

ORIGINAL ARTICLE

Occurrence of canine hip dysplasia, cranial cruciate ligament rupture and patellar luxation in dogs in a retrospective study of 100 orthopedic cases

Ocorrência de displasia coxofemoral, ruptura do ligamento cruzado cranial e luxação patelar em cães em estudo retrospectivo de 100 casos ortopédicos

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Abstract

Canine hip dysplasia (CHD), cranial cruciate ligament rupture (CrCLR) and patellar luxation (PL) are the main causes of lameness in orthopedics of dogs. The present study evaluated dogs with these conditions attended at the Veterinary Unit of the Pontifical Catholic University of Paraná (PUCPR), between the years 2014 and 2018. A 100 charts were analyzed, the animals were divided by weight [w1 (0 - 20 kg), w2 (20.1 - 40 kg), w3 (40.1 - 60 kg), w4 (60.1 - 80 kg)], age [puppy (0-1year), adult (1.1-7 years), aged (> 7 years)], gender, reproductive status (neutered and non-neutered), PL degrees (I to IV), and affected limb. The correlation of the degree of PL with gender was analyzed by Mann Whitney. The degree of PL with weight and age by Kruskal-Wallis. Other data were correlated with the diseases by the Chi-Square Test. In the w1 category, the prevalence of CrCLR and LP was 73.7% and 87%, respectively, while the majority of CHD (65.3%) was found in the w2 category. Most dogs with

CHD were male (54.9%), for PL most were female (89%), whereas in CrCLR there was no gender predisposition, as there was no predisposition regarding age and reproductive status for any of the conditions. The highest prevalence of affections was CHD (44%), followed by PL (16%) and CrCLR (8%). Concerning comorbidities, 3% of the cases had CHD, PL and CrCLR, another 3% had CHD and CrCLR, 2% CHD and PL, 24% CrCLR and PL, totaling 51% of animals with CHD, 38% with CrCLR and 45% with PL. These findings elucidates that CHD, CrCLR and PL can be considered concomitantly in unresolved cases of lameness in pelvic limbs of dogs, therefore tests should be performed to rule out such conditions. The data obtained are similar to the literature consulted, however, prevalence and correlations remain not well understood.

Keywords: Cranial cruciate ligament. Hip dysplasia. Patellar luxation. Dogs.

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Resumo

Displasia coxofemoral (DC), ruptura do ligamento cruzado cranial (RLCCr) e luxação patelar (LP) são as maiores causas de claudicação para cães na ortopedia. O presente estudo avaliou cães com essas patologias atendidos na Unidade Veterinária da Pontifícia Universidade Católica do Paraná (PUCPR) entre os anos 2014 e 2018. Foram analisados 100 prontuários, e os animais divididos por peso [w1 (0 - 20 kg), w2 (20,1 - 40 kg), w3 (40,1 - 60 kg), w4 (60,1 - 80 kg)], idade [filhote (0 - 1 ano), adulto (1,1 - 7 anos), idoso (> 7 anos)], gênero, estado reprodutivo, graus de luxação patelar (I a IV) e membro afetado. A correlação entre LP e sexo foi analisada utilizando o teste Mann Whitney, e entre peso e idade utilizou-se Kruskal-Wallis. Os demais dados foram correlacionados com as doenças pelo teste Qui-quadrado. Na categoria de peso w1, a prevalência de RLCCr e LP foi de 73,7% e 87%, respectivamente, enquanto a maior parte de DC (65,3%) foi observada na categoria de peso w2. A maioria dos cães em DC eram machos (54,9%) e em LP eram fêmeas (89%), enquanto em RLCCr não houve predisposição sexual. Não houve predisposição quanto à idade ou estado reprodutivo para nenhuma das condições. A maior prevalência das afecções foi DC (44%), seguida por LP (16%) e RLCCr (8%). Considerando as comorbidades, 3% dos casos tinham DC, LP e RLCCr, outros 3% tinham DC e RLCCr, 2% DC e LP, 24% RLCCr e LP, totalizando 51% dos animais com DC, 38% com RLCCr e 45% com LP. Esses achados elucidam que DC, RLCCr e LP podem ser consideradas simultaneamente em casos não resolvidos de claudicação de membros pélvicos de cães, portanto, testes devem ser realizados para descartar tais condições. Os resultados obtidos são semelhantes à literatura consultada, entretanto, prevalências e correlações ainda não são bem compreendidas.

