



September 2014

Dr. Norman Ackerman served the University of Florida, College of Veterinary Medicine with distinction as Professor of Radiology from 1979 to 1994. A concerned teacher of veterinary students and residents of all disciplines, Dr. Ackerman also reached the veterinary scientific community through his writing. His numerous clinically pertinent publications are still today a vital part of the veterinary literature; therefore, it is appropriate this site perpetuates Dr. Ackerman's dedication to teaching. This site is presented in recognition of Dr. Norman Ackerman and his contributions to the field of veterinary diagnostic imaging.

Sponsorship of the display supports the Dr. Norman Ackerman Memorial Fund, dedicated to the teaching of diagnostic imaging residents at the University of Florida College of Veterinary Medicine.

- Calvin
- 9 year old NM DLH

## **Dr. Norman Ackerman Memorial Radiography Case Challenge**

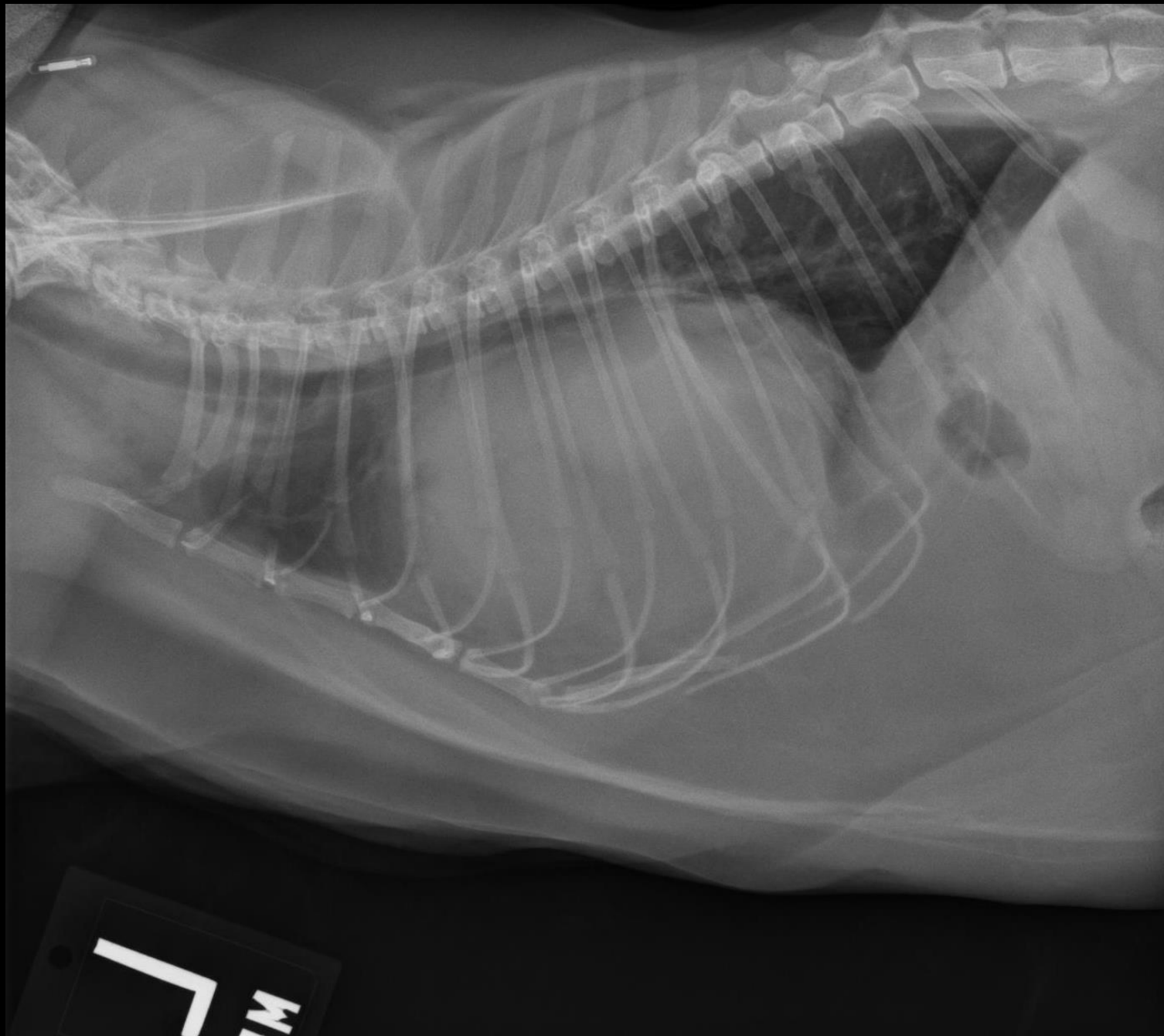
Radiography Case Challenge

