

Canine Gastric Dilatation-Volvulus (Bloat)

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BLOAT NOTES

News from the Canine Gastric Dilatation-Volvulus Research Program

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Measurements and Bloat History: Data Obtained at the 1994 Great Dane National Specialty

At the invitation of the Great Dane Club of America (GDCA), a team from Purdue obtained measurement and bloat history data for 118 Great Danes at the GDCA National Specialty in Kansas City, Missouri, 25-26 October, 1994. This breed is of much interest because it ranked no. 1 in bloat risk among 24 breeds studied in a retrospective study.¹

Each dog was measured, using a tape measure and a Canine Caliper (for depth and width of the chest and abdomen). Owners were asked for information about each dog, including whether the dog or any of its close relatives had ever had bloat, and whether any treatments were being used in an attempt to prevent bloat.²

The 118 dogs included 65 females and 52 males (sex not recorded for 1). The mean age of 115 dogs was 2.6 years, with a standard deviation (a measure of variability) of ± 2.1 years (age not recorded for 3 dogs). Twelve dogs (10%) had had a bloat episode.

Figure 1 below shows the distribution of **abdominal** depth/width ratios. Figure 2 shows the distribution of **chest** depth/width ratios. The black portion of a bar indicates the number of dogs with a history of bloat.

Figure 1 Distribution of abdomen depth/width ratio for 118 Great Danes by bloat status

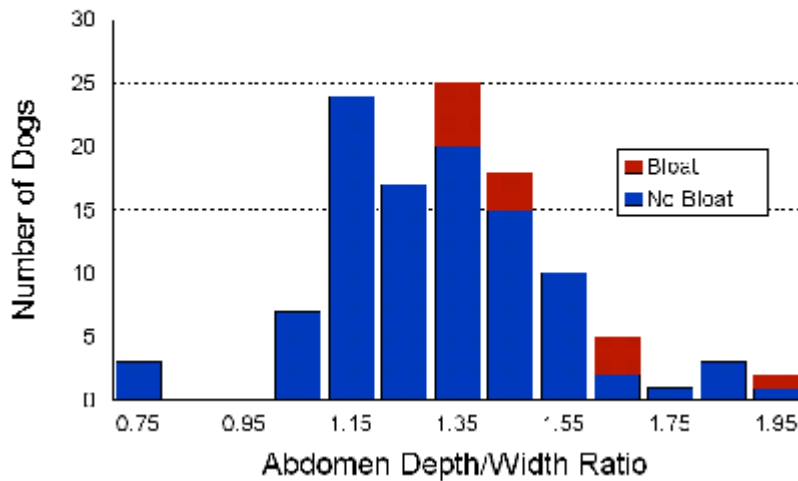
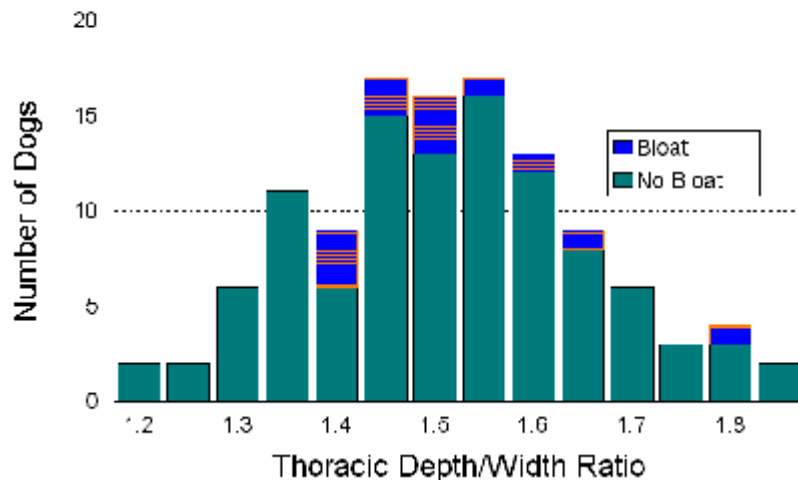


Figure 2 Distribution of thoracic depth/width ratio for 118 Great Danes by bloat status



When dogs with moderate abdominal depth/width ratios (1.31-1.45) were compared with those who had lower ratios (0.70-1.30), the risk of bloat increased about **5 1/2 times**; with the highest abdominal depth/width ratios (1.46-1.92), the risk increased almost **8 times**. The increased risks associated with the greater abdominal depth/width ratios were statistically significant.

Measured dogs who had bloated were more likely to have a parent or sibling who had bloated; the differences were statistically significant ($P < 0.1$). They were also more likely to have other relatives who had bloated:

<u>Relative Who Bloat</u>	<u>No. (%) of Dogs with Bloat</u>	<u>No. (%) of Dogs without Bloat</u>
Parent	6/10* (60%)	24/92 (26%)
Full sibling	3/7 (43%)	10/90 (11%)
Grandparent	4/8 (50%)	23/64 (36%)
Aunt or uncle	5/8 (63%)	19/59 (32%)
Offspring	1/7 (14%)	3/74 (4%)

*Number of dogs whose parent had bloated/total measured dogs who had bloated and whose parents' bloat status was reported.

Treatments intended to prevent bloat were being used for only a small proportion of the dogs measured. Four (3%) had had prophylactic gastropexy; 8 (7%) were receiving antacid, 7 (7%) anti-gas medication, and 5 (5%) medication to increase stomach motility. Rational decisions about prophylactic treatment cannot be made until the effectiveness of the various methods is determined in future studies.

1. LT Glickman, NW Glickman, CM Perez *et al.*: Analysis of risk factors for gastric dilatation and dilatation-volvulus in dogs. *JAVMA* 204(4):1465-1471, 1994.

2. We wish to express appreciation to all the Great Dane owners and breeders who participated in this study.

Diet and Obesity in Female Pet Dogs

Every dog owner is concerned about the best diet for their dog. Veterinarians are concerned about obesity, perhaps the most common disease of dogs, which may put stress on the heart, joints, immune system, etc., as in humans. Despite the importance of diet to the health of dogs, there has been little quantitative information in the scientific literature about what dogs **actually eat** or about risk factors for obesity. Most of what we read is derived from marketing surveys by pet food companies, which merely tell us what commercial foods are sold. These surveys do not consider table food.

An article in the most recent issue of the journal *Veterinary Clinical Nutrition*¹ reports the results of a dietary survey of adult female dogs conducted in the 1980s. Although not about bloat, this article presents information that will help us interpret the results of the case-control study of risk factors for bloat -- including diet. The study objectives were to:

Describe what pet dogs eat in terms of:

total energy intake

% of calories derived from different commercial food types and table foods, and

% of calories from fat, protein, and carbohydrate.

Calculate an obesity index for purebred dogs and identify risk factors for obesity.

The diet study was part of a larger study to identify risk factors and prognostic factors for breast cancer. It included 289 adult, female dogs: 146 with breast cancer and 143 with other cancers (excluding lipoma or liposarcoma). The 2 groups could be combined for this analysis because adult obesity and adult diet were not found to be associated with breast cancer risk.

Telephone interviews were conducted with dog owners, using an extremely detailed questionnaire. The diet information was collected for a time period 1 year before the cancer had been diagnosed. The owner was asked about the brand name and amount consumed of 4 dog food types (commercial canned, dry, semi-moist, and treats), and about the frequency, amount and preparation of 75 specific human foods. (The diet questionnaire itself had previously been tested and found to agree with 7-day dietary records kept by owners.)

A diet profile was constructed consisting of total food intake in grams of dry matter and total calories of metabolizable energy for each of the 4 types of dog food and for table food, and for each of 3 fuel sources (protein, fat, and carbohydrate) in the food.

