Acta Veterinaria-Beograd 2018, 68 (2), 161-167
UDK: 636.7.09:616.33-073
DOI: 10.2478/acve-2018-0012

*Research article*

# ASSESSMENT OF THE PREVALENCE OF GASTRIC "GRAVEL SIGN" IN DOGS WITH ACUTE GASTRIC DILATATION-VOLVULUS

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(Received 25 March, Accepted 15 June 2018)

Radiological examination of gastric "gravel sign" was retrospectively conducted in 60 dogs presented with acute gastric dilatation-volvulus (GDV) syndrome. Other radiographic findings including loss of peritoneal serosal detail, presence of radiopaque foreign bodies, gastric pneumatosis, splenomegaly, and megaesophagus, were also examined in these patients. "Gravel sign" was detected on the pre-operative radiographs of 17 dogs with acute GDV (28.3%), suggesting that these patients could be suffering from chronic partial gastric obstruction before examination. German Shepherd dogs were significantly over-represented in this group (10/17, 58.8%). Dogs with acute GDV showing "gravel sign" should be carefully investigated for the presence of underlying gastrointestinal processes that might be associated with chronic partial obstruction.

**Key words:** gravel sign, gastric dilatation volvulus, dogs, German Shepherd dog

## INTRODUCTION

Acute gastric dilatation-volvulus (GDV) syndrome is a common, life-threatening multifactorial condition affecting primarily purebred and large or giant breed dogs with a deep and narrow chest conformation [1,2]. Fatality rates range from 14% to 33%, with gastric wall necrosis being the major complication associated with mortality [3]. Acute GDV has been widely described in dogs; however, the exact cause of this pathological condition is not clearly understood. Multiple risk factors, such as decreased gastric motility, delayed gastric emptying, underweight or old age, and nervous and fearful behavior have been postulated [1,4]. Larger volume of food per meal once a day, previous splenectomy, and presence of gastric foreign bodies have been reported as a significant risk factor for acute GDV in predisposed dogs [5-7]. On the other hand, chronic gastric volvulus has rarely been described in dogs. Typically affected dogs are not presented as emergencies and show a chronic history of non-specific clinical

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signs, including weight loss, vomiting, and bloating [8]. Chronic gastric instability with presumed incomplete volvulus has also been suggested as a predisposing factor for developing acute GDV [8].

"Gravel sign" is a radiographic finding characterized by the accumulation of granular mineral opacity material within the gastrointestinal tract (GIT), indicating poor gastrointestinal motility and/or emptying, suggesting chronic partial obstruction [9].

The purpose of this retrospective study was to determine the prevalence of gastric "gravel sign" in dogs suffering from acute GDV and to investigate if the presence of chronic partial obstruction could predispose this pathology.

## MATERIAL AND METHODS

Complete medical documentation including abdominal radiographs of all dogs with diagnosis of acute GDV established at the Veterinary Teaching Hospital of the University Autonomous of Barcelona between 2007 and 2012, were analyzed retrospectively. Inclusion criteria included confirmation of GDV at surgery and at least one diagnostic high quality right lateral abdominal radiograph. Data including breed, gender, age, and surgical report were obtained from the medical records. When available, previous clinical history was also reviewed.

All abdominal radiographs were assessed by two observers (ED, RA) in order to establish the presence of gastric "gravel sign". "Gravel sign" was defined as radiopaque granular material accumulated in a distended stomach due to a gastric outflow problem. All available projections were used to aid in the identification of the "gravel sign". When present, the location of the "gravel sign" was classified as being within the gastric fundus, body, or pyloric antrum. Also, other radiographic findings including loss of serosal detail, presence of radiopaque foreign bodies, gastric pneumatosis, splenomegaly, and megaesophagus were evaluated. In the case of initial disagreement between the observers, the authors reviewed the images to reach a consensus.

### Statistical analysis

Descriptive statistics of the radiographic findings (presence of "gravel sign", loss of serosal detail, radiopaque foreign bodies, gastric pneumatosis, splenomegaly, and megaesophagus), signalment (age, sex, and breed) and clinical data were considered. Continuous variables were assessed for normality using visual inspection of data distribution. Mean standard deviation or median with minimum and maximum values were used to describe continuous variables. Qualitative variables were described by absolute and relative frequencies and analyzed by Fisher's Exact test and Pearson Chi-Square test. Statistical analyses were performed with SPSS version 20.0 (IBM) and a Type I error of 5% were used in all analyses.

