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PREDISPOSITION OF DOG BREEDS TO RUPTURE OF THE CRANIAL CRUCIATE LIGAMENT

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Abstract

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Obtaining more data on breed predisposition of dogs to the cranial cruciate ligament (CCL) rupture and data on accompanying abnormalities of joints of pelvic limbs affected by the CCL rupture may help in answering some questions concerning the etiology and pathogenesis of the disorder.

In 183 patients affected by the CCL rupture out of the total of 11579 dogs, evaluated and/or treated in the Clinic of Surgery and Orthopedics at the Veterinary and Pharmaceutical University Brno from January 1997 till April 2000, the breed, weight, sex and concurrent joint abnormalities of pelvic limbs (hip dysplasia, patellar luxation and osteochondrosis of the stifle joint) were recorded.

A total of 213 stifle joints (16.39% of cases were bilateral CCL ruptures) were affected. Increased breed predisposition (χ^2-test; $p < 0.01$) was found in American Staffordshire Terrier, Rottweiler, Brazilian Fila, Labrador Retriever, American Cocker Spaniel, Chow Chow, German Shorthaired Pointer, Saint Bernard and Bullmastiff and also on the 5% level of significance in Boxer.

Contrary to published data, the high incidence of CCL rupture was found in Brazilian Fila (13.43% of prevalence). The risk of the CCL rupture in German Shepherd Dog was significantly lower (χ^2-test; $p < 0.01$) than in other breeds studied. At the same time in 27 patients with the CCL rupture we diagnosed canine hip dysplasia, in 9 dogs medial patellar luxation and in 5 cases osteochondrosis of the stifle joint. The data found are briefly discussed in relation to the possible CCL rupture etiology.

Stifle joint, cranial cruciate ligament injury, prevalence, etiopathogenesis

Cranial cruciate ligament (CCL) rupture belongs to the most frequent acquired diseases of the stifle joint not only in dogs and cats (Ryer 1981) but also in man (Griffin et al. 2000). Many questions concerning the etiopathogenesis of the CCL rupture remains unanswered. The integrity of the cranial cruciate ligament may be lost due to direct trauma of the stifle which may also result in damage of other structures of the stifle such as the caudal cruciate ligament, medial and lateral collateral ligaments, meniscus, joint capsule and eventually bone structures of the joint (femur, tibia and patella) (Bruce 1998). The number of cases of in such a way originated CCL ruptures is relatively small. With regard to the absence of direct trauma of the stifle joint in most cases of CCL rupture, various predisposing factors taking part in decreasing the firmness of the ligament, resulting in its inability to stand up to normal loading and subsequent rupture have been considered. Decreased CCL resistance to forces of pull has been proved in animals with aging. Results of concurrent histological examination have proved degenerative changes of the ligament that were more severe with advancing age of dogs and occurred earlier in dogs of large breeds (body weight > 15 kg) (Vasseur et al. 1985). There may also be other predisposing factors such as

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immune-mediated arthropathies (Niebauer and Menzel 1982; Niebauer et al. 1987), abnormalities in the stifle joint constitution (Arnoczky 1993) and growth deformities with abnormal stance of pelvic limbs (Read and Robins 1982). Predisposition to the CCL rupture in dogs was proved in many breeds (Duval et al. 1999; Whitehair et al. 1993). Whitehair et al. (1993) mentions increased occurrence of the CCL rupture in females. Surgically sterilized dogs (male and female) suffered from the CCL rupture more often. The CCL injury occurred most frequently from 7 to 10 years of age (Whitehair et al. 1993). There was a higher incidence of the CCL rupture found in dogs of large breeds (> 22 kg) than in smaller breeds (≤ 22 kg) and the clinical symptoms appeared at a younger age (Whitehair et al. 1993). Duval et al. (1999) found, that in the group of young dogs up to two years of age having the CCL rupture mostly large breeds (> 22 kg) are represented.

