

A RETROSPECTIVE STUDY OF SURVIVAL RATES IN DOGS WITH GASTRIC DILATATION-VOLVULUS FOLLOWING SURGICAL TREATMENT (2010-2019)

STUDIUL RETROSPECTIV AL SUPRAVIEȚUIRII CÂINILOR CU SINDROM DE DILATARE GASTRICĂ CU VOLVULUS SUPUȘI TRATAMENTULUI CHIRURGICAL (2010-2019)

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ABSTRACT | REZUMAT

Twenty-three dog case records were included in an analysis of dogs treated by a standardized surgical protocol for gastric dilatation-volvulus syndrome between 2010 and 2019. In all cases the gastric dilatation-volvulus were confirmed at surgery, of which 11 had 180 degrees torsion and 12 had torsion between 270 and 360 degrees. Among dogs with gastric dilatation-volvulus, the fatality rate was 21.7% (5/23). Two (8%) dogs with gastric dilatation-volvulus that underwent partial gastrectomy, splenectomy, and gastropexy but just as the other three with gastric necrosis and gastrectomy without splenectomy (13%), died or were subsequently euthanized. In comparing the group of dogs with gastric dilatation-volvulus that survived to those who died, there were no statistical differences regarding the: age, body weight, duration of surgery or of anesthesia, degree of volvulus, and type of gastropexy. A predisposition was demonstrated for German Shepherd Dogs and large mixed-breed dogs. The time lapsed from the onset of clinical signs until presentation at the clinic and treatment initialization represents a significant factor associated with a lower survival rate. Cardiac arrhythmias were detected in 48% (11/23) of the dogs with GDV. There was also no statistical correlation between development of cardiac arrhythmias and outcome in dogs with gastric dilatation-volvulus. The causes of death in dogs with gastric dilatation-volvulus were multiple, but gastric necrosis was a common reason for death or euthanasia (5 dogs).

Key words: dog, gastric dilatation-volvulus, gastrectomy, gastropexy, splenectomy

Douăzeci și trei de cazuri de câini cu sindrom de dilatare gastrică cu volvulus, înregistrate între 2010 și 2019 și tratate printr-un protocol chirurgical standard, au fost incluse în acest studiu. În toate cazurile, diagnosticul de dilatație gastrică cu volvulus a fost confirmat la intervenția chirurgicală, dintre acestea 11 cazuri prezentând torsiune gastrică de 180 de grade și 12 cazuri torsiune gastrică între 270-360 grade. La câinii cu dilatație gastrică cu volvulus, rata mortalității a fost de 21,7% (5/23). Doi câini (8%) cu dilatație gastrică cu volvulus au suferit gastrectomie parțială splenectomie și gastropexie, dar la fel ca ceilalți trei cu necroză gastrică și gastrectomie fără splenectomie (13%) au murit sau au fost ulterior eutanasiați. În compararea grupului de câini cu GDV care au supraviețuit cu grupul celor care au murit, nu au existat diferențe statistice în ceea ce privește vârsta câinelui, greutatea corporală, durata intervenției chirurgicale sau a anesteziei, gradul de torsiune gastrică și tipul de gastropexie. O predispoziție pentru dilatație gastrică-volvulus a fost demonstrată pentru câinii din rasa Ciobănesc German și metișii cu greutate corporală mare. Timpul scurs de la debutul semnelor clinice până la prezentarea la clinică și inițializarea tratamentului reprezintă un factor semnificativ asociat cu o rată redusă de supraviețuire. Aritmiile cardiace au fost detectate la 48% (11/23) dintre câinii cu dilatație gastrică cu volvulus. Nu a existat o corelație statistică între dezvoltarea aritmiei cardiace și supraviețuire. Cauzele decesului la câinii cu dilatație gastrică cu volvulus au fost multiple, dar necroza gastrică a reprezentat cauza decesului sau a deciziei de eutanasiere pentru 5 cazuri.

Cuvinte cheie: câine, dilatație gastrică cu volvulus, gastrectomie, gastropexie, splenectomie

Gastric dilatation-volvulus (GDV) is an acute, life-threatening condition of dogs that needs immediate medical and surgical management (2, 3, 4, 9, 10). The precise pathophysiology of GDV is unclear but is characterized by a rapid accumulation of gas in the sto-

mach, distention and malpositioning of the stomach, increased intragastric pressure which in turn lead to decreased venous return, portal hypertension and often shock (18, 19). Initial treatment consists of gastric decompression and shock therapy (6, 9, 10). Surgical intervention is necessary for correction of visceral displacement and to prevent recurrence of GDV. Surgical goals of treatment for GDV are to decompress the stomach, to correct the malpositioning and to fix the stomach so that recurrence is prevented (3, 10).

