

Idiosyncrasies in Feline Blood Transfusions

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There are important differences between blood transfusions in dogs and cats. Although not as common as canine transfusions, feline transfusions are becoming more common. Newly discovered feline red blood cell (RBC) antigens and improved diagnostic tests for determining feline blood types are helping improve the practicality and safety of feline transfusion medicine.¹

Feline Blood Types

Having a basic understanding of feline blood types can help with feline blood transfusion and blood banking. Feline blood types are classified according to an AB blood group system: cats have type A, B, or AB blood. This blood-typing system is not related to the human ABO blood-typing system. Most cats in the United States have type A blood, but this can vary slightly by region. Domestic shorthaired cats are slightly more likely to have type B blood in the South and on the West Coast than in the Northwest or Northeast.² In addition, certain feline breeds, including the British shorthair, Cornish rex, sphinx, and Persian, are more likely than other breeds to have type B blood.³ Cats with type AB blood are extremely rare.

Cats have naturally occurring alloantibodies in their blood. This means that cats are born with antibodies—on the surface of their blood cells—that recognize antigens from other feline blood types as foreign. Cats with type B blood have very strong anti-A alloantibodies, and cats with type A blood have weak anti-B alloantibodies. Although cats with type AB blood theoretically do not have alloantibodies, it is recommended that these cats receive type A blood to prevent minor incompatibility reactions.⁴ Therefore, cats, unlike dogs, do not have a universal blood type. This is one reason why feline blood is not commonly found in local animal blood banks. It would be very costly and labor intensive for local animal blood banks to stock all types of feline blood.

It is important to remember that fatal neonatal hemolytic reactions can occur in kittens if they are born with a different blood type than the queen. For example, if a tom with type A or type AB blood breeds with a queen with type B blood, the kittens may have type A or type AB blood. In utero, the placenta protects the fetuses from the queen's strong anti-A antibodies. However, after birth, when the kittens receive colostrum containing protective

antibodies from the queen during nursing, they also receive the queen's strong anti-A antibodies. This causes the kittens to develop a severe and often life-threatening hemolytic reaction known as *neonatal isoerythrolysis*. The kitten's immune system begins to recognize its own blood cells as foreign and destroys them. This can be prevented by blood typing cats before mating and not allowing toms with type A blood to breed with queens with type B blood.

Theoretically, because dogs do not have naturally occurring alloantibodies, when they receive an initial blood transfusion (whatever the blood type), they should not have a transfusion reaction (but blood typing and crossmatching are still recommended in dogs). However, cats must always receive type-specific blood because of their alloantibodies, even during an initial transfusion. If a cat receives as little as 5 mL of an incompatible type of blood, an acute, life-threatening transfusion reaction may occur.²

Feline Blood Typing

Commercial, in-house feline blood-typing kits (RapidVet-H IC, DMS Laboratories; Quick Test A+B, Alvedia) are relatively inexpensive, quick, and effective for screening types A and B blood when blood typing results are needed immediately. However, these tests sometimes have difficulty differentiating between types B and AB blood.⁴ Although off-site tests (modified gel and tube tests) take longer and are slightly more expensive, they are still considered the gold standard for feline blood typing and should be used for conclusive blood typing of breeding queens and blood donors.

Anti-Mik Alloantibody

It has been demonstrated through crossmatching and

Key Points

- Cats must always receive type-specific blood because of their alloantibodies, even when receiving a transfusion for the first time.
- To prevent a fatal hemolytic reaction, it is imperative to crossmatch all feline blood products (even those that are type specific) with the recipient's blood before each transfusion.
- Component therapy is the preferred transfusion method in cats.

Box 1. Slide Crossmatch^{a,8}

- Major crossmatch: Place 2 drops of the recipient's plasma and 1 drop of the donor's EDTA-anticoagulated whole blood on a glass slide, gently invert (mix) for 1 min, and observe for agglutination.
- Minor crossmatch: Place 2 drops of the donor's plasma and 1 drop of the recipient's EDTA-anticoagulated whole blood on a glass slide, gently invert (mix) for 1 min, and observe for agglutination.
- If agglutination is observed on either test, a new donor should be selected.

^aUse this method only in emergencies because it might produce false-negative results.

