NOTE *Wildlife Science*

Gastric Dilitation-Volvulus in a Red Panda (*Ailurus fulgens*)

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ABSTRACT. A 10-year-old male red panda presented acutely with symptoms of shock due to acute abdominal distress and respiratory compromise. Abdominal ultrasound confirmed a severely distended stomach for which passage of an orogastric tube for relief was unsuccessful. Intra-operatively, the stomach was found to be distended and torsed around its long axis supporting the diagnosis of Gastric dilitation-volvulus (GDV). The animal arrested and died intra-operatively and was submitted for necropsy with lesions supportive of the diagnosis of GDV. No risk factors for GDV were found to correlate between the panda and those described in domestic dogs. This case suggests that red pandas can be susceptible to this condition in captive settings.
KEY WORDS: *Ailurus fulgens,* gastric dilitation-volvulus, Red Panda, torsion.

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Gastric dilitation-volvulus (GDV) is a common condition in domestic dogs yet is rarely described in zoological collections. Amongst non-canids, reports of GDV have been documented in the domestic cat (*Felis catus*), jaguar (*Pathera onca*), sun bear (*Helarctos malayanus*), polar bear (*Ursus maritimus*) and guinea pig (*Cavia porcellus*) [1, 3, 6, 9, 10]. GDV has been associated with concurrent disease unrelated to the gastrointestinal system and is believed to have a multifactorial etiology and complex pathophysiology [5]. In the domestic dog, risk factors for GDV include large breed status, advanced age, rapid eating speed, aerophagia or eating from an elevated position [7, 8]. The GDV syndrome consists of rapid gas accumulation in the stomach, ventrolateral rotation of the gastric fundus, impaired eructation or gastric emptying, and resulting shock and cardiorespiratory collapse [5].

A 5.4 kg, 10-year-old, adult, male Red Panda (*Ailurus fulgens*) presented in acute abdominal distress and protracted foamy vomiting. The animal had no previous history of abdominal disease and was noted to be eating and behaving normally approximately 2 hr prior to presentation. The animal had a previous history of gingivitis and had been noted to have passed a large amount of mucus in the feces, as has been reported in other captive red pandas, approximately nine months prior to presentation. The panda was current on vaccinations for Rabies (Imrab 3, Merial, Athens, GA, U.S.A.) and Canine Distemper (PureVax, Merial) and maintained on monthly ivermectin heartworm preventive (Ivomec, Merial, 0.05 mg/kg). Upon presentation, the Panda was severely depressed with pale mucus membranes, slow capillary refill time (4 sec), a severely distended abdomen and pronounced dyspnea. Due to the severity of shock, only manual restraint was required for hands-on examination. Immediately upon presentation, supplemental oxygen was provided by facemask and intravenous catheter access obtained in the right cephalic vein. Intravenous fluids (Normosol-R, Hospira Inc., Lake Forest, IL, U.S.A.) were immediately begun at a rate of 550 m*l*/hr (100 m*l*/kg/hr).

Abdominal ultrasound revealed a large, gas distended stomach with large amounts of free abdominal fluid. Gas in the stomach attenuated ultrasonic view of other abdominal viscera. A 20 gauge catheter was inserted on the ventral midline just cranial to the umbilicus for abdominocentesis. Ultrasound was used to confirm placement of the needle in free fluid. Approximately 500 m*l* of pink, turbid fluid with a sweet odor was collected and submitted for analysis. Based on the suspicion of GDV and possible gastrointestinal perforation due to the unusual color and odor of the fluid, exploratory laparotomy was performed. Analysis of the abdominal fluid revealed a proteinaceous fluid (Specific Gravity 1.026, TP 4.2 g/d*l*) with approximately 660 nucleated cells/μl(fluid PCV, 2%). Nucleated cells consisted of macrophages with few mesothelial cells and lymphocytes with moderate numbers of large extracellular rod shaped bacteria. Repeated attempts at gastric decompression via stomach tube were performed, but passage through to the cardia through the esophageal sphincter was unsuccessful. Due to the severe respiratory distress, needle gastrocentesis was performed using a 20 g over-the-needle polypropylene catheter. Large amounts of gas were expelled with a notable reduction of abdominal size and decrease in respiratory effort.

