Surgical Management of Idiopathic Chylothorax

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Introduction

Chylothorax is a primary (idiopathic) or secondary condition where chyle accumulates in the pleural space. This lecture will discuss the typical signalment and clinical signs, etiology, diagnostic plan including advanced imaging modalities, medical management and surgical intervention, anesthesia and post-operative care for patients with chylothorax. Pertinent veterinary literature and case examples will also be discussed.

Anatomy Review

The thoracic duct is the primary channel for return of lymph from most of the body. It begins in the sublumbar region as a continuation of the cisterna chyli (dilated retroperitoneal lymph channel that lies ventral to the lumbar vertebrae along the abdominal aorta). The thoracic duct travels dorsolateral to the aorta on the right in dogs and on the left in cats. It crosses to the left in dogs at the fifth or sixth thoracic vertebrae and terminates in the left external jugular vein. There are significant anatomic variations in the configuration and number of thoracic duct branches (there are over 20 reported variations in dogs!)

Signalment and Clinical Signs

There appears to be a predisposition for Afghan hounds and Oriental breeds of cats for the development of chylothorax. No age range appears to be overrepresented (reports are from months to years old).

Duration of clinical signs can be range from days to months. Typical historical findings include lethargy, decreased appetite, tachypnea/dyspnea/persistent panting, weight loss, cough, exercise intolerance and vomiting. Physical exam findings are typically characteristic of pleural effusion; muffled cardiac sounds and thoracic auscultation ventrally with a restrictive breathing pattern. Other clinical signs may be detected depending on the presence of a primary cause.

Etiology

The pathogenesis of chylothorax is thought to occur secondary to decreased drainage of the thoracic duct into the venous system and/or increased lymph burden within the lymphatic system. It can also result from any condition that increases hydrostatic pressure in the cranial vena cava. Potential causes of chylothorax include: cardiac disease (specifically right sided), cranial mediastinal masses (lymphoma, thymoma), heartworm, fungal granulomas, thrombosis of the caudal vena cava, congenital abnormalities (i.e. peritoneal pericardial diaphragmatic hernia), trauma, lung lobe torsion, neoplasia and idiopathic. Often, an underlying cause cannot be identified and the disease is considered idiopathic. In chronic cases, patients may develop fibrosing pleuritis, which restricts pulmonary expansion even with successful therapeutic thoracocentesis.

Diagnostics

Definitive diagnosis of chylothorax is made from analysis of the pleural effusion however a full patient workup is recommended (complete blood count, serum chemistry panel, urinalysis, heartworm test, thoracic radiographs, abdominal ultrasound, echocardiogram, pleural fluid analysis and pleural fluid culture/sensitivity). Chyle is an opaque fluid absorbed by the intestinal lacteals during digestion and consists of lymphocytes, proteins and triglycerides with chylomicrons. Grossly, it is milky white or white with a pink hue ("strawberry milkshake"). The protein count is typically between 2.5-4 g/dL with cell counts less than 7000/uL (modified transudate). The definitive diagnosis comes from the triglyceride count in the fluid vs. the serum triglyceride count. With chylous effusions, the triglyceride concentration is higher and cholesterol is lower in the effusate as compared with serum.

Advanced Imaging

For the surgeon, it is imperative to know where the least number of thoracic duct branches are located, so that ligation may be performed in the area with the fewest branches to maximize not missing branches and therefore surgical success. Preoperative imaging, specifically, lymphangiograms help identify the number and location of these ducts. The popliteal and mesenteric lymph nodes are typically utilized for these imaging studies. Access to the popliteal lymph node is easier than catheterization of a mesenteric lymph node (however, a study by Enwiller in 2003 showed that the mesenteric lymph node was better). For imaging, can either do serial radiographs or computed tomography (Singh et al in 2011 showed that a significantly greater number of thoracic duct branches were observed with CT).

CT lymphangiogram utilizing the popliteal lymph node is my method of choice. First, a CT scan of the patient is performed from mid abdomen to the thoracic inlet. The purpose of this scan is to look for primary causes or evidence of comorbidities. Then, a small

surgical approach to the popliteal lymph node is made to ensure isolation and successful injection of contrast medium (Iohexol). Immediately after a slow injection, a post contrast CT is obtained from mid abdomen to the thoracic inlet. Using these images, the area in which the least number of thoracic ducts is identified in the caudal thorax. Thoracic lymphangiectasia is very common with idiopathic chylothorax and appears as a "birds nest" of contrast filled lymph ducts in the cranial thorax.

Treatment

Treatment options consist of medical management and surgical intervention. Medical management is not highly successful and because there are many potential surgical treatments it suggests that none carries a definitive, curative therapy. Management may include a low fat diet in an attempt to decrease the fat in the fluid and increase fluid absorption from the pleural space. Benzopyrones have been used to treat edema in humans have been attempted in veterinary patients with chylothorax. Rutin (a benzopyrone) is the most popular in veterinary medicine and its proposed mechanism is to stimulate protein breakdown and removal in lymphatic vessels, reducing leakage from vessels and increases macrophage phagocytosis of chyle (dose 50 to 100 mg/kg PO q8hr). Their efficacy has not been shown but treatment is benign. Octreotide has been anecdotally to result in a cure in some veterinary patients however patients on this medication need careful monitoring during treatment. Medically managed patients need to be monitored for the development of fibrosing pleuritis, which may be more common in cats. If after several weeks, medical management has failed, surgical intervention is recommended.

