Signalment: “Bandit” 4 yr old MN French Bulldog

History: Bandit presented to VMSG Emergency service for a 2-day history of anorexia and sudden onset of vomiting, which was later determined to include some episodes of regurgitation. Past history was unremarkable aside from occasional self-resolving short periods of inappetance.

Clinical Exam: On presentation the patient was bright, alert, and responsive and TPR was within normal limits. Physical Exam was largely unremarkable aside from muffled heart sounds along with marked referred upper airway noise. The patient was witnessed to regurgitate in the hospital following evaluation.

Laboratory Findings: CBC and Chemistry performed on presentation were within normal limits aside from a mild elevation in phosphorous of 6.7 (2.9-6.6).

Diagnostic Imaging:
Radiography: Thoracic and abdominal radiographs performed showed severe enlargement of the cardiac silhouette with superimposition of small intestines along the ventral and cranial margins as well as paucity of abdominal viscera caudal to the diaphragm. Herniation of small intestines and liver into the pericardial sac was suspected based on imaging.

Diagnosis: Peritoneopericardial diaphragmatic hernia (PPDH)

Treatment/Management: Following initial presentation Bandit was discharged on Sucralfate 1g slurry PO TID, Omeprazole 20mg PO q 24h and a soft-food diet to treat symptomatically for regurgitation. A surgical consultation was recommended to discuss recommendations regarding surgical correction of PPDH.

Bandit presented to the VMSG surgery service 3 days later at which time vomiting had resolved but regurgitation was persistent with an average of 3 episodes daily. Additional history obtained from the owner revealed a chronic, non-progressive exercise intolerance and an occasional cough. After discussing risks and benefits of surgery with the owner, surgical repair of PPDH was elected. Herniorrhaphy to repair PPDH was performed and 3 liver lobes, the gall bladder, the majority of the small bowel and a portion of the spleen were all found to be traversing the rent into the pericardial sac. The abdominal viscera were evacuated from the pericardial sac and herniorrhaphy was performed without complication. The patient was maintained on a mechanical ventilator throughout the procedure to prevent hypoventilation.

Post-operative care: Bandit recovered in oxygen overnight and was successfully weaned off oxygen the following morning. He did develop an increased respiratory rate and hypertension overnight and FAST scan revealed pericardial effusion. Further evaluation the next morning revealed fluid and air in what was later confirmed to be the enlarged pericardial sac. A Mila chest tube was placed and 120mls of hemorrhagic fluid (PCV 38%) was evacuated. Radiographs to confirm tube placement showed the tube in place in a markedly enlarged pericardial sac. Yunnan Baiyao (the red pill) was administered to aid in reduction of ongoing hemorrhage. No
further accumulation of fluid in the pericardial sac was appreciated on serial follow-up ultrasounds and the tube was pulled the following day. Bandit did continue to regurgitate several times a day for the three days following surgery and had not regurgitated for the last 24 hours at the time of discharge 4 days following surgery. The patient was discharged on Tramadol 2.7 g/kg PO q8-12 hr x 2 weeks, Famotidine 0.5 mg/kg PO BID indefinitely, Cerenia 2mg/kg PO q 24h x 2 days, Sucralfate 500mg slurry PO q 8h and Acepromazine PRN.

Bandit returned for a recheck 3 weeks following surgery and was doing well. He had regurgitated occasionally at home but had not regurgitated for 1 week prior to recheck.

**Discussion:** PPDH is a solely congenital condition caused by embryologic malformation of the septum transversum (ventral portion of diaphragm) and possibly the pleuropertitoneal folds (from dorsolateral diaphragm) resulting in communication of the pericardial and peritoneal cavities allowing herniation of cranial abdominal contents (3). Prevalence of PPDH in dogs in one study was reported to be 0.015% (2) and Weimaraners have been noted to be over-represented (2).

The patient in this case study presented with GI signs (inappetance, vomiting, regurgitation) which is consistent with previously reported trends for dogs to present most commonly with GI signs whereas cats present more commonly with respiratory signs (1). Dyspnea is one of the most common clinical signs in both dogs and cats (2), however it is difficult to evaluate if dyspnea related to PPDH was present in this patient due to concurrent brachycephalic syndrome creating an overlying reason for dyspnea in this patient.

The patient did have a long-time history of exercise intolerance, which has also been previously noted in a dogs diagnosed with PPDH (1, 2).

The mean ages of diagnosis in dogs that have been previously reported are 1.2 years (2) and 2.5 years (1). Our patient was 4 years of age, which is higher than the mean but within the upper limit of the range reported in the 2 most recent studies including dogs (1, 2). Prior to 2010, only one report had looked at postoperative mortality associated with surgical repair of PPDH and the study only evaluated cats. This mortality rate was reported to be 14% (5). Since then, two studies have evaluated outcomes of surgical correction of PPDH in dogs. Short-term mortality of dogs undergoing surgery was 12.5% in one study (2) and 8.8% including dogs and cats in another study (1). Postoperative complications previously reported have been generally uncommon and usually considered minor (1, 2). Hemorrhagic pericardial effusion has not been previously reported in dogs or cats. Intraoperative hemorrhage has been reported in cases where adhesions were present on the myocardium (1) or between the liver and pericardium (2). Since the hemorrhagic pericardial effusion resolved in this patient following pericardiocentesis and Yunnan Baiyao administration, further evaluation to determine the source of hemorrhage was not indicated.

The most recent 2013 study evaluating outcome did not find any significant difference in long-term outcome between dogs and cats or between surgically and non-surgically treated PPDH (2). The general conclusion based on recent literature is that patients with signs attributable to PPDH are good candidates for surgical herniorrhaphy and conservative management for patients without clinical signs where PPDH is an incidental finding can do well with conservative management (2, 5).

**References:**

**Figures:**

Figure 1: Right lateral radiograph of thorax showing enlargement of cardiac silhouette and visible bowel loops cranial and ventral to the heart consistent with PPDH.

Figure 2: Intraoperative photograph of small bowel and spleen entering the pericardial space through the PPDH.