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For the Health and Well-Being of All Cats
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Feline Blood Types and Neonatal Isoerythrolysis

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Cats have one blood group system with three blood types: type A, type B, and type AB. Based on the fact that each individual has two sets of chromosomes, these are due to different forms (alleles) of the same gene. Thus, only cats carrying two copies of the B allele (genotype homozygous B/B) will have blood type B. Cats with blood type A may have two copies of the A allele (homozygous AA) or one only copy (heterozygous A/B). Type A is completely dominant over type B. The third blood type, type AB, appears to be a third form of the same gene, but it is rare. Type A is the most common feline blood type, present in up to 94%-99% of all domestic shorthair and longhair cats in the United States.

The frequency of the feline blood groups varies both by breed and by location within the United States. The lowest frequency of type B cats is in the Northeast and North Central/Rocky Mountain regions. Higher frequencies of type B cats are found on the West Coast, peaking in the Northwest with 6% type B cats.

Siamese cats and related breeds with oriental blood have thus far all been shown to have type A blood. The American Shorthair breed, due to its close relationship to non-pedigreed shorthair cats, is also largely blood type A. However, some other breeds may have astoundingly high numbers of type B cats. The frequency of the blood types does not vary geographically for pedigreed cats.

All blood type B cats have strong antibodies against type A blood cells as of three months of age. Blood type A cats generally have very low anti-B antibody titers. It is very important to note that these antibodies are <u>naturally</u> occurring; unlike other species, no previous pregnancy or transfusion is necessary for antibody development. The strong anti-A antibodies in type B cats are important in two situations: blood transfusion reactions following the administration of type A blood to type B cats and neonatal isoerythrolysis (NI or hemolysis of the newborn) due to the newborns' type A or AB erythrocytes being attacked by the anti-A antibodies in the type B queen's colostrum. The anti-B antibodies have not been shown to cause NI, but can lead to transfusion reactions if type B blood is given to type A cats. Fortunately these situations can now be avoided.

Frequency of Blood Types in Pedigreed Cats

(From surveys conducted by the University of Pennsylvania)

Breed	% Type A	% Type B
Abyssinian	86	14
American Shorthair	100	0
Birman *	82	18
British Shorthair *	64	36
Burmese	100	0
Cornish Rex	67	33
Devon Rex	59	41
Exotic Shorthair	73	27
Himalayan	94	6
Japanese Bobtail	84	16
Maine Coon	97	3
Norwegian Forest Cat	93	7
Oriental Shorthair	100	0
Persian	86	14
Russian Blue	100	0
Scottish Fold *	81	19
Siamese	100	0
Somali *	82	18
Sphynx *	83	17
Tonkinese	100	0

(* indicates breeds with some type AB cats)

Neonatal isoerythrolysis is an immunologic, genetic problem seen in cats, but not dogs. It may be responsible for a large proportion of fading kittens and neonatal deaths in some pedigreed catteries, where the blood type of breeding cats is unknown. NI occurs in blood type A kittens born to a type B queen mated to a type A male. If the tomcat is homozygous (A/A), then all the kittens in the litter will be blood type A and at risk for NI. If the male cat is heterozygous (A/B), then 50% of the offspring would be expected to be heterozygotes with blood type A (genotype A/B) and at risk for NI. This problem can also occur in type AB kittens born to type B queens.

When kittens nurse from the queen after birth, they receive colostrum that contains antibodies to protect them against common viral infectious diseases, but also antibodies against blood types. The kitten's digestive tract is able to absorb these antibodies, which pass into their bloodstream, for about the first 12-24 hours of life. After that time, "gut closure" occurs in the neonate that prevents absorption of any antibodies. When type A or AB kittens nurse on a type B queen during the first day of life, they receive anti-A antibodies in the colostrum, which in turn get into the blood stream and bind to their red blood cells and destroy them (this is known as isoerythrolysis).

Urine from a normal kitten (right) and a kitten with NI (left)

Clinical signs of NI are variable. Large variations in clinical signs may be due to ingestion of varying degrees of anti-A antibodies in colostrum or as yet undetermined factors. Typically, kittens are born healthy and nurse well. Clinical signs may appear rapidly, with some kittens dying suddenly, within hours. Other kittens will stop nursing within the first three days of life with suggestive signs of failure to thrive, red-brown urine, jaundice, and anemia. As they deteriorate, lethargy, weakness, rapid breathing, a very slow or rapid heart rate, as well as collapse, and eventually death may occur. Some kittens appear to have subclinical disease with no obvious clinical signs. If tested, they may have anemia, however. Surviving kittens may develop damage to the skin of the tail tip up to two weeks later.

Kittens with signs of NI should immediately be removed from the queen to prevent further absorption of antibodies. They need be removed from the queen for only about the first 24 hours of life since no antibodies are absorbed after that time. The kittens should be foster-nursed by a queen with type A blood if available, or hand-fed a kitten milk replacer. Kittens with severe anemia require a transfusion, but unfortunately these efforts are rarely if ever successful.

Since the mortality rate with NI is high, the predisposing situation should be prevented by knowing the blood type of breeding cats in breeds with known occurrences of type B blood. In breeds with low type B blood frequencies and catteries with mostly type A breeders, cats that are blood type B may not be used for breeding, in order to minimize future problems with NI. Many breeders are now recording each cat's blood type on pedigree charts to facilitate breeding decisions. Blood typing can be done in a referral laboratory or by using in-clinic blood typing cards (RapidVet-H®, DMS Laboratories, 2 Darts Mill Rd., Flemington, NJ 08822, 1-800-567-4367). The rare type AB results may be due to autoagglutination or other technical difficulties and should therefore be confirmed in a reference laboratory by a tube assay such as the laboratory at the University of Pennsylvania uses (http://w3.vet.upenn.edu/research/centers/penngen/). In 2006, the genetic mutations responsible for Type A and Type B were identified in the cat. A genetic test is now available for these blood types from the Veterinary Genetics Laboratory, University of California, Davis (http://www.vgl.ucdavis.edu/).

When a breeding between a type B queen and a type A tom must be done, the breeder should endeavor to be present at the birth of the kittens to prevent nursing from the queen. The easiest method is to breed a second queen with type A blood a little earlier, so that the litters from the 2 queens can be exchanged. The second queen's litter should be over 24 hours old in order to exchange litters. The other option is to hand feed the kittens with a commercial milk replacer. Experience suggests that these kittens will do fine,

although they will not have any protective antibodies. In either case, the kittens can be returned to their own mother in 18-24 hours. Some breeders who elect to hand feed milk replacer allow the kittens to stay with the mother for care, but fit the queen with a type of body stocking so that the kittens are unable to nurse. However there are some clever neonates that still find their way to the nipples and suffer the consequences.

For more information:

Veterinary Genetics Laboratory
http://www.vgl.ucdavis.edu/service/cat/bloodgroup.html

Feline Advisory Bureau
http://www.fabcats.org/blood_groups.html