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## **Cardiac Neoplasia and Idiopathic Pericardial Effusion**

The **pericardium** is a fibrous sac that encloses the heart and great vessels at the heart base (aorta, pulmonary artery, proximal pulmonary veins, vena cava). It is attached caudally to the diaphragm. It is fluid “filled”, normally containing 1-15 mL of fluid. The fluid contains phospholipids that lubricate the heart, allowing it to have motion without generating friction. The pericardium also fixes the heart, prevents excess motion, and links the diastolic distensibility of the ventricles. That is, the distension of one ventricle decreased the distensibility of the other. With acute changes in venous return (i.e. exercise), the pericardium limits ventricular filling. With chronic cardiac enlargement, the pericardium also enlarges, and may not have as greater a role at limiting ventricular filling, at least at rest. When the pericardial fluid accumulation is rapid, increased pressure results in tamponade. With tamponade, ventricular filling is restricted, and cardiac output is decreased. The right atrium and ventricle, with thinner walls and lower pressure, are the most vulnerable.

**Acquired** Pericardial effusion (PE) can occur due to congestive heart failure and can be medically managed by treating chamber overload. However, pericardial effusion not due to primary congestive heart failure can be divided into that caused by neoplasia, idiopathic, septic, and traumatic. Recent study by Tobias et. al. reveals results of 87 cases in dogs, 35 of which were golden retrievers, Labradors or their crosses. Large breed dogs are most affected.

**Congenital: Peritoneopericardial diaphragmatic hernia (PPDH)**, pericardial cysts, partial or complete absence of the pericardium.

**Pericardial disease is uncommon in cats.** If present, differential diagnoses to consider include feline infectious peritonitis (FIP), cardiomyopathy, PPDH and lymphosarcoma.

**Phases** of tamponade are:

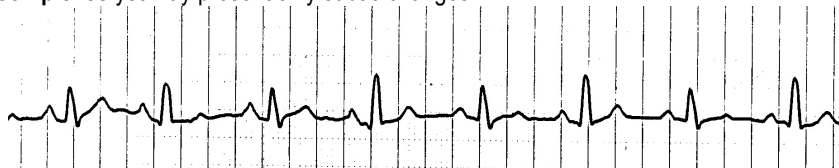
- Modest compromise
- Right heart failure: Ascites, exercise intolerance
- Cardiogenic shock: Decreased cardiac output, poor pulse quality, pulsus paradoxus (variations in pulse quality)

**Causes** of pericardial effusion include:

- Neoplasia
  - Right atrial (RA) hemangiosarcoma
  - Heart base (aortic body) tumors
  - Mesothelioma
  - Rhabdomyosarcoma
  - Ectopic thyroid carcinoma
  - Metastatic neoplasia
- Idiopathic

- Congestive heart failure
- PPDH
- Pericardial cyst (seen in younger dogs, usually are caudoventral)
- Hypoalbuminemia
- Pericarditis (Bacterial, fungal: *Coccidioides immitus*)
- Left atrial tear secondary to valvular disease
- Coagulopathy

**Symptoms** of ascites, lethargy, exercise intolerance, NDR, pale mucous membranes, weak pulses, pulsus paradoxus, respiratory distress, predominantly uniform cardiomegaly, hepatomegaly, or any combination of these symptoms can be detected. Generalized or sectorial globoid cardiomegaly may be seen on **radiographs** with small pulmonary vessels. Pulmonary edema is not typically found. Concurrent pulmonary metastatic disease is possible. **EKG** may present electrical **alternans** or **small complexes** yet may present only subtle changes.



Electrical alternans

**Echocardiography** is essential in cases of “minimum suspicion” of PE.

Echocardiographic findings with pericardial effusion include:

- Anechoic space between the heart and the pericardium
- Abnormal side-to-side cardiac motion
- Decreased chamber size (right ventricle [RV] and left ventricle [LV]).
- Presence of a pericardial or cardiac mass
- TAMPONADE: Early diastolic RA and RV collapse.

70% of cases in Tobias’ study detected intrapericardial tumors. 63% were of the right auricle and presumed to be **hemangiosarcoma** (HSA) frequent in golden retrievers and German shepherds. 8% presented with heart based tumors either **chemodectomas** (Boxers, Bulldogs, and Bostons) or ectopic thyroid **adenocarcinoma**. 27% of the total cases did not demonstrate obvious neoplasia during echo study. 3 of these cases were diagnosed with **mesothelioma** and 1 with myocardial **lymphoma** on cytology. 4 were diagnosed with **idiopathic pericarditis**, 1 with **septic pericarditis**, 1 traumatic and 1 with a constrictive form. Abbot et al (ACVIM 2006) reports echo sensitivity of 17-68% for cardiac neoplasia with a significant sonographer experience variability in retrospective studies, but remains in the upper limits of this range when current technology and multiple planes are utilized.