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Fixation methods for the stomach include tube gastropexy, belt-loop gastropexy, circumcostal gastropexy, gastrocolopexy, ventral midline gastropexy and incisional gastropexy (1).

Reported prevalence values for GDV in dogs varies widely across differing breeds and populations (4, 11, 12, 14, 16, 20), but it is generally recognized as a disorder that mainly affects large and giant breeds (12). Breeds at highest risk include the Great Dane, Gordon Setter, Irish Setter, Weimaraner, Saint Bernard, Standard Poodle, and Bassett Hound (4, 12, 16). Although the exact aetiology of GDV remains unclear, several studies have concentrated on breed-related and environmental risk factors for development of the disease. Possible predisposing factors include lean body condition, increasing age, increased thoracic depth-to-width ratio, aggressive or fearful temperament, decreased food particle size, once daily feeding, histologic evidence of inflammatory bowel disease, increased hepatogastric ligament length, previous splenic torsion or splenectomy with a large splenic mass, and stress (2, 11, 12, 15, 18, 19).

Although in the veterinary literature there are several studies (4, 8, 11, 12, 14, 16, 17, 20) that have examined the risk factors for death following the surgical treatment of GDV, in our country, as far as we know, nobody has evaluated the incidence or risk factors associated with GDV, thus there is no data showing the impact on current morbidity and mortality rates in Romania.

The objective of this study is to report the prevalence, risk factors associated with death and clinical results for dogs with GDV that were treated surgically in the Surgery Clinic of Banat's University of Agricultural Sciences and Veterinary Medicine, Timisoara, Romania between 2010 and 2019.

MATERIALS AND METHODS

Medical records of the Surgery Clinic of Banat's University of Agricultural Sciences and Veterinary Medicine, Timisoara, Romania between 2010 and 2019 were reviewed to identify dogs that had gastric dilatation-volvulus (GDV).

The analysis was based on the records of individual dogs. Criteria for including dogs in the study were based on preoperative clinical and radiographic examinations, and intraoperative confirmations of GDV.

The standardized surgical protocol for gastric dilatation-volvulus in our clinic, in according with rational, practical and clinically proven protocols for the management of this condition (1, 3, 10), includes:

- Initial medical management of GDV involves shock therapy, and gastric decompression, followed by management of cardiac arrhythmias. Patients who are hemodynamically stable can sometimes be treated

with orogastric intubation prior to fluid resuscitation. Mild to moderate hypovolemic shock is treated with lactated Ringer's solution at 90 ml/kg which is administered during the first hour. With severe hypotension, intravenous administration of dextran 70 by bolus infusion of 5 ml/kg over 5 minutes is followed by administration of lactated Ringer's solution at 60 ml/kg/h over the first hour. Ventricular arrhythmia therapy - a slow bolus of lidocaine at 1-2 mg/kg IV may be followed by a continuous infusion of 25-75 µg/kg/min.

- Gastric decompression by orogastric tube Food can be removed by gastric lavage, in cases that have ingested large amounts of food. If passage of the tube is unsuccessful, intragastric gas can be removed via gastrocentesis. If gastrocentesis is inefficient, a percutaneous gastrostomy is used by inserting a 22 Fr Foley tube.

- Radiographic examination is always postponed until after patient stabilization.

- Anaesthesia. Induction is performed with butorphanol and diazepam, followed by orotracheal intubation and maintenance by inhalation narcosis with isoflurane.

- Surgical management involves: a) repositioning of the stomach with resection or partial invagination of any devitalized gastric wall by standard methods and b) a prophylactic gastropexy technique to prevent recurrence, frequently resorting to belt-loop or circumcostal techniques gastropexy.

- Postoperative management involves: maintaining shock therapy; in cases with chronic gastric atony, metoclopramide (0.2 mg/kg TID) is added to the treatment. When gastric ischemia and / or necrosis are suspected, antibiotic therapy consists of cefazolin or ampicillin (22 mg / kg IV TID) supplemented with metronidazole (10-15 mg / kg IV TID).

Data recorded and analysed for each patient included: breed, age, body weight, sex, time elapsed from the onset of clinical signs to the time of presentation in the Surgery Clinic, respectively initiation of therapeutic management, type of gastric decompression, duration of anaesthesia, duration of surgery, degree of volvulus, type of surgical treatment chosen (repositioning of the stomach and partial invagination of the stomach, or gastrectomy, and / or splenectomy plus gastropexy).

