

**Y U Keep Regurgitating?**

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## **Introduction**

Pyloric stenosis is a condition characterized by benign muscular hypertrophy of the pylorus.<sup>1,2,4</sup> There are many terms used interchangeably in veterinary literature to refer to this condition, including benign antral muscular hypertrophy, congenital hypertrophic stenosis, and congenital pyloric muscle hypertrophy. Other terms associated with benign gastric outflow obstruction include chronic antral mucosal hypertrophy and chronic hypertrophic pyloric gastropathy (CHPG). Chronic antral mucosal hypertrophy, also known as pyloric or gastric mucosal hypertrophy, chronic hypertrophic gastritis, multiple polyps of the gastric mucosa, and acquired hypertrophy, refers to hypertrophy of the pyloric mucosa.<sup>1,2,4</sup> CHPG has been used to refer to acquired mucosal hypertrophy by some authors, while others use the term to refer to either muscular (type I) or mucosal (type II and III) hypertrophy.<sup>1,4</sup>

Pyloric stenosis is a congenital disease of the stomach, most commonly affecting brachycephalic breeds of dog and Siamese cats.<sup>1,2,3,4,5,7,8</sup> It often leads to delayed gastric emptying, vomiting, and/or regurgitation.<sup>1,2,4,8,9</sup> Aside from hiatal hernia, pyloric stenosis is the most common abnormality involving the stomach with a suspected hereditary link.<sup>8</sup> Affected animals tend to show signs at a very young age, typically when they begin to eat solid food.<sup>1,2,4</sup> While pyloric stenosis is reported in both males and females, some sources state it is more common in males.<sup>4,9</sup> Bloodwork abnormalities can include hypokalemia, hypochloremia, metabolic alkalosis, anemia, and hypoalbuminemia.<sup>2,6,9</sup> Many usually have significant concurrent diseases such as hyperadrenocorticism or renal disease.<sup>9</sup>

## **History and Presentation**

At the time of initial presentation, Fiona was a 2-year-old female spayed French Bulldog that presented to Mississippi State University College of Veterinary Medicine's Small Animal Internal Medicine Service on November 19, 2020 for acute onset of regurgitation, neck pain, and possible aspiration pneumonia. One year prior to presentation, Fiona underwent an exploratory laparotomy by her primary veterinarian, who is also her owner, due to vomiting and a poor appetite; at that time she was diagnosed with pyloric stenosis. In the time since that surgery, Fiona was medically managed for pyloric stenosis using omeprazole and occasional cisapride and experienced only infrequent regurgitation. On November 17, 2020 Fiona began exhibiting severe neck pain; therefore, her owner began treating her with gabapentin, buprenorphine, and dexamethasone sodium phosphate. Subsequently, she was not interested in eating and started regurgitating, despite having not eaten for two days.

During Fiona's initial physical exam at MSU-CVM, she was depressed yet responsive and regurgitated partially digested food and bile twice during the examination. She weighed 9.2 kilograms with a body condition score of 5/9. Vital parameters included a temperature of 100.2°F, a heart rate of 136 beats per minute, and a respiratory rate of 28 breaths per minute. She was approximately 8% dehydrated with a prolonged skin turgor and tacky mucous membranes. She had a capillary refill time of less than two seconds. There was also a mild amount of mucoid discharge present in both eyes. Upon auscultation, no murmurs or arrhythmias were noted, however, crackles were heard in the cranioventral lung fields. Her abdomen was tense and mildly distended, and she exhibited mild pain on palpation. Her cutaneous trunci reflex cut off at the level of T11. Fiona did not show signs of cervical pain but had reluctance against ventroflexion of her neck. Upon dorsal flexion of her neck she coughed, which showed ballooning on the left side of the neck.

## Differential Diagnoses and Diagnostic Approach

Following the initial physical examination an AFAST and TFAST were performed, revealing a markedly distended stomach and B-lines bilaterally. A blood gas was performed with clinically significant abnormalities including metabolic alkalosis (pH 7.473 [reference range: 7.350-7.460]; HCO<sub>3</sub> 30.1 mmol/L [reference range: 19.0-24.0 mmol/L]), hypochloremia (95.9 mmol/L [reference range: 109.0-120.0 mmol/L]), and hypokalemia (3.34 mmol/L [reference range: 3.90-4.90 mmol/L]). In the case of significant gastric outflow obstruction, electrolyte and acid-base imbalances include a hypochloremic, hypokalemic alkalosis, which can be a result of chronic vomiting but can also be a cause of gastric hypomotility.<sup>2</sup> Due to the patient's history, physical exam, and bloodwork, differential diagnoses at this time included pyloric stenosis, megaesophagus, and esophagitis.