Dr. Norman Ackerman Memorial

# History and case presentation

- Calvin presents to your clinic with history of labored and open mouth breathing and drooling. The client reports a long history of respiratory difficulty (which was thought to be allergy related by the previous vet) and tachycardia.
- On physical examination, Calvin has tachycardia, tachypnea, pale pink mucous membranes, CRT 3 sec and muffled heart sounds. The temperature is 102.2 F° .
- Your plan includes radiographs of the thorax







# Findings

The cardiac silhouette is severely, generally enlarged in all the projections.

As a result, the intrathoracic trachea is severely dorsally displaced.

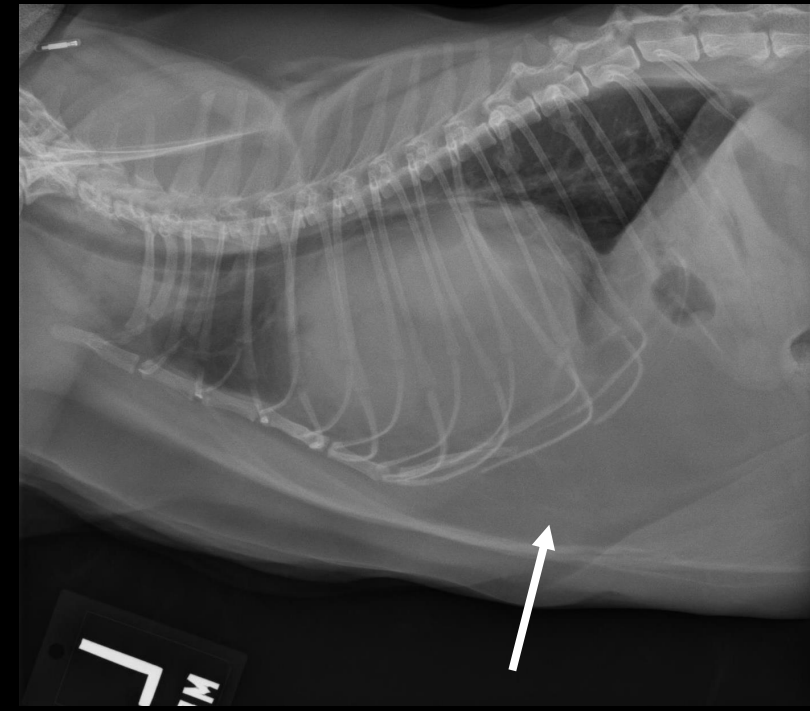
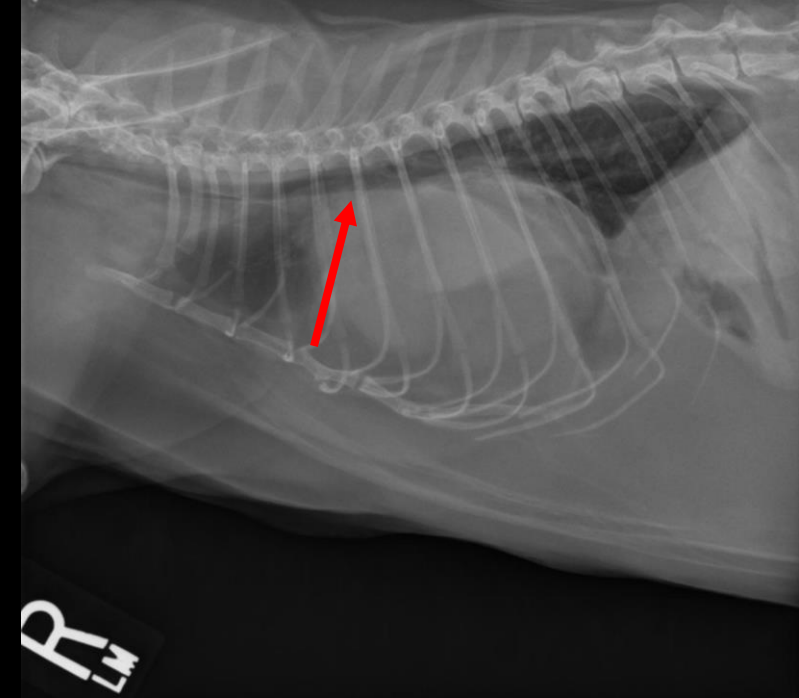
There is loss of the ventral diaphragmatic surface and the caudal ventral cardiac silhouette due to an heterogeneous increase in soft tissue to fat opacity superimposed over the ventral portion of the caudal lung lobes, that is effacing these structures

