PAPER

Assessment of the incidence of GDV following splenectomy in dogs

OBJECTIVE: To establish if splenectomy increases the incidence of gastric dilatation and volvulus (GDV) in dogs.

METHODS: Two case-series studies of cases and controls were performed. Records of dogs that had undergone splenectomy (37 cases) were compared with records of dogs that had undergone other abdominal surgery (43 cases). Records of dogs that presented for non-elective gastropexy (33 cases) were compared with records of dogs presented to the hospital for unrelated reasons (39 cases). Survival following splenectomy and development of GDV in the first 12 months following surgery were retrieved from the clinical records and by questionnaire-based canvassing of the referring clinician. The incidence of GDV following splenectomy was established and the association between a current episode of GDV and previous splenectomy was assessed.

RESULTS: There was no evidence that splenectomy was associated with an increased incidence of subsequent GDV (P=0·469). No association between a current episode of GDV and previous splenectomy was found.

CLINICAL SIGNIFICANCE: Splenectomy is not associated with an increase in the incidence of GDV.

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INTRODUCTION

Splenic disease is common in the dog (Hosgood 1987, Hosgood and others 1989, Marino and others 1994) and splenectomy is the mainstay of surgical management (Hosgood 1987). Life-threatening gastric dilatation and volvulus (GDV) has been described as a potential complication following splenectomy in cases with splenic torsion (Millis and others 1995, Neath and others 1997) and with splenic haemangiosarcoma (Marconato 2006). Authors have speculated that GDV may follow splenectomy due to stretching and disruption of gastric ligaments increasing stomach mobility (Marconato 2006, Tillson 2003) although it is also possible that an apparent association between splenectomy and GDV is purely coincidental. In order to establish if the incidence of GDV increases following splenectomy in the dog, two retrospective studies were performed. Records of dogs which had splenectomy performed at a veterinary referral hospital were reviewed. The incidence of GDV in the 12 months following splenectomy was established by follow-up survey of referring veterinary surgeons. The results were compared to a control group of dogs presenting for abdominal surgeries that did not include splenectomy. It was hypothesised that if splenectomy increased the incidence of subsequent GDV it was reasonable to expect that dogs presenting with GDV would be more likely to have had splenectomy performed in the past compared to the general hospital population. Therefore, an additional retrospective study was performed comparing the occurrence of previous splenectomy in dogs that presented with GDV to that of a control group.

MATERIAL AND METHODS

Evaluation of the incidence of GDV developing in the 12 months following splenectomy case records of dogs that had undergone splenectomy at a referral hospital between 1999 and 2007 were retrieved (referred to as the "splenectomy group"). To be included, records had to be from dogs that had splenectomy performed not less than 12 months before the collection of follow-up data by questionnaire. Data retrieved from the clinical record included if gastropexy had been performed before presentation for splenectomy, if GDV had developed before presentation for splenic disease, if prophylactic gastropexy was performed at the time of splenectomy, if GDV developed following splenectomy and before discharge from the hospital and if the dog survived to discharge. Information retrieved by questionnaire-based canvassing of the referring veterinary surgeon included if the dog was still alive, if the

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dog had died, how long after splenectomy death had occurred and if GDV had developed postoperatively (Appendix 1). Cases which had gastropexy performed before or at the time of splenectomy or which had an episode of GDV recorded before splenectomy were not included. Cases for which no questionnaire was received were removed from the subsequent analyses.

A second group of dogs was selected from the referral hospital database to act as a control group. As splenic disease is reported to be more common in larger dogs, this group was bodyweight matched to the splenectomy group and was referred to as the "splenectomy control group". To meet the inclusion criteria for this group, these dogs had to have had abdominal surgery performed during the period of the study. Dogs were excluded if splenectomy had been performed, if they had GDV diagnosed before or at initial presentation or if gastropexy had been performed previously. A postoperative period of not less than 12 months had to have elapsed between initial abdominal surgery and the time that follow-up data were collected. The reason for abdominal surgery was retrieved from the clinical record. Additional data retrieved by questionnaire-based survey of the referring veterinary surgeons included if the dog was still alive, if the dog had died, how long after abdominal surgery this had occurred and if GDV had developed postoperatively (Appendix 2). Cases for which no questionnaire was received were removed from the subsequent analyses.

