CANINE BREEDS PREDISPOSED TO DEVELOP DISKOSPONDYLITIS: A RETROSPECTIVE STUDY OF 181 CASES (2009-2018)

PREDISPOSIÇÃO RACIAL CANINA PARA O DESENVOLVIMENTO DE DISCOESPONDILITE: ESTUDO RETROSPECTIVO DE 181 CASOS (2009-2018)

RESUMO

Para determinar a prevalência e predisposição racial da discoespondilite (DS) em cães realizou-se uma pesquisa numa população de 5497 animais submetidos a exame de tomografia computadorizada ou radiografia digital da coluna entre 2009 e 2018. Variáveis como raça, sexo, idade, segmento vertebral e total de vértebras acometidas foram coletadas e submetidas aos testes de prevalência, Qui-quadrado e odds ratio. Foram identificados 181 cães com DS, prevalência de 3,4%. Destes, 65% eram machos, probabilidade 1,6x maior que fêmeas (CI 1.17-2.17). Cães maiores que 10 anos tem probabilidade 1,5x maior (CI 1.10-2.05), enquanto em cães entre 2-5 anos a probabilidade diminui 51% (CI 0.34-0.77). Observou-se o predomínio de cães de grande porte (>30 kg; 45%), com 3,8x mais chances de DS (CI 2.56-5.33); seguido de 28% de cães de pequeno porte, ainda que demonstrada uma probabilidade 34% menor (CI 0.24-0.47). O labrador apresenta 3,7x mais chances que todas as raças estudadas (CI 2.56-5.33) e o buldogue francês, entre as raças de pequeno porte, 2,8x mais susceptibilidade (CI 1.51-5.06). Conclui-se que fatores como idade avançada, grande porte e, especialmente labradores, apresentam maior probabilidade a serem portadores de DS. O buldogue francês deve ser mais estudado quanto a sua discrepância em comparação a raças de mesmo porte.

Palavras-chave: Buldogue Francês. Cão. Coluna Vertebral. Labrador Retriever. Mielopatias.

ABSTRACT

A study to determine the prevalence and predisposition of dog breeds to develop diskospondylitis (DS) was carried out on a population of 5,497 animals submitted to computed tomography or digital radiography of the spine between 2009 and 2018. Variables such as breed, gender, age, vertebral segment and total number of vertebrae affected were collected and submitted to the prevalence tests, chi-square and *odds ratio*. A total of 181 dogs presented DS, a prevalence of 3.4%. Of these, 65% were males with a probability 1.6x greater than females (CI 1.17-2.17). Dogs more than 10 years old have a 1.5x higher probability (CI 1.10-2.05), while those between 2-5 years the probability decreases 51% (CI 0.34-0.77). Large dogs (>30 kg; 45%) showed a 3.8x greater chance to develop DS (CI 2.56-5.33) than small dogs (<15 kg; 28%), although the small dogs showed a 34% lower probability (CI 0.24-0.47). The Labrador Retriever breed was 3.7x more likely to develop DS than all the other breeds studied (CI 2.56-5.33) and the French Bulldog, among the small breeds, was 2.8x more susceptible (CI 1.51-5.06). In conclusion older dogs, large dogs, especially Labrador Retrievers, are more likely to develop DS. The French bulldog should be studied further.

Keywords: Dog. French Bulldog. Labrador Retriever. Myelopathies. Spine.

INTRODUCTION

Diskospondylitis (DS) is a primary infection of the cartilaginous vertebral endplates with secondary involvement of the intervertebral disk that leads to neurologic disorders (THOMAS, 2000). Conventionally, the diagnosis of diskospondylitis has relied on the presence of characteristic radiographic findings such as the loss of the vertebral end plate margin definitions, narrowing or collapse of the intervertebral disk (IVD) space and various degrees and combinations of endplate lysis, sclerosis, and bony proliferation (GENDRON et al., 2012; HARRIS et al., 2013; RUOFF et al., 2017).

Spinal pain is the most common finding; however, clinical signs can be non-specific such as weight loss, depression, fever, and anorexia (HARRIS et al., 2013). The dogs may be neurologically normal or with various degrees of neurologic impairment (BURKERT et al., 2005). Several pathological processes can account for the neurologic deficits in this disease and include extrusion of intervertebral disk material secondary to collapse of an affected disk space, osseous or soft tissue proliferation within the vertebral canal in response to chronic inflammation, vertebral subluxation or pathological fracture secondary to marked bone lysis, and secondary meningitis or myelitis (GENDRON et al., 2000; RUOFF et al., 2017; DAVIS et al., 2000).

