Chapter 53

Gastric Dilatation and Gastric Dilatation-Volvulus in Dogs

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"Size counts. That's all."
Gina Gershon

CLINICAL IMPORTANCE

Gastric dilatation (GD) is distention of the stomach with a mixture of air, food and fluid. GD often occurs intermittently, usually in young dogs, particularly as a result of overeating or some other dietary indiscretion. Gastric dilatation-volvulus (GDV) is characterized by rotation of the stomach on its mesenteric axis, entrapping gastric contents and compromising vascular supply to the stomach, spleen and pancreas. Acute GDV is a medicosurgical emergency with high morbidity and mortality (Monnet, 2003; Buber et al, 2007). Rarely, chronic, intermittent GDV may occur associated with a partial (i.e., <90 degree) rotation of the stomach.

GDV most commonly affects large-breed, deep-chested dogs and has been estimated to affect 40,000 to 60,000 dogs annually (Lantz et al, 1992). Based on necropsy findings, GDV accounted for 3.4% of deaths of military dogs (Jennings, 1992) and has been reported to occur at a monthly rate of 2.5 cases/1,000 military dogs (Herbold et al, 2002). A review of data from the Veterinary Medical Database, Purdue University, West Lafayette, IN, suggests a 1,500% increase in the frequency of GDV from 1964 to 1974 within cases presented to veterinary teaching hospitals (Glickman, 1996).

PATIENT ASSESSMENT

History and Physical Examination

Clinical signs of GD include nausea, belching and vomiting. Conversely, there may be no effort to vomit, but instead lethargy, reluctance to move and grunting sounds with respiratory effort. The onset of GDV is usually acute and often occurs at night or in the early morning. Owners often report some precipitating stressful event. Boarding, hospitalization, travel and participation in shows have been associated with GDV. Affected dogs exhibit restlessness, progressive abdominal distention with tympany, abdominal pain, hypersalivation and repeated, nonproductive attempts to vomit. Occasionally, owners will find affected dogs dead or in shock.

Chronic GDV is a rare manifestation of the syndrome. Dogs present with intermittent, progressive signs including vomiting, borborygmus, inappetence and weight loss. Periods of illness are interspersed with periods of normalcy. If untreated, these dogs often progress to acute GDV.

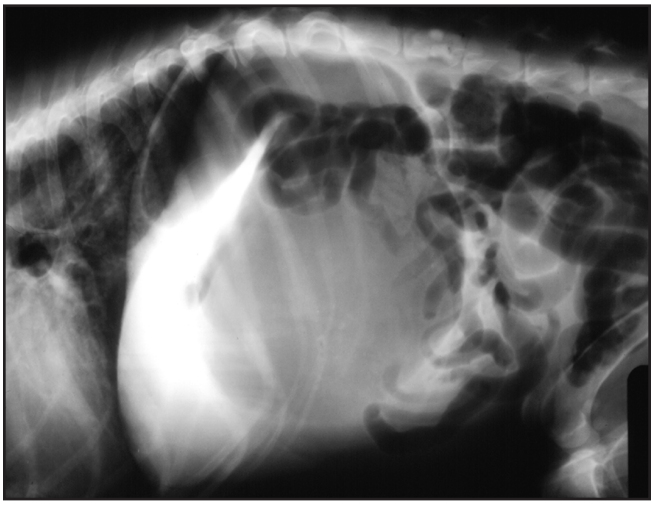

Figure 53-1. Lateral abdominal radiograph from a nine-year-old neutered male Doberman pinscher with a 180-degree gastric dilatation-volvulus. (Courtesy Dr. Joanne Burns, Veterinary Imaging Services, Topeka, KS.)

The most prominent sign of GD and GDV is abdominal distention. In some dogs, concurrent splenomegaly may be identified by abdominal palpation. Clinical manifestations of cardiovascular shock include tachycardia, delayed capillary refill time, pallor and weak pulses.

Laboratory and Other Clinical Information

Laboratory assessment of patients with GD or GDV should include a complete blood count, serum biochemistry profile, urinalysis and blood gas analysis. The complete blood count often reflects stress and can provide early evidence of disseminated intravascular coagulopathy if thrombocytopenia is present. If faced with thrombocytopenia, a complete coagulation panel is recommended before surgery.