Palavras-chave: Ligamento cruzado cranial. Displasia coxofemoral. Luxação patelar. Cães.

Introduction

Canine hip dysplasia (CHD), rupture of the cranial cruciate ligament (CrCLR) and patellar luxation (PL) are the main causes of limb lameness in orthopedics for dogs. In order to diagnose such conditions, it is necessary, in addition to examining

locomotion, to perform specific orthopedic tests such as drawer testing, tibial compression, patellar luxation test, pelvic limb manipulation, and subsequent radiographic examination (Brinker et al., 2009; Schulz, 2018). However, in the presence of a positive tibial compression test, or clinically detected patellar dislocation, the hip is often not investigated; yet large dogs are diagnosed as dysplastic, and there may be concomitant stifle lesions, occurring underdiagnosed affection in both cases. Radiographic exam is the definitive diagnosis for CHD, and clinical tests for CrCLR and PL, radiographic evaluations for evaluation of concomitant lesions and surgical planning are recommended in all animals (Fries and Remedios, 1995; Bach et al., 2015).

CHD is a polygenic, multifactorial disease (Ginja et al., 2010; Peterson, 2017), described for the first time in 1935 (Schnelle, 1935), being the most commonly diagnosed orthopedic condition in the dog, with a prevalence of up to 71% in some breeds (King, 2017). It is defined by abnormal development of the hip joint that usually occurs bilaterally (Brinker et al., 2009), commonly observed in large breeds of dogs with fast growth (Riser et al., 1964; Fries and Remedios, 1995; Schulz, 2018). There is variation in the degree of lassitude of the hip joint, with the onset sometimes observed in very young animals, less than sixty days old, associated with muscle weakness, especially of the gluteal muscles (Morgan, 1987). This disorder causes progressive subluxation of the femoral head, which, leads to acetabular deviation, flattening of the head and thickening of the femoral neck, in addition to osteoarthritis (Peterson, 2017; Schulz, 2018).

Patellar luxations (PL), on the other hand, was classified in four grades by Putnam (Putnam, 1968), adapted by Singleton (Singleton, 1969), and simplified by Roush (Roush, 1993) to facilitate comprehension during the physical examination: Degree I - a patella can be manually dislocated, but automatically returns to its normal position; Degree II - the patella dislocates to knee flexion or manual manipulation and remains dislocated until knee extension or manual repositioning; Degree III - the patella is dislocated permanently, but its manual repositioning is still possible; Degree IV - The patella is permanently dislocated and cannot be

repositioned manually. PL affects, on average, 40% of companion animals (Nganvongpanit and Yano, 2011), with 20 to 25% of animals being bilaterally affected (Fernandes, 2015).

PL concomitant with CrCLR is present in 15 to 20% of the knees of adult dogs to the elderly, with chronic PL (Brinker et al., 2009), while CrCLR alone is present with approximately 12% of the animals (Souza et al., 2011). It is not yet clear whether CrCLR is the cause or consequence of PL (Holt, 2017). The cranial cruciate ligament and the patellar ligament are responsible for restricting the cranial translation movement of the tibia, in addition to restricting the internal rotation of the knee and preventing hyperextension. Its rupture mainly implies degenerative joint disease, precisely because it allows this erroneous movement of the tibia in relation to the femur (Denny and Butterworth, 2006; Schulz, 2018). About 30 to 40% of the dogs that present CrCLR have the contralateral cranial cruciate ligament also affected in two years (Schulz, 2018). Straight limbs, tibial plateau angle and narrowing of the intercondylar notch may be contributing factors for ligament rupture (Brinker et al., 2009; Schulz, 2018).