There is abundant fat ventral to the cardiac silhouette that appears contiguous with the falciform fat

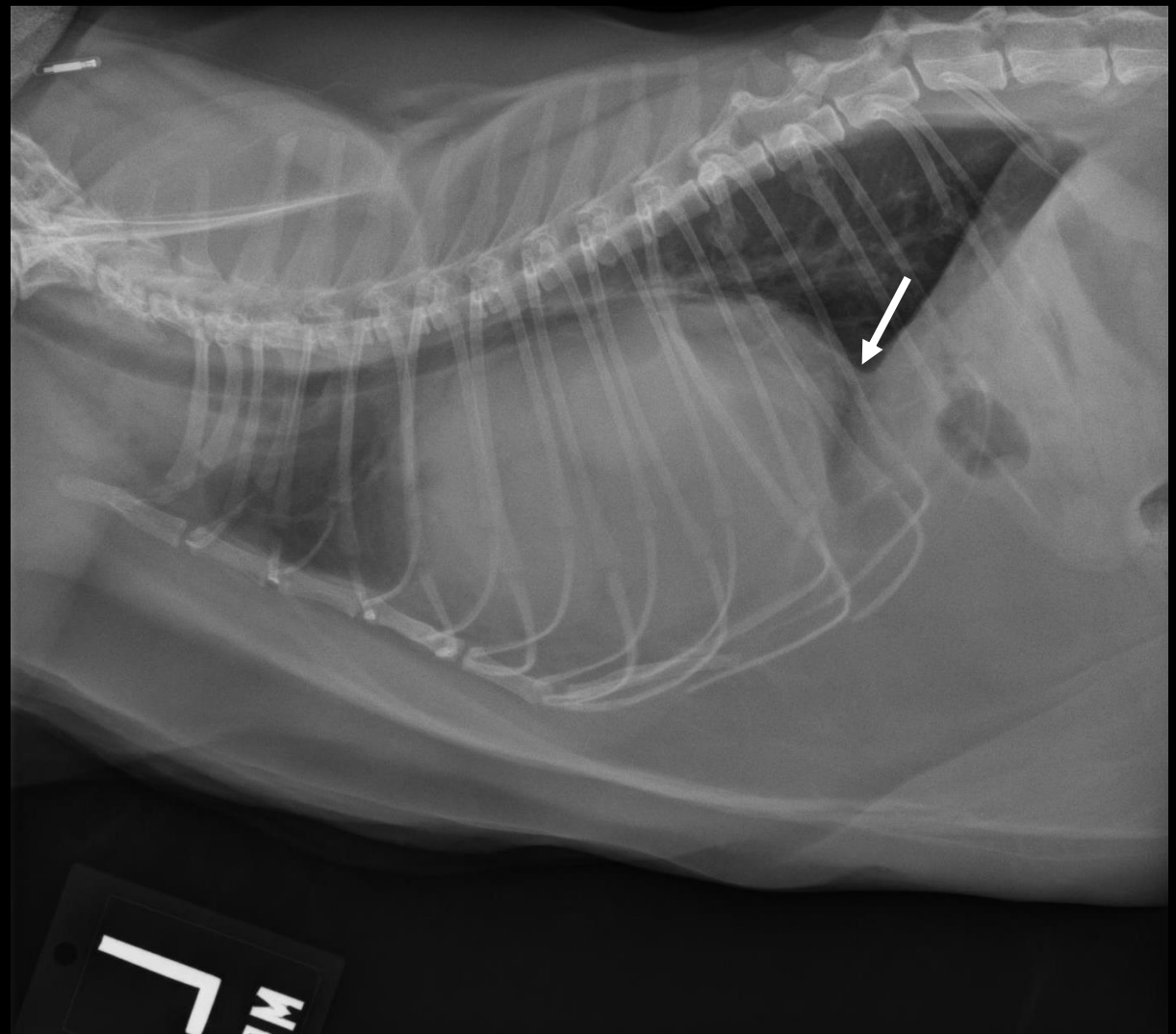