This study is aimed at determining the dog breed predisposition to the CCL rupture, finding out concurrent orthopedic abnormalities in the limb affected by the CCL rupture and relating the data to the possible CCL rupture aetiology.

Materials and Methods

From the dogs evaluated and/or treated in the Clinic of Surgery and Orthopedics at the Veterinary and Pharmaceutical University Brno from the beginning of January 1997 till the end of April 2000 (n = 11579), dog patients, in which the CCL rupture was clearly and fully diagnosed, were included in this study. Diagnosis of the CCL rupture was based on orthopedic examination including specific tests such as the cranial draver sign in the stifle joint and the tibial compression test, and radiographic findings (joint effusion, arthrotic changes, cranial displacement of the tibia relative to the femur) and/or stifle joint arthrotomy. Data on breed, body weight, sex and concurrent orthopedic abnormalities of hind limb (hip dysplasia, patellar luxation and osteochondrosis of the stifle joint) of each patient were recorded. In each clinical case of the CCL rupture such data as the age of the patient at the time of the rupture (there could have been differences in bilaterally affected animals) and the side of pathological changes localisation in the stifle were determined. We computed mean values and standard deviation values for the body weight and age of patients. The breed predisposition (evaluated using the χ^2-test) and prevalence of the CCL rupture (expressed as per cent) included only such breeds that were represented by two or more individuals affected by the CCL rupture. Breed prevalence values were computed as the proportion of affected patients of a given breed to the total number of individuals of that breed treated.

Results

The CCL rupture was diagnosed in 183 patients (1.58%) of 48 dog breeds including mongrels out of the total of 11579 dogs during a period longer than 3 years. We found increased breed predisposition (χ^2-test; $p < 0.01$) in the following breeds represented by at least two cases of CCL rupture: American Staffordshire Terrier, Rottweiler, Brazilian Fila, Labrador Retriever, American Cocker Spaniel, Chow Chow, German Shorthaired Pointer, Saint Bernard and Bullmastiff. We also proved increased breed predisposition in Boxers on the level of significancy $p < 0.05$ (χ^2-test). We did not find increased risk for the CCL rupture in mongrels and the following breeds: Poodle, Doberman Pinscher, Maltese, Rhodesian Ridgeback, Spitz, Beagle, Cocker Spaniel, Golden Retriever, Giant Schnauzer, West Highland White Terrier and Yorkshire Terrier. The risk of the CCL rupture was significantly lower (χ^2-test; $p < 0.01$) in German Shepherd Dogs. Table 1 shows the prevalence of the CCL rupture in breeds represented by at least two cases of rupture.

In all, there were 213 stifle joints affected in these 183 patients with diagnosed CCL rupture. A total of 30 dogs (16.39%) were bilaterally affected and the remaining 153 dogs (83,61%) had only unilateral changes. The joint of the right limb was affected in 135 cases (63.38%) and the (left) other one in 78 cases (36.62%). There were 98 males (53.55%) and 85 females (46.45 %). The age of patients at the time of the CCL rupture varied from 1 to 18 years with the mean age of 5.71 ± 3.89 years. The body weight of patients varied from 2 to 80 kg with the mean value of 24.20 ± 15.93 kg.

Routine clinical and radiographic evaluation resulted in finding hip dysplasia, apart from

Table 1
Risk of CCL rupture for breeds of dogs represented by ≥2 cases

Breed	Number of affected dogs	Number of dogs in population	Prevalence (%)
High at risk			
American Staffordshire Terrier	16	246	6.50
Rottweiler	12	213	5.63
Boxer	9	273	3.30
Brazilian Fila	9	67	13.43
Labrador Retriever	7	149	4.70
American Cocker Spaniel	6	130	4.62
Chow Chow	4	25	16.00
German Shorthaired Pointer	4	71	5.63
Saint Bernard	3	20	15.00
Bullmastiff	2	22	9.10
Not at risk			
Mongrel	29	1569	1.85
Poodle	22	988	2.28
Doberman Pinscher	7	414	1.70
Maltese	3	103	2.91
Rhodesian Ridgeback	3	73	4.11
Spitz	3	161	1.86
Beagle	2	67	2.99
Cocker Spaniel	2	553	0.36
Golden Retriever	2	113	1.77
Giant Schnauzer	2	105	1.91
West Highland White Terrier	2	48	4.18
Yorkshire Terrier	2	269	0.74
Low at risk			
German Shepherd Dog	7	1321	0.52

