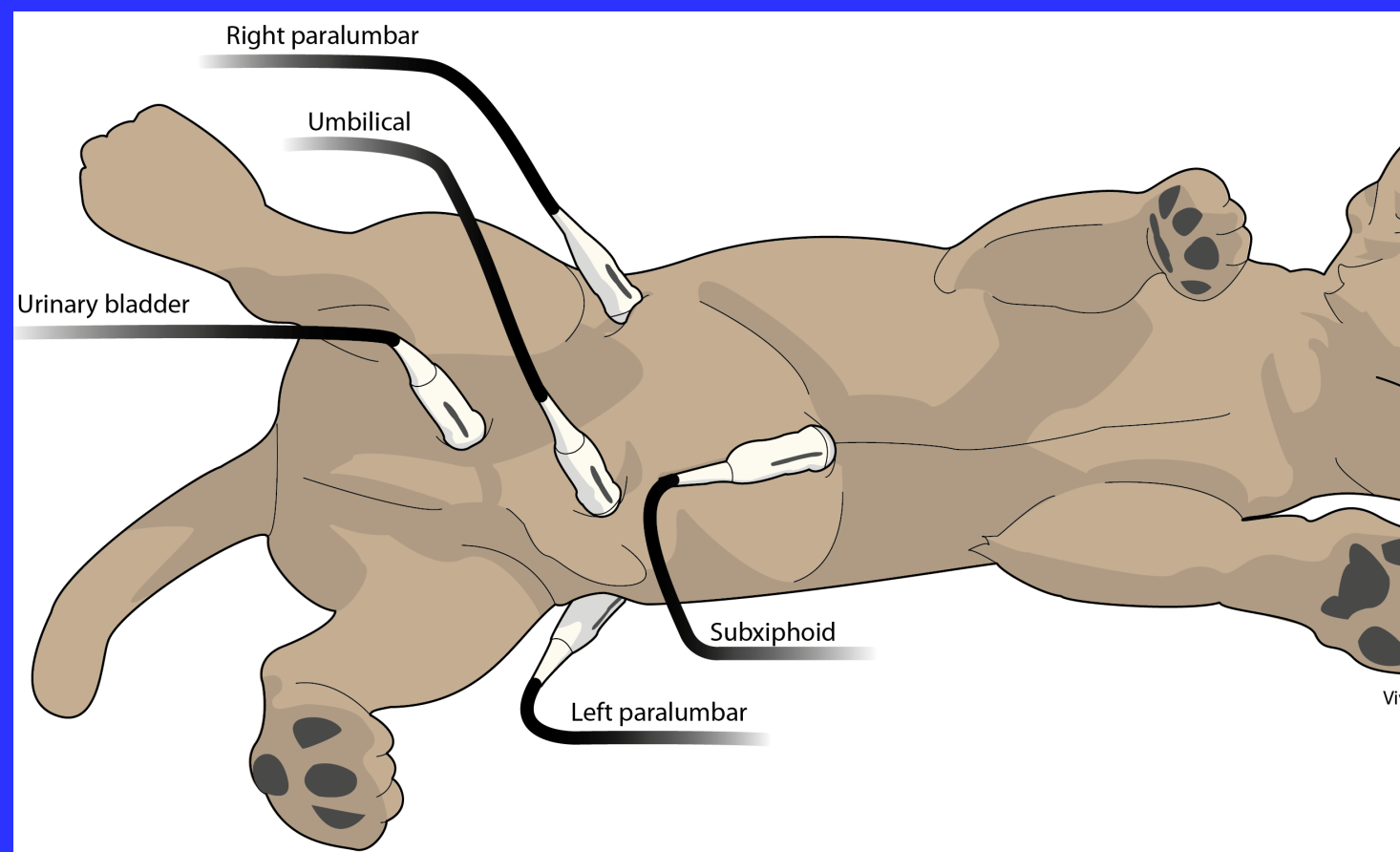


POCUS and unstable patients.....

Shock has many causes and requires

- Dyson considerations:
- Currently no respiratory signs
 - Cardiovascular POCUS
 - APOCUS to assess abdominal
 - Reassess as cage side

Abdominal POCUS

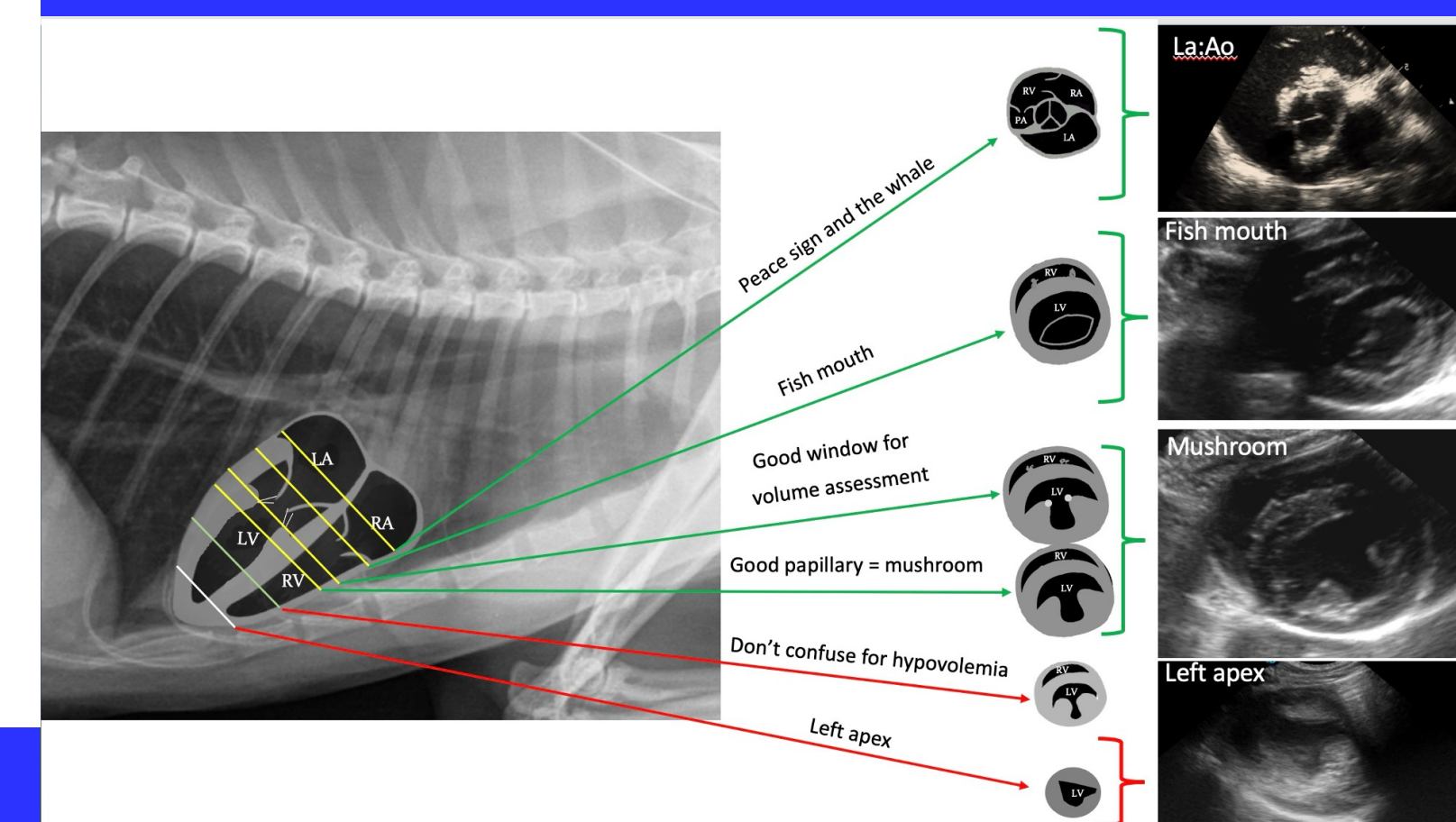


Systems...

Cardiac function

Complete baseline POCUS

Cardiovascular

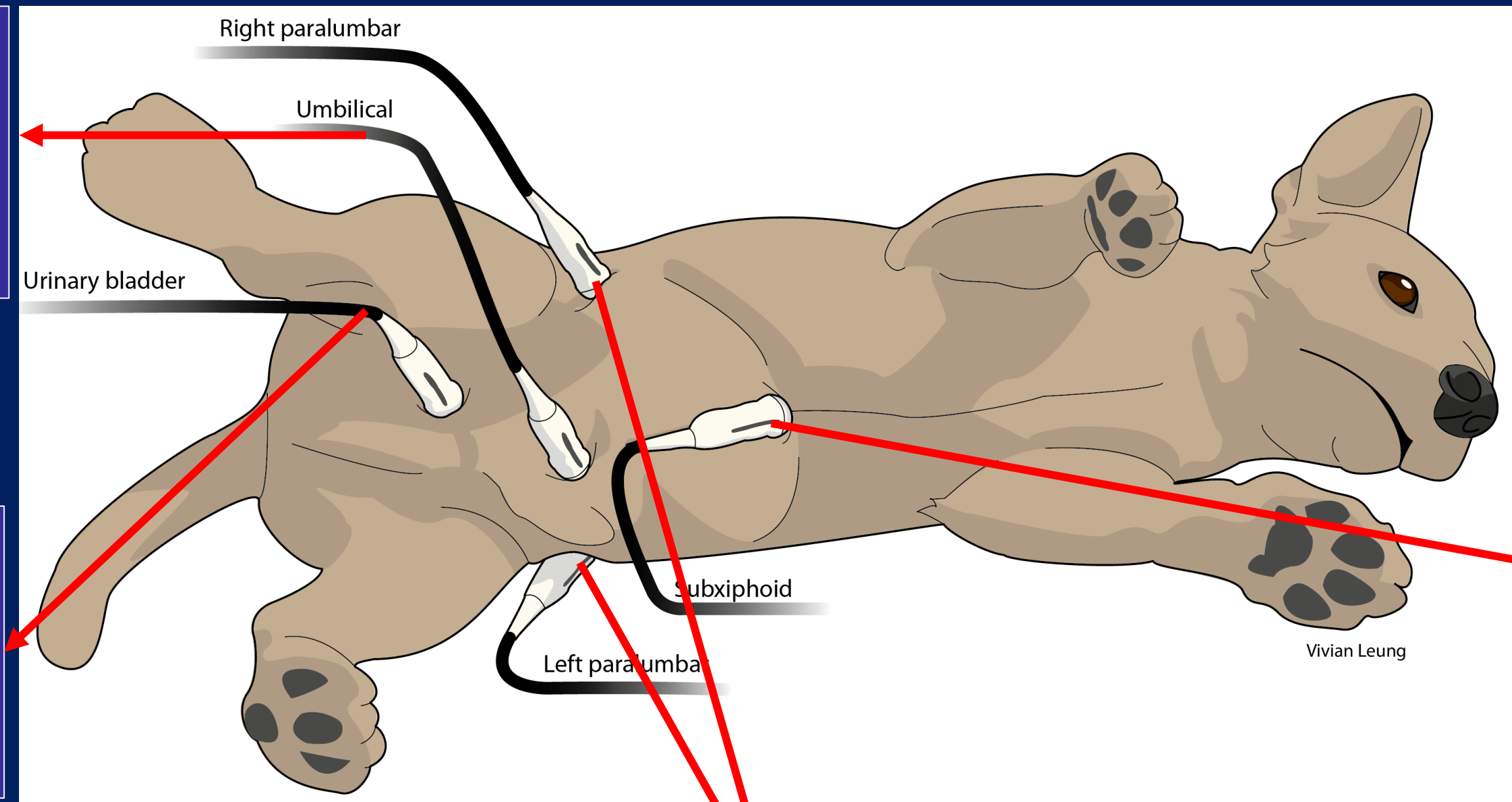


5-Point APOCUS binary response questions

All Sites: 1) Is there free abdominal fluid Y/N* 2) Is there free abdominal air Y/N*

12) Splenic masses? More research needed

3) Urine production Y/N
3b) Pyometra?



4) Is there generalized ileus Y/N? (duodenum)
5) Is there renal pelvic dilation Y/N?

6) Is there gallbladder wall edema Y/N*

7) Is there gastric ileus +/- fluid distention Y/N

8) OK to give a fluid bolus? Y/N
(CVC assessment)**
(combined with heart)

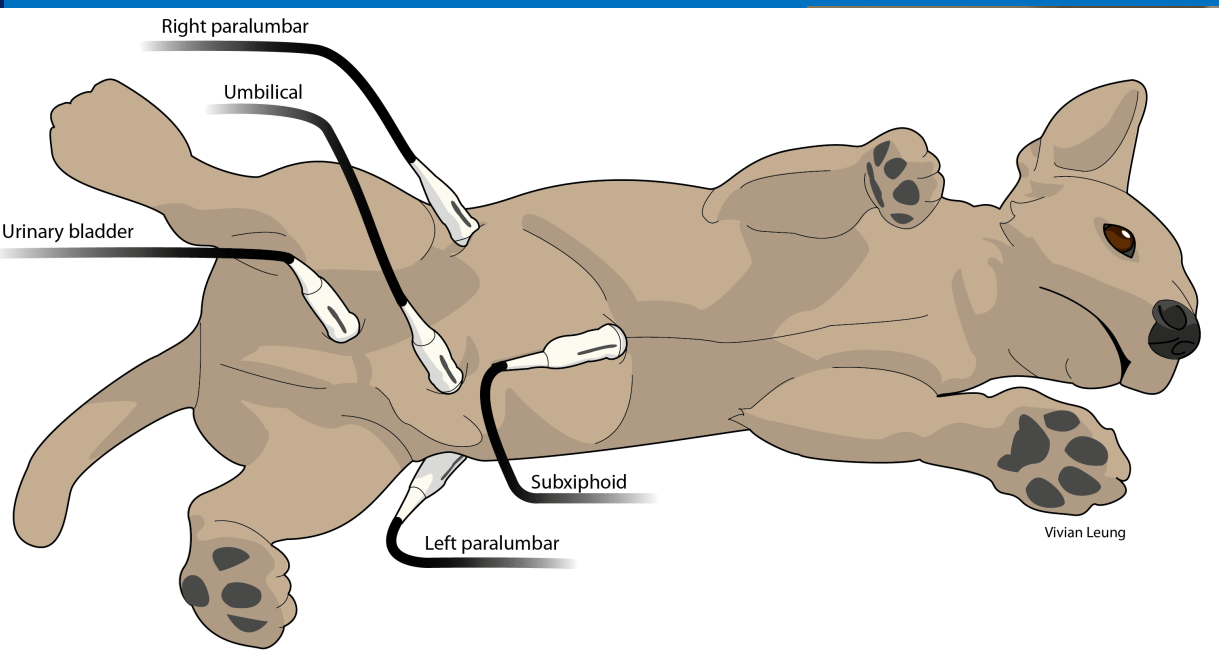
9) Is there pericardial effusion Y/
(combined with heart)

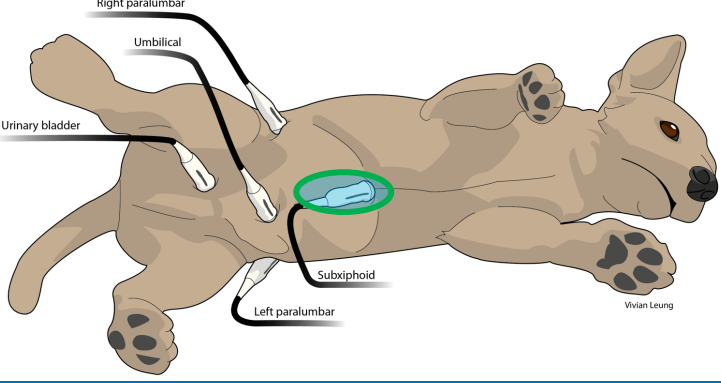
10) Is there CPR cardiac activity Y/N?