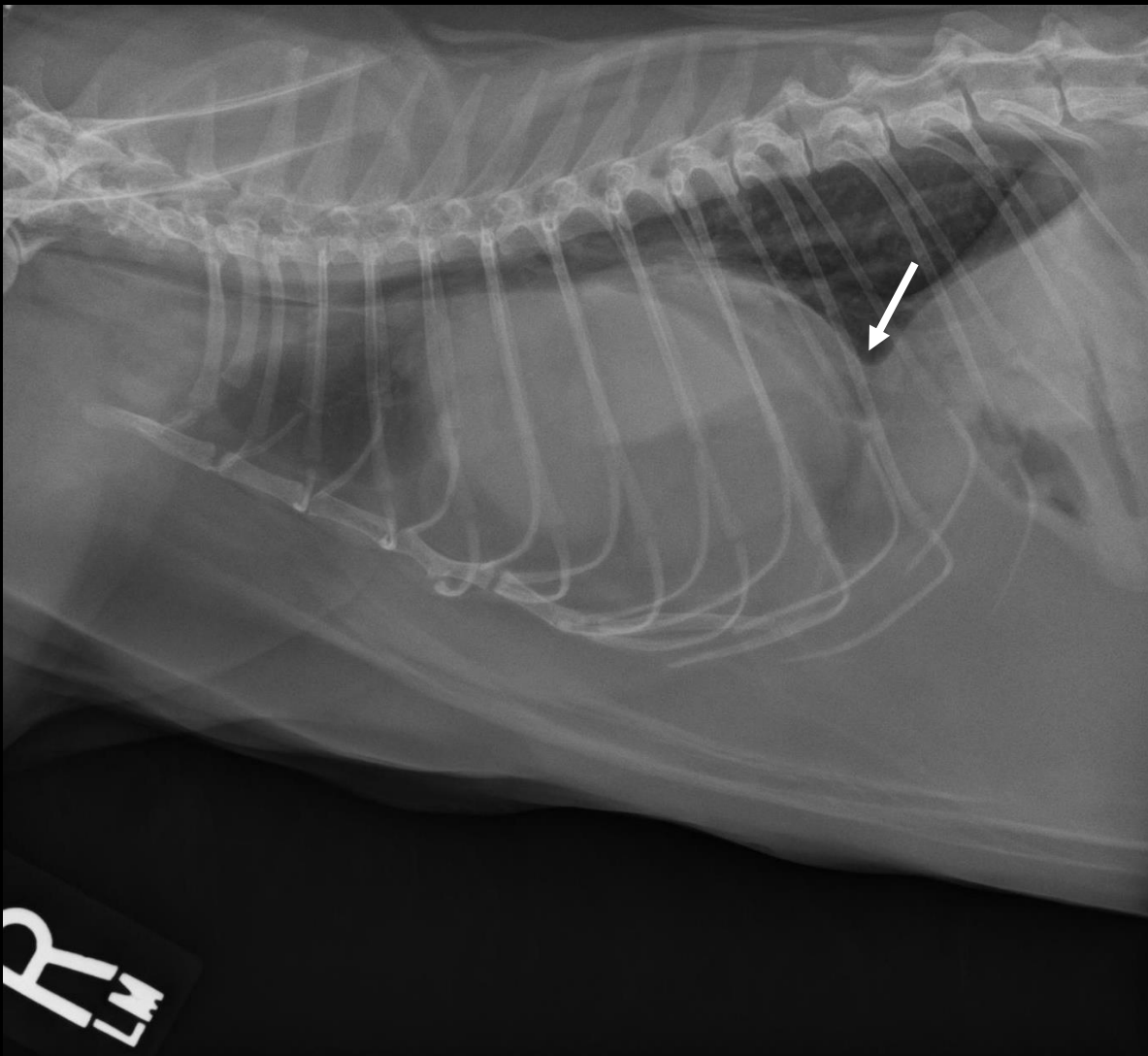
The hepatic silhouette is no longer seen within the cranial abdomen

