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BRIEF COMMUNICATION

Prevalence of dog erythrocyte antigens in retired racing Greyhounds

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Key Words
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Background: Blood groups in dogs are designated as dog erythrocyte antigen (DEA) 1.1, 1.2, 3, 4, 5, 7, and *Dal*. There is limited information about the frequency of different antigens in Greyhound dogs, despite their frequent use as blood donors.
Objectives: The aims of this study were to determine the frequencies of DEA 1.1, 1.2, 3, 4, 5, and 7 in Greyhounds, to compare the frequencies with those of non-Greyhound dogs, and to evaluate the presence of naturally occurring anti-DEA antibodies.
Methods: Blood was collected from 206 Greyhound and 66 non-Greyhound dogs being screened as potential blood donors. Blood-typing was performed at Animal Blood Resources International by tube agglutination utilizing polyclonal anti-DEA antibodies.
Results: Of the Greyhound dogs, 27/206 (13.1%) were positive for DEA 1.1, and this frequency was significantly lower ($P < .0001$) than for non-Greyhound dogs of which 40/66 (60.6%) were DEA 1.1-positive. The frequency of positivity for both DEA 1.1 and 1.2 was also lower in Greyhounds ($P < .0001$). There were no significant differences between Greyhounds and non-Greyhounds for DEA 1.2, 3, 4, 5, or 7. All 137 dogs (113 Greyhounds and 24 non-Greyhounds) that were evaluated for naturally occurring anti-DEA antibodies in serum were negative. A higher percentage of Greyhound dogs (57.3%, 118/206) were considered "universal donors" (negative for all DEAs except DEA 4) compared with non-Greyhound dogs (28%, 13/46).
Conclusion: The frequency of positivity for DEA 1.1 in our population of Greyhounds was significantly lower than previously reported for dogs. Furthermore, a large majority of Greyhounds met the criteria for universal donors.

Blood groups were first recognized in dogs in the early 1900s. The original blood group system described by Swisher and Young was designated by letters A through G.[1] In 1976, during the Second International Workshop on Canine Immunogenetics, many of the blood groups were designated as belonging to the dog erythrocyte antigen (DEA) system, and letters were replaced by numbers. Seven different canine blood groups have undergone international standardization, and typing sera are available for 6 antigens: DEA 1.1, 1.2, 3, 4, 5, and 7.[2] After transfusion of incompatible blood to a previously sensitized recipient, clinical manifestations are tremors, emesis, incontinence, fever, dyspnea, hemoglobinuria, and hemoglobinemia.[3] Owing to the potential consequences of mismatched transfusions, especially resulting from the immunologic characteristics of DEA 1.1 and 1.2 and the limited information about the frequency of blood types in Greyhounds, often used as blood donors, we evaluated the DEA profiles of Greyhound dogs and compared them with those of non-Greyhound dogs. Because of the potential for clinical consequences of mismatched transfusions with these groups, we evaluated the frequency of the RBC antigens in Greyhounds and non-Greyhound dogs.

The 272 dogs evaluated in this report were presented to The Ohio State University Veterinary Medical

Center (OSU-VMC) for screening as potential blood donors during the 12-year period from 1998 to 2009. The age range was 1–7 years with a mean age of 4.0 years for Greyhounds and 3.2 years for non-Greyhounds. There were 103 females, including 75 Greyhounds and 28 non-Greyhounds, and 169 males, including 131 Greyhounds and 38 non-Greyhounds. All dogs were current on vaccines, were on preventative heartworm and flea products, and had never been transfused.

Blood samples for blood-typing were obtained from 206 retired racing Greyhound dogs and from 66 non-Greyhound dogs from the jugular vein and placed in tubes containing EDTA (Monoject, Mansfield, MA, USA) for DEA testing. The 66 non-Greyhound dogs included Labrador Retrievers ($n = 13$), Golden Retrievers ($n = 8$), German Shepherd dogs ($n = 4$), Boxers ($n = 4$), Mastiffs ($n = 5$), mixed-breed dogs ($n = 17$), and 1 of each of the following breeds: Coonhound, Foxhound, Irish Wolfhound, Gordon Setter, Standard Poodle, Collie, Saint Bernard, Siberian Husky, Giant Schnauzer, Great Pyrenees, Great Dane, Swiss Mountain Dog, Doberman, Dogue de Bordeaux, and Rottweiler. In a subpopulation of 137 dogs (113 Greyhounds and 24 non-Greyhounds), 2 mL of blood were placed in a tube without anticoagulant, and serum was harvested to determine the presence of naturally occurring antibodies against all known DEAs by tube agglutination performed at Animal Blood Resources International (Stockbridge, MI, USA).

The first screening step for potential blood donors at The OSU-VMC is to evaluate positivity for DEA 1.1 using typing cards (Rapid VetH, DMS Laboratories Inc., Flemington, NY, USA). Twenty non-Greyhound dogs were positive for DEA 1.1 using typing cards and did not undergo further testing. Blood samples from all Greyhounds and 46 non-Greyhounds were sent to Animal Blood Resources International for additional DEA testing (short panel if before 2006, full panel starting in 2006).