The panda was intubated and placed on sevoflurane (Petrem, Piramal Healthcare Ltd., Boise, ID, U.S.A.) for surgery. The panda was clipped and prepped for surgery, and a ventral midline incision was performed. Upon entering the abdomen, the stomach was found to be distended and torsed

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approximately 270 degrees on its long axis (Fig. 1). Replacement of the stomach into the normal anatomical alignment relieved the gas distension and allowed passage of a stomach tube for removal of stomach contents. Approximately 30% of the serosal surface of the stomach possessed a dark red discoloration (hemorrhage) with additional hemorrhage within the omentum. The base of the spleen was also enlarged and dark red with a clear line of demarcation present at midpoint between healthy and affected spleen. Following the replacement of the stomach into normal anatomic position, the panda became bradycardic and unresponsive to changes in anesthesia. Approximately 5 min following stomach replacement, the panda arrested and did not respond to cardiopulmonary resuscitation and two iterations of epinephrine (IMS Limited, SO EL Monte, CA, U.S.A., 1 mg/m*l*) and atropine sulfate (Med Pharmex, Pomona, CA, U.S.A., 0.54 mg/m*l*) given five min apart.

Gross necropsy examination confirmed the observations and lesions noted in surgery. On histologic examination, the stomach possessed severe hemorrhage and edema in the submucosa with similar hemorrhage and loss of enteric glands in the mucosa. A gastric infarct with severe hemorrhage was diagnosed. In addition to the stomach, a section of spleen possessed organized thrombi and severe congestion along with a section of liver, which also displayed congestion and loss of hepatic cords (Fig. 2). The pancreas also contained multifocal hemorrhage and marked edema in the local connective tissues. Although no evidence of rupture in the gastrointestinal tract was found at necropsy, evaluation of the abdominal fluid obtained prior to surgery was suggestive of an organ perforation based on the presence of extracellular bacteria and fibrous material within the sample. In addition to these findings, a focus of pyogranulomatous inflammation due to a gram positive, acid-fast negative filamentous bacterium was noted within one lymph node. Further, evidence of fibrosis and suppurative inflammation was found in the lungs, indicative of a previous pneumonia.

Clinical, necropsy and histologic findings in this case support the diagnosis of Gastric dilitation-volvulus in this Red Panda. It is important to note that other necropsy findings (prior pneumonia, infectious processes) may have played a role in the rapid decompensation seen in this case or predisposed the panda to GDV. Concurrent disease has been associated with GDV in domestic felids with diaphragmatic hernia being the most important risk factor [6]. Acute emergent conditions like GDV are more problematic in zoo collections given the likelihood of animals to mask the signs of disease, and the advanced state of disease animals may be in prior to presentation. It is important to note the timeline in this case with signs appearing to progress from clinically normal to moribund within approximately 2 hr.

The management of GDV in domestic dogs centers on stabilization of the initial abnormalities to facilitate surgical correction. In this case, surgery was initiated as splenic ischemia, and progressive gastric necrosis was deemed to be imminent and survival unlikely if both occurred. Due to the rapid decompensation, it was unlikely surgery would have resulted in a favorable outcome. In this case, devitalized regions of the stomach and surgical appearance of the spleen would likely have resulted in partial gastrectomy and splenectomy had the patient survived surgery. Both partial gastrectomy and splenectomy, as well as hypotension and possible sepsis, which were highly likely in this case, are all associated with decreased survival in dogs [2]. Further, dogs presenting in a recumbent or comatose state were shown to have significantly higher mortality rates as might be expected [2]. Reperfusion injury was also likely and has been described as a component of the GDV pathophysiology [5]. De-rotation of the stomach releases oxygen-free radicals and inflammatory mediators into the circulation causing widespread tissue injury, which can contribute to disseminated