The main differential diagnoses for diskospondylitis are neoplasia and degenerative intervertebral disk disease (IVDD). Vertebral tumors may have features similar to diskospondylitis, although the location of the lesions usually involves a single vertebra and is centered on the vertebral body rather than the endplates, also the intervertebral disk is not affected. Bone-marrow tumors tend to be multifocal and similarly the endplates and the intervertebral disks are not affected. Finally, in IVDD the endplates may appear sclerotic, but do not show any erosion or destruction of the cortical bone (THOMAS, 2000; DA COSTA & MOORE, 2010; GENDRON et al., 2012).

Acute cases may be a diagnostic challenge since clinical signs can be non-specific and radiographic findings appear belatedly. Thus, it is important to "keep in mind" the possibilities of DS according to the breed of the dog, its gender, age and medullary neurological dysfunctions. The aim of this study was to describe the signalment of dogs with DS, compare them with a population of dogs submitted to spinal image exams and determine which specific characteristics increase the odds to develop DS.

MATERIAL & METHODS

All the computerized tomography (CT) scans or digital radiography (RX) exams of the electronic medical record system acquired between April 2009 and June 2018 at a Veterinary Reference Center (HIDDEN FOR SUBMISSION) were searched for “diskospondylitis”. The radiographs and CT scans found were reviewed and only the exams that described features such as loss of definition of end-plate margins, narrowing of the IVD space, lytic bone changes of vertebrae adjacent to the IVD space and sclerosis at the margins of bone lysis were included (DS group). The other canine patients submitted to spine TC or RX exams during the same interval were used as controls (C group). Signalment (sex, age, breed), IVD space and number of vertebrae affected were recorded. The dogs in both groups were categorized according to the standard breed size (small, <15 kg; medium, 15-30 kg; large, >30 kg or mixed-breed) and age (puppy, <2 years old; young, 2-5 years old; adult, 5-10 years old; elderly, >10 years old). The owners of dogs with DS were contacted by phone to obtain the outcome of the disease.

Statistical analyses were performed with statistical software packages. The results were described as percentages (frequency). Contingency tables were generated for the categorical variables (sex, breed and age). The twenty most prevalent breeds were compared to the control group and to the same breed size group (small, medium or large breed groups). Distribution of factors were compared between DS and C groups via the X^2 test. Odds ratio (OD) and 95% confidence interval (CI) were determinate for each comparison. Data for age, anatomical site and owner’s perception of the outcome was evaluated using Kruskal-Wallis nonparametric analysis of variance. Factors were considered significant when the P value was $\leq$0.05 and the exceeded 1.0.

RESULTS

One hundred eighty-one cases with a diagnostic for diskospondylitis (127 CT and 54 RX) met the inclusion criteria (DS group) and 5,316 dogs (3,001 TC and 2,315 RX exams) were used as control cases (C group). The prevalence of the disorder was 3.4%. In the DS group 65% (117) were male and 35% (64) were female dogs. Male dogs has 1.6 times more chance to had DS than females (OR 1.6; CI 1.17-2.17) (Table 1).

The mean age of the dogs was similar in the DS and C groups (8±4 years, p=0.898). Animals more than 10 years old had 1.5 times more chance to develop DS (OR 1.5; CI 1.10-2.05) while dogs between 2 to 5 years old had 51% less probability (OR 0.51; CI 0.34-0.77) (Table 1). The average number of vertebrae affected was 3 varying from 2 to 12. The most prevalent vertebral segments affected were the thoracolumbar and lumbosacral, with 28% (51) each (Table 2).

In terms of breeds, 44.7% (81) of the DS cases were large breed dogs, 27.6% (50) were small breeds, 13.3% (24) were medium breeds and 14.4% (26) were mixed-breeds (Table 1). Large breeds had a 3.8 times greater chance to develop DS (OR 3.8; CI 2.80-5.12); however, for small breeds, the chances decreased 34% (OR 0.34; CI 0.24-0.47). The most frequent large breed in the DS group was the Labrador Retriever (22% - n=40) which presented significantly increased chances (OR 3.7; CI 2.56-5.33) compared to all the other breeds (Table 3 and 4). In relation to small breeds, the French Bulldog (FB) was the most frequent (32% - n=16). When compared to other small breeds, FB presented a significant increase in the possibility to develop this disorder (OR 2.7; CI 1.51-5.06). Also, the age of French Bulldogs affected was significantly lower compared with all groups studied (Table 5).