Owners were also asked about their dog's body condition, i.e., whether the dog was thin, average, slightly overweight, or overweight, at age 9-12 months (juvenile) and 1 year before cancer was diagnosed (adult). For purebred dogs, the validity of the owner's assessment was confirmed by comparison with an obesity index (actual weight divided by the ideal weight for females of that breed). Obesity was defined as 15% or more above ideal body weight.

The dogs ranged in age from 5 to 17 years (mean 10.3); 155 (55%) had been spayed; 166 (74%) were purebred and 58 (26%) were mixed-breed; breed was not reported for 1 dog.

Diet

The average energy intake was almost 1,000 calories of metabolizable energy per day, with about 1/3 of the total calories from table food. (Some dogs were fed only table food.)

Obesity

About 40% of the dogs were overweight as adults and 6% as juveniles. Those who were overweight as juveniles were 1.5 times more likely to be overweight as adults than those who were thin as juveniles. There was no significant association between adult body condition and neuter status.

The mean obesity index (actual weight/ideal weight) for breeds with ≥ 9 dogs is summarized in the table:

<u>Breed</u>	<u>No. Dogs</u>	<u>Mean Obesity Index</u>
<i>Cocker Spaniel</i>	11	0.94
<i>German Shepherd</i>	14	1.17
<i>Irish Setter</i>	9	1.04
<i>Miniature Poodle</i>	23	0.91
<i>Miniature Schnauzer</i>	17	1.26
<i>Toy Poodle</i>	10	0.81
<i>Other purebred dogs</i>	105	1.26

Figure 1 shows that the % of daily caloric intake from dry food increased significantly with breed size, while the % derived from table food decreased with size.

Figure 2 shows that carbohydrate consumption increased with breed size, while fat consumption tended to decrease with size. Protein intake was 25% for all sizes.

1. LT Glickman, EG Sonnenschein, NW Glickman, S Donoghue, MH Goldschmidt: Pattern of diet and obesity in female adult pet dogs. *Vet Clin Nutr* 2(1):6-13, 1995.

All in the Family? (Part 2)

We have mentioned before that, as in many human diseases, e.g., cancer, there may be a *sporadic* form and a *familial* form of bloat. In the sporadic form -- which probably accounts for most cases -- there may be no obvious genetic predisposition. In contrast, clusters of cases within families suggests a *familial* form, in which the genetic influence is strong. Understanding the genetic influence on bloat risk would help breeders made sound breeding decisions.

At the Irish Setter and Great Dane national specialties in 1994, owners were asked about the bloat history of relatives of the dog being measured (index dog). Index dogs who had bloated were more likely to have relatives who had bloated, thus suggesting a genetic link.

Some owners of Irish Setters and Great Danes have sent us pedigrees with bloat histories, which allowed *preliminary* evaluation of the influence of inbreeding on bloat risk. The coefficient of inbreeding is the probability that the 2 genes at the same site on the chromosome are identical because they have come from the same ancestor. This coefficient was higher for dogs who had bloated than for those who had not:

	<u>No. of Dogs</u>	<u>Coefficient of Inbreeding</u>
<i>Irish Setters*</i>		
<i>Dogs with bloat</i>	8	0.1306
<i>Dogs without bloat</i>	11	0.0924
<i>Great Danes**</i>		
<i>Dogs with bloat</i>	3	0.1042
<i>Dogs without bloat</i>	14	0.0413

*Based on 5-generation pedigrees.

**Based on 4-generation pedigrees.

The differences in coefficients suggest that inbreeding may increase the risk, which in turn suggests that bloat has a genetic component in these breeds. However, more Irish Setter and Great Dane pedigrees are needed to complete this study (see col. 2).

Measurement data from Irish Setters at the 1994 show suggested that chest depth/width ratio is a significant bloat risk factor in this breed. Geneticist Dr. Robert Schaible and Irish Setter breeder Jan Ziech are conducting the first detailed pedigree and morphometry study of a familial cluster of bloat cases; this has been a labor-intensive effort! The first results suggest that in this family, the chest depth/width ratio is controlled by a single major gene rather than many genes having smaller effects.