Thoracic radiographs were taken the same day, which revealed an unstructured interstitial pattern coalescing to an alveolar pulmonary pattern in several lung lobes, indicating multifocal aspiration pneumonia, notably worst in the caudal subsegment of the left cranial lung lobe. Multiple thoracic hemivertebrae were noted to be causing kyphosis and narrowed intervertebral disc spaces, resulting in intervertebral disc disease. Additionally, spondylosis deformans was noted multifocally. Abdominal radiographs were taken next which revealed moderate to severe gastric dilation with a gravel sign in the ventral aspect of the pylorus. The primary differential for the gastric dilation and gravel sign was chronic mechanical pyloric obstruction because of the patient's history of pyloric stenosis.

Due to the findings of the abdominal radiographs, it was decided to place a nasogastric tube. Fiona was sedated with dexmedetomidine and methadone intravenously for tube insertion, which was followed by radiographs to check for proper placement. After confirmation of

placement, approximately 30 milliliters of thick stomach contents were suctioned out. A complete blood count was also performed which revealed a stress leukogram (segmented neutrophils 13,559.0/ul [reference range: 3,100.0-11,800.0/ul]; lymphocytes 596.0/ul [reference range: 1,100.0-4,800.0/ul]). It was decided that Fiona should be hospitalized and placed on intravenous fluids, maropitant citrate, ondansetron, pantoprazole, gabapentin, and Unasyn with instructions to continue to suction stomach contents during her overnight stay.

The following day it was reported that Fiona had regurgitated on average every 2 hours overnight and only had a small amount suctioned from her nasogastric tube. After flushing the tube, approximately 80 milliliters of stomach contents were suctioned out. A brief ultrasound revealed a significantly less distended stomach. She felt well enough to eat two Pill Pockets but was not given anything else to eat. Fiona was then taken to radiology for a full abdominal ultrasound which revealed a thickened gastric wall measuring up to 6.3 millimeters and proportional thickening of the submucosal layer of the gastric wall. The pyloric antrum was also moderately thickened with a heterogenous hyperechoic muscularis layer. The proximal duodenum appeared to telescope into the lumen of the pyloric antrum, resembling a gastroduodenal intussusception with the duodenum being located abnormally cranial.

Literature denotes that in cases of pyloric stenosis abdominal radiographs and ultrasound can reveal gastric distention as well as a thickened pyloric wall.<sup>4,9</sup> Diagnosis is also aided by contrast radiographs which reveal delayed gastric emptying of the contrast material with abrupt narrowing of the pylorus, and only a narrow stream of barium passing through, also referred to as a “beak sign”.<sup>2,6,7,8,9</sup> Endoscopy may also be helpful in visual assessment of the pyloric antrum, often revealing thickened pyloric mucosa.<sup>2,6,7,8,9</sup>

Following the ultrasound, emergency surgery was recommended for the suspected gastroduodenal intussusception. With permission from her owner to move forward with treatment, Fiona was anesthetized and taken to endoscopy briefly to assess the extent of possible esophagitis. Endoscopy revealed mild esophagitis, but no evidence of megaesophagus.

### **Treatment and Management**

The treatment of choice for pyloric stenosis is surgery.<sup>1,2,5,6,8,9</sup> Different surgical techniques used to correct this condition include Y-U pyloroplasty, modified Finney Jaboulay pyloroplasty, Heineke-Mikulicz pyloroplasty, and Billroth 1.<sup>2,4,5,6,9</sup> The Y-U pyloroplasty technique is commonly indicated in cases with mucosal and muscular hypertrophy and gives good luminal visualization, allowing for excision of polyps and hypertrophic issue, and widening the outflow tract.<sup>4,5,9</sup> Finney Jaboulay is indicated for severe thickening and inflammation of the pylorus.<sup>5</sup> A Billroth 1 is preferred when the mucosa and muscularis are so hypertrophied that they become inflexible.<sup>4,6</sup>