11) Is there pleural effusion Y/N

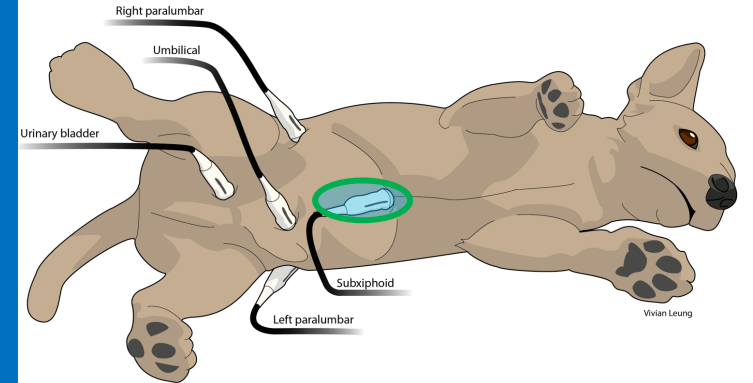
Review: Veterinary POCUS: Rapidly assessing acute abdominal conditions using the 5-point abdominal point-of-care ultrasound (POCUS) exam

The 5 APOCUS sites for abdominal fluid and air



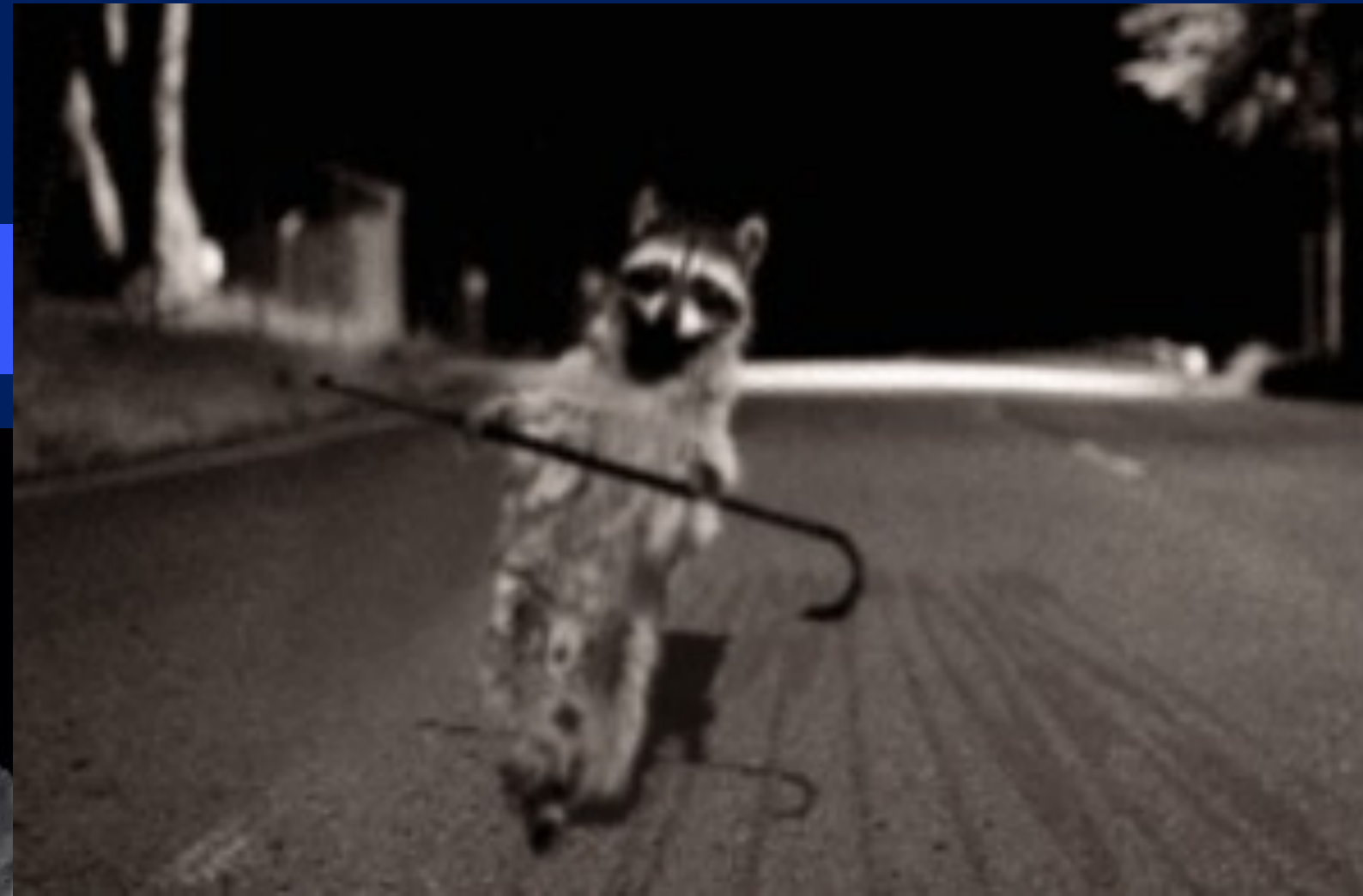


Subxiphoid site: Gallbladder

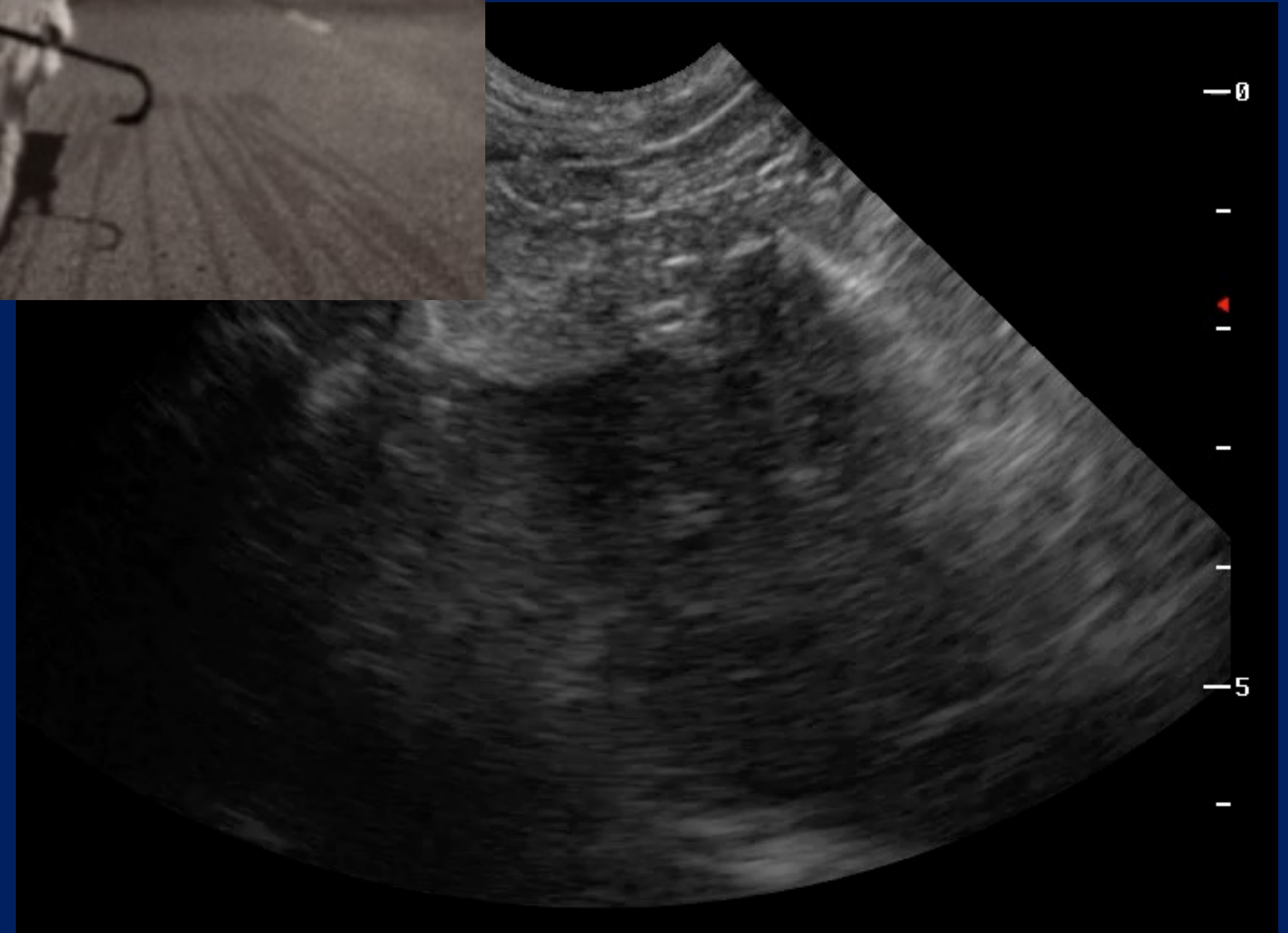
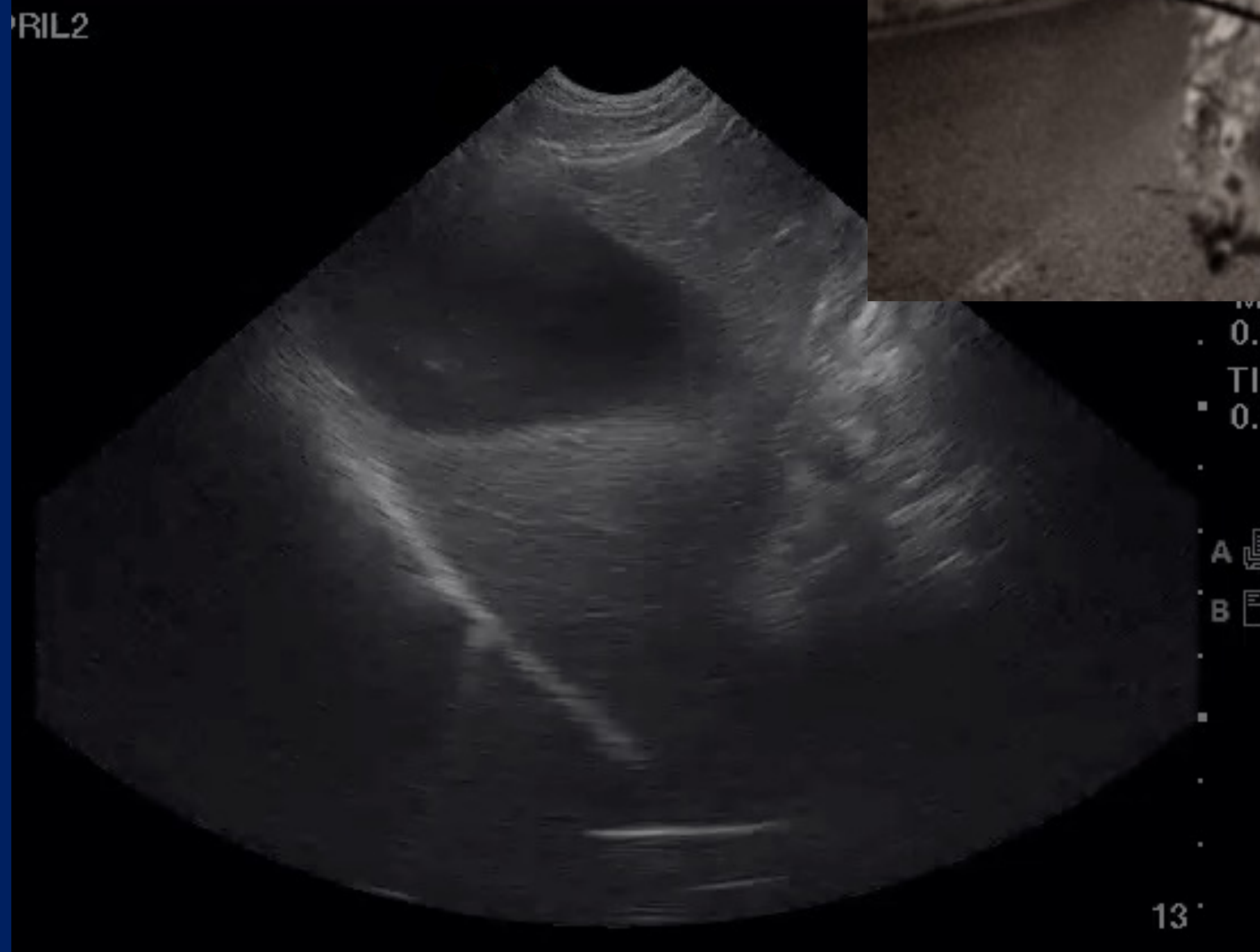


Dyson: Interpretation?

Normal dog



Dyson



Gallbladder wall thickening & edema

J Am Vet Med Assoc. 2017 Sep 15;251(6):681-688. doi: 10.2460/javma.251.6.681.

Comparison of clinical findings between dogs with suspected anaphylaxis and dogs with confirmed sepsis.

Walters AM, O'Brien MA, Selmic LE, McMichael MA.

Anaphylaxis

Sepsis

Right sided heart failure

Pericardial effusion

Other: hypoalbuminemia, renal insufficiency, cirrhosis, IMHA, cholecystitis, pancreatitis, etc.

Quantz et al J Vet Emerg Crit Care. 19(6) 2009

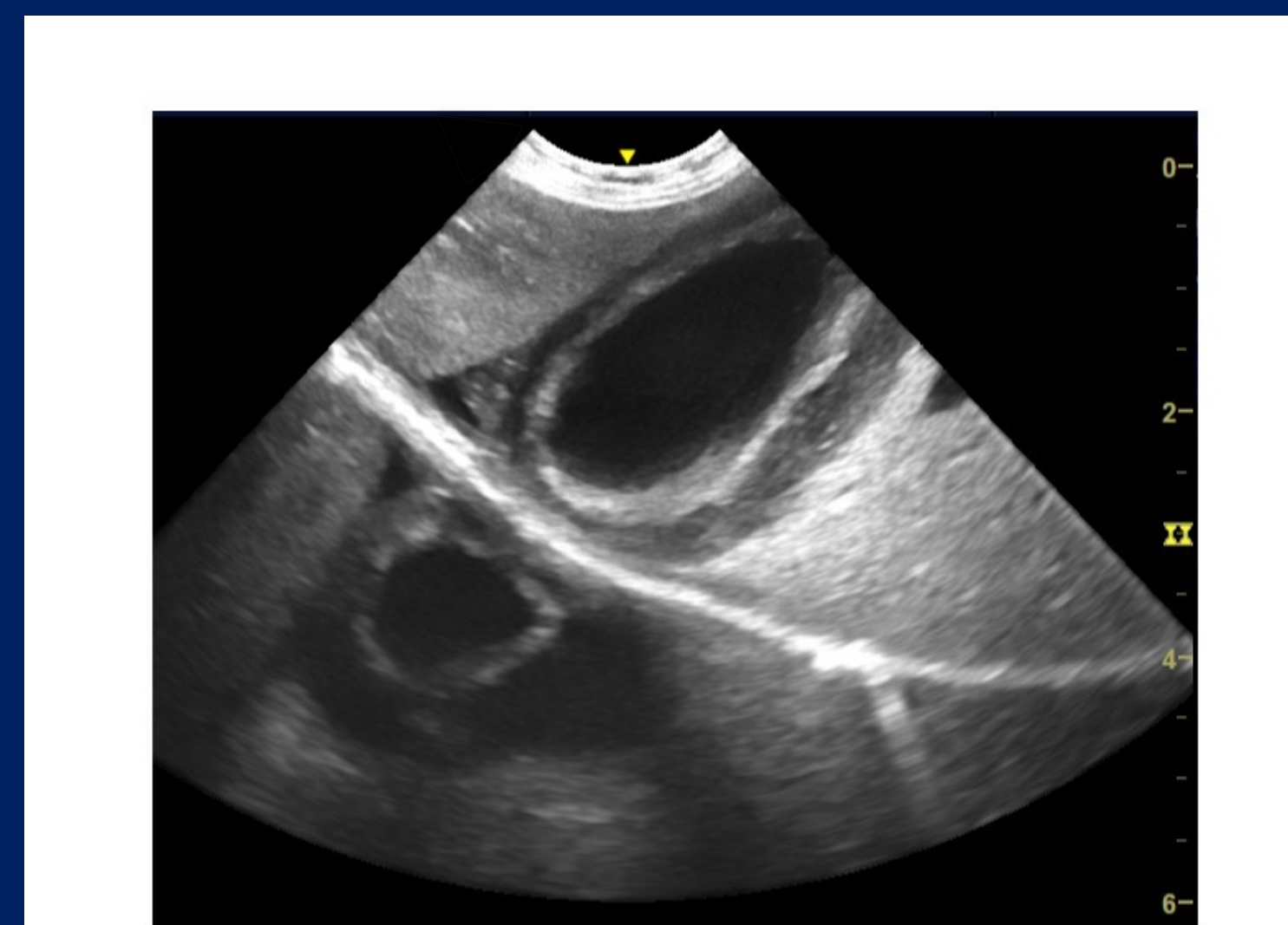
Walters et al. J Am Vet Med Assoc. 251(6) 2017

Merveille Abstract J Vet Intern Med, 2017

Merveille Abstract J Vet Intern Med, 2019

Fluid overload

Dexmedetomidine?