the CCL rupture, in 27 patients (exclusively dogs of large and giant breeds, weighing > 22 kg). In 9 cases (exclusively dogs of small and medium size breeds, weighing ≤ 22 kg) we found medial patellar luxation in the joint affected by the CCL rupture, and in 5 cases (exclusively dogs of large and giant breeds, weighing > 22 kg) osteochondrosis was also diagnosed in the affected stifle. Lesions of osteochondrosis were localised in all cases on the lateral femoral condyle.

Discussion

The cranial cruciate ligament rupture belongs to relatively frequent disorders in dogs. In our collection patients with this disorder amounted to 1.58% of all the dogs treated, which is a similar incidence as that mentioned by other authors (Johnson et al. 1994; Whitehair

et al. 1993). As far as diseases of the stifle joint are concerned, the CCL rupture takes part in more than one half of cases (Johnson et al. 1994).

According to Whitehair et al. (1993) the CCL rupture occurs more frequently in large dog breeds (> 22 kg). We also found (within our study) that in the group of 10 breeds with significantly higher CCL rupture incidence 9 breeds were weighing more than 22 kg (American Staffordshire Terrier, Rottweiler, Boxer, Brazilian Fila, Labrador Retriever, Chow Chow, German Shorthaired Pointer, Saint Bernard and Bullmastiff) and only one breed less than 22 kg (American Cocker Spaniel). Though dogs of large breeds are most frequently affected, body weight of patients cannot be considered as the only predisposing factor regarding the fact that the German Shepherd belongs to breeds with lower incidence of the CCL rupture (Whitehair et al. 1993). We also found increased CCL rupture incidence in Brazilian Fila, which was not mentioned as a predisposed breed by Whitehair et al. (1993). Contrary to this, it was one of the most frequently affected breeds (13.43% of prevalence) in our study.

In the above-mentioned breeds we can recognise some abnormalities which may contribute to the CCL rupture such as a hyperextended stance of pelvic limbs (Arnoczky and Marshall 1977) frequently occurring in breeds such as Chow Chow, Rottweiler, American Staffordshire Terrier, Boxer, Brazilian Fila, Saint Bernard and Bullmastiff. One of the causes of hyperextended stance of pelvic limbs can be hip dysplasia, which was diagnosed in our collection of patients in 27 cases of the CCL rupture (exclusively dogs of large and giant breeds, weighing > 22 kg). Other predisposing factors might be obesity to which there is a higher disposition in Labrador Retrievers and Cocker Spaniels (Edney and Smith 1986) and quick maximum load (Arnoczky 1993; Cabaud 1983) mainly in working and prone to aggression breeds such as Chow Chow, Rottweiler, American Staffordshire Terrier, Brazilian Fila and German Shorthaired Pointer. Even this explanation of predisposing factors for the CCL rupture is not unambiguous because there are breeds that fall into the above-mentioned criteria and, in spite of this, higher incidence of this disorder is not noticed.

In some dogs the CCL rupture may be associated with medial patellar luxation (Arnoczky 1993; Moore and Read 1996). This disorder was found in 9 cases of the CCL rupture in our collection of patients exclusively in dogs of small and medium size breeds (body weight ≤ 22 kg).

A number of papers proved a higher incidence of the CCL rupture in females than in males (Barnes 1977; Denny and Minter 1973; Whitehair et al. 1993). In our sample of patients males and females were rather equally represented (53.55% of males and 46.45% of females).