Of 46 non-Greyhound dogs, 22 were tested for DEA 1.1, 1.2, and 7 (short panel) and 24 for DEA 1.1, 1.2, 3, 4, 5, and 7 and for antibodies to known DEAs (full panel). Of 206 Greyhounds, 93 were evaluated using the short panel and 113 using the full panel. Reagents for detecting DEA 5 were not always available; therefore, information about this antigen was missing for 39 Greyhounds and 4 non-Greyhounds. The frequencies of different antigens for Greyhounds and non-Greyhounds were compared using contingency tables and Fisher's exact test (GraphPad Prism statistical software, GraphPad Software, San Diego, CA, USA) with significance set at $P < .05$.

Of the 206 Greyhounds, 27 were positive for DEA 1.1, 6 for DEA 1.2, and 60 for DEA 7 (Table 1). Of the 113 Greyhounds, 28 were positive for DEA 3 and all 113 for DEA 4. DEA 5 was positive in 17/74 Greyhounds tested. In contrast, 40/66 non-Greyhound dogs were positive for DEA 1.1, 0/46 were positive for DEA 1.2, and 19/46 were positive for DEA 7. Of the 24 non-Greyhound dogs tested, 5 were positive for DEA 3 and all 24 for DEA 4. DEA 5 was positive in 4/20 non-Greyhound dogs tested. There were 173/206 Greyhounds that were negative for both DEA 1.1 and 1.2 compared with 25/65 non-Greyhounds negative for both antigens ($P = .0001$). The frequency of DEA 1.1 was significantly lower in Greyhounds than in non-Greyhounds ($P < .0001$), as was prevalence of dogs that were positive for both DEA 1.1 and DEA 1.2 ($P < .0001$). There were no significant differences between Greyhounds and non-Greyhounds for frequencies of DEA 1.2, 3, 4, 5, or 7. Of the 137 dogs evaluated for the presence of naturally occurring antibodies to known DEA in serum, none was positive. These findings are similar to those of a previous study where $< 0.3\%$ of 2500 blood samples had anti-DEA 1.1.[4]

Two types of donors, universal and positive, were defined based on results of DEA testing. Universal blood donors were dogs that were negative for DEA 1.1, 1.2, and 7, if only short panels were performed; if full panels were performed, universal donors were also negative for DEA 3 and 5, positive for DEA 4, and lacked anti-DEA antibodies to all 6 DEAs. Positive

Table 1. Frequency of dog erythrocyte antigens (DEA) in different study populations.

DEA	Swisher[1] % (Number Tested)	Hale[7] %*	Hale[8] % (Number Tested)	OSU Greyhounds % (Number Tested)	OSU Non-Greyhounds % (Number Tested)
1.1	44.6 (332)	42	42 (9570)	13.1 (206)	60.6 (66)
1.2	19 (332)	20	12 (9570)	2.9 (206)	0 (46)
3	5.5 (867)	6	7 (9570)	24.8 (113)	20.8 (24)
4	98.4 (947)	98	98 (9570)	100 (113)	100 (24)
5	22.3 (764)	23	11 (9570)	23.0 (74)	20.0 (20)
7	Not done	45	20 (9570)	29.1 (206)	41.3 (46)

OSU, The Ohio State University.
*Number tested not reported.

Table 2. Frequency of "universal" (negative for all DEA except DEA 4) and "positive" (negative for all DEA except DEA 1.1 and 4) donors.

	Short Panel % (Number Tested)	Full Panel % (Number Tested)	Combined % (Number Tested)
Greyhounds			
Universal	63.4 (93)	52.2 (113)	57.3 (206)
Positive	6.5 (93)	7.1 (113)	6.8 (206)
Non-Greyhounds			
Universal	18.2 (22)	37.5 (24)	28 (46)
Positive	45.5 (22)	(Not available)*	

*Non-Greyhound dogs positive for DEA 1.1 did not have full panels.

blood donors had similar results except that they were positive for DEA 1.1. In a clinical setting, recipient dogs are typically typed for only DEA 1.1, as this typing is readily done by the card method. As the status of other antigens is usually not known, dogs that are positive for DEA 1.2, 3, 5, or 7 are not used as blood donors. Although it has traditionally been proposed that canine universal blood donors can be positive for DEA 4, a hemolytic transfusion reaction due to DEA 4 alloantibodies has been reported in a dog.[5] However, the presence of DEA 4 is accepted for universal and positive blood donors, as in previous studies up to 98% of dogs were reported to be positive for this antigen.[3,6] In our study population, all dogs were positive for DEA 4. As expected, there were significantly more "universal donors" in the Greyhound group than in the non-Greyhound group ($P < .0001$, Table 2).

In conclusion, the frequency of positivity for DEA 1.1 in our population of Greyhound dogs was significantly lower than that of non-Greyhound dogs in the current study and that reported for dogs in previous studies, in which frequencies were 42–44.6%.[1,7,8] The frequency in the non-Greyhound dogs in our study was higher than previously reported for dogs. As blood types are inherited as autosomal dominant traits, further studies considering pedigree should be conducted.

Disclosure: The authors have indicated they have no affiliations or financial involvement with any organization or entity with a financial interest in, or in financial competition with, the subject matter or materials discussed in this paper.

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