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Pericardial Diseases

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Diseases affecting primarily the pericardium account for approximately 1% of all patients with cardiovascular disease.[1] Although primary pericardial disease represents a small percentage of the total number of cardiac diseases in small animals, it is an important cause of right heart failure in the dog. Pericardial disease of all types are uncommon in the cat.[2,3] Several types of primary and secondary pericardial diseases occur, the most common of which are those resulting in the accumulation of pericardial effusion.

CONGENITAL DISEASES

There are several congenital diseases of the pericardium recognized in small animal species. While peritoneopericardial diaphragmatic hernias (PPDH) are the most common type of congenital abnormality encountered [1], sporadic reports of partial pericardial defects [5,6] and intrapericardiac cysts [4] have been published. Congenital complete absence of the pericardium is quite rare.[5]

PERICARDIAL DEFECTS

Peritoneopericardial diaphragmatic hernias are commonly reported in dogs and cats. Peritoneopericardial diaphragmatic hernias have been reported in littermates, but there is no reported evidence that the lesion is hereditary. It has been suggested that Weimaraner dogs are predisposed to PPDH.[6]

A large portion (48%) of dogs and cats with PPDH are diagnosed prior to one year of age and another 36% are diagnosed between one and four years of age.[6] Clinical signs are most commonly gastrointestinal (anorexia, vomiting, discomfort following a meal) or respiratory (cough, dyspnea). Signs of cardiac compromise (abdominal distention and acute collapse) may occur, but are uncommon.

Physical examination may reveal an apical impulse, which is displaced or decreased in intensity. Cardiac murmurs may be detected if concurrent cardiac malformations are present. If the hernia is large and a significant amount of abdominal viscera has herniated, the abdomen may seem empty on palpation. Signs of CHF (ascites, jugular venous distension) may be present, but are uncommon. Concurrent defects (sternal malformations, cranial abdominal hernias) may be detected.

Thoracic radiographs are extremely helpful in establishing a definitive diagnosis of PPDH. Radiographic abnormalities may include: overlap of the caudal cardiac silhouette and cranial diaphragm, variable radiographic densities within the cardiac silhouette, gas-filled bowel loops crossing the diaphragm, and sternal malformations. Oral administration of barium may help outline bowel loops present within the pericardial sac (Figure 1). Ultrasonography can readily identify the presence of abdominal viscera within the pericardial sac and help establish a definitive diagnosis.

Surgical correction of the hernia with replacement of viable herniated viscera is the recommended therapy. Consideration of the severity of concurrent congenital malformations should be made prior to surgical intervention. In uncomplicated (no concurrent malformations) cases, the prognosis following surgical repair is excellent.

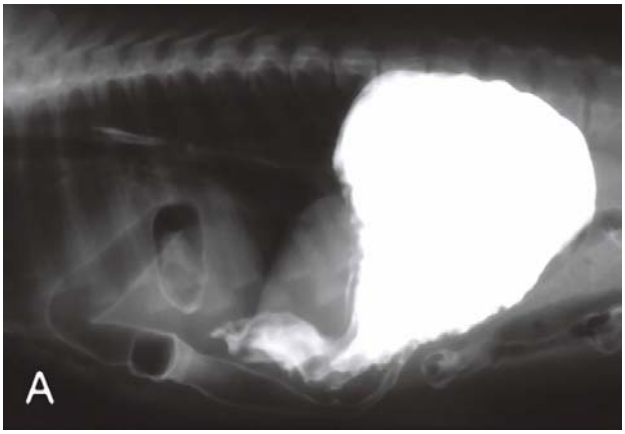
ACQUIRED PERICARDIAL DISEASES

Pericardial Effusion

Diseases causing pericardial effusion are the most common causes of clinically significant pericardial disease in the dog.[1] Idiopathic intrapericardial hemorrhage (Golden retrievers are over represented) with or without pericardial reaction and neoplasia of the heart, heart base, or pericardium are the most common causes of hemorrhagic effusion in dogs.[1] Clinically important tumor types in dogs include hemangiosarcoma of the right atrium (especially common in German Shepherds and Golden Retrievers). Aortic body tumors (chemodectoma, nonchromaffin paraganglioma) with invasion of

the heart base are most commonly seen in aged brachycephalic breed dogs. Other neoplasms associated with pericardial effusion are ectopic (heartbase) thyroid carcinoma, mesothelioma of the pericardium, and metastatic carcinoma to the heart or pericardium. A well recognized but uncommon cause of intrapericardial hemorrhage in small breed dogs is left atrial tear secondary to severe chronic endocardiosis of the mitral valve.