Hypokalemia is common in patients with GDV and should be managed with intravenous potassium supplementation because hypokalemia can potentiate cardiac dysrhythmias. Metabolic acidosis, metabolic alkalosis, respiratory acidosis and mixed acid-base disorders have been reported to occur in dogs with GDV (Muir, 1987). Routine use of alkalinizing fluids and sodium bicarbonate, therefore, is not recommended.

Radiography is critical to the diagnosis of GD and GDV. Dorsoventral and right lateral views should be evaluated to distinguish simple GD from GDV (**Figure 53-1**). In most cases, gastric rotation is clockwise (i.e., with the dog in a dorsoventral position, viewed from above) and ranges from 90 to 360 degrees. Other significant findings may include splenomegaly and free abdominal air, which indicates gastric rupture.

Electrocardiographic recordings should be monitored in patients with GDV pre- and postoperatively because cardiac dysrhythmias occur in approximately half of patients (Muir, 1982; Brockman et al, 1995; Buber et al, 2007). The distended, malpositioned stomach compresses the caudal vena cava and portal vein resulting in cardiovascular compromise. Reduction in venous return and cardiac output leads to myocardial ischemia and cardiovascular shock. Cardiac dysrhythmias, gastric necrosis and multiple organ ischemia are potential consequences if gastric decompression is not performed expeditiously. Generally, dysrhythmias are ventricular in origin and can be life-threatening.

Risk Factors

Considerable effort has been expended over the last 30 years in attempts to identify the cause or causes of GD and GDV. Despite these efforts, no definitive cause for the syndrome has been identified. However, a number of predisposing and precipitating risk factors have been demonstrated through epidemiologic studies (**Table 53-1**).

GD and GDV occur most frequently in large-breed, deep-chested dogs, but may occur rarely in smaller dogs and in cats. A number of breeds including Great Danes, Irish setters, Gordon setters, Weimaraners, Saint Bernards, Doberman pinschers and basset hounds appear to be at risk. Other large breeds, notably the retriever breeds, have much smaller odds ratios. Attempts to assess the GDV risk in individual breeds demonstrated a lifetime incidence of 25% in Irish setters and a risk of 10% in Great Danes by the age of 2.6 years (Glickman, 1996). In a prospective cohort study, the likelihood of large- (bloodhounds, Akitas, Weimaraners, Irish setters, standard poodles, collies and rottweilers) or giant-breed dogs (Great Danes, Irish wolfhounds, Saint Bernards and Newfoundland dogs) developing GDV during their lifetime ranged from 21 to 24%, with the highest incidence occurring in Great Danes (Glickman et al, 2000).

Within breeds, certain anatomic and conformational factors increase the risk of GDV (Glickman et al, 1994). Increased adult body size compared with breed standards and specific types of thoracic conformation as determined radiographically appear to be related to the incidence of GDV. A chest depth-width ratio greater than 1.5 is associated with increased risk for developing GDV in certain breeds (Glickman et al, 1996; Schaible et al, 1997; Schellenberg et al, 1998). Dogs with GDV were found to have elongated hepatogastric ligaments as compared with control dogs of similar breeds (Hall et al, 1995). A longer hepatogastric ligament may allow increased gastric mobility or stretch as a consequence of GDV (Monnet, 2003).

GD or GDV appears not to have an age predisposition, but both occur more commonly in middle-aged dogs. The syndrome is also more common in male dogs (Glickman et al, 1997). Having a first-degree relative (sibling, sire, dam, offspring) with GDV also increases the risk by 63% (Glickman et al, 2000). This finding has led to the recommendation for prophylactic incisional, laparoscopic-assisted or endoscopically-assisted gastropexy for such dogs (Watson and Tobias, 2006; Ward et al, 2003; Rawlings et al, 2002; Dujowich and Beimer, 2008). These procedures can be performed in young female dogs (six to eight months) at the time of ovariohysterectomy. Percutaneous endoscopic gastrostomy is not recommended for prophylactic gastropexy because it is does not create consistently strong pexy sites and is associated with higher morbidity than

incisional or laparoscopic techniques (Waschak et al, 1997).

Other dog-related risk factors include a nervous or fearful temperament and being underweight. The incidence of GDV in dogs characterized by their owners as fearful was increased 257% compared to those considered non-fearful. Conversely, the owner-perceived personality trait of "happiness" appears to reduce the incidence of GDV by 78% (Glickman et al, 1997, 2000). Physiologic differences between happy and fearful dogs might influence gastrointestinal motility. These findings suggest that behavioral modification should be considered as part of a GDV preventive program in aggressive, nervous dogs.