Evaluation of the association between non-elective gastropexy and previous splenectomy

A separate retrospective study was performed in order to establish if the development of a current episode of GDV was associated with a dog having undergone a splenectomy previously. The database of the veterinary referral hospital was searched for dogs which had presented for gastropexy for the management of GDV (referred to as the "gastropexy group"). These dogs were selected on the basis that they had gastropexy performed as a non-elective procedure for a current or recent episode of GDV. A recent episode of GDV was defined as having GDV diagnosed within the preceding four weeks confirmed radiographically or surgically. This definition was used as some dogs presented to the hospital were referred specifically for gastropexy which had not been performed during the original surgery for repositioning of the stomach. The clinical records were reviewed to establish if splenectomy had been performed before presentation to the hospital. Clinical records of bodyweight matched dogs selected from the hospital database which had presented during the period of the study were selected as a control group (referred to as the "gastropexy control group"). Dogs that had been referred for management of splenic disease were excluded. The clinical records were reviewed to establish if splenectomy had been performed before presentation to the hospital.

Statistical analysis

Differences in weight between groups were evaluated using standard two sample t-tests. The association between having had a splenectomy and the occurrence of GDV following abdominal surgery in the splenectomy and splenectomy control groups was analysed with Fisher's exact test. All analyses were performed using Minitab version 14 (Minitab Inc., State College, PA) with statistical significance set at a $P<0{\cdot}05$.

RESULTS

Evaluation of the incidence of GDV in the 12 months following splenectomy

Thirty-seven records met the inclusion criteria for the splenectomy group. One dog (3 per cent) developed GDV 48 hours following splenectomy. Twenty-two breeds were included (Airedale terrier [n=2], basset hound [1], bearded collie [2], border collie [2], boxer [3], Briard [1], cocker spaniel [4]), crossbred [4], deerhound [1], flat coated retriever [1], German shepherd [1], golden retriever [2], Irish terrier [1], Jack Russell terrier [1], Labrador [3], Leonberger [1], miniature schnauzer [1], Muensterlaender [1], papillon [1], rottweiler [2], Staffordshire bull terrier [1], West Highland white terrier [1]). Forty-three records met the inclusion criteria for splenectomy control group. Sixteen breeds were included (bearded collie [n=1], border collie [4], boxer [1], crossbred [6], English setter [1], English springer spaniel [2], German shepherd dog [5], golden retriever [1], labrador [10], otterhound [1], Pyrenean mountain dog [1], rottweiler [3], shi-tzu [1], springer spaniel [4], St. Bernard [1], West Highland white terrier [1]). There was no statistically significant difference in mean bodyweight between the two groups (splenectomy mean = 25·4 kg, splenectomy control mean = 26·3 kg, $P=0{\cdot}746$). None of these dogs developed GDV within the 12 months following surgery. No statistically significant association of the incidence of GDV occurring in the 12-month postoperative period could be found with dogs in which splenectomy had been performed compared to dogs in which coeliotomy had been performed for other reasons ($P=0{\cdot}469$).

Evaluation of the association between non-elective gastropexy and splenectomy

Thirty-three dogs were identified from the hospital database that had presented for management of a current or recent episode of GDV and hence met the inclusion criteria for the gastropexy group. Twenty-three breeds were included (basset hound [n=2], bloodhound [1], border collie [1], boxer [1], bulldog [1], chow chow [1], dachshund smooth haired [1], Dalmation [1], English bull terrier [1], flat coat retriever [1], German shepherd dog [4], German shorthaired pointer [1], Gordon setter [1], great Dane [3], Irish setter [3], Irish wolfhound [1], Japanese Akita [1], Labrador [1], Newfoundland [2], retriever [1], St. Bernard [1], Weimaraner [3]). Thirty-nine dogs were selected for the gastropexy control group. Seventeen breeds were included (Bernese mountain dog [n=1], border collie [1], boxer [5], Briard [1], crossbred [2], Dalmatian [1], deerhound [1], Dogue de Bordeaux [1], German shepherd dog [2], golden retriever [2], Gordon setter [1], Labrador [14], large Muensterlaender [1], Newfoundland [1], Rhodesian ridgeback [2], Staffordshire bull terrier [1], Weimaraner [2]). There was no statistically significant difference in mean bodyweight between the two groups (gastropexy mean = 34·7 kg, gastropexy control mean = 35·7 kg, $P=0{\cdot}714$). None of the dogs in either group had splenectomy performed before presentation to