Figure 1.
Lateral and ventrodorsal radiographs from a dog with a peritoneopericardial diaphragmatic hernia following barium administration. Notice the markedly enlarged cardiac silhouette with variable radiographic densities and how the barium administration outlines the bowel loops which traverse the diaphragm and are contained within the pericardial sac.



DIAGNOSIS

Special breed predilections have been noted previously. Most frequently, animals with pericardial disease are presented with vague signs. Clients will frequently describe lethargy, exercise intolerance, and anorexia. Occasionally, patients will be presented for signs of compromise of right heart function: abdominal distension, respiratory difficulty, or syncope.

Signs of elevated right heart pressures are consistently present in patients with clinically significant pericardial disease. Jugular venous distention or a positive hepatojugular reflux are invariably present, but commonly overlooked (Figure 2). Heart sound intensity is frequently diminished. Lung sounds may be diminished if pleural effusion is present. Other auscultatory abnormalities (gallop rhythms, cardiac murmurs, arrhythmias) are uncommon. Dogs with left atrial tears secondary to chronic degenerative valvular disease will have a systolic murmur that may be decreased in intensity when compared to previous examinations. Hepatomegaly and free abdominal fluid are common findings. If the disease is chronic, significant weight loss may be observed.

Figure 2.
Jugular venous distension in a Golden Retriever with pericardial effusion and cardiac tamponade secondary to a right atrial hemangiosarcoma.

Thoracic radiography usually demonstrates abnormalities when there is significant accumulation of pericardial fluid. The cardiac silhouette loses its angles and waists and becomes globe-shaped (Figure 3). Most cases are not "classic" and require integration with the other data. Pulmonary vascularity is often reduced from low cardiac output in contrast to CHF from cardiomyopathy or valvular disease in which the pulmonary vascularity may be increased (especially the pulmonary veins). If CHF has developed, distension of the caudal vena cava hepatomegaly and pleural effusion are usually evident. Less commonly, distension of the pulmonary veins and increased pulmonary interstitial densities (edema) may be detected. Heart base tumors may deviate the trachea and produce a mass effect.

Figure 3.
Ventrodorsal radiograph from a dog with idiopathic pericardial effusion. Notice both the substantial generalized cardiomegaly and the relatively scant pulmonary vasculature.

Although there are no pathognomonic electrocardiographic findings for pericardial disease, there are several electrocardiographic abnormalities that are commonly seen. Electrical alternans is a beat-to-beat voltage variation of the QRS or ST-T complexes. It may be recorded in as many as 50% of patients with pericardial effusion. Elevation of the ST segment is commonly recorded in patients with pericardial disease. This represents an epicardial injury current. Reductions in QRS voltage (R < 1 mV in Lead II) are commonly recorded in dogs with pericardial effusion. Low

electrocardiographic QRS voltage is considered a weak predictor of the presence of pericardial effusion. In the author's experience, arrhythmias other that sinus tachycardia are uncommon in primary pericardial disease.

Echocardiography is the most sensitive and specific non-invasive method of detecting pericardial effusion currently available. The hemodynamic consequences of pericardial effusion depend not only on the amount of pericardial effusion present, but also on the rapidity with which the effusion has accumulated. A small or moderate amount of fluid accumulating rapidly (left atrial rupture) may produce significant hemodynamic compromise, while a large amount of effusion accumulating over months may have little hemodynamic effect. These principles should be remembered when assessing the significance of an echocardiographically-detected pericardial effusion. Echocardiography can detect as little as 15 ml of intrapericardial fluid. An anechoic space between the epicardium and pericardium is the classic echocardiographic finding in pericardial effusion. Cardiac motion is commonly abnormal often with dramatic side-to-side movement and diastolic compression (Figure 4). Overall cardiac chamber size is usually diminished due to impaired cardiac filling. Intrapericardiac or cardiac mass lesions may be visualized (Figures 5A-D).