EDTA = ethylenediaminetetraacetic acid.

hemolytic reactions that blood incompatibilities can occur even when feline blood transfusions are type specific.¹ These blood incompatibilities led to the discovery of a common RBC antigen called *Mik* in domestic shorthaired cats.⁵ Approximately 94% of domestic shorthaired cats that are tested have the *Mik* antigen.¹ Although the naturally occurring anti-*Mik* alloantibody is rare, its discovery may lead to the discovery of new feline blood types or even a more specific feline blood-typing system. (PennGen Laboratories at the University of Pennsylvania [Philadelphia] offers the *Mik* blood type test.⁶) For now, to prevent fatal hemolytic reactions, it is imperative to crossmatch all feline blood products (even those that are type specific) with the recipient's blood before transfusion.

Crossmatching

Crossmatching tests for incompatibilities due to additional antibodies in the blood of recipients and donors. A crossmatch can be major or minor. A major crossmatch tests for antibodies against donor cells in a recipient's plasma. A minor crossmatch tests for antibodies against the recipient's cells in the donor's plasma. The major crossmatch is more important than the minor crossmatch because the former predicts the greatest likelihood of a major hemolytic reaction due to a transfusion. If the blood from either crossmatch is found to be incompatible, a different donor should be used. If a cat will receive a second transfusion from the same donor, the second blood product should also be crossmatched with the recipient. After a transfusion, it may take as few as 4 days for alloantibodies to be present, but they can last for years after a blood transfusion.⁷ Therefore, incompatibility reactions are not prevented by using the same donor for a recipient. **BOX 1**⁸ describes the slide crossmatch method, and **BOX 2**⁹ describes the blood crossmatch method.

Feline Blood Donation

Even if you are fortunate enough to have a local animal blood bank in your area, feline blood products may not be available. However, they can be purchased from large commercial blood banks (i.e., Animal Blood Resources International, Dixon, California, or ACCES Blood Bank Seattle, Washington; **BOX 3**). Alternatively, feline blood products can be obtained in-house from clinic cats or volunteer donors.

Box 2. Blood Crossmatch⁹

1. Collect 1 mL of the recipient's blood, place it in an EDTA tube, and label it "Recipient's blood."
2. Collect 1 mL of the donor's blood from the pigtail on the bag of blood and place it into a red-top tube. Alternatively, draw 1 mL of blood directly from the donor, place it into an EDTA tube, and label it "Donor's blood."
3. Centrifuge each tube for 10 min at 3000 rpm.
4. Remove and save the plasma from each tube and label them "Donor's plasma" and "Recipient's plasma."
5. Wash the donor's RBCs by adding 5 mL of 0.9% saline to 0.2 mL of the donor's RBCs. In a separate tube, add 5 mL of 0.9% saline to the recipient's RBCs. Centrifuge these tubes for 1 min and remove the supernatant.
6. Repeat step 5 three times.
7. Label three tubes "Major crossmatch," "Minor crossmatch," and "Recipient's control."
8. Add 2 drops of plasma and 2 drops of RBCs to each tube as follows:
 - Major crossmatch—2 drops of the recipient's plasma and 2 drops of the donor's RBCs
 - Minor crossmatch—2 drops of the donor's plasma and 2 drops of the recipient's RBCs
 - Recipient control—2 drops of the recipient's plasma and 2 drops of the recipient's RBCs
9. Let the tubes sit for 15–30 min, and then centrifuge them at 3000 rpm for 15 sec.
10. Observe for hemolysis.^a
11. Gently invert the tubes to resuspend the precipitate.
12. Add 1 drop from each tube to a correspondingly labeled slide, and examine for microscopic agglutination.^a

^aSuspect immune-mediated hemolytic disease if the recipient's control sample demonstrates hemolysis or agglutination. Select a new donor if hemolysis or agglutination is observed in the major or minor crossmatch samples.

EDTA = ethylenediaminetetraacetic acid.

The general guidelines for feline blood donors are as follows:

- No history of a blood transfusion
- Adult (2 to 8 years of age)
- Good natured
- Indoor only
- Healthy
- Weigh at least 8.8 lb (4 kg)
- Test negative for FeLV and FIV
- Current on all core vaccinations
- Biannual complete blood counts, blood chemistry panels, fecal parasite examinations, and physical examinations
- Other tests for infectious disease (e.g., infection with *Mycoplasma haemofelis*, *Cytauxzoon felis*, or *Babesia* spp) may be recommended based on the region of the country
- Regular flea and tick preventives
- A packed cell volume (PCV) of at least 30%; 35% is ideal⁵

Box 3. National Commercial Animal Blood Banks^a

ACCES Blood Bank

Seattle, Washington
Phone: 206-364-1660
<http://www.criticalcarevets.com/newbloodbank.html>

Animal Blood Resources International

Dixon, California; Stockbridge, Michigan
Phone: 800-243-5759
<http://www.abrint.net/>

Eastern Veterinary Blood Bank

Purcellville, Virginia
Phone: 800-949-3822
<http://www.evbb.com/>

HEMOPET

Garden Grove, California
Phone: 714-891-2022
<http://www.hemopet.org/products.html>

Penn Animal Blood Bank

Philadelphia, Pennsylvania
Phone: 215-573-7222
<http://www.vet.upenn.edu/RyanVHUPforSmallAnimalPatients/SpecialtyCareServices/BloodBank/tabid/432/Default.aspx>

^aThis is not a comprehensive list.