From the Literature --

The most recent issue of *Veterinary PreViews*, a Purina publication which is sent to all veterinarians in the US, includes an article describing the bloat epidemiology research project at Purdue.¹ The article presents an overview of the studies which have been mentioned in this and previous issues of BLOAT NOTES.

Another *Veterinary PreViews* article² summarizes current knowledge about gastric bacteria in dogs. Dogs' stomachs commonly harbor *Helicobacter* and *Gastrospirillum* species which resemble the bacteria (*Helicobacter pylori*) known to cause ulcers in humans, but their role in disease in dogs is not yet known.

Requests for copies can be addressed to *Veterinary PreViews*, Ralston Purina Company, Checkerboard Square, St. Louis MO 63164.

1. LT Glickman *et al.*: Epidemiologic studies of bloat in dogs. *Veterinary PreViews* 2(2):10-13, 15, 1995.

2. KA Eaton: Gastric bacteria in dogs and cats. *Veterinary PreViews* 2(2):3-6, 1995.

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Incidence of and breed-related risk factors for gastric dilatation-volvulus in dogs.

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OBJECTIVE: To compare incidence of and breed-related risk factors for gastric dilatation-volvulus (GDV) among 11 dog breeds (Akita, Bloodhound, Collie, Great Dane, Irish Setter, Irish Wolfhound, Newfoundland, Rottweiler, Saint Bernard, Standard Poodle, and Weimaraner).

DESIGN: Prospective cohort study. **ANIMALS:** 1,914 dogs. **PROCEDURE:** Owners of dogs that did not have a history of GDV were recruited at dog shows, and the dog's length and height and depth and width of the thorax and abdomen were measured. Information concerning the dogs' medical history, genetic background, personality, and diet was obtained from owners, and owners were contacted by mail and telephone at approximately 1-year intervals to determine whether dogs had developed GDV or died. Incidence of GDV based on the number of dog-years at risk was calculated for each breed, and breed-related risk factors were identified.

RESULTS AND CLINICAL RELEVANCE: Incidence of GDV for the 7 large (23 to 45 kg [50 to 99 lb]) and 4 giant (> 45 kg [> 99 lb]) breeds was 23 and 26 cases/1,000 dog-years at risk, respectively. Of the 105 dogs that developed GDV, 30 (28.6%) died. Incidence of GDV increased with increasing age. Cumulative incidence of GDV was 5.7% for all breeds. The only breed-specific characteristic significantly associated with a decreased incidence of GDV was an owner-perceived personality trait of happiness.

BLOAT (GVD) STUDY

Study on multiple causes of bloat was started in about 1998 and ended in 2004. These are highlights:

Nutrient Intake and Bloat

CONTENTS OF FOOD AND BLOAT

Malathi Raghavan, DVM, MS; Lawrence T. Glickman, VMD, DrPH; Nita W. Glickman, MS, MPH; Diana B. Schellenberg*,

Dietary risk factors for gastric dilatation-volvulus (GDV) in dogs were identified using a nested case-control study. Of 1991 dogs from 11 large- and giant-breeds in a previous prospective study of GDV, 106 dogs that developed GDV were selected as cases while 212 remaining dogs were randomly selected as controls. A complete profile of nutrient intake was constructed for each dog based on owner-reported information, published references and nutrient databases. Potential risk factors were examined for a significant relationship with GDV risk using unconditional logistic regression.

The study confirmed previous reports of increased risks of GDV associated with increasing age, having a first-degree relative with GDV, and having a raised food bowl. New significant findings included a 2.7-fold (or 170%) increased risk of GDV in dogs that consumed dry foods containing fat among the first four ingredients.

The risk of GDV was increased 4.2-fold (or 320%) in dogs that consumed dry foods containing citric acid that were also moistened prior to feeding by owners. Dry foods containing a rendered meat meal with bone among the first four ingredients significantly increased GDV risk by 53.0%.