Only sixty-two owners were found and forty (64%) reported that their dogs had no outcome or remained with sequelae. In ten cases, the diskospondylitis was the direct cause of death or euthanasia.

DISCUSSION

This retrospective study confirms the high prevalence of large breeds developing DS, highlighting the significant risk for Labrador Retrievers in relation to other large breeds. In addition, the results highlight the increased chances of French Bulldogs to develop DS, which, to the authors knowledge, has not been reported previously.

The results showed that DS had a prevalence of 3.4% in dogs submitted to spinal image exams. In order to reduce the limitation of non-access to any clinical record, this study only included dogs that had undergone CT or RX exams of the vertebral column. These exams are important tools to diagnose spinal-medullary disorders. Another retrospective study used all canines that had been admitted to the veterinary clinic as the control group during the study period (BURKERT et al., 2005) which would certainly justify the lower prevalence observed, compared with the present study.

Some epidemiological aspects previously described were endorsed: (1) male dogs are more affected (HUROV et al., 1978; DAVIS et al., 2000; BURKERT et al., 2005; CANAL et al., 2016); (2) Large breeds are more susceptible (HUROV et al., 1978; DAVIS et al., 2002; HARRIS et al., 2013; CANAL et al., 2016); (3) The average age of dogs affected is five years old (HARRIS et al., 2013, CANAL et al., 2016), although older dogs (>10 years) are more prevalent (DAVIS et al., 2000; BURKERT et al., 2005).

Interestingly, dogs between two to five years old have a 51% less chance of a spinal disorder being DS. However, various reports have highlighted the occurrence of DS in puppies (ADAMO & CHERUBINI, 2001; FINNEN et al., 2012; KIRBERGER, 2016), especially in large breeds, while prospective/retrospective studies describe a high prevalence in elderly dogs (BURKERT et al., 2005). In humans, the presence of any endplate lesion has statistically and significantly been associated with the elderly (WANG et al. 2012, AGUILAR-COMPANY et al., 2018), but has not been reported in children as observed in young dogs. In general, most studies suggest that DS is frequently associated to canine urinary tract and prostatic infections (BURKERT et al., 2005), common diseases of male and elderly dogs, but fungus (SCHULTZ et al., 2008), previous surgeries (THOMAS, 2000; CANAL et al., 2016; SHWARTZ et al., 2016) and previous infections from foci elsewhere in the body (ADAMO & CHERUBINI, 2001; KIRBERGER, 2016) have also been associated to DS. In humans, the risk factor includes advanced age, diabetes mellitus, hypothyroidism, genitourinary tract infections, respiratory tract infections, rheumatoid arthritis, immunosuppression and surgery (FRIEDMAN et al., 2002; AGUILAR-COMPANY et al., 2018).

Although any region of the vertebral column can be affected, in our study 28.1% were observed along the thoracic spine (T1-T13) and the same high prevalence was observed at the lumbosacral IV space (L7-S1). Davis et al. (2000), Kurbert et al. (2005) and Harris et al. (2013) observed similar findings that demonstrate the significance of DS as a differential diagnosis for pain and neurological dysfunctions in these regions. The high prevalence of the LS space may be explained by Carrera et al. (2011) and Gendron et al. (2012) who demonstrated using Magnetic Resonance Imaging that the lumbosacral joint was a predilection site for endplate lesions and the most common presumptive endplate lesion is DS. The vertebral endplate is responsible for transferring stress between disc and vertebral body, and its concavity is important in dispersing compression stress (HE et al., 2012). Humans with osteoporosis, sclerosis, vascular compromise and necrotic areas developed in the vertebral endplates are known to result in microfractures and later in infection – but such microfractures in vertebral endplates as a precursor to vertebral infection have not been detected in dogs (BURKERT et al., 2005). Burkert et al. (2005) hypothesizes that intermittent venous occlusion or stasis of blood flow at the lumbosacral junction during locomotion may lead to focal endplate necrosis and an episode of bacteremia could then lead to focal colonization.

