Epidemiology of gastric dilation and gastric dilatation volvulus in New Zealand working farm dogs

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Abstract

Gastric dilatation (GD) and gastric dilation-volvulus (GDV) are acute life-threatening conditions in dogs. The incidence of GDV and GD in the New Zealand dog population is unknown. However, a recent study of working farm dogs in New Zealand found that 4% of the 1,024 visits, unrelated to trauma, were diagnosed as having a GDV diagnosed. A retrospective study was done, including a case-series and a case-control study to present information about GDV cases in New Zealand working farm dogs and identify potential risk factors. The case series conducted 62 hospitalized GD(V) case between August 2004 and September 2009 and the sample population of the case-control study consisted of 31 hospitalized working farm dogs with GD(V) and 62 hospitalized working farm dogs with trauma between April 2008 and April 2009.

The case-series study showed that 64% of the cases that arrived at the veterinary practice returned to work. The case-control study showed that the risk factors for GD(V) were breed and age. The odds of disease in Huntaways were 19 times higher than in other breeds. Further prospective research is required to evaluating the role of feeding practices and exercise in the pathogenesis of GDV in NZ working farm dogs.

Introduction

Gastric dilatation (GD) and gastric dilation-volvulus (GDV) are acute life-threatening conditions in dogs. GD is characterized by a rapid accumulation of gas in the stomach which creates an increased intragastric pressure. In the case of a GDV the dilatation is accompanied by dislocation of the stomach. In both GD and GDV dilation of the stomach results in compression of major blood vessels in the abdomen which results in decreased venous return to the heart and hypovolemic shock. (Glickman *et al*. 1994).

An American study reported that the frequency of GD and GDV per 1,000 canine hospital admissions ranged from 2.9 to 6.8 and the case fatality rate was 28.6 and 33.3 respectively (Glickman *et al*. 1994). The incidence of GDV and GD in the New Zealand dog population is unknown. However, a recent study of working farm dogs in New Zealand found that 4% of the 1,024 visits to the veterinarian, unrelated to trauma, were diagnosed as having a GDV diagnosed (Cave *et al*. 2009). These cases were all reported during a clinical visit, which excludes all the working farm dogs with a GD(V) that didn't visit a veterinarian.

GDV is a multifactorial disease and a number of factors including age, sex, weight, breed, feeding practices and exercise have all been have been proposed as possible risk factors. In a study of 1,934 canine hospital admissions with GDV and 3,868 controls the risk of GD and GDV was found to increase with increasing age and weight (Glickman *et al*. 1994). However, the study found no association between GD and GDV and sex or neuter status. In contrast a follow-up study found that males were at greater risk of GDV and GD than females (Glickman *et al*. 1997). Other predisposing factors identified by Glickman et al. (1997) included being underweight, eating one meal a day, eating rapidly and a fearful temperament. It is not clear if the relationship between GDV and weight is a true associate or due to the fact that many large dog breeds are pre-disposed to the disease. This is supported by findings that GD and GDV are more common in Great Danes, German Shepherd Dogs, large mixed-breed dogs and Standard Poodles (Brockman *et al*. 1995). In a research involving high risk dog breeds, the risk of GDV was highest in dogs fed a large volume of food once a day (Raghavan *et al*. 2004). Further analysis of the study group also found dogs fed a high proportion of oil and fats were at increase the risk of GDV or GD, but there was no association between the disease and the proportion of animal-protein, soy and cereal ingredients (Raghavan *et al*. 2006). A study in Great Danes found no significant association between GDV and daily exercise (<2 hours per day, ≥2 hours per day) and interval between exercise and feeding (Theyse *et al*. 1998).

The dogs working on the farms in New Zealand are predominantly Huntaway and Heading dog breeds. These working farm dogs are not recognized by the New Zealand kennel club, and do not have any specific breed standards, as they are bred mainly for optimal performance. The Huntaway is a large breed dog, averaging 28kg, with a height of 51cm-61cm. The Huntaway's purpose is to bark on demand and to drive the sheep. The Heading dog is a smaller dog, averaging 19kg, and the breed is based on the Border Collie. The purpose of these dogs is to control the stock by heading them off or herding them in a particular direction.

The aim of this paper is to present information about GDV cases in New Zealand working farm dogs and identify potential risk factors.

Materials and method

This paper presents the analysis of data collected in a 12 month survey of veterinary practices that aimed to determine the relative frequency of specific diseases affecting working dogs that presented to veterinary clinics. The study design is described in detail in Cave et al (2009). Briefly, 66 rural veterinary practices were convenience sampled based on location and practice size. Practices were enrolled during March 2008. Data collection commenced during April 2008, and continued until the 30th April 2009. The analysis of data is divided into two sections: (i) case-series of GD(V) and (ii) hospital based case control study.