## RESULTS

Sixty dogs met the inclusion criteria; 37 entire males (61.7%), 11 entire females (18.3%), 9 neutered males (15%) and 3 spayed females (5%) with a mean age of 7.6 ± 3.2 years (range 2–13 years). The subjects included mixed breed dogs (n=8), German Shepherd dogs (n=20), Dobermann (n=4), Great Dane (n=4), Saint Bernard (n=3), Briard (n=3), Bobtail (n=2), Golden Retriever (n= 1), Siberian Husky (n=1), Basset Hound (n=1), Spanish Mastiff (n=1), Giant Schnauzer (n=1), Spanish Greyhound (n=1), Ibizan Hound (n=1), Bruno Jura Hound (n=1), Bernese Mountain Dog (n=1), Canary Mastiff (n=1), Shar-Pei (n=1), Pit Bull (n=1), Rottweiler (n=1), Fila Brasileiro (n=1), Belgian Shepherd (n=1) and Chow Chow (n=1).

Seventeen dogs (28.3%) showed radiographic evidence of "gravel sign" on the pre-operative radiograph within the body or fundus of the stomach. Presence of gastric foreign bodies, loss of serosal detail, splenomegaly and megaesophagus were identified in 9 (15%), 42 (70%), 25 (41.7%) and 7 (11.7%) patients respectively. Gastric pneumatosis was not identified in any dog. Increased prevalence of loss of serosal detail (82.4%) and splenomegaly (70.6%) was found in the "gravel sign" group, however, only splenomegaly was statistically significant (P= 0.004). The results related to the influence of age and prevalence of the radiographic findings in dogs with and without presence of "gravel sign" are shown in Table1. In the "gravel sign" group (17/60), there were 10 German Shepherd dogs (10/17, 58.8%), making this breed statistically over-represented (P= 0.008). Pre-existent medical records were available in 9 patients of the "gravel sign" group. Previous history of GIT signs was identified in 4 dogs including chronic vomiting (4/4), chronic diarrhea (3/4), gastric dilatation (1/4), and pica (1/4). Of these patients, 2 were German Shepherd dogs. Other concurrent pathologies were dermatitis (6/9), cardiac disease (2/9), leishmaniasis (1/9) and hyperadrenocorticism (1/9).

**Table 1.** Group prevalence of radiographic findings and age distribution.

| | **Gravel Sign Group** | **No Gravel Sign Group** |
|---|---|---|
| Population (N=60) | 17(28.3%) | 43 (71.7%) |
| Mean Age ± SD* (years) | 6.2 ± 2.3 | 8.2 ± 3.3 |
| Gastric Foreign Bodies | 1 (5.9%) | 8 (18.6%) |
| Loss of Serosal Detail | 14 (82.4%) | 28 (65.1%) |
| Splenomegaly | 12 (70.6%) | 13 (30.2%) |
| Megaesophagus | 1 (5.9%) | 6 (13.9%) |
| Gastric Pneumatosis | 0 (0%) | 0 (0%) |

*Standard deviation (SD)

## DISCUSSION

To our knowledge, this is the first report describing the prevalence of "gravel sign" on radiographs of dogs with diagnosed acute GDV (Fig 1). In this study, 28.3% of patients with acute GDV showed gastric "gravel sign" on the preoperative radiographic assessment, suggesting that these patients might have been suffering from chronic and partial gastric obstruction before admission (Fig 2). Delayed gastric emptying may have been the result of altered gastrointestinal motility and/or a partial pyloric outflow obstruction in these dogs. The etiopathogenesis of GDV is still not completely understood and appears to be multifactorial and influenced by different risk factors [1,4]. Chronic gastric volvulus has been suggested as a predisposing factor for developing acute GDV and also associated with partial pyloric outflow obstruction in dogs [8]. Therefore, pre-existence of this entity could not be excluded in these patients.