A retrospective study identified intestinal lesions consistent with inflammatory bowel disease in approximately 25% of dogs with GDV (Braun et al, 1996). Splenectomy for treatment of hemangiosarcoma and splenic torsion has also been recognized as a risk factor for GDV in dogs (Monnet, 2003; Marconato, 2006; Millis et al, 1995; Neath et al, 1997). For that reason, large- and giant-breed dogs undergoing splenectomy should be recommended for a prophylactic gastropexy (Monnet, 2003).

Several dietary risk factors have been identified in one or more epidemiologic studies (Raghavan et al, 2006, 2004; Glickman et al, 2000, 2000a, 1994, 1997; Elwood, 1998; Theyse et al, 1998). Feeding from an elevated bowl, feeding a large volume of food per meal, feeding only one meal a day, feeding only one type of food, rapid eating, episodes of overeating, consumption of large volumes of water, postprandial exercise and a food particle diameter less than 5 mm have been implicated. Factors that appeared to decrease the risk of GDV in one case-control study were the inclusion of moist food or table foods as part of the diet (Glickman et al, 1997). In another study, consuming foods with a particle size greater than 30 mm was protective (Theyse et al, 1998).

In the past, consumption of dry dog food, unmoistened dry food, nutritional supplements and cereal- or soy-based foods were incriminated as dietary risk factors for GDV. More recent epidemiologic studies have not found these factors to increase the risk of GDV (Raghavan et al, 2004, 2006). In a European study of GDV cases, 40% of patients consumed dry food, 26% ate moist food and 25% received fresh meat diets, reflecting no increased risk associated with food form (Nagel and Neumann, 1992).

Attempts to reproduce GDV by dietary manipulation have been unsuccessful. In one study, researchers found no difference in gastric motility or emptying in large-breed dogs fed either a moist, meat-based food free of soybean meal or a dry, extruded, cereal-based food containing soybean meal with and without moistening (Burrows et al, 1985). A similar study evaluating Irish setters fed either a commercial dry food or a meat and bone mixture again showed no difference in gastric emptying or gastric acid secretion between diet types (Van Kruiningen et al, 1987). Investigators concluded that most large dogs are fed dry cereal-based food for reasons of cost and convenience, and that these foods may have been wrongly incriminated as a predisposing factor in GDV (Burrows et al, 1985; Raghavan et al, 2004).

In a nested case-control study of a group of dogs consuming dry foods as more than 95% of their diet, investigators found an association between dietary fat and GDV (Raghavan et al, 2006). If a vegetable oil or animal fat source was included as one of the first four label ingredients, dogs were at 2.4-fold increased risk of GDV. In such foods, the percent of metabolizable energy of the food derived from fat was higher than that in control foods. This unexpected finding contradicts the authors' earlier work in the same population of dogs, which demonstrated that patients with and without GDV consumed similar fat intakes (Raghavan et al, 2004). At this time, it is unclear which set of results from this population are most significant, suggesting the need for further investigation (Kass, 2006).

Table 53-1. Risk factors for canine gastric dilatation-volvulus.*

Consuming a food with vegetable oil or animal fat listed as one of the first four ingredients
Eating a large volume of food per meal
Eating from an elevated food bowl
Eating only one meal per day
Excluding moist food, table food and treats from the diet
Exclusive feeding of one food type
Exercising more than two hours per day
Fearful, nervous or aggressive temperament
Feeding food with a mean particle size <5 mm
Having an affected first-degree relative
Increased adult weight, based on breed standards
Increased chest or abdominal depth:width ratio
Increasing age
Large- or giant-breed status
Great Danes, Weimaraners, Saint Bernards, Gordon setters, Irish setters, standard poodles, basset hounds, Doberman pinschers, Old English sheepdogs, German shorthaired pointers
Lean body condition (body condition score ≤2/5)
Male gender
Purebred status
Rapid eating
Stressful events (boarding in kennel or travel)

