CHYLOTHORAX
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Chyle is the term used to denote lymphatic fluid arising from the intestine which contains a high quantity of fat. Chyle is usually transported to the venous system by a network of lymphatic vessels in the mesentery. These lymphatics arborize into the cisterna chyli, a large dilated sac that lies adjacent to the aorta at L1 to L4 vertebrae. The thoracic duct is the cranial continuation of the cisterna chyli and is generally said to begin between the crura of the diaphragm. It runs adjacent to the aorta on the right side in the dog, and in the cat on the left side between the aorta and the azygous vein.

The duct terminates in the venous system of the neck, left external jugular vein or even directly in the cranial vena cava.

Chylothorax is an infrequent condition in cats and dogs in which chyle accumulates within the thoracic cavity. The condition can pose a therapeutic challenge as the pathophysiology of chylothorax in cats and dogs is poorly understood. Early reports of the disease suggested that chylothorax most commonly resulted from a defect in the thoracic duct, usually secondary to trauma. Recent research has challenged this conjecture and for the majority of cases of chylothorax, an underlying disease process is never identified, and therefore the condition is considered idiopathic.¹

The incidence of chylothorax in the Afghan breed of dogs is inordinately high but it is unknown if this predisposition is hereditary.² Lung lobe torsion is also overrepresented in that breed, many of them have chylous effusion at the time of diagnosis or just a few days after removal of the torsioned lobe.³ It is speculated that lymphangiectasis may allow extravasation of chyle through the lymphatic vessel wall. Malignancies or thrombosis that occludes the cranial vena cava might induce chylothorax by such a mechanism.

Mediastinal lymphangiosarcoma has been diagnosed in dogs with chylothorax and even chyloabdomen. The chaotic, irregular anastomotic plexuses of neoplastic vessels associated with mediastinal lymphangiosarcoma probably contributes to chronic lymphatic obstruction.¹ Elevation in systemic venous pressure secondary to congestive heart failure likely explains why chylothorax occurs with cardiomyopathy, tricuspid dysplasia, heartworm disease and other conditions affecting the heart.

Regardless of the cause, chylothorax is a potentially devastating disease. The basal rate of lymph flow in the thoracic duct of dogs has been estimated to be 2 ml/kg/hr. This rate varies depending on diet and is higher after a high fat meal. Sixty to seventy percent of all ingested fats are directed to the blood stream by way of the thoracic duct. This duct is also the main pathway for protein transport from the capillary spaces to the venous system. Consequently chylothorax results in compromised respiration and debilitation because of large amounts of protein, fats, fat-soluble vitamins and lymphocytes in the pleural cavity. Electrolyte abnormalities may occur in animals with chylothorax; hyperkalemia and hyponatremia have been noted in dogs with experimental and spontaneous chylothorax undergoing numerous thoracocentesis.⁵

Immunocompetence becomes impaired due to loss of antibodies, lymphopenia and malnutrition. Another potential effect of persistent chylous effusion is the development of constrictive pleuritis, especially in cats where it has been reported.⁶ The cause of constrictive pleuritis associated with feline chylothorax is unknown. Presumably effusions are irritating to the pleura and constrictive pleuritis is probably the end stage of a response to severe long-standing inflammation.

DIAGNOSIS

Diagnosis of chylothorax is based on recognition of characteristic clinical and radiographic findings of pleural effusion and by demonstration of chyle on fluid analysis. Chylous fluid typically has triglyceride levels that are 12 to 100 times greater than levels measured in the serum in samples collected at the same time. Cholesterol levels in chylous effusions are not elevated when values are compared to values in serum. Anorectic animals with chylous effusions may have greatly reduced levels of chylomicrons. Pleural fluid from such animals may easily be mistaken for a modified transudate or obstructive effusion. Feeding a fatty meal is often necessary to demonstrate the chylous nature of a pleural effusion in these animals. Pleural effusions high in cholesterol or lecithin-globulin complexes appear grossly similar to chylous effusions but are due to degenerating cells associated with chronic inflammatory or malignant processes. These effusions are termed pseudochylous effusions. These may be low in triglycerides and may have a high cholesterol level.

Handling animals with chylothorax can be problematic, especially with cats. During radiographic procedures, minimizing manipulation and stress by taking dorsoventral rather than ventrodorsal views, and standing lateral views may be necessary to prevent further compromise of respiration. Supplementing oxygen by face mask during the procedure may also be beneficial. In severely dyspneic cats it is best to remove fluid by needle thoracocentesis before taking radiographs. A small gauge butterfly system works well. Removal of even small amounts of pleural effusion may greatly improve the cat’s ability to ventilate. Animals that remain dyspneic following removal of pleural fluid should be suspected of having underlying pulmonary parenchymal or pleural disease such as fibrotic or constrictive pleuritis.

Given the multitude of diseases associated with chylothorax, further diagnostic evaluations, including radiography, ultrasonography, fluid culture and sensitivity and echocardiography are recommended to identify an underlying primary disease condition. If no underlying pathology is identified, the diagnosis of idiopathic chylothorax is made.
TREATMENT

Medical Management

Medical management should be considered if trauma is suspected or before surgery in idiopathic cases. Medical management involves evacuation of the pleural space with a thoracostomy tube and supplementation with fluids and electrolytes, which are depleted. Although a low fat diet has been recommended in the treatment of chylothorax, it has not been shown to decrease thoracic duct flow. Some believe that although flow rate is not affected, lymph with a reduced lipid content may be more readily absorbed. Medium-chain triglyceride supplementation has been advocated in the past but recent evidence shows that medium-chain triglycerides are carried in the thoracic duct lymph and supplementation is no longer indicated. Benzopyrones (rutin at a dose of 50 mg/kg administered orally three times daily) have been recommended to stimulate macrophages to break down proteins and promote reabsorption of lymph. The effectiveness of that drug is still not clear. Rutin is a flavone derivative extracted from the fruit of the brazilian Fava d’Antra tree (Dimorphandra).