Approximately 30% of all cases of GDV in this study could be attributed to consumption of dry foods containing fat among their first four ingredients, while 32% could be attributed to consumption of owner-moistened dry foods that also contained citric acid. These findings can be used by owners to reduce their dogs' risk of GDV. This manuscript has been accepted for publication in the Journal of the Animal Hospital Association.

Diet-Related Risk Factors for Gastric Dilatation-Volvulus in Dogs of High-Risk Breeds

FINDINGS: VOLUME OF FOOD FED Malathi Raghavan, DVM, PhD Nita Glickman, MS, MPH
George McCabe, PhD Gary Lantz, DVM Lawrence T. Glickman, VMD, DrPH

From the Departments of Veterinary Pathobiology, (Raghavan, N. Glickman, L. Glickman), Veterinary Clinical Sciences (Lantz), and Statistics (McCabe), Purdue University West Lafayette, Indiana 47907-2027.

A nested case-control study was conducted among 1634 dogs with complete diet information in a 5-year prospective study to determine diet-related risk factors for gastric dilatation-volvulus

(GDV). Cases included 106 dogs that developed GDV; controls included 212 dogs without GDV that were frequency matched to cases by year of GDV onset.

Proportionate energy consumed from major food types and from carbohydrates was determined. Dogs were categorized as consuming either a low volume or high volume of food based on the median number of cups of food fed per kg of body weight per meal. Dogs fed a larger volume of food per meal were at a significantly increased risk of GDV, regardless of the number of meals fed daily.

For both large-and giant-breed dogs, the risk of GDV was highest for dogs fed a larger volume of food once daily.

This is from 2002 and is still current: A Review S. Greene

For over 30 years breeders and owners of Standard Poodles have been concerned about reducing their dogs' risk of bloat. Here's some generalized information to help you understand new information learned from a Purdue University Bloat (Gastric Dilation - Torsion Complex)

The term "Bloat" refers to any of three conditions:

- Acute gastric dilation
- Torsion
- Volvus

Bloat also known as the overfeeding or overeating syndrome, involves a swelling up of the stomach from gas, fluid or both (acute gastric dilation). Once distended, the stomach may twist abruptly on the long axis. If it does twist, but the twist is 180 degree or less, it is called a torsion.

A twist greater than 180 degrees is called a volvulus.

Signs and Symptoms of Non-Torsion Bloat - Acute Gastric Dilation The signs are excessive salivation and drooling, extreme restlessness, attempts to vomit or pass stool and evidence of abdominal pain - the dog whines and groans when you push on the stomach wall. The abdomen will be distended. If your dog can belch or vomit, quite likely the condition is not caused by a twist. You must take the dog to a veterinarian where a long rubber or plastic stomach tube will be passed into the stomach. If there is a rush of air from the tube, the swelling in the abdomen will subside and there is almost immediate relief.

Signs and Symptoms of Torsion or Volvulus - A LIFE AND DEATH SITUATION

The initial signs are those of acute gastric dilation, except the distress is more marked. The dog breathes rapidly, has cold and pale mouth membranes and may even collapse. The shock-like signs are caused by strangulation of the blood supply to the stomach and the spleen in torsion or volvulus, a tube cannot be passed into the stomach. The only treatment is IMMEDIATE surgery and you must rush the dog to closest veterinary surgeon.

Preventing Bloat - The Purdue University Study

Many measures have been recommended and tried, but-until recently there has been little scientific evidence that any worked. Now, thanks to the Purdue University Bloat Study that picture is starting to change. Supported by grants from the American Kennel Club's Canine Health Foundation, Morris Animal Foundation and 11 parent breed clubs, including the Poodle Club of America, this five-year prospective study is the first of its kind. And it is yielding information on what breeders and owners should and shouldn't do to reduce Standard Poodles risk of bloat.

The Purdue researchers, led by veterinarian and epidemiologist Dr. Lawrence T. Glickman, have thus far issued two reports of their findings, both published in the peer-reviewed Journal of the American Veterinary Medical Association. The more recent of the two, which appeared in the November 15, 2000, issue of JAVMA, contains findings that should cause Standard Poodle breeders and owners to step back and re-think bloat prevention information.