According to this study prognoses in the HSA cases were < 9 months with **surgical, thoracoscopic, or balloon pericardectomy** +/- tumor resection or debulking and **adriamycin** therapy but was consistently better than mere **repeated pericardiocentesis** (max 1 month). This practitioner has seen repeated pericardiocentesis allow for 3 months of some quality of life yet this tends to be the exception. Couto et. al. reports HSA masses “disappearing” in 48-72 hours after Adriamycin therapy only to return refractorily. Tobias reports 1 case lasting 245 days after pericardectomy with pulmonary metastasis. Fossum reports that surgical excision of RA hemangiosarcoma with pericardectomy carries a poor prognosis given that micro metastasis has usually already occurred. Median survival is approximately 4 months.

**Heart based tumors (HBT) such as chemodectomas**, on the other hand, tend to be “slow movers.” These masses grow slowly and metastasize late. Surgical pericardectomy in these cases revealed 302 and 615 days in 2 respective cases in Couto’s study. The others did not fair well with pericardiocentesis alone. Fossum reports that **long term survival is actually up to several years with aortic body chemodectomas** depending on position and if concurrent age related disease warrants surgical intervention in this case of slow moving neoplasia. Aortic impingement and PE are of primary functional concern. Cases of idiopathic pericarditis responded well to pericardiocentesis (94 to >664 days) without further treatment. Patients with Chemodectoma fare better and median survival of 730 days after pericardectomy has been reported. Mesothelioma cases responded fairly well to capsulation following pericardectomy ranging from 265 to >351 days. The remaining non-neoplastic cases responded well to pericardectomy and antibiotics without further treatment.

**Cytology** revealed important results in 2 cases (lymphoma and septic pericarditis) otherwise, conjecture has been made regarding a lower PH being more indicative of idiopathic and higher PH more neoplastic from PE fluid analysis. Yet there is considerable overlap and Abbot’s study (ACVIM 2006) confirms little value is found with cytological analysis of the effusate. Troponin-1 analysis shows some promise as a marker for hemangiosarcoma (higher value) when differentiating against other PE causes.

### **Idiopathic Pericardial Effusion** is a diagnosis of exclusion.

If pericardial effusion is found on serial echocardiogram studies, and no mass is imaged, a tentative diagnosis of idiopathic pericardial effusion is made. There is a great chance that apparent cases of idiopathic disease are actually due to underlying neoplasia. These dogs frequently undergo pericardiocentesis, and the effusion is typically hemorrhagic. Recent evidence suggests that there might be a diagnostic role for determination of troponin-I; serum concentration of this biomarker is greater in dogs with cardiac HSA than in dogs with idiopathic pericarditis. Despite this encouraging finding, the non-invasive etiologic diagnosis of PE generally is made by echocardiography and clinical course. **Each time the effusion recurs; a complete echocardiographic exam needs to be done to attempt to image a mass that may have been too small to previously see.** With cases of idiopathic pericardial effusion, approximately 50% of dogs will be cured with one tap. Other dogs may be cured with multiple taps, but in some cases the fluid will continue to recur. Surgery is usually the best option for these dogs.

### **Peritoneal pericardial Diaphragmatic Hernia (PPDH):**

This is a congenital hernia seen in dogs and cats in which the abdominal contents (liver, small intestine, spleen, stomach) herniate into the pericardial sac. Persians cats and Weimeraners have an increased incidence. Clinical signs include gastrointestinal signs and dyspnea. Treatment entails surgery, or asymptomatic animals may just be observed for clinical signs.

### **Constrictive Pericarditis**

In this uncommon condition a nondistensible, thickened, fibrotic pericardium exists. With echocardiography, the pericardial thickness is typically not appreciated.

Echocardiographic findings reported include:

- Flat diastolic LV wall motion
- Rapid E-F slope
- Early pulmonic valve opening
- Abnormal systolic or diastolic septal motion
- Respiratory variation in IVRT
- Doppler: MV and pulmonary vein decrease with expiration

**Prognosis:** Cardiac hemangiosarcoma: < 8 months with surgical debulking and chemotherapy.

Chemodectoma (aortic derived): MST 730 days post pericardectomy.

Idiopathic: 50% complete resolution post cardiocentesis, curative with pericardectomy (surgical, balloon thoracoscopic)

Mesothelioma: Poor

Restrictive pericarditis: Poor without surgical stripping.

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