Screening eligibility criteria in canine whole blood transfusion

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Abstract
Whole blood contains all the elements that are necessary for oxygen delivery and hemostasis, in nearly physiologic ratios and concentrations. Transfusion therapy is a major resource that can improve the patient's capability to overcome the underlying disease. As veterinary critical care becomes more frequently used, the advantages of a basic knowledge of transfusion therapy and blood banking increased. The most cogent argument supporting component therapy is that blood is a precious resource considering its therapeutic potential and the logistics and costs required in obtaining and delivering blood products. The objective of this article is to discuss and offer current knowledge on blood transfusion and its allied practices in dogs including blood donor screening, blood typing, storing blood and crossmatching tests. The article discuses new developments, standard practices and protocols for conventional blood product collection in a private veterinary clinic.
Keywords*: screening, blood donor, dog, transfusion*

Introduction

The first documented transfusion in any species occurred in 1665 when Richard Lower withdrew blood from one dog and replaced it with blood from another dog. However, it was not until the 1950s that the use of transfusion medicine became more prominent in veterinary medicine because of the availability of equipment and techniques.

A blood or blood component transfusion generally is a life-saving measure, but absolute safety can never be guaranteed. Although potentially life-saving, this procedure does carry some inherent risk. In addition to immune-mediated reactions caused by infusion of allogeneic cells or proteins, blood-borne pathogens can be transmitted by transfusion, potentially causing disease in the transfused recipient. To practice successful transfusion medicine, the veterinary doctor must understand not only when and how to administer the appropriate blood product; but also how to collect and store these products to minimize the potential for an adverse outcome. Also, in an effort to minimize pathogen transmission, all blood donors should be appropriately screened for infectious agents. Availability of expanded donor screening, typing modalities, and crossmatching techniques make choosing the right donor unit for each patient potentially more complicated.

Firstly, blood is not 'just another fluid', but a complex, physiologically balanced, biological mixture. An understanding of its content is important when considering administering transfusions. All blood donors should be given thorough physical examinations at each donation and be annually screened haematologically, biochemically, and serologically. Donors should be healthy, receiving adequate nutrition, and be parasite free. All donors should be blood typed and be current on appropriate vaccinations. Female donors should not have had pups or kittens and preferably not be intact.

Selection of donors. To be accepted into the donation program, the dog must meet the following eligibility criteria:

1. The donor is between 1 and 8 years' old
2. The donor weight is over 25 kg
3. The donor is clinically healthy

4. The donor is docile and cooperative
5. The donor has never benefited from transfusion therapy
6. The donor does not suffer from chronic conditions
7. The donor has no heart problems
8. The donor is not currently receiving antibiotic treatment
9. The donor has never suffered from Babesiosis
10. The donor is not a carrier of blood-borne diseases

Donation procedure implies harvesting from the jugular vein, monitoring the amount of blood collected on a scale, hermetically seal the bags using the dmachT sealant.

Fig. 1. Monitoring the amount of blood collected

Haematological and biochemical analisys

For safety of both the blood donor and recipient, the health of a dog is evaluated prior to enrollment as a donor and then annually through a complete medical history, physical examination and laboratory evaluation including a hemogram and serum biochemistry profile. The following selection criteria were used to include dogs as blood donors: values of complete blood count (CBC) and serum biochemical profile (SBP) (total protein, albumin, urea, alkaline phosphatase, and alanine aminotransferase). In addition, a brief history, physical examination and measurement of packed cell volume (PCV) and haemoglobin (Hgb) concentration is performed prior to each blood donation. Donor PCV and HGB concentration should be at least 40% or 13g/dL, respectively.

General principles of blood group testing

Blood group testing can be performed in the clinic to screen potential dog blood donors and to type the recipient for appropriate donor selection prior to crossmatch and transfusion. To perform the test, 10 µl of whole blood collected on EDTA is required. Using a pipette, place the appropriate amount of blood into a clean tube, without additives and add 3 drops from the kit buffer. The solution is homogenized, then the strip is placed. After 2-4 minutes the migration is completed and the result can be interpreted.

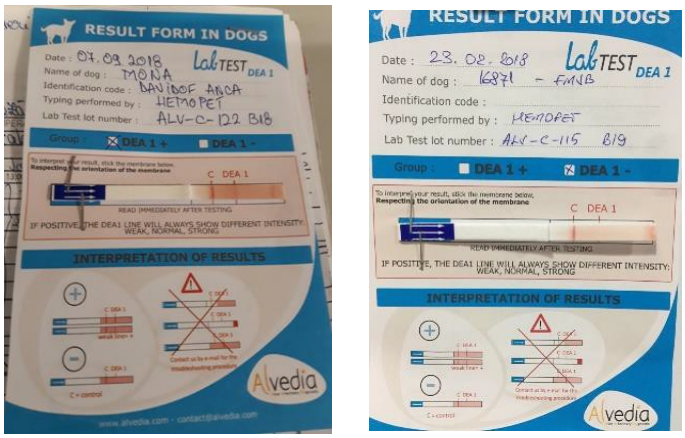

Fig. 2. Determination of the DEA 1 group using the Alvedia kit

There are eight commