

Feline blood transfusions

practical guidelines for vets

This 'Practice Pointers' article from the ISFM is complemented by practical guidelines for vet nurses, and an information sheet for owners on offering their cat as a blood donor. Together the series is intended to improve the practice of blood transfusions and, in turn, the welfare of the cats involved.

Indications

Severe anaemia

Severe anaemia with associated clinical signs – particularly if anaemia has developed acutely, with little time for compensatory mechanisms to develop – is the principal reason why a blood transfusion may be performed in a cat. If there is concurrent hypovolaemia (eg, blood loss), whole blood will be most appropriate. If the cat is normovolaemic (eg, haemolysis), packed red blood cells (RBCs) are most appropriate, although not readily available so whole blood is usually given.

Provision of clotting factors

In some cats, a requirement for clotting factors contained within fresh plasma may warrant a transfusion; consideration can be given to separating red cells/plasma for an individual patient, but this is rarely performed in the UK. Note that clotting factors degrade relatively quickly even if blood/plasma is refrigerated. Furthermore, transfusions are not a good source of platelets, although whole blood does contain some functional platelets, so may be of some benefit in thrombocytopenic patients.



Feline blood types and blood-type reactions

Cats have three main blood types, A, B and AB, based on the blood type antigens they possess. Other blood types (eg, *mik*) have been reported in the literature but are not routinely tested for. The presence of other blood types may, however, be a reason for reduced survival of transfused cells in cats of the same (A or B) blood type.

In the UK most non-pedigree cats are type A, with a smaller percentage of type B and type AB, although the prevalence of type B appears to be increasing among non-pedigrees. Type B can be very prevalent (approaching 50%) in some pedigree breeds, especially the British Shorthair, Ragdoll, Birman and Rex breeds. Type B cats are also commonly encountered among Persians, Somalis, Abyssinians and Scottish Folds. Siamese cats are almost invariably type A.

Weighing up the risks versus benefits

There are potential risks to the donor cat associated with blood collection that must be carefully weighed up against the potential gain for the recipient cat. In all cases it is important to be certain that a blood transfusion is definitely the most appropriate treatment. Not every anaemic cat will need a blood transfusion and so the cat's condition must be fully assessed and every treatment option considered. If the cat's anaemia is regenerative it may be that supportive treatment is adequate for a short period of time while the patient replaces its own RBCs. Blood substitutes such as Oxyglobin (OPK Biotech) may also be appropriate. The impact of diagnostic investigations, and the cause of the anaemia, need to be considered too; in a cat with a terminal illness (eg, neoplasia, FeLV) the potential benefit of a blood transfusion may not outweigh the risk to the donor.

The potential gain to the recipient cat must outweigh the risk to the donor.

In contrast to dogs, cats possess naturally occurring alloantibodies reactive against the blood-type antigen that they are lacking:

- >70% of type A cats have anti-B alloantibodies, mostly at low titres;
- All type B cats have anti-A alloantibodies, often at high titres;
- Type AB cats are not thought to have alloantibodies to either type A or type B antigens.

These alloantibodies are responsible for the two main blood-type reactions seen in cats: haemolysis due to incompatible blood transfusion reactions, even with a first transfusion, and neonatal isoerythrolysis. **Incompatible blood transfusion reactions can be fatal in type B cats given type A blood**, as the recipient's anti-A alloantibodies rapidly haemolyse the donor type A RBCs. **In type A cats given type B blood, the transfusion reaction is unlikely to be fatal, but the transfused cells will be extremely short-lived.** Neonatal isoerythrolysis can cause kitten mortality and fading kitten syndrome and typically arises when a type B queen (having mated with a type A tom) has type A kittens which ingest anti-A alloantibodies in the first 24 hours of life via their mother's colostrum. These anti-A alloantibodies rapidly destroy the kitten's type A RBCs and can cause death.

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clinical advice from the International Society of Feline Medicine

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Which type to give?