A mild cranial shift of the gastric axis suggest a cranial displacement of the liver (most likely) or a decrease in size of the liver

Six sternebrae are noted





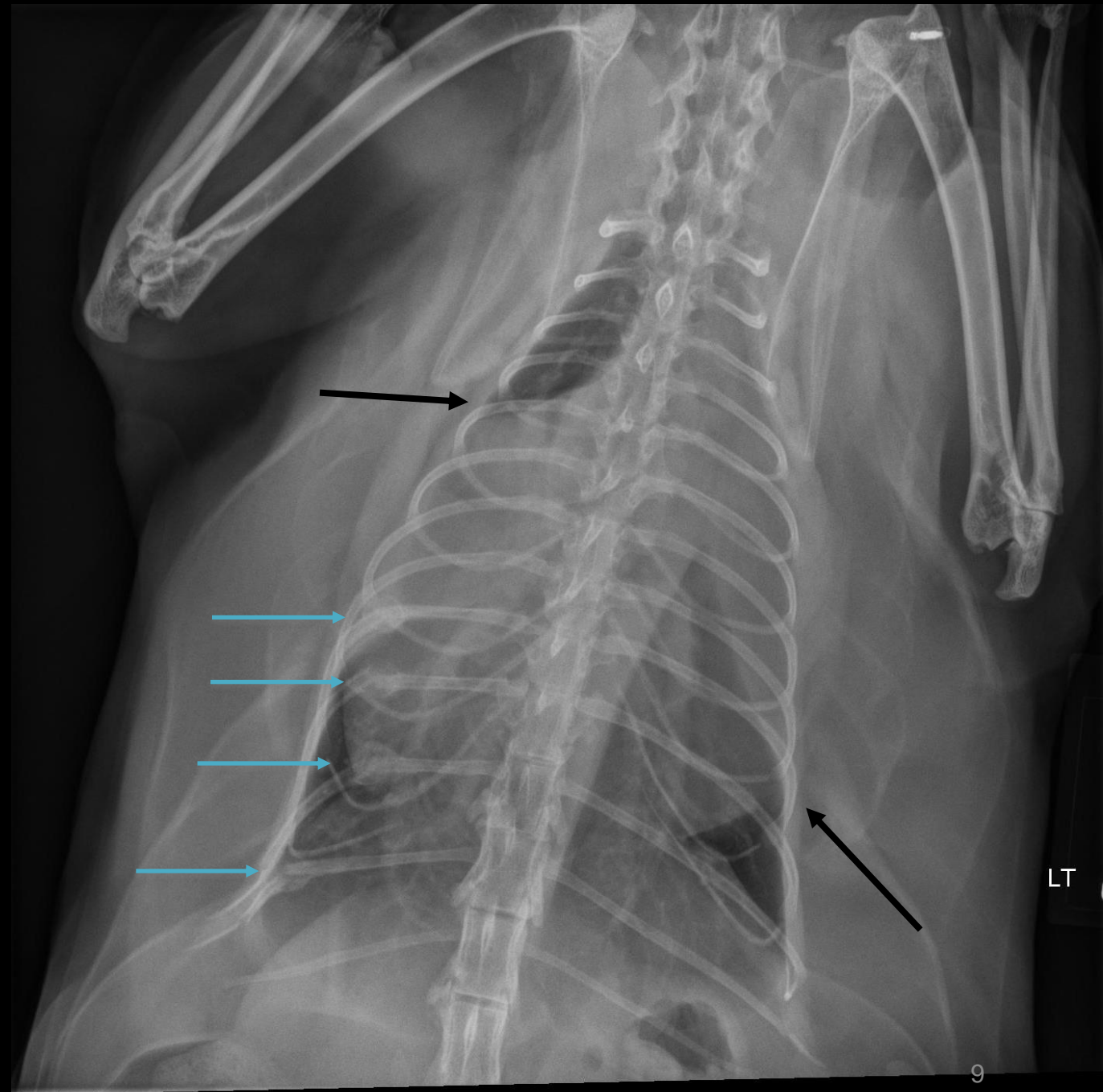


A distinct curvilinear soft tissue opacity is identified between the caudal aspect of the cardiac silhouette and the diaphragm on the lateral projections and is consistent with a dorsal peritoneopericardial mesothelial remnant (DPMR)



A severe, diffuse alveolar pulmonary pattern is seen within the cranial and caudal subsegments of the left and within the right middle lung lobes.

Rib fractures with associated bony callus are noticed at the level of ribs IX-X-XI-XII



# Conclusion

You have found a severely, generalized enlargement of the cardiac silhouette associated with loss of the outline of the ventral diaphragmatic surface and the ventral cardiac silhouette. Also, there