*Adapted from Glickman LT, Glickman NW, Schellenberg DB, et al. Multiple risk factors for the gastric dilatation-volvulus syndrome in dogs: A practitioner/owner case-control study. Journal of the American Animal Hospital Association 1997; 33: 197-204. Theyse LFH, Van Den Brom WW, Van Sluijs FJ. Diet and other risk factors for gastric dilatation-volvulus in Great Danes. Journal of Veterinary Surgery 1997; 26: 260. Theyse LFH, Van Den Brom WE, Van Sluijs FJ. Small size food particles and age as risk factors for gastric dilatation-volvulus in Great Danes. Veterinary Record 1998; 143: 48-50. Raghavan M, Glickman NW, Glickman LT. The effects of ingredients in dry dog foods on the risk of gastric dilatation-volvulus in dogs. Journal of the American Animal Hospital Association 2006; 42: 28-36.

Etiopathogenesis

A single cause of GDV will probably not be found. GDV is more likely a condition that arises because of the interaction of two or more risk factors. The gastric distention manifested in GDV is associated with an as yet uncharacterized functional or mechanical gastric outflow obstruction. This obstruction results in loss of the normal means for removing air from the stomach (i.e., eructation, vomiting and gastroduodenal flow). In some dogs, gastric volvulus apparently develops as a consequence of gastric distention, but, in others, gastric volvulus may precede the dilatation. Because gastropexy prevents recurrence of GDV, some authors have postulated that volvulus is the initial event.

Table 53-2. Key nutritional factor for dry foods for dogs for the prevention of gastric dilatation and volvulus.

Factor	Recommendation
Kibble size	Large particle size: >30 mm was protective against GDV in giant-breed dogs (Great Danes). Somewhat smaller kibble dimensions may be effective in medium- and large-breed dogs as long as the size of the kibble is sufficiently large to prevent rapid eating.

Table 53-3. Kibble size comparison of selected large-kibble dry commercial foods to consider for feeding medium-, large- and giant-breed dogs to reduce the risk of gastric dilatation and volvulus.*

Factor	Kibble cross sectional dimension(s)**
Recommendation	**>30 mm for giant-breed dogs** Somewhat smaller kibbles (<30 mm) may be effective in medium- and large-breed dogs as long as the kibble is sufficiently large to prevent rapid eating
Hill's Prescription Diet t/d Canine	28.3 x 26.4 mm
Medi-Cal Dental Formula	23.3 x 20.3 mm
Purina Veterinary Diets DH Dental Health	21.9 x 21.2 mm
Royal Canin Giant Adult 28	29.72 x 28.88 mm

*For additional key nutritional factors of importance for canine maintenance, see appropriate lifestage recommendations (Chapters 13 through 17).
**Kibble size represents the mean of measurements (diameter or width X thickness) made on three randomly selected kibbles from one bag of each product listed.

GD episodes may persist after gastropexy (Monnet, 2003).

Gas in the stomach of dogs with GDV is primarily atmospheric air, which differs greatly in composition from the gas produced by bacterial fermentation (Caywood et al, 1977). For that reason, aerophagia is believed to be the primary source of gastric gas in dogs with GDV. In some cases, carbon dioxide concentrations in the trapped stomach gas approached 10% (Caywood et al, 1977). The most likely source for this gas is the interaction between gastric acid and bicarbonate secretions. Normally, swallowed air is eructated and does not accumulate in excessive quantities. It has been hypothesized that dogs with GDV have defective eructation mechanisms. In one study, esophageal motility abnormalities were observed in 60% of dogs with GDV (Van Sluijs and Wolvekamp, 1993). It is possible that such abnormalities are linked to defective eructation complicated by the anatomic relationship of the stomach and esophagus in deep-chested, large-breed dogs, which also may interfere with effective eructation of air (Guilford, 1996). Aerophagia increases with rapid food consumption, excitement, stress and exercise; thus, controlling these factors is recommended in high-risk dogs.

Hypergastrinemia is present in dogs with acute GDV and persists after treatment and recovery, suggesting that dogs with GDV have a pre-existing hypergastrinemia (Leib et al, 1984). Gastrin increases gastroesophageal junction pressure and some investigators have postulated that hypergastrinemia may be a factor in the pathogenesis of GDV (Leib et al, 1984). However, further investigations revealed no relationship between the degree of gastric distention and the magnitude of plasma gastrin increase (Leib et al, 1985). Others suggest that hypergastrinemia in dogs with GDV is a result of the syndrome rather than a cause (Hall et al, 1989).