One of the more important findings was that there are significant differences between the "large breeds" studied (Akita, Bloodhound, Collie, Irish Setter, Rottweiler, Standard Poodle and Weimaraner) and the "giant breeds" studied (Great Dane, Irish Wolfhound, Newfoundland and Saint Bernard).

The results reported here apply to the "large breeds" only, e.g. our Standard Poodles

Old Thoughts: What We Used to Think About Bloat Over the years, breeders, owners and veterinarians have developed a body of lore about what causes bloat and how it can be prevented.

Here are some of those things which we now know are correct, i.e.

- Bloat is caused by too much exercise on a full stomach
- Overloading the stomach.
- Swallowing air when eating.

We used to think that bloat could be prevented or reduced by:

- Wetting dry kibble so that it won't swell in the stomach.
- Raising the food dish above floor level.

Weight, breed size, the ratio of the depth of the thorax to its width and stress were not significantly associated with the risk of bloat in large breed dogs.

In addition, several measures that have long been recommended to reduce the risk of bloat were found to have no effect.

Factors That Make Difference - These measures, long been thought to reduce the risk of bloat, **were found to have no effect:**

- Restricting exercise before or after eating
- Restricting water intake before and/or after meals
- Feeding two or more meals per day
- Moistening dry kibble before feeding

Factors That DO Make A Difference

These four (4) factors ARE associated with an increased risk of bloat in large breed dogs

- 1) Raising the food dish more than doubled the risk for bloat
- 2) Speed of eating -Dogs rated by their owners as very fast eaters had a 38% increased risk of bloat
- 3) Age: The study found that risk increased by 20% with each year of age. Owners should be more alert to early signs of bloat as their dogs grow older.
- 4) Family History: Having a first-degree relative (parent, sibling or offspring) that had bloated increased a dog's risk by 63%.

Conclusions

The Purdue research team concluded these are the things you can do to prevent bloat:

- The strongest recommendation to prevent GVD (bloat) should be to not breed a dog that has a first degree relative that has had bloat. This places a special responsibility on an owner to inform the breeder should their dog bloat.
- Do not raise the feeding dish
- SLOW the dog's speed of eating.

A future report from the research team will provide data on dietary factors and how they may or may not be associated with bloat risk

References:

1. <http://www.vet.purdue.edu/epi/bloat.htm>
2. Glickman LT, Glickman NW, Schellenberg, DB, et al. Non-dietary risk factors for gastric dilatation-volvulus in large and giant breed dogs.
3. Dog Owner's Home Veterinary Handbook, Delbert G. Carlson, DVM and James M. Giffin, MD

Incidence of and breed-related risk factors for gastric dilatation-volvulus in dogs

Lawrence T. Glickman, VMD, DrPH; Nita W. Glickman, MS, MPH; Diana B. Schellenberg, MS; Malathi Raghavan, DVM; Tana Lee, BA

(Journal of the American Veterinary Medical Association, Vol. 216, No. 1, January 1, 2000)

Objective-To compare incidence of and breed-related risk factors for gastric dilatation-volvulus (GDV) among 11 dog breeds (Akita, Bloodhound, Collie, Great Dane, Irish Setter, Irish Wolfhound, Newfoundland, Rottweiler, Saint Bernard, Standard Poodle, and Weimaraner).

Design-Prospective cohort study. **Animals**-1,914 dogs.

Procedure-Owners of dogs that did not have a history of GDV were recruited at dog shows, and the dog's length and height and depth and width of the thorax and abdomen were measured. Information concerning the dogs' medical history, genetic background, personality, and diet was obtained from owners, and owners were contacted by mail and telephone at approximately 1-year intervals to determine whether dogs had developed GDV or died. Incidence of GDV based on the number of dog-years at risk was calculated for each breed, and breed-related risk factors were identified.