- Type A cats must only receive type A blood
- Type B cats must only receive type B blood
- Type AB cats should receive type AB blood, but when not available type A blood is the second choice

Choosing a blood donor

The following are prerequisites for a blood donor:

- Large (>4 kg) and non-obese;
- Calm temperament;
- Aged 1 to 8 years (ideally 1 to 5 years);
- Most importantly, healthy (indoor, fully vaccinated cats are ideal) and clinically well.

In practice, this requires a number of (initial and ongoing) assessments:

- Comprehensive clinical examinations should be performed, and a complete donor history collected;
- Haematology (complete blood count) and biochemistry (urea, creatinine, total protein/albumin/globulin, ALT, ALP, blood glucose, Na, K, Cl) should be confirmed to be normal;
- The cat should be screened for bloodborne infectious diseases (FeLV-, FIV- and *Haemoplasma*-negative essential; ± *Bartonella* screening) as close to the time of donation as possible. *Haemoplasma* testing may be omitted in an emergency situation, but owners should be made aware of this if testing is not performed;
- Packed cell volume (PCV) of the donor should be determined before each donation and be ≥35%;
- The donor's blood pressure should ideally be checked before each donation to ensure this is normal (120–180 mmHg). Occult heart disease and other conditions can be associated with low blood pressure that is exacerbated by sedation and blood donation;
- Echocardiography should ideally also be performed in all cats prior to donation, to assess for occult heart disease.

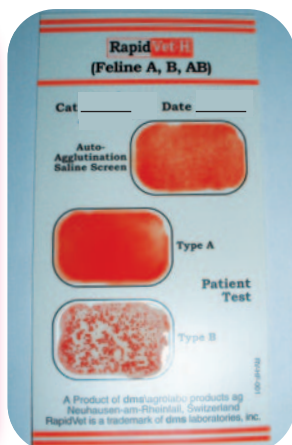
Blood typing

Donors and recipients must be blood typed before transfusions. A number of methods are available that can type the cat as being A, B or AB.

- EDTA blood samples can be submitted to veterinary laboratories (eg, at the Universities of Bristol and Glasgow).
- Various in-house kits are available, allowing immediate results. Examples include:
 - In-house cards (Rapid Vet-H). These use a small quantity of EDTA blood and the result is based on visualisation of an agglutination reaction on the card. See www.rapidvet.com for more details.
 - Strip test (Feline Quick Test A+B). This uses a small quantity of EDTA blood and the result is based on visualisation of a test line on the strip. See www.alvediavet.com/products_new.php for more details.

Blood typing

It is essential that all feline donors, regardless of breed, as well as recipients are blood typed prior to collecting blood to prevent incompatibility of mismatched transfusions.



Vet checklist prior to collecting blood from a donor

- Checked donor eligibility
- Talked through owner information sheet and owner signed consent form
- Blood typed
- Ensured not donated blood in the past month
- Full history and physical examination (including weight) performed, with no findings of concern
- Blood pressure checked on day of donation
- Routine haematology and biochemistry confirmed to be within normal limits, at least within the past 6 months but as close to the time of donating blood as possible
- Confirmed *Haemoplasma*-negative as close to the time of donating blood as possible
- Negative FeLV/FIV ELISA on day of donation
- PCV determined on day of donation

- A diagnostic DNA PCR test, performed on blood or buccal swabs, is available in the US (www.vgl.ucdavis.edu/services/abblood.php) that can differentiate type B from type A or AB cats (but cannot determine if a cat is type A or AB). This may be most appropriate for breeders in the selection of mating pairs to avoid the risk of neonatal isoerythrolysis. This test has not been validated in all breeds, however.

Cross-matching

Cross-matching may be performed in addition to blood typing if previous transfusions have been given (>5 days earlier) or if a non-A/B blood group system incompatibility is suspected, provided both sufficient time and blood is available.

- The **major cross-match** tests for alloantibodies in the recipient's serum/plasma against donor RBCs. An incompatible major cross-match can result in an acute haemolytic transfusion reaction, where donor erythrocytes are destroyed by alloantibodies in the recipient's plasma.
- The **minor cross-match** tests for alloantibodies in the donor's serum/plasma against recipient RBCs. A minor cross-match incompatibility is less likely to cause a transfusion reaction because the volume of donor plasma is small and becomes markedly diluted in the recipient.

The cross-match procedure, described below, is relatively complex; where possible it should be performed by someone with experience of doing this.

Cross-matching

Procedure

- 1 Take 1 ml EDTA blood and 1 ml of plain clotted blood from both donor and patient. (Ideally serum should be used in a cross-match but, if this is problematic, plasma derived from a larger sample of EDTA blood can be used instead.) Label tubes.
- 2 Centrifuge (at 3000 rpm for 5–10 minutes) and separate plasma and serum from RBCs. Discard the plasma. Store serum in a separate tube, and label.
- 3 Wash RBCs by adding 2–3 ml of normal saline solution to the RBCs, mixing gently, centrifuging (at 3400 rpm for 1 minute), then removing the supernatant saline. Repeat twice.
- 4 After the third wash, decant the supernatant and resuspend the RBCs with saline to give a 4% RBC suspension (ie, 0.2 ml RBCs with 4.8 ml saline).
- 5 Label four tubes and place the following in each tube:
 - Major cross-match** 1 drop patient serum and 1 drop donor RBC suspension;
 - Minor cross-match** 1 drop donor serum and 1 drop patient RBC suspension;
 - Patient control** 1 drop patient serum and 1 drop patient RBC suspension;
 - Donor control** 1 drop donor serum and 1 drop donor RBC suspension.
- 6 Incubate the tubes for 15 minutes at 37°C.
- 7 Centrifuge the tubes (at 3400 rpm for 15 seconds).
- 8 Read the tubes.

(cross-matching continues on page 3)

Collection of blood from the donor

Remember blood collection takes time, approximately 30 minutes on average. If immediate support of a collapsed cat is required, an alternative to a blood transfusion will be needed (see later).

How much blood can safely be collected?

- Total blood volume in cats is approximately 66 ml/kg, so a 4 kg cat has around 260 ml of blood
- Collection of up to 20% of blood volume is usually safe but intravenous crystalloid fluids should be given to prevent hypovolaemia
- Collection of <10% blood volume from a donor does not usually require intravenous fluids
 - A 4–5 kg cat can give approximately 50 ml of blood, equivalent to 20% of its blood volume

● Check the weight of the donor and measure its PCV using blood collected from the cephalic vein

to preserve the jugular veins.

● Sedation of the donor is usually required. An intramuscular combination of 5 mg/kg ketamine and 0.25 mg/kg midazolam is recommended (0.1 ml increments of a mixture of 2.5 mg/kg ketamine and 0.125 mg/kg midazolam can be given intravenously to the donor as top-up doses if sedation wears off). Other sedative agents may be suitable but advice should be sought to ensure an appropriate choice is made for the individual cat. Sedative agents that have a significant effect on blood pressure (eg, medetomidine, ACP) should be avoided.

● Application of local anaesthetic (EMLA; AstraZeneca) cream to the jugular area 30 minutes prior to donation can be helpful in providing local analgesia.

● Prepare blood collection equipment. Flush through syringes, needle, T-port and three-way tap with anticoagulant, and place 1–1.5 ml anticoagulant into each 10 ml syringe, or 3 ml into each 20 ml syringe. Heparin is not recommended as an anticoagulant unless no other options are available. (If using heparin, add 125 units per 10 ml of blood. Blood must be used immediately if heparinised.)

● Place an intravenous catheter in the donor.

● Set up intravenous fluids (normal saline or lactated Ringer's solution) for the donor. A total of twice the volume of blood removed (ie, 100 ml) should be given over about 1–2 hours, starting during or immediately after blood collection.