the hospital indicating that there was no evidence for an association between dogs presenting with a current episode of GDV and a previously performed splenectomy in comparison to a control group.

DISCUSSION

Reports have described GDV as a complication of splenectomy for the management of splenic torsion (Millis and others 1995, Neath and others 1997) and splenic neoplasia in the dog (Wood and others 1998). Some authors have recommended that prophylactic gastropexy be considered at the time of splenectomy for dogs with splenic torsion (Millis and others 1995, Neath and others 1997), splenic haemangiosarcoma (Marconato 2006) and other causes of splenomegaly (Monnet 2003, Rasmussen 2003, Tillson 2003). In this study, no statistically significant difference between the incidence of GDV in dogs that had undergone splenectomy in comparison to dogs that had undergone exploratory abdominal surgery for other reasons was found suggesting that there was no large increase in incidence of GDV developing in dogs in the 12 months following splenectomy. Evaluation of the association between a current episode of GDV and previous splenectomy was also assessed as it was hypothesised that, if splenectomy increased the incidence of subsequent GDV, dogs presenting with GDV would be more likely to have had splenectomy performed in the past. As no dogs in either the gastropexy or gastropexy control groups had splenectomy performed before presentation to the hospital, no evidence was found to support this hypothesis. No evidence was found to support the suggestion that GDV is a specific complication of splenectomy.

Both splenic disease and GDV are more prevalent in larger breed, deep-chested dogs (DeHoff and Greene 1973, Betts and others 1974, Spangler and Culbertson 1992, Glickman and others 1994, 1996, 1997, Millis and others 1995, Schaible and others 1997, Brockman and others 2000, Ward and others 2003) and the apparent association between splenectomy and GDV may be coincidental (Millis and others 1995). It is possible that GDV following splenectomy reported in the veterinary literature may reflect an association between specific splenic diseases (for example, torsion) and an increased risk of developing GDV rather than a causal link between splenectomy itself and subsequent GDV. Three out of four cases reported in which GDV occurred following splenectomy have suffered from splenic torsion (Millis and others 1995, Neath and others 1997). The pathogenesis of isolated splenic torsion is unknown (Goldsmid and others 1994, Hurley 1994, Weber 2000) but several authors have suggested that splenic displacement and torsion may occur secondary to GDV which then spontaneously resolves (Maxie and others 1970, Stead and others 1983, Goldsmid and others 1994, Hurley 1994, Neath and others 1997, Brockman and others 2000). This process, rather than the act of splenectomy itself, might account for an apparent association between the two disease processes. It would be interesting to evaluate the incidence of GDV occurring subsequent to splenectomy performed for management of splenic torsion in comparison with splenectomy performed for other reasons as this might identify a need to consider elective gastropexy during management of splenic torsion specifically.

A limitation of a retrospective study is obtaining clinical information and follow-up data for large numbers of cases. It is possible that splenectomy may lead to a small increase in the incidence of GDV occurring postoperatively which has not been demonstrated because of the relatively small sample sizes available from one centre in this study. Retrospective questionnaire-based studies may also produce inaccurate or skewed data. A multi-centre prospective trial of outcome following splenectomy may be more likely to identify a small increase in incidence of GDV if one exists. Alternatively, it may be that dogs undergoing splenectomy do not survive long enough to go on and subsequently develop GDV. However, if a small increase in the incidence of developing GDV subsequent to splenectomy could be identified, it would be prudent to evaluate how this compared to the incidence of complications following elective gastropexy before this procedure could be recommended prophylactically.