Dyson presents ambulatory- where will fluid accumulate?

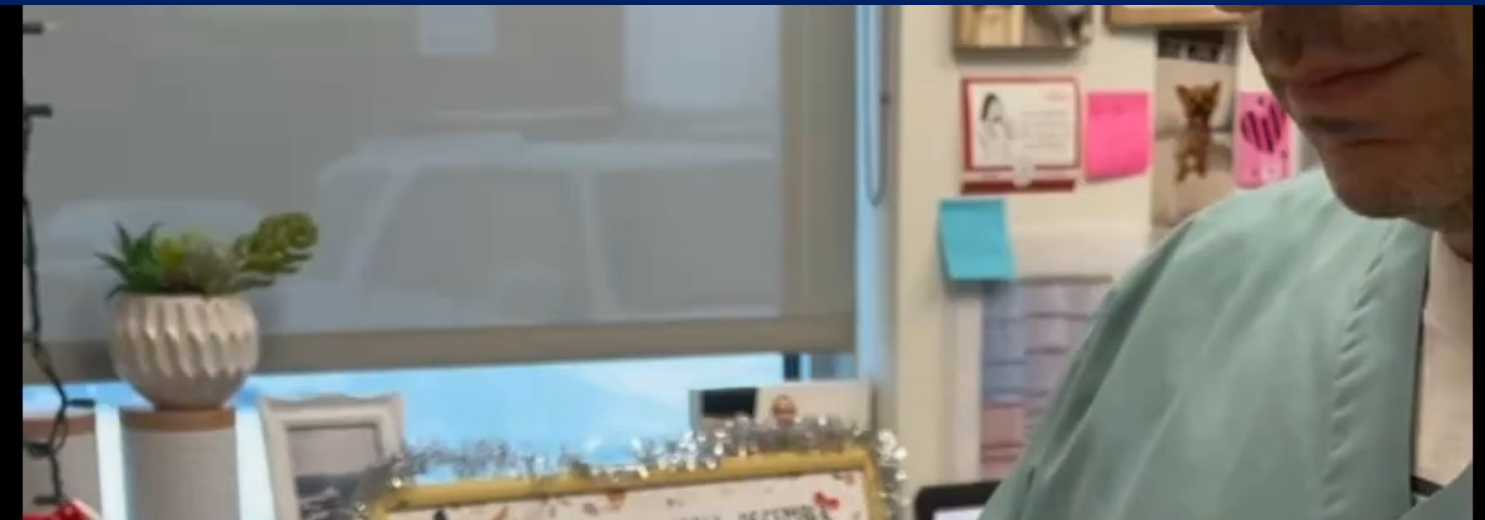
Review: Veterinary POCUS: Rapidly assessing acute abdominal conditions using the 5-point abdominal point-of-care ultrasound (POCUS) exam

Pushing hard can displace fluid!



Abdominocentesis with in house fluid analysis!

- Save a sample for culture
- Will take a few minutes to prep and assess the slide
- Let's go back to Dyson while we wait for cytology results
 - Unstable, free abdominal fluid, halo sign
 - Secured IV access
 - Additional POCUS findings?

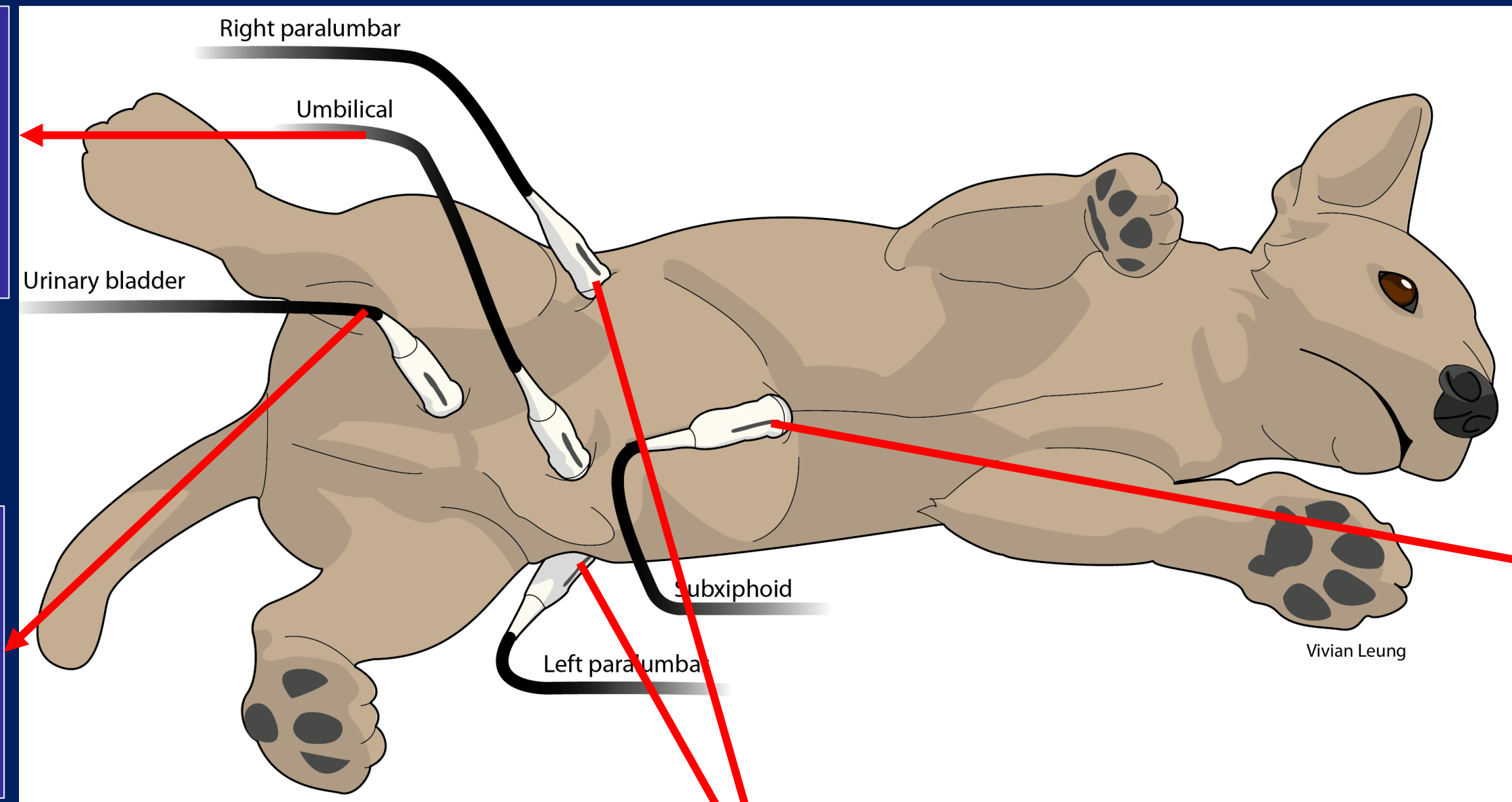


5-Point APOCUS binary response questions

All Sites: 1) Is there free abdominal fluid Y/N* 2) Is there free abdominal air Y/N*

12) Splenic masses? More research needed

3) Urine production Y/N
3b) Pyometra?



4) Is there generalized ileus Y/N? (duodenum)

5) Is there renal pelvic dilation Y/N?

6) Is there gall bladder wall edema Y/N*

7) Is there gastric ileus +/- fluid distention Y/N

8) OK to give a fluid bolus? Y/N
(CVC assessment)**
(combined with heart)

9) Is there pericardial effusion Y/
(combined with heart)

10) Is there CPR cardiac activity Y/N?

11) Is there pleural effusion Y/N

Combine the answer of abdominal POCUS findings with other POCUS results, history and clinical findings to narrow the differential diagnosis

Dyson: Post methadone

- Which site is most sensitive for free abdominal air in Dyson?
- **REMEMBER:** Scan the patient in the position they are most comfortable!



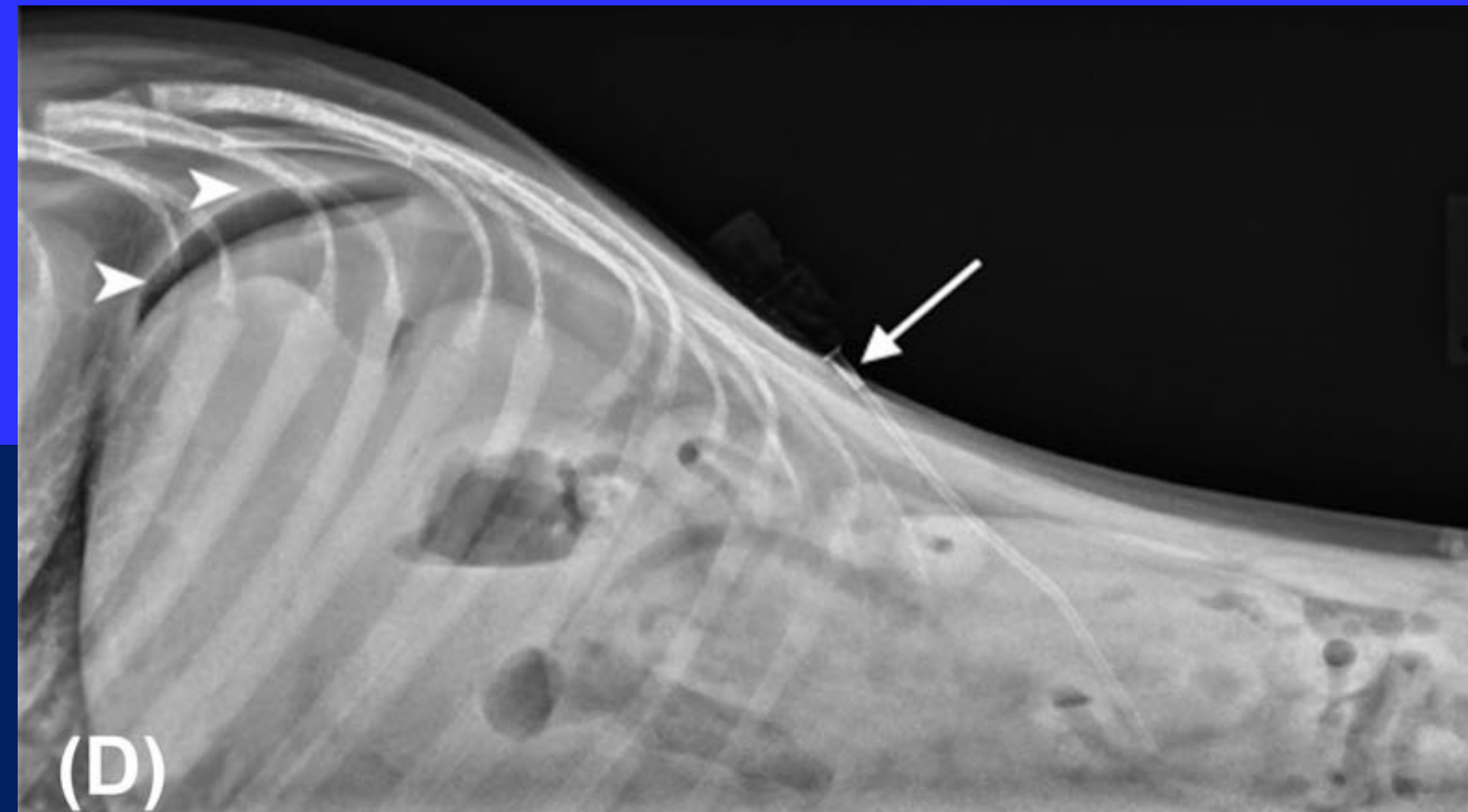
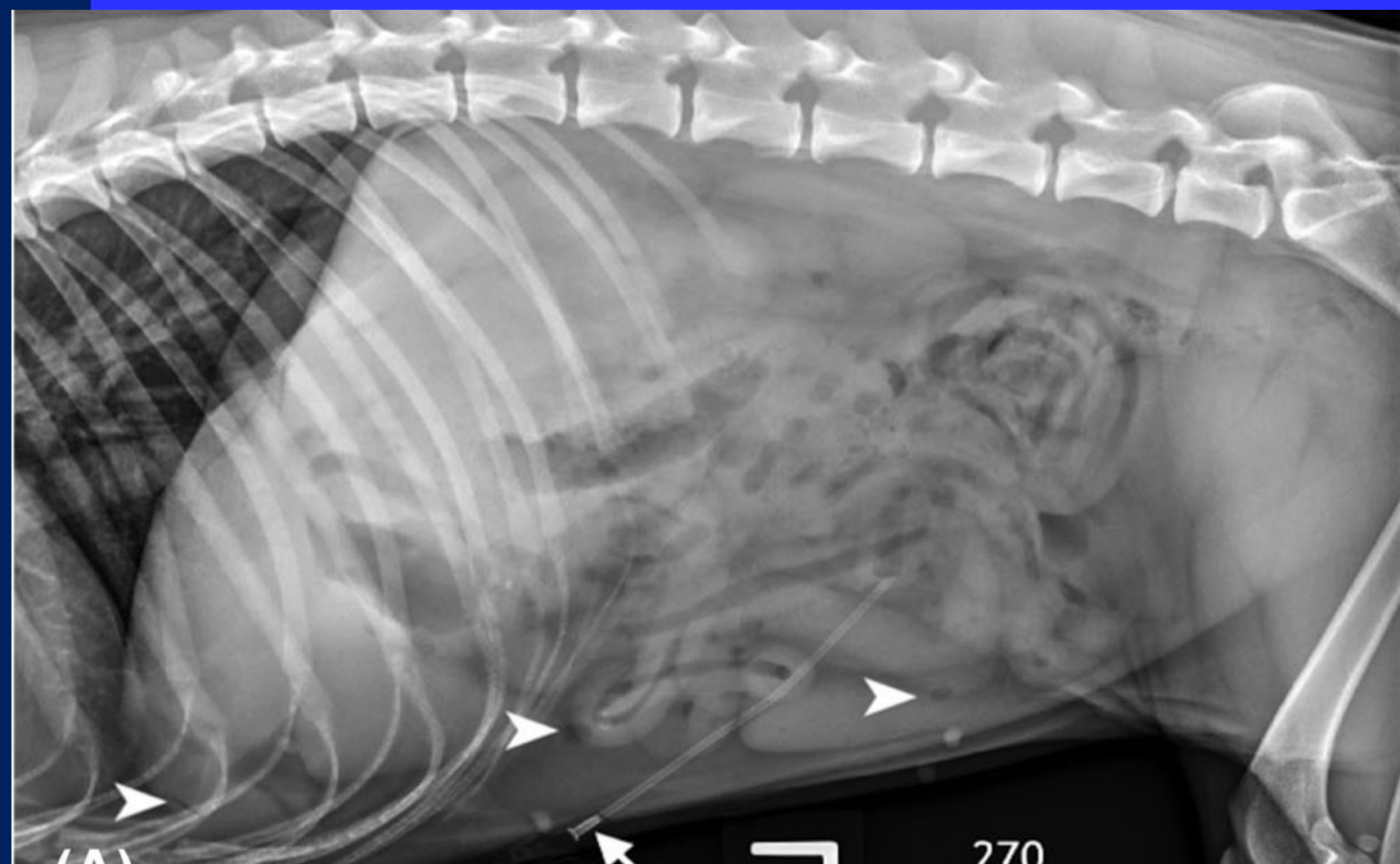
The 5 APOCUS: free abdominal air



Diagnosis: Abdominal radiographs

- Humans: 55%–85% accuracy with abdominal plain film radiographs
- Canine studies:
 - 57.1-78.9% accuracy depending on amount of air present
 - Requires 5-10 ml of gas to be consistently diagnosed by a board-certified radiologist, inaccurate below 2.5 ml of gas

Ng VetRadiolUltrasound 2020



Diagnosis: Ultrasound

- Canine study: consistently diagnosed with as little as 0.4 ml of gas

Choi, J. Vet. Med. Sci. 74(4): 491–494, 2012

- In humans US has been shown to have a sensitivity of 85% and a specificity of 100% for pneumoperitoneum: higher than plain film radiography