is no evidence of the hepatic silhouette within the cranial abdomen. Herniation of the liver into the pericardial sac is considered most likely.

You identified a dorsal peritoneopericardial mesothelial remnant (DPMR) between the heart (caudal cardiac silhouette) and the diaphragm on the lateral views.

Your findings are pathognomonic of a **peritoneopericardial diaphragmatic hernia (PPDH)**. The DPMR represents the dorsal border of the true peritoneopericardial hernia.

Also, you found severe, diffuse left cranial and right middle lung lobe alveolar pulmonary patterns that represent atelectasis, resulting from the mass effect caused by the enlarged cardiac silhouette. The lung lobes may be chronically collapsed. The presence of underlying pulmonary disease cannot be ruled out.

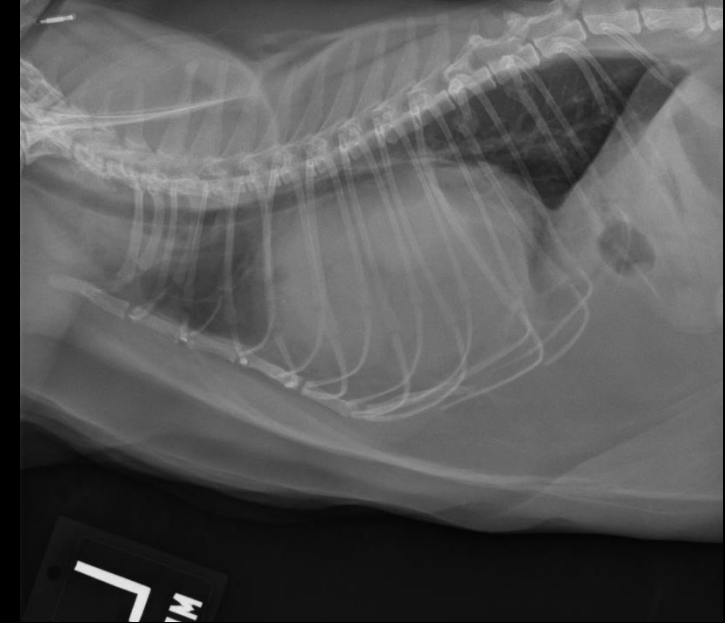
You recognize sternal anomaly and chronic rib fractures.

