

Determining the Genetic Basis for Knee Disease in the Newfoundland Breed of Dog

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Vicki L. Wilke, Research Associate,
Brian P. Kinghorn, Professor, University of New
England, Armidale, New South Wales Australia
Mike G. Conzemius, Associate Professor, College of
Veterinary Medicine
Max F. Rothschild, Distinguished Professor

Summary and Implications

A survey was performed to determine the number of Newfoundlands that were seen at the Iowa State University College of Veterinary Medicine (ISU-CVM) for cranial cruciate ligament disease (CCLD) from January, 1996 through December, 2002. Of the 163 Newfoundlands seen at the ISU-CVM, 22% were diagnosed with CCLD. Further study of Newfoundlands was performed to collect pedigrees and ascertain whether or not individuals that were affected with CCLD or not were related. This information was used to determine the level of inbreeding, and the pattern of inheritance (i.e. recessive, sex-linked) for CCLD. This study found a recessive pattern of inheritance with partial penetrance of 59%. Therefore a dog has a 59% chance of showing signs of the disease when it has the recessive genotype.

Introduction

Cranial cruciate ligament disease is the rupture of the cranial cruciate ligament. This causes instability in the knee leading to debilitating arthritis and lameness. Particular breeds of dogs (e.g. Labrador retriever, Newfoundland) are frequently diagnosed with CCLD while other breeds (e.g. Greyhound) are rarely affected with the disease. The goal of this research is to determine if CCLD has a genetic basis.

Materials and Methods

Medical records were collected from the ISU-CVM for all Newfoundlands that were seen for veterinary care from 1996 through 2002. All records were evaluated for evidence of cruciate disease. Then a large scale recruitment study was performed to collect five generation pedigrees from Newfoundlands.

Newfoundlands were examined by a veterinarian and classified as affected with CCLD if they had signs of the disease. These signs included pain on hyperextension of the knee, knee inflammation, decreased knee range of motion, instability of the knee, radiographic evidence of knee arthritis, and/or surgical confirmation of a ruptured cranial cruciate ligament. Pedigrees were constructed and a program was used to predict the pattern of inheritance.

Results and Discussion

Of the 163 Newfoundlands presented to the ISU-CVM, 22% were diagnosed with CCLD. From the recruitment study, pedigrees were collected on 267 Newfoundlands, of which 56 (33 female, 23 male) were affected with CCLD and 211 (109 female, 102 male) were normal dogs. The level of inbreeding was 0.002 for the pedigree population. Of the animals that were inbred, average inbreeding was 0.05 (range 0.004 – 0.17). A recessive pattern of inheritance was found, with the frequency of the recessive allele estimated to be 0.65 with 59% penetrance. This implies that only 59% of all dogs that have the affected genotype will show the signs of CCLD.

Conclusions

Cranial cruciate ligament disease is a debilitating disease due to its resultant progressive arthritis. Surgery is the best choice for treatment in the majority of dogs, costing the public hundreds of millions of dollars each year. Many different causes for CCLD in the dog have been proposed, but this is the first study that has defined the genetic basis of this disease in the Newfoundland breed. Based on this study, breeders should not breed animals that show signs of CCLD. Further studies should be done to create a genetic test that would identify all animals with 1 or 2 copies of the recessive allele. This would identify carriers of the disease, or those that have the recessive genotype but are not exhibiting clinical signs, thereby eliminating them from the breeding population.

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