Surgery

Absolute indications for surgical intervention are not established in animals. The following indications for surgery are suggested:

1. Failure to significantly diminish the flow of chyle after five to ten days of medical management,
2. Losses of chyle exceeding 20 ml/Kg/day over a five day period, or
3. Protein-calorie malnutrition and hypoproteinemia.

Once the surgical decision is made, a lymphangiography should be done in order to recognize at what point of the caudal thorax the thoracic duct is single, because when ligating we must not miss any branch that could perpetuate chyle circulation toward the cranial thorax.

The list of possible surgical options to treat chylothorax include:

1. Thoracic duct ligation, which will be described here.
2. Pleurodesis
3. Active pleurovenous and pleuropitoneal shunting.
5. Omental pedicle drainage.

It must be remembered that there is a difference in the surgical approach in dogs and cats with chylous effusions because chyle is transported from the intestine to the venous system via the thoracic duct on the right side in dogs and on the left side in cats. Because of the anatomical differences in location, the thoracic duct is approached through a right thoracotomy in dogs and a left thoracotomy in cats, at the 10th or 11th intercostal space. In cats, it is also possible to approach the surgical site through cranial abdominal.

In surgical cases, I have performed duct ligation previously identified by means of methylene blue dye injected into a mesenteric lymphatic vessel or a lymph node, but there are surgeons who prefer in-block ligation of mediastinal tissues dorsolateral to the aorta.

Thoracic duct ligation has reported a success rate of no more than 59% in dogs and substantially less in cats. The less than ideal success rate with thoracic duct ligation has prompted the development of numerous techniques as the aforementioned.

After thoracic duct ligation, numerous lymphaticovenous anastomoses are formed which transport chyle to the venous system from abdominal lymphatic vessels.

The advantage of thoracic duct ligation over other techniques is that it completely stops chyle leakage and accumulation in pleural cavity. Disadvantages are that surgical operating time is quite long, possibly chylous or non-chylous effusion can reaccumulate after surgery, and lymphangiography could be bothersome to perform, especially in cats.

Without mesenteric lymphangiography, one cannot be sure at all if the duct was ligated, but even when performing it we could get false positives, that is, it could appear to have been ligated but still some little branch could remain permeable.

Preoperatively, the animal is fasted for 12 hours and only 2 or 3 hours before surgery cream or oil is fed to help detection of mesenteric lymphatic vessels. To perform mesenteric lymphangiography, the dog is placed in left lateral recumbency and a right paracostal incision is done. The caecum is exposed and careful dissection of the mesentery is undertaken to find a lymphatic vessel. It will be catheterized with an over-the-needle catheter 20-22 gauge and an extension tube is connected that was previously filled with heparinized saline. The catheter is fixed with a 3-0 silk suture around the lymphatic vessel. Contrast medium is diluted at a rate of 1 ml/kg in 0.5 ml/kg of saline. Contrast agents like iohexol or similar other agents are suitable. As the last milliliter of contrast medium is being injected, a lateral thoracic radiograph is taken to visualize the thoracic duct. Then, an intercostal thoracotomy through the 8th, 9th or 10th intercostal space is done, depending on where the duct is single or not.

To improve thoracic duct perception, methylene blue can be injected in the lymphatic catheter through the extension tubing. No more than 0.5 or 1 ml of methylene blue is diluted in saline.

Duct ligation is done with silk 2-0 or 3-0, or even using haemostatic clips.

Again, a radiograph is obtained after ligation as contrast medium is being injected through the extension tubing to ensure there is no contrast medium opacifying the duct farther than the ligature site.

The thorax is closed in a routine manner, the lymphatic catheter is dislodged and the abdomen is closed. It is advisable to place a thoracostomy tube for a few days and observe and remove the potential effusion.
I find pleuroperitoneal or pleurovenous active shunting somehow complex to handle by owners and most of them will not be willing to accept the risk of complications such as thrombus formation, continuous heparinization and laboratory control that coagulation status would demand.

Treating chylothorax in cats can be a little more complicated and failure to stop chyle formation happens more often than in dogs. In my experience, omentalandization, duct ligation and also pericardiectomy in the same animal has yielded good results.

In cats, constrictive pericarditis can cause a diminished venous return to right atrium. This condition is very difficult to assess and cardiac catheterization is necessary for a precise diagnosis, so when performing surgical treatment of feline chylothorax, pericardiectomy can help prevent relapse of chyle accumulation.

In general, cats with cardiac disease are prone to chylous pleural effusion. Omentalization has proved very useful to promote clearance of chylous thoracic effusion. The omentum has many properties that render it useful in a variety of veterinary surgical procedures, including prostatic abscessation, treatment of large and chronic nonhealing wounds, vascular surgery and gastrointestinal surgery. The omentum contains aggregates of lymphoid tissue that have direct contact with the peritoneal cavity and provide efficient lymphatic drainage. These lymphatics eventually drain in the subpyloric and splenic lymph nodes and into the thoracic duct to reach systemic circulation. The omentum serves as a physiological drain in the treatment of chylothorax. However, the chyle goes back to the thoracic duct so an alternative explanation for the role of the omentum in resolving chylothorax is that the angiogenic and adhesion-forming properties of the omentum stimulates healing of the source of seepage. So far, the true function of the omentum in chylothorax remains unknown.

The combination of these three procedures can be a good alternative to promote a satisfactory outcome for chylothorax in cats.

References