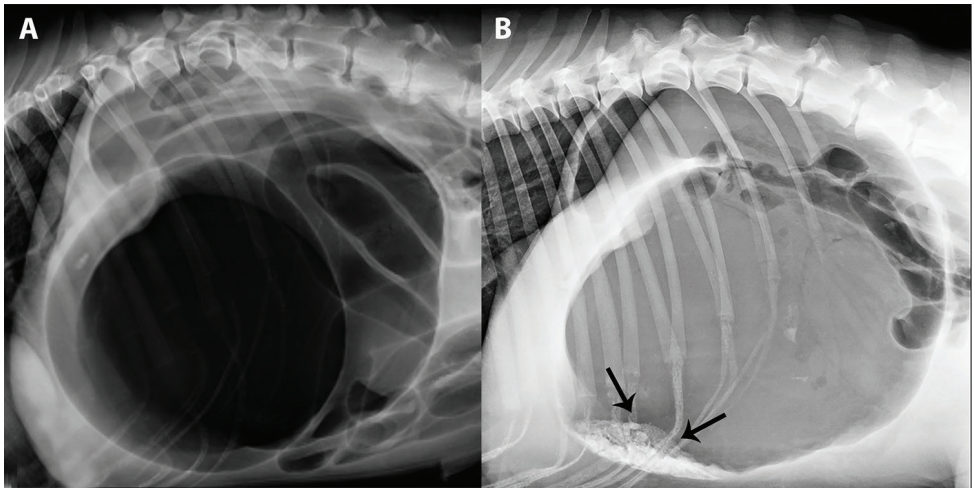


**Figure 1.** Right lateral radiographs show noticeable changes corresponding to gastric volvulus in two patients **(A,B)**. In both cases, the stomach is markedly distended with gas. Presence of gastric compartmentalization between the pylorus and body, being the pylorus on the dorsocranial aspect of the abdomen was also noted. Note the presence of gastric "gravel sign" labeled with black arrows **(B)**.

The population of dogs in the present study was similar to data reported in previous studies in terms of impact on breed and age on the development of GDV [5,10,11,]. Nevertheless, males were over-represented in this study, although no sex predilection has been previously demonstrated [1]. Similarly to other studies, German Shepherd dogs have been found to be at a higher risk for developing GDV [10,11]. Moreover, in this study the presence of this breed in the "gravel sign" group was significantly increased, depicting 58.8% of the population.

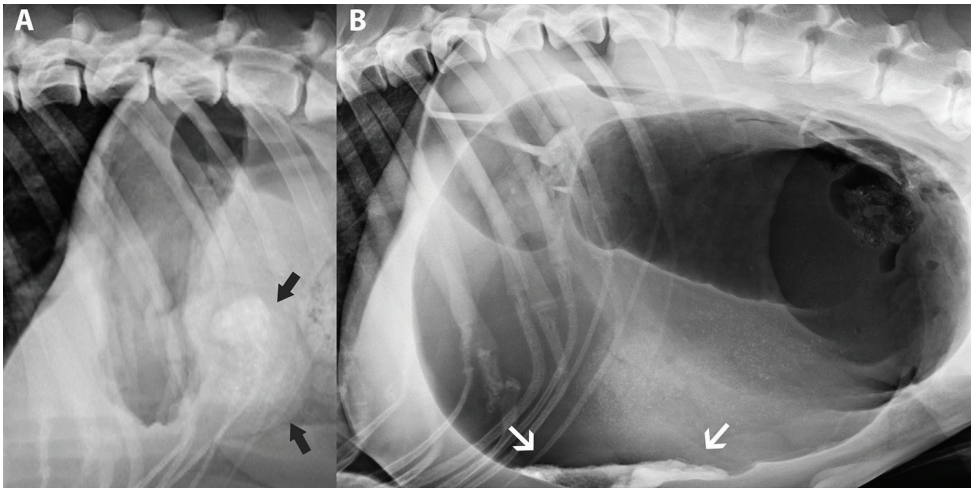


**Figure 2.** Right lateral radiograph shows mild gastric distention with gas and presence of some opaque gastric contents settled into the dependent pyloric region of the stomach (black arrows), suggesting the "gravel sign" **(A)**. Right lateral radiograph of the same patient three weeks after initial examination, demonstrates acute gastric dilatation-volvulus **(B)**. Note the presence of mineral opacity material within the gastric fundus consistent with "gravel sign" (white arrows).

Prophylactic gastropexy has been recommended in dogs with breed predisposition to GDV syndrome undergoing exploratory laparotomy for any reason, but above all in cases of splenectomy [12]. On the basis of the results obtained in this study, prophylactic gastropexy might have to be considered in German Shepherds showing nonspecific gastrointestinal signs and gastric "gravel sign" on radiographs, suggesting processes causing partial chronic obstruction or delayed gastric emptying.

The cause of the increased prevalence of loss of abdominal serosal detail and splenomegaly in the "gravel sign" group is unknown. Loss of serosal detail might be more prevalent due to a more chronic underlying gastrointestinal pathology and secondary weight loss. In accordance with previous studies, concurrent gastric foreign bodies were found in 15% of dogs [7].

Limitations of the present study were its retrospective nature, incomplete preexistent medical records, and the small population sample.

In conclusion, a relatively high prevalence of gastric "gravel sign" was detected on preoperative radiographs of dogs suffering from acute GDV, with German Shepherd dogs over-represented. This finding might suggest that these dogs were suffering from underlying gastrointestinal pathology causing partial chronic obstruction. To confirm this association, further prospective studies are needed for better understanding the relationship between both entities, and investigating presence of underlying processes causing chronic obstruction in these patients.