Case series

Records from Cave et al. were examined to identify all GD(V) cases. Between October and December 2009 the practices were contacted and asked to provide medical records relating to the GD(V). A suspected case was classified as a GD(V) if diagnosis was confirmed by X-ray, operation or post mortem examination. Deceased dogs that came in the practice with a distended abdomen but didn't have a post-mortem examination were excluded. Information provided by the clinic was used to create a number of variables to describe the presentation of the case. The outcome, diagnosis, when the symptoms where noticed and the time that the dog arrived at the clinic were described as well as if there was a gastropexy done, when they were fed, if there was devitalized tissue and if a gastrotomy was done.

A number of practices (n = 5) also provided details about GD(V) cases in working dogs that occurred during or after the study period for Cave et al. (2009), but had previously not been

reported. The case definition for all of the additional cases was identical to that used for cases arising directly from the study by Cave et al. that is. These additional cases were included in the case-series analysis.

Case-control study

The case-control study comprised of all confirmed cases of GD(V) identified in the study conducted by Cave et al. (2009) and the additional GD(V) cases that occurred between the 1st April 2008 and 30th April 2009. Two controls per case were randomly selected from the working dogs in the study by Cave et al. that presented at veterinary clinics with traumatic injuries. Data collected in the study by Cave et al. (2009) was used to create explanatory variables.

Data analysis

In the cases series the number and percentage of animals with specific clinical features was determined (Table 1).

Separate, unmatched, logistic regression procedures were used to determine the association between GD(V) and each explanatory variable in the data set (Table 2). Explanatory variables associated at $P<0.30$ were included in a multivariable logistic regression model. A preliminary main effects model was developed using a backward stepwise procedure in which variables were retained if P was significant. Variables not significant in the preliminary main effect model were separately and retained if significantly associated with the outcome. All biologically plausible two-way interactions were considered for inclusion in the model and significance assessed using deviance test statistic. The fit of the model was assessed through the estimation of the Hosmer-Lemeshow goodness of fit statistic (Hosmer and Lemeshow 2000). Model diagnostics involved evaluation of plots of the Pearson residuals, Hat matrix and Delta-Betas against predicted values (Allison 2001; Dohoo *et al.* 2003). Data analysis was completed using SAS (Version 9 for Windows). Significance was set at P less than 0.05.

Results

The data set comprised of a 62 cases from a total of 13 practices: 32 cases were obtained from the study by Cave et al, 9 occurred during the study period but were only reported when researchers contacted the veterinary clinic and 21 cases occurred before the 30th April 2008 or after the 30th April 2009. Eleven of the cases were classified as having experienced a GD, 48 had a GDV and in three cases it was not possible to differentiate between GD and GDV.

Sixty-four percent (n = 40) of the cases that arrived at the veterinary practice returned to work (Table 1). Forty-seven patients have had surgery and at least 19% needed a gastrotomy. It was possible for 40 of the surgery patients to have a gastropexy and in at least 83% of those cases a gastropexy was performed.

Although 56% of the data is missing about when the dogs were fed before the GD(V), only 6% was fed on a different time than in the evening or night. The first symptoms were noticed in 30% of the GD(V) cases between after being fed in the evening or night and before going to work in the morning. Only in 9% of the time the first symptoms were noticed during the day or during work. This is evident with the finding that 52% of the dogs arrived at a veterinary practice between 19:00 and 12:00 o'clock and 26% between 12:00 and 19:00 o'clock. (Table 1)

The case-control analysis comprised of 41 cases and 82 controls. Table 2 describes the unconditional association between breed, age, weight and gender and the disease status. Multi-variable analysis found that the risk factors for GD(V) were breed and age (Table 3). Specifically, the odds of disease in Huntaways were 19 times higher than in other breeds of working dogs.

Discussion

This is the first epidemiological study of gastric dilation and gastric dilatation volvulus in New Zealand working dogs. Given that the dogs in this study are limited to those that were brought to a veterinary clinic the timing when symptoms are noticed, distance to the nearest practice and an owner's willingness to pay are important factors to consider when interpreting these results of this study. For example, the finding that over half the dogs with GD(V) in the current study returned to work cannot be extrapolated to all GD(V) cases in working dogs, because the study population did not include animals that may have died before an owner noticed the symptoms, died on route to the farm or were destroyed on farm. Consequently, the animals presenting at the veterinary hospital may have had a less severe disease.

