UNIVERSITY OF SASKATCHEWAN

Emergency Imaging Tips and Tricks

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The Plan

- Part I:
  - Pitfalls of emergency imaging
  - Thorax
- Part II:
  - Abdomen
  - Musculoskeletal

- Interactive emergency imaging cases

Reading Room

Emergency Imaging

- Rule #1: “No patient dies in radiology”
  - Stabilize patient first
  - If patient is in pain and/or distress do what you can in that moment, then plan to get better radiographs/complete study once patient has improved

Potential Pitfalls of Imaging

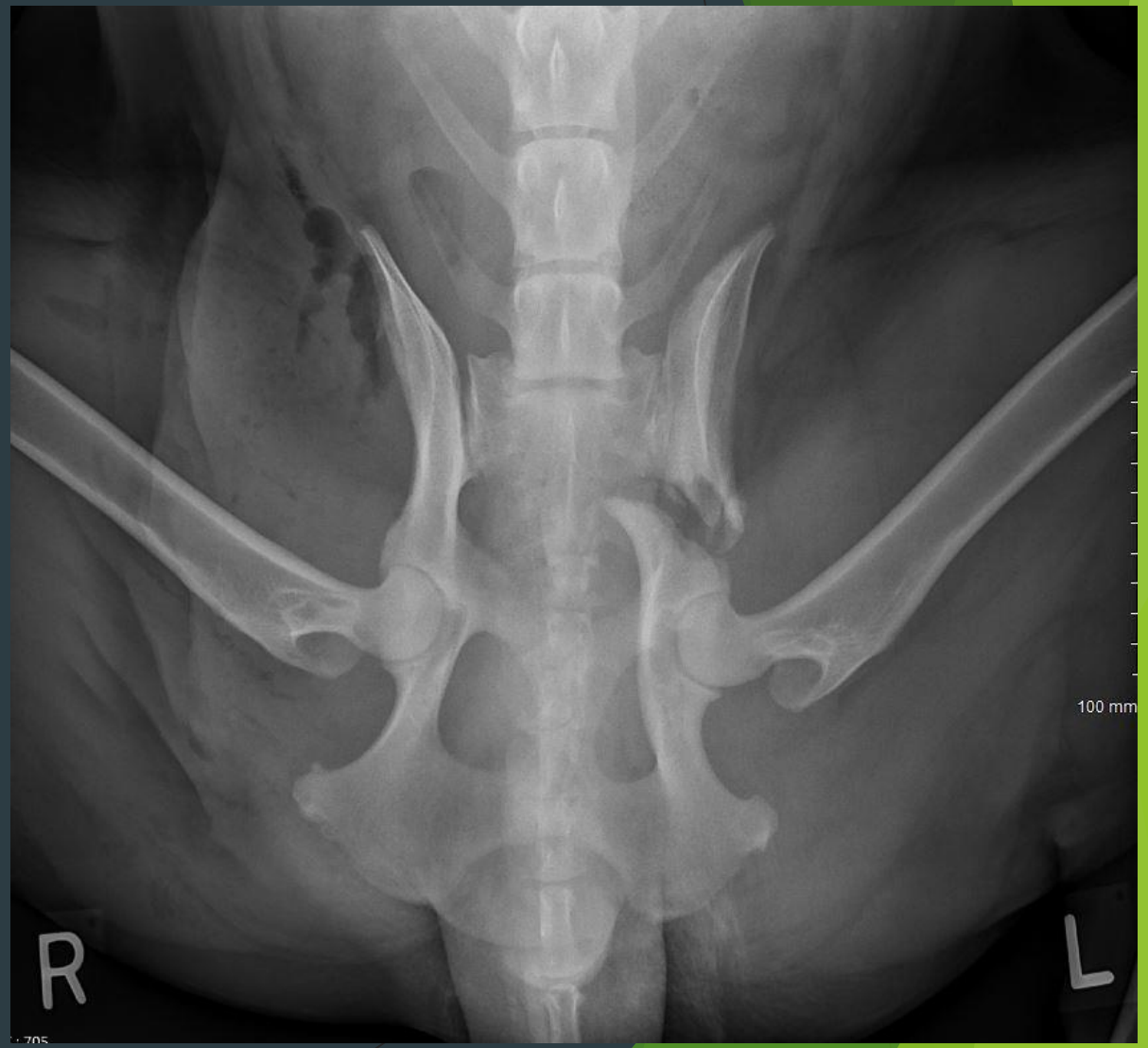
- Technical errors
- Perception errors
  - Occur when searching for a lesion
  - Satisfaction of search errors are the most common and result from incomplete evaluation
- Analysis errors
  - Occur when establishing a meaning to the finding(s). Radiographic signs may be seen but not recognized as abnormal
  - Recognition error

Technical Errors

- Positioning errors are the most common reason for radiographs to be non-diagnostic or misinterpreted
- Other technical errors which can lead to misinterpretation are:
  - No/Wrong marker
  - Incomplete studies
  - Wrong exposure
  - Effects of sedation or anesthesia

No/Wrong Marker

Initial

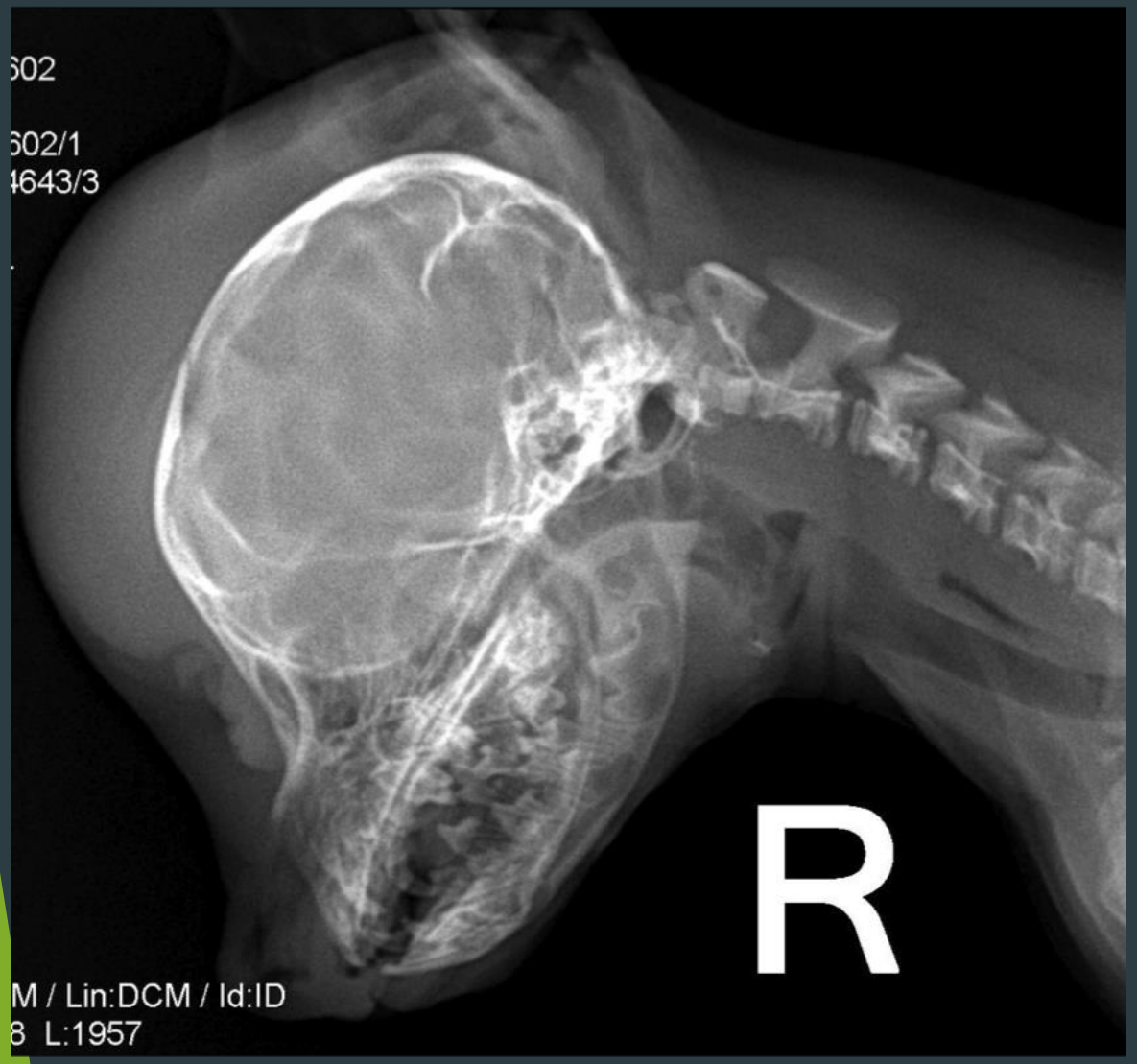


Intra-operative

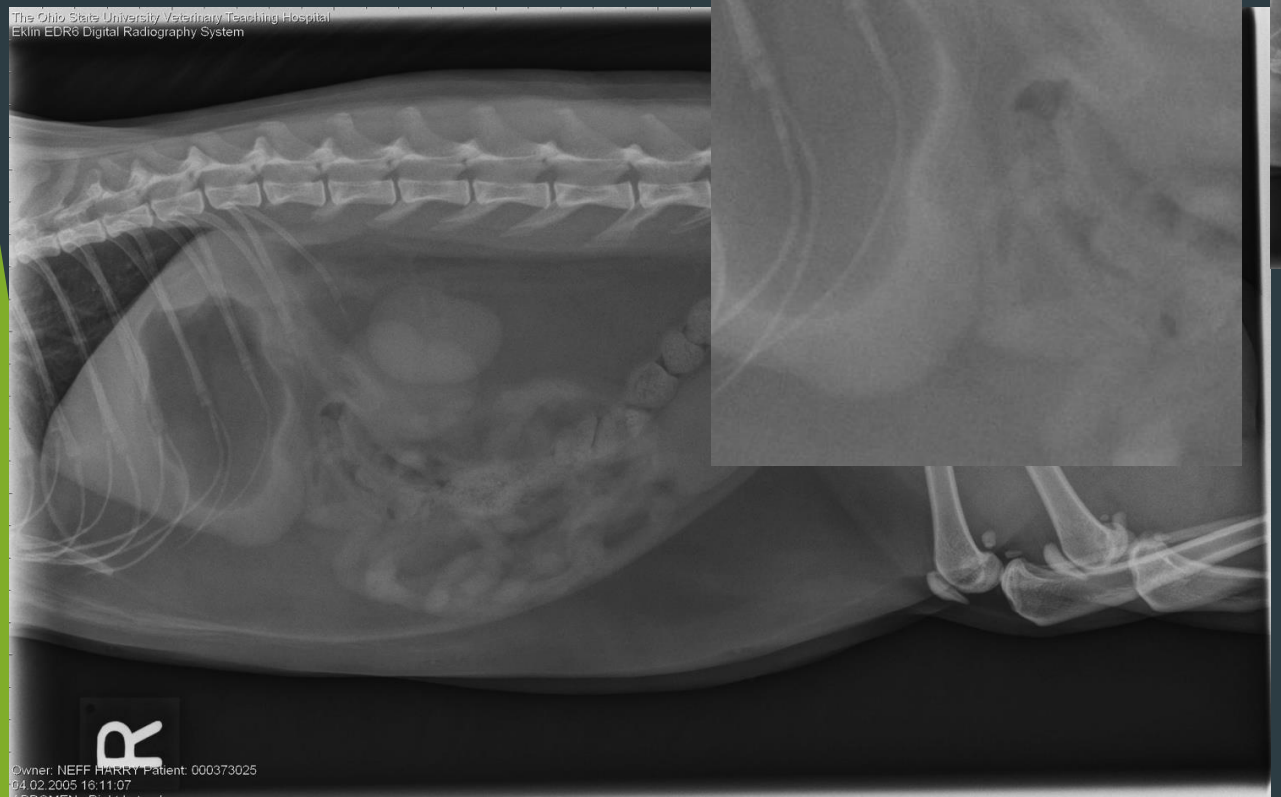
Incomplete Study

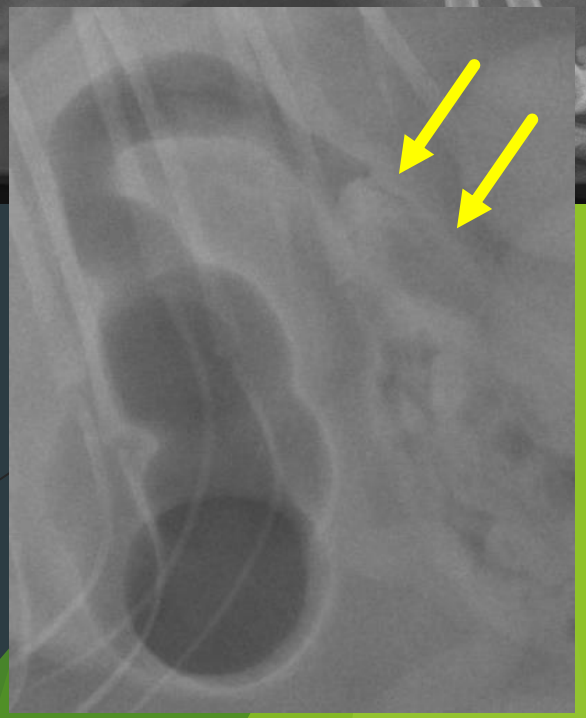
Orthogonal Views are imperative!

Incomplete Study

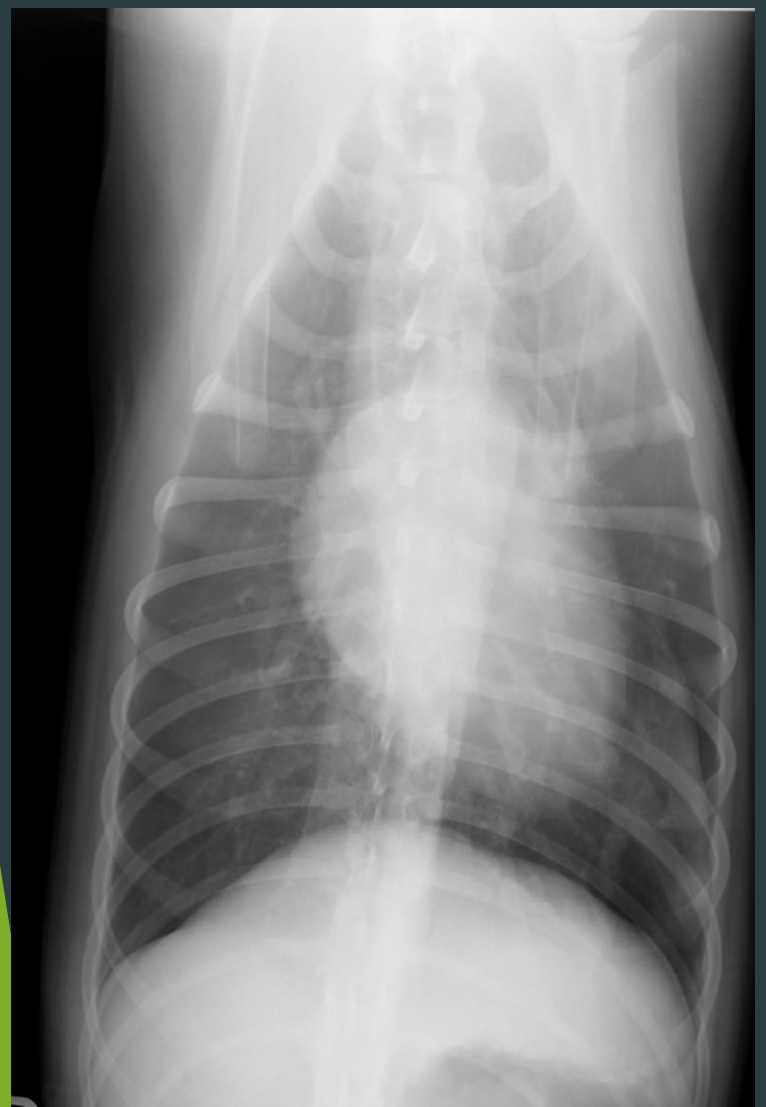


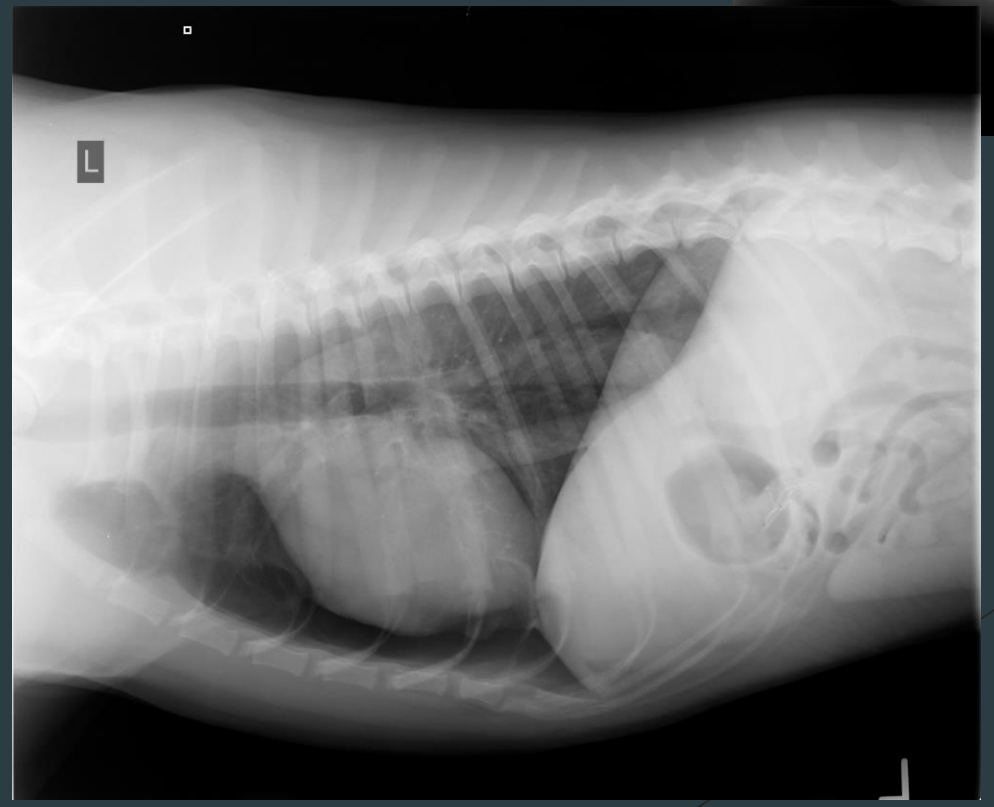
Three-view Abdomen for Gastrointestinal Disease