Key Nutritional Factor

The only key nutritional factor that may be of concern for dogs with an increased risk for GDV is food particle size. Fat content may play a role as described in the Risk Factor section above and the Other Nutritional Factor section below. The key nutritional factors for postoperative patients are similar to those for patients with acute gastritis (Chapter 52).

Kibble Size

Commercial dry extruded dog food particles having a diameter of less than 5 mm have been implicated as a risk factor for GDV. Also, in a study involving Great Danes, consuming foods with a particle size greater than 30 mm was protective (Theyse et al, 1998). The study included dry foods, moist chunky foods and homemade foods. The working assumption is that larger particles require more extensive and prolonged mastication, and in most dogs, probably prevents rapid eating of food. Somewhat smaller food particles might have a similar beneficial effect in medium- and large-breed dogs at risk for GDV, as long as the food particles are large enough to sufficiently slow eating. Thus, a practical consideration for medium-, large- and giant-breed dogs at risk for GDV would be to offer large kibble foods to slow eating (**Table 53-2**).

Other Nutritional Factor

Fat

Dietary fat can delay gastric emptying. One study found an association between dietary fat and GDV (Raghavan et al, 2006). If a vegetable oil or animal fat source was included as one of the first four label ingredients, dogs were at 2.4-fold increased risk of GDV. Unfortunately, percent dry matter content of fat was not recorded in the report. Ingredient order doesn't always reflect dietary fat content. Splitting ingredients on the first part of the product label can result in high fat ingredients being moved further down the label (Chapter 9). Thus, a food could be relatively high in dietary fat content but have a fat source ingredient at fifth or sixth place on the ingredient label. Until more information regarding dietary fat content and its relationship to GDV is available, this information cannot be reliably used. However, the data do suggest that lower fat is better.

FEEDING PLAN

Without early diagnosis and appropriate treatment, GDV is usually fatal. Initial management includes cardiovascular stabi-

Box 53-1. Recommendations from the 1990 Morris Animal Foundation Panel on Bloat in Dogs.

The following measures may reduce the incidence and recurrence of acute gastric dilatation-volvulus ("bloat"). These measures are especially important when managing purebred dog kennels and individual pet animals of the most susceptible breeds.

1. Large dogs should be fed two or three times daily, rather than once a day, and at times when the owner can observe post-feeding behavior.
2. Owners of susceptible breeds should be aware of prodromal signs (i.e., actions from the dog that signal abdominal discomfort). These signs include evidence of abdominal fullness after meals, whining, pacing, getting up and lying down, stretching, looking at the abdomen, anxiety and unproductive attempts to vomit. A veterinarian should examine animals with these signs as soon as possible.
3. Owners of susceptible breeds should establish a good working relationship with their local veterinarian and should discuss emergency measures in the event of bloat, including administration of antacids (e.g., Mylanta[a] and Di-Gel[b]), passing a stomach tube or piercing the abdomen with a hypodermic needle to relieve bloat.
4. Water should be available to dogs at all times, but should be limited immediately after feeding if overconsumption is a problem.
5. Vigorous exercise, excitement and stress should be avoided one hour before and two hours after meals. Walking, however, is permissible because it may help stimulate normal gastrointestinal function.
6. Food changes should be made gradually over three to five days.
7. Susceptible dogs should be fed individually and, if possible, in a quiet location.
8. Special attention should be paid to the above measures after animals return home from veterinary hospitals and boarding facilities.
9. Dogs that have survived bloat are at increased risk for future episodes; therefore, prophylaxis in the form of preventive surgery or medical management should be discussed with the veterinarian.

ENDNOTES

a. Stuart Pharmaceuticals, Wilmington, DE, USA.
b. Schering-Plough, Corp. Madison, NJ, USA.

lization (i.e., treatment of shock and cardiac dysrhythmias), gastric decompression (i.e., orogastric intubation, gastric trocharization), surgery (i.e., gastric repositioning and permanent gastropexy) and appropriate postsurgical care (Monnet, 2003). If a permanent gastropexy is not performed after gastric repositioning, the recurrence rate of GDV approaches 80% (Wingfield et al, 1975) and median survival times fall from 547 to 188 days (Glickman et al, 1998). The feeding plan is implemented as part of a preventive strategy or after rapid, aggressive emergency management.