It is also known that age is a contributing factor in soft tissue deformities adjacent to the knee, and that these older dogs have a greater tendency to have patellar luxation and also rupture of the cranial cruciate ligament (Holt, 2017). Still according to Holt (2017), dogs with congenital PL are almost seven times more likely to develop cranial cruciate ligament rupture than dogs with traumatic PL, because animals with congenital luxation present more abnormal forces acting on the stifle joint and pelvic limb muscles than animals who suffered traumatic PL.

CHD and PL originate from poorly developed hip and knee joint, respectively, with aggravating environmental factors, whereas CrCLR is preceded by synovitis and fragility of the ligament fibers, with or without the association of traumatic injury. In common, the three orthopedic disorders alter the biomechanics of dog's locomotion, causing articular incongruities, inflammatory reactions, and, consequently, degenerative joint disease (Denny and Butterworth, 2006; Brinker et al., 2009; Raynauld et al., 2016).

The aim of this study was to evaluate the data on dogs studied at the Veterinary Unit of the Pontifical Catholic University of Paraná (PUCPR) from 2014 to 2018, with clinical and radiographic diagnosis of CHD, CrCLR and PL, correlating those affections among them and the epidemiological data.

Material and methods

Inclusion criteria

One hundred medical records of dogs that were attended at the Veterinary Unit of PUCPR were analyzed from April 2014 to April 2018. The medical records were selected from the pelvic and knee radiographic examinations database. The examinations were performed in the Veterinary Unit. Data were collected considering the side affected limb, being unilateral right or left and bilateral, and the presence or absence of conditions alone or concomitantly.

For patellar luxation the degree of luxation was considered, the side of affected limb, being classified as unilateral right or left, or bilateral. The diagnosis of PL was taken by clinical examination described by Denny and Butterworth (2006). In cases of PL the radiographic image was taken to analyze degeneration of the knee articulation.

Data such as weight, age, gender, and reproductive status, neutered and non-neutered, were also collected from the charts and compiled into spreadsheets, and missing data were counted as missing data. All the articles used to reference this article were taken from Google Scholar and Pubmed Database.

Statistical analysis

The animals were divided into four weight categories: w1 (from 0 to 20 kg); w2 (20.1 to 40 kg); w3 (40.1 to 60 kg); w4 (60.1 to 80). This parting in weight categories was made to standardize weights, seeing that we have studied animals with great variation of size. Three age classes were established, puppy: less than 1 year; adult: 1.1-7 years; aged: > 7 years. The division by age classes allowed the framing of adopted animals with no complete

history, and unknown age information. Regarding the reproductive status, they were considered neutered or non-neutered.

In order to correlate gender, reproductive status, weight and age categories with the occurrence of the condition, the Qui² test was used, which was also used for the prevalence of PL and CrCLR sides. The comparison of gender between degree of luxation was performed by U-Mann Whitney test (non-parametric). Weight and age categories were compared in degree of luxation using the Kruskal-Wallis test. When null hypothesis was rejected by this test, Mann-Whitney test was applied. All analysis considered p = 0.050 and the software used for statistical analysis was the IBM SPSS statistics.

Results

The prevalence of isolated and concomitant affections is shown in Figure 1, and the breeds are listed in Table 1. It was not possible to evaluate the racial predisposition among the affections in this study due to the great variability of breeds and sample volume.

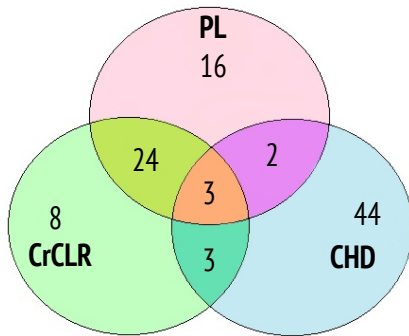


Figure 1 - Prevalence in percentage (%) of patellar luxation (PL), cranial cruciate ligament rupture (CrCLR), and canine hip dysplasia (CHD) in 100 dogs attended at the Veterinary Unit of PUCPR from April 2014 to April 2018.