Feline Blood Collection

Feline blood collection varies greatly from canine blood collection. Unlike dogs, most feline donors are sedated before blood donation, which adds some risk to the procedure. Because most cat owners are hesitant to have their cats sedated to donate blood, it is often difficult for local animal blood banks to find enough feline blood donors to meet the demand for each blood type. Large animal blood banks usually have in-house cat colonies to provide adequate quantities of type-specific blood.

Feline blood can be collected using a closed system or an open system. In either case, the donor cat is often sedated; many experts recommend using ketamine (20 mg/cat IM)⁸ or an IM combination of ketamine (5 to 6 mg/kg) and diazepam or midazolam (0.5 mg/cat).⁹ The jugular vein area is clipped and aseptically prepared. Many experts recommend giving feline donors 0.9% saline (~90 mL SC) after blood collection to help maintain homeostasis and hydration.² (In addition, I recommend giving feline blood donors lots of affection after the transfusion.) The open collection system usually consists of a 19-gauge butterfly catheter and a 60-mL syringe containing 7 mL of citrate phosphate dextrose adenine (CPDA-1). Approximately 53 mL of blood can be aseptically collected from a feline donor's jugular vein over a 10-minute period.¹⁰ Drawing blood too quickly can cause an unsafe drop in blood pressure. Because the open collection system allows contact between the blood and the environment (room air), the blood



Figure 1. A small animal, double-bag, syringe collection set. (Courtesy of Animal Blood Resources International)

should be used immediately or refrigerated for no longer than 24 hours to prevent potential bacterial contamination.¹⁰ Because of its simplicity and convenience, the open collection system is used most often in cats. However, because blood collected this way cannot be stored for more than 24 hours, component therapy was not possible in cats until a closed collection system was created.

Using a closed system is preferred for feline blood collection because it decreases the risk of contamination and allows blood to be separated into its components and stored for longer periods of time. Penn Animal Blood Bank and Tufts University have both developed closed collection systems for cats. Animal Blood Resources International sells a closed collection system for cats (**FIGURE 1**). Because a closed collection system does not expose the blood to the environment or room air, the collected blood can be stored for up to 35 days (if CPDA-1 is used) or centrifuged into components.² Once the blood has been centrifuged, packed RBCs can be refrigerated for 21 days and fresh frozen plasma (FFP) can be frozen for 1 year if CPDA-1 is used.¹ Separating blood into its components requires special equipment and expertise. If this is not performed properly, the storage life of blood products can be substantially shortened.

Component Therapy

As in dogs, component therapy is the preferred transfusion method in cats. Component therapy involves centrifuging whole blood into its components (packed RBCs and plasma) and transfusing only what the recipient needs. Because any blood component can cause a transfusion reaction, only transfusing what is needed reduces the risk. Although component therapy is less common in cats, it is a much safer option for them.

Blood Product Administration

All blood products should be administered through an IV catheter and IV set separate from those for administering other fluids and medications.⁷ Refrigerated blood should be warmed to room temperature before transfusion. The temperature should not exceed

Glossary

Alloantibody—An antibody produced by one individual that reacts with alloantigens of another individual of the same species^a

Alloantigen—An antigen that exists in alternative forms in a species, thus inducing an immune response when one form is transferred to members of the species that lack it^a

Component therapy—Centrifuging whole blood into its individual elements (i.e., packed red blood cells and fresh frozen plasma) and only transfusing the components that the recipient needs

Crossmatching—Testing for incompatibles due to alloantibodies in the recipient's and the donor's blood

Fresh frozen plasma—A blood component that is frozen immediately after it is separated from whole blood

Hemoglobinemia—Excess hemoglobin in the blood as a result of intravascular hemolysis

Hemoglobinuria—Excess hemoglobin in the urine as a result of intravascular hemolysis

Mik—A red blood cell antigen in domestic shorthaired cats

Neonatal isoerythrolysis—A condition in which a newborn has a hemolytic reaction to its own blood due to antibodies it received from its mother (of another blood type) during nursing

Packed red blood cells—A blood component that consists of concentrated red blood cells separated from plasma

Urticaria—Hives

^aBlood DC, Studdert VP, Gay CC. *Saunders Comprehensive Veterinary Dictionary*, 3rd ed. Toronto, Canada: Saunders Elsevier; 2007:59.