Chao, West J Emerg Med. 2015;16(2):302

IMAGES IN EMERGENCY MEDICINE

Diagnosis of Pneumoperitoneum with Bedside Ultrasound

Alice Chao, MD
Laleh Gharahbaghian, MD, RDMS
Phillips Perera, MD

Stanford University, Department of Emergency Medicine, Stanford, California

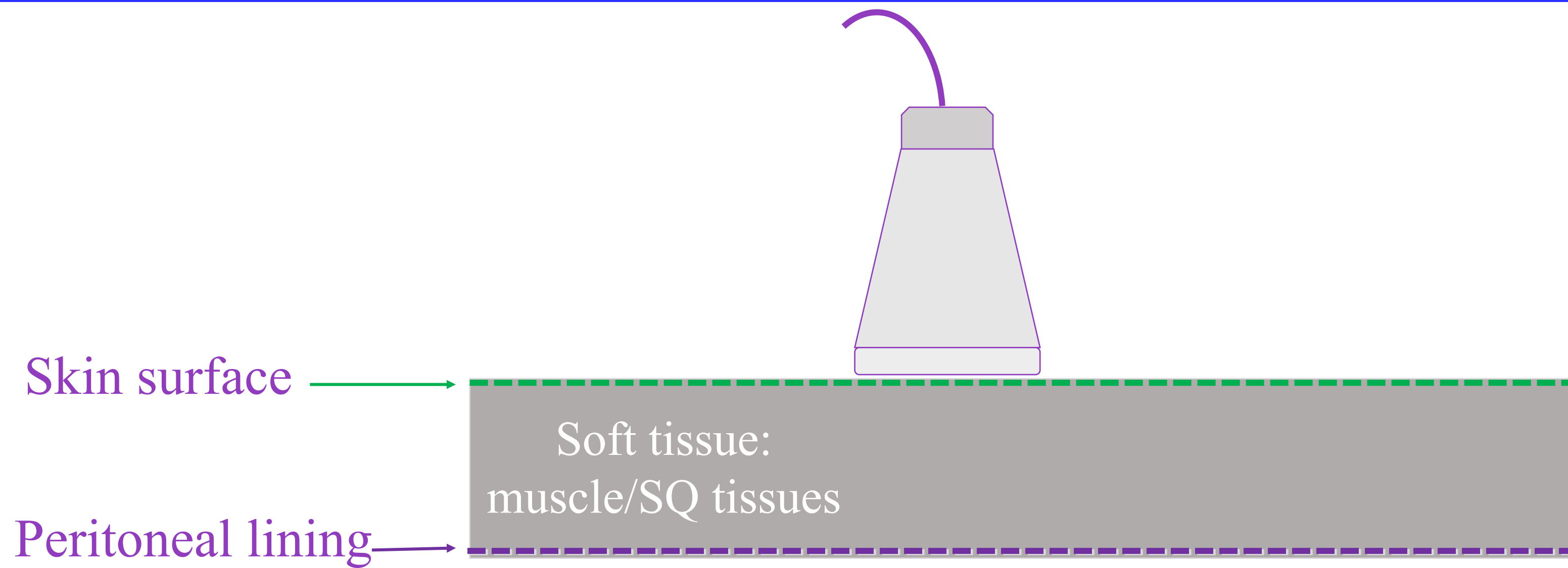
Sonographic Detection of Small Amounts of Free Peritoneal Gas in Beagle Dogs

Hojung CHOI¹⁾, Youngwon LEE¹⁾, Kitae PARK²⁾, Seongchan YEON²⁾ and Heechun LEE²⁾*

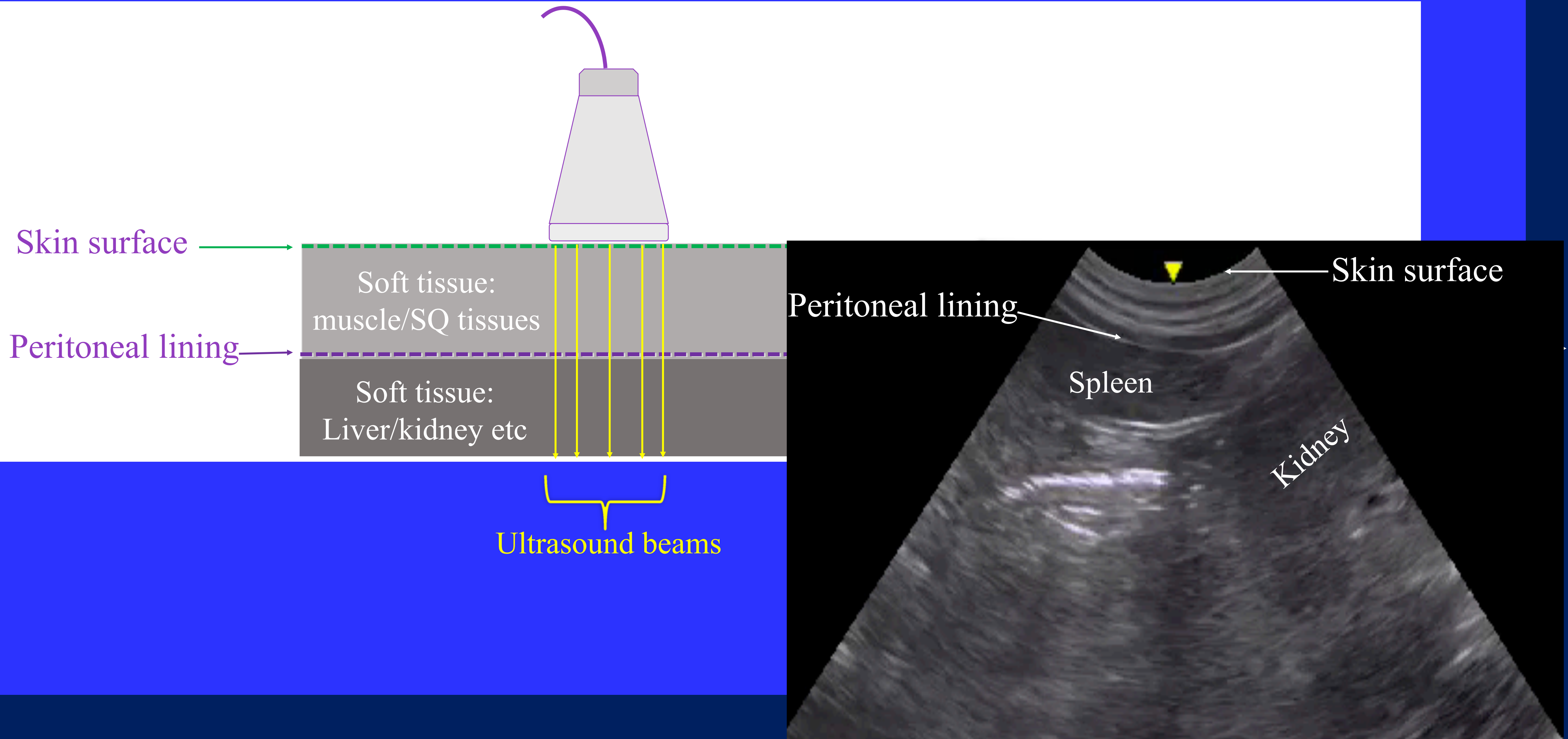
¹⁾Department of Veterinary Medical Imaging, College of Veterinary Medicine, Chungnam National University, Daejeon, Korea

²⁾Research Institute of Life Sciences, Gyeongsang National University, Jinju, Korea

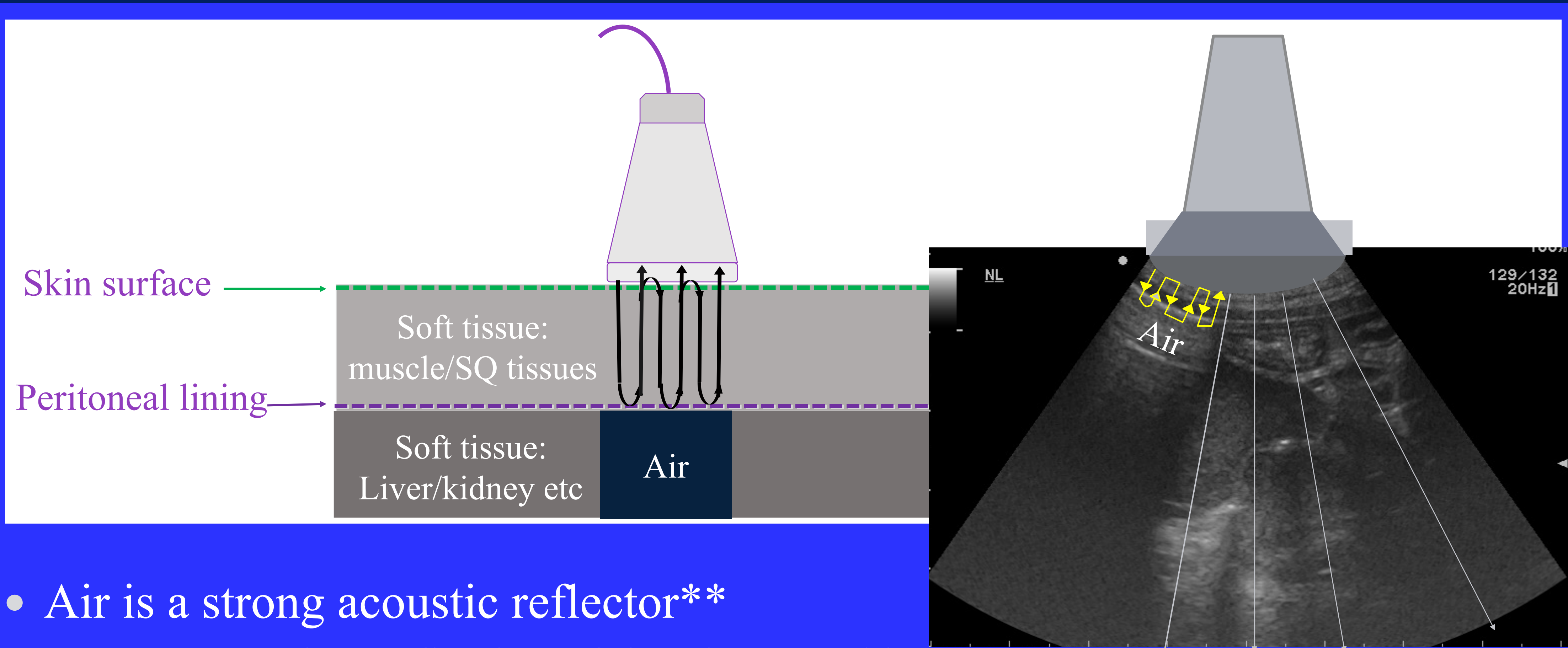
Ultrasound diagnosis: Normal and artefact



Ultrasound diagnosis: Normal and artefact

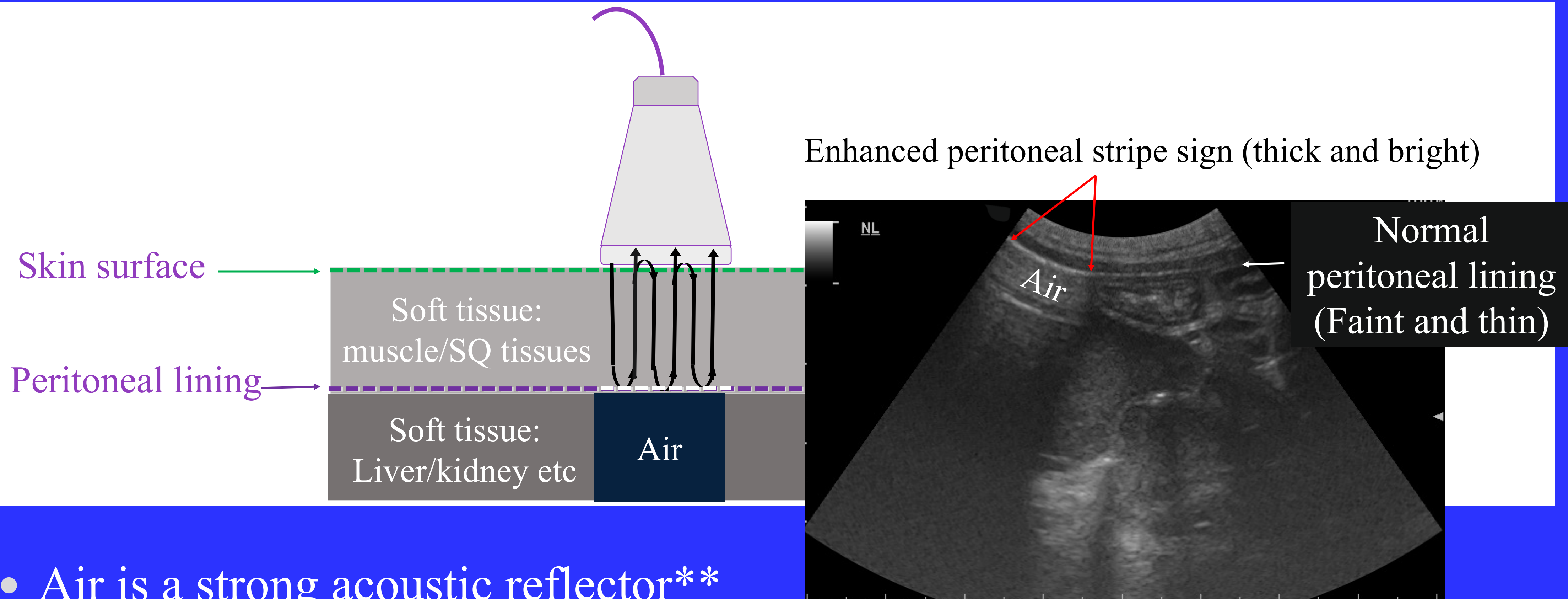


Ultrasound diagnosis: Normal and artefact



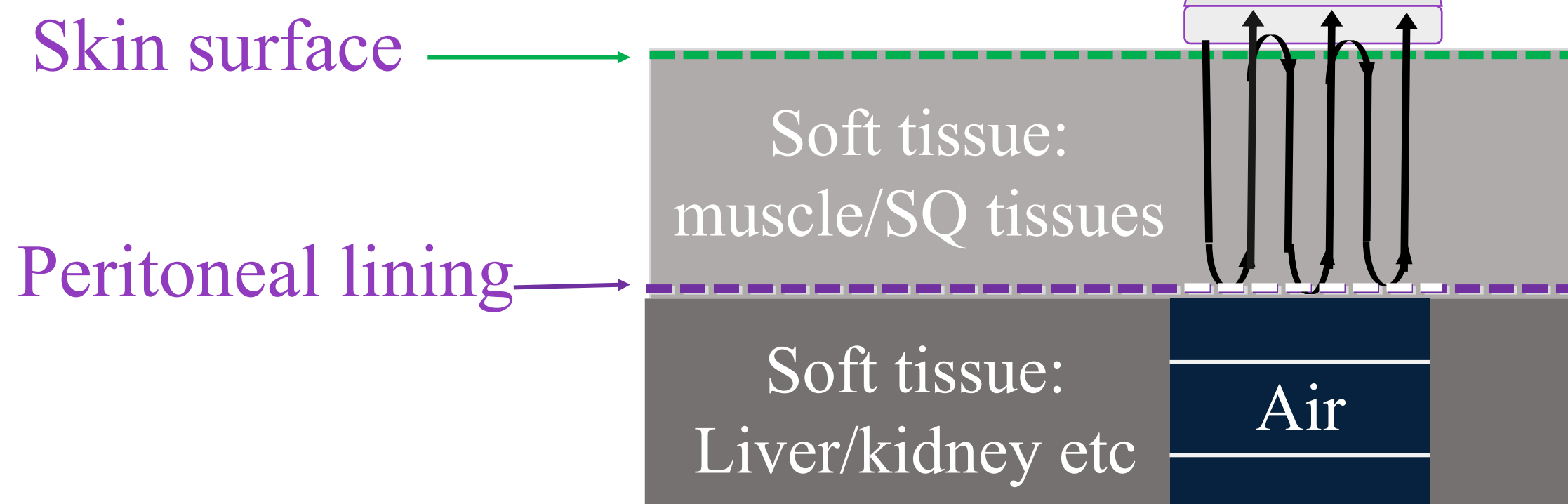
- Air is a strong acoustic reflector**
 - Near complete reflection of the ultrasound beam
 - Results in readily identifiable sonographic artifacts