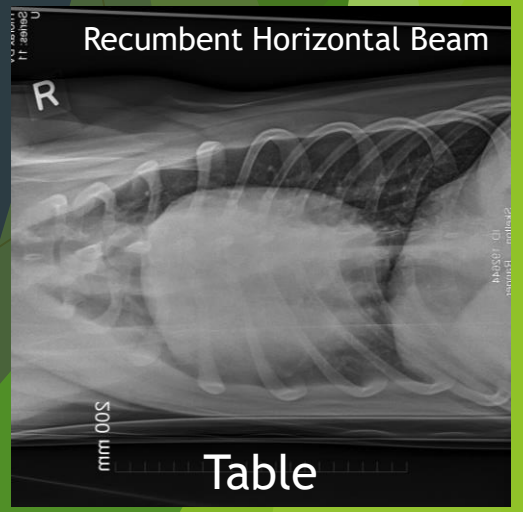




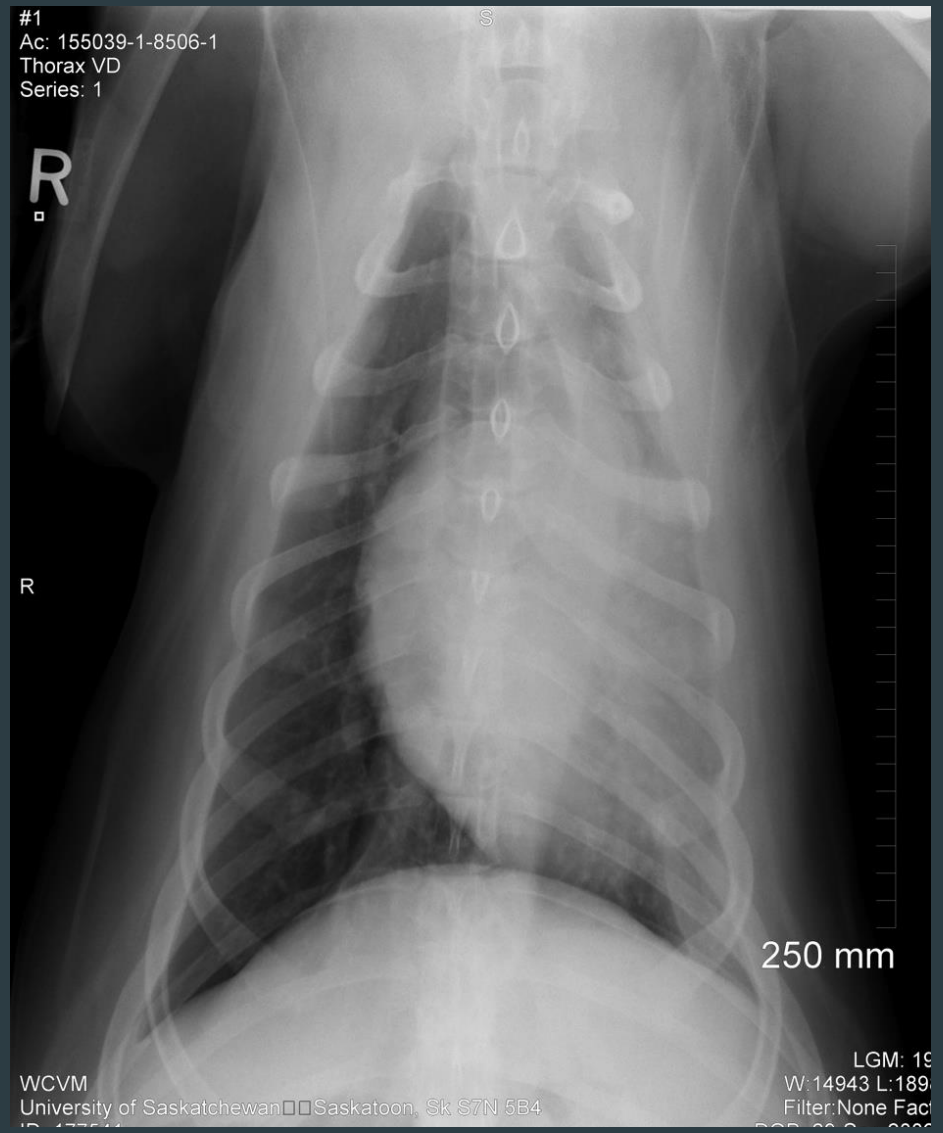
Three-View Thorax



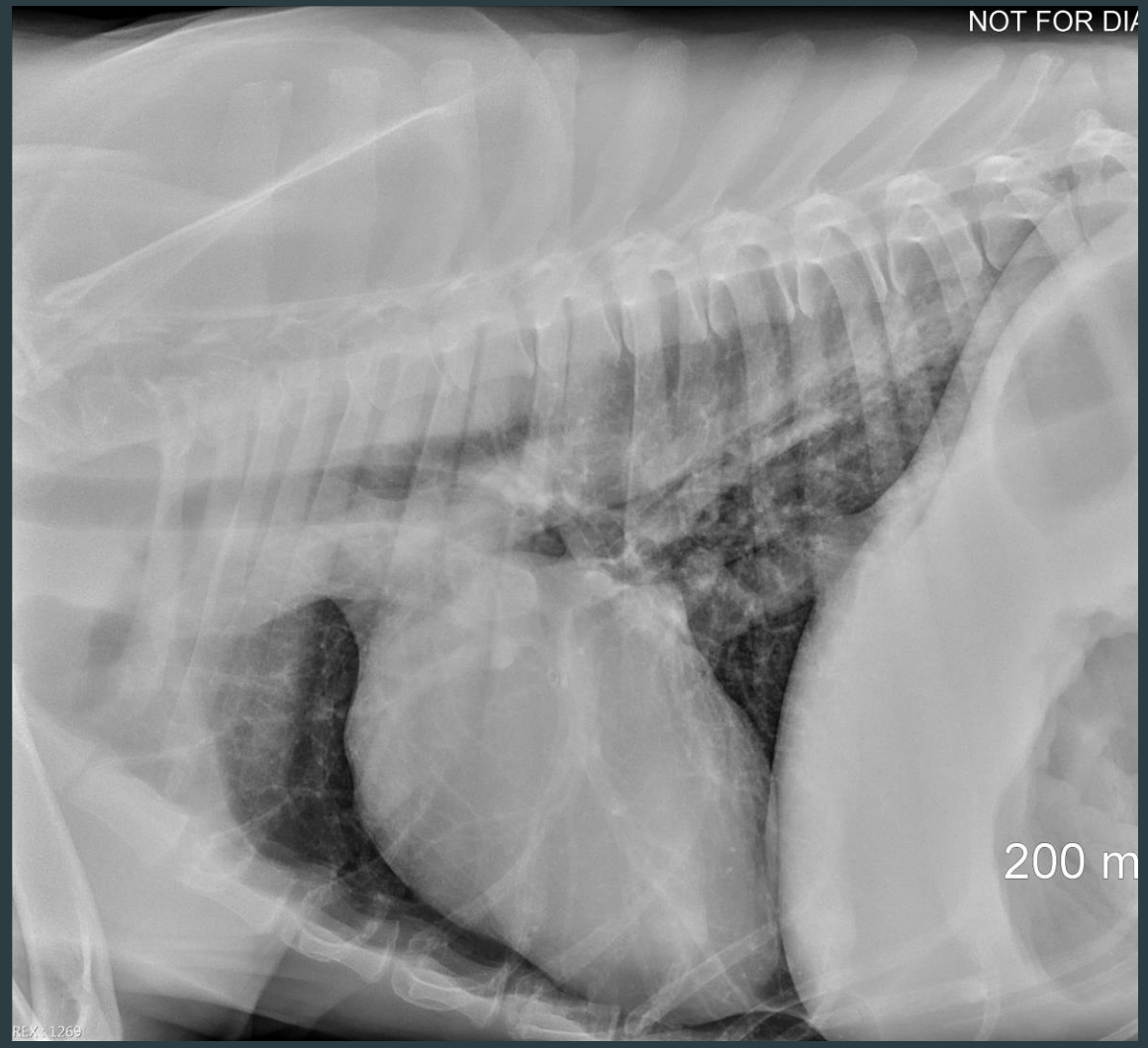


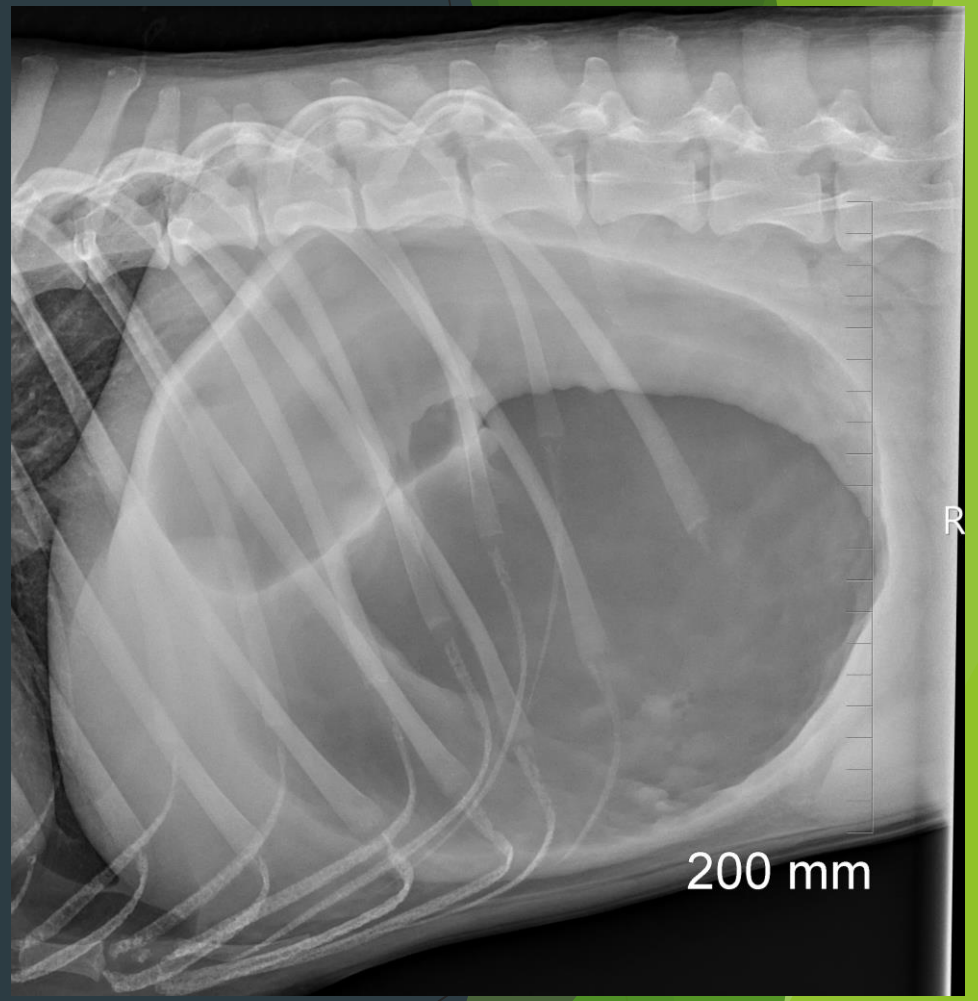


Atelectasis vs. Disease



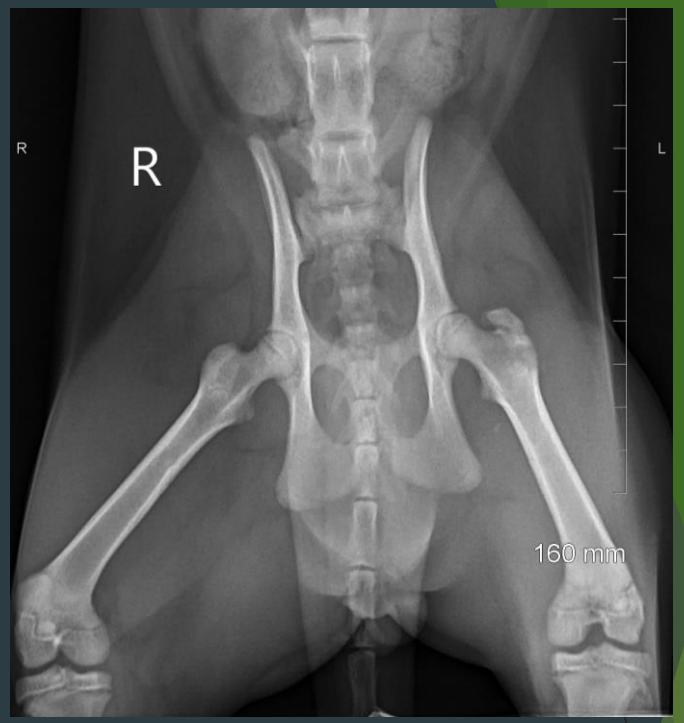
Perception Error



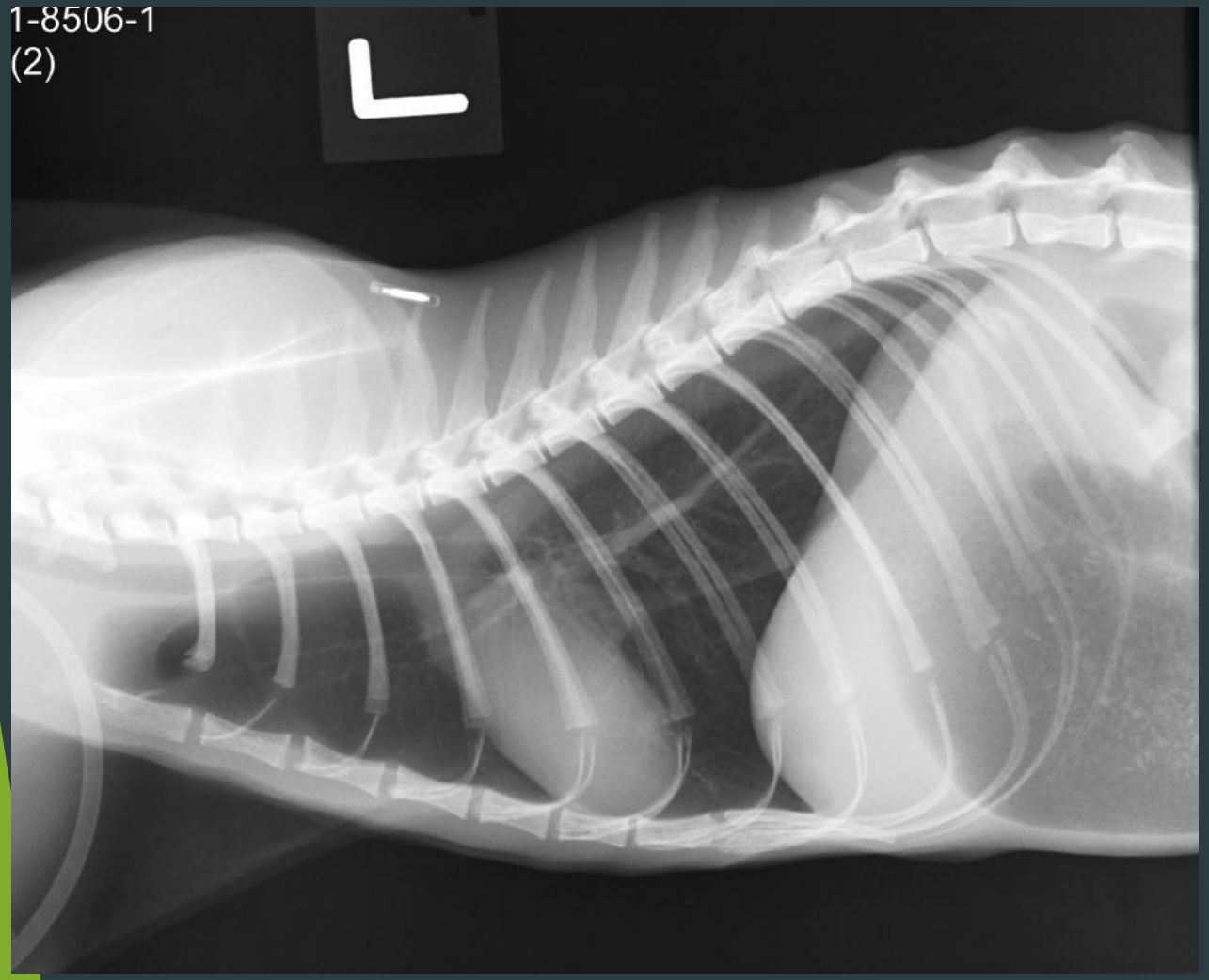


Remember to evaluate structures at the edge of the image

Satisfaction of Search Error



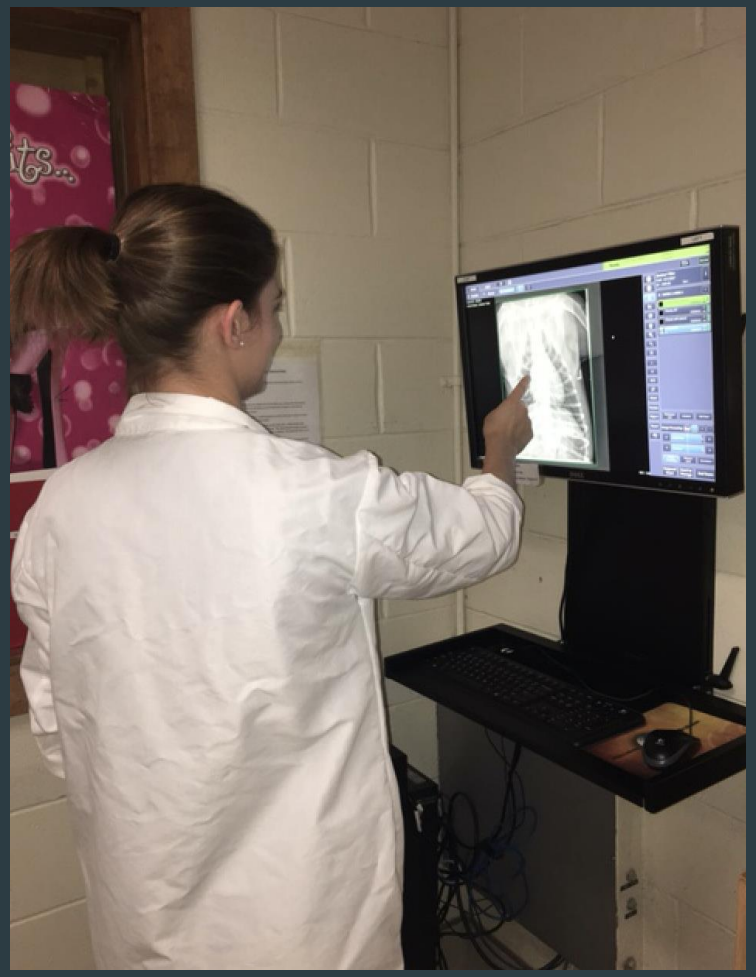
Recognition Error

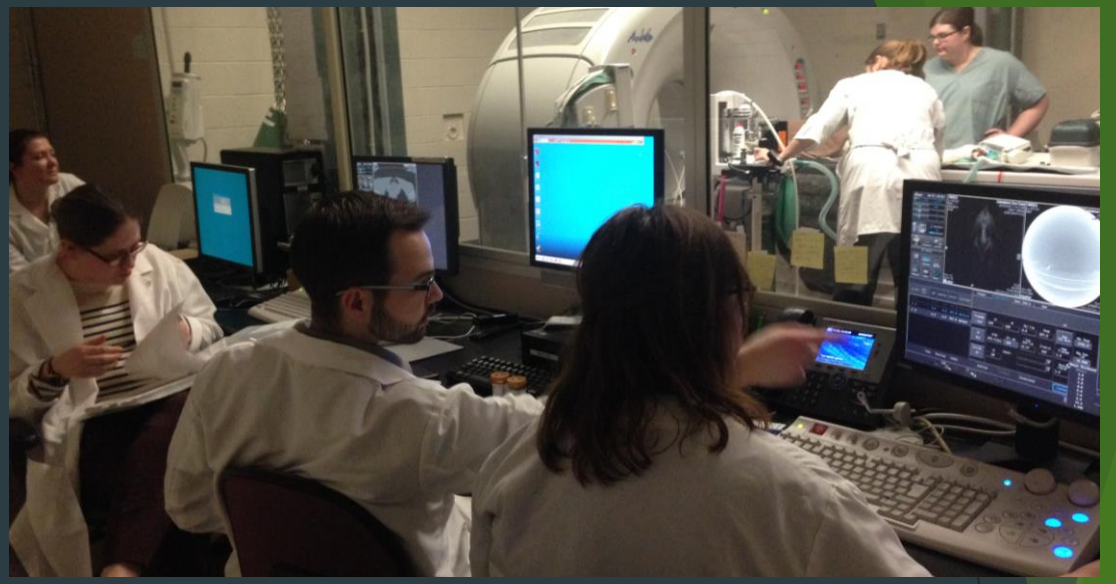


Ultrasound

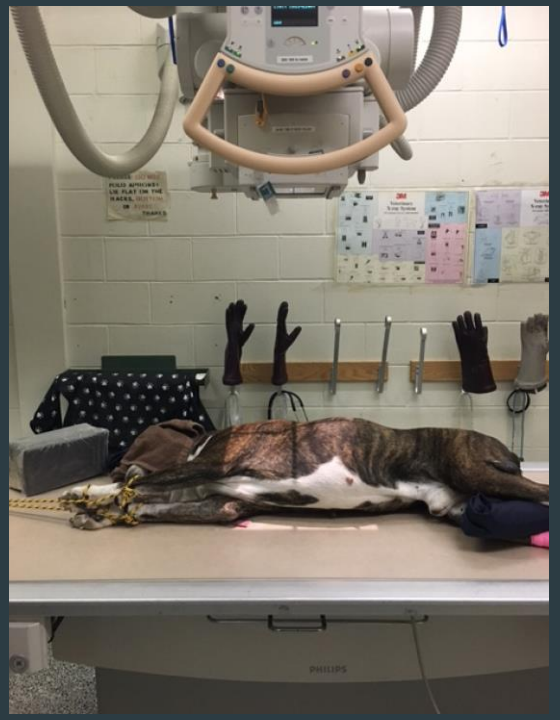
Intestinal Foreign Body

Thorax





CT Suite



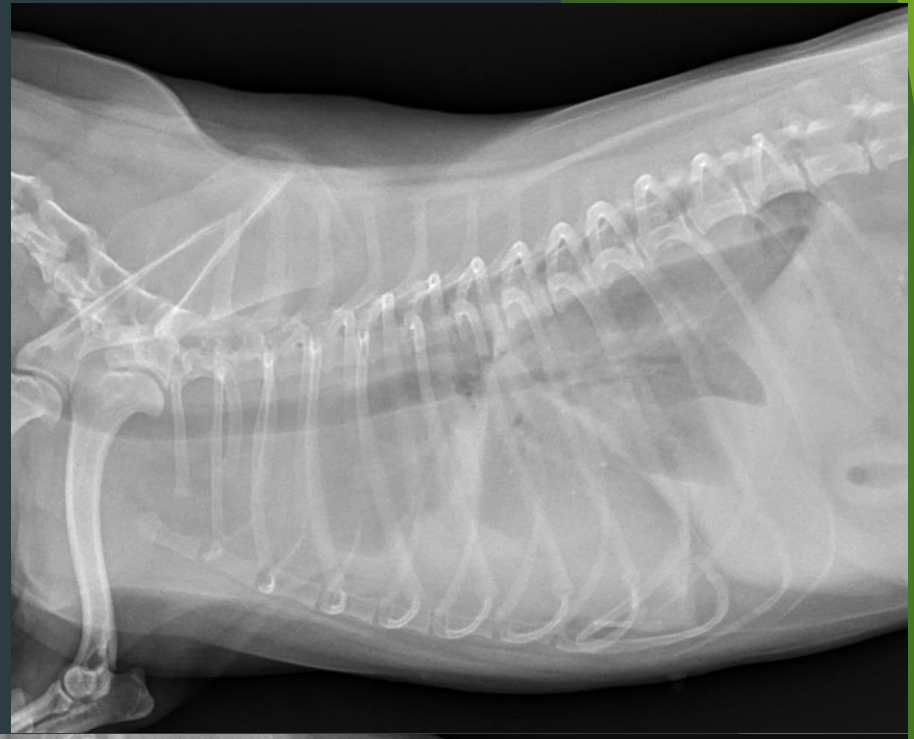
Radiography Suite

Pleural Effusion

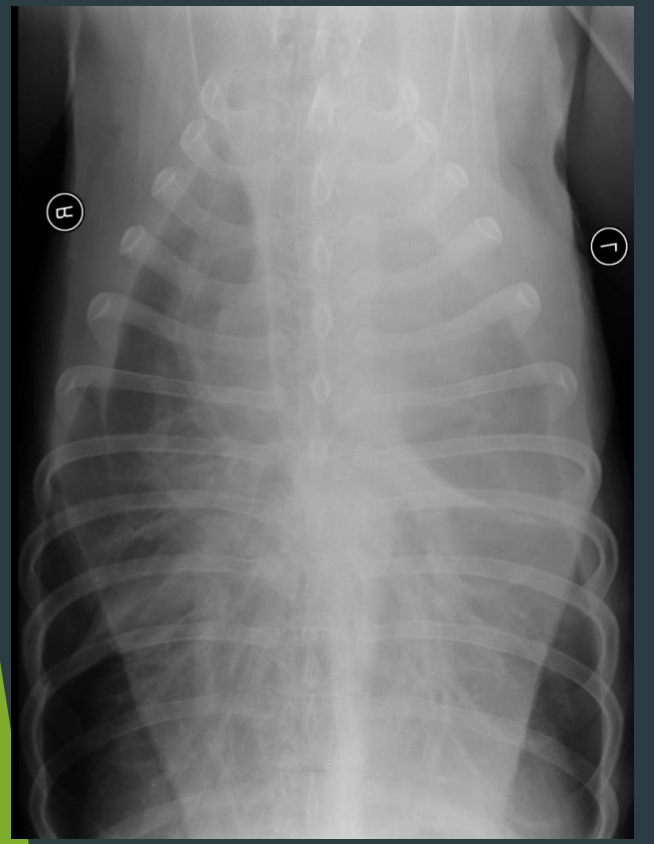
- Need approximately 100ml of fluid in the pleural space of med sized dog before widened interlobar fissures become visible
- Small volume – lateral>VD>DV
- Be on the watch for bi-cavitary effusion
- Horizontal beam radiography can be useful to identify masses/hernias or detect small volumes of fluid
- US can be utilized to identify fluid pockets and potentially detect masses

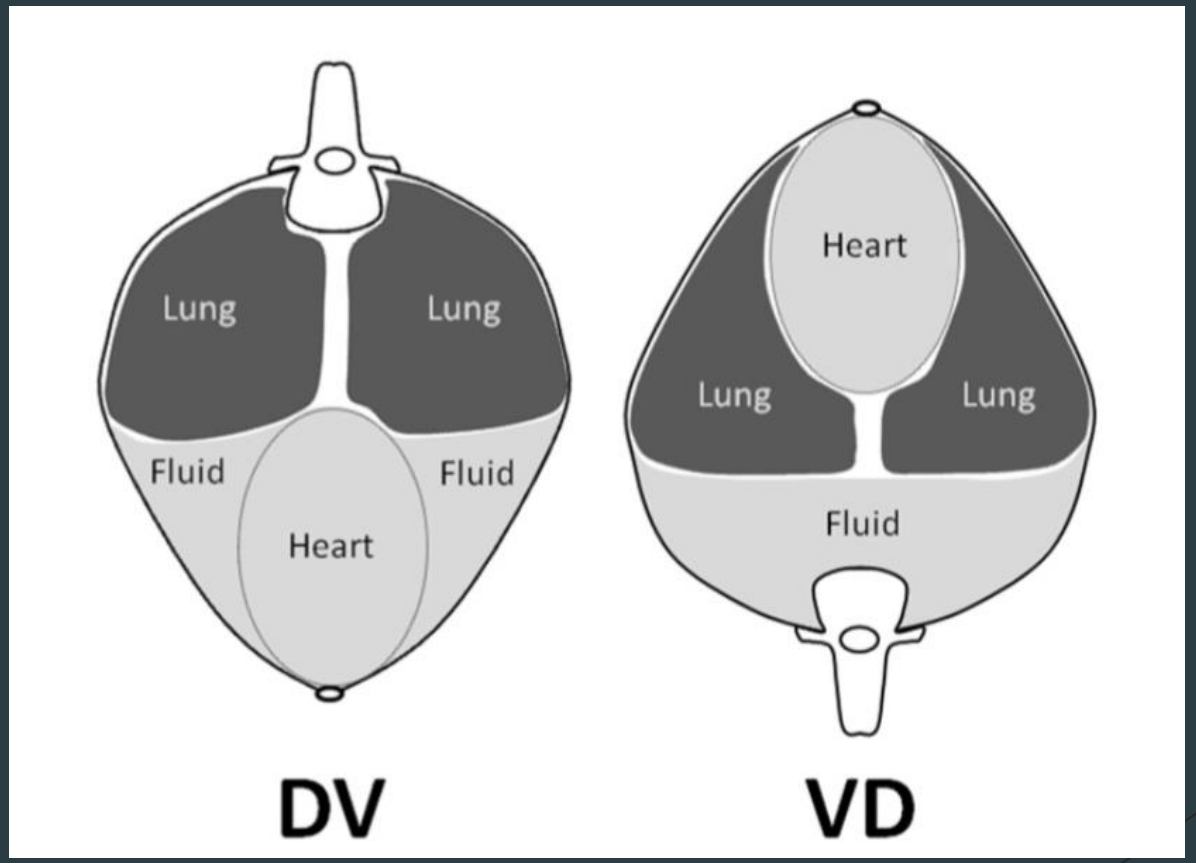
Start with a DV

Drain Fluid?
Stabilize?

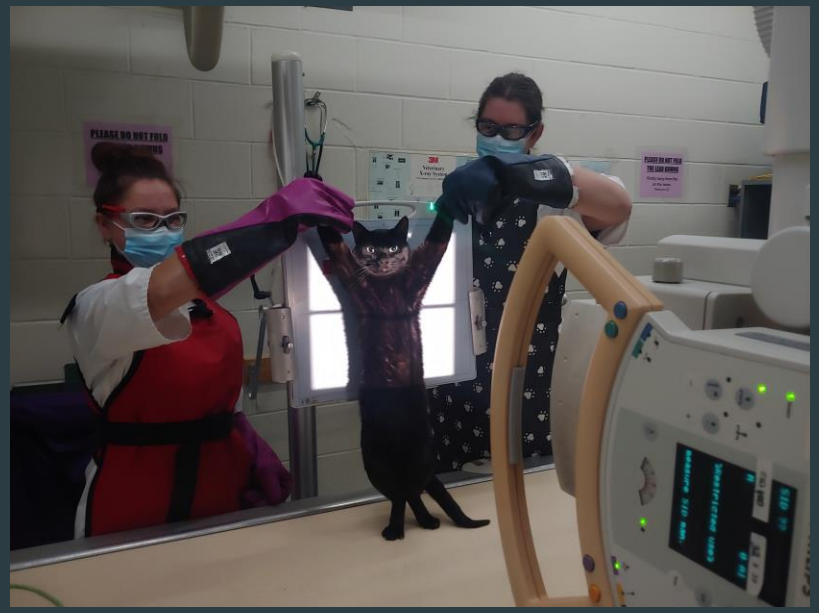


DV vs. VD with Pleural Effusion



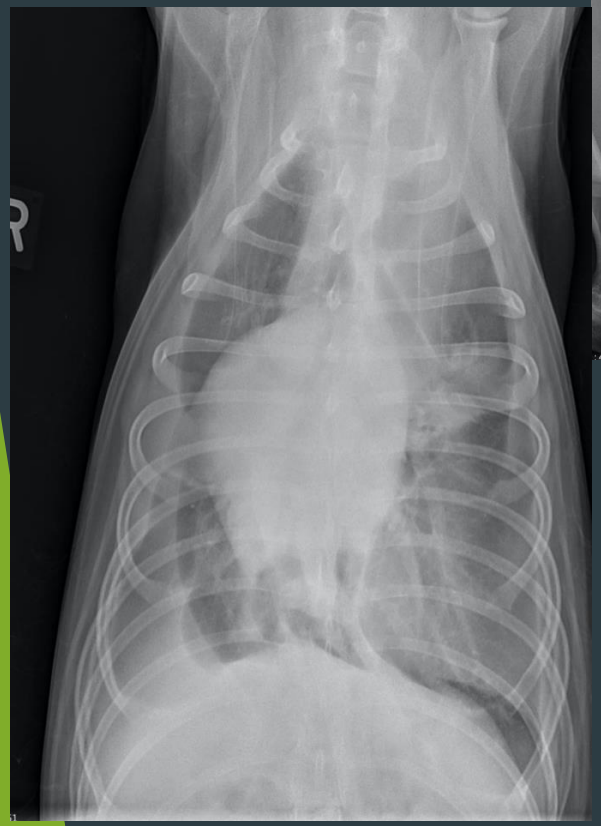


Mass or Effusion?