98.6°F (37°C) or the cells may be damaged.² Blood collected using an open system should be filtered through a 20- μ m syringe blood filter (i.e., Hemo-Nate [Utah Medical Products] or Kogenate filter [Bayer HealthCare]). If a closed collection system is used or a single component is administered, the blood product should be administered using a feline blood administration set. The recipient should be monitored immediately before the transfusion so that baseline vital signs can be obtained.

The volume of blood or blood product to administer varies depending on the donor's and the recipient's PCVs, the reason for the transfusion, and the condition of the recipient. Generally, when whole blood is transfused, the recipient's PCV can be expected to increase by 1% if 3 mL/kg of blood is transfused.¹¹ In cats, plasma is generally transfused at a dose of 10 mL/kg.¹¹

Transfusion Reactions

A transfusion should be very slow (0.25 mL/kg/h²) for the first 15 minutes to allow early detection of an acute transfusion reaction, including fever, urticaria, vomiting, or diarrhea. If any of these signs are observed, the transfusion should be stopped and the reaction treated immediately. Fever can be treated with an antipyretic (e.g., metamizole at 20 mg/kg slow IV).¹¹ Antihistaminergic drugs (e.g., diphenhydramine HCl at 2 mg/kg IV) can be used to treat urticaria.¹² Antiemetics (e.g., chlorpromazine HCl at 0.5 mg/kg IV, IM, or SC) can be used to treat vomiting.¹² If the transfusion reaction is mild and there are no signs of a severe, life-threatening hemolytic reaction (e.g., hemoglobinemia, hemoglobinuria, intravascular hemolysis), the transfusion may be continued at a slower administration rate while the recipient is continuously monitored for signs of a transfusion reaction. However, if the transfusion reaction was severe, administration of the blood product cannot be resumed. Severe transfusion reactions that cause shock should be treated using IV fluid therapy and glucocorticoids (e.g., prednisolone sodium succinate at 50 to 100 mg IV¹¹) as for any other type of anaphylaxis.

If no signs of an acute transfusion reaction are observed within the first 15 minutes, the rate of administration can be increased to as high as 22 mL/kg/h.² The entire transfusion should take no longer than 4 hours.⁴ Throughout the transfusion, the recipient should be carefully monitored for signs of a reaction. No special aftercare is recommended for the donor.

Conclusion

Blood transfusion is very different in dogs and cats. Knowledge of the idiosyncrasies of feline transfusion medicine is increasing with continued research, the findings of which have improved the practicality and safety of blood transfusions in feline patients.

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1. Which blood type is most common in cats in the United States?

- a. the universal feline blood type
- b. type A
- c. type B
- d. type AB

2. Neonatal isoerythrolysis can be prevented by

- a. blood typing all cats after breeding.
- b. not breeding toms with type B blood to queens with type A blood.
- c. not breeding toms with type A blood to queens with type B blood.
- d. ensuring that all kittens receive colostrum from their mother.

3. If as little as ___ mL of an incompatible type of blood is given to a cat, a severe, life-threatening reaction can occur.

- a. 1
- b. >1
- c. 3
- d. 5

4. _____ antigen is an RBC antigen found in ~94% of domestic shorthaired cats in the United States.

- a. A
- b. B
- c. DSH
- d. Mik

5. Crossmatching tests for

- a. incompatibilities due to additional antibodies in the recipient's and the donor's blood.
- b. all feline blood types.

- c. incompatibilities due to major antibodies in the recipient's blood.
- d. incompatibilities due to minor antibodies in the recipient's blood.

6. Incompatibility reactions can be prevented by

- a. blood typing the recipient and the donor.
- b. blood typing and crossmatching the recipient and the donor.
- c. always using the same donor.
- d. never using the same donor.

7. Feline blood donors should have a PCV of at least

- a. 20%.
- b. 25%
- c. 30%.
- d. 45%.

8. Blood collected using an open collection system

- a. is often separated into packed RBCs and plasma.
- b. should be used within 24 hours.
- c. is not convenient for component therapy.
- d. b and c

9. Component therapy is preferred because

- a. it is less expensive for clients.
- b. it is safer for patients.
- c. whole blood transfusions are dangerous.
- d. none of the above

10. Whole blood can be separated into

- a. FFP and packed RBCs.
- b. FFP only.
- c. packed RBCs only.
- d. none of the above