Figure 4.
Right parasternal long-axis 2-dimensional echocardiogram obtained in diastole showing the classic findings of cardiac tamponade. Notice the anechoic space surrounding the heart and the marked collapse of the right atrium (Arrow)

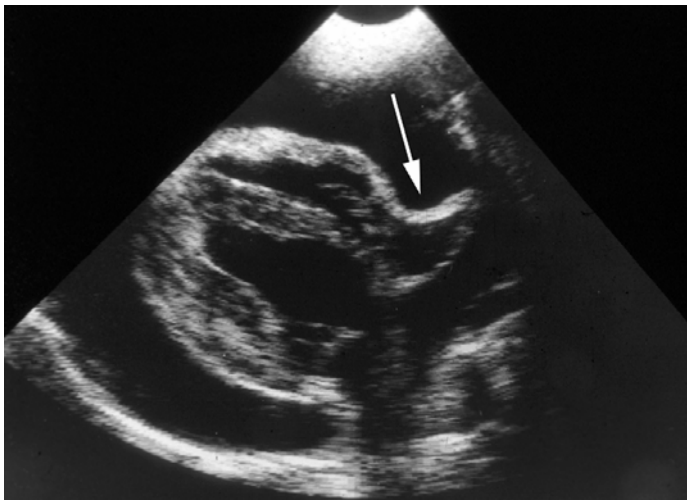
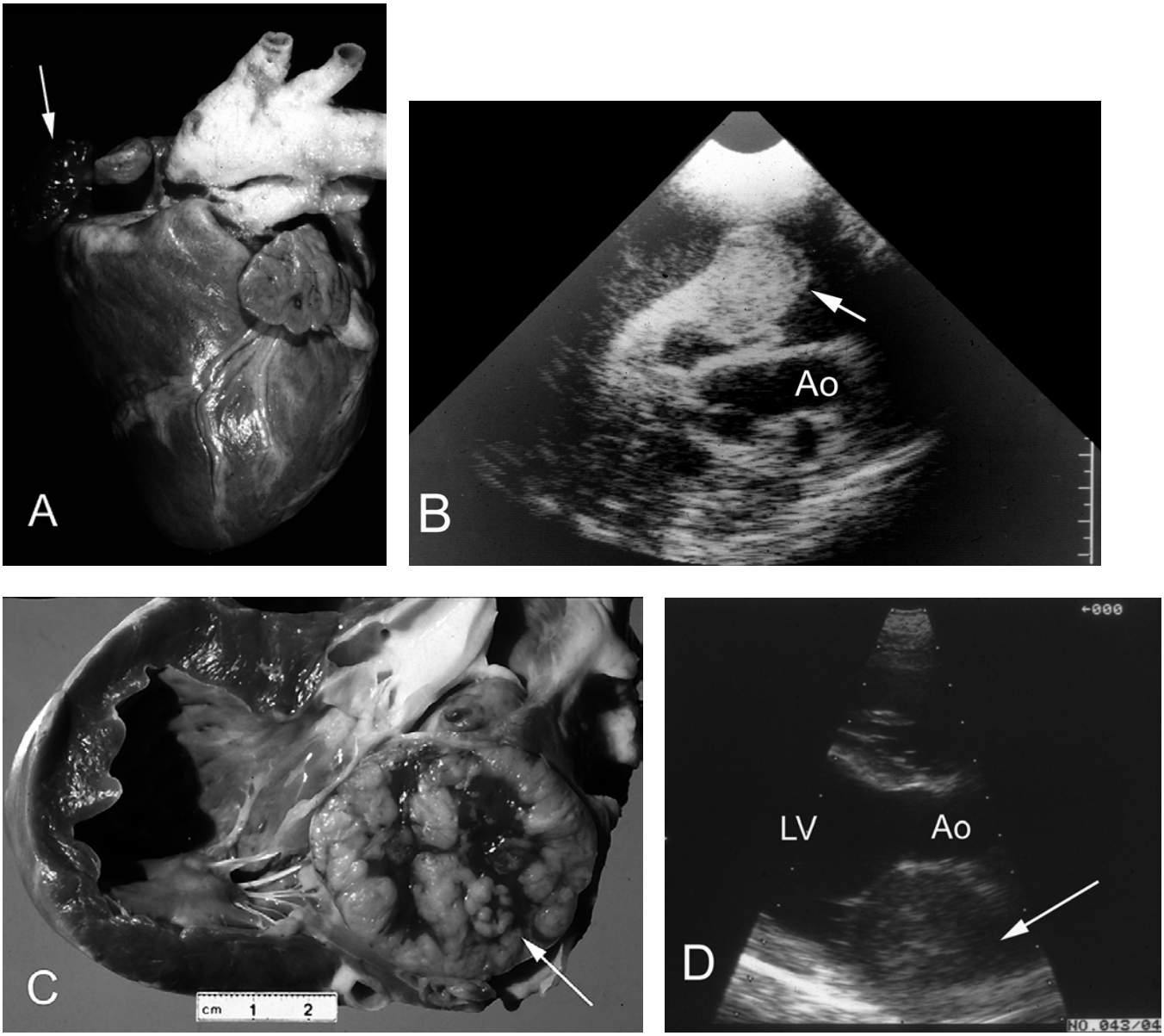


Figure 5.
Gross specimens and correlating echocardiograms from dogs with cardiac neoplasia. **A** The heart is viewed form the left side showing a large irregular mass (hemangiosarcoma) at the right atrioventricular junction (arrow). **B** Right parasternal long axis echocardiogram showing the mass lesion (arrow) cranial to the aorta in the region of the right atrium. **C** The heart has been sectioned in the same plane as the right parasternal long axis echocardiogram. A large mass (arrow) originating at the aortic root (chemodectoma) has invaded the left atrium and fills it almost completely. **D** Right parasternal long axis echocardiogram showing the mass lesion (arrow) within the left atrium. This patient has no obvious pericardial effusion. (Ao= aorta; LV = left ventricle)



THERAPY AND PROGNOSIS

Pericardiocentesis

Pericardiocentesis is the treatment of choice for initial stabilization of dogs and cats with pericardial effusion and cardiac tamponade. When performed properly, pericardiocentesis is associated with minimal complications. Prior to performing pericardiocentesis, it is necessary to shave and surgically prepare a large area of the right hemithorax (sternum to mid thorax, third to eighth rib). Local anesthesia is usually adequate; however, mild sedation is sometimes necessary. It is important to insure that the pleura has been infiltrated, as pleural penetration seems to cause significant discomfort. The patient is placed in sternal or lateral recumbency, depending on demeanor. Occasionally, pericardiocentesis can be accomplished in the standing animal, but adequate restraint is essential to prevent cardiac puncture or pulmonary laceration. Electrocardiographic monitoring during the procedure is helpful since epicardial contact often causes ventricular arrhythmias.

The puncture site is usually determined based on the location of the heart on thoracic radiographs. This is most commonly between the fourth and sixth rib spaces at the costochondral junction. Ultrasound guidance is infrequently necessary unless the volume of effusion is very small or the effusion is compartmentalized. The size of the needle or catheter used is dependent on the size of the animal. In cats, a 19 to 21 gauge butterfly catheter may be adequate, while in large dogs, a 16 gauge over-the-needle catheter (usually with additional side holes) may be needed. The needle or catheter should be attached to a 3-way stopcock, extension tubing, and a syringe, to allow constant negative pressure to be applied during insertion and drainage. Care should be taken to avoid the large vessels that run along the caudal border of the ribs. Once the catheter has been inserted through the skin, negative pressure should be applied. If pleural effusion is present, it will be obtained immediately upon entering the thoracic cavity. It is most commonly a clear to pale yellow color. As the catheter is advanced and contacts the pericardium, a scratching sensation will be noticed. Minimal advancement will result in penetration of the pericardium.