This study found that the odds of GD(V) in Huntaway's was 19 times greater than in other working farm dog breeds. The high odds ratio provides evidence that this finding is causal. This finding is also supported by studies in other dog populations that have found large breed dogs were predisposed to GDV such as Great Danes, German Shepherd Dogs, large mixed-breed dogs and Standard Poodles (Brockman *et al*. 1995) and Great Danes (Theyse *et al*. 1998). This study also reported an increased risk of GD(V) in older working dogs, which is

consistent with earlier work by Glickman et al. (1994) of 1,934 canine hospital admissions with GDV and 3,868 controls. After adjusting for confounders this study found no significant association between sex and GD(V) but differs from a follow up study by Glickman et al. (1997) that found an increased risk of GD(V) in male dogs. There are several differences between the studies that could be responsible for the differences including differences in study populations and method used to collect data.

Previous studies have examined the relationship between feeding practices (Glickman *et al*. 1997; Raghavan *et al*. 2004). The current study relied on data that was collected retrospectively from medical records supplied from the veterinary clinics. Consequently, all the necessary data to examine this relationship was not available. Future researchers would be advised to design a study that involves the collection of explanatory variables from owners of case and control dogs.

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200 **Table 1: Description of the clinical features of GD(V) cases presenting at participating veterinary practices between April 2008 and December 2009.**

Variable	Level	N	%
Outcome	Returned to work	40	64
	Euthanized/died	22	36
Diagnosis[a, b]	GDV	48	77
	GD	11	18
	Missing data	3	5
When Fed	Evening/Night before	23	37
	Other	4	6
	Missing data	35	56
First Symptoms Noticed	Evening/Night (after fed)	8	13
	Morning (before work)	17	27
	During day/work	9	15
	Missing data	28	45
Time the dog arrived at the clinic	06:00-12:00	27	44
	12:00-19:00	16	26
	19:00-06:00	5	8
	Missing data	14	23
Gastropexy[a,c]	Yes	33	83
	No	2	5

	Missing data	5	13
Devitalized tissue[a,d]	Yes	18	31
	No	22	37
	Missing data	19	32
Gastrotomy[a,e]	Yes	8	19
	No	20	48
	Missing data	14	33

[a]Excluded three dogs that were dead on arrival at the clinic.

[b] Differential diagnosis was not possible for three cases.

[c] The 22 cases not included in this group were either dead on arrival, euthanized or did not have surgery(n)

[d]Forty-seven patients had surgery, 40 out of 47 were reported devitalised or not devitalised.

[e] Gastrotomy could only be done in 42 cases, because the other cases were euthanized before or during surgery or dead on arrival.

Table 2 : Association between a number of independent variables and GD(V). Data obtained from a survey of 66 veterinary practices during the period of April 2008-April 2009, ordered according to the level of statistical significance.

Variable	Level	Case	Control	Odds Ratio	95% CI	P-value
Breed[a]	Not Huntaway	3 (6%)	48 (94%)	REF		<0.0001
	Huntaway	38 (53%)	34 (47%)	18.67	5.1-62.7	
Age	<2	2 (6%)	33 (94%)	REF		<0.0001
	2-4	6 (23%)	20 (77%)	5	0.91-26.92	
	5-7	22 (56%)	17 (44%)	21.5	4.48-101.71	
	>7	11 (48%)	12 (52%)	15.33	2.92-78.34	
Weight	<20	7 (16%)	38 (84%)	REF		<0.0001
	20-24	3 (14%)	19 (86%)	0.89	0.2-3.69	
	25-29	9 (43%)	12 (57%)	4.17	1.25-13.27	
	≥ 30	22 (63%)	13 (37%)	9.39	3.19-26.47	
Gender	Female	11 (22%)	40 (78%)	REF		0.02
	Male	30 (42%)	42 (58%)	2.54[a]	1.15-5.87	

[a] Interpretation – The unadjusted odds of a GDV/GD is 19 times higher in Huntaways than in other working dog breeds.

Table 3: Risk factors conditionally associated with GD(V). Data obtained from a survey of 13 veterinary practices during the period of April 2008-April 2009.

Variable	Level	Beta	SE	OR	95% CI
Breed[a]	Not Huntaway	REF			
	Huntaway	1.47	0.35	18.81[a]	4.76-74.29
Age	<2	REF			
	2-4	-0.22	0.49	6.23	0.94-41.25
	5-7	1.12	0.42	23.62	4.11-135.64
	>7	1.14	0.49	24.26	3.65-161.39

[a] Interpretation – After adjusting for age the odds of GDV/GD in Huntaway dogs is 19 times higher than the odds of GDV in non-Huntaway dogs.