Results and Clinical Relevance-Incidence of GDV for the 7 large (23 to 45 kg [50 to 99 lb]) and 4 giant (> 45 kg [> 99 lb]) breeds was 23 and 26 cases/1,000 dogyears at risk, respectively. Of the 105 dogs that developed GDV, 30 (28.6%) died. Incidence of GDV increased with increasing age. Cumulative incidence of GDV was 5.7% for all breeds. The only breed-specific characteristic significantly associated with a decreased incidence of GDV was an owner-perceived personality trait of happiness. (*J Am Med Vet Assoc* 2000;216: 40-45)

Non-dietary risk factors for gastric dilatation-volvulus in large and giant breed dogs

Lawrence T. Glickman, VMD, DrPH; Nita W. Glickman, MS, MPH; Diana B. Schellenberg, MS; Malathi Raghavan, DVM; Tana Lee, BA

(Journal of the American Veterinary Medical Association, Vol. 217, No. 10, November 15, 2000)

Objective-To identify non-dietary risk factors for gastric dilatation-volvulus (GDV) in large breed and giant breed dogs.

Design-Prospective cohort study.

Animals-1,637 dogs >- 6 months old of the following breeds: Akita, Bloodhound, Collie, Great Dane, Irish Setter, Irish Wolfhound, Newfoundland, Rottweiler, Saint Bernard, Standard Poodle, and Weimaraner.

Procedure-Owners of dogs that did not have a history of GDV were recruited at dog shows, and the dog's length and height and the depth and width of its thorax and abdomen were measured. Information concerning the dog's medical history, genetic background, personality, and diet was obtained from the owners, and owners were contacted by mail and telephone at approximately 1-year intervals to determine whether dogs had developed GDV or died. Incidence of GDV, calculated on the basis of dogyears at risk for dogs that were or were not exposed to potential risk factors, was used to calculate the relative risk of GDV.

Results and Clinical Relevance-Cumulative incidence of GDV during the study was 6% for large breed and giant breed dogs. Factors significantly associated with an increased risk of GDV were increasing age, having a first-degree relative with a history of GDV, having a faster speed of eating, and having a raised feeding bowl. Approximately 20 and 52% of cases of GDV among the large breed and giant breed dogs, respectively, were attributed to having a raised feed bowl. (*J Am Vet Med Assoc* 2000;217:1492-1499)

Gastric Dilatation-Volvulus in Dogs

Acute gastric dilatation-volvulus (GDV) is a life-threatening condition, with fatality rates ranging from 10% to 60%.¹ The animals most commonly affected by GDV include older, large or giant breed, deep-chested dogs, including Great Danes, German Shepherds, Standard Poodles, and large mixed breed dogs. Early diagnosis, medical stabilization, surgical intervention and post-operative monitoring are important factors in reducing the mortality rate.

Gastric dilatation-volvulus is the result of accumulation of gas, fluid, or a combination of the two in the stomach. Factors responsible for causing dilatation include aerophagia, exercise after ingesting a meal, and overeating. The stomach distends with gas or fluid, and rotation along the axis of the esophagus and cardia follows. The rotation is generally in the clockwise direction (when viewed in dorsal recumbency), and can be up to a maximum of 360°. A less common fate is a counter-clockwise rotation, to a maximum of 90°. In addition to the accumulation of gas and/or fluid, there is often an outflow obstruction due to a mechanical or functional abnormality.²

The clinical signs associated with GDV are restlessness, anxiousness, respiratory dysfunction, hypersalivation, retching, abdominal distension and frequent attempts to vomit. The animal may present weak, collapsed, or comatose, depending on the degree of shock. Signs related to hypovolemic shock are pale mucous membranes, prolonged capillary refill time, rapid, weak, thready pulses, and tachypnea. Diagnosis of GDV is based upon clinical signs, inability to pass a gastric or nasogastric tube effectively, and consistent radiographic findings.

The major life threatening abnormality associated with GDV is shock. Shock is due to compression of the caudal vena cava, from distension of the stomach, and the portal vein, from distension and rotation of the stomach. As a result, there is decreased tissue perfusion, which leads to hypoxia and ischemia of tissues. Ischemia of cardiac muscles can result in arrhythmias, and ischemia of abdominal organs can lead to necrosis/death of affected organs/tissues.