Concurrent skeletal abnormalities are common findings in cats with PPDH.

Underlying cardiomyopathy cannot be ruled out.

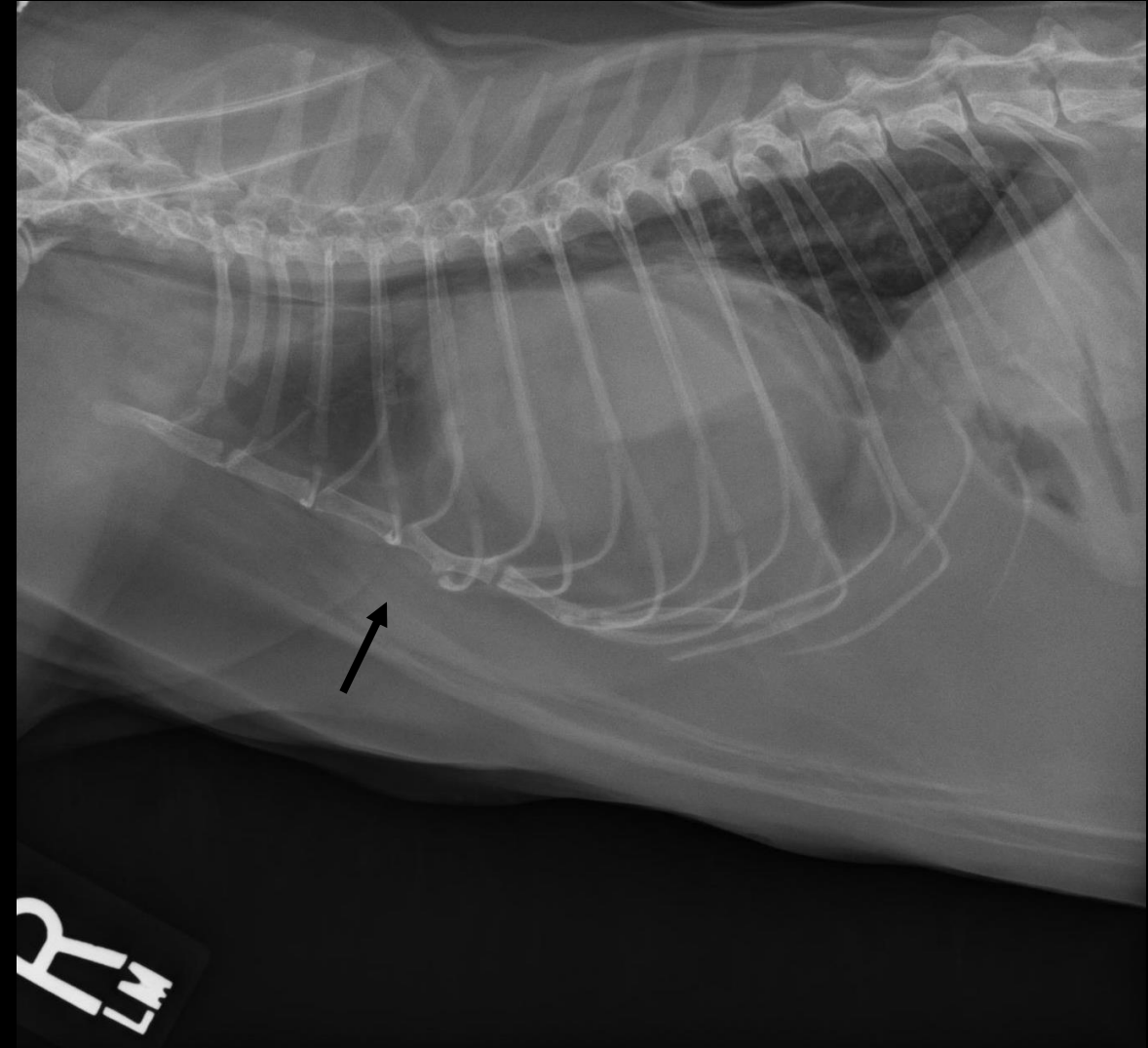
# ... your diagnosis is PPDH!