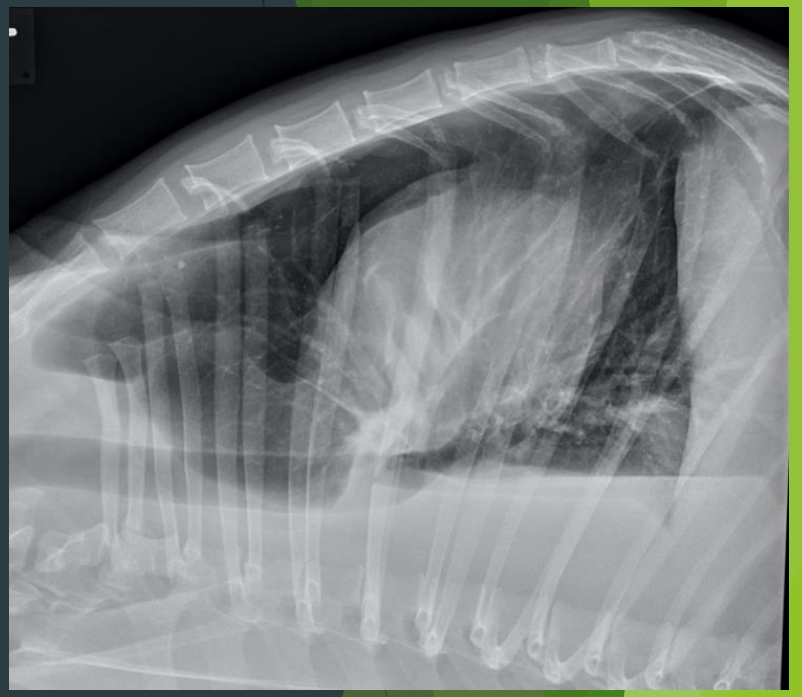


Standing Horizontal Beam

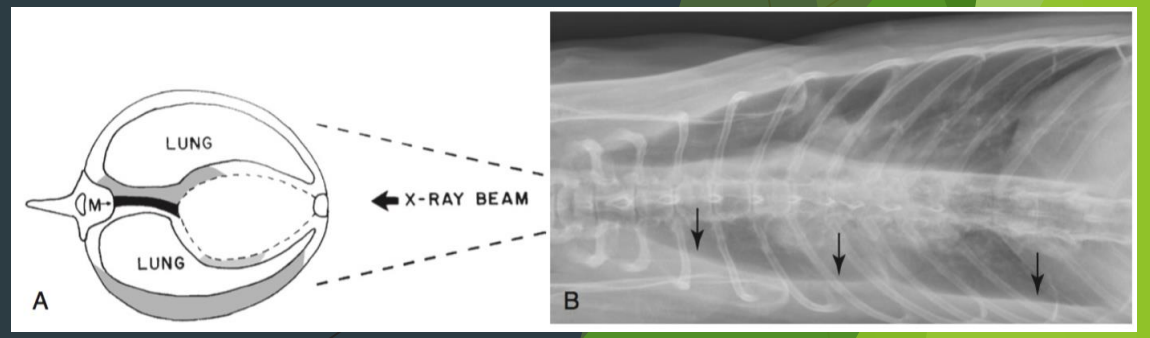
Horizontal Beam Radiography



Diaphragmatic Hernia?



Horizontal Beam



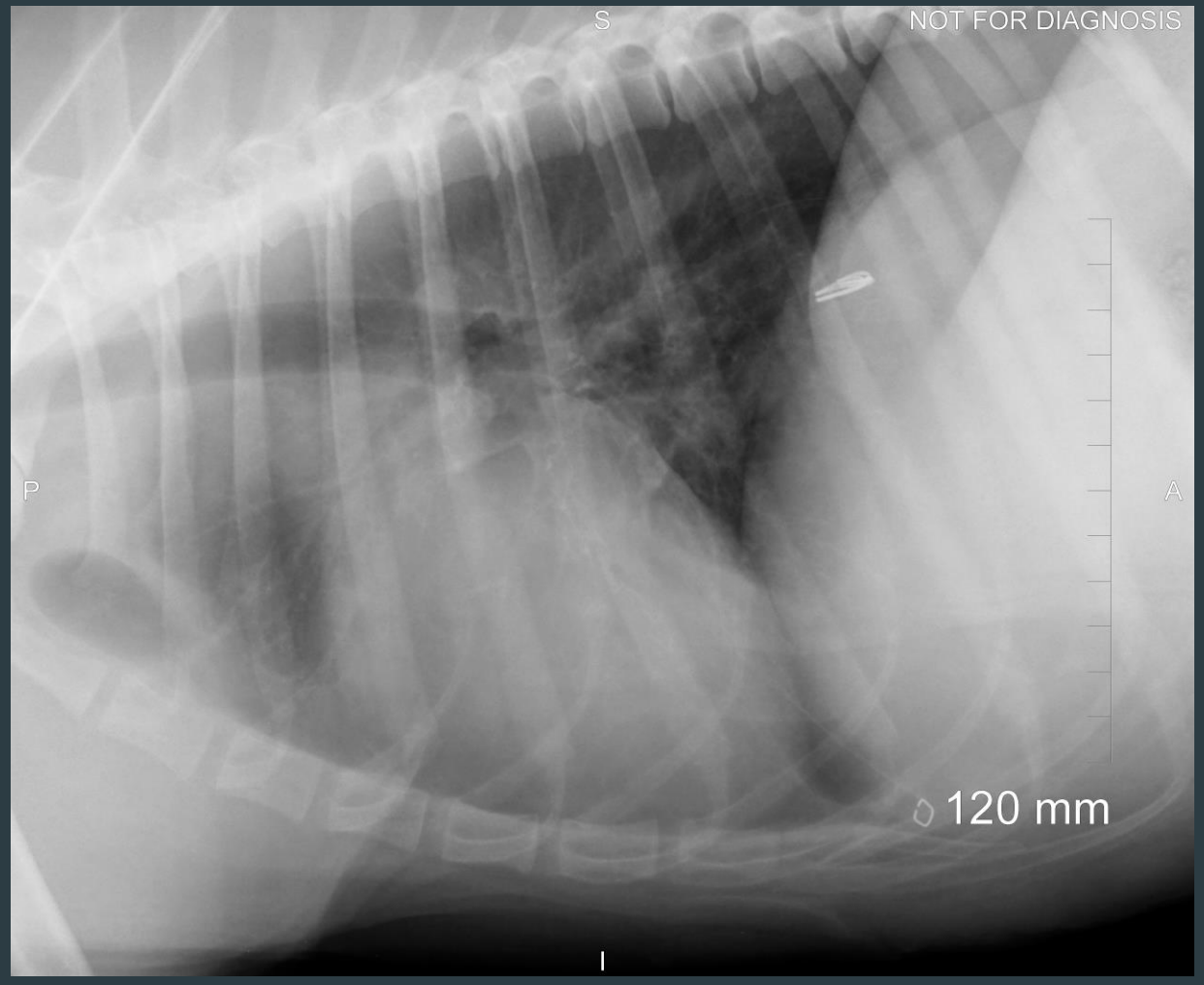
Small Volume of Fluid

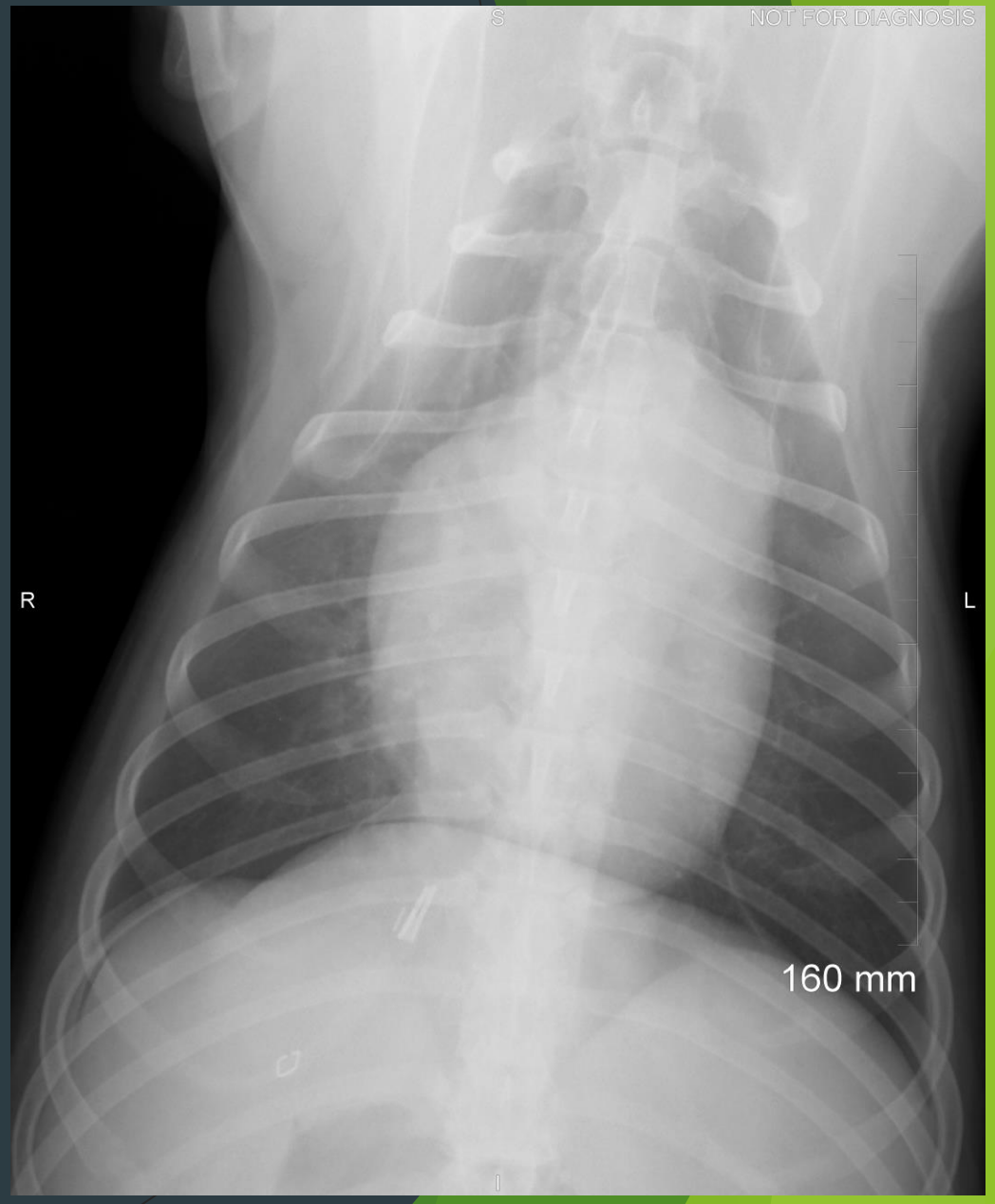
Pulmonary Thromboembolism

- Complication of hypercoagulability, stasis or blood flow and damage to endothelial lining of vessels
- Causes: IMHA, cardiac disease, neoplasia, PLN, hyperadrenocorticism, sepsis, trauma and major surgery
- Antemortem diagnosis can be difficult
- Radiographic findings: pleural effusion (67%), loss of pulmonary artery (52%), alveolar infiltrates (48%) hyperlucent lung regions (29%), enlargement of MPA (19%)
- Thoracic radiographs are normal in 27% of patients with PTE

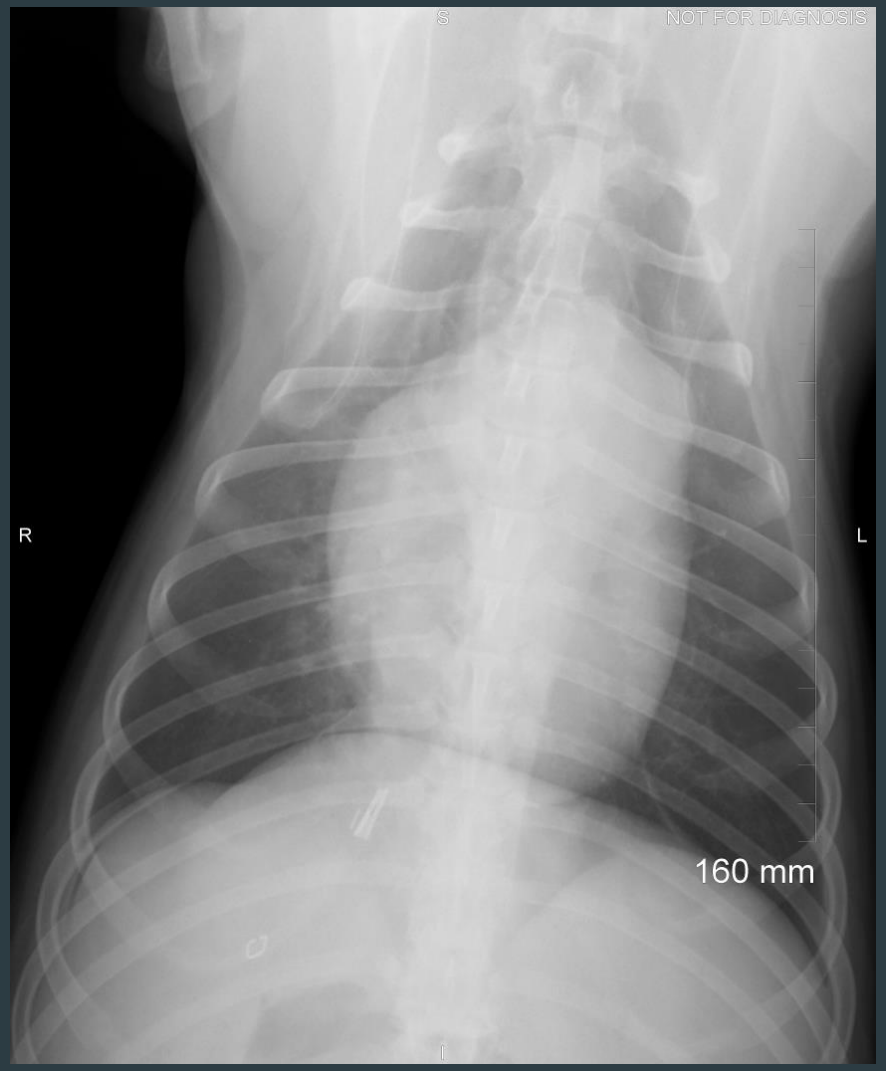
Johnson, LR. et al. Pulmonary Thromboembolism in 29 Dogs: 1985-1995. JVIM 1999

Pulmonary Thromboembolism

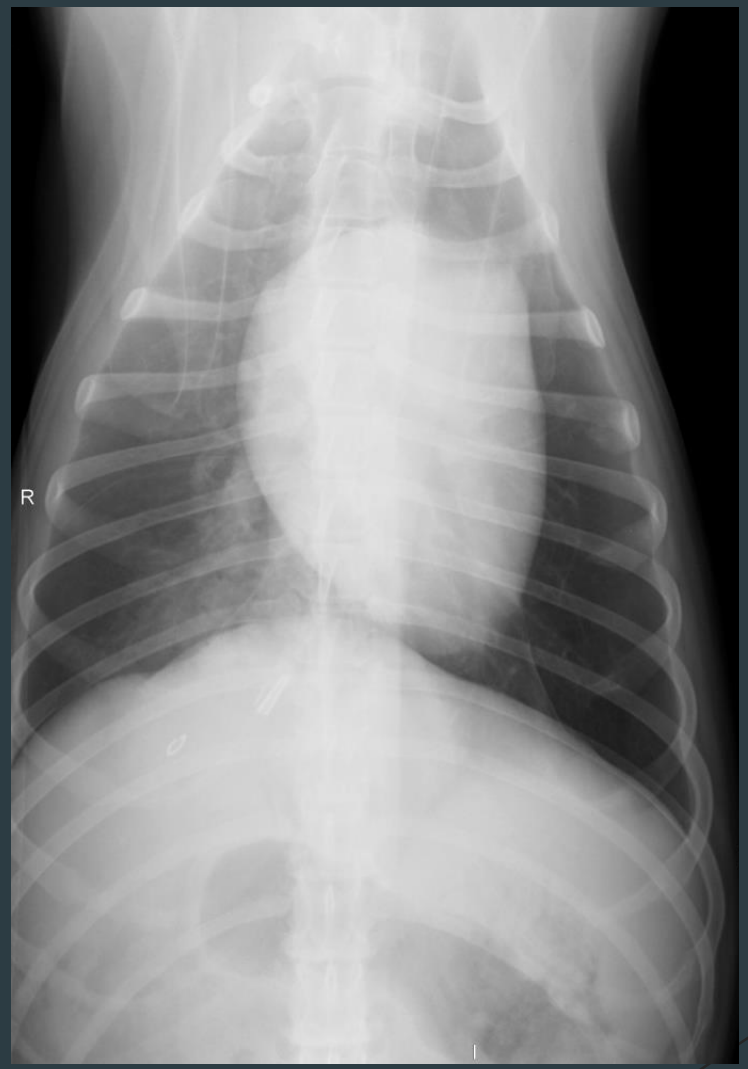




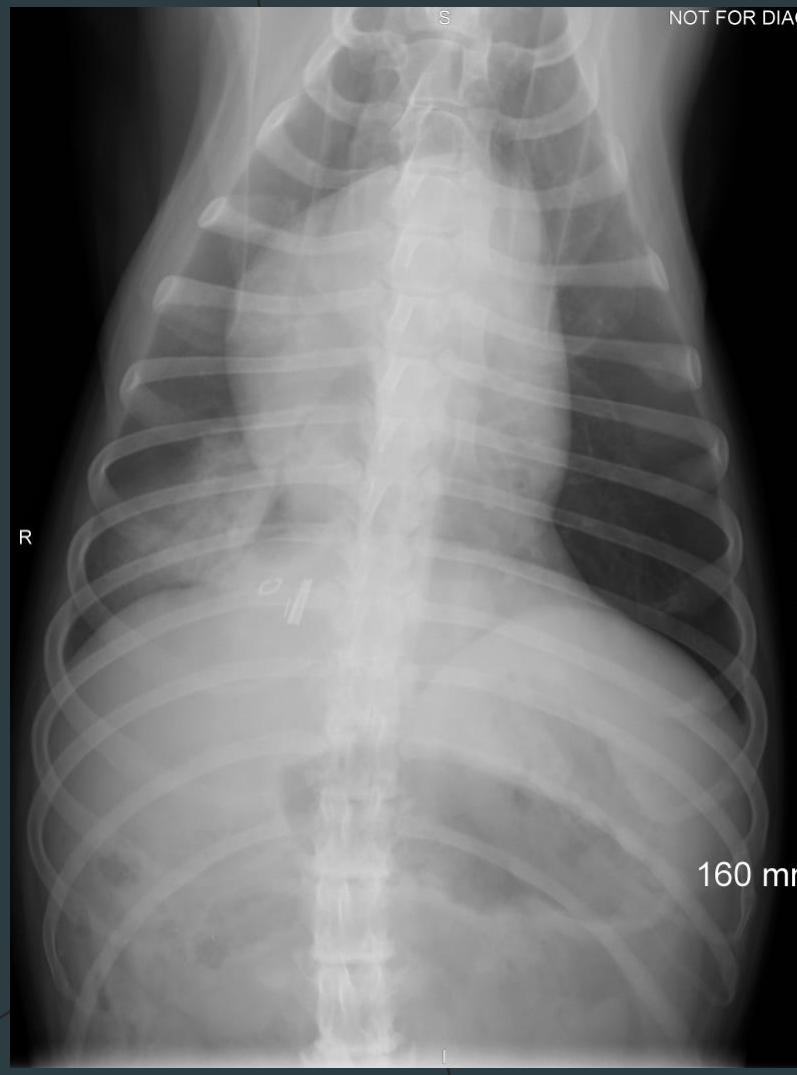
Pulmonary Thromboembolism



Initial

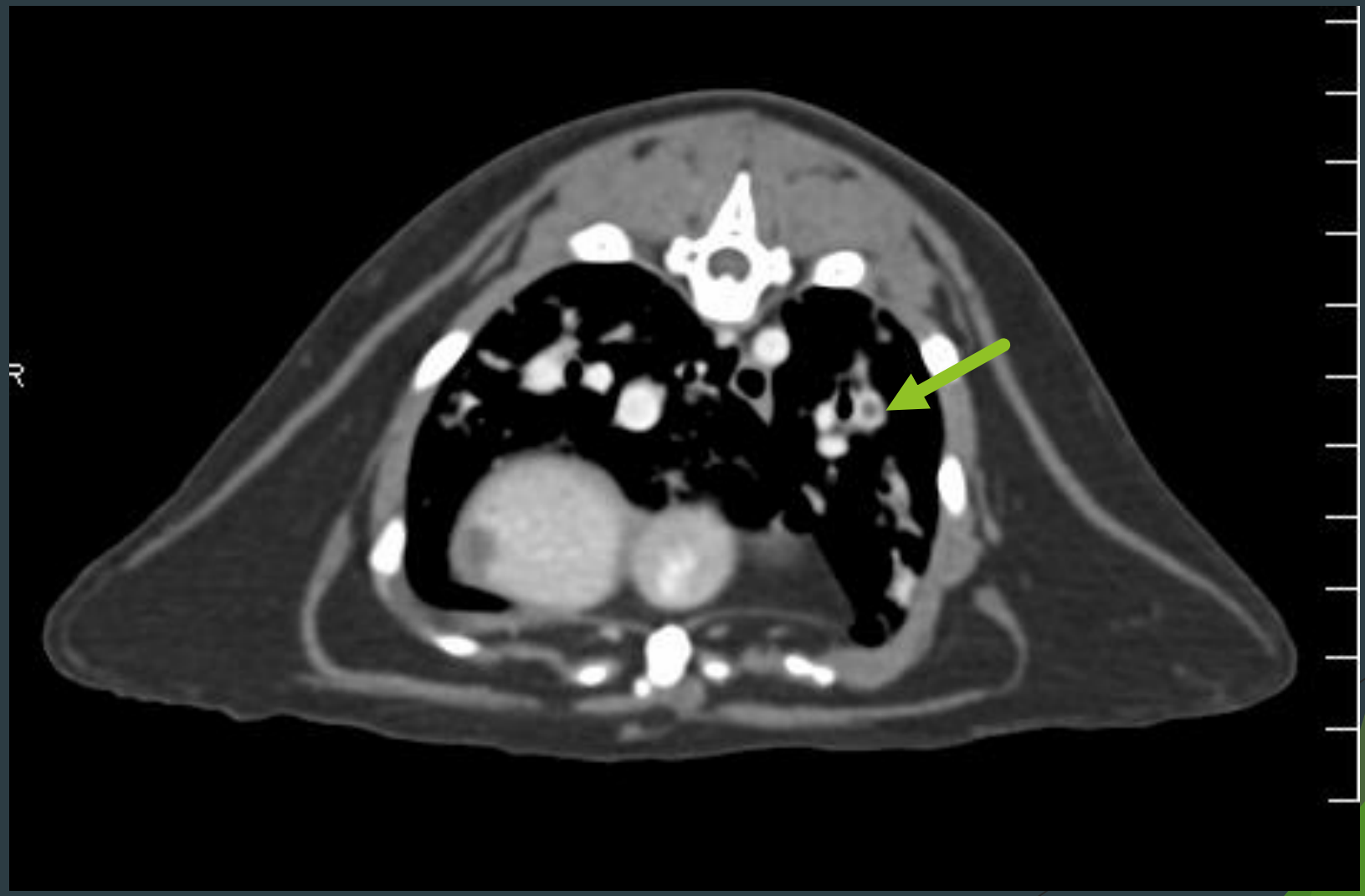


Day 2



Day 3

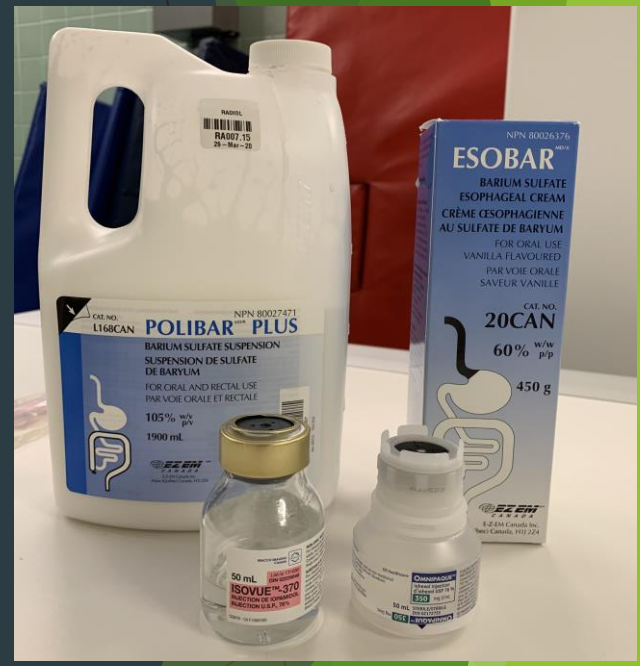
Pulmonary Thromboembolism - CT



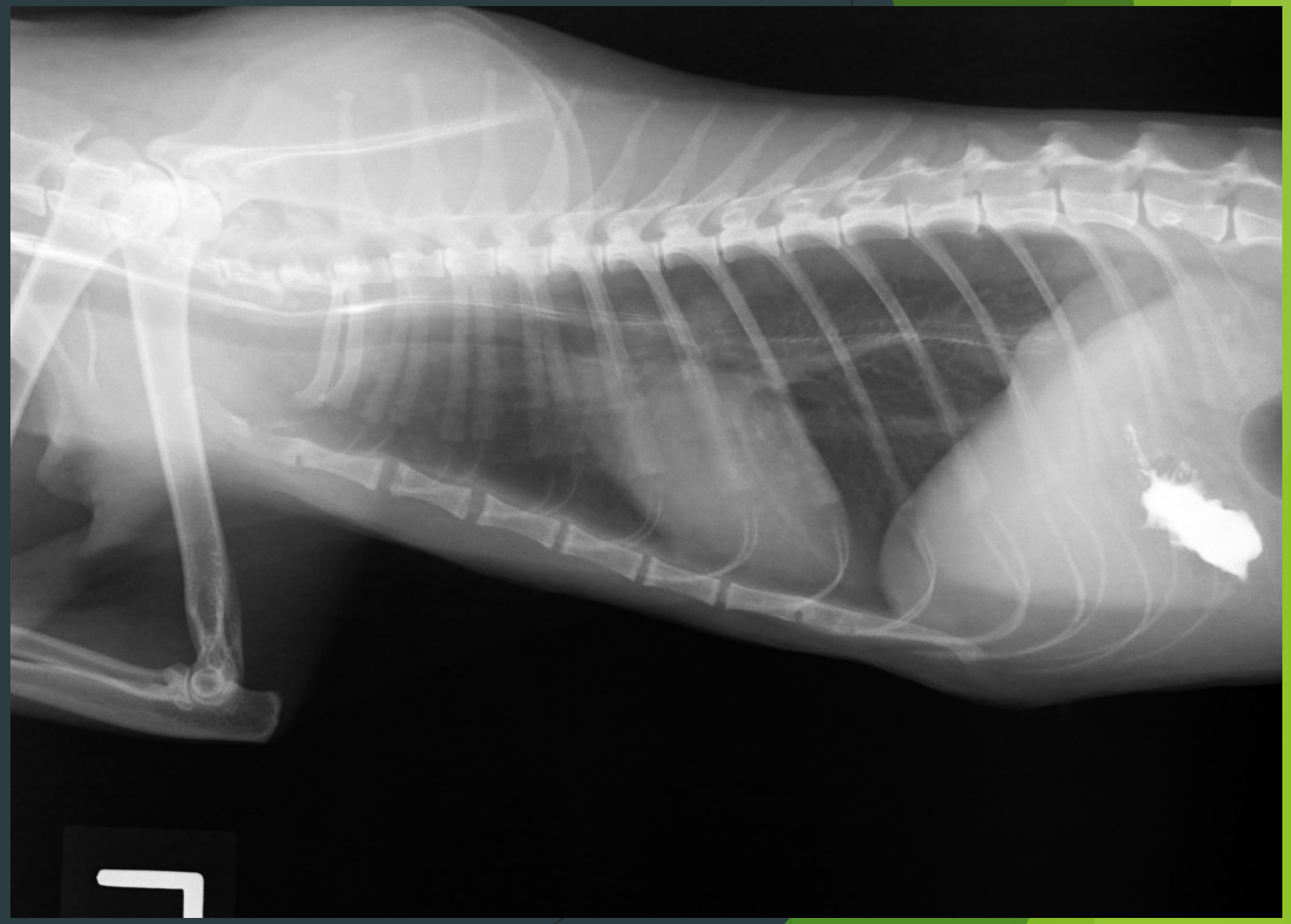
Esophageal Disease

Volume of Barium Suspension:
Cat: 5-7ml
Small Dog: 15 ml
Large Dog: 20-30 ml

- An ESOPHAGRAM is warranted when esophageal air or fluid is detected in animals with clinical signs of disease
- ALWAYS do survey radiographs before any contrast study
  - Check for signs of aspiration pneumonia or perforation
- Barium paste is contraindicated for patients at risk of aspiration (paste can cause airway obstructions)
- Use non-ionic contrast medium if a perforation is suspected
- Aspiration of small amounts of liquid is usually insignificant
- In general, there should be no retention of barium during swallowing