The average weight of dogs with isolated conditions was 18 kg for PL, 12 kg for CrCLR, 31 kg for CHD. There was a positive correlation (p < 0.05) for the occurrence of PL in animals weighing 0 - 20

kg (Table 2). There was a predominance of 87% of animals from 0 - 20 kg with PL, 73.7% from 0 - 20 kg in CrCLR, 65.3% from 20 - 40 kg with CHD, 94.7% from 0-20 kg with PL bilateral and 90% of 0 - 20 kg with right CrCLR. Comparing the weight of dogs with concomitant affections, the average was 10 kg for PL with CrCLR, 11 kg for PL with CHD, 23 kg for CrCLR with CHD, and 26 kg for PL with CrCLR and CHD.

Table 1 - Percentage distribution of the main breeds that expressed patellar luxation (PL), cranial cruciate ligament rupture (CrCLR), and canine hip dysplasia (CHD) alone or simultaneously

Disease	Breed	%
PL	Poodle	25.0
CrCLR	Pinscher	25.0
	Mongrel	25.0
CHD	Pastor Alemão	18.0
	Mongrel	31.0
PL + CrCLR	Pinscher	29.0
PL + CHD	Shih Tzu	50.0
	Staff Bull	50.0
CrCLR + CHD	Husky Siberiano	33.3
	Pit Bull	33.3
	Mongrel	33.3
PL + CrCLR + CHD	Labrador	33.3
	Pastor Alemão	33.3
	Mongrel	33.3

Table 2 - Weight average of patellar luxation (PL), cranial cruciate ligament rupture (CrCLR), and canine hip dysplasia (CHD) alone or in comorbidity one with other

Disease	Weight average (kg)	Weight category
PL	18*	W1
CrCLR	12	W1
CHD	31	W2
PL + CrCLR	10	W1
PL + CHD	11	W1
CrCLR + CHD	23	W2
PL + CrCLR + CHD	26	W2

Note: *Positive correlation between weight average and the presence of patellar luxation (p < 0.05), Qui² test. W1 = 0 - 20 kg; W2 = 20.1 - 40 kg.

Regarding age (Table 3), the average was 2 years for PL, 9 years for CrCLR, 7 years for CHD, 8 years for PL with CrCLR, 2 years for PL with CHD, 3 years for CrCLR with CHD, and 2 years for PL with CrCLR and CHD. There was no significant correlation of age for any of the conditions, nor age regarding the degree of PL.

Table 3 - Distribution of patellar luxation (PL), cranial cruciate ligament rupture (CrCLR) and canine hip dysplasia (CHD) in correlation with age of the dogs

Disease	Age (years)	Age Category
PL	2	Adult
CrCLR	9	Aged
CHD	7	Adult
PL + CrCLR	8	Aged
PL + CHD	2	Adult
CrCLR + CHD	3	Adult
PL + CrCLR + CHD	2	Adult

In CHD, the percentage of males (54.9%) was higher, while in PL the percentage of females (89.5%) was higher ($p < 0.050$). In the group of dogs with CrCLR and PL associated, 91% weighed 0 - 20 kg ($p < 0.050$).

Regarding the degree of PL, considering unilateral or bilateral cases, ($n = 38$) the distribution between grades was 14.5% Grade I, 50.9% Grade II, 10.9% Grade III, and 23.6% Grade IV.

There were only three cases that presented the three conditions (PL, CrCLR and CHD) in association. The exact weight of the animals coincided in 26 kg, being two non-neutered females (Labrador retriever and Mongrel) and one castrated male (German Shepherd). Both females at the age of 3 years and the male at the age of seven months.

The main breeds involved in the isolated or simultaneous expression of the affections are represented in Table 1. In the associated conditions, in PL with CrCLR, miniature pinscher represented 29% of the cases. PL with CHD was observed only in two animals, namely a Shi-Ttzu and a Staffordshire bull terrier. For CrCLR with CHD there were three animals, namely a Siberian Husky, a Pit Bull and

a Mongrel, and for PL with CrCLR and CHD there were three breeds, namely a Labrador Retriever, a German Shepherd and a Mongrel. Other correlations of gender, age, weight and reproductive status were not significant.