According to the proposed purpose, we evaluated mortality and its causes in GDV. In all cases of GDV, we evaluated factors based on recorded data, which might be associated with higher mortality. The following quantitative recorded data (age, body weight, time lapsed of the onset of clinical signs and moment of presentation at the clinic, time duration of anaesthesia, and duration of surgery) were examined by the Student's t-test with regard to the risk of death.

Interpretation of statistical significance in patients that died than those that survived was for Student's t-test, p value < 0.05. For statistically significant data, the standard deviation, 95% confidence intervals and odds ratio were calculated. For each of the potential risk factors identified above, we characterized the two groups of dogs (those that survived and those that died) by the χ^2 -test with regard to the risk of death. The difference between the two groups was considered to be significant at p < 0.05. Values higher than or lower than 1.00 indicated higher or lower risks, respectively. Mortality was determined for each group.

Statistical calculation of the t test, standard deviation, confidence intervals, relative risk - odds ratio and the χ^2 test was performed with software available at <https://www.socscistatistics.com>.

RESULTS AND DISCUSSIONS

In the medical records of the Surgery Clinic of the Banat's University of Agricultural Sciences and Veterinary Medicine, Romania, registered between 2010 and 2019, 23 dogs were diagnosed and surgically treated for GDV. Dogs with GDV represented approximately 0.2% of all the patients treated at our Surgery Clinic. This prevalence of the syndrome corresponds with other studies reporting the range of 0.13% to 0.76% of all the patients treated (10, 12, 20). Because the dogs included in our study have no representative of the pet population in general, it is not possible to accurately estimate the total number of pet dogs that will develop GDV each year. However, GDV is clearly a major cause of morbidity and mortality in large dogs (4, 12, 14).

Table 1

Clinical cases of the dogs with GDV's surgery - the results obtained after applying the Student test to identify the potential risk factors for death

RACE	German Shepherd	Mixed	Caucasian Shepherd	Other 8 breeds (<i>Basset, Boxer, Chow Chows, Doberman, Irish Setters, Labrador, Rottweiler, Tosa Inu</i>) with only one case	
No (died/survival)	8 (2/6)	5 (2/3)	2 (0/2)	8 (0/8)	
AGE	up to 5 years			over 5 years	
No (died/survival)	10 (2/8)			13 (3/10)	
BODY WEIGHT	25-35 kg			over 35 kg	
No (died/survival)	12 (1/11)			11 (4/7)	
SEX	Male			Female	
No (died/survival)	9 (0/9)			14 (5/9)	
TIME from clinical signs to surgery	Up to 6 hours		6-12 hours*	over 12 hours*	
No (died/survival)	2 (0/2)		8 (0/8)	13 (5/8)	
GASTRIC DECOMPRESSION	Orogastric tube		Gastrocentesis	Percutaneous gastrostomy	
No (died/survival)	11 (0/11)		9 (2/7)	3 (3/0)	
TIME anesthesia and surgery	Up to 1 hour		1-2 hours	Over 2 hours	
No (died/survival)	12 (0/12)		5 (0/5)	6 (5/1)	
DEGREE OF VOLVULUS	180 degree torsion		Torsion between 279-360 degree		
No (died/survival)	11 (0/11)		12 (5/7)		
TYPE OF SURGICAL TREATMENT	1	2	3*	4*	5
No (died/survival)	12 (0/12)	5 (0/5)	3 (3/0)	2 (2/0)	1 (0/1)
GASTROPEXY	Incisional		Belt loop	Circumcostal	Ventral midline
No (died/survival)	1 (1/0)		11 (2/9)	10 (2/8)	1 (0/1)
CARDIAC ARRHYTHMIAS	yes			no	
No (died/survival)	11 (2-9)			12 (3-9)	

Legend

No - number

* - statistically significant values of the t-Student test to identify potential risk factors for death

Type of surgical treatment

1- stomach repositioning, gastropexy

2- stomach repositioning, partial invagination of the stomach and gastropexy

3- stomach repositioning, gastrectomy and gastropexy

4- stomach repositioning, splenectomy and gastropexy

5- stomach repositioning, gastrectomy, splenectomy and gastropexy

Table 2

**Identification by statistical analysis
of the potential risk factors for survival of dogs with GDV**

Risk factor	Number of Dead Dogs	Number of Survived Dogs	95% confidence intervals	Odds Ratio	Probability Values (χ^2 -test)	Relative risk
1. Time between the onset of clinical signs and the admission to surgery						
up to 12 hours	0	10	11.6-20.3	12.96	p < 0.05	3.6
over 12 hours	5	8				
2. Gastric necrosis						
treated by gastrectomy	3	0	1.3-1.6	1.38	p < 0.05	1.3
treated by gastrectomy and splenectomy	2	1				

According to the existing studies (15), the long length of the hepatogastric ligament favors the appearance of GDV in dogs. The recorded and analyzed data are presented in Table 1.