The first priority for treatment of GDV is cardiovascular stabilization. Dogs that have persistent circulatory collapse are thought to be at greater risk of dying than those dogs that are stabilized.¹ Hosgood, et al, suggests that intravenous therapy with 7% sodium chloride plus 6% dextran initially, followed by 9% sodium chloride, is superior to 9% sodium chloride alone. Once the animal is stabilized the stomach is decompressed using orogastric intubation or needle gastrocentesis. Radiographs are taken prior to surgery to determine if a volvulus is present. Broad spectrum antibiotics are administered prophylactically. The use of corticosteroids remains controversial, but have shown to be beneficial in instances of septic or endotoxic shock.

The timing of surgery also remains controversial, as there are advantages and disadvantages to early and late surgical intervention. The surgical techniques used for repair of GDV include tube gastrostomy, circumcostalgastropexy, belt-loop gastropexy, and permanent incisional gastropexy. Complications associated with tube gastrostomy are peritonitis (due to premature removal or loosening of the tube), cellulitis (due to gastric content leakage), and alteration of gastric myoelectric activity. There is some evidence suggesting gastropexy procedures lead to chronic bloaters by altering gastric emptying.³

Perfusion of the tissues is maintained perioperatively and post-operatively, using an intravenously administered, balanced electrolyte solution. Perioperative and post-operative monitoring of the patient for perfusion, as well as abdominal distension, are important. The parameters used to assess tissue perfusion include capillary refill time, blood pressure, peripheral pulse pressures, arterial blood gas, urine output, PCV, and total protein. Abdominal distension is monitored due to the potential of re-bloating following surgery.

There are many complications that can occur postoperatively, most of which are secondary to the initial problems associated with GDV. Cardiac arrhythmias, usually of ventricular origin, tend to occur in the first

12-36 hours following surgery. A continuous ECG is recommended to monitor for arrhythmias, and anti-arrhythmic drugs (lidocaine, procainamide) are used when the arrhythmia is responsible for poor tissue perfusion. Additional complications include disseminated intravascular coagulation, sepsis caused by gastric leak or aspiration pneumonia, protein loss, gastric ischemia and esophagitis.

Additional medical options available for the treatment of GDV include: a lipid peroxidase inhibitor to prevent lipid peroxidation secondary to reperfusion injury; cisapride, metoclopramide, erythromycin, and ranitidine to facilitate gastric emptying; and vasoactive intestinal peptide to facilitate eructation and lower esophageal sphincter tone in animals which are chronic bloaters. The effect of metoclopramide on gastric emptying in dogs with GDV has been studied, and the results suggest there is no improvement of gastric emptying.⁴

Left untreated, GDV can lead to multiple organ failure, circulatory shock and death.⁴ Factors which contribute to a higher mortality rate include gastric necrosis, gastric resection, splenectomy and pre-operative cardiac arrhythmias.⁵ It is therefore important to be familiar with the clinical signs of GDV in order to arrive at an early diagnosis, stabilize the patient as soon as possible, surgically correct the volvulus, and medically manage any additional complications.

-by Elizabeth Natz, Class of 1999

-Edited by Brad L. Njaa, DVM, MVSc

Post Publication Correction

The section discussing fluid therapy for gastric dilatation-volvulus in dogs should have read "... intravenous therapy with 7% NaCl (5ml/kg) in 6% Dextran 70 (HS/D70) initially followed by 0.9% NaCl is superior to 0.9% NaCl alone." Resource is Section 7/Gastrointestinal Disorders, Chapter 4/Disease of the Stomach, pp. 675 of Saunders Manual of Small Animal Practice, edited by Stephen J. Birchard and Robert G. Sherding, W.B. Saunders Company, 1994.

<http://www.addl.purdue.edu/newsletters/1999/fall/gdv.shtml>