Discussion

The results of the present study are in agreement with Souza et al. (2011), Holt (2017) and Peterson (2017), who found CHD alone in 50%, CrCLR in 12% and PL in 4.8% of dogs treated with joint affection, respectively.

Regarding the degree of PL, Souza et al. (2011) also found a higher incidence of degree II PL in 32.7% of the cases, while in the present study it was 50% of the cases, corroborating the fact that degree II was the most expressive plot among the degrees of classification of PL.

Although in this study there is no correlation with gender and reproductive status, Holt (2017) reports factors such as female gender and spaying as a risk for PL, because of the decrease in anabolic sexual hormones influencing the amount of muscle mass, compromising the stability of the joints. Souza et al. (2011) also found a prevalence of increased PL in females (62.9%). Regarding the breed, the miniatures are the most affected by PL, but medium, large and giant sizes are not excluded, according to the present study (Denny and Butterworth, 2006). Another study also showed a positive correlation between early sterilization and CrCLR, arguing that early castration would affect hormonal production in the early stages of life, worsening the muscular condition in relation to uncastrated or late castrated animals (Torres de la Riva et al., 2013).

Regarding the weight of dogs, in the study of Souza et al. (2011), average weight for PL was 8.9 kg, 24 kg for CrCLR and 32.1 kg for CHD, close to the values found in the current study, which showed a higher prevalence of CHD in large sized, CrCLR in medium sized and PL in small sized dogs.

The developmental disparity, between the bony and muscular structures in dogs of large breeds, with accelerated growth, predisposes to deformation and articular incongruity. The factor that explains the higher prevalence of CHD in males is that such

disparity is even more observed, since they are larger and grow faster than females (Schulz, 2018).

Studies with larger sampling allowed the verification of racial predisposition for the affections studied. Data from 889 animals collected by Souza et al. (2011), showed similar prevalence of PL with most of the sample, being Poodle 36.2% of the cases. For CrCLR, most of the dogs were Mongrel (29.8%). For CHD, they found higher prevalence in the German Shepherd breed (21.6%) and Mongrel (15.7%).

The age of the diagnosis of the affections is variable. For CrCLR, the diagnosis of the affected dogs occurs from a year and a half on, finding differences in the degree of joint degeneration, that the more degenerate the greater the lameness, but the degree of degeneration increases along the years, leading then the disease's diagnosis delay (Döring et al., 2018). The diagnosis of PL is more common between 12 and 24 months (Nilsson et al., 2018). Brinker et al. (2009) stated that PL concomitant with CrCLR is present in 15 to 20% of knees from adult to elderly dogs with chronic PL. Many studies have been directed towards greater clarification of predisposing morphological and biomechanical factors among orthopedic affections in dogs (Kaiser et al., 2001; Griffon, 2010; Souza et al., 2011). According to Brinker et al. (2009), the lack of collaboration of the patellar ligament in blocking the cranial translation of the tibia, overloads the cranial cruciate ligament, predisposing it to rupture. However, it is still unclear whether CrCLR is the cause or consequence of PL (Holt, 2017).

There were only three cases in which they presented the three affections (PL, RLCC and CHD) in association. The exact weight of the animals coincided in 26 kg, being two integral females (Labrador and Mongrel) and one castrated male (German Shepherd). Both females with three years and male with seven months. Few reports of the coexistence of the three conditions are found in the literature (Griffon, 2010).

Conclusion

The main findings of this study were the positive correlations between the associated diseases, which may be useful during diagnosis

approach. Tests should be performed to rule out such conditions in cases of unresolved lameness of pelvic limbs in dogs. It can be verified that the data in our environment tend to resemble the literature consulted, and that some of the prevalence and correlations remain not well understood. It is suggested that more studies be performed correlating the affections for a better understanding of their pathogenesis.

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