On November 20, 2020 Fiona was taken to emergency surgery for a Y-U Pyloroplasty and duodenopexy. Under general anesthesia, she was placed in dorsal recumbency, and an incision was made extending from the xiphoid process to just cranial to the pubis. Once inside the abdomen, the duodenum and pylorus were palpated for the suspected intussusception, which was not present. Then a full-thickness “Y” shaped incision was made into the pylorus and extended into the duodenum. A full-thickness biopsy of what appeared to be thickened mucosa in the duodenum was retrieved. Stay sutures were placed and the point of the flap was connected to the base of the Y. The sides of the Y incision were subsequently closed in a two-layer closure. The enterotomy site was locally lavaged with sterile saline, followed by gloves and instruments being changed and the abdomen was copiously lavaged. An incisional duodenopexy was

performed by incising approximately three centimeters into the seromuscular layer of the duodenum and suturing it to an equal-sized incision in the right body wall. The duodenopexy was performed to aid in the prevention of a future intussusception.

Fiona's surgery was uneventful, and her recovery was without complications. Postoperatively she was maintained on intravenous fluids, maropitant citrate, ondansetron, pantoprazole, gabapentin, Unasyn, sucralfate, metoclopramide, and a fentanyl CRI. In the days following surgery, Fiona's skin incision began to heal appropriately with decreasing pain scores each day. She began to drink and ate small meatballs of canned dog food, which she was able to keep down without regurgitating. The nasogastric tube was removed, and she was transitioned to oral medication.

The full-thickness biopsy sample of duodenum was submitted for histopathology. It was noted that the gastric mucosa was moderately to markedly thickened with irregular papillary projections and increased numbers of mucus cells, indicating hyperplasia. The changes were determined to be consistent with chronic hypertrophic pyloric gastropathy associated with pyloric stenosis.

### **Pathophysiology**

Very little is known about the etiology of pyloric stenosis. Due to the variation in association of mucosal and muscular hypertrophy, it is unknown if the pathogeneses of these follow the same mechanism.<sup>9</sup> One mode of pathogenesis is suspected to be due to excessive gastrin levels.<sup>1,4</sup> A 1976 study demonstrated that after pregnant animals were exposed to prolonged stimulation with pentagastrin, a synthetic polypeptide that mimics gastrin, the neonates developed pyloric stenosis as a result of hypertrophy of the muscle.<sup>3,4</sup> Neuromuscular

dysfunction has also been hypothesized as an etiology.<sup>4,7</sup> The thought is that neuromuscular dysfunction causes disordered motility in the stomach and duodenum, leading to failure of the pylorus to open properly.<sup>7</sup> Other thoughts on potential causes include trauma or acute stress, stimulating the sympathetic nervous system and leading to reduced gastric motility.<sup>4</sup> The retention of gastric contents would then lead to gastric distention and eventually release of gastrin, causing hypertrophy.<sup>4</sup> Authors have also speculated that genetics, environment, hormonal, and immune-mediated mechanisms might be involved.<sup>9</sup>

### **Case Outcome**

Follow-up thoracic radiographs were taken to assess the severity of Fiona's aspiration pneumonia which was found to be improved. Her cervical pain also resolved during her stay at MSU-CVM. Four days postoperatively Fiona was discharged to her owner with instructions to limit activity, cold pack her incision, maintain her Elizabethan collar, and administer the oral medications maropitant citrate, gabapentin, sucralfate, omeprazole, maropitant citrate, Clavamox and Tylenol 3. Her owner was also instructed to remove the staples at her incision site in 10 to 14 days and continue to perform recheck radiographs to monitor her aspiration pneumonia.

### **Conclusion**

This case is a classic example and presentation of pyloric stenosis. It should be considered as a differential in brachycephalic dogs and Siamese cats that present with frequent regurgitation. The prognosis for pyloric stenosis is good with surgical treatment.<sup>2,4</sup> Post-operative surgical success rates ranging from 85-90% have been reported, with failures usually being due to dehiscence or inappropriate surgical technique.<sup>4,9</sup> As the literature states, progress in



understanding the pathogenesis of this disease may be slow due to the low incidence of spontaneously occurring disease.<sup>9</sup>

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