● Blood is collected aseptically from the jugular vein via a



Blood collection equipment

- Anticoagulant: citrate phosphate dextrose acid (CPDA) or acid citrate dextrose (ACD) from human blood collection bags is preferred
- Syringes: 5–6 x 10 ml or 3 x 20 ml
- 21G needle and T-port or 19G butterfly needle
- Three-way tap
- Small (100 ml) blood collection bag if available (or human blood collection bag emptied of anticoagulant), with exit tubing tied off/blocked; or Hemonate filter and syringe driver

needle attached to the T-port, which is connected via the three-way tap to a 10 or 20 ml syringe. The easiest way of achieving this is by restraining the donor in an upside-down position, with the handler raising the vein at the base of the neck and the bleeder holding the cat's head and extending its neck. The bleeder inserts the needle into the jugular (aiming towards the base of the neck for a cat positioned as just described) and draws back the 10 or 20 ml syringe to collect the blood. The syringe must be regularly inverted to allow mixing of the anticoagulant and blood to prevent clotting. It may be easier, while the bleeder holds the needle steady within the jugular vein, for a third person to hold the collection syringe, enabling rotation of the syringe as blood is collected into it.

● Once the first syringe is filled, the three-way tap is closed off, the syringe is disconnected and a 19G needle is placed on the hub. A second syringe is attached, the three-way tap is opened and blood collection continues until all five or six 10 ml syringes (or three 20 ml syringes) are filled. Filled syringes should be inverted intermittently to prevent clotting.

● Transfer the collected blood slowly into a blood collection bag via a 19G needle, and attach a blood filter giving set to the bag for administration to the patient. Alternatively, blood can be administered directly from the syringe using an in-line Hemonate filter (Utah Medical Products) and a syringe driver.



Cross-matching (continued)

Interpretation

Macroscopic With compatible blood there should be no clumping or agglutination – when the tubes are rotated, RBCs should float off freely from the centrifuged 'pellet' of erythrocytes. Supernatant should be free of haemolysis.

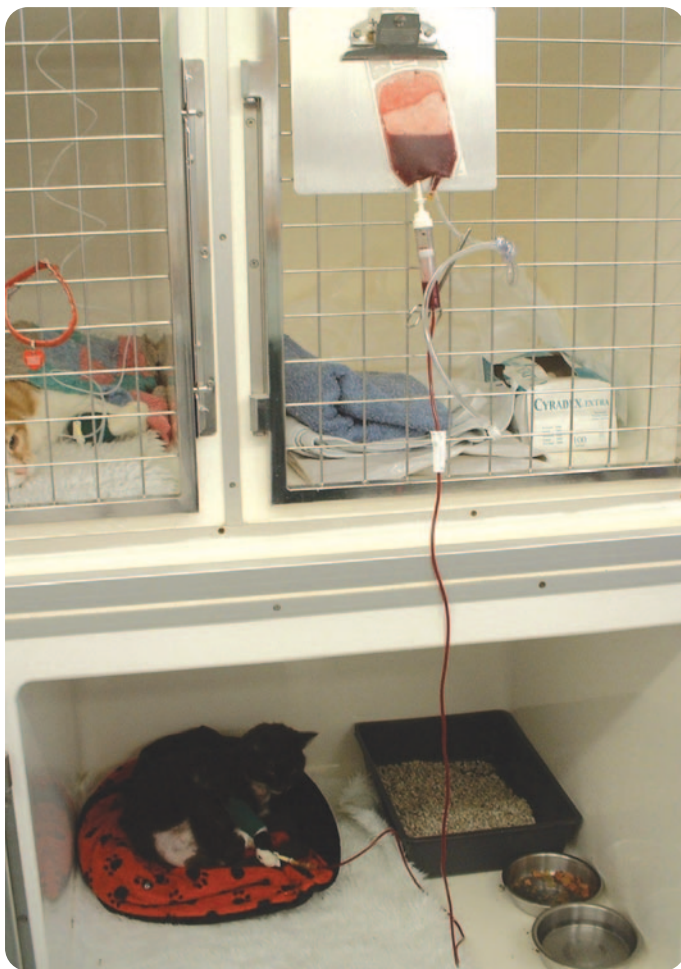
Microscopic A drop of the RBC/serum mixture is placed on a slide and a cover slip is applied. Under the microscope RBCs should appear as individual cells and not in clumps. Rouleaux formation, where RBCs appear as stacks of coins, can look macroscopically like agglutination and can be confirmed by microscopy.

