

Pericardiectomy in the Canine Patient with Pericardial Effusion



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Introduction:

Pericardial disease accounts for approximately 1% of cardiovascular disease in dogs and cats; however, pericardial disease is very rare in cats.³ According to Dr. Catriona, the main functions of the pericardium are as follows: to maintain the heart in a normal position, to protect the heart against any trauma, to provide a smooth gliding surface for heart motion, to prevent the great vessels from becoming kinked, to prevent any disease from spreading across the pleural space and heart, and to prevent over dilatation of the heart.³ Dr. Catriona defined pericardial effusion as an abnormal collection of fluid in the pericardium.³ There is, normally, approximately 0.25 mL/kg of fluid within the pericardial sac. Abnormal fluid accumulation within the pericardium causes an increase in pericardial pressure, cardiac tamponade, decreased cardiac output, and decreased blood pressure (right heart failure).⁴ Pericardial effusion in the canine patient can be caused by neoplasia, infectious organisms (bacterial, viral, or fungal), congenital abnormality, or idiopathic disease.⁸ Golden Retrievers, German Shepherds, Boxers, Saint Bernards, and Labrador Retrievers tend to be over represented, and it is more commonly seen in canine patients around 6 years old.^{4,8} Patients with pericardial effusion commonly present to the referring veterinarian for increased respiratory effort and rate.⁸

Pericardial effusion is treated medically by performing pericardiocenteses to relieve fluid from around the heart and alleviate cardiac tamponade.⁴ Surgery is the treatment of choice when the fluid accumulation repeated recurs. Surgical treatment of pericardial effusion involves removal of all or a piece of the pericardium in order to permanently prevent fluid accumulation within the pericardial sac.³ A pericardiectomy is considered definitive treatment for idiopathic pericardial effusion (IPE) and palliative treatment for malignant pericardial effusion.⁷

History and Presentation:

Dogs with pericardial effusion commonly present to their referring veterinarian with signs of lethargy, anorexia, collapse, syncope, abdominal distention, ascites, and dyspnea. Abdominal distention and dyspnea may be seen in dogs with right sided heart failure secondary to cardiac tamponade.⁵ Pericardial effusion Bulldogs, Boston Terriers, Scottish terriers, English setters, Afghan hound, flat-coat retrievers, Irish water spaniels, French bulldogs, saluki, and Labrador Retrievers. Pericardial effusion is typically found in dogs that are approximately 6 years of age, and is more commonly seen in males.^{4, 7, 8}

Pathophysiology:

The pericardium is a thick double layered sac that encloses the heart. Two layers make up the pericardium, the outer layer which is a fibrous layer, and an inner layer, which is a serous layer. The fibrous layer is composed of the great vessels dorsally, and the pericardiophrenic ligament, ventrally. The pericardiophrenic ligament attaches the pericardium to the diaphragm.³ According to Dr. Catriona, the main functions of the pericardium are as follows: to maintain the heart in a normal position, to protect the heart against any trauma, to provide a smooth gliding surface for heart motion, to prevent the great vessels from becoming kinked, to prevent disease from spreading from the pleural space into the heart, and to prevent over dilation of the heart.³ There is, normally, approximately 0.25 mL/kg of fluid within the pericardial sac.⁸

Pericardial effusion occurs when fluid accumulates within the pericardial sac, increasing intrapericardial pressure^{3, 8}. Cardiac tamponade occurs when intrapericardial pressure is greater than right ventricular pressure.⁸ The large fluid accumulation impedes filling of the right ventricle, resulting in reduced diastolic filling and decreased cardiac output. This results in a

decrease in venous return, ventricular filling, stroke volume, and cardiac output. Increasing venous pressure leads to pleural and peritoneal effusion.^{3,8}

Initially, the patient can compensate by increasing heart rate and vascular resistance, to maintain blood pressure at a normal range. If the intrapericardial pressure continues to increase, left ventricular filling also becomes compromised, causing cardiogenic shock due to left sided heart dysfunction. Once left-sided cardiac output declines, the blood pressure declines as well.⁸ Clinical signs are dependent on the rate at which fluid accumulates and compliance of the pericardium. With gradual pericardial effusion, the pericardium stretches and is able to accommodate a larger volume before cardiac tamponade develops. On the other hand, the pericardium is unable to respond to a rapid increase in pericardial fluid; thus, cardiac tamponade occurs at much smaller volumes.³ Depending on how well they compensate depends on how long the patient will live with this condition, as each patient differs in their ability to compensate.