**Authors' contributions**

AR participated in the conception, design acquisition and interpretation of data of the study, drafted the article, and performed the statistical analysis. NR and EY helped in the analysis and interpretation of data and revised article for intellectual content. DE conceived of the study, participated in its design, acquisition and interpretation of data, and helped to draft the manuscript. All authors read and approved the final manuscript.

**Declaration of conflicting interests**

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

## REFERENCES


1. Monnet E: Gastric dilatation-volvulus syndrome in dogs. Vet Clin North Am Small Anim Pract 2003, 33(5):987-1005.
2. Marinković D, Özvegy J, Aničić M, Vučićević I, Nešić S, Kukolj V: Gastric Dilatation and Volvulus in Brown Bear (Ursus arctos). Acta Vet (Beograd) 2016, 66(3):422-428.
3. Fischetti AJ, Saunders HM, Drobatz KJ: Pneumatosis in canine gastric dilatation-volvulus syndrome. Vet radiol ultrasound 2004, 45:205-9.
4. Glickman LT, Glickman NW, Schellenberg DB, Raghavan M, Lee T: Non-dietary risk factors for gastric dilatation-volvulus in large and giant breed dogs. J Am Vet Med Assoc 2000, 217(10):1492-9.
5. Raghavan M, Glickman N, McCabe G, Lantz G, Glickman LT: Diet-related risk factors for gastric dilatation-volvulus in dogs of high-risk breeds. J Am Anim Hosp Assoc 2004, 40(3):192-203.
6. Sartor AJ, Bentley AM, Brown DC: Association between previous splenectomy and gastric dilatation-volvulus in dogs: 453 cases (2004–2009). J Am Vet Med Assoc 2013, 242(10):1381-4.
7. de Battisti A, Toscano MJ, Formaggini L: Gastric foreign body as a risk factor for gastric dilatation and volvulus in dogs. J Am Vet Med Assoc 2012, 241(9):1190-3.
8. Paris JK, Yool DA, Reed N, Ridyard AE, Chandler ML, Simpson JW: Chronic gastric instability and presumed incomplete volvulus in dogs. J Small Anim Pract 2011, 52(12):651-5.
9. Seiler G, Maï W: The Stomach. In: BSAVA Manual of Canine and Feline Abdominal Imaging. England: O'Brien R. Ed. British Small Animal Veterinary Association; 2008, 87-109.
10. Beck JJ, Staatz AJ, Pelsue DH, Kudnig ST, MacPhail CM, Seim III HB, Monnet E: Risk factors associated with short-term outcome and development of perioperative complications in dogs undergoing surgery because of gastric dilatation-volvulus: 166 cases (1992–2003). J Am Vet Med Assoc 2006, 229(12): 1934-9.
11. Green JL, Cimino Brown D, Agnello, KA: Preoperative thoracic radiographic findings in dogs presenting for gastric dilatation-volvulus (2000–2010): 101 cases. J Vet Emerg Crit Care 2012, 22(5): 595-600.

12. Allen P, Paul A: Gastropexy for prevention of gastric dilatation-volvulus in dogs: history and techniques. Top Companion Anim Med 2014, 29(3): 77-80.

## PROCENA ZASTUPLJENOSTI SADRŽAJA "ŠLJUNKOVITOG" IZGLEDA U ŽELUCU PASA SA AKUTNOM GASTRIČNOM DILATACIJOM - VOLVULOSOM

ALTUZARRA Raul, NOVELLAS Rosa, ESPADA Yvonne, DOMÍNGUEZ Elisabet

Izvršeno je retrospektivno radiološko ispitivanje tzv. "šljunkovitog" sadržaja želuca sprovedenog na 60 pasa sa znacima sindroma akutne gastrične dilatacije – volvulusa (GDV). Ostali radiološki nalazi prisutni kod ispitanih pacijenata uključuju gubitak detalja peritonealne seroze, prisustvo senke stranog tela, pneumatozu želuca, splenomegaliju u megaesofagus. "Šljunkoviti" izgled je ustanovljen na preoperativnim snimcima 17 pasa sa akutnim GDV (28,3%), što navodi na mogućnost da su ovi psi prethodno bolovali od parcijalne gastrične opstrukcije. U okviru ove grupe pasa, nemački ovčari su bili značajno više zastupljeni (10/17; 58,8%). Psi sa akutnom DTV koji pokazuju navedenu promenu bi trebalo da budu pažljivo pregledani kako bi se utvrdilo prisustvo gastrointestinalnog procesa koji se može povezati sa hroničnom parcijalnom opstrukcijom.