Emergency situation

An emergency cross-match may be performed more easily in-house by mixing two drops of patient serum and one drop of donor RBCs on a glass slide and examining microscopically for agglutination (differentiate from Rouleaux as above) after 1–5 minutes. Patient and donor controls should also be performed.

Administration of blood to the recipient

- Blood is usually administered via the cephalic or jugular veins, but intraosseous administration via the proximal femur is possible if peripheral access is not available.
- Blood is transfused at an initial rate of 0.5 ml/kg/hour over the first 5–15 minutes, with the recipient being observed closely for adverse reactions. The rate can then be increased to 10 ml/kg/hour. In hypovolaemic patients, the rate of administration can be increased to 20 ml/kg/hour. If the patient has renal or cardiac failure, a rate of 2 ml/kg/hour should be used to prevent circulatory overload. The heart rate, pulse rate and temperature should be frequently monitored throughout the transfusion. The transfusion should be completed within 4 hours of blood collection, to minimise the risk of bacteraemia.



How much blood to transfuse?

$$\text{Volume to be transfused} = \frac{66 \times \text{weight of patient (kg)} \times (\text{desired PCV}^* - \text{patient PCV})}{\text{PCV of donor}}$$

(*The desired PCV is usually about 20%, to allow significant clinical improvement in the patient. Usually 50 ml are collected from a donor, as discussed earlier.)

Generally, 2 ml/kg of whole blood increases a patient's PCV by 1%. This is a rough guideline only, however, and the precise increase in PCV will be dependent on the interaction of multiple dynamic factors within the patient. The response to transfusion should always be assessed by measurement of PCV post-transfusion and evaluation of improvement in clinical signs.

- Adverse transfusion reactions manifest as tachycardia, urticaria (facial swelling), hypotension, and haemoglobinuria if there is severe intravascular haemolysis. Vomiting may occur as a non-specific finding or due to rapid administration of blood. Dyspnoea and tachypnoea may arise where there is circulatory overload. Pyrexia can develop as a self-limiting febrile non-haemolytic reaction, but can also be seen with haemolysis or sepsis. Severe transfusion reactions are rare if appropriately typed blood is used.

Alternatives to blood transfusion

- If the cat is hypovolaemic, consider volume support with crystalloids and colloids.
- If oxygen-carrying volume support is required immediately, Oxyglobin is an alternative treatment for stabilising the patient, or offers an alternative to blood transfusion if a donor is not available. Obviously, it only provides oxygen-carrying support and not the other benefits of whole blood (eg, clotting factors). Oxyglobin is a haemoglobin solution which is stable at room temperature. It is unlicensed for use in cats.
 - Dose: 5–10 ml/kg at 0.5–2 ml/kg/hour.
 - 0.2–2 ml/kg boluses over 5–10 minutes can be used, and repeated up to a total of 10 ml/kg over 30 minutes, in severely collapsed hypovolaemic patients.
 - The patient should be monitored using haemoglobin values. Great care should be taken in cases prone to circulatory overload, such as cats with cardiac disease (occult hypertrophic cardiomyopathy), as well as cats with renal disease and respiratory disease.

Transfusion reactions

If an adverse reaction is suspected, stop the transfusion and consider treatment with glucocorticoids, antihistamines, rapid rate intravenous fluids and/or adrenaline. Antipyretics may be required in some cases. If circulatory overload has resulted in pulmonary oedema, diuretic treatment and oxygen support may be required.

Further information in the 'Feline blood transfusions' series:

- Vet nurse pointers:

'Feline blood transfusions: practical guidelines for vet nurses' at www.isfm.net

- Cat owner pointers:

'Offering your cat to be used as a blood donor' at www.fabcats.org

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ISFM is the veterinary division of FAB, the leading cat charity dedicated to feline wellbeing through improved knowledge

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