The Labrador Retriever is frequently described as one of the most affected breeds in diskospondylitis clinical studies (DAVIS et al., 2000; HARRIS et al., 2013; BURKERT et al., 2005). Also, in this study the prevalence of DS in Labrador Retrievers was 26% and the chances were four times greater compared to all the other breeds studied here, which emphasizes the potential risk for this breed. Labradors are a very popular household pet dog breed and one of the most common breeds used worldwide as working dogs. Recently studies demonstrated that this breed also has a genetic predisposition to similar diseases to DS such as lumbosacral stenosis (MUKHERJEE et al., 2017) and osteoarthritis (ANDERSON et al., 2018). Other hypothesis that may explain the high prevalence includes the genetic predisposition to obesity (MANKOWSKA et al., 2017). Similarly to humans dog obesity can predispose or exacerbate several clinical conditions such as osteoarthritis, respiratory airway distress, renal diseases, diabetes mellitus and metabolic derangements (IMPELLIZERI et al., 2000; TVARIJONAVICIUTE et al., 2013). Notably both over-nutrition and obesity have been associated with impaired immunity and chronic low-grade inflammation in humans and mouse models (NIEMAN et al., 1999; BERG & SCHERER, 2005). In fact, Anderson et al. (2018) reports that breeds at or above mean breed bodyweight were 2.3 times more likely to have osteoarthritis than dogs below average weight.

French Bulldogs, a chondrodystrophic, brachycephalic and screw-tailed breed has a high risk of congenital vertebral anomalies (BERTRAN et al., 2018). Theses vertebral malformations can occur in isolation or be multiple and are frequently associated with vertebral malalignment and angulations (BAILEY e MORGAN, 1992; WESTWORTH & STURGES, 2010). Furthermore, it is unclear why most dogs with vertebral malformations are often asymptomatic, while some dogs develop clinical signs (MOISSONNIER et al., 2011; GUEVAR et al., 2014; RYAN et al., 2017; BERTRAM et al., 2018). Since this breed has become increasingly popular, recent epidemiological studies have demonstrated that FBs are prone to several neurological disorders: Mayousse et al. (2017) reported that 18.7% of FBs have neurological disorders whereas 64.7% were myelopathies; O'Neil et al. (2018) reported that the most common cause of death in primary care were brain disorders (11.9%), spinal cord disorders (9.5%) and vertebral spinal disorders (6%). In fact, the most common disorder is IVDD (AIKAWA et al., 2014), but the risk of developing DS reported in our study may provide new insights to clinical practice.

Although only 34% (62) of the owners of the DS group were found, 64% (40) of them reported that their animal did not recover from the disease. This represents at least 22% of the DS cases. The prognosis for dogs with DS is considered to be good; however, long-term treatment with antimicrobials and confinement to a cage to rest is necessary, which is more difficult with large breeds (BURKERT et al., 2005). Moreover, elderly dogs may be debilitated by age or have some concurrent disease. Consequently, the morbidity and mortality among cases may appear to be high. Diskospondylitis may be associated with severe morbidity and neurological impairment if the definitive diagnosis is delayed as a result of doubtful or normal radiographic findings in acute cases. Advanced imaging such as computed tomography and magnetic resonance have shown greater sensitivity and precocity diagnosis for DS (GENDRON et al., 2012; HARRIS et al., 2013; RUOFF et al., 2018), and is therefore a differential in the acute phase of the disorder.

CONCLUSION

Large breed dogs are more susceptible to develop DS and the Labrador Retriever breed has a higher risk than all large breeds studied here. Although small breeds have less chance to develop DS, the French Bulldogs require further investigations - as diskospondylitis can be considered an important differential diagnosis for this breed.

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TABLES

Table 1. Results of univariate analysis to identify factors associated with prevalence of diskospondylitis (DS) in 5,497 dogs submitted to vertebral computerized tomography (n=3,128) or digital radiography (n=2,369) from 2009 to 2018.

Characteristics	**with DS %(n)**	**without DS %(n)**	**OD**	**95% CI**	**P value***
All animals	3.4% (181)	96.6% (5316)	-	-	-
Breeds					
small (<15 kg)	27.6% (50)	53% (2815)	0.34	0.24-0.47	<0.001
medium (15-30 kg)	13.3% (24)	16.2% (863)	0.79	0.51-1.22	0.334
large (>30 kg)	44.7% (81)	17.6% (937)	3.78	2.80-5.12	<0.001
Mixed	14.4% (26)	13.2% (704)	1.10	0.72-1.68	0.744
Age					
puppy (<2ys)	11.0% (20)	7.2% (382)	1.60	1.00-2.58	0.069
young (2-5ys)	15.5% (28)	26.4% (1403)	0.51	0.34-0.77	0.001
adult (5-10ys)	38.1% (69)	39.7% (2110)	0.936	0.69-1.27	0.728
elderly (>10ys)	35.3% (64)	26.7% (1418)	1.504	1.10-2.05	0.012
Sex					
Male	64.6% (117)	53.4% (2840)	1.60	1.17-2.17	0.004
Female	35.4% (64)	46.6% (2477)	0.63	0.46-0.85	0.004

OD – *odds ratio*; CI – confidence interval
* X^2 test

Table 2. BREED distribution for cases with diskospondylitis (DS) and controls.