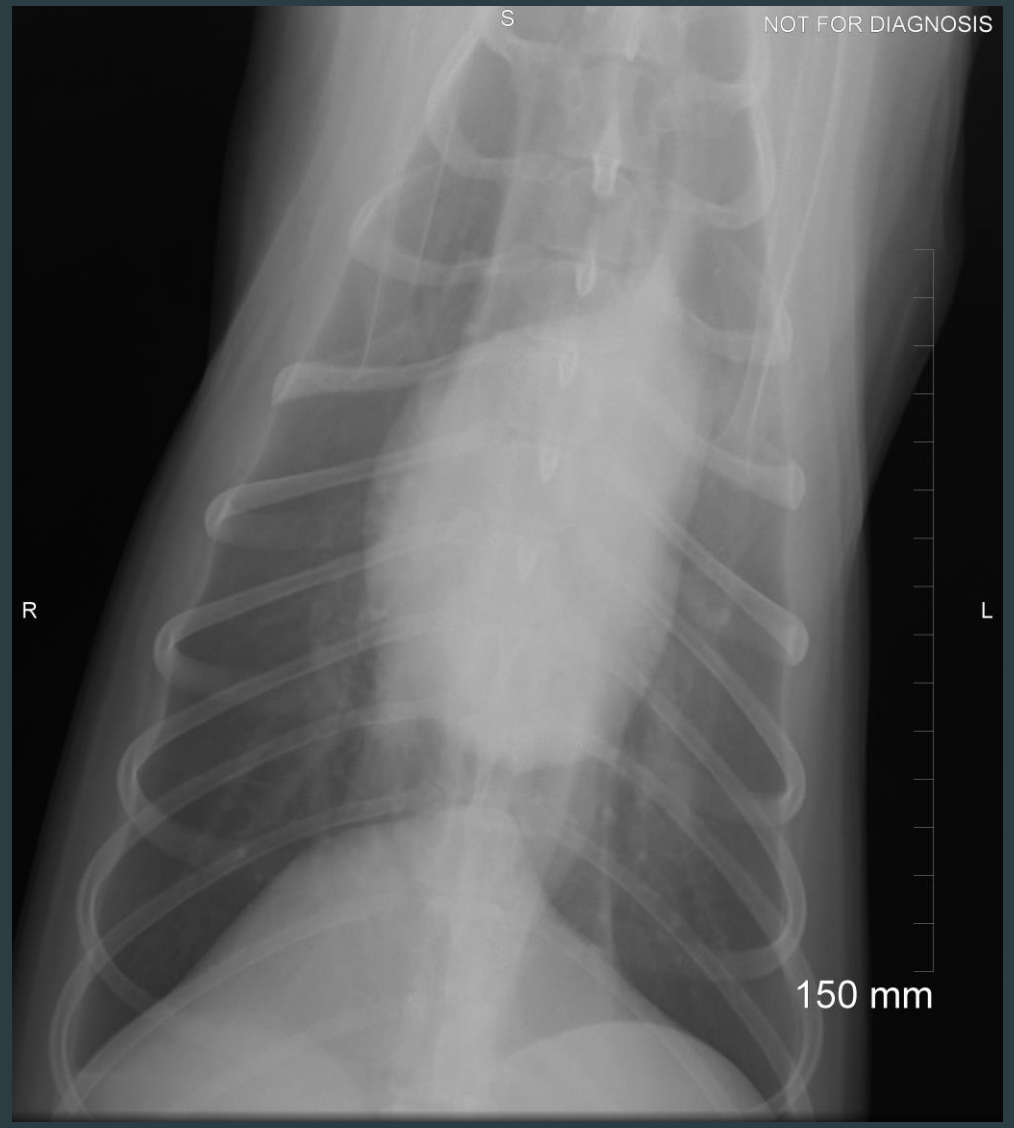


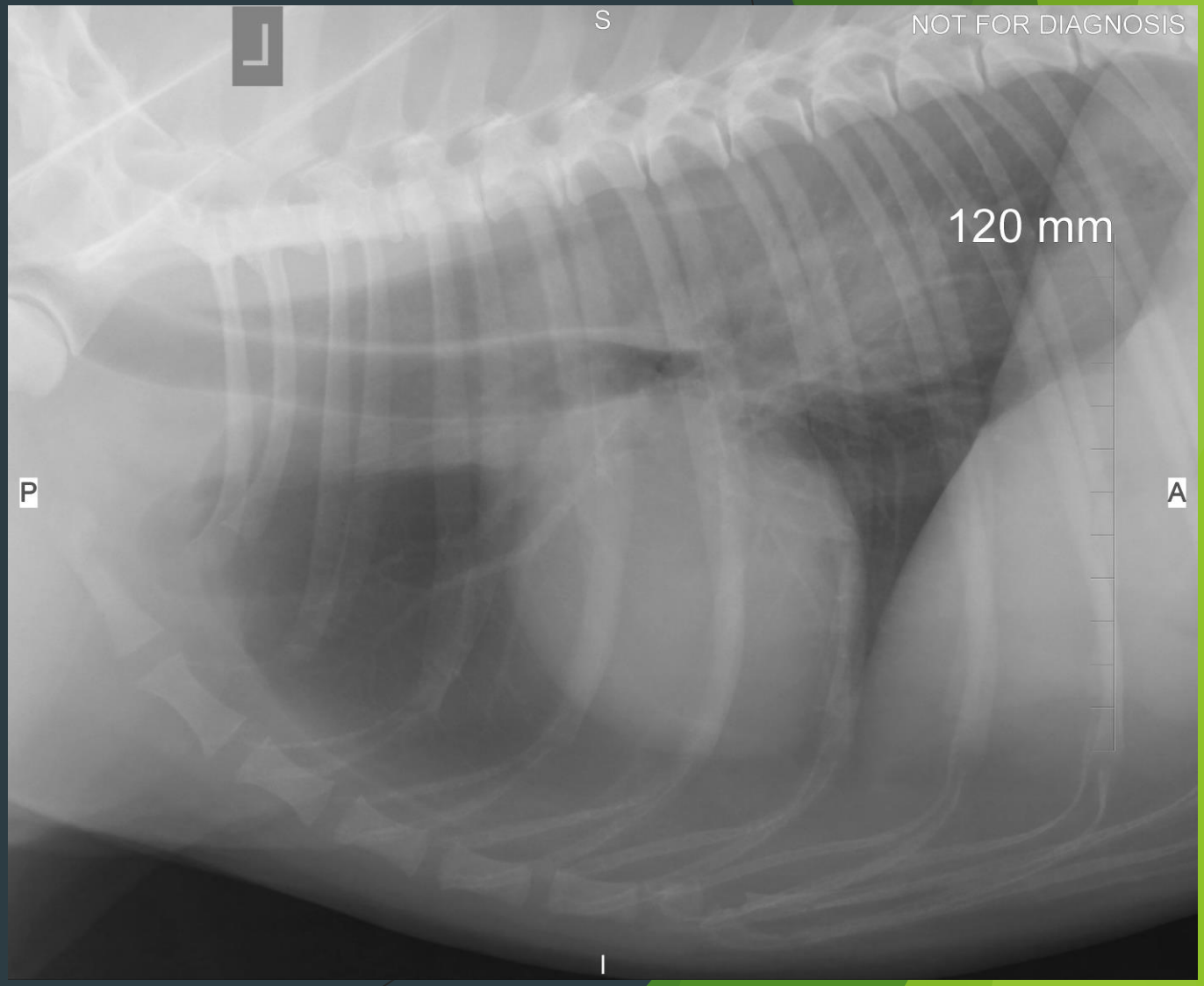
Normal Esophagram



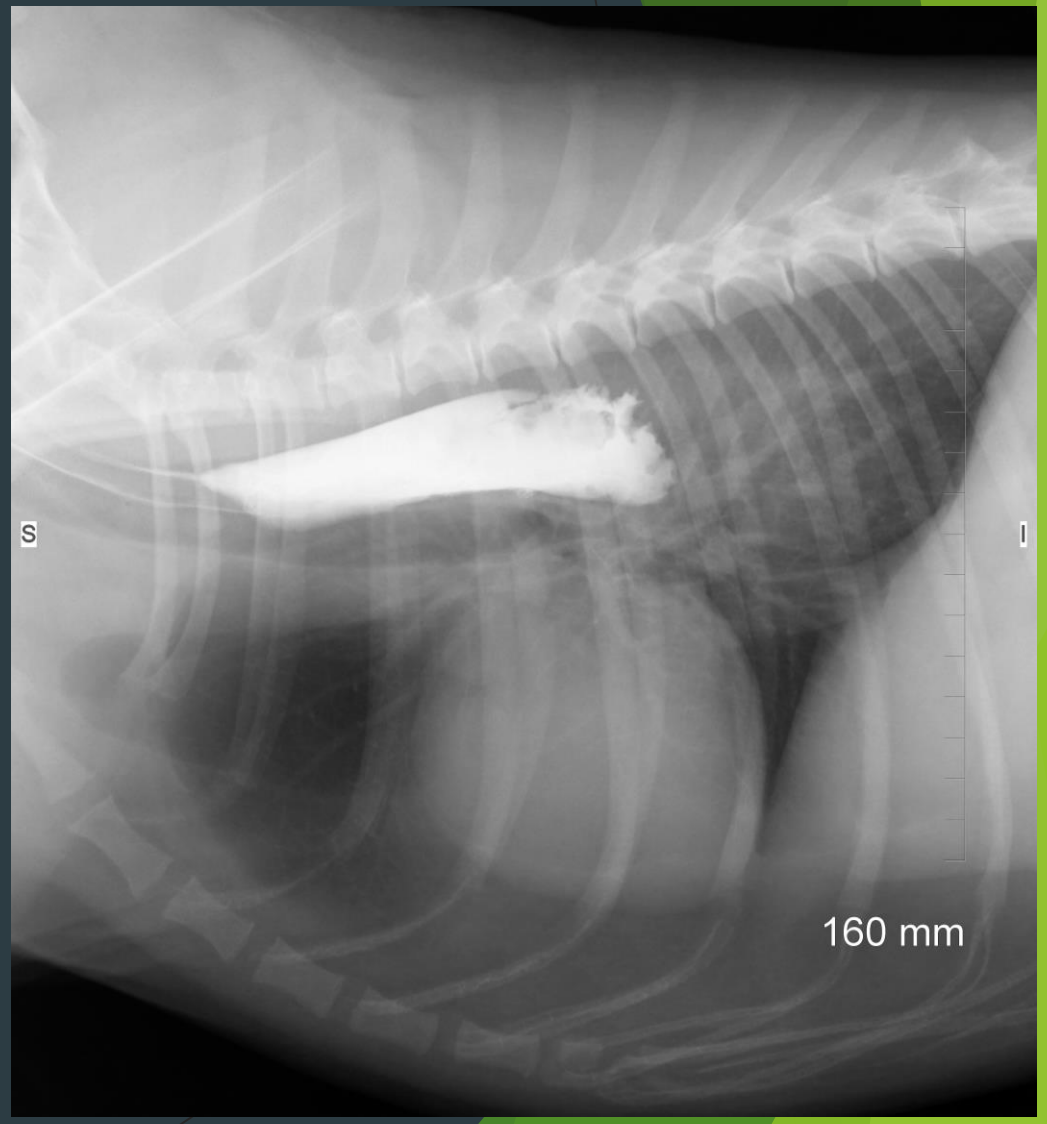
Cat: Herringbone Pattern (Caudal 1/3rd)

Esophageal Foreign Body





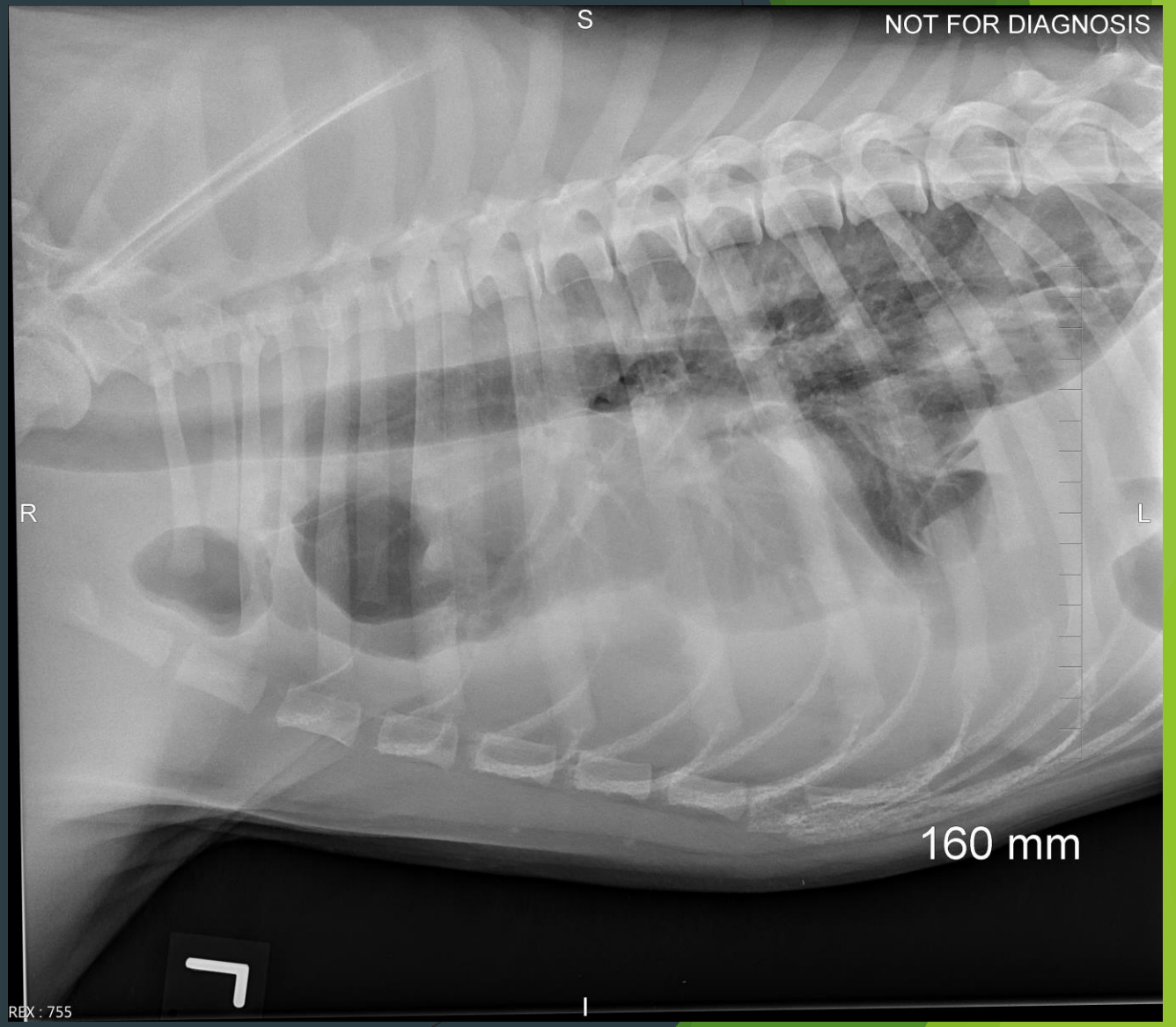
Esophageal Foreign Body: Esophagram



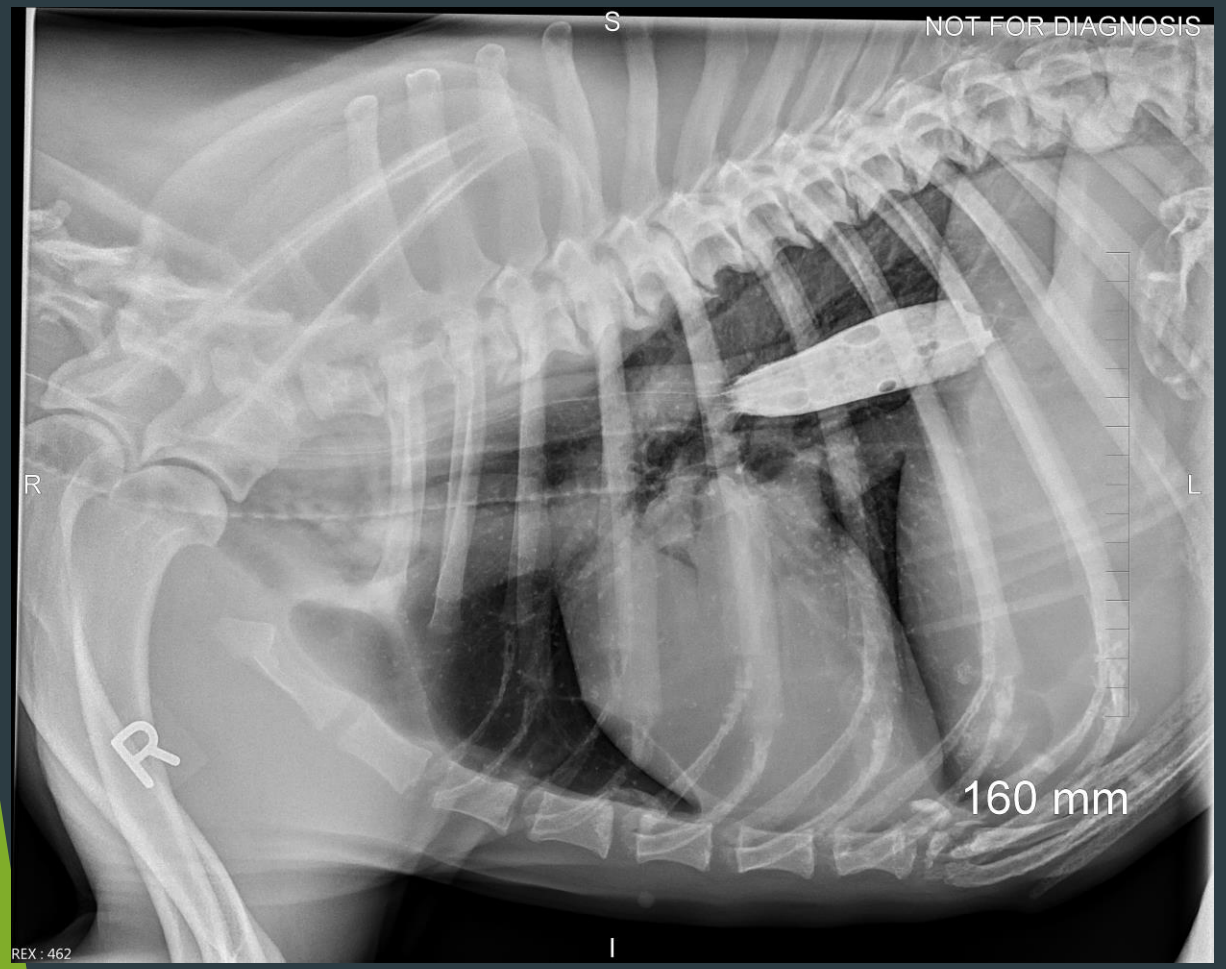
Esophageal Disease or Pulmonary Mass?