- Peritoneopericardial diaphragmatic hernia (PPDH) in the cat is due to an abnormal communication between the pericardial sac and peritoneal cavity. Persian, Himalayans and domestic longhair cats are reported to be overrepresented breeds.
- The liver is herniated most frequently (stomach, omentum and small bowel have a less frequent occurrence).
- When not an incidental radiographic finding, common clinical signs attributable to PPDH are exercise intolerance, tachypnea, dyspnea, cough, or vomiting.
- On physical examination common findings are muffled heart sounds and tachypnea.
- Radiologic signs include abdominal organs identified in the pericardial fat, large and round cardiac silhouette, convex projection of the cardiac silhouette, indistinguishable border of the ventral thoracic diaphragmatic surface and the caudal ventral cardiac silhouette, confluent silhouette between the diaphragm and the heart, dorsal peritoneopericardial remnant between the heart and diaphragm on the lateral views.
- Echocardiography is suggested to better assess the heart (and differentiate from pericardial effusion, generalized heart enlargement or both) and investigating for any occult condition given the history of tachycardia.



Additionally:  
Congenital sternal anomaly

- Congenital sternal deformities, such as reduction in number of segments, fusion of neighboring segments, pectus carinatum/excavatum, sternobral absence, splitting (sternal dysraphism) or malformation may be associated with the peritoneopericardial diaphragmatic hernia
- Other congenital abnormalities may be present, such as supraumbilical hernia, umbilical hernia, cryptorchidism, cardiac septal defect and pulmonary vascular anomalies





# PPDH

*Surgical and nonsurgical treatment of peritoneopericardial diaphragmatic hernia in dogs and cats: 58 cases (1999-2008). Burns CG, Bergh MS, McLoughlin MA JAVMA 2013; 242(5):643-50*

- Peritoneopericardial diaphragmatic hernia is an uncommon congenital malformation that can lead to dyspnea, collapse and death for cats and dogs. This malformation allows passage of abdominal contents (liver, omentum, gallbladder, stomach, intestines or spleen) through the diaphragmatic hernia into the pericardial sac, and may result in cardiac tamponade, compromised function of the respiratory tract, gastrointestinal obstruction, gallbladder torsion, or splenic or hepatic entrapment.
- Persian, Himalayan, domestic longhair cats and Weimaraners are reported to be overrepresented breeds.
- The developmental abnormality responsible for the malformation has not been identified yet and several theories regarding the pathogenesis of PPDH have been proposed.
- PPDH is diagnosed during evaluation of animal with clinical signs attributable to such condition. However, frequently a diagnosis is made accidentally via evaluation of radiographic images obtained for other reasons. Clinical signs may be exacerbated after a trauma or other pathological conditions.
- When clinical, signs include exercise intolerance, tachypnea, dyspnea, cough, vomiting, and anorexia.
- Thoracic radiographic findings may include cardiomegaly, loss of distinction between the heart and the diaphragm attributable to superimposed soft tissue or fat opacities, presence of gas-filled abdominal organs in the pericardial sac, identification of mesothelial remnant between the heart and the diaphragm on the lateral view in cats, and inability to identify the borders of the diaphragm.
- Concurrent skeletal abnormalities are common findings in cats with PPDH. Frequently other congenital abnormalities may be detected.
- PPDH can be treated either surgically or conservatively. Conservative treatment is often chosen when it is an incidental finding or when age or concurrent disease makes surgery an impractical choice.