Breeds	**with DS %(n)**	**without DS %(n)**	**OD**	**95% CI**	**P value***
All dogs	n=181	n=5316	-	-	-
Labrador Retriever	22.1% (40)	7.1% (379)	3.70	2.56-5.33	<0.001
Mixed-breed	14.4% (26)	13.4% (713)	1.05	0.69-1.61	0.894
French Bulldog	8.8% (16)	7.7% (409)	1.16	0.69-1.96	0.670
Yorkshire	5.5% (10)	6.1% (325)	0.90	0.47-1.72	0.867
Golden Retriever	5% (9)	2.9% (154)	1.75	0.88-3.49	0.163
Poodle	5% (9)	11.1% (591)	0.42	0.21-0.82	0.013
Rottweiler	4.4% (8)	2.6% (139)	1.72	0.83-3.57	0.213
Shepherd (all breeds)	3.9% (7)	2.9% (155)	1.34	0.62-2.90	0.602
Boxer	2.8% (5)	2.1% (113)	1.31	0.53-3.24	0.749
Dachshund	2.8% (4)	10.2% (541)	0.20	0.07-0.54	<0.001
English Bulldog	2.2% (4)	0.8% (45)	2.65	0.94-7.44	0.129
Schnauzer	2.2% (4)	1.9% (99)	1.19	0.43-3.27	0.952
Pit bull	1.6% (3)	0.9% (46)	1.93	0.59-6.27	0.476
Pug	1.6% (3)	1.9% (102)	0.86	0.27-2.74	0.981
Maltese	1.1% (2)	4.5% (239)	0.24	0.06-0.96	0.045
Beagle	0.5% (1)	2.3% (123)	0.23	0.03-1.69	0.189

OD – *odds ratio*; CI – confidence interval
* X^2 test

Table 3. ***SMALL BREED*** distribution of cases with diskospondylitis (DS) and controls.

Breeds	**with DS %(n)**	**without DS %(n)**	**OD**	**95% CI**	**P value***
All small breeds	n=50	n=2815	-	-	-
French Bulldog	32% (16)	14.5% (409)	2.77	1.51-5.06	0.001
Yorkshire	20% (10)	11.5% (325)	1.91	0.95-3.87	0.105
Poodle	18% (9)	21.0% (591)	0.83	0.40-1.71	0.733

OD – *odds ratio*; CI – confidence interval
* X^2 test

Table 4. LARGE BREED distribution of cases with diskospondylitis (DS) and controls.

Breeds	**with DS %(n)**	**without DS %(n)**	**OD**	**95% CI**	**P value***
All large breeds	n=81	n=937	-	-	-
Labrador Retriever	49.4% (40)	40.4%(379)	1.44	0.91-2.27	0.147
Golden Retriever	11.1% (9)	16.4% (154)	0.64	0.31-1.30	0.273
Rottweiler	9.9% (8)	14.9% (139)	0.63	0.30-1.33	0.292

OD – *odds ratio*; CI – confidence interval
* X^2 test

Table 5. Diskospondylitis **SITE** distribution.

disk spaces affected	(n=181)	LR (n=40)*	FB (n=16)**
cervical (C1 to C7)	10.4%(19)	7.5% (3)	(0)
cervicothoracic (C7-T1)	7.7% (14)	17.5% (7)	(0)
thoracic (T1 to T13)	28.1% (51)	22.5% (9)	25% (4)
thoracolumbar (T13-L1)	1.6% (03)	2.5% (1)	6.2% (1)
lumbar (L1 to L7)	12.7% (23)	5.0% (2)	6.2% (1)
lumbosacral (L7-S1)	28.1% (51)	40.0% (16)	50% (8)
Multifocal	11.4% (20)	5.0% (2)	12.5% (2)

* Labrador Retriever

** French Bulldog