Pericardial effusion in the canine patient is caused by neoplasia, a congenital cause, right-sided heart failure, or idiopathic disease. The congenital causes of pericardial effusion include peritoneopericardial diaphragmatic hernia (PPDH) and pericardial cyst. The most common cause of congenital pericardial deficiencies in dogs and cats is PPDH.⁸ Acquired causes of pericardial effusion include the following: neoplastic (hemangiosarcoma, chemodectoma, heart base tumor, mesothelioma, thyroid carcinoma, lymphosarcoma, connective tissue tumor, or other metastatic tumors), idiopathic, and other (right sided heart failure, left atrial rupture, traumatic atrial rupture, anticoagulant rodenticide toxicity, uremic pericarditis, bacterial or fungal infections, and constrictive pericarditis).^{7,8} The most common causes of acquired pericardial effusion in the canine patient are neoplastic and idiopathic diseases. Neoplastic pericardial effusion occurs in 58% of cases. The most common neoplasms associated with pericardial effusion include

hemangiosarcoma (60-75%), aortic body tumors (10%), and mesothelioma (5%). Idiopathic pericardial effusion, a sterile hemorrhagic effusion, is diagnosed in 19% of cases.⁸

Diagnostic Approach/ Considerations:

On physical examination, patients will present anywhere from bright, alert, and responsive to dying. Dogs with cardiac tamponade are usually lethargic, inappetent, and exercise intolerant. They may also present with a pot-bellied appearance, dyspnea, and collapse. Mucous membrane color will vary from pink to muddy or pale. There is usually a delay in capillary refill time. Tachycardia and muffled heart sounds are typically present in an animal with pericardial effusion. A ventricular arrhythmia may be present. Dyspnea and muffled lung sounds are a possibility in many patients. Femoral pulses are usually weak.⁵ Because of increased venous pressures, jugular venous distention, with or without jugular pulses, may be present. If peritoneal effusion is present secondary to cardiac tamponade, an abdominal fluid wave may be detected. Electrocardiography reveals electrical alternans in approximately 60% of cases with pericardial effusion.^{3,5} Sudden death or collapse are possible in patients with acute cardiac tamponade.⁷

There are no laboratory findings that are specific for pericardial effusion.^{5,7} Liver enzyme elevations associated with hepatic congestion can be present. At times, an increase in partial thromboplastin times or activated partial thromboplastin time is seen in patients with a coagulopathy.⁵ A mild, nonregenerative, anemia may occur due to blood loss or due to chronic disease anemia. A mild leukocytosis can also occur.⁷

Radiographs may reveal mild to severe cardiomegaly. The size of the cardiac silhouette increases due to chronicity of effusion and increased fluid volume.⁷ Radiographs may reveal a normal sized heart, indicating acute fluid accumulation, while a globoid heart would indicate a

chronic effusion.^{5,7} Radiographs can reveal metastatic lesions.⁵ Pleural effusion can be visualized along with caudal vena cava enlargement due to right sided congestive heart failure.⁷

An echocardiogram is the diagnostic test of choice to confirm pericardial effusion.⁴ If echocardiography is operated by an experienced user, the specificity is >99%, while the sensitivity is 74-82%, depending on the cause. However, serial echocardiography increases the sensitivity of the echocardiogram⁵. If a mass is present in the heart, an echocardiogram can identify the mass; however this is dependent on amount of effusion and experience of the user.⁴