Most pericardial effusions are hemorrhagic and have a "port wine" appearance. Once effusion of this character is obtained, the catheter should be advanced over the needle, and the needle removed. The remainder of the drainage should be performed using the catheter. Advancing the needle too far will result in contact with the epicardium. This is often felt as a tapping or more intense scratching sensation and commonly results in ventricular arrhythmias. These arrhythmias are usually self-limiting following retraction of the needle or catheter.

Pericardial effusion can be differentiated from peripheral blood in that it rarely clots unless it is from very recent hemorrhage and the PCV is significantly lower than that of peripheral blood. Every attempt should be made to drain the pericardial space as completely as possible. Drainage of the pericardium is often associated with an increase in the complex size on the ECG, a reduction in heart rate, and an improvement in arterial pulse quality. Potential complications include cardiac puncture (with resultant hemorrhage or arrhythmias), coronary artery laceration, lung puncture or laceration, and dissemination of infection or neoplasia throughout the thoracic cavity. Diagnostic evaluations of fluid obtained should include PCV and cytologic evaluation. Bacterial culture and sensitivity should be performed if indicated by cytologic evaluation. Caution should be exercised when evaluating the cellular component of pericardial effusion. Clinically important neoplasia of the heart and pericardium (hemangiosarcoma, chemodectoma) commonly do not exfoliate, resulting in frequent false negative evaluations. Reactive mesothelial cells within the pericardial sac are commonly over interpreted as being neoplastic, causing false positive results.

The long-term prognosis for dogs with hemorrhagic effusion is dependent on the underlying etiology. With idiopathic hemorrhagic pericardial effusion, pericardiocentesis is curative in approximately 50% of the cases. In the remainder, repeat centesis is necessary to control clinical signs. Fluid may reaccumulate rapidly (within several days) or may not recur for months to years. In patients requiring more than 2 centeses, the author recommends subtotal pericardiectomy. Following the initial pericardial tap, administration of oral prednisolone (starting at a dose of 1 mg/kg orally every 12 hours, then gradually tapering off over a two to three week period) may be beneficial. Although anti-inflammatory doses of prednisolone are commonly administered to dogs with idiopathic pericardial effusion, there are no

controlled studies to confirm the efficacy of this therapy. Subtotal pericardiectomy is usually curative in dogs with idiopathic pericardial effusion.

If cardiac or pericardial neoplasia is the cause of the pericardial effusion, the recommended therapy is subtotal pericardiectomy. The prognosis is again dependent on the nature of the underlying etiology. Aortic body tumors are commonly associated with slow growth and are late to metastasize. Subtotal pericardiectomy may afford palliation for up to three years.[5] Hemangiosarcoma of the right atrium is associated with a poor long-term prognosis. Most mass lesions involving the right atrium or right ventricle are not amenable to surgical removal. The tumor has commonly spread to the lungs at the time of diagnosis and these patients may have neoplastic lesions in the spleen or liver as well. In those patients, subtotal pericardiectomy should be considered palliative.

Recent reports have suggested that both thorascopic pericardiectomy and percutaneous pericardial balloon dilation may be reasonable alternatives to subtotal pericardiectomy in both neoplastic and benign effusions. These techniques allow the pericardial fluid to drain into the pleural space to be reabsorbed. This may provide significant palliation for patients with pericardial effusion and the resultant cardiac tamponade without necessitating a thoracotomy. These therapeutic modalities warrant further evaluation in canine patients.

FELINE PERICARDIAL DISEASE

Pericardial diseases appear to be quite uncommon in cats.[2,3] Recent reports addressing the topic suggest that the most common single cause of pericardial disease in the cat is feline infectious peritonitis (FIP).[2,3] FIP infection can cause massive accumulations of intrapericardial fluid and resultant cardiac compromise. Pericardial effusion is common secondary to cardiomyopathy. Echocardiography can readily detect pericardial effusion and determine the nature of concurrent myocardial disease. Peritoneopericardial diaphragmatic hernias may go undiagnosed for years in cats. Sternal abnormalities are commonly observed along with PPDH. Frequently, only falciform fat and liver will be present within the pericardial sac, making barium contrast studies less informative in cats than in dogs.

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