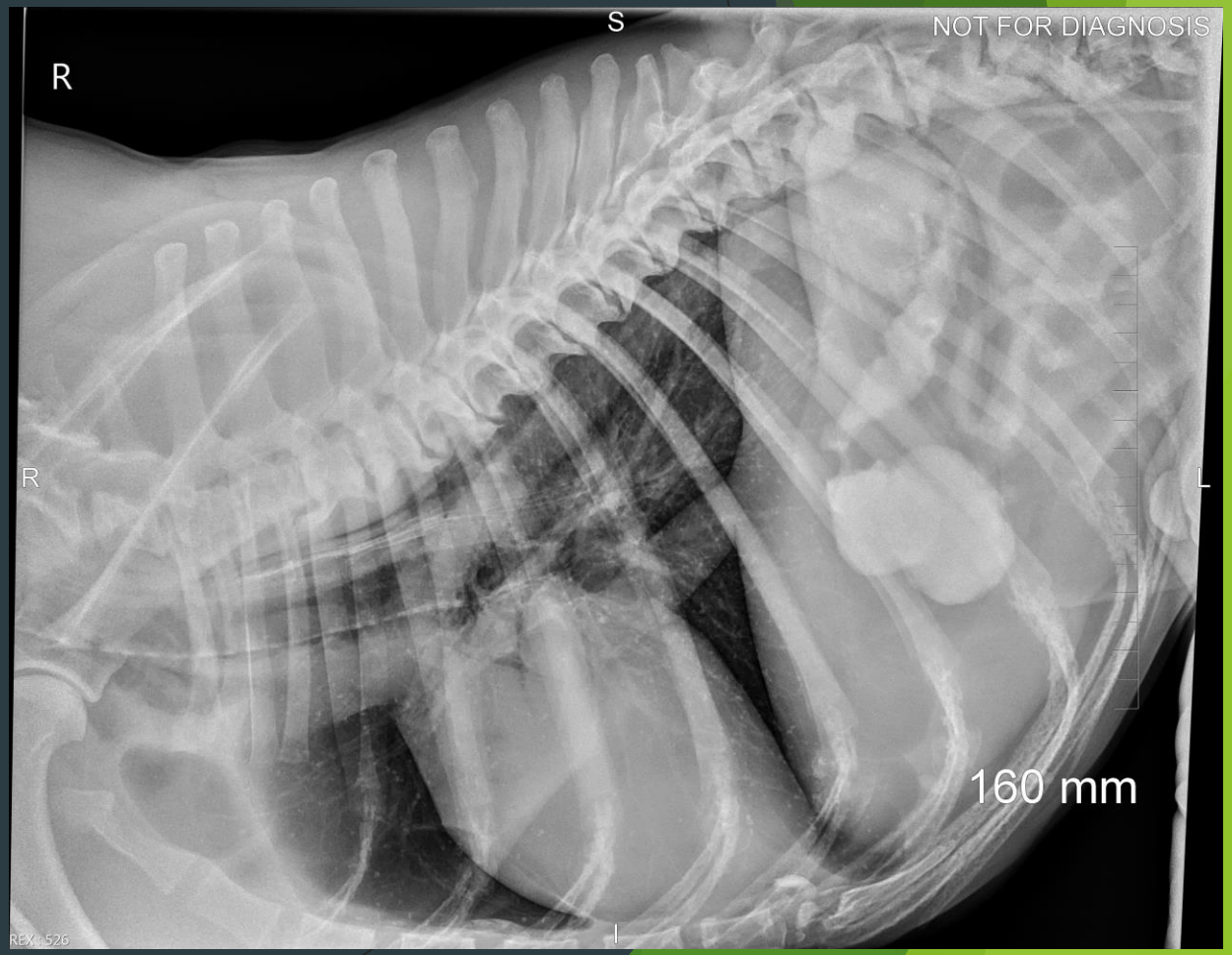
Esophageal Mass: Esophagram

Esophageal Rupture



Non-Ionic Contrast Esophagram





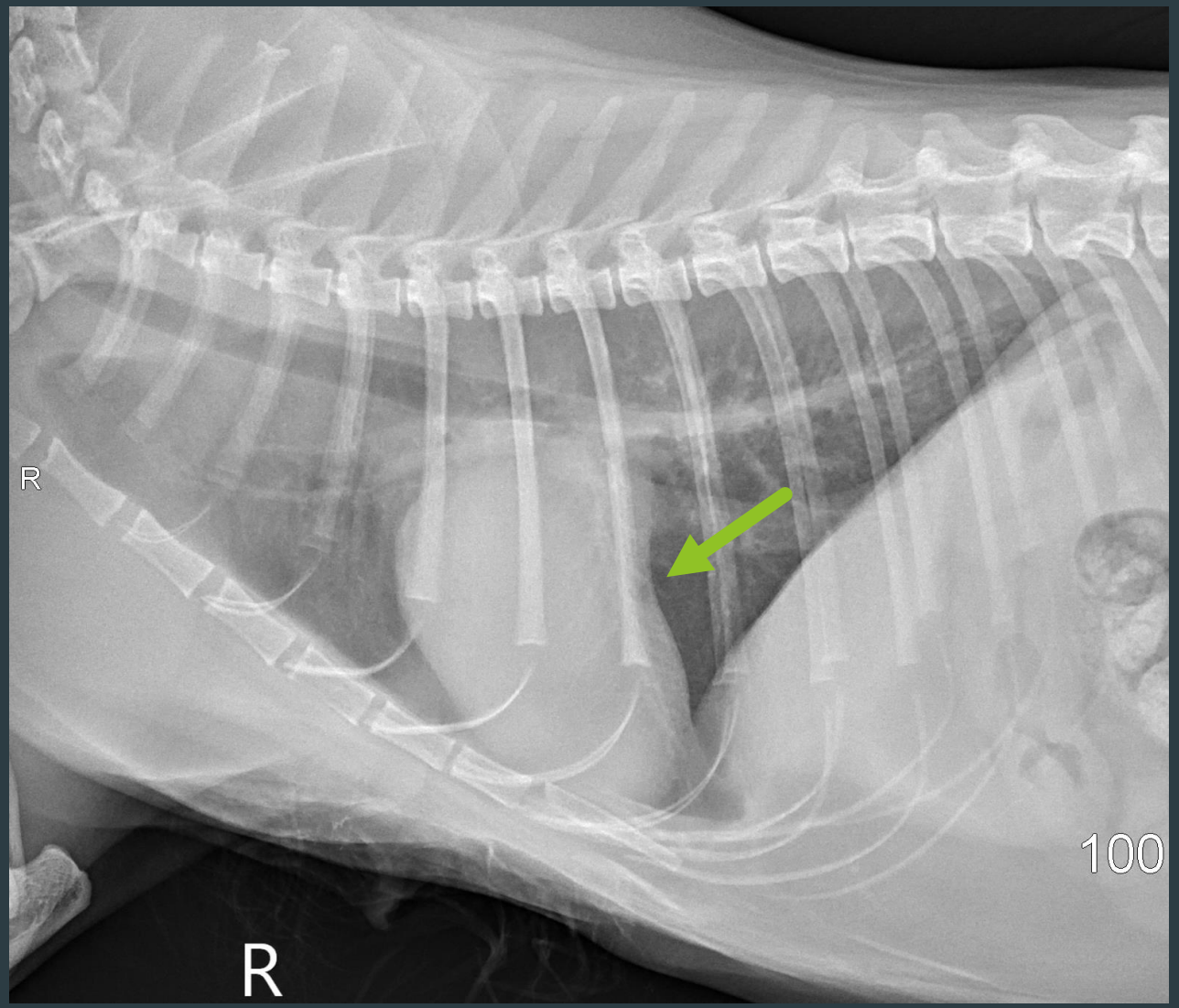
Congestive Heart Failure in Cats

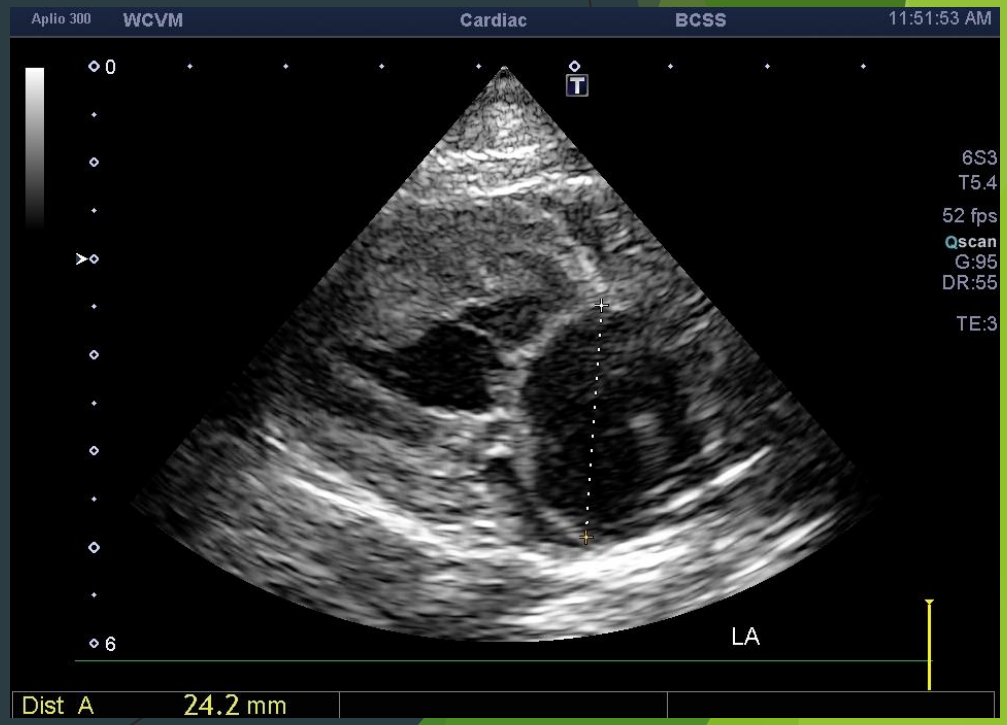
- About 50% cats have pleural effusion which can complicate the diagnosis
- Appearance of pulmonary infiltrates is more variable in cats than dogs
- Pulmonary venous enlargement is a poor indicator of left-sided CHF
- VHS typically 7-8 (6.7-8.1) in cats
- Using 8.1 as cut off, approximately 90% of cats have cardiomegaly in CHF
- Left atrial enlargement as assessed on radiographs is a very poor tool to assess for CHF in cats

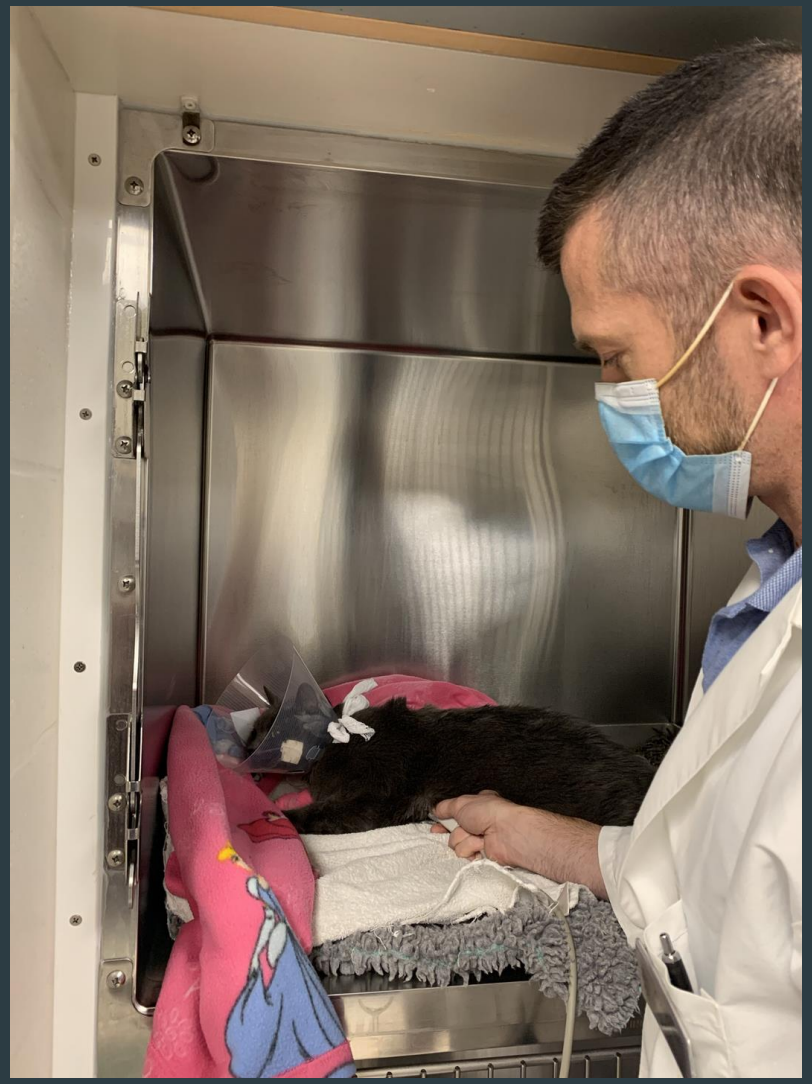
Schober KE., et al. Radiographic and Echocardiographic assessment of left atrial size in 100 cats with acute left-sided congestive heart failure. 2013. VRU

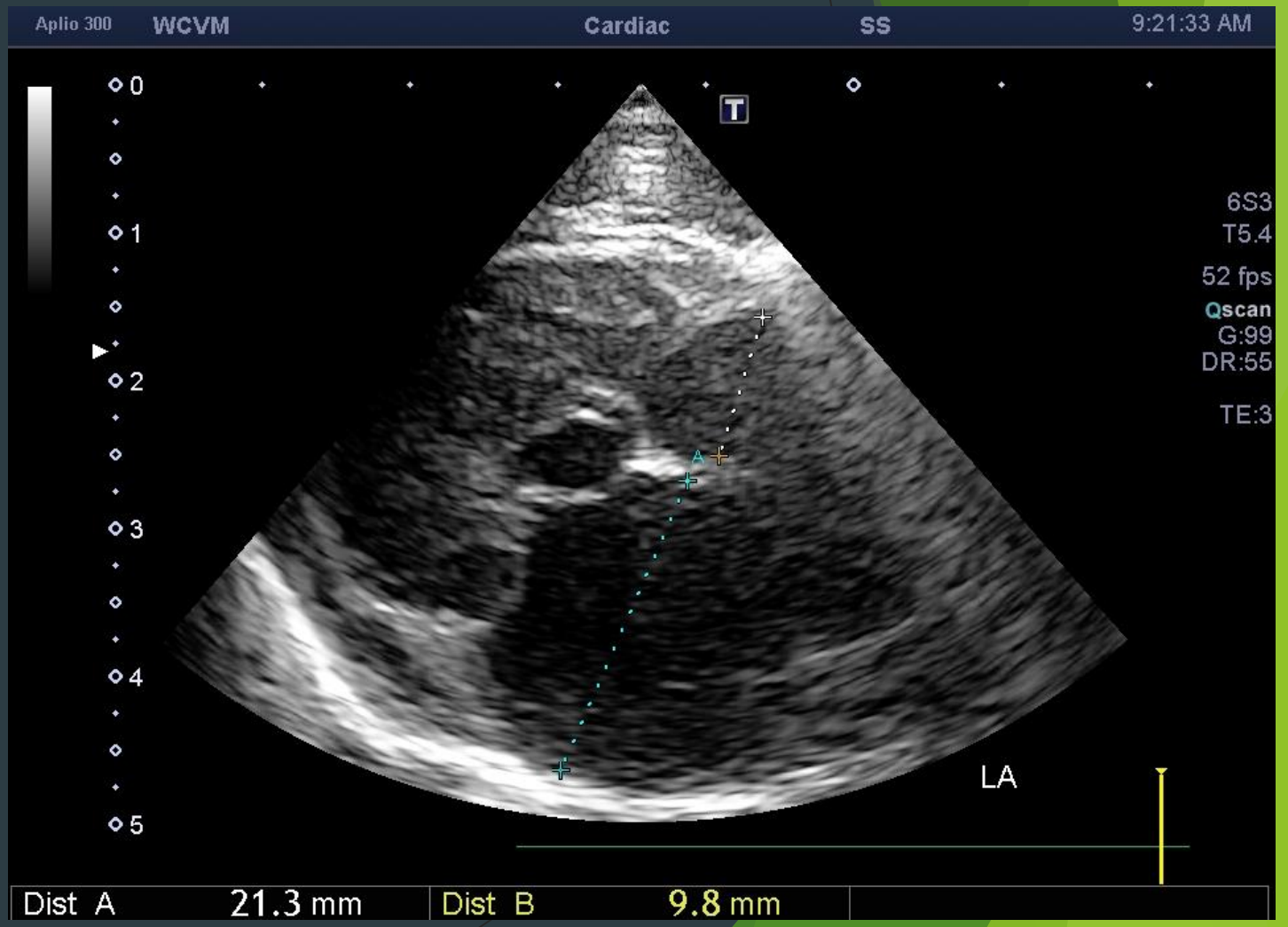
CHF pulmonary patterns can vary widely in cats

Left Atrial Enlargement



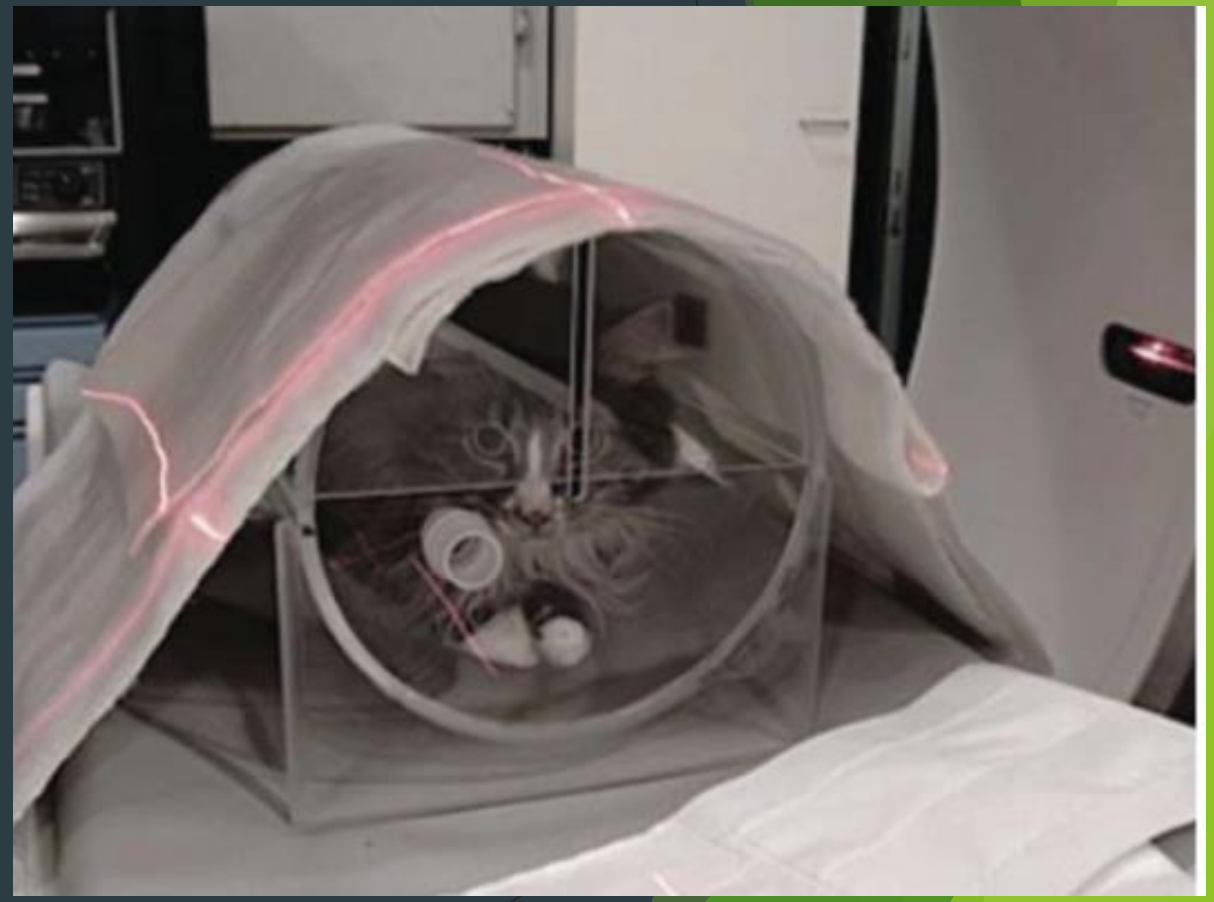





Aplio 300
WCVM
Cardiac
SS
9:21:33 AM
0
1
2
3
4
5
6S3
T5.4
52 fps
Qscan
G:99
DR:55
TE:3
LA
Dist A
21.3 mm
Dist B
9.8 mm

“Cat in a Box”

- Dyspneic cats can be imaged with minimal physical restraint in an oxygen rich chamber
- Imaging can occur earlier in the clinical work-up
- Improves characterization of lung pattern, mass lesions and identification of left atrial size and cardiac wall thickness

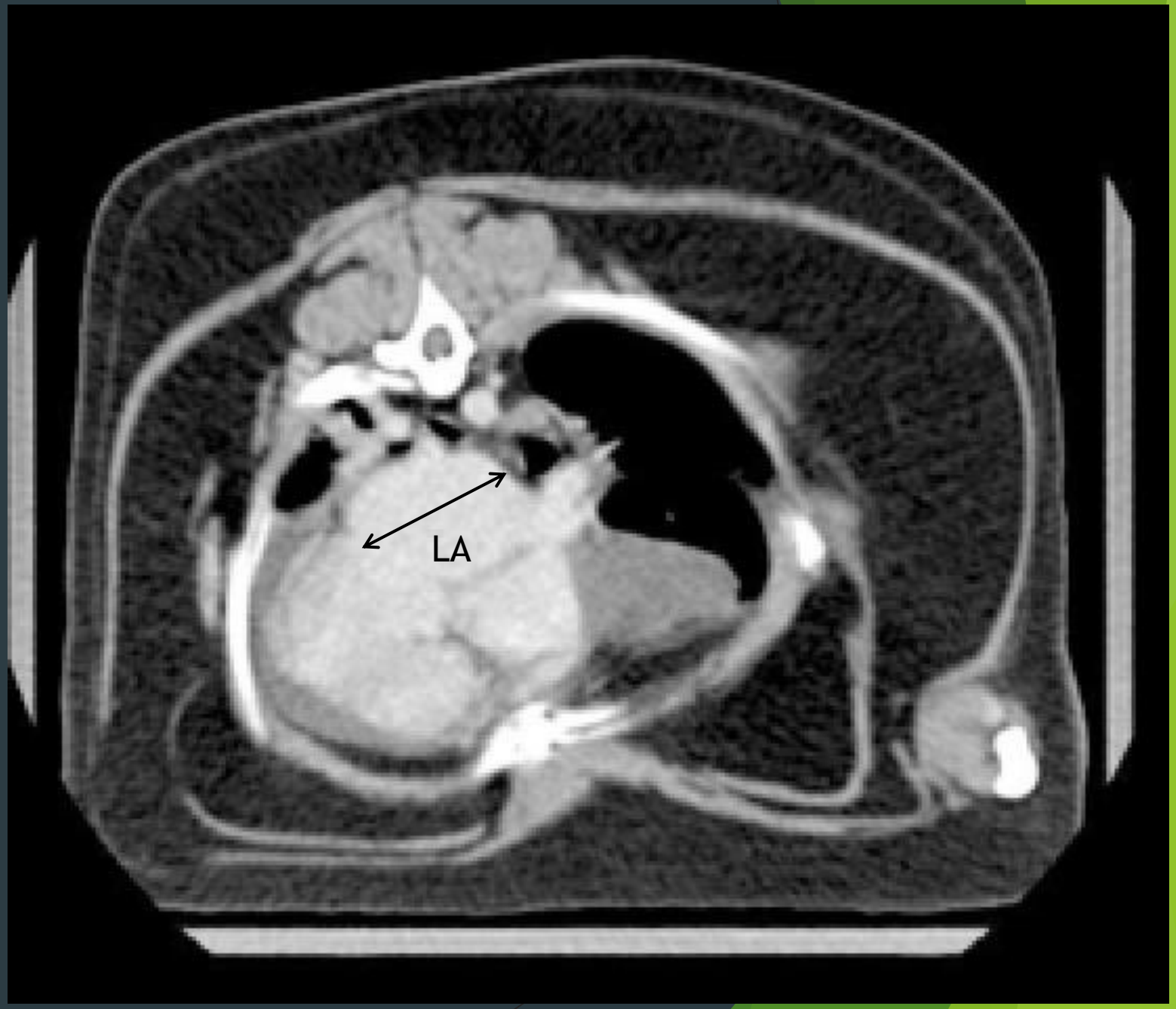


“Cat in a Box”

Findings:

- Left Atrium: 24 mm
- Pleural and pericardial effusion
- Patchy alveolar pattern

→ Responded to treatment for congestive heart failure

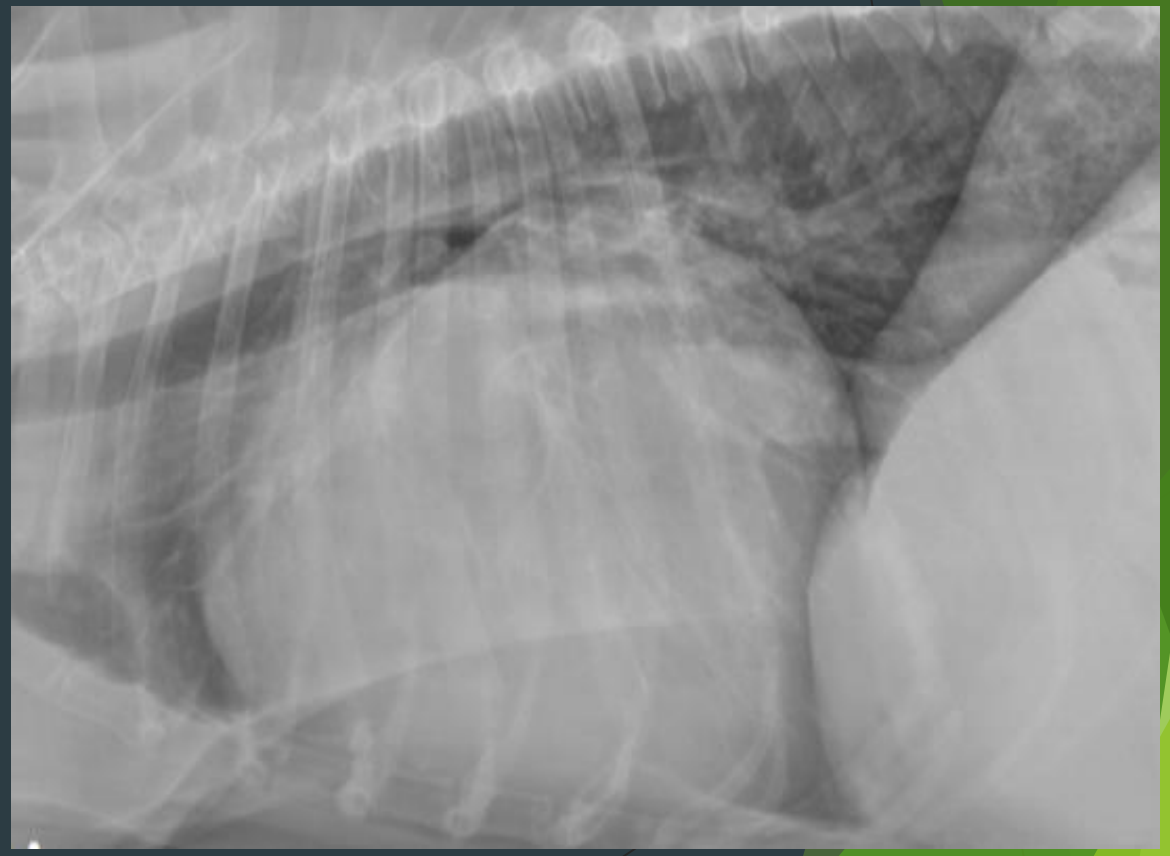


Generalized Cardiomegaly in Dogs

- DDX:
  - DCM
  - Pericardial effusion
  - Peritoneal-pericardial diaphragmatic hernia (PPDH)
  - Any end-stage heart disease
- Radiographs can be relatively insensitive to mild-moderate increases in heart size secondary to DCM (especially Doberman Pinchers)
- Cardiac ultrasound is very important in these cases