Assess and Select the Food

Foods that have relatively large kibble size and that are appropriate for the patient's current lifestage and activity level should be provided. Selected foods that have large kibble size are listed in **Table 53-3** along with their typical kibble dimensions. Other feeding practices can be used to slow eating. (See Assess and Determine a Feeding Method below.) Because foods are fed for adult maintenance, foods should be chosen that are appropriate for the dog's lifestage and activity level (Chapters 13 through 17). In the postoperative period, foods should be used that provide levels of the key nutritional factors outlined for acute gastritis (Chapter 52).

Assess and Determine the Feeding Method

Because feeding methods are often altered in postoperative patients and patients at risk for GD and GDV, a thorough assessment should include verification of the feeding method currently being used. Items to consider include feeding frequency, amount fed, how the food is offered, access to other food (e.g., access to other pets' food, table food, treats, etc.), relationship of feeding to exercise and who feeds the dog. All of this information should have been gathered when the history of the animal was obtained. If the animal has a normal body condition score (2.5/5 to 3.5/5), the amount of food it was fed previously (energy basis) was probably appropriate.

It appears prudent to recommend feeding a dog at risk for GDV two to three times per day in an environment that decreases competitive eating. At risk dogs should not be fed from an elevated platform or feeder. If the dog typically eats too fast, placing large balls or rocks in the food bowl or feeding the dog from a muffin tin may slow consumption of food and decrease aerophagia. A specially made food bowl[a] that has three large vertical cylinders protruding from the bottom to slow food consumption is available for dogs at risk for GDV. Feeding a mixture of moist and dry food appears to reduce the risk of GDV (Glickman et al, 1997). Alternatively, feeding foods with kibble sizes greater than 30 mm is also thought to reduce the risk of GDV (Theyse et al, 1998). To deliver foods with particle sizes this large, a mix of chunked moist food and dry food, a canine dental food,[b] formed complete meals[c] or a food formulated for giant breeds[d] may be used. However, none of these commercial products have been demonstrated to prevent or reduce the risk of GDV. Although no definitive link between exercise and GDV has been found, limiting exercise within three to four hours of eating (i.e., corresponds to normal gastric emptying time) is prudent. The Morris Animal Foundation Canine Bloat Panel recommends avoiding vigorous exercise at least one hour before and two hours after feeding (1990) (**Box 53-1**).

REASSESSMENT

Postoperative patients should be monitored closely for cardiac dysrhythmias, coagulopathies, surgical dehiscence, electrolyte and acid-base abnormalities and infections. Treatment with H_2-receptor blockers and sucralfate is indicated for most dogs with gastric mucosal damage. In most cases, food can be reintroduced within 24 to 36 hours postoperatively. Postoperative patients are best fed small meals frequently. Judicious use of antiemetics and/or metoclopramide in conjunction with continuous feeding may allow adequate caloric intake by patients with persistent vomiting. If tube gastrostomy was chosen as the method of permanent gastropexy, this indwelling catheter should be used for feeding (Chapter 25).

After the patient is discharged, the owner should monitor its appetite, activity level and attitude. Rechecks should include body weight and body condition assessment. Food dosages should be adjusted to maintain the dog at ideal body condition. The ultimate marker of success in GDV patients is the prevention of recurrent disease. Rarely, GD will develop in dogs that have had a gastropexy. Any episode of dilatation and precipitating factors should be reported and evaluated.

Persistent vomiting in a postoperative patient may indicate an outflow obstruction arising from an improperly positioned gastropexy site. If the angle between the pyloric antrum and duodenum is too acute, a functional obstruction may occur (Watson and Tobias, 2006).

ENDNOTES

a Brake-Fast Dog Food Bowl. Brake-Fast LLC., Virginia Beach, VA, USA.
b. Prescription Diet t/d Canine. Science Diet Oral Care Adult Canine. Hill's Pet Nutrition, Inc., Topeka, KS, USA.
c. WholeMeals. Mars Petcare U.S. Inc., Franklin, TN, USA.
d. Royal Canin Giant Adult 28. Royal Canin USA, Inc., St. Charles, MO, USA.

REFERENCES

The references for **Chapter 53** can be found at www.markmorris.org.