In conclusion, there is no evidence that splenectomy increases the incidence of subsequent GDV.

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For Appendix 1 and 2 please see the following pages

Appendices

ROYAL (DICK) SCHOOL OF VETERINARY STUDIES
Small Animal Soft Tissue Surgery Service

The University of Edinburgh
Hospital of Small Animals
Easter Bush Veterinary Centre
Roslin Midlothian
EH25 9RG

Telephone 0131 650 7650
Fax 0131 650 7652

Dear colleague,

I am a resident in Small Animal Surgery working at the Hospital for Small Animals of the Royal (Dick) School of Veterinary Studies. As part of my training programme, I am conducting a retrospective study evaluating the results of splenectomy in the dog. One question that we are particularly interested in is whether or not splenectomy increases the risk of subsequent gastric dilatation volvulus (GDV) which has been reported anecdotally.

From our records we have found that {patient name} treated and referred by you has had a splenectomy performed at the R(D)SVS. We would be very grateful if you would fill in this short questionnaire to help us to find out more about {patient name} and the possible complications which occurred following splenectomy.

Patient: {patient name},{breed} Owned by: {owner name}, {owner address} R(D)SVS case number: {case no,}

1. a) Is {patient name} still alive? Yes □ No □
   b) If **NO**, was {patient name} euthanatized (PTS) or did {patient name} die? Die □ PTS □
   How long after the splenectomy did {patient name} die? _____

2. a) If {patient name} is dead, was this attributed to the disease that necessitated splenectomy?
   Yes □ No □
   b) If **YES** please provide a brief explanation: _____
   _____
   c) If **NO**, why did {patient name} die/ was euthanatized? _____

3. a) Did {patient name} ever develop GDV? Yes □ No □
   b) If **Yes** did this occur before or after the splenectomy? before □ how long? _____
   after □ how long? _____

4. Did {patient name} die from GDV? Yes □ No □

5. Are you happy for us to contact you again in writing or telephone regarding this study?
   Yes □ No □

Appendix 1. Questionnaire used to gather information about the splenectomy group of dogs

ROYAL (DICK) SCHOOL OF VETERINARY STUDIES
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Telephone 0131 650 7650
Fax 0131 650 7652

Dear colleague,

I am a resident in Small Animal Surgery working at the Hospital for Small Animals of the Royal (Dick) School of Veterinary Studies. As part of my training program, I am conducting a retrospective study evaluating the results of splenectomy in the dog. One question that we are particularly interested in is whether or not splenectomy increases the risk of subsequent gastric dilatation volvulus (GDV) which has been reported anecdotally. We have chosen dogs having had an explorative celiotomy as our ***control group***.

From our records we have found that {pet name} treated and referred by you has had an explorative celiotomy performed by the R(D)SVS. We would be very grateful if you would fill in this short questionnaire to help us to find out more about the possible complications which occurred following surgery.

Patient: {patient name}, {breed} Owned by: {owner name}, {owner address} R(D)SVS Case no.: {case no.}

1. a) Is {patient name} still alive? Yes □ No □
   b) If **NO**, was {patient name} euthanatized (PTS) or did {patient name} die? Die □ PTS □
   How long after the explorative celiotomy did {patient name} die? _____

2. a) If {patient name} is dead, was death attributed to the disease that necessitated celiotomy?
   Yes □ No □
   b) If **YES** please provide a brief explanation: _____
   _____
   c) If **NO**, why did {patient name} die/ was euthanatized? _____

3. a) Did {patient name} ever develop GDV? Yes □ No □
   b) If **Yes** before or after the explorative celiotomy? before □ how long? _____
   after □ how long? _____

4. Did {patient name} die from GDV? Yes □ No □

5. Are you happy for us to contact you again in writing or telephone regarding this study?
   Yes □ No □

Director of Veterinary Clinical Services: RONNIE SOUTAR
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Appendix 2. Questionnaire used to gather information about the splenectomy control group of dogs