Ultrasound diagnosis: Normal and artefact

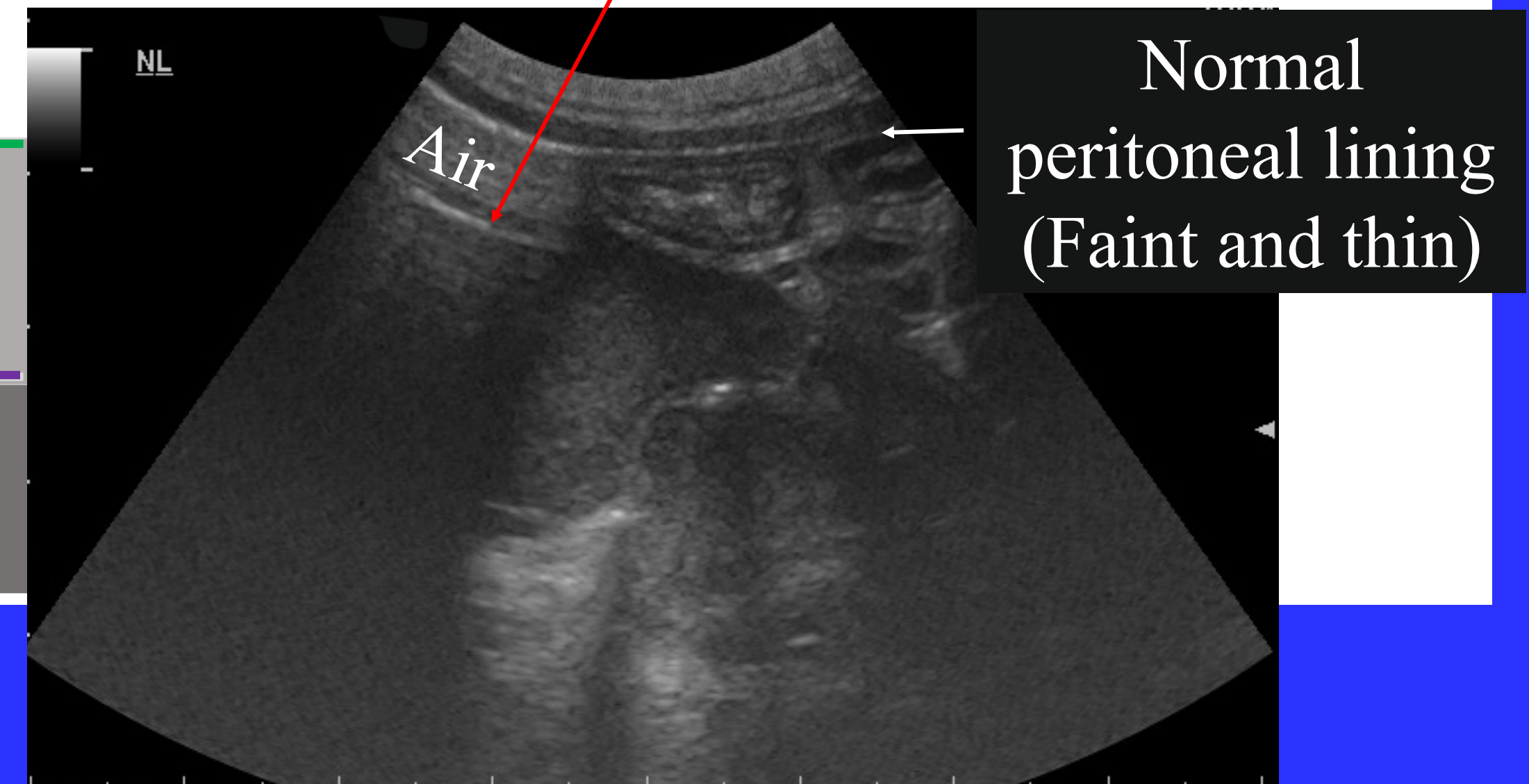


- Air is a strong acoustic reflector**
 - Near complete reflection of the ultrasound beam
 - Results in readily identifiable sonographic artifacts

Diagnosis: Normal and artefact



Reverberation artefact



- Air is a strong acoustic reflector**
 - Near complete reflection of the ultrasound beam
 - Results in readily identifiable sonographic artifacts

Pneumoperitoneum

Three key steps to perform...

- 1) Identify peritoneal lining
- 2) Look for an enhanced peritoneal stripe sign
- 3) Look for reverberation artifacts
 - originate at the peritoneal lining
 - extend distally
 - obliterate normally visible structures**

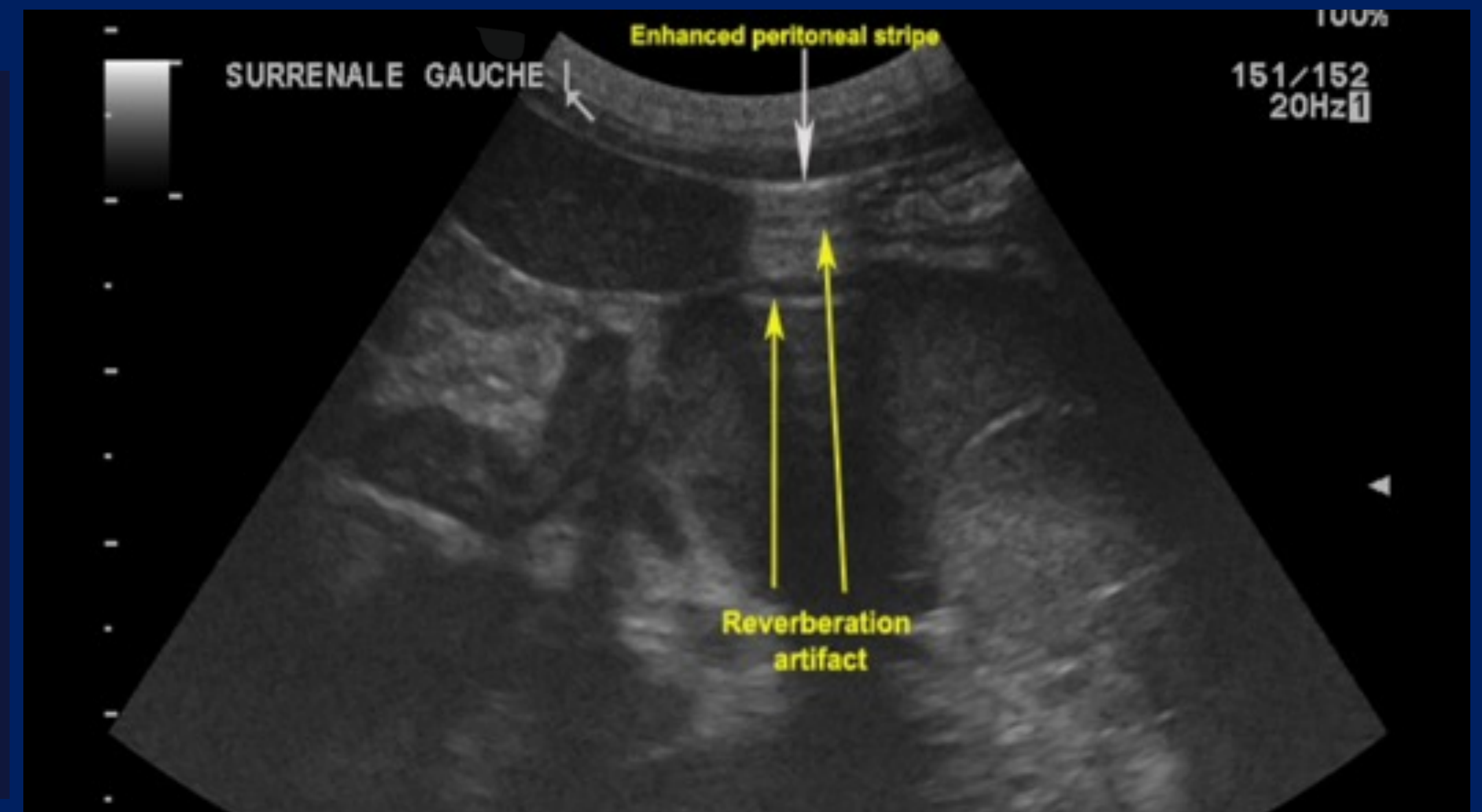


Image courtesy of: Aureline FONLUPT FANTINI

pISSN 1229-845X, eISSN 1976-555X
J. Vet. Sci. (2014), 15(2), 195-198
<http://dx.doi.org/10.4142/jvs.2014.15.2.195>
Received: 22 Mar. 2013, Revised: 5 Jul. 2013, Accepted: 14 Aug. 2013

JOURNAL OF
**Veterinary
Science**

Original Article

Accuracy of sonographic diagnosis of pneumoperitoneum using the enhanced peritoneal stripe sign in beagle dogs

Song Yeon Kim, Ki Tae Park, Seong Chan Yeon, Hee Chun Lee*

0.2 ml of air

ULTRASONOGRAPHIC FINDINGS IN DOGS AND CATS WITH GASTROINTESTINAL PERFORATION

SØREN R. BOYSEN, DVM, AMY S. TIDWELL, DVM, DOMINIQUE G. PENNINGCK, DVM, DVSC

2003, *Vet rad. ultrasound*

Pitfalls: Interposition of the gastrointestinal gas

Does the reverberation artifact extend up to the peritoneal lining and make it bright white or is it separated from it (by layers of intestine)?

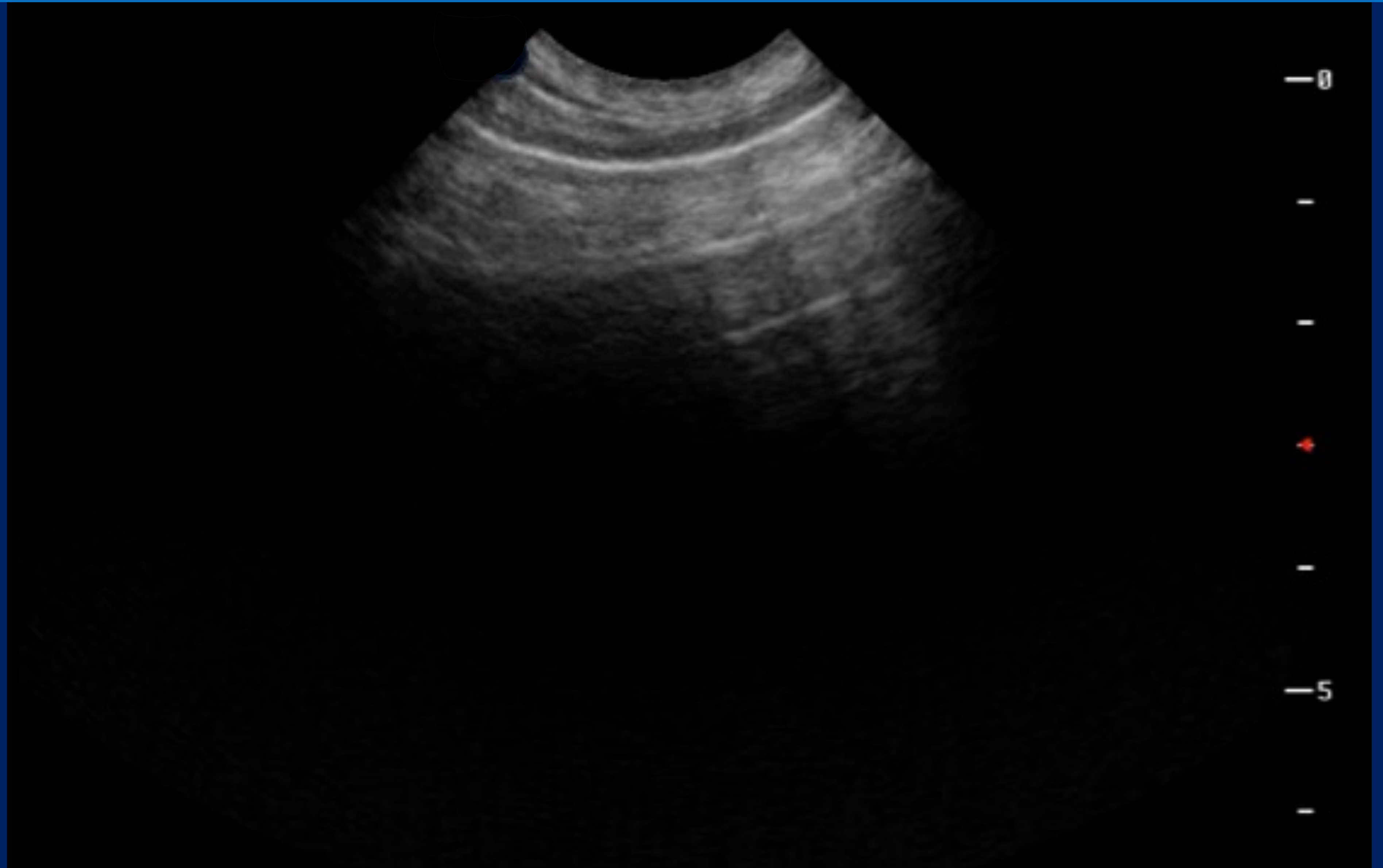


FERRELL Radiology & Ultrasound, Vol. 44, No. 3, 2003, pp 307-308.

- Hint – identifying the spleen, kidney and/or stomach helps locate the peritoneal lining

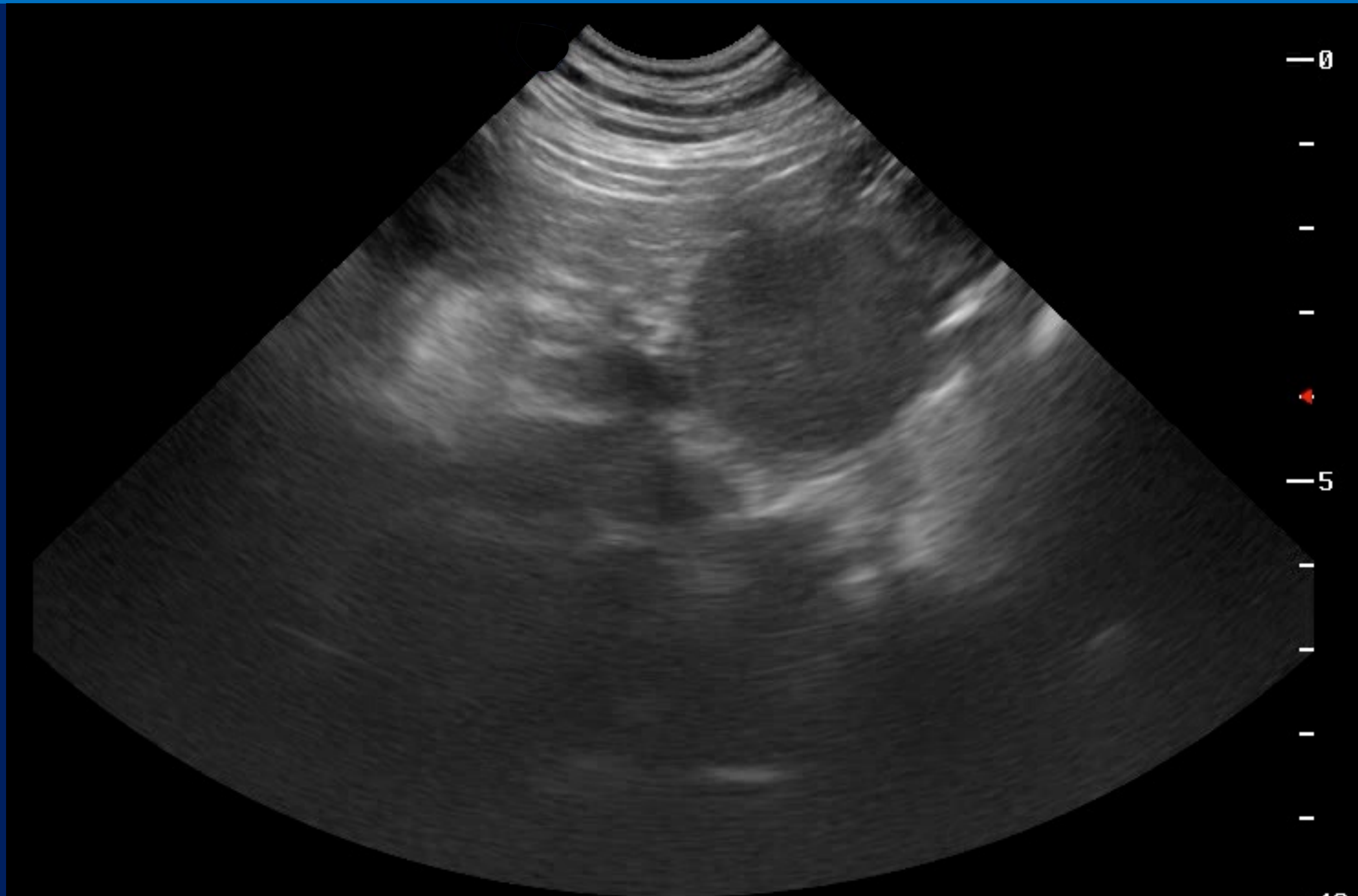
Pneumoperitoneum

Free gas Y/N?