Mean age of dogs at the time of the CCL rupture in our clinical sample of patients was 5.71 ± 3.89 years. The highest incidence of CCL rupture was recorded between 2 and 4 years of age. This range of age is somewhat lower than commonly mentioned data on the highest incidence of this disease in dogs of 7 to 10 years of age (Whitehair et al. 1993). It may be, apart from other causes, due to the fact that in our group there was a higher number of large dog breeds, in which there is an earlier occurrence of the CCL rupture (Duval et al. 1999).

Bilateral stifle joint affection in our collection of 183 dogs with the CCL rupture was found in 30 individuals (16.39% of cases) during the study period. As mentioned in the literature the incidence of bilateral CCL rupture varies from 8% (Bennett et al. 1988) to 31-37% (Duval et al. 1999; Pond and Campbell 1972). Regarding the relatively short period of pursuing our patients, the real number of cases of bilateral CCL rupture would probably be higher in our group of patients.

Disruption of integrity of intraarticular ligaments and their subsequent rupture may be caused by immune-mediated arthropathies. The arthropaties mentioned affect more joints and may cause bilateral CCL ruptures (Goring and Beale 1993, Moore and Read 1996) which are most often found in lymphocytic–plasmacytic synovitis (Hopper 1993). The fact

that immune-mediated mechanisms play an important role in pathophysiology of the CCL rupture is supported by a number of studies (Galloway and Lester 1995; Lawrence et al. 1998; Niebauer and Menzel 1982; Niebauer et al. 1987). It is supposed that there may be also other factors taking part in etiopathogenesis of CCL rupture such as degenerative changes of the CCL (Vasseur et al. 1985). These changes in the cranial cruciate ligament are then the precondition to the rupture under fewer loads compared to the healthy ligament. Poor blood supply to the central part of the ligament may be one cause of degenerative changes of the CCL in dogs (Tirgari 1978). More study is required to explain all unanswered questions concerning etiopathogenesis of this common orthopaedic condition.

Plemenná predispozice psů k ruptuře předního zkříženého vazu

Rozšíření údajů o plemenné predispozici psů k ruptuře předního zkříženého vazu a doprovodných abnormalitách kloubů pánevních končetin postižených rupturou LCC může přispět k objasnění některých otázek etiopatogeneze uvedeného onemocnění.

U 183 pacientů s rupturou kraniálního zkříženého vazu ze souboru 11579 psů vyšetřených a/nebo ošetřených na Klinice chirurgie a ortopedie Veterinární a farmaceutické univerzity v Brně v období od ledna 1997 do dubna 2000 bylo zaznamenáno plemeno, hmotnost, pohlaví a souběžné abnormality kloubů pánevních končetin (dysplazie kyčelního kloubu, luxace pately a osteochondróza kolenního kloubu).

Celkem bylo postiženo 213 kolenních kloubů (16,39 % případů byly bilaterální ruptury LCC). Zjištěna byla zvýšená plemenná predispozice (χ^2-test; $p < 0,01$) u amerického stafordšírského teriéra, rotvajlera, brazilské fily, labradorského retrívra, amerického kokršpaněla, čau-čau, německého krátkosrstého ohaře, bernardýna, bulmastifa a na 5% hladině významnosti (χ^2-test) také u boxera.

Na rozdíl od dostupných literárních údajů byla prokázána vysoká incidence ruptury LCC také u brazilské fily (prevalence 13,43 %). Riziko vzniku ruptury LCC u německých ovčáků bylo signifikantně nižší (χ^2-test; $p < 0,01$) než u ostatních sledovaných plemen. U 27 pacientů s rupturou LCC byla současně diagnostikována dysplazie kyčelních kloubů, u 9 psů mediální luxace pately a v 5 případech osteochondróza kolenního kloubu. Zjištěné údaje jsou diskutovány v souvislosti s možnou etiologií ruptury LCC.

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