Dilated Cardiomyopathy

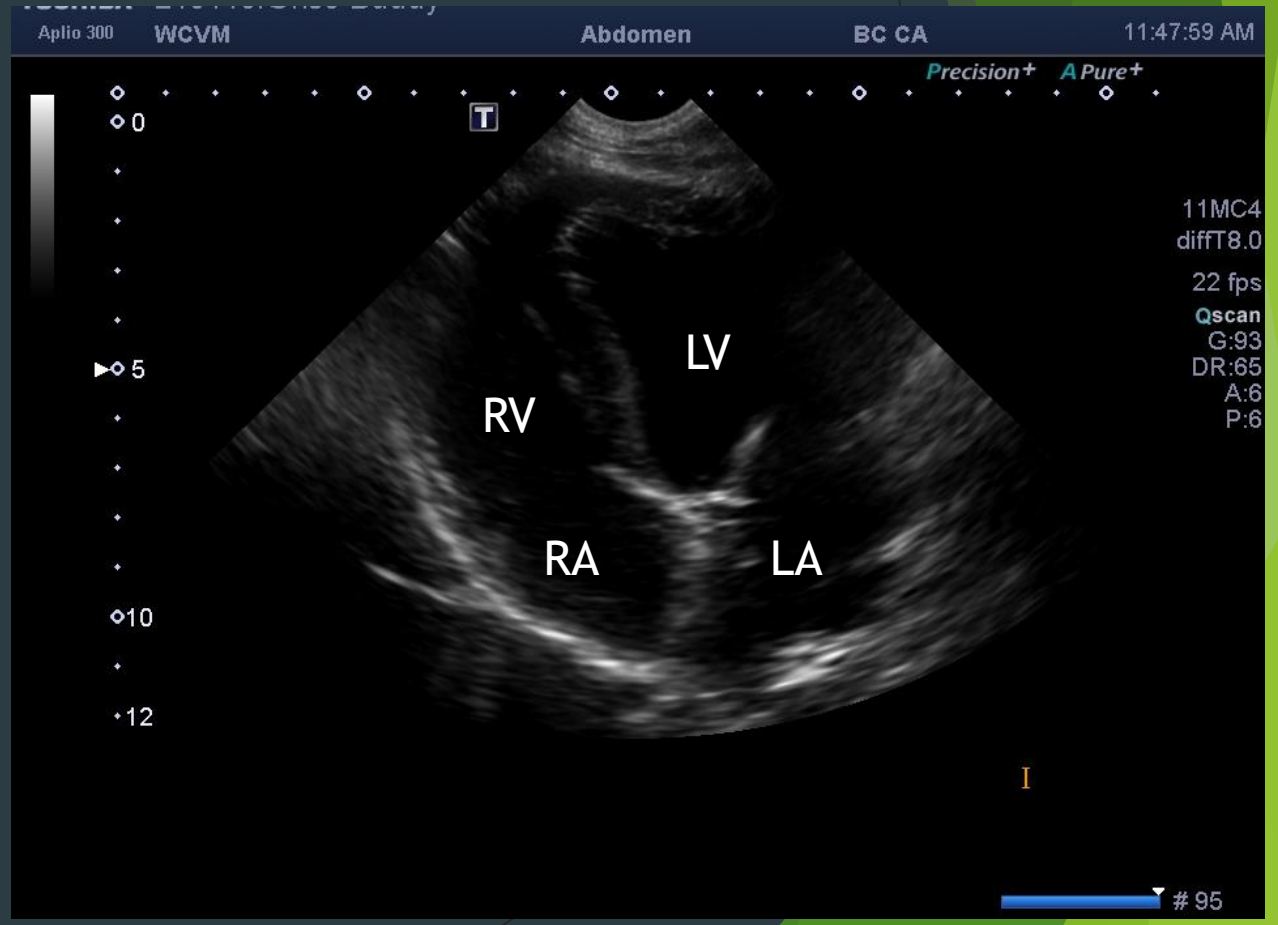
Cardiac Tamponade



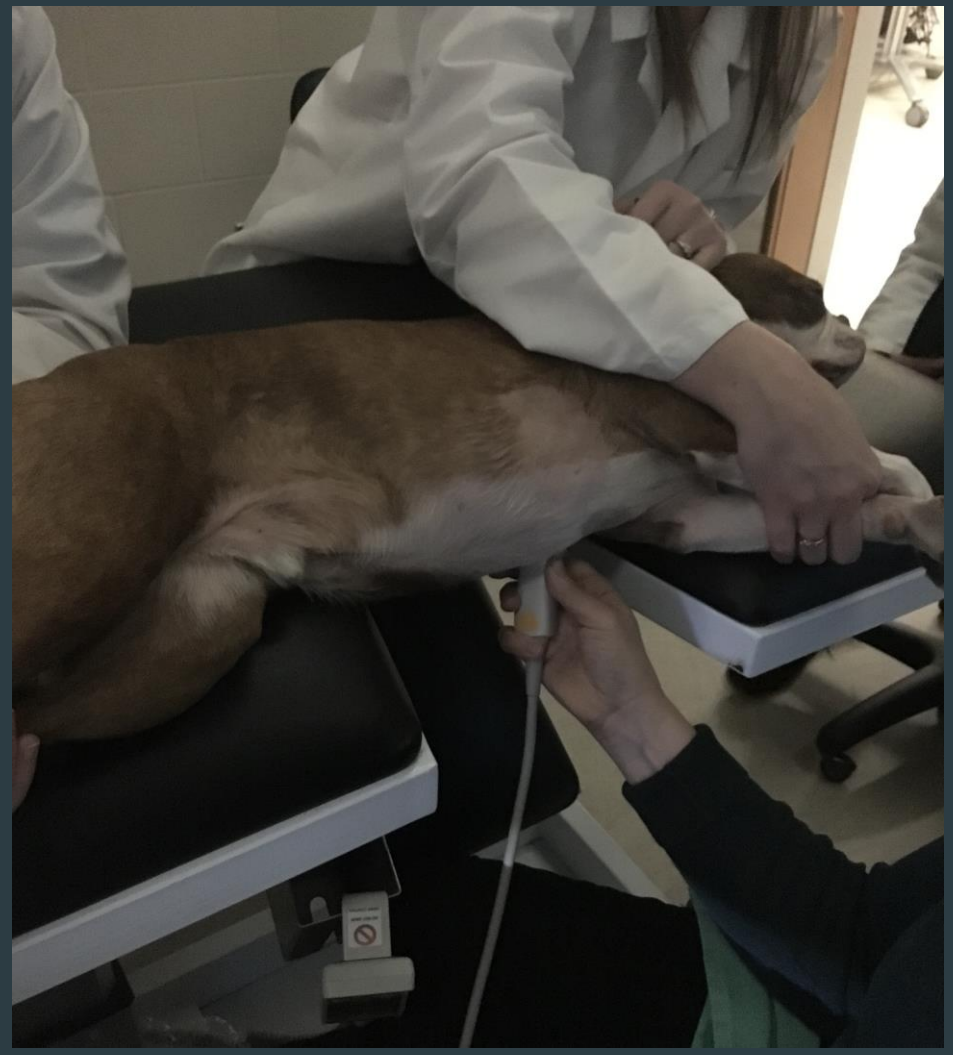
Four-Chamber View of the Heart

University of Saskatchewan

- Tip the patient towards the probe
- Stay near the sternum
- Direct the probe from caudoventral → craniodorsal



Equipment




VET-RAY
Technology
by SEDECAL
Premium Vet


REPORT
TRACE
PATIENT BROWSER
EXAM REVIEW

Four-Chamber View of the Heart

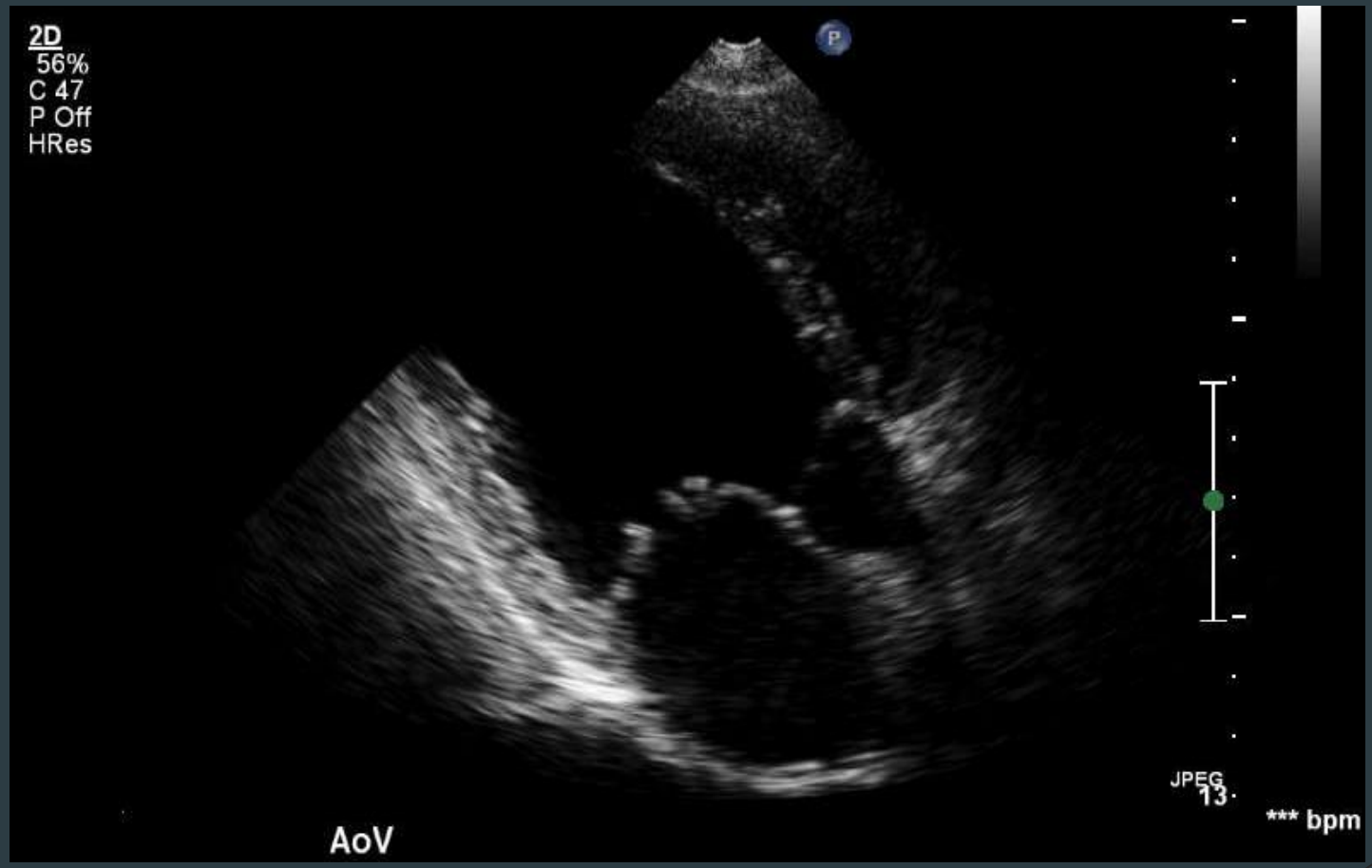
Can use reference values from:

- Breed specific RIs
- Normalizing chamber measurements to BW

Weight		4.04	kg	Normalized value to Body weight*	Reference Range
2D - measurements					
Aortic Diameter -Ao (short axis)		1.49	cm	0.93	0.59 - 0.97
Left Atrial Diameter - LA (short axis)		1.75	cm	1.08	0.63 - 0.96
LA / Ao		1.17			
M-Mode measurements					
Interventricular septum	(diastole)	0.59	cm	0.42	0.29 - 0.59
Left Ventricular diameter	(diastole)	2.22	cm	1.46	1.19 - 1.63
Left Ventricular Free wall	(diastole)	0.52	cm	0.38	0.29 - 0.60
Interventricular septum	(systole)	0.86	cm	0.62	0.43 - 0.79
Left Ventricular diameter	(systole)	1.16	cm	0.68	0.5 - 0.92
Left Ventricular Free wall	(systole)	1.02	cm	0.75	0.48 - 0.87
Fractional Shortening %		47.7	%		
Ejection Fraction % (Simpson's Method of Disc)			%		46.7 - 80.7
E Point Septal Separation			cm		
Spectral Doppler					
Pulmonary valve outflow velocity		1.02	m/s		
Aortic outflow tract velocity		1.48	m/s		
Mitral Regurgitation jet velocity		5.66	m/s		
Tricuspid Regurgitation jet velocity		3.01	m/s		
Pulmonary regurgitation velocity		n/a	m/s		
Mitral valve "E" velocity			m/s		
Mitral valve "A" velocity			m/s		
Tricuspid valve "E" velocity			m/s		
Tricuspid valve "A" velocity			m/s		

Visser LC., et al. Echocardiographic quantitation of the left heart size and function in 122 healthy dogs: A prospective study proposing reference intervals and assessing repeatability. 2019. JVIM.

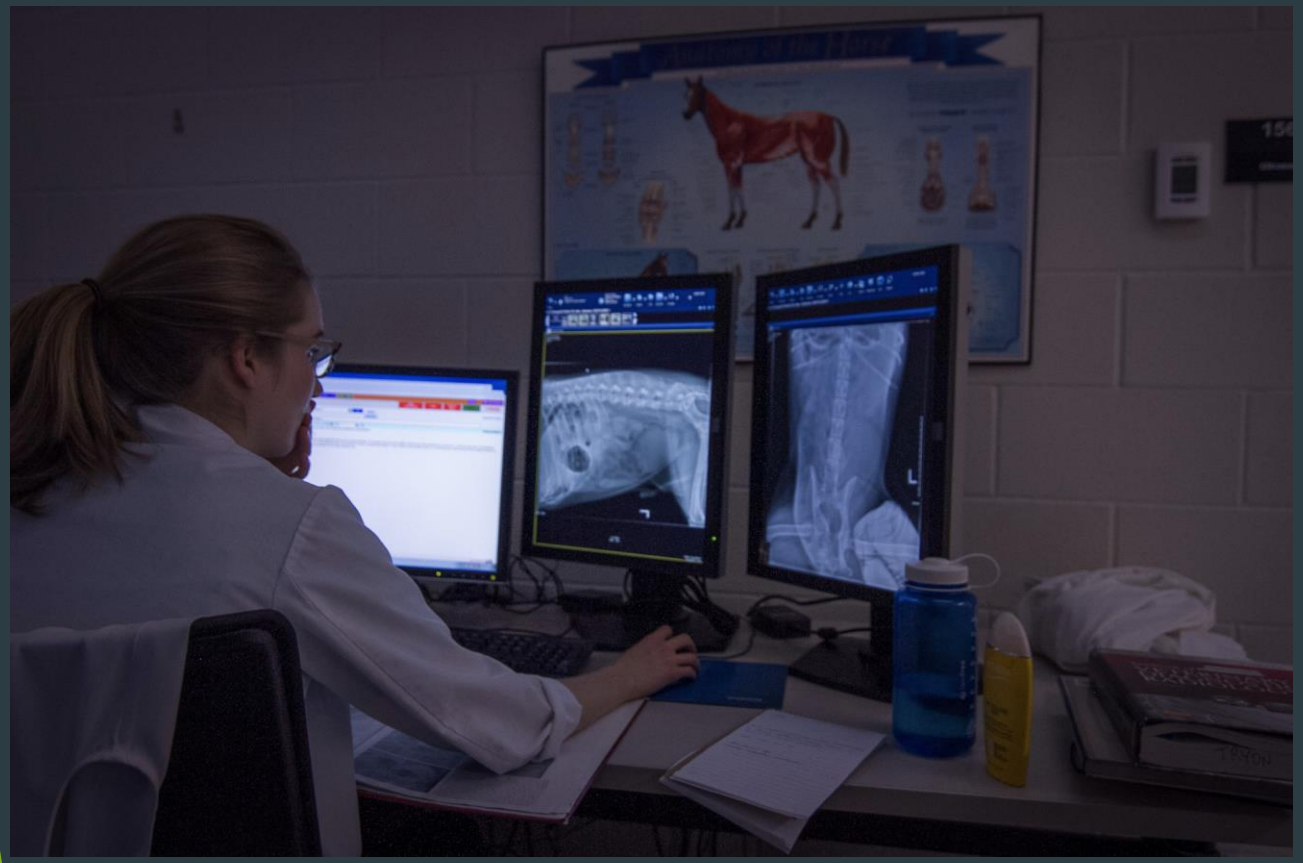
Dilated Cardiomyopathy



Pericardial Effusion

Questions?

Abdomen



Medical Imaging Resident

The “Fishbowl”

Imaging the Urinary System

- Radiographic exam remains a critical tool for the diagnosis of disease involving the lower urinary tract
- Cystography, retrograde urethrography and vaginourethography can be extremely helpful
- Main indications: bladder rupture or hernia, urethral strictures, tears and stones
- NEVER use barium – always non-ionic contrast (50:50 dilution typically)

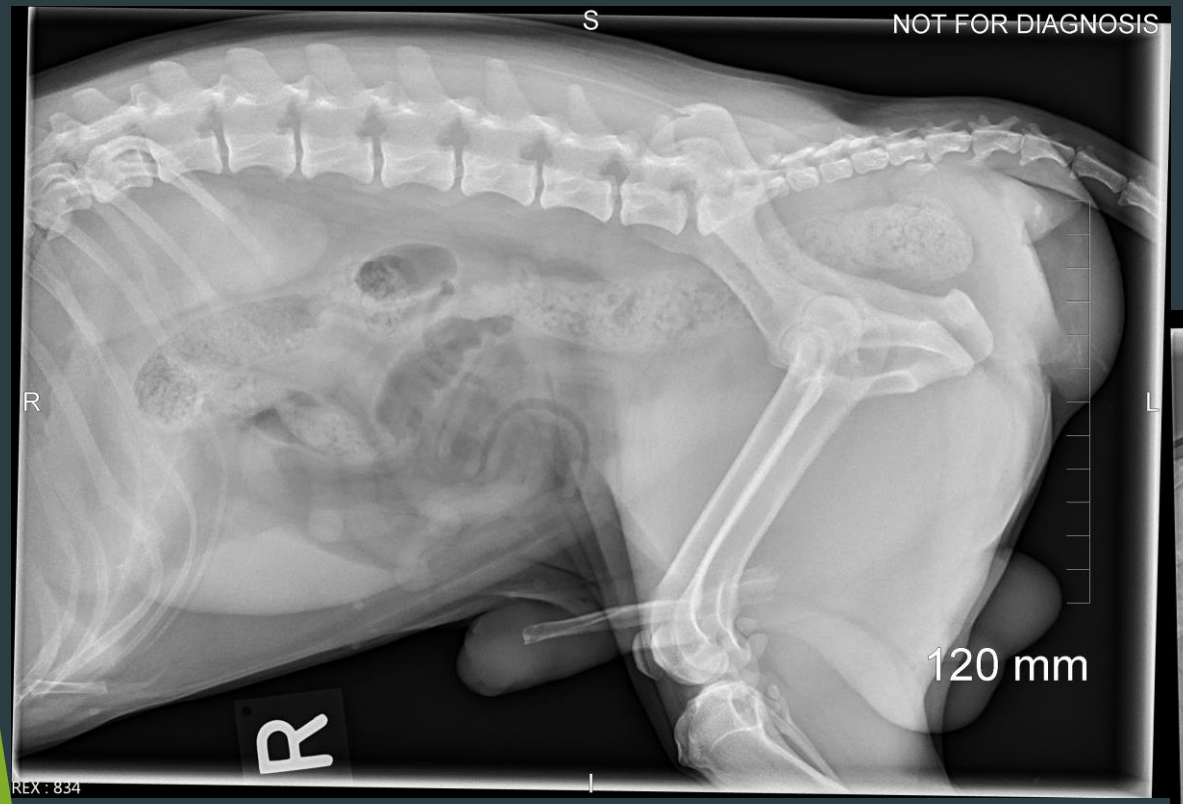
Cystoliths


S
NOT FOR DIAGNOSIS
R
L
160 mm
I
REX : 673


S
NOT FOR DIAGNOSIS
R
L
160 mm
R
I
REX : 647

Radiolucent Urethrolith

Bladder and Prostate Hernia



Urethral Tear

Gastric Dilatation and Volvulus

- The ”money shot” is the right lateral view
- A DV can also be considered as can see compartmentalization in some instances in this view with the added benefit of visualizing the location of the spleen
- Frequent concurrent findings include; generalized loss of serosal detail, functional ileus of the small intestines, esophageal gas dilation, hypovolemia
- Additionally findings:
  - Gastric pneumatosis
  - Free peritoneal gas

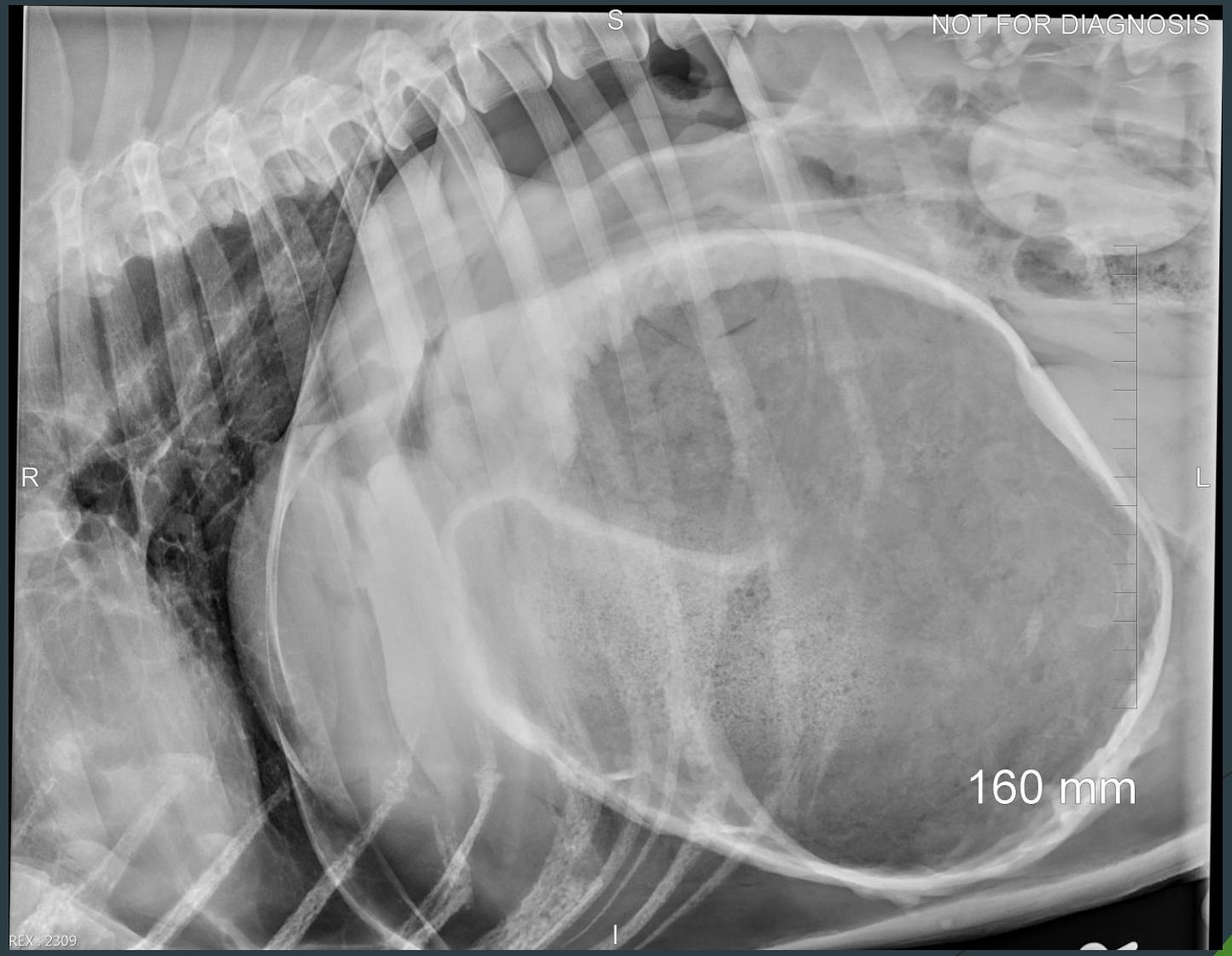
The DV View: Compartmentalization

GDV

Normal Positioning

The DV View: Spleen

Gastric Pneumatosis

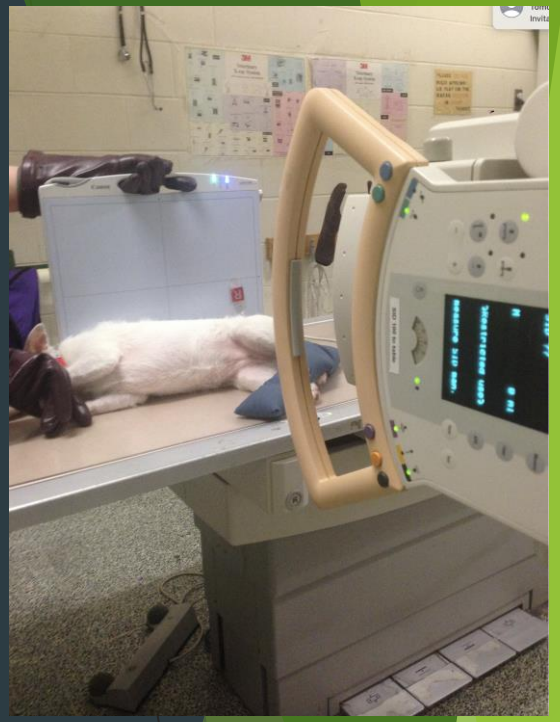


Pneumoperitoneum

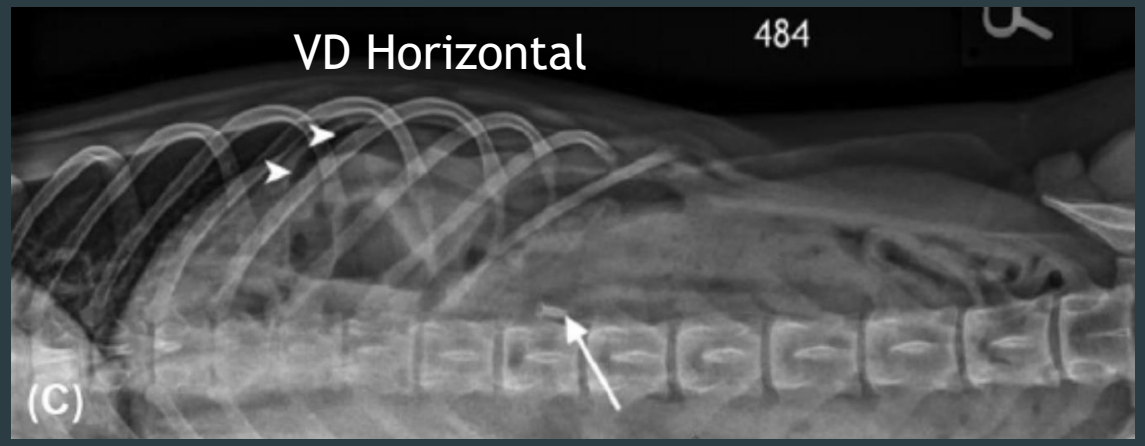
- Approximately 75% of dogs develop pneumoperitoneum due to perforation of a hollow viscus, generally the GIT
- Post-operative pneumoperitoneum usually resolves in 3-6 days but can persist for up to 3 weeks
- Small volumes of free peritoneal gas can be difficult to identify
- Radiographic findings:
  - Gas bubbles in region of the liver or trapped in the omentum and mesentery (usually angular in shape)
  - Visualization of the abdominal wall of the diaphragm
  - Increased serosal contrast of abdominal organs
- US and CT can also be considered