Pneumoperitoneum

Free gas Y/N?



Dyson updated problem list and treatments

- 7-year-old male neutered Boxer cross
- Unstable, tachycardic
- Hyperemic mucous membranes, bounding pulses, rapid CRT
- APOCUS: Abdominal fluid, halo sign, free abdominal air
- Received methadone
- IV catheter placed
- Cytology:
- Cultures: Pending

Can I give fluids!!!!!!



Dyson



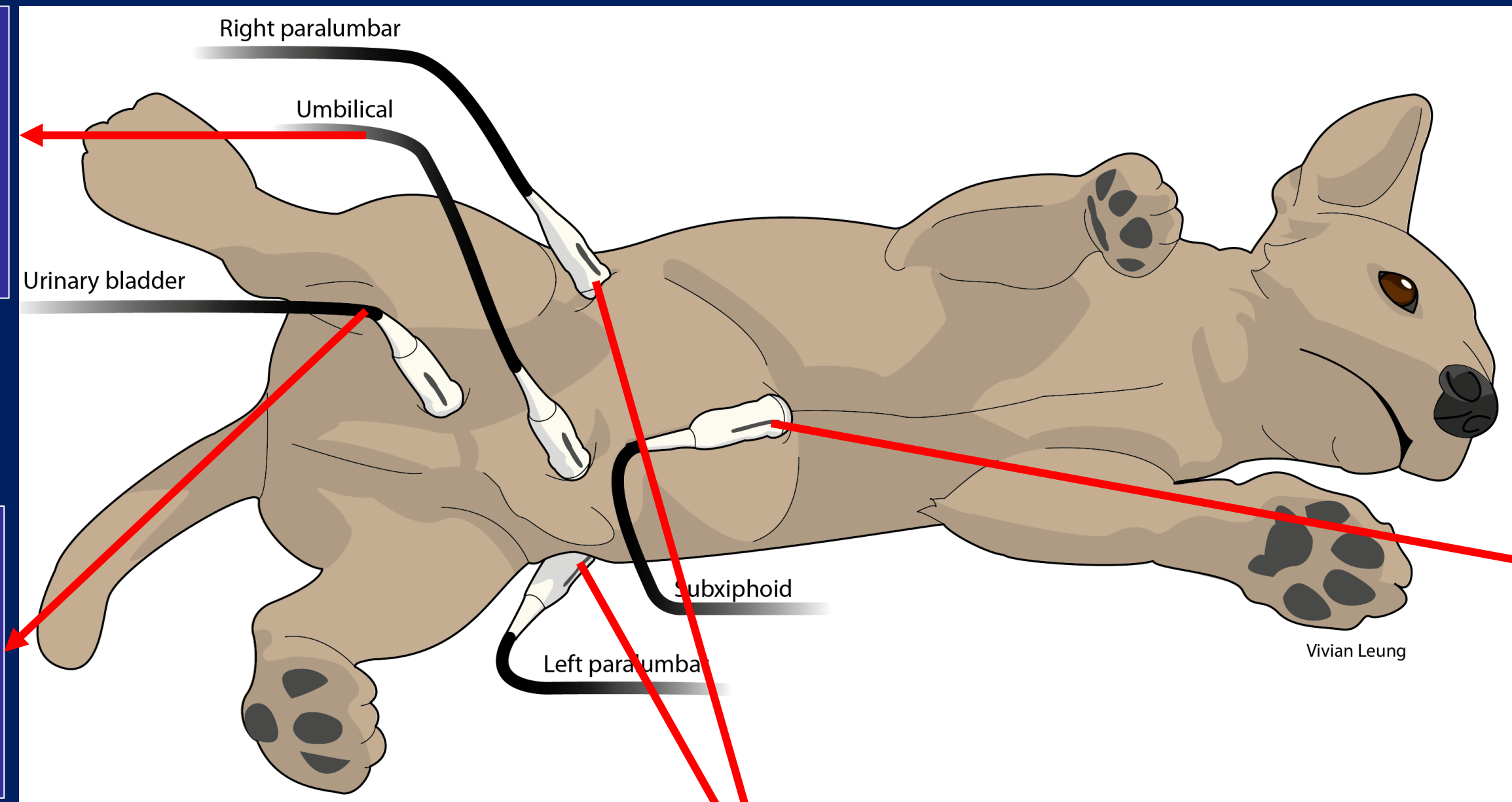
Start broad spectrum IV antibiotics (don't delay antibiotic therapy)

5-Point APOCUS binary response questions

All Sites: 1) Is there free abdominal fluid Y/N* 2) Is there free abdominal air Y/N*

12) Splenic masses? More research needed

3) Urine production Y/N
3b) Pyometra?



4) Is there generalized ileus Y/N? (duodenum)
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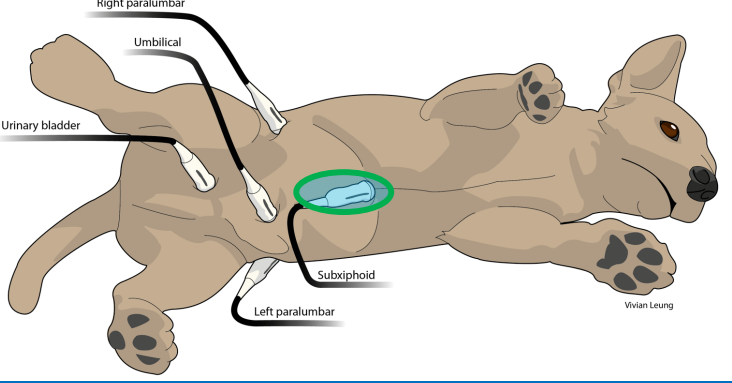
8) OK to give a fluid bolus? Y/N
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9) Is there pericardial effusion Y/
(combined with heart)

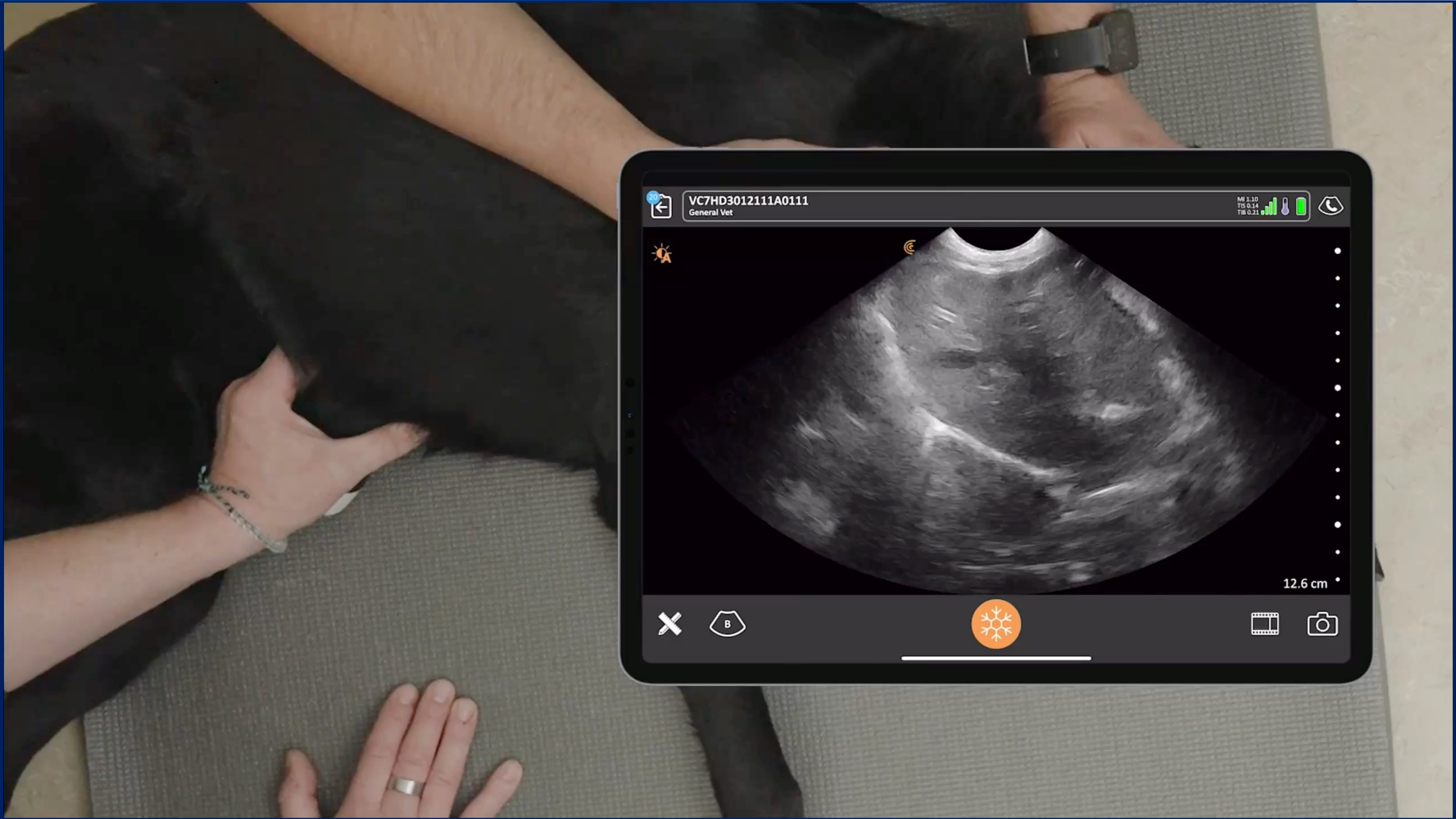
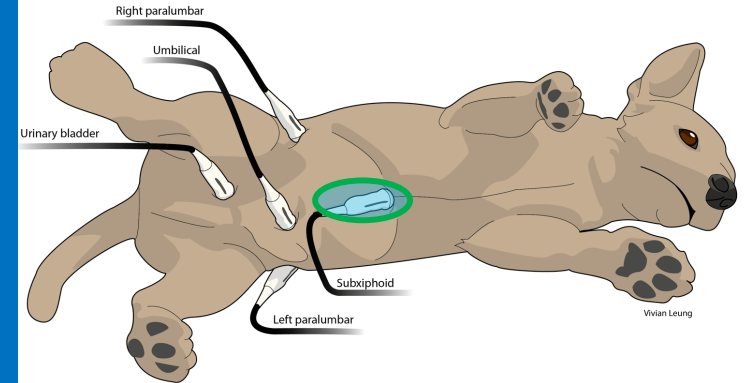
10) Is there CPR cardiac activity Y/N?

11) Is there pleural effusion Y/N

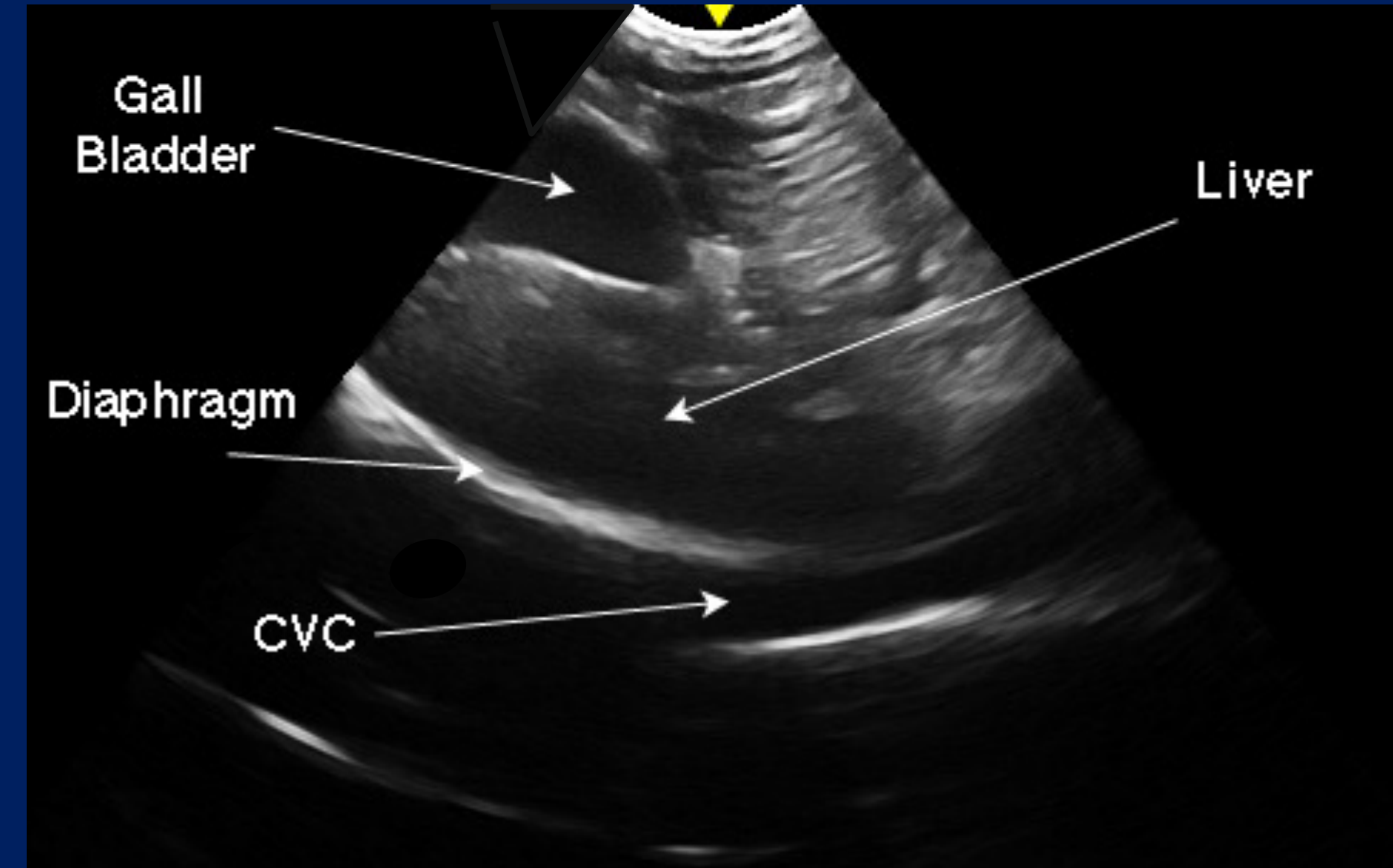
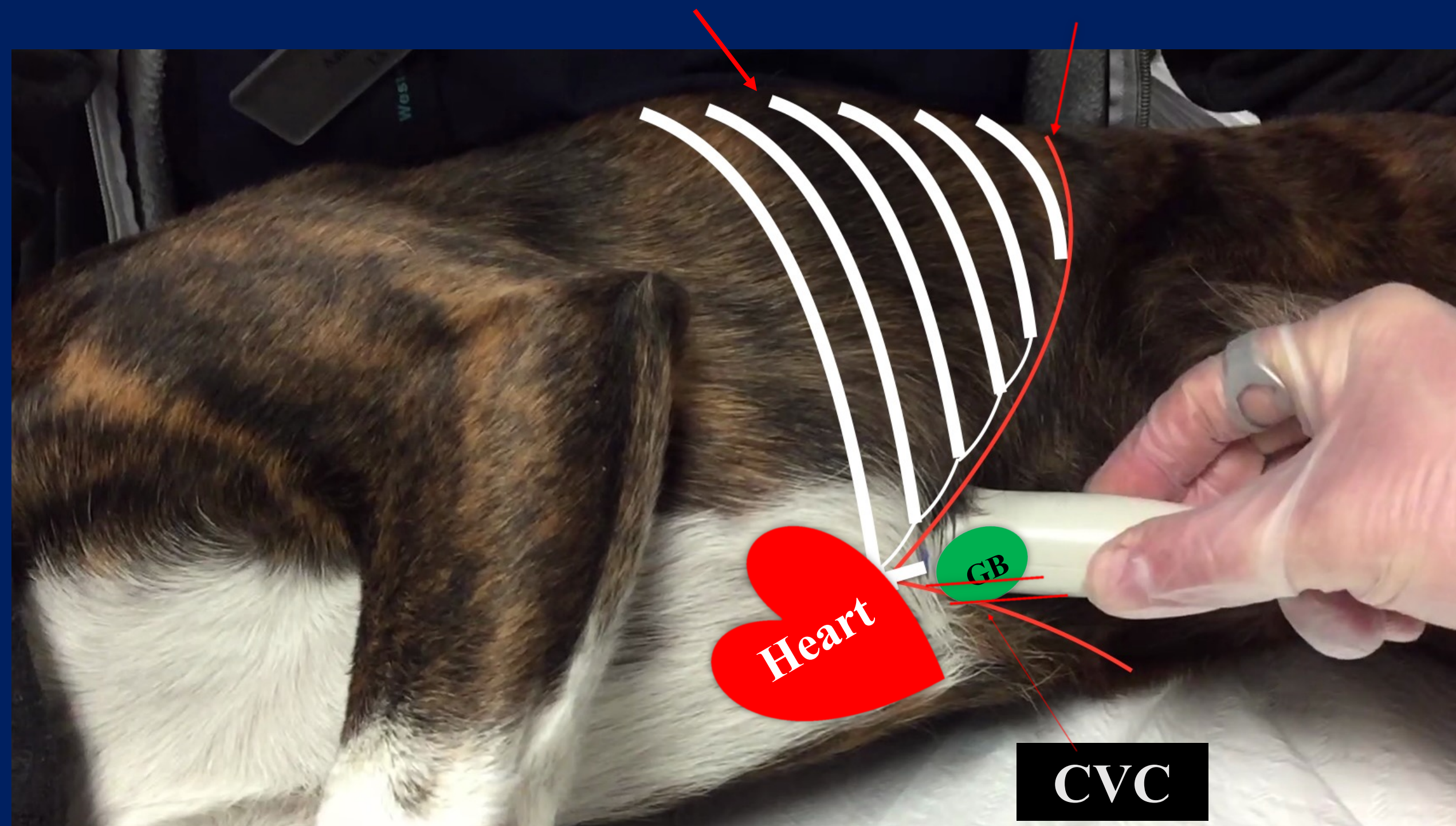
Combine the answer of abdominal POCUS findings with other POCUS results, history and clinical findings to narrow the differential diagnosis