Pericardial fluid analysis and culture can help identify the possibility of the origin of the effusion.⁴ However, most of the fluid samples tend to be hemorrhagic, and tend to be non-diagnostic.⁵ If an infectious agent or lymphoma are the cause of pericardial effusion, then the fluid will yield a definitive diagnosis. Neoplasia is rarely diagnosed using only cytology, unless it is lymphoma. However, if the cytology suggest the cause is infectious or inflammatory, the fluid can be sent off for culture.⁷ Idiopathic pericardial effusion is a diagnosis of exclusion, meaning infectious, neoplastic, and cardiac causes have been ruled out. Fibrosis and inflammatory infiltrates are commonly found on post-mortem examination in patients with IPE. Additionally, IPE patients tend to have a thickened and non-elastic pericardium with no evidence of neoplasia.⁵

Treatment and Management:

Treatment for pericardial effusion starts with providing the patient oxygen therapy. Intravenous fluids, such as an isotonic crystalloid, should be started to improve perfusion and vascular volume.⁴ An emergency pericardiocentesis is indicated to treat cardiac tamponade by alleviating intrapericardial pressure. In cases that do not show clinical signs or echocardiographic signs, pericardiocentesis is not warranted. There are a few side effects associated with

pericardiocentesis, such as ventricular premature contractions, coronary artery laceration, and sudden death. Some pericardial effusion cases will resolve after having one or more pericardiocenteses performed.⁷

Medical treatment is rarely effective. Anti-inflammatory medication may be used to prevent fluid from reoccurring. Chemotherapy may be used in neoplastic causes of pericardial effusion.⁵

Surgery is the most commonly performed treatment for pericardial effusion. A pericardiectomy is a definitive treatment for IPE and a palliative treatment for malignant pericardial effusion⁷. Surgery to remove the pericardial sac is necessary to obtain a biopsy and to resect a mass of unknown origin. The resected pericardial sac should be sent to a veterinary pathologist for evaluation.¹

There are 3 methods of performing a pericardiectomy: subtotal, total, or a pericardial window. A subtotal pericardiectomy is incising ventral to both phrenic nerves, removing the majority of the pericardial sac. A subtotal pericardiectomy is usually curative in dogs with IPE. A total pericardiectomy is removing the pericardium as close to the base of the heart as possible while elevating the phrenic nerves from the pericardial sac. A pericardial window is removing only a part of the pericardium and the technique requires a minimally invasive surgical equipment. A pericardial window should be approximately 4-5 cm in diameter to prevent clinical signs. It is very important to submit the pericardium for culture and sensitivity and histopathologic evaluation in order to obtain a definitive diagnosis.³

A lateral thoracotomy for a subtotal pericardiectomy is the best approach to manage restrictive pericardial disease.⁵ While there are other treatment options such as thoracoscopy to create a pericardial window, this technique is used for minimally invasive exploration, and is

used in cases such as heart base masses and hemangiosarcoma.^{5,7} The advantage of a thoracoscopic procedure is that it decreases the morbidity rate versus a traditional thoracotomy. The main disadvantage of a pericardial window performed via thoracoscopy is the possibility that a small pericardial window could close over time.⁷

While creation of a pericardial window is potentially curative for IPE, the subtotal pericardiectomy approach is more commonly performed.⁵ If restrictive pericarditis is present, then a subtotal pericardiectomy must be performed to remove the constricting tissue of the pericardium. The advantage of an open thoracotomy is to remove the pericardium below the phrenic nerve, identify masses on the right atrium, and to allow for excising the right auricular appendage mass.⁷

In cases with a longer term prognosis, the goal is for drainage to occur from the pericardial fluid into the pleural space. This allows for improved lymphatic drainage and for the fluid to be reabsorbed in patients with reoccurring effusion. This will also prevent the recurrence of cardiac tamponade.⁷