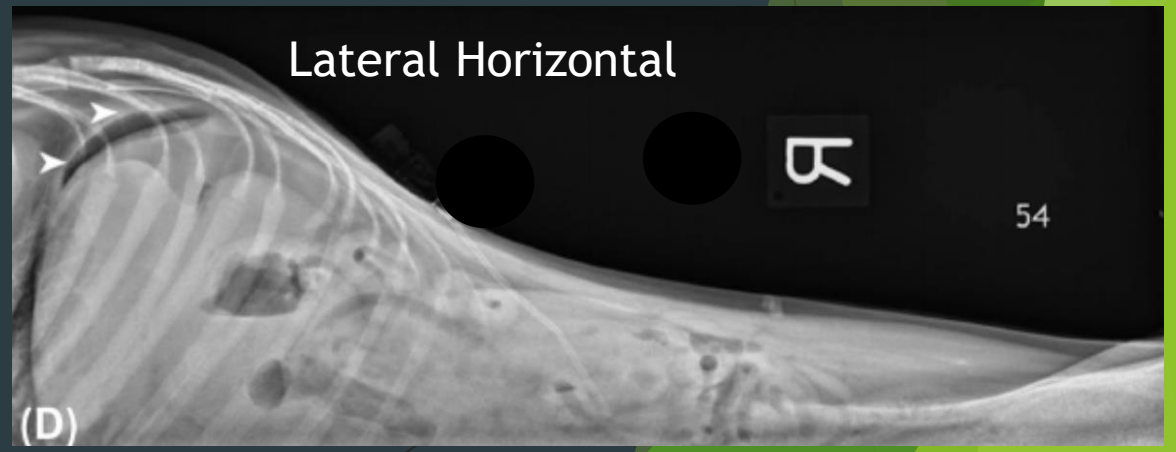
Identifying small volume pneumoperitoneum in dogs

- The left lateral and lateral horizontal projections performed better than the VD or VD horizontal projections at all volumes of injected air
- Recent study found that the left lateral projection was not significantly different from the lateral horizontal projection at all volumes of air injected



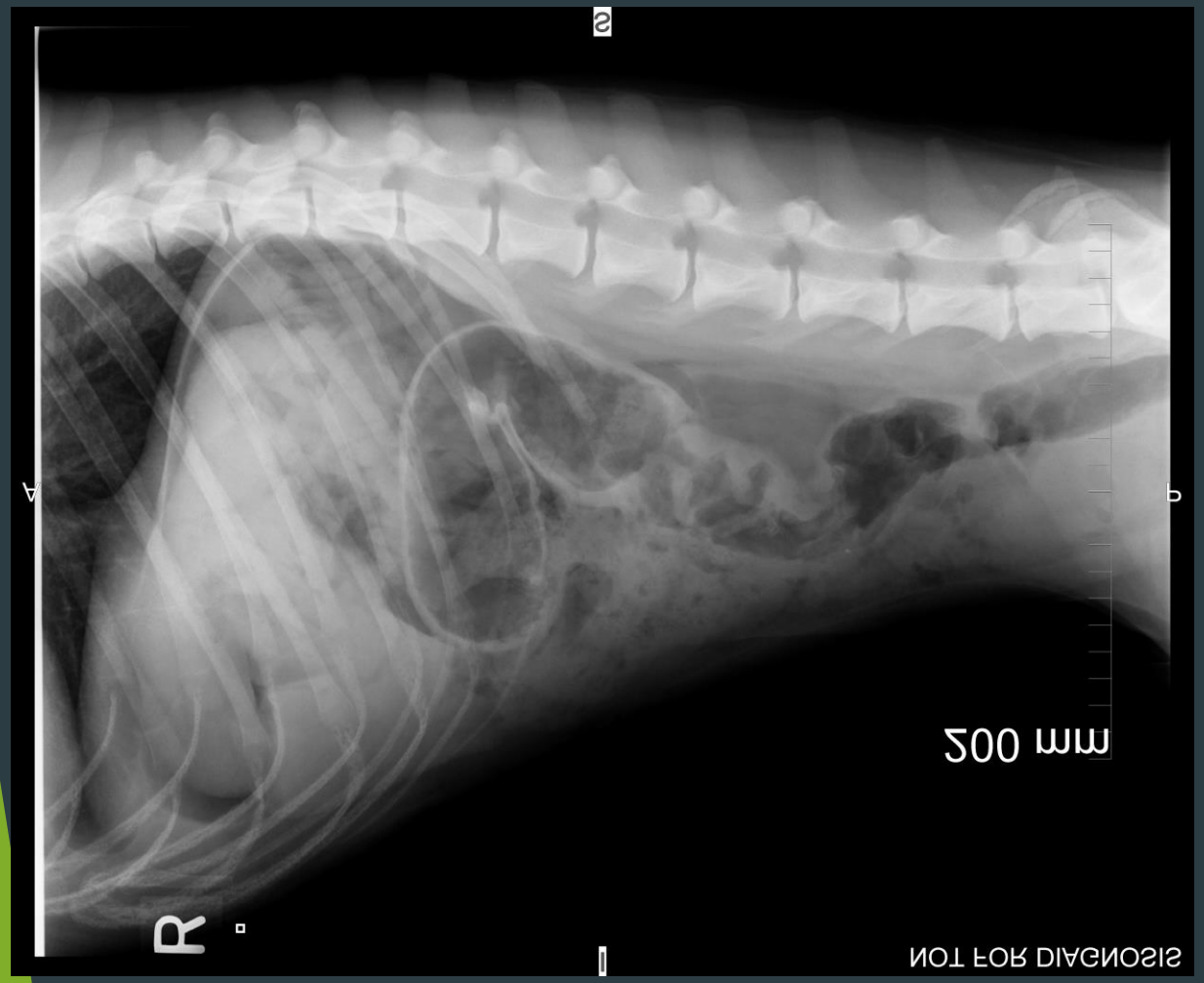
VD Horizontal





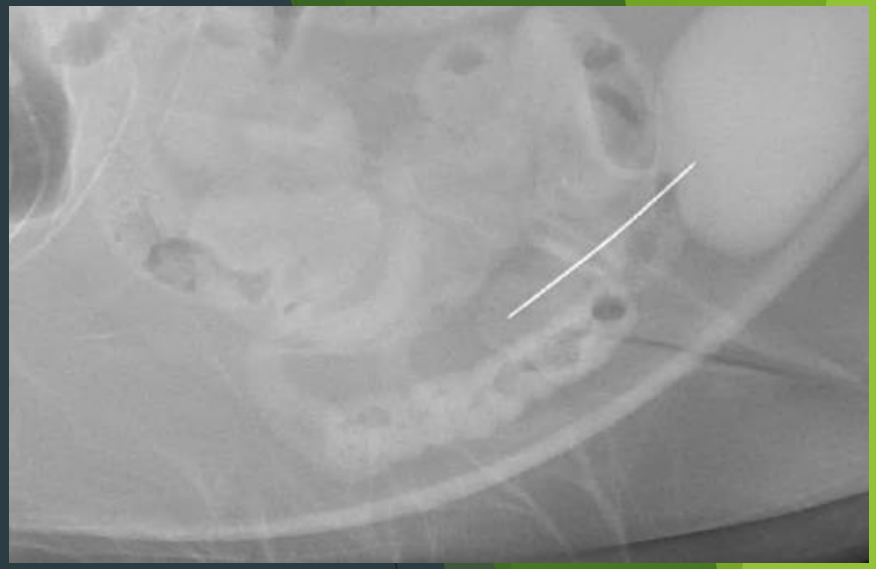
Ng J., et al. The left lateral projection is comparable to horizontal beam radiography for identifying experimental small volume pneumoperitoneum in the canine abdomen. 2019. VRU

Free Peritoneal Gas: Structures Become More Conspicuous

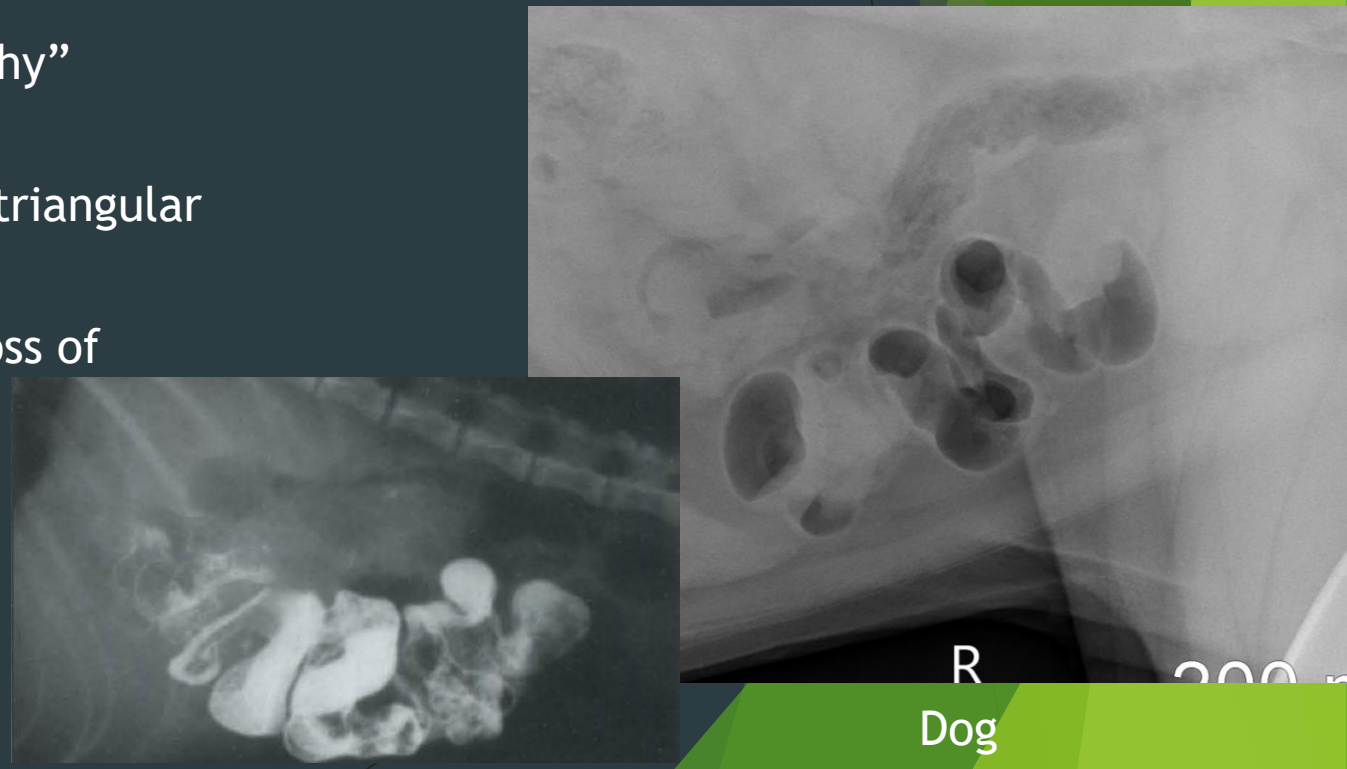


Linear Foreign Bodies

- Most dogs anchor in the pylorus while cats more frequently found under the tongue
- Small intestinal ileus more common in dogs
- Hairpin bends more common in dogs; ”scrunchy” appearance in cats
- Classic finding is teardrop, crescent-shaped, triangular and irregular shaped gas bubbles
- Carefully assess for free peritoneal gas and loss of abdominal serosal detail
- Intussusceptions can be a concurrent finding



Cat



Dog

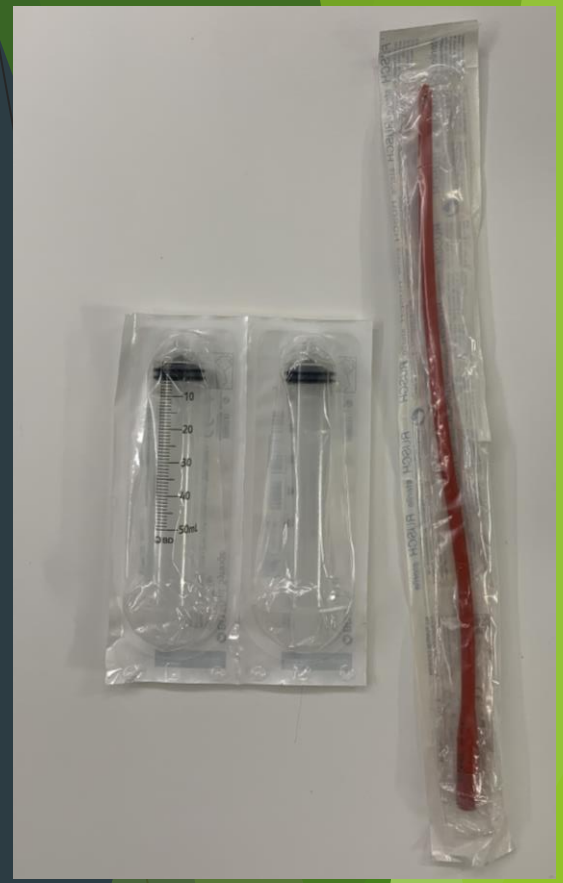
Dog Linear Foreign Body

Cat Linear Foreign Body

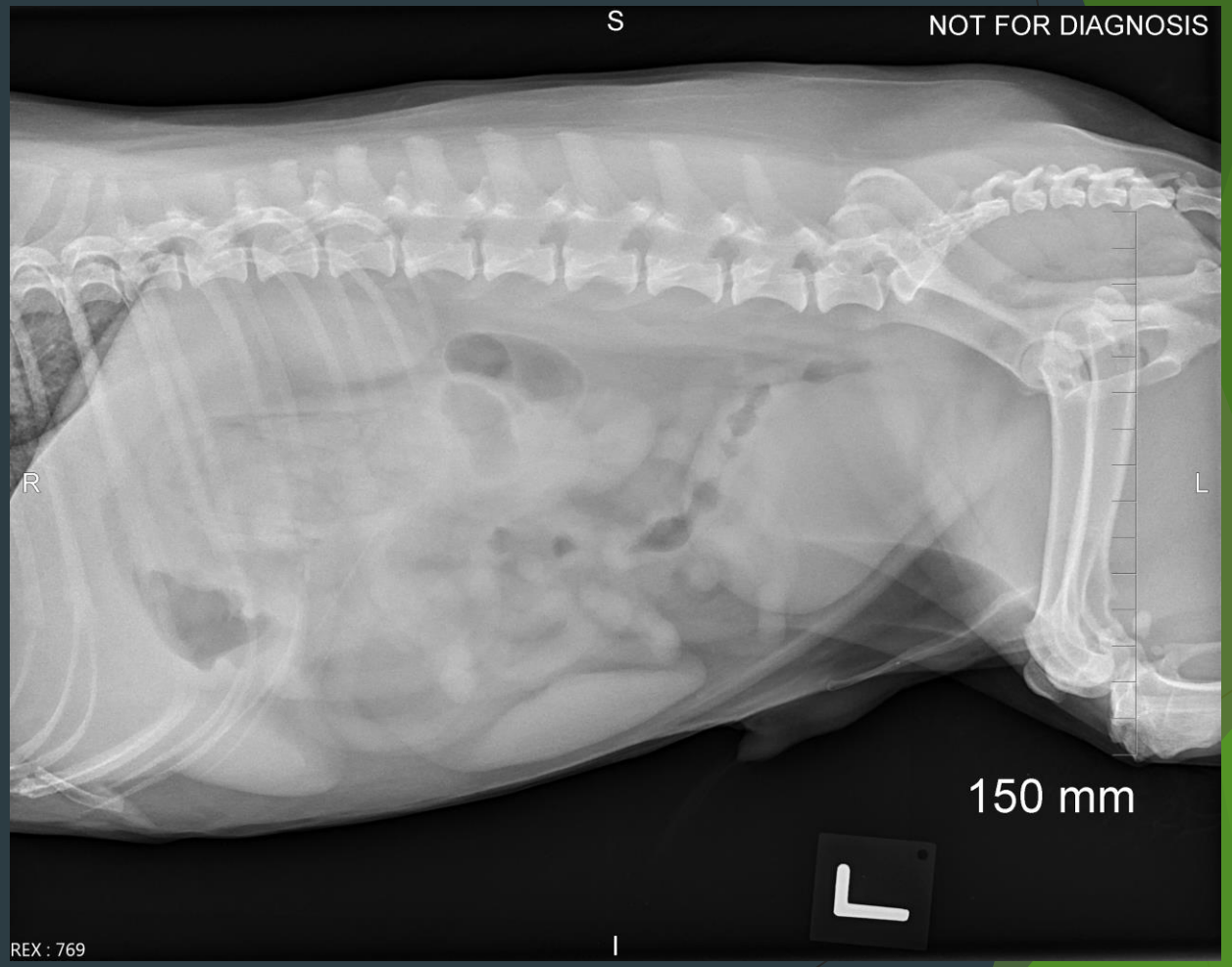
Plication Video

Pneumocologram

- A negative (air) contrast study
- Can help ascertain which loops are part of the large intestine vs. small intestine
- Described volume is 8ml/kg of air but we typically use to effect
- Single VD view may be all that is necessary



Small Intestinal Obstruction or Colon?



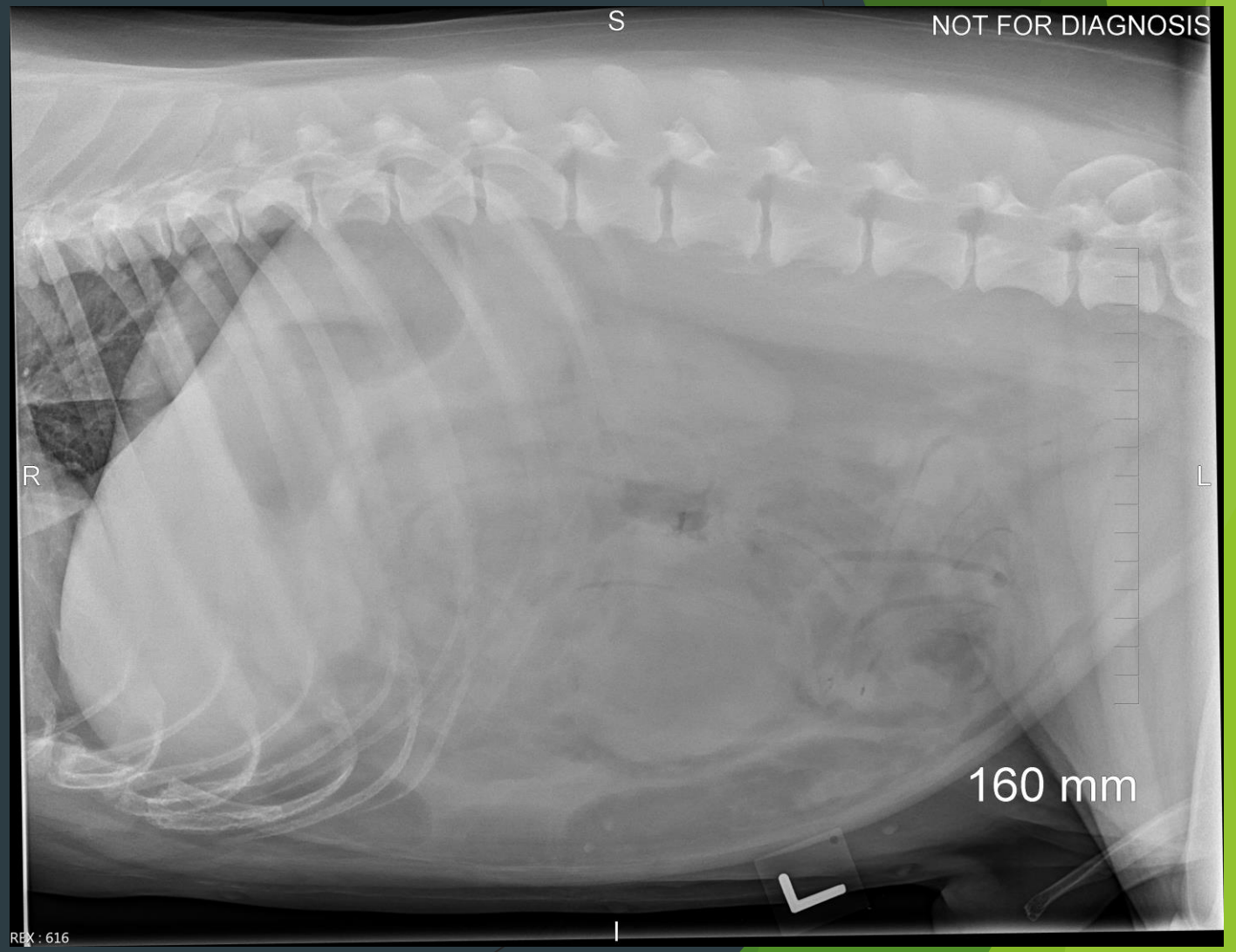
Pneumocologram

Hemoabdomen and Evaluating the Spleen

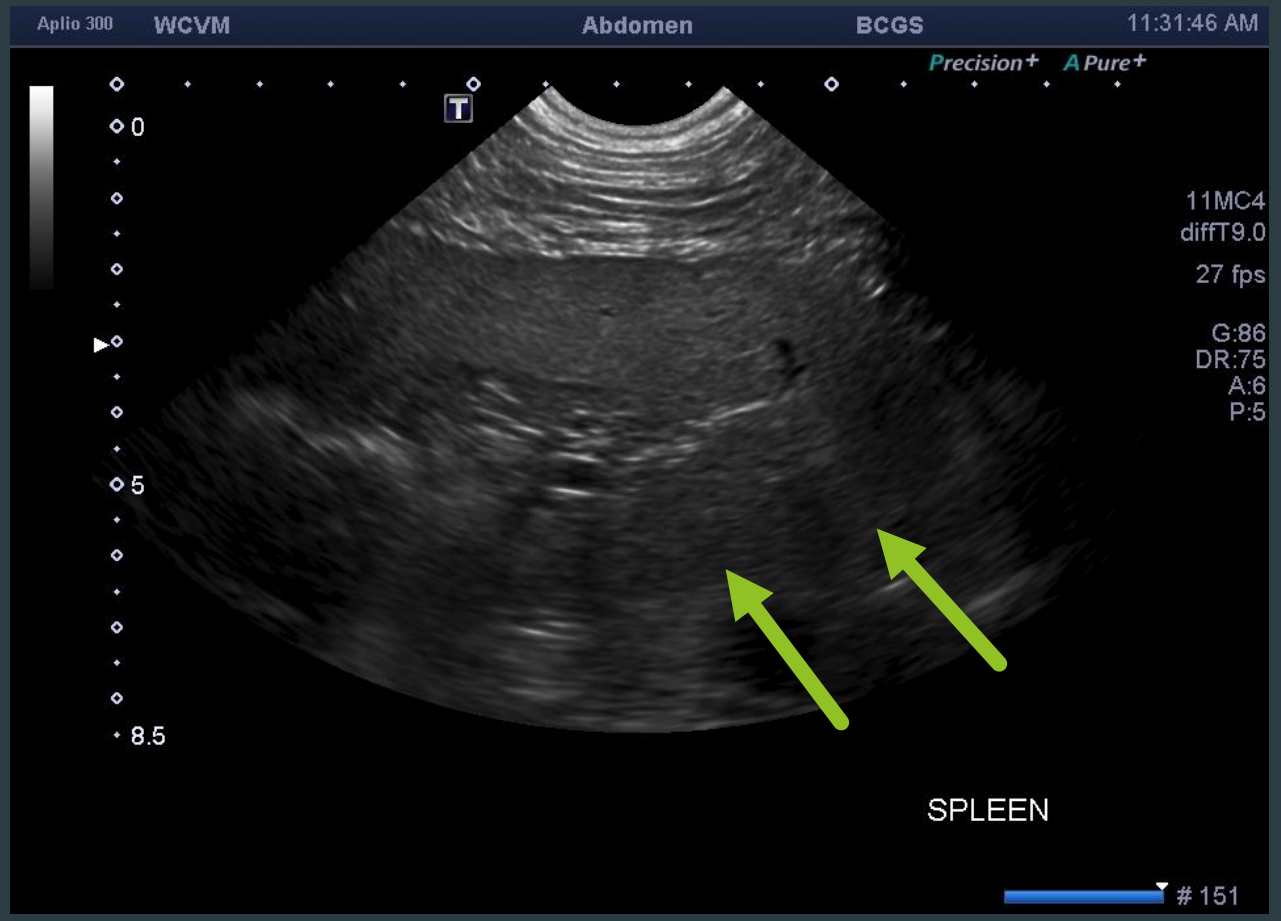
- Most common cause of a nontraumatic hemoabdomen is rupture of an intra-abdominal mass
  - 87% were due to neoplasia (of which 76% were hemangiosarcoma)
- The spleen is the most common organ to develop neoplasia
- The rate of concurrent right atrial mass detected by cardiac ultrasound in dogs with splenic hemangiosarcoma was 8.7%

Lux CN., et al. Perioperative outcome in dogs with hemoperitoneum: 83 cases (2005-2010). 2013. JAVMA
Boston S., et al. Concurrent splenic and right atrial mass at presentation in dogs with HAS: A retrospective study. 2011. JAAHA