Subxiphoid site: CVC for volume status

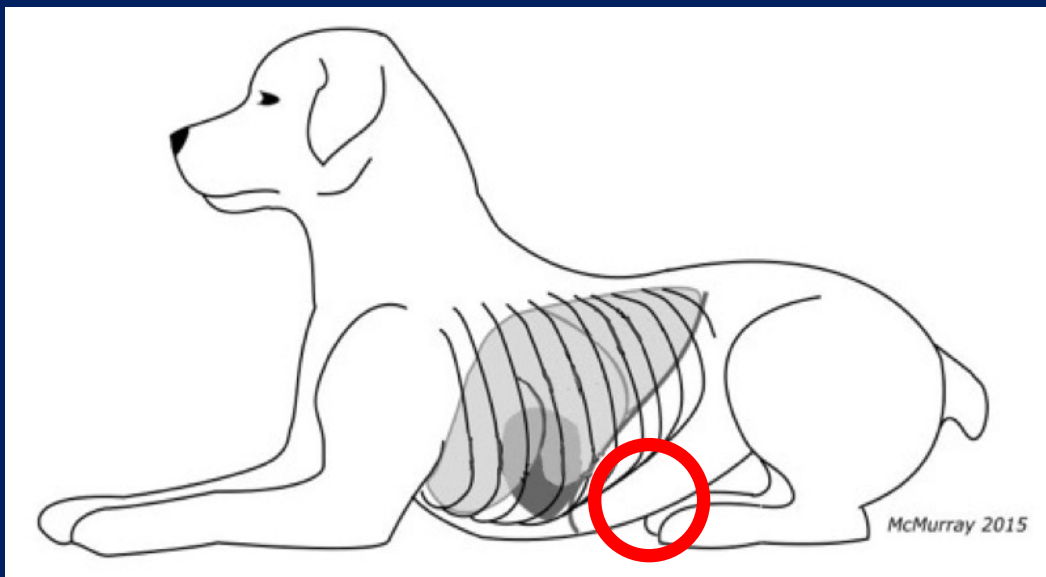


5-Point APOCUS: IV volume estimation



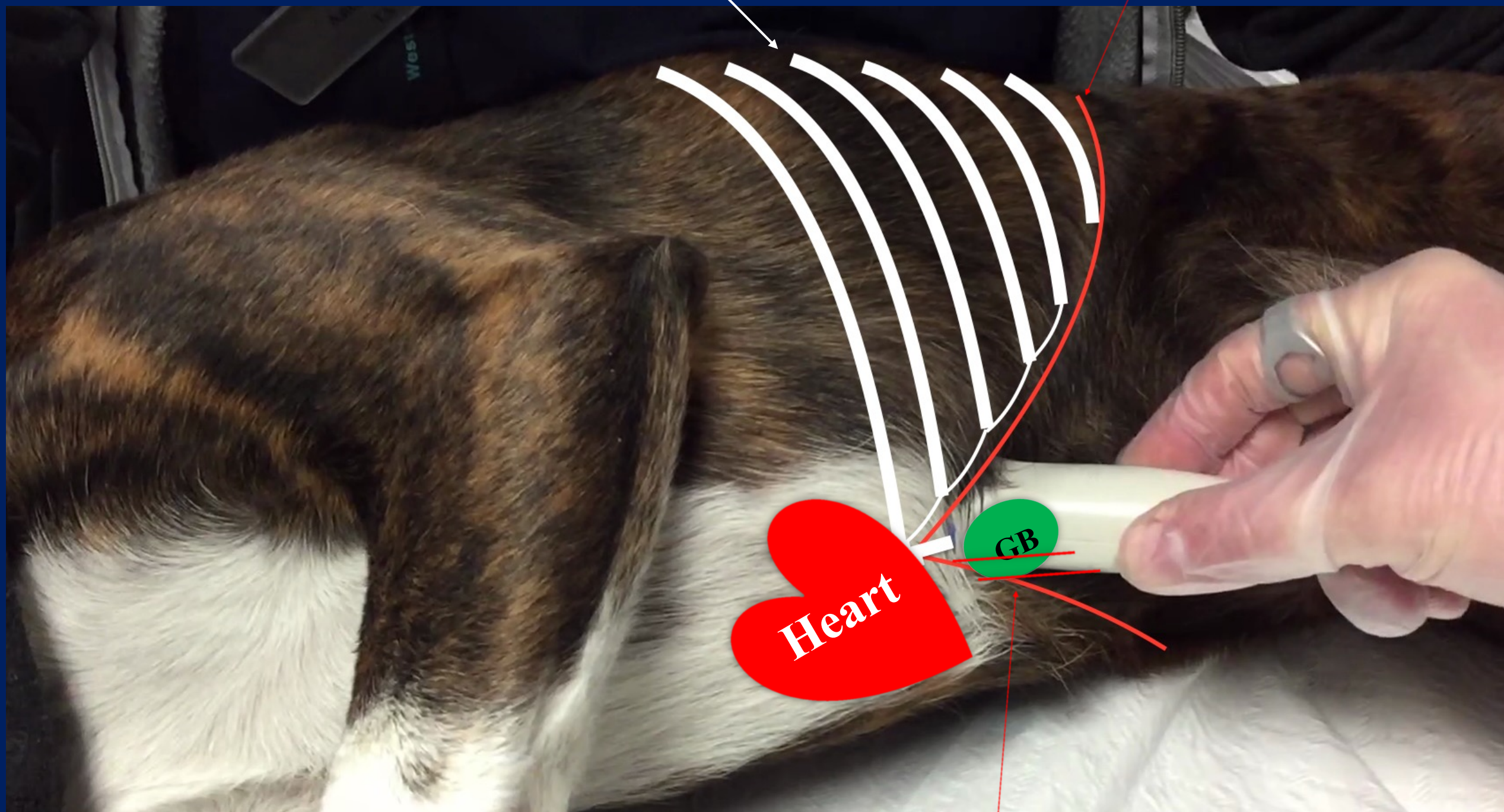
- CVC diameter change $> 25\%$ Y/N?
 - Measure maximum expiration
 - Minimum inspiration
- Cardiac pulse Y/N?