Complications associated with performing a pericardiectomy include phrenic nerve transection, lung laceration, hemorrhage, or the development of arrhythmias such as atrial fibrillation or ventricular tachycardia that may be fatal. Hemorrhage can occur postoperatively if vessels are not cauterized or ligated.³

One study showed that pleural effusion was the most common complication seen immediately postoperative, but it resolved in all dogs by the 5th day postoperatively. Acute respiratory distress, without evidence of pleural effusion or significant pulmonary infiltrates, is suggestive of pulmonary edema or pulmonary thromboembolism. Oxygen could be beneficial in such cases. At this time, a thrombolytic agent can be used to help reduce the occurrence of

thromboembolism. Postoperative pain is treated with systemic opioids and local anesthetic techniques. A pericardial window that is too small may seal over and may allow for the remaining pericardium to adhere to the heart and cause a recurrence of pericardial effusion.³

Expected Outcome/ Prognosis:

Pericardial effusion usually returns unless surgery is performed to make a window into the pericardium or to remove the pericardium. Depending on the primary cause, prognosis for pericardial effusion can vary greatly. Congenital causes tend to have a more favorable prognosis; while neoplastic causes have a poorer prognosis, with an average survival time of 1 to 3 months. Traditionally, dogs that respond to a pericardiocentesis, initially, will have clinical signs that can reoccur, due to pericardial effusion. Aortic body tumors tend to grow slowly; therefore, the prognosis tends to be longer (129 days without a pericardiectomy, and 661 days with a pericardiectomy). Infectious causes have a guarded to good prognosis, while IPE has a good to excellent prognosis. There may be a spontaneous resolution after one or two pericardiocenteses, or the patient may require a pericardiectomy. In one study, one half of patients were still alive 1,500 days after being diagnosed with IPE, while another study reported a survival rate of 72% after 18 months.⁷ In a long term survival study of 23 dogs with pericardial effusion; 14 of the 23 dogs were diagnosed with IPE; 3 of these dogs were treated successfully with one pericardiocentesis, the remaining 11 cases had pericardial effusion reoccur, 6 of those with recurring pericardial effusion were managed with 2 to 11 repeated pericardiocenteses, and the remaining 5 cases were treated with a pericardiectomy. Of the 6 cases with repeated pericardiocenteses the median survival time was 5 years and 9 days.⁶

IPE dogs treated with subtotal pericardiectomy via thoracotomy had a significantly longer disease free interval and median survival time versus IPE dogs treated with a

thoracoscopic pericardial window procedure. The difference may be due to initial diagnosis or ineffectiveness of pericardial window to relieve signs of IPE long term.²

Surgical outcomes depend on the severity of the underlying disease. Pericardiectomy is palliative for neoplastic effusion and curative for idiopathic effusion. Dogs that undergo a pericardiectomy have a significantly longer survival time, approximately 661 days, versus dogs that were treated medically, approximately 129 days. The survival time of dogs greater than 18 months postoperatively was 72% in one study. In another study median survival time was approximately 15 months. One study revealed that dogs treated by a subtotal pericardiectomy live significantly longer versus dogs treated with a pericardial window technique, with the reasoning being unknown. There is thought that the sample size was too small for an accurate histopathology sample or the window was made too small to alleviate long term clinical signs. If pleural effusion develops greater than 30 days postoperatively, the effusion is associated with disease recurrence and has a poor survival rate.⁷ IPE dogs that received a pericardiectomy and were discharged from the hospital had a good prognosis for a complete recovery.¹

Conclusion:

While pericardial effusion is rare in dogs and cats, it can still occur. Pericardial effusion is usually seen in large breed, male dogs, approximately 6 years of age.^{4,8} It is important to distinguish the cause of the effusion in order to prevent the fluid from recurring. A subtotal pericardiectomy is the treatment of choice to treat pericardial effusion, in most cases.³ A subtotal pericardiectomy also provides a longer median survival time for many causes of pericardial effusion. Typically, if diagnosed in time, dogs with pericardial effusion tend to have a good prognosis, unless there is a neoplastic cause⁷.

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