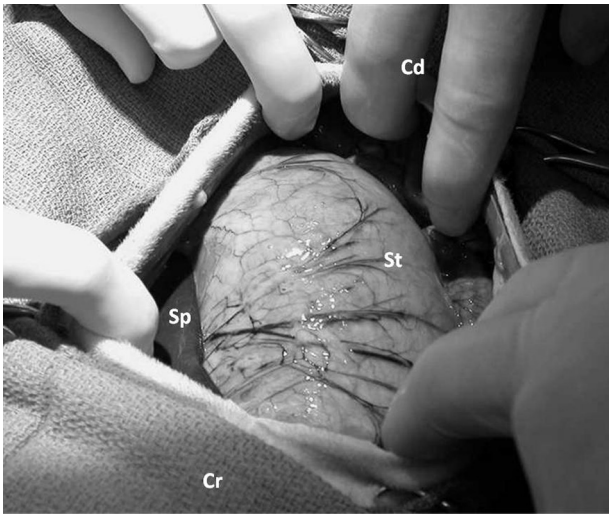

Fig. 1. Intra-operative view of the stomach (St) showing torsion which resulted in the rotation of the spleen (Sp) back to the left side of the abdomen. (Cr − Cranial, Cd –Caudal).

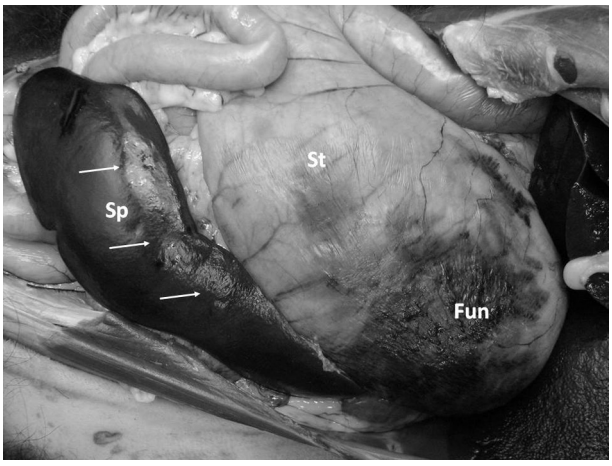

Fig. 2. Gross necropsy images of the stomach (St) showing regional hemorrhage in the fundic region (Fun) and the spleen (Sp) with a prominent line of demarcation between healthy and affected spleen (arrows).

intravascular coagulation and death. The rapid decompensation following de-rotation of the stomach suggests this may have been a factor in the panda's death. Cardiac arrhythmias, which are present in many cases of GDV in domestic dogs, were not observed in this case.

Early detection of GDV in canine cases is related to better clinical outcomes; however, if the clinical course of the disease is exceedingly rapid, detection in time to intervene may be problematic. Certainly, if the disease occurs with any frequency in wild populations, it is unlikely to be detected due to behavior and the rapid course if other occurrences proceed with the same pattern. What is concerning in this case is the rapid progression from initial onset of clinical signs to shock and decompensation. Clinical signs for greater than 6 hr in dogs have been associated with decreased survival, and the rapid course in this case raises fear that the pathophysiology of the disease may be more aggressive in this species, although additional cases would be required for confirmation [2].

The events of this case did precipitate an evaluation of the risk factors for GDV in the management of this panda, as they relate to the accepted risk factors for GDV amongst domestic canids. Pandas were fed a combination of bamboo, Marion Leafeater Lemur biscuits (Marion Zoological, Plymouth, MN, U.S.A.) and various fruits. Panda management did not include any feeding practices related to once daily or elevated feeding, which has been documented as a risk factor for GDV in dogs [8]. Reports of diaphragmatic hernia as a risk factor for GDV in cats have been explored, however, no history of this condition was present in this case, nor was any diaphragm pathology present at necropsy [6]. Advanced age as a factor has also been noted, yet in this case the patient was of middle age. An association has also been hypothesized between GDV and Inflammatory Bowel Disease (IBD), noting that dogs with histological evidence of IBD appeared to be at a higher risk for the development of GDV [4]. Previous reports in the animal's history relating to mucus filled stools could suggest that low grade IBD may have been present in the past, however, no active lesions were described on histology that would suggest this was a factor in this presentation.

This incident suggests that Red Pandas may be susceptible to GDV although similarities in pathophysiology and specific risk factors in common with those seen in domestic canids cannot be definitively determined from this single case. The progression in this case appears to follow a rapid course, warranting vigilance and close observation on the part of caregivers, if future cases are to be recognized and treated successfully, should this prove through further investigation to be a representative case of GDV in this species.

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