Hemoabdomen



Ultrasound of the Spleen

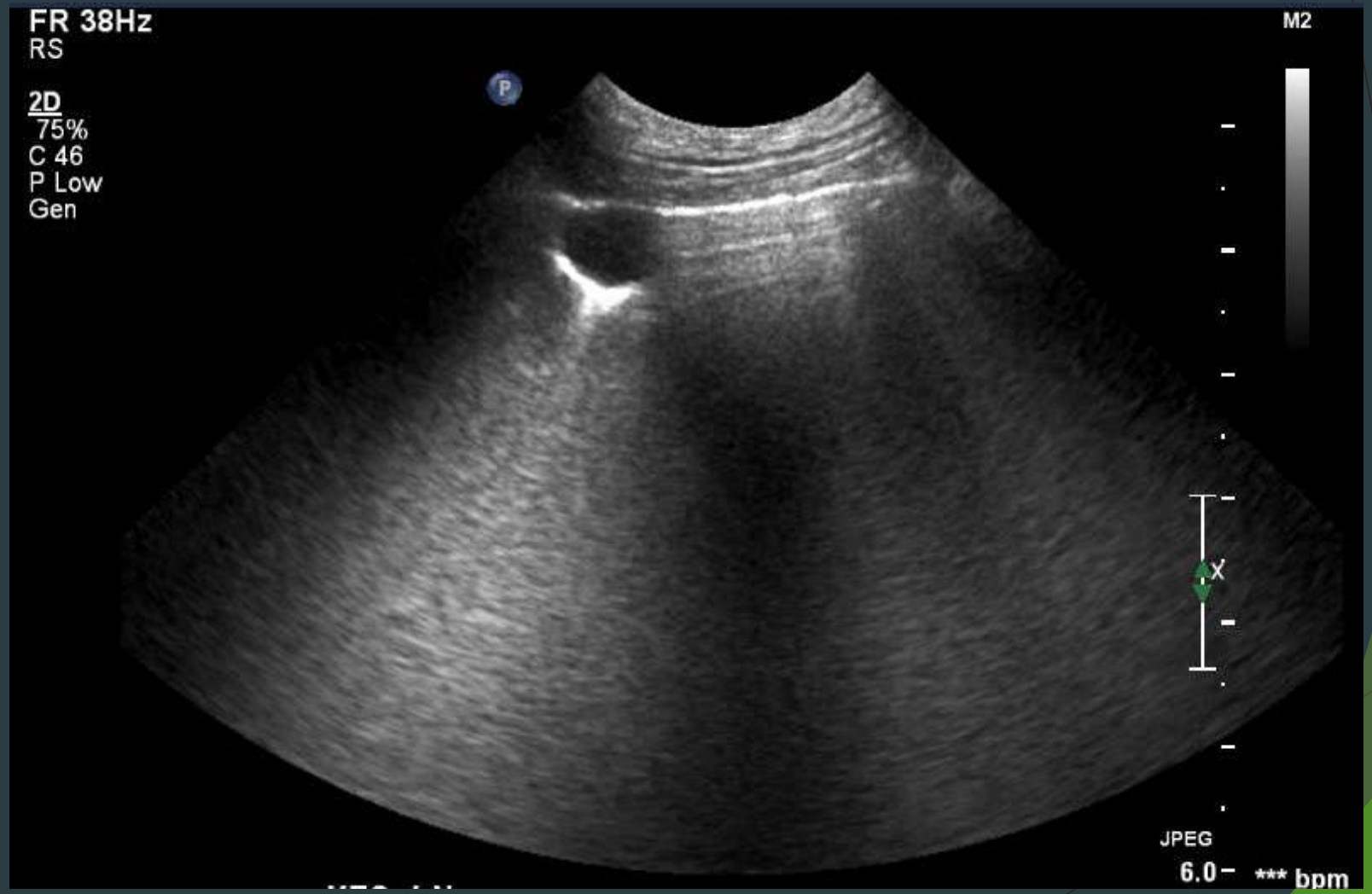


Anatomy of the Spleen

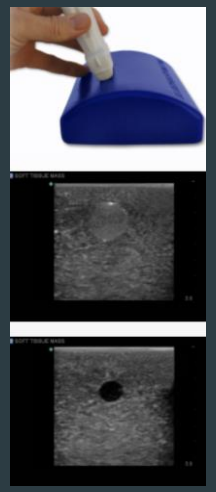
Hemangiosarcoma

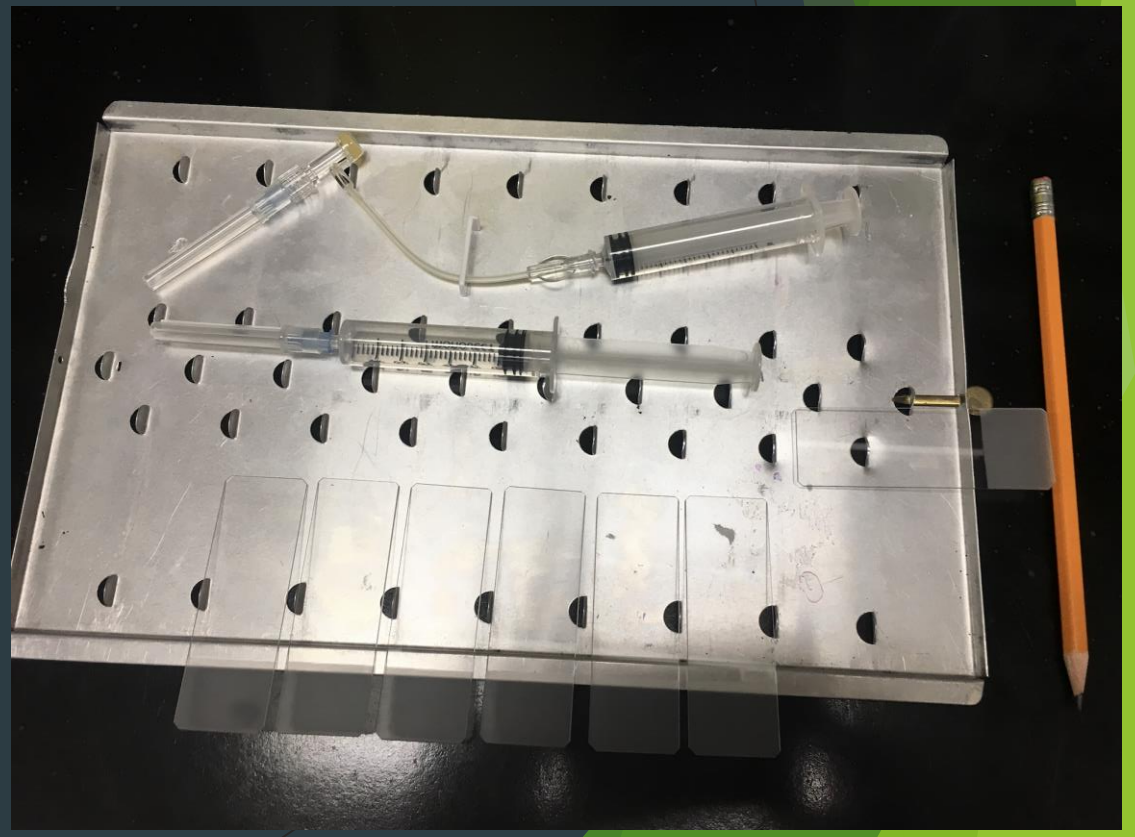
Evaluating the Liver

Ultrasound of the Pleural Surface



Guided Aspirates for Fluid

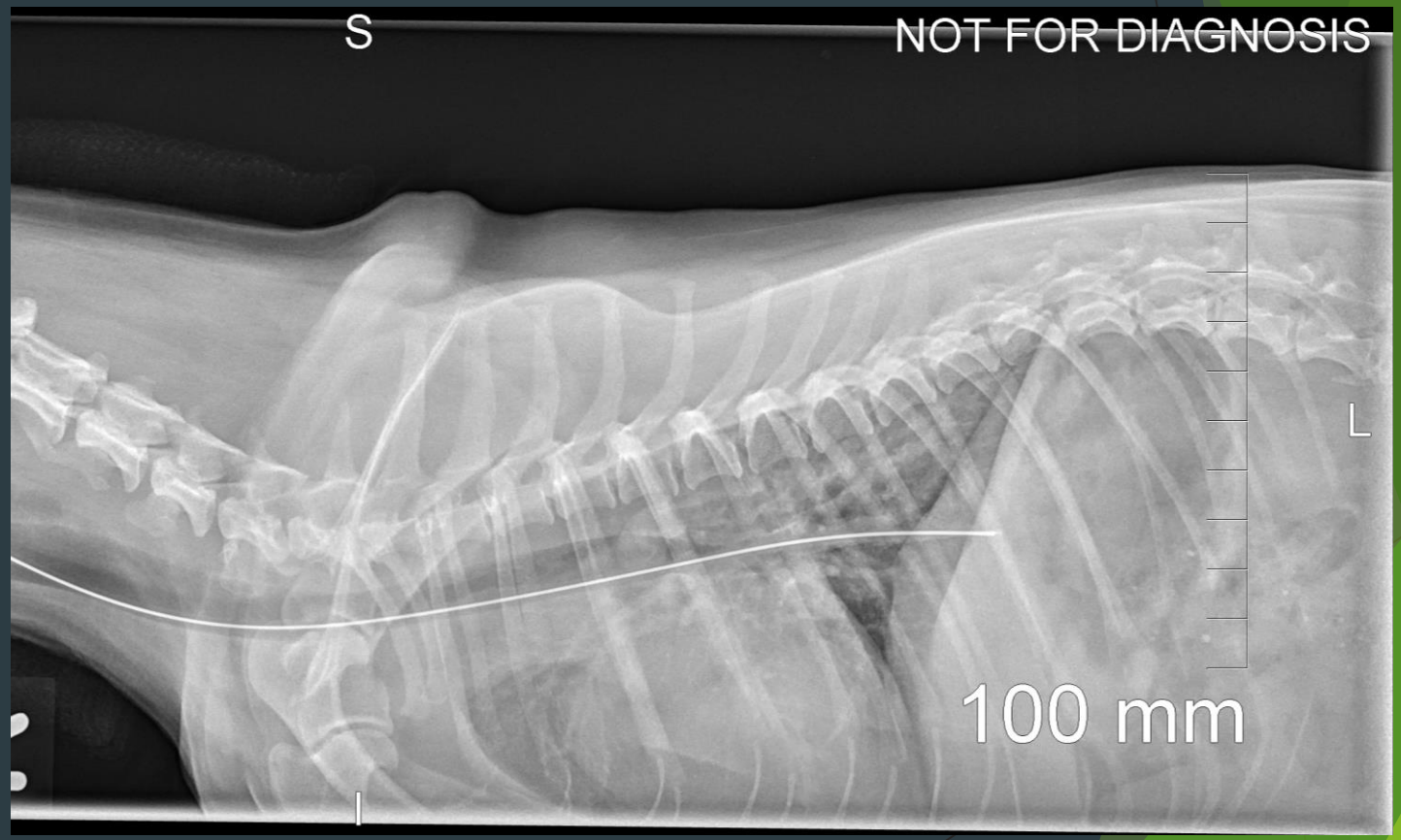




Let gravity be your friend….

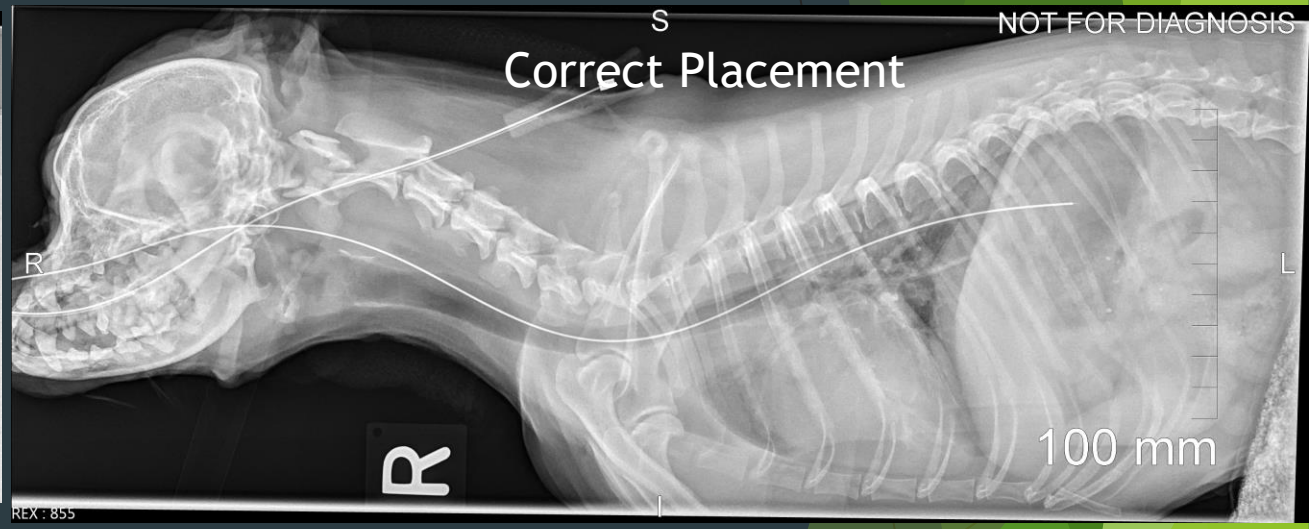
Nasoesophegeal and Nasogastric Feeding Tubes

Is this in the right location?



Feeding Tubes

- Include both the larynx and stomach in the view
- Place 2-3 ml of non-ionic contrast (followed by 2-3ml air) to check placement



Musculoskeletal

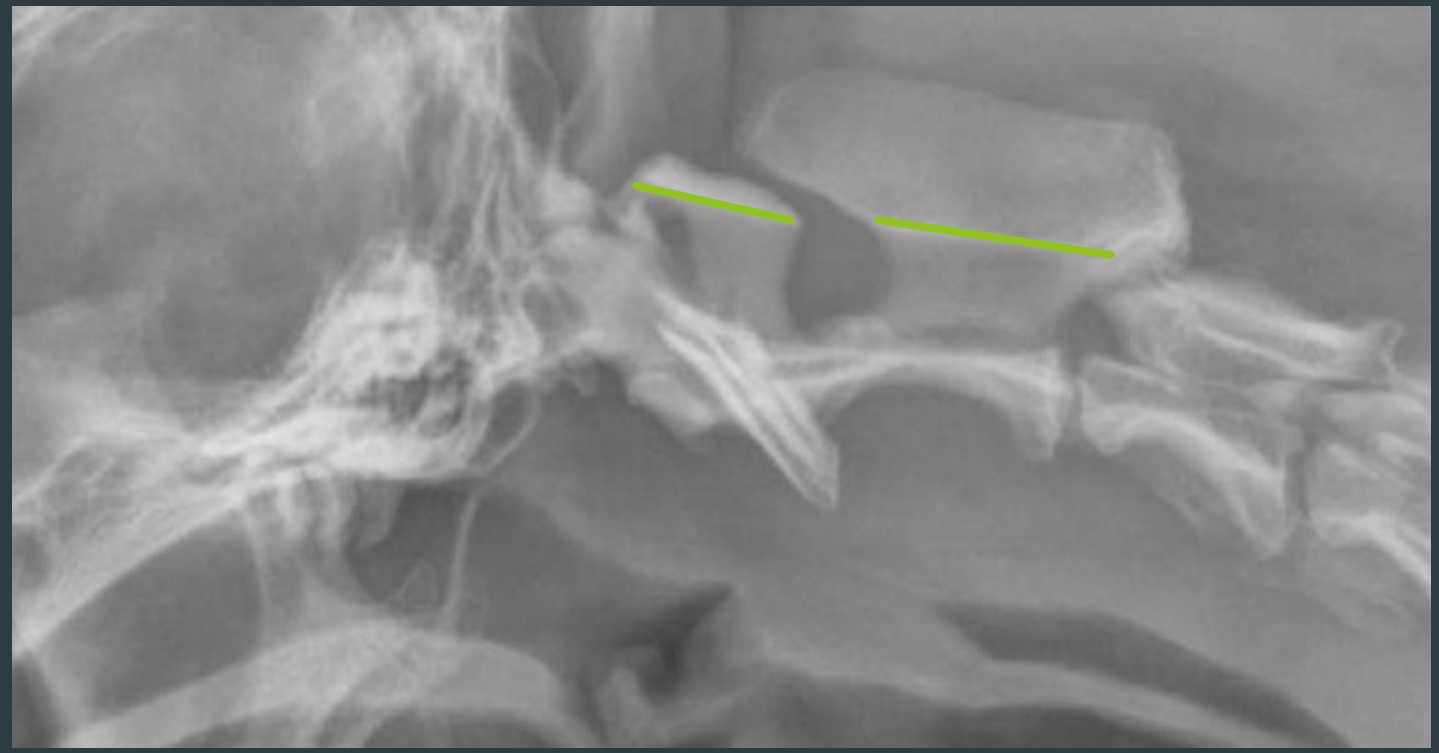
MRI

Students at work

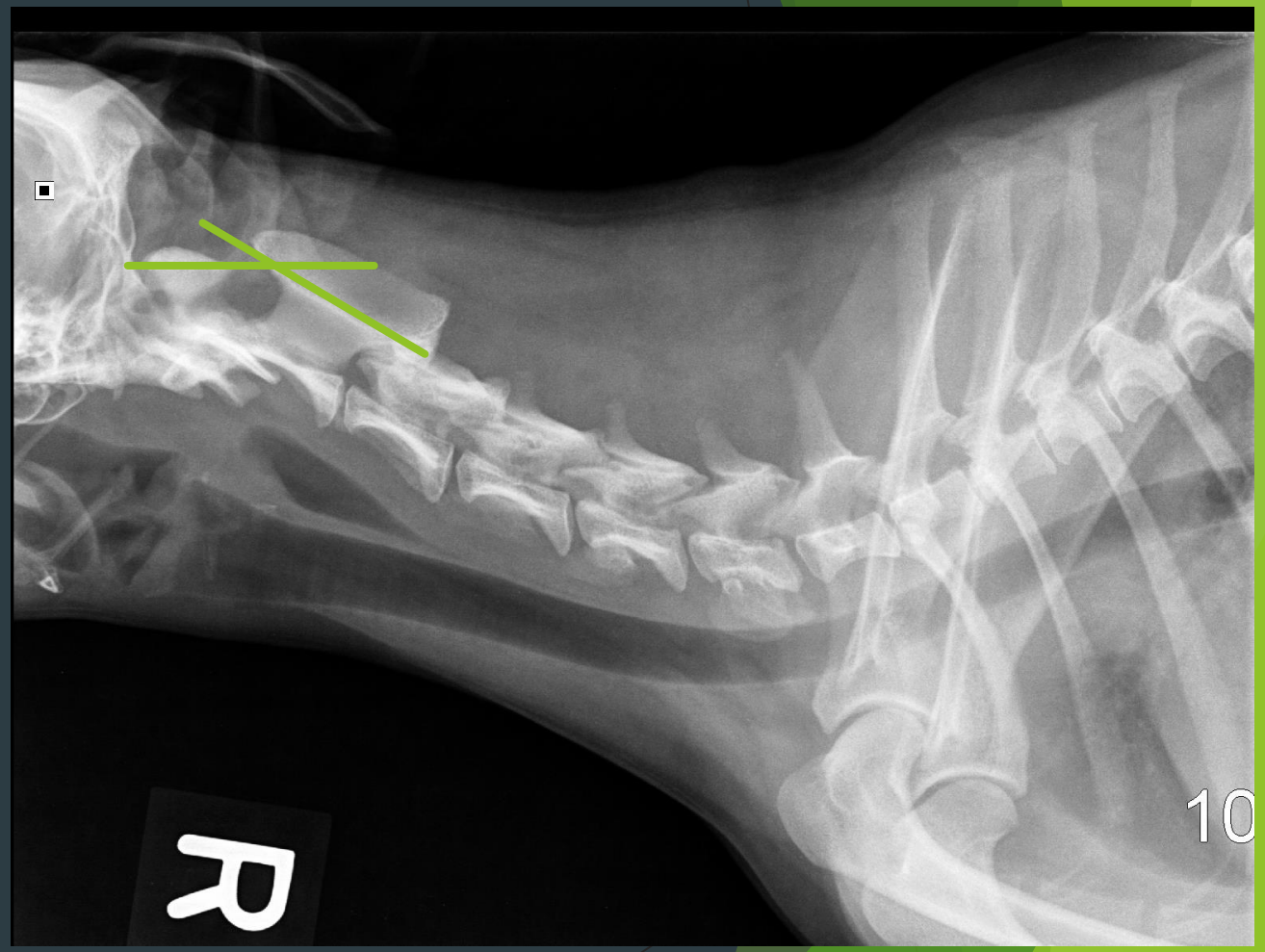
Atlantoaxial Subluxation

- The axis (C2) is displaced dorsally with respect to the atlas (C1)
- Can be either congenital or as a result of trauma
- Handle patient carefully. Do not flex neck!
- An oblique lateral radiograph can be used to visualize the dens
- A standing cervical spine radiograph can be useful

Normal Atlantoaxial Relationship



NORMAL linear relationship between lamina of C1 and C2


R
10

Oblique Cervical Spine

Straight

15-30 Degree Oblique

Standing Cervical Spine

Tips to Make MSK Lesions More Apparent

Soft Tissue Trauma

UNIVERSITY OF SASKATCHEWAN

Digits

Not taped

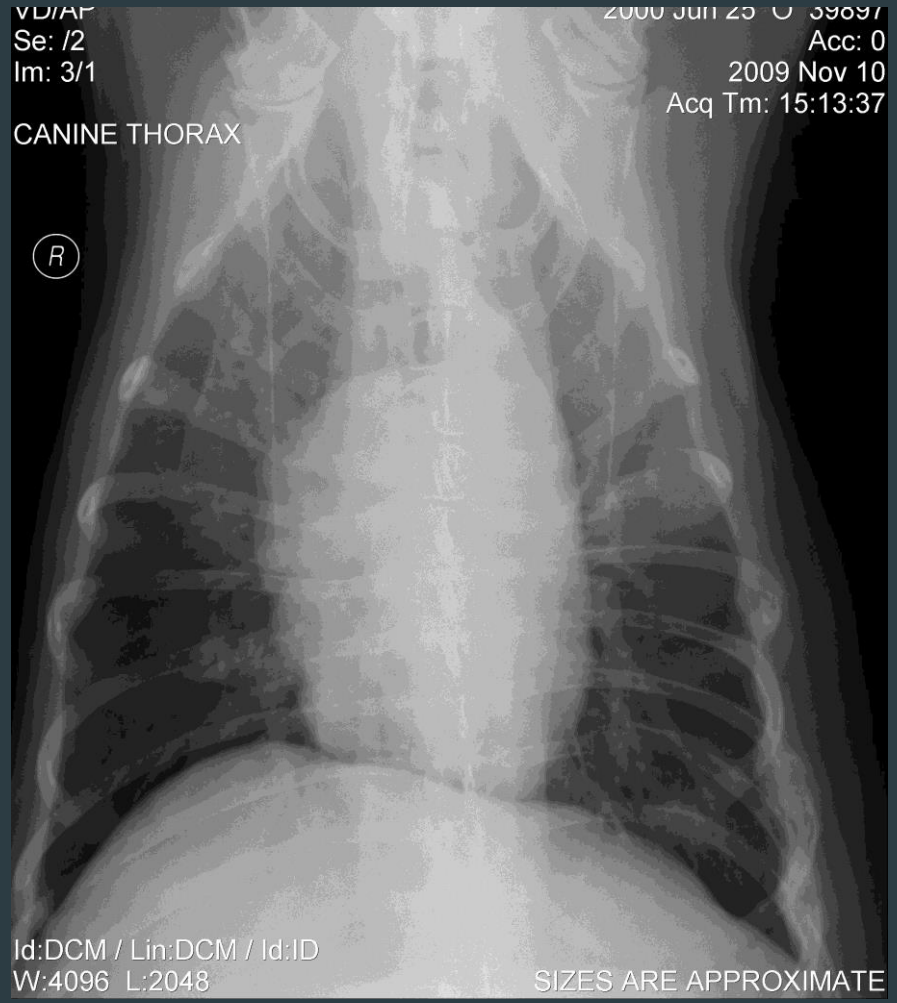
Taped

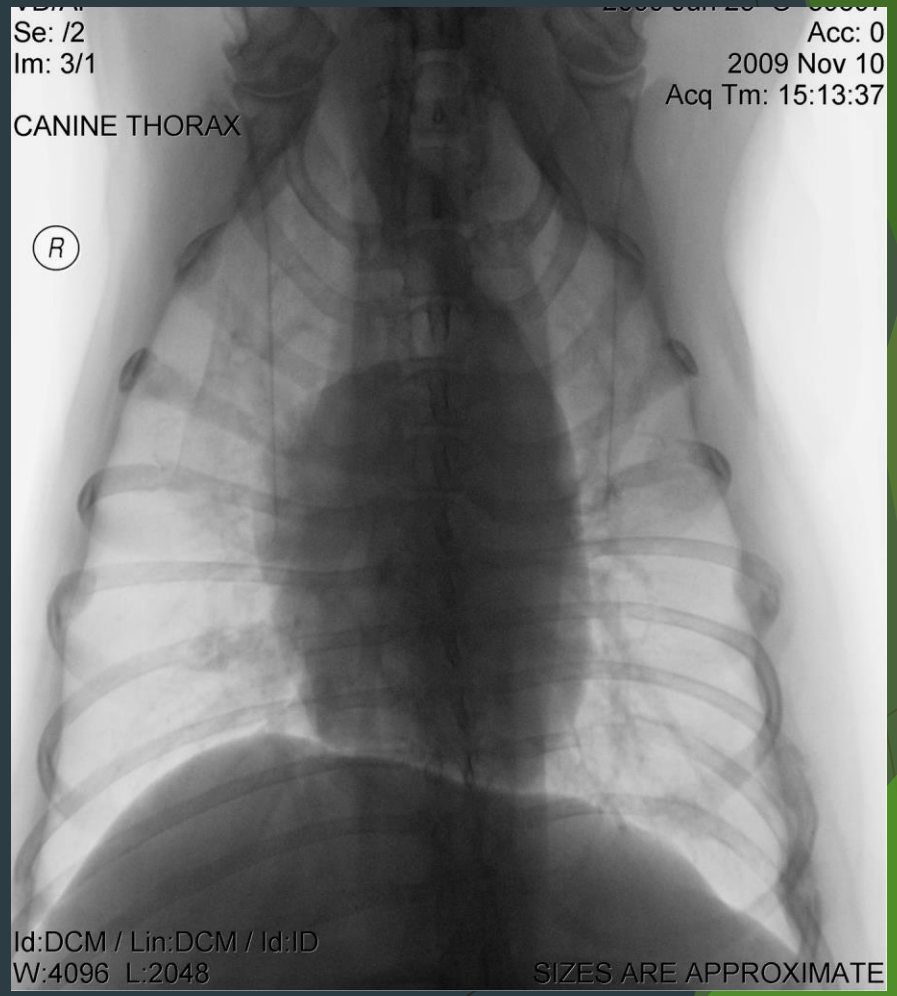
Digits

Not taped

Taped

Ribs: Try Black/White Inversion





Questions?

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