5-Point APOCUS: IV volume estimation

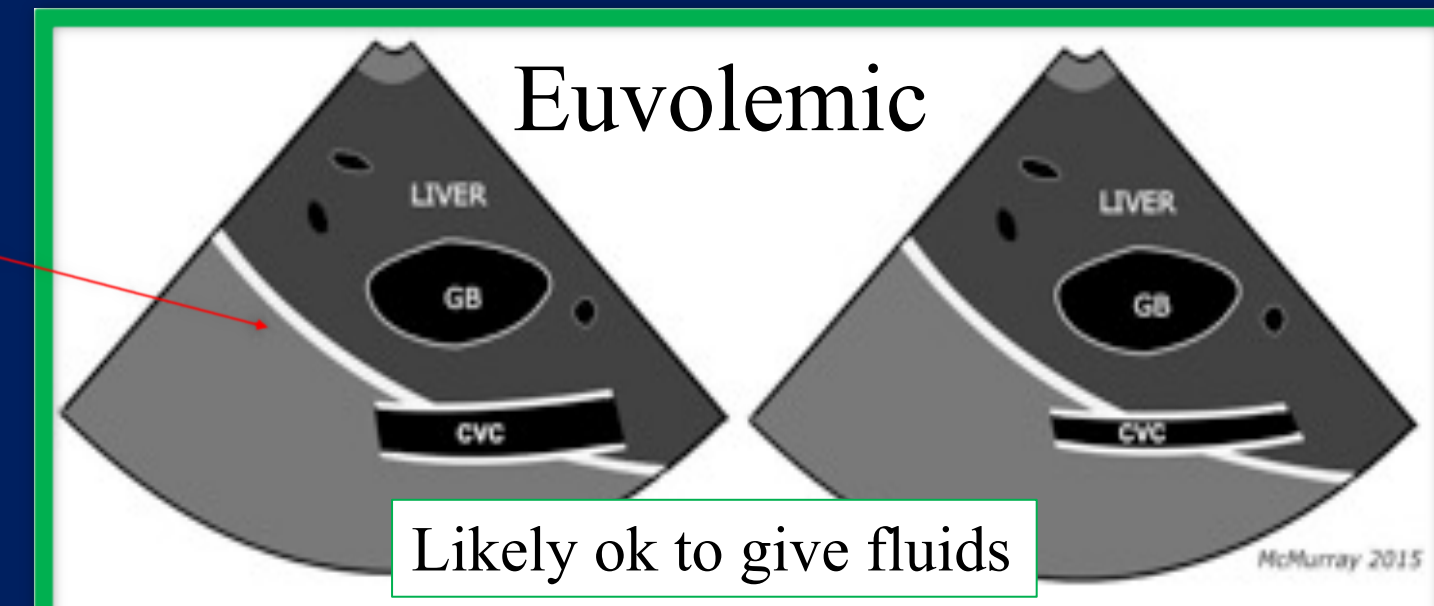


Rib cage

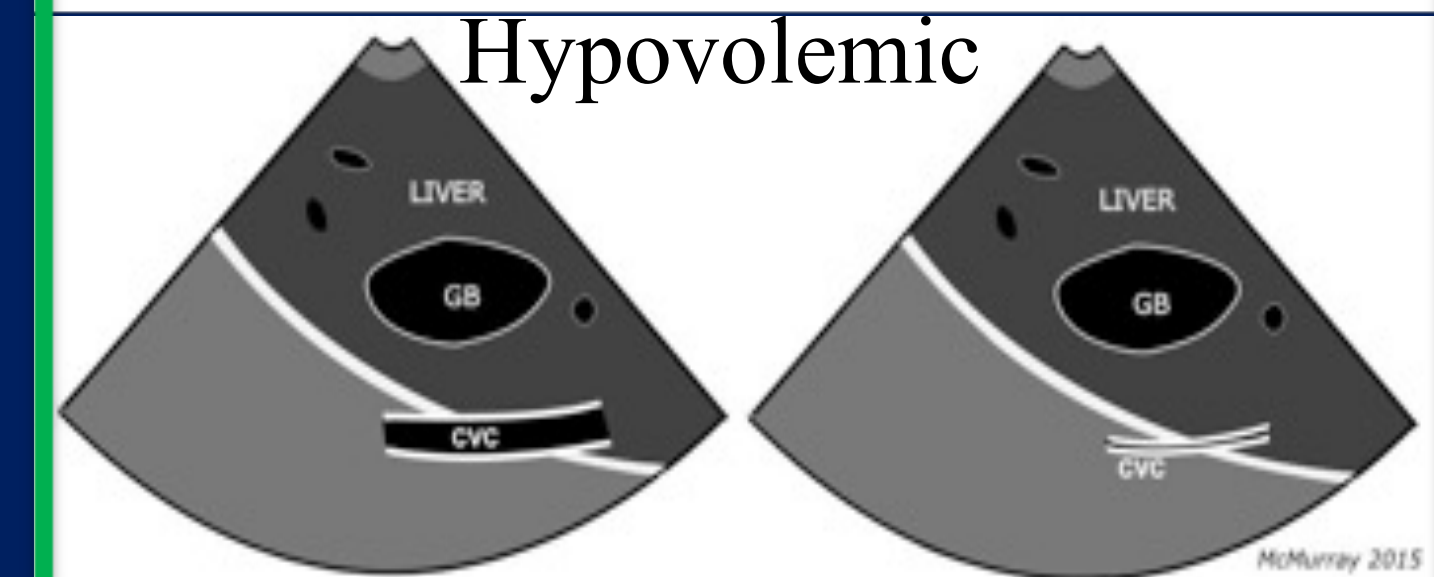
Diaphragm



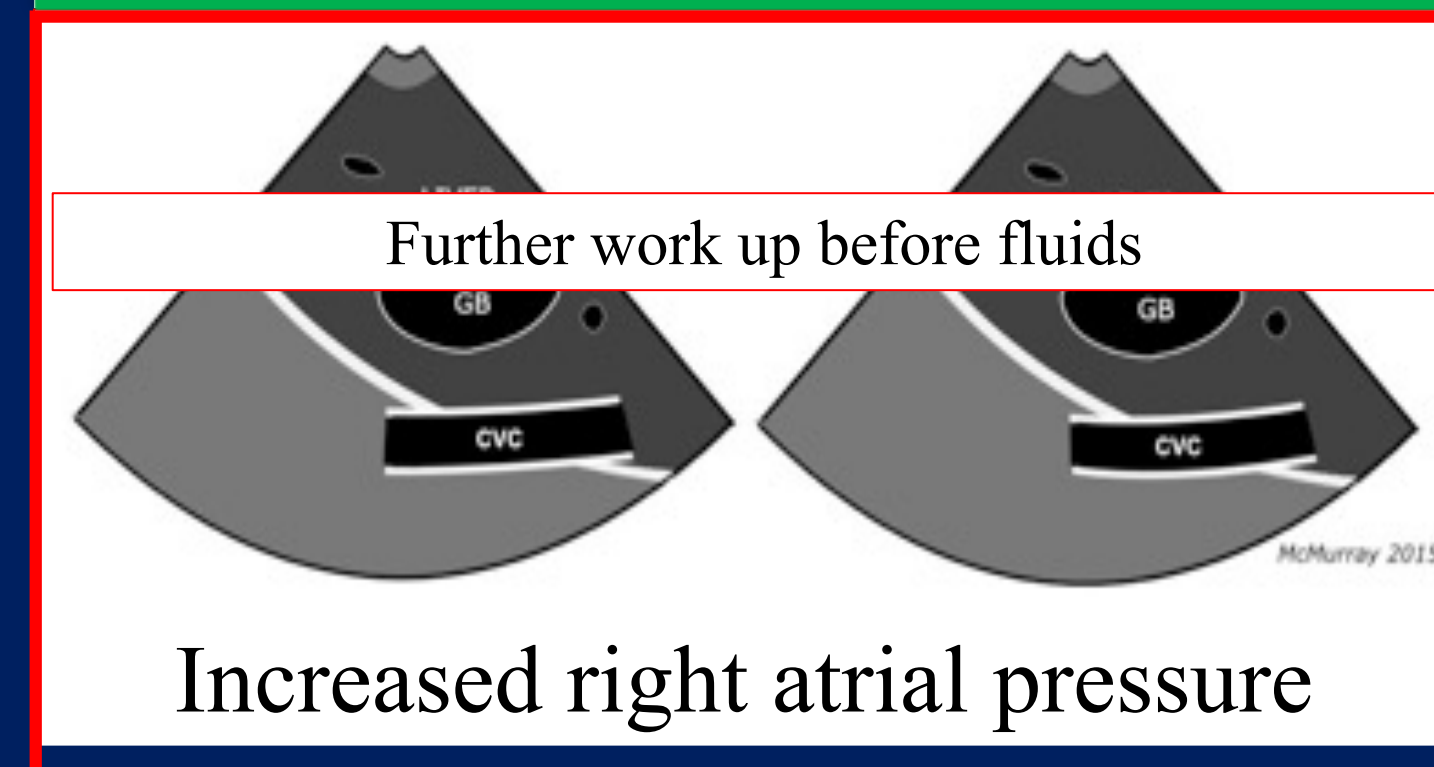
CVC



Likely ok to give fluids

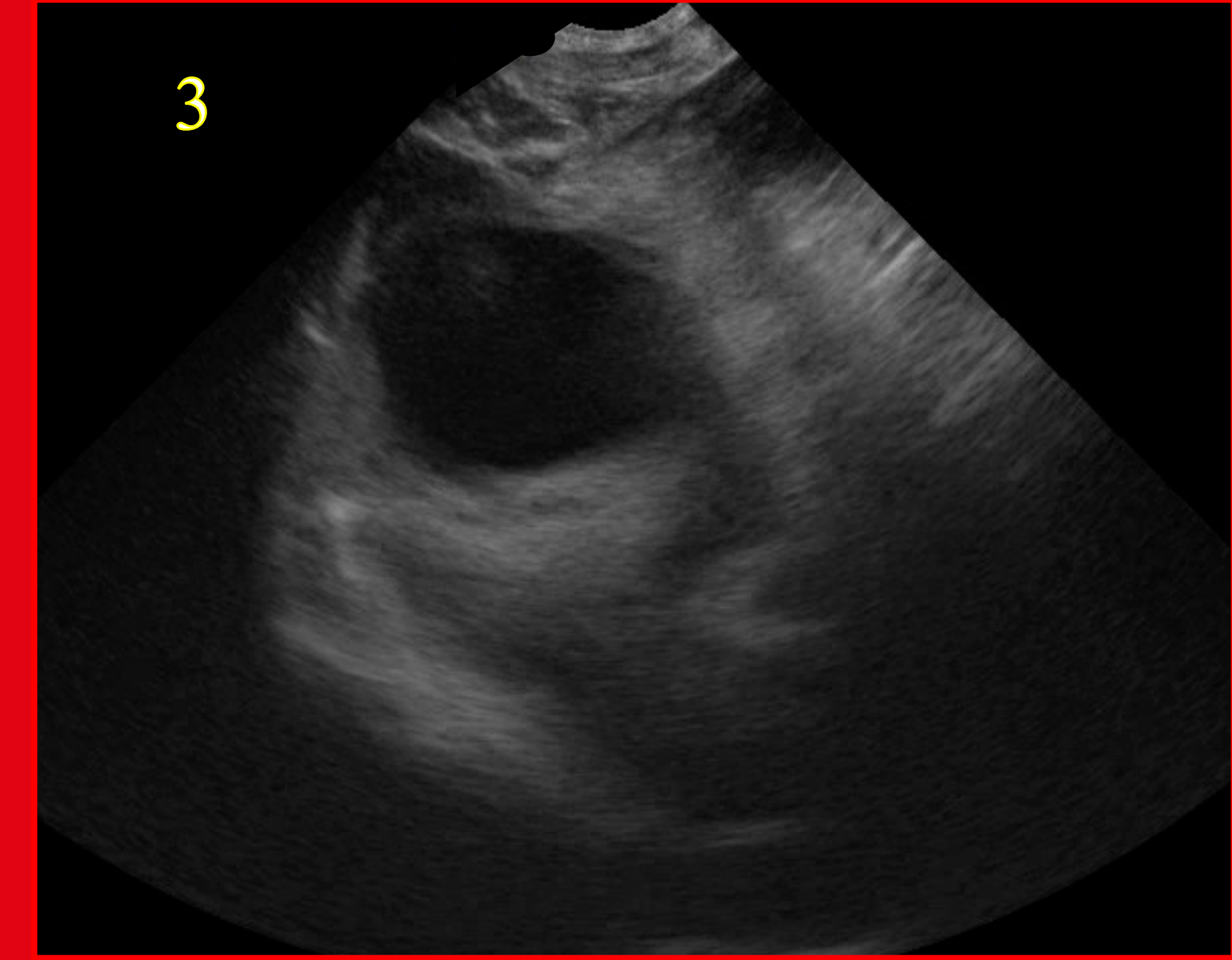
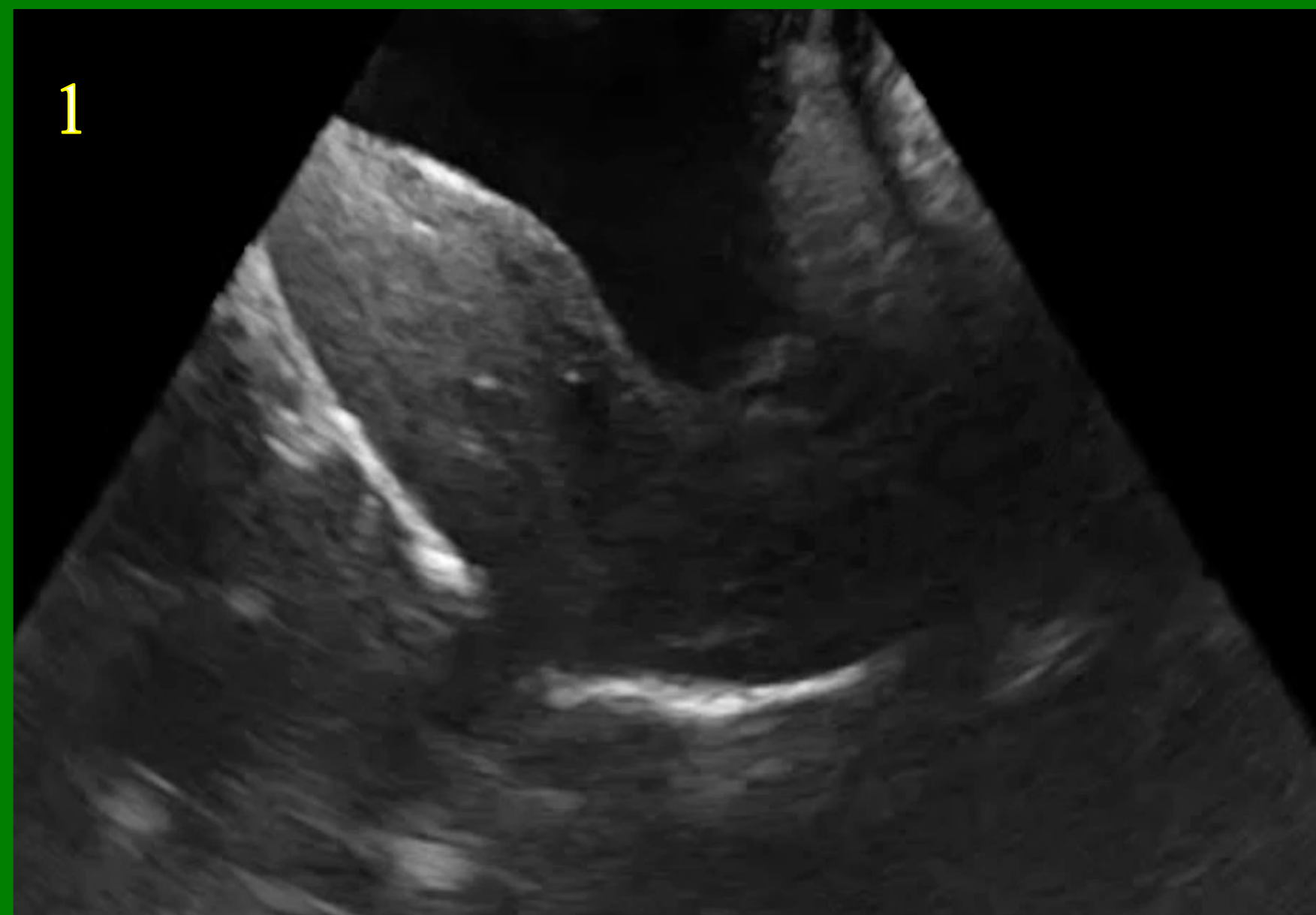


Hypovolemic



Further work up before fluids

Increased right atrial pressure



If clinical signs suggest hypovolemia/hypoperfusion: which patient(s) would you give an IV fluid bolus to?



Combine CVC with cardiac volume assessment

Tying the CVC and halo sign together

Increased right atrial pressures

Increased vascular permeability

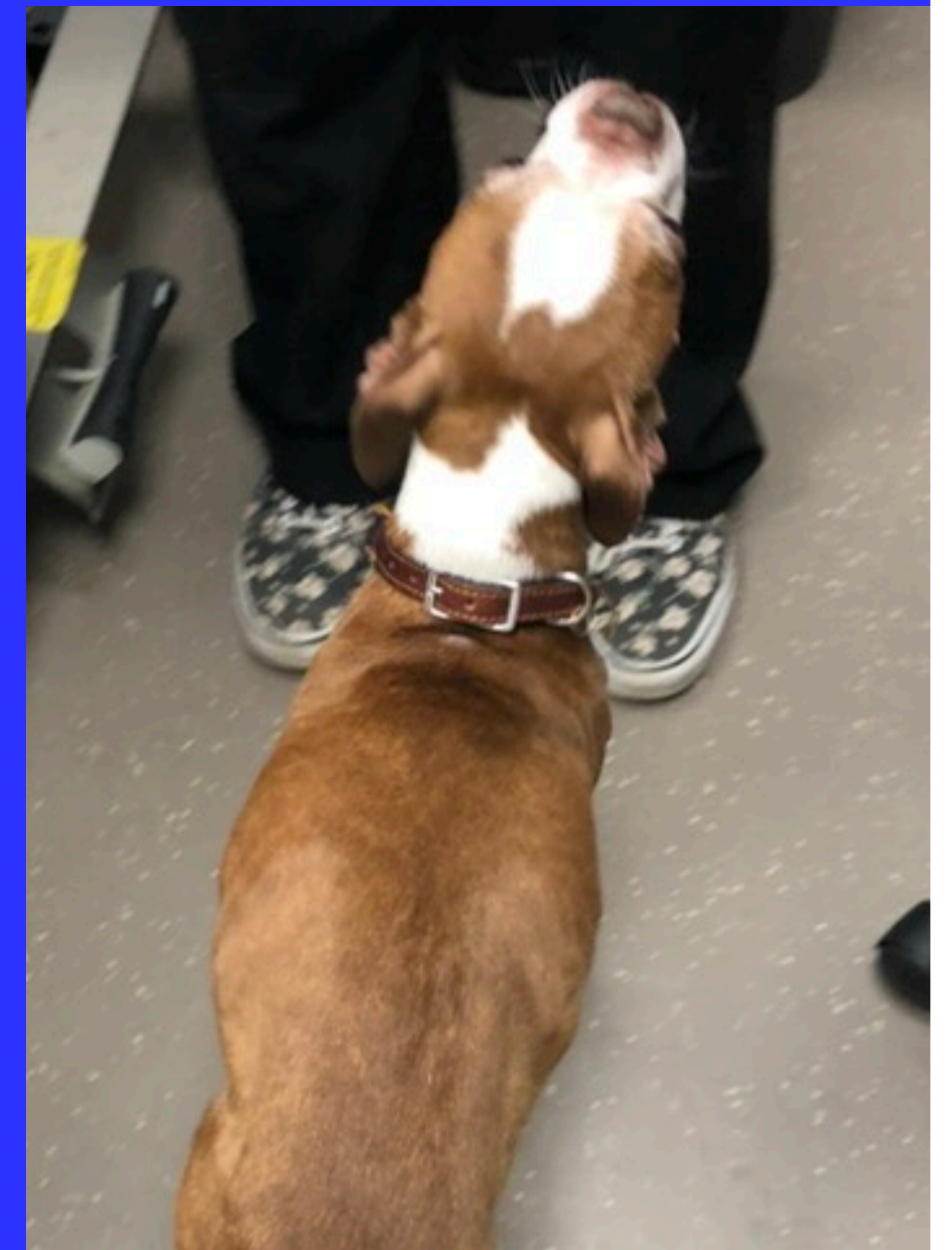


Which case has increased right atrial pressure vs. increased vascular permeability

Dyson: Summary

- 7-year-old male neutered Boxer cross
- Unstable
- Abdominal fluid, Free abdominal air, gallbladder wall edema
- Cytology (sample via abdominocentesis)
 - Degenerative neutrophils
 - Intra and extra cellular bacteria
- Received methadone
- Bolus fluid therapy initiated
- Broad spectrum antibiotics started IV
- Further work up for the underlying cause (other imaging)
- Save fluid sample for culture and sensitivity
- CBC and chemistry panel pending

Dyson



Summary

- Consider the history and initial findings to drive POCUS evaluation
- Patient positioning will influence where sonographically detectable pathology accumulates: fluid falls/gas rises
- Ultrasound can detect several findings associated with sepsis:
 - Free fluid, free air, gall bladder wall edema, volume status and fluid response, possible cause
- Dyson: GI perforation secondary to a foreign body
- Had surgery and went home



Thanks for joining us!!!



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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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Pre-Register

Poll

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

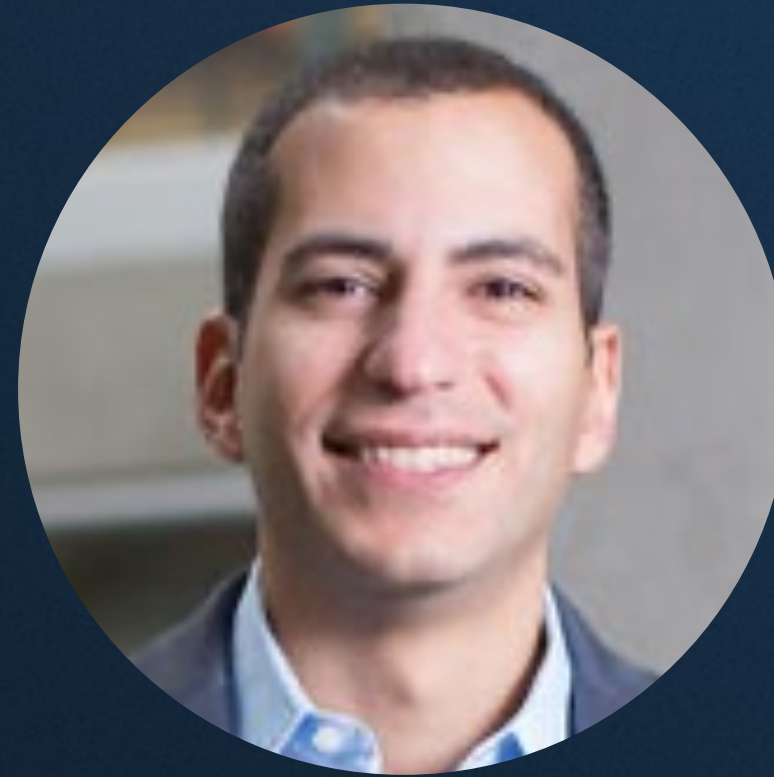
Tuesday, March 12th 2024
2PM Pacific | 5PM Eastern

www.clarius.com/ultrasound-webinars

Questions



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Thank you!