CASE 53-1

Acute Vomiting in an Irish Setter

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Patient Assessment

A seven-year-old neutered female Irish setter was examined for vomiting and retching of two hours' duration. The dog vomited approximately 20 times during the hour before presentation, producing small amounts of phlegm each time. Earlier in the morning the dog had escaped from the yard and wandered freely. The owner reported no previous gastrointestinal (GI) problems.

Physical examination revealed a 28-kg dog with normal body condition (body condition score [BCS] 3/5) and a firm, distended abdomen. Vital signs (mucous membrane color, pulse rate and strength, capillary refill time, respiratory rate) were normal. Abdominal radiographs revealed a dilated stomach that was full of ingesta but appeared to be in its normal position. The ingesta contained a large amount of calcified material.

A tentative diagnosis of gastric dilatation (GD) was made and emergency treatment instituted. An orogastric tube was easily passed into the stomach but only a small amount of gas, fluid and nonspecific debris was recovered. Total decompression was not achieved even after warm water lavage. Intravenous fluids and a sedative were administered; gastric lavage with suction was continued. Large pieces of a plastic bag were removed and the lavaged gastric contents contained a large amount of shellfish debris. Sufficient decompression was still not obtained; therefore, an exploratory celiotomy was performed.

During surgery, the stomach was found to be in a normal position and a gastrotomy was performed. A large volume of shrimp and crab legs was removed and the stomach was lavaged with saline solution. The stomach was sutured closed and attached to the abdominal wall using a modified gastropexy technique. The abdomen was closed routinely and recovery from anesthesia was uneventful.

Assess the Food and Feeding Method

The dog was normally fed a combination of a commercial dry grocery brand dog food mixed with various commercial moist grocery brand dog foods and table foods. This food combination was offered in the early evening when the owner returned home from work. Water was available free choice.

Questions

1. What are risk factors for GD and gastric dilatation-volvulus (GDV) in dogs?
2. Outline a feeding plan (foods and feeding method) for this patient.

Answers and Discussion

1. Several risk factors for development of GD and GDV have been identified. These risk factors include large breed (i.e., Great Danes, Weimaraners, Saint Bernards, Gordon setters, Irish setters, standard poodles, Newfoundlands, basset hounds, Doberman pinschers), purebred dogs, older age (mean six to seven years old), heavier body weight (greater than 23 kg), rapid eating, feeding less moist dog food, feeding once daily rather than multiple times, feeding less table foods, feeding fewer snacks, gulping water, feeding small kibbles (<5 mm diameter; feeding large kibbles [>30 mm] is protective), excessive belching or flatulence, esophageal motility disorders, previous GI disease (e.g., inflammatory bowel disease) and personality (fearful or aggressive vs. happy and easy going). Other risk factors for GDV identified in Irish setter dogs included feeding a single food form, recent car journey (i.e., within preceding 24 hours), recent time in a boarding kennel (within preceding 24 hours), a history of aerophagia and thin body condition (BCS 1/5 or 2/5).
2. Dietary indiscretion obviously played an important role in development of GD in this dog and should be avoided. However, strategies to avoid other dietary risk factors for GD and GDV should also be considered, including offering a highly digestible food in multiple small meals. Meals should be avoided in association with exercise or traveling in a motor vehicle. Multiple small meals may also help eliminate rapid eating and significant aerophagia. Excessive or recurrent belching, flatus, vomiting, regurgitation and diarrhea may indicate underlying GI disease and warrant further diagnostic evaluation before implementing a feeding plan.

Progress Notes

The dog was offered a small amount of water and a moist highly digestible commercial veterinary therapeutic food (Prescription Diet i/d Canine[a]) the day following surgery. The amounts of water and food were gradually increased over the next couple of days. The dog was released to the owner's care with instructions to continue the therapeutic food in an amount to meet the daily energy requirement at home (1.6 x resting energy requirement = 1,450 kcal [6.07 MJ]). The food was to be offered in three separate meals (one can each meal) during the day (morning, immediately after work, late evening before bed). The owner was warned about the increased risk of GDV in Irish setter dogs, the potential for a fatal outcome, associated clinical signs and the need for emergency treatment if the problem recurred. Restricted exercise and avoiding rides in a motor vehicle in close association with meals were suggested. The owner was advised to make all attempts to avoid dietary indiscretion. Three months following surgery, the owner reported the dog was normal and doing well.

Endnote

a. Hill's Pet Nutrition Inc., Topeka, KS, USA.

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