The recorded and analysed data reveals that the majority of dogs operated for GDV (56%) were from the German Shepherd breed (8/13) and large mixed-breed dogs with a body weight greater than 35 kg (5/13). Large or giant deep-chested and purebred dogs, including German Shepherds, Great Danes, Collies, Weimaraners, Irish and Gordon Setters, Bloodhounds, Akitas, Saint Bernards, Mastiffs, Standard Poodles, Labrador and Golden Retrievers, Doberman Pinschers, and Chow Chows, are at high risk for GDV (10, 12, 20).

Out of the 23 dogs operated by us, 14 were females (60%). This data is similar to that reported by Evans and Adams -2010 (11) - 55% - in their study conducted in UK. In the literature there are studies that show a greater predisposition of males (2, 10) but also studies that say that there is no gender predisposition (9). The mortality rate for the 23 dogs operated for GDV was 21.7%. On the basis of recent studies, the mortality rate for GDV in dogs ranges from 10% to 33% (2, 5, 10, 11, 14).

The results obtained after applying the Student test to identify the potential risk factors for death were statistically significant for the time elapsed between the onset of clinical signs and admission to surgery, respectively the initial medical management. The time periods between the onset of clinical signs and admission to surgery, respectively the initial medical management, as they were longer, showed statistical significance in the patients who died than those who survived (Student's test, p < 0.05). The analysis of our cases reveals that most of the owners (91%) came to the clinic after 6 hours.

Applying the χ^2 test for the period of time between the onset of clinical signs and admission to surgery, respectively the initial medical management, showed values which indicated higher risk of mortality (3.6) –

Table 2. The mortality was 100% for the group in which the period of time elapsed between the onset of clinical signs and hospitalization for surgery, respectively the initial medical management, was over 12 hours.

Similar findings are also found in other articles (16, 20), but there are studies (4) that show that post-operative mortality is not significantly influenced by time between onset of clinical signs and surgery.

Other factors identified with higher risk of mortality were gastric necrosis treated by gastrectomy, with or without splenectomy (odds ratio > 1), at which the mortality rate was also 100% and the relative risk of death was 1.3 – Table 2. These types of treatment also involved a longer duration (> 2 hours) of anesthesia and surgery, but we could not identify factors that show that the duration of anesthesia and surgery significantly influences survival.

GDV compromises the blood supply of the gastric wall. The vessels of the gastric *fundus* are more vulnerable to ischaemia. In addition, gastric and splenic displacement can cause mechanical obstruction of local blood vessels as well as obstruction by thrombus formation. Ischaemia-induced gastric necrosis is most frequently seen at the gastric *fundus* and sometimes in the *cardia* area. Splenic displacement can lead to venous congestion, thrombosis, splenic artery avulsion and partial or complete splenic infarction whether or not accompanied by splenic torsion (19). Other studies (8, 13, 17, 18) have shown partial gastrectomy to be a negative risk factor for survival in dogs with GDV. In contrast, partial gastrectomy was not found to be a significant risk factor for death in the Beck's et al. study - 2006 (2). A possible explanation for a better result is the use of stapling devices for gastrectomy (2, 7).

In comparing the group of dogs with gastric dilatation-volvulus that survived to those that died, there were no statistical differences in the patients' age, body weight, duration of surgery or of anesthesia, degree of volvulus, and type of gastropexy.

Cardiac arrhythmias were detected in 48% (11/23) of the dogs with GDV but no statistical correlation be-

tween development of cardiac arrhythmias and outcome in dogs with gastric dilatation-volvulus. The results obtained and their interpretation are similar to those of other studies that reported 40-50% of cardiac arrhythmias in dogs with GDV (2, 4, 6) although another article (14) shows that the factors that were associated with a significant increase in overall mortality were the presence of pre- and postoperative cardiac arrhythmias, simple splenectomy and splenectomy with partial gastric resection. Our findings indicated that the risk factors that significantly influence survival after GDV surgery in dogs are gastric wall necrosis and the time elapsed from the onset of clinical signs to the time of initiation of treatment.

CONCLUSIONS

The mortality rate for the 23 dogs operated for GDV was 21.7%. The factor that was associated with a significant decrease in the overall mortality rate was short time from the onset of clinical signs to admission for surgery. Gastric necrosis was a common reason for death or euthanasia in dogs with GDV.

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