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Titres of alloantibodies against A and B blood types in non-pedigree domestic cats in Turkey: assessing the transfusion reaction risk

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The severity of a transfusion reaction depends on alloantibody titres within the recipients' blood. Determination of an agglutination titre of naturally occurring alloantibody may help to assess the risk of transfusion reactions following an unmatched transfusion in a cat population. In this group of 312 cats 227 had blood type A, 78 had blood type B, and seven had type AB blood. All type B cats tested showed gross evidence of agglutinating anti-A antibody with plasma titres ranging from 2 to 256. Among the 227 type A domestic cats tested for plasma anti-B alloantibody titres, 70% had gross agglutination with titres ranging from 2 to 16, while 17.6% had microscopic agglutination. The remaining 12.4% of the type A cats were negative for both gross and microscopic agglutination. Based on agglutinating titres, the relative risk of a transfusion reaction when type A or AB blood was given to a type B cat was 6.4% with acute severe reaction, acute mild reactions in 85.9% and premature red cell destruction in 7.7%. On the other hand, transfusion of type AB blood or type B blood to type A cats carries a potential risk of acute mild transfusion reaction in 4.4% and premature red cell destruction in 83.3%. Transfusion of type A or B blood to type AB cats results in no apparent clinical transfusion reactions.

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The blood group system in cats includes type A, type B, and very rare type AB blood groups (Auer and Bell 1981, Giger 2000). Type O blood group has not been identified. Despite using the same letters as are applied to the human blood groups, the erythrocyte surface antigens in the feline AB blood group system are different from the human ABO blood group system (Auer and Bell 1981). In recent years the use of transfusions has increased in feline medicine (Hohenhaus 2004, Weingart et al 2004).

Transfusion reactions with variable degrees of severity occur in cats due to naturally occurring alloantibodies in their plasma. The reaction may occur in the first transfusion of mismatched blood (Auer and Bell 1983). The severity of transfusion reactions depends on alloantibody titres of the recipient blood (Giger and Bucheler 1991, Wilkerson et al 1991). It is well established that type B cats have high titres of naturally occurring isoagglutinins against type A cells, and type A cats have generally low titred isoagglutinins against type B erythrocytes (Auer and Bell 1981, Giger et al 1989, Knottenbelt et al 1999a, Arikan and Akkan 2004). In contrast, cats having type AB blood do not have alloantibodies in their plasma (Griot-Wenk et al 1996). When a type B cat is transfused with type A blood, severe transfusion reactions may occur (Giger and Akol 1990). As type A cats have low titre type B antibodies in their plasma, less severe transfusion reactions occur when a type A cat is transfused with type B blood (Griot-Wenk and Giger 1995).

Alloantibody titres are also important to determine the severity of neonatal isoerythrolysis (NI). Neonatal isoerythrolysis occurs when type A or AB kittens are born to a type B queen (Cain and Suzuki 1985, Giger 1991). This reaction is the

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result of naturally occurring alloantibodies in the colostrum of type B queen's that bind to the type A or AB blood cells of the kitten, which subsequently results in destruction of red blood cells. Kittens with NI often die within the first few days of life (Hubler et al 1987, Giger et al 1997). To prevent NI, type A and AB kittens must be removed from the type B queen at birth prior to nursing and fed a commercial milk replacer for the first 24 h, so that no colostrum is absorbed (Casal et al 1996, Bucheler 1999). A type A female can give birth to both type A and B kittens as type A queens have low titres to anti-B antibodies and these are unlikely to be high enough to result in NI in the kittens.

The severity of incompatibility reactions in blood transfusion is proportional to the alloantibody titres of the recipient blood (Giger and Bucheler 1991). Thus, determination of antibody titres may help to assess the risk of transfusion reactions following an unmatched transfusion or the risk of NI affecting kittens born to parents of unknown blood type. The aim of the present study was to determine agglutination titres of naturally occurring alloantibodies against the feline blood group antigens in non-pedigreed domestic Turkish cats, and to assess the risk of transfusion reactions following an unmatched transfusion.

Materials and methods

A total of 312 blood samples from domestic non-pedigree cats were examined for alloantibody titres. The cats were from four different regions of Turkey: Istanbul, Izmit, Kırıkkale and Giresun. Cats were blood typed according to the method described by Arikan et al (2003). Type A blood was identified by its reaction to the plasma of a type B cat, while type B blood was determined using a solution of Triticum Vulgaris as an anti-B reagent. Blood samples reacted with the anti-B reagent were also back-typed. Back-typing is a procedure where the type B plasma is incubated with both type A and type B feline red blood cells. After blood typing, plasma was stored at −20°C. The titres of alloantibodies were assessed using a microtitre assay as previously described by Knottenbelt et al (1999a).

The estimated post-transfusion reaction risk, caused by the effects of recipient alloantibodies when donor and recipient cats are of different blood types, was calculated as previously described by Knottenbelt et al (1999a). The proportion of matings at risk for NI was calculated as previously described by Giger et al (1991). In brief, B allele frequency (q) was calculated assuming Hardy-Weinberg equilibrium, $p^2 + 2pq + q^2 = 1$, $p = 1 - q$ and q^2 = the proportion of type B cats.

Results

Distribution of anti-A antibody titres

All type B cats were tested for the presence of anti-A alloantibody in their plasma. All plasma samples showed gross evidence of agglutinating anti-A antibody with titres ranging from 2 to 256 (Table 1). The anti-A antibody was present in 85.9% of type B cats with titres ranging from 8 to 64. The titre was 4 or lower in 7.7%, and was 128 or higher in 6.4% of type B cats (Table 1).

Distribution of anti-B antibody titres

Of the 227 type A domestic cats tested for the plasma anti-B alloantibody titres, 65.6% had gross agglutination at a titre of 2 or 4, and 4.4% had gross agglutination at a titre of 8 or higher. Microscopic agglutination was seen in 17.6% of the plasma samples. The remaining 12.4% of samples were negative for both gross and microscopic agglutinations (Table 1).

Estimated transfusion reaction risks

The estimated post-transfusion reaction risk in an-untyped blood transfusion based on the present study is presented in Table 2. Transfusion of type A or AB blood to type B cats carries a potential risk for an acute severe reaction in 6.4%, an acute mild reaction in 85.9% and premature red cell destruction in 7.7% of the recipient cats. Likewise, administration of type AB blood to type A cats, as well as administration of type B blood to type A cats, carries the potential risk for an acute mild reaction and premature red cell destruction in 4.4% and 83.3% of the recipients, respectively. In contrast, transfusion of type A or type B blood to the type AB cats appears to result in no clinically apparent transfusion reactions in the recipient cats. The estimated frequency of kittens at risk for NI was 18.75%.

Discussion

Type B non-pedigree domestic Turkish cats display gross evidence of agglutinating anti-A

Table 1. Anti-B and anti-A antibody titres in type A and type B cats

Number of type A cats	Anti-B antibody titres in type A cats	Number of type B cats	Anti-A antibody titres in type B cats
28	0	–	–
40	M	–	–
71	2	3	2
78	4	3	4
9	8	17	8
1	16	22	16
–	–	21	32
–	–	7	64
–	–	3	128
–	–	2	256

M = microscopic agglutination.

antibody in their plasma (Auer and Bell 1981, Giger et al 1989, Giger and Bucheler 1991, Bucheler and Giger 1993, Knottenbelt et al 1999a). An anti-A antibody in type B cats with a titre of less than 4 is rare. A previous study reported anti-A antibody titre as low as 2 in two out of 45 type B cats (Arikan and Akkan 2004), while in another study, Knottenbelt et al (1999a) reported anti-A antibody titres as low as 4 in one out of 40 type B cats. In this study, three out of 78 type B cats had anti-A antibody titre as low as 2. This is comparable to the previous studies and indicates that most of the type B cats have significantly high levels of alloantibodies. Kittens begin to produce their own alloantibodies between 5 and 7 weeks of age, and alloantibodies reach their maximum levels at 2–3 months of age (Bucheler and Giger 1993). The low titres in a few type B cats could reflect the cats' age. Although the overall prevalence of type B cats in Turkey was very high compared to the date generated worldwide (Knottenbelt et al 1999b, Giger 2000, Bagdi et al 2001, Mylonakis et al 2001), the overall level of anti-A antibody titre in type B cats in Turkey were lower in comparison to previously published reports from Australia and USA (Auer and Bell 1981, Bucheler and Giger 1993). Our results may reflect differences in the geographical variations. This hypothesis is supported by the UK data (Knottenbelt et al 1999a), which are quite close to our results.

The data presented in this study indicate that the transfusion of type A or type AB blood to type B cats carries a potential risk of transfusion reactions that are acute severe in 6.4% and mild clinical reactions in 85.9% of recipients (Table 2). The overall reaction severity found in the present study was similar to that of a previous study in

Table 2. The estimated post-transfusion reaction risk due to the recipient alloantibodies following unmatched blood transfusions

Donor blood type	Recipient blood type	Acute severe reactions (%) (RAT ≥ 128)	Acute mild reactions (%) (RAT = 8 to <128)	Premature red cell destruction (%) (RAT = M to <8)
A	B	6.4	85.9	7.7
AB	B	6.4	85.9	7.7
AB	A	0.0	4.4	83.3
B	A[a]	0.0	4.4	83.3
A	AB	0.0	0.0	0.0
B	AB	0.0	0.0	0.0

M = microscopic agglutination, RAT = recipient antibody titre. Calculations were accomplished according to the criteria set by the previous studies (Knottenbelt et al 1999a).

[a] Type A plasma (12.3%) was negative for both gross and microscopic agglutination.

which estimated risks of acute severe and mild clinical reactions for recipients were 8.9% and 77.8%, respectively (Arikan and Akkan 2004).

Administration of type AB blood to type A cats or type B blood to type A cats carries a potential risk of 4.4% acute mild transfusion reactions which are characterised by discomfort, listlessness, tachycardia and tachypnoea (Giger and Bucheler 1991). Low levels of anti-B alloantibody are found in the plasma of 83.3% of type A cats. In these cats early destruction of transfused type B red cells will occur within hours of transfusion. The remaining 12.3% of type A plasma was negative for both gross and microscopic agglutinations indicating that transfusion reactions with type B or AB blood would be unlikely (Table 1). Transfusion of type A or B blood to type AB cats appears to cause no apparent clinical transfusion reactions in recipient cats.

Neonatal isoerythrolysis is characterised by hemoglobinuria, hemoglobinaemia and other complications of red cell destruction in kittens (Casal et al 1996, Giger et al 1997). Unlike Rh factor incompatibility in humans, NI may be seen in the first litter as well as the subsequent litters of a queen. Often the clinical signs of NI may go unrecognised (Bucheler 1999). The syndrome occurs following intestinal absorption of alloantibodies in the milk of type B queen by the type A or AB kittens. As these alloantibodies are only absorbed during the first day of life through the intake of colostrum, type A kittens born to a type B queen should be fed with kitten milk replacer for the first 24 h of life. Among the determinants of NI is the high frequency of type B cats with high alloantibody titres. Although titres of antibody in type B cats in Turkey are lower in comparison to those reported from other geographic areas (Auer and Bell 1981, Bucheler and Giger 1993, Knottenbelt et al 1999a), the high frequency of type B cats increases the chance of NI among the cats in Turkey. To date no cases of NI have been reported in Turkey, this may reflect lack of awareness of this condition by both breeders and veterinarians.

In conclusion, untyped blood transfusions in Turkish cats carry a high risk of clinically apparent and life-threatening transfusion reactions. Type A or type AB kittens borne to type B mothers are at risk for NI because of the anti-A antibody present in the queen's colostrum. The data presented here suggest that NI is a potential problem for non-pedigree Turkish cats due to high prevalence of type B cats. It is, therefore, recommended that blood typing should be performed before blood transfusion as well as prior to mating.

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