

Fe - Feline Medicine

FELINE BLOOD TYPING AND TRANSFUSION – A PRACTICAL APPROACH

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The most common *reason for blood transfusions* in the cat are anemias due to blood loss (mostly acute, rarely chronic), intra- or extramedullary mediated ineffective erythropoiesis or hemolysis. The decision whether a blood transfusion is indicated depends on the hematocrit (Hct). A RBC transfusion is recommended for critically ill cats if the Hct falls below 10-15%. However, even more important is the general condition of the patient: parameters like tachycardia, weak pulse, prolonged capillary refill time, lethargy, and weakness are indicators for the need of a transfusion. In cases of acute anemia or if the animal needs surgery, blood transfusions are given at higher Hct values. Cats with a chronic anemia tolerate a low Hct better than those with an acute anemia.

The most important *blood group system* in cats is the AB system with the blood groups A, B, and AB which is biochemically not related to the human AB0 system. Recently, another erythrocyte antigen has been described in a Domestic shorthair cat, the so-called Mik antigen.

In European and American short- and longhair cats the blood group A is dominating. The percentage of cats with this blood group varies geographically between 73.7 and 100%. In purebred cats the frequency of blood group B varies. There are breeds in which type B cats have not been reported (Siamese, Burmese, Russian Blue, Tonkinese) or have been found between 1-10% (Maine Coone, Norwegian forest cat), 11-20% (Abyssinian, Birman, Persian, Somali, Sphinx, Scottish Fold), and 20-45% (Exotic and British shorthair, Cornish and Devon rex). The third blood group AB is very rare in pedigree and non-pedigree cats (e.g. in Germany 0.7%).

Cats possess, unlike dogs, *naturally occurring antibodies (alloantibodies)* against the blood group they are lacking. Cats of blood type B have strong hemagglutinating antibodies of the IgM type against type A cells, and cats of blood type A have weak hemolysin and hemagglutinating

antibodies of the IgM and IgG type against type B cells. Kittens of both blood groups have no antibodies against other blood groups during the first weeks of life. Plasma of type AB cats of all ages does not contain anti-A or anti-B antibodies.

Prior to blood transfusion in cats *blood typing* of donor and recipient is strongly recommended since naturally occurring alloantibodies can lead to incompatibility reactions in case of incompatible transfusions. Cats with blood type B which receive type A blood may develop a severe acute hemolytic transfusion reaction with clinical signs such as lethargy, bradycardia, dyspnea, cardiac arrhythmia, salivation, vomitus, defecation and urination, and neurological disorders. Death might occur during this phase. If the cats survive they develop tachycardia, tachypnea, hemoglobinemia, and hemoglobinuria. Receive type A cats blood of type B cats, only mild incompatibility reactions like restlessness, tachycardia, and tachypnea can be observed. However, the transfusion is not efficient due to a rapid destruction of erythrocytes. Therefore, type A cats may only receive type A blood and type B cats only type B blood. Type AB cats, which have no antibodies, may be transfused with blood of the blood types AB or A.

These alloantibodies are also important for breeders since type A kittens born to a type B queen are at risk for *neonatal isoerythrolysis*.

For *blood typing* a test card method suitable for practice (Rapid Vet®H Feline, DMS laboratories, Flemington, NJ) has been developed. In case of spontaneous agglutination of the patient's erythrocytes, blood typing is only possible if the agglutination is not persisting after washing the RBC with physiological saline. Recently, a new gel containing tube system for the identification of blood types has been introduced (DiaMed-VET®, Cressier Morat, Switzerland).

If blood type B is suspected the so-called "back typing" can be performed for confirmation:

EDTA blood of the proband is being centrifuged at 1000 g for 2 minutes; 30 µl of the plasma is mixed with 15 µl EDTA whole blood of a type A cat on a glass slide. Agglutination confirms blood type B.