The goals of surgery are the decrease the flow of lymph through the thoracic duct and promote formation of alternate lymphaticovenous drainage routes (the available evidence for this is conflicting, however). Surgery involves thoracic duct ligation plus another technique to achieve the highest success rates. The combination of thoracic duct ligation plus pericardectomy carries an 80-100% success rate and has some of the highest success rates reported in dogs and cats with idiopathic form of chylothorax. If the pericardium is thickened, this may limit the diastolic filling of the right side of the heart which can increase right atrial and central venous pressure. Allman et al in 2010 reported an 86% success rate in dogs with idiopathic chylothorax and only a 40% success in dogs with non-idiopathic chylothorax. Thoracic duct ligation with cisterna chyli ablation appears to have similar success rates to thoracic duct ligation and pericardectomy. Omentum can be utilized by tunneling through the diaphragm or the subcutaneous space. Theoretically, the increased intrathoracic venous surface area provided by the omentum may allow absorption of chyle and also may help seal leaky lymphatics. Pleurodesis is an effective technique in humans, but has not been of use in dogs (obliteration of the pleural space by forming an adhesion between the visceral and parietal pleura).

During a thoracoscopic or open approach to the thoracic duct, a separate abdominal approach (paracostal) is made and a mesenteric lymph node is isolated and injected with

dilute methylene blue to aid in identification of the thoracic duct. The thoracic duct is approached through the previously identified intercostal space and isolated from the nearby descending aorta and intercostal arteries. Ligation and transection is achieved through a combination of hemoclips or endoclips (if thoracoscopy) and Ligasure. An additional injection of methylene blue into the mesenteric lymph node can be made while visualizing the transected thoracic duct for evidence of leakage. If a CT lymphangiogram was not performed preoperatively, an "en bloc" ligation can be performed which includes everything dorsal to the aorta and ventral to the sympathetic trunk, including the azygous vein to attempt to include all thoracic ducts in the most caudal aspect of the thorax. Repeat injection with methylene blue is still recommended to ensure that all the ducts have been included and no leakage is observed. Following the thoracic duct ligation, a subtotal pericardectomy +/- cisterna chyli ablation is performed. Samples of the pericardium should be submitted for histopathology and culture/sensitivity. Depending on the anticipated success, a PleuralPort® can be placed for long term management at the time of surgery. These resemble vascular access ports, except for the tubing enters the pleural space and the port is within the subcutaneous tissues on the lateral thorax. Regardless, the patient is recovered with thoracostomy tubes (prefer Mila small bore chest tubes or Jackson Pratt drains) and the effusion is monitored daily with a paired serum sample for triglyceride levels. If successful, the volume of pleural effusion will dramatically decrease and importantly, the triglyceride level in the pleural effusion will be less than the serum triglyceride level.

Anesthesia

Regardless of the approach, the goals of anesthesia should be to maintain adequate ventilation and multimodal analgesia. Monitoring should include heart rate, respiratory rate (with capnography), pulse oximetry, blood pressure monitoring and temperature. Due to the intensity of these cases, direct arterial blood pressure and the ability to perform blood gas analysis is recommended. If thoracoscopy is chosen, one-lung ventilation can aid in keeping the surgical site of interest more visible during dissection. This requires special equipment and continuous monitoring. Typical analgesia protocols consist of an opioid as a premedication and continuous rate infusion during the procedure combined with either ketamine and/or lidocaine. Intercostal nerve blocks with bupivacaine are performed prior to entering the thoracic cavity. Postoperatively, bupivacaine can be sterilely infused into the thoracostomy tube or through a wound diffusion catheter. A well balanced analgesia plan will maximize ventilation in the postoperative period.

Post-operative Care

Post-operative care should focus on analgesia, chest tube monitoring/care and maintaining adequate ventilation. Typically, a continuous rate infusion of fentanyl and ketamine with a wound diffusion catheter instilled with bupivacaine is an appropriate starting point for most patients. The chest tube is aspirated frequently in the first few hours after surgery to remove any residual air and fluid. Then, chest tube aspiration frequency can decrease

as the volume of pleural effusion decreases. Approximately 24 hours after surgery, a paired triglyceride level (pleural fluid to serum) will be performed to evaluate the success of the procedure. This is performed daily until we are confident that the triglyceride level has dropped and the volume of the pleural fluid has plateaued. There is no "hard and fast" rule as to when the chest tube is to be removed. It depends on the fluid production/volume (typically wait for it to plateau), fluid cytology, and triglyceride level. If the patient has been fitted with a PleuralPort®, the patient may be discharged with intermittent outpatient monitoring.

Once the chest tube has been removed and the patient discharged, activity restriction is for two weeks. If blood work and anesthesia were uneventful and the patient has no history of recent steroids, non-steroidal anti-inflammatories are appropriate additions to typical opioid administration.

Complications

Complications associated with the treatment of chylothorax include persistent chylothorax, persistent nonchylous pleural effusion, lung lobe torsion, and pneumothorax. For those cases with recurrent effusions, options include percutaneous drainage (PleuralPort®), pleuroperitoneal shunts and medical management (low fat diets, Rutin). Additional CT's/lymphangiograms are not typically recommended for routine follow-up however if a patient continuous to have chylous effusion, additional scans to look for additional lymph ducts would be suggested.

Prognosis

With ligation of the thoracic duct combined with pericardectomy +/- cisterna chyli ablation success rates reported between 50-100% (for idiopathic chylothorax). Non-idiopathic cases in general have a much lower success rate, only around 40% (except for trauma, which typically resolves within 1-2 weeks after placement of thoracostomy tubes). If cases are chronic and have evidence of sclerosing pleuritis, lung expansion and a functional return to normal activity may not be possible. Therefore these patients have a guarded prognosis. Patients with chronic effusions may be at higher risk for lung lobe torsion in the future.

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