If blood typing is not possible, a *blood crossmatching* (BCM) can be performed in case of emergency. While blood typing tells which type of antigens are on a red cell, BCM detects the donor and recipient antibody compatibility or incompatibility. The major CM tests the recipient plasma against the donor cells, while the minor CM tests the donor plasma against the recipient cells. If there is agglutination, then the two individuals are incompatible. In case of autoagglutination a crossmatch can not be performed. BCM does not prevent sensitization to RBC antigens, which may result in a hemolytic reaction during future transfusions, because it detects only antibodies that are currently present in the donor or recipient.

If cat plasma is administered it should be the same blood type as the recipient.

In case of an identical AB blood type of donor and recipient the BCM should turn out negative. However, especially for cats which had been transfused several times incompatibilities have been described despite AB compatibility. A BCM is recommended in these (multiple) transfused cats.

BCM procedure: After gentle centrifugation (1000 g, 2 min) plasma and RBC of donor and recipient are separated. Plasma and the RBC suspension are mixed on glass slides according to the following scheme: major – 50 µl (2 drops) recipient plasma + 25 µl donor RBC; minor – 50 µl donor plasma + 25 µl recipient RBC; recipient control for autoagglutination – 50 µl recipient plasma + 25 µl recipient RBC.

Donor cats should be healthy, adult, large, with a pleasant disposition, no history of a former blood transfusion, and slender so that the jugular veins are easily accessible. The cats must have an Hct > 30%, best > 35%. After a clinical examination, a CBC and clinical chemistry (mainly renal and liver parameters) should be performed before blood donation. In order to ensure the absence of infectious agents such as FeLV, FIV, and hemotropic mycoplasma, the tested blood donors should be owned by the clinic or in the case of “voluntary” donors should solely kept indoors. Control of ectoparasites is important in donor cats. Testing for *Bartonella henselae*, *Cytauxzoon felis*, ehrlichia and babesia should be considered if cats have been in endemic areas.

The entire blood volume of the (slender) cat amounts to approx. 66 ml/kg and 10% of the blood volume can be collected from healthy cats without

side effects. After blood donation, the cats should be monitored and infused subcutaneously (approx. 20 ml/kg Ringer’s lactate) or intravenously (especially if larger amounts of blood have been taken). If cats donate regularly every 3-4 weeks, an oral iron supplementation is recommended.

Taking blood from cats is best performed from the jugular vein after clipping and disinfection. Sedation is necessary in most cases (e.g. ketamine 5-6 ml/kg body weight mixed with midazolam 0.5 mg per cat IM). Blood can be taken via plastic syringes which contain 1 ml 3.13% sodium citrate per 9 ml of blood and which are connected with a 19-gauge butterfly needle (“open system”). The blood should preferably not be stored for longer than 24 hours in the refrigerator if collected by an “open system”.

If the blood is needed for transfusion immediately or within 8 hours, sodium citrate can be used as anticoagulant. For longer storage CPDA-1 (1.2 ml CPDA-1 per 8.8 ml blood) withdrawn from a blood bag port using a syringe should be used as anticoagulant.

The principle of *component therapy* consists in dividing whole blood into its single elements by centrifugation. The small blood volume collected and the difficulties in separation of blood elements make fresh whole blood transfusions the norm in feline patients. Clinically significant disorders of primary and secondary hemostasis and hypoalbuminemia are rarer in cats than in dogs and, therefore, the need for plasma and platelet products is significantly smaller.

Transfusion: Blood which is collected in syringes can be transferred into 150 ml transfer bags or in empty physiological saline infusion bottles. The transfusion is being administered with a special transfusion set with an incorporated micro filter (sizes of pores approx. 170 µm).

Initially, the blood should be transfused very slowly (2-3 ml over 5 minutes); the patient needs to be monitored for signs of incompatibility. Subsequently, depending on the status of the recipient the transfusion rate is increased. Normovolemic cats can receive up to 10 ml/kg/hour, cats with cardiac insufficiency have to be transfused very slowly (1-4 ml/kg/hour). In massive hemorrhage, the transfusion should be given as rapidly as possible. The transfusion should be completed within 4 hours of initiation because of the risk of bacterial growth. To dilute the blood and thus regulating the velocity of transfusion more exactly and in order to wash the small amount of blood entirely out of the bag only physiological saline can be used.

The transfusion volume depends on the Hct and the general condition of the patient, in cats, however, it often depends on the amount of blood which

is available. Based on a donor's Hct of 37%, the Hct of the recipient can be increased by approx. 1% with a transfusion of 3 ml whole blood per kg body weight, provided that no further blood loss exists. Cats with coagulopathy receive plasma at a dosage of about 10 ml/kg.

Transfusion reactions (TR) mostly appear during or shortly after the transfusion and can be caused by every component of the blood. However, altogether they are rare (1.2% of 163 whole blood transfusions at the Clinic for Small Animals, FU Berlin) and often mild. By following the transfusion guidelines with reference to donor selection, blood typing, blood storage, and administration, most transfusion reactions can be prevented.

TR can be divided into acute immunologic (acute hemolytic reaction, febrile nonhemolytic reaction, urticaria, head edema), acute nonimmunologic (electrolyte disturbances – hypocalcemia due to citrate intoxication, hyperkalemia, hypomagnesemia; embolism; endotoxic shock; circulatory overload; contamination of blood – bacteria, protozoa, spirochetes; physical damage – freezing, overheating; hypothermia; vomitus), delayed immunologic (delayed hemolytic reaction, posttransfusion purpura), delayed nonimmunologic (infectious disease transmission – e. g. FeLV, FIP, FIV, bartonellosis, hemotropic mycoplasma). Acute TR occur during or within a few hours after a transfusion, and delayed reactions occur after completion of the transfusion. The delay may be months to years, delayed reactions have not been reported in the cat.

If TR occur, the transfusion should be stopped. The serum and urine of the patient should be examined for hemoglobinemia and hemoglobinuria. A sample of the erythrocyte product should be examined for signs of in vitro hemolysis and a microbiological analysis should be performed. Repeating the blood typing of donor and recipient and repeating the crossmatching might be indicated. Severe transfusion reactions with signs of shock should

be treated with intensive fluid therapy and with glucocorticoids (e.g. methylprednisolone succinate 20 mg/kg IV, once). High fever can be treated with cooling and antipyretics (e.g. metamizol 20 mg/kg slowly IV). In case of erythema or urticaria antihistaminergic drugs (diphenhydramine 2 mg/kg IV) and / or anti-inflammatory doses of glucocorticoids (prednisolone 0.5 mg/kg) should be applied. In the case of vomitus antiemetics are recommended. Do the transfusion reactions subside and no hemolysis exists, the transfusion may be restarted at a slower rate and the recipient observed carefully.

An alternative for RBC transfusion is the application of a *hemoglobin-based oxygen-carrying (HBOC) fluid, Oxyglobin®* (Biopure Corporation, Cambridge, USA). This is an ultrapurified polymerized hemoglobin of bovine origin in a modified Ringer's lactate solution which is licensed for dogs in Germany but not yet for cats. The small size of the molecules produces an equal distribution within the vascular system, yet also a fast passage of the renal glomeruli so that the plasma half-life only lasts 30-40 hours. Blood typing and crossmatching is not necessary because the RBC membrane, which is the major cause of transfusion incompatibility, has been removed during the manufacturing process. A further advantage compared to blood is the storage time of 3 years at room temperature. We recommend for cats a dosage of 5-7.5 ml/kg, the infusion rate should not exceed 5 ml/kg/hour. Especially in cats with cardiopulmonary disease, overexpansion of the vascular volume can lead to pulmonary edema and pleural effusion. Other possible side effects are a discoloration of the mucous membranes, sclera, urine and skin, vomitus, and neurological signs. Moreover, a dark red discoloration of urine and plasma leads to invalidity of colorimetric laboratory measurements. While the concentration of plasma hemoglobin rises, the Hct may be decreased after the infusion due to hemodilution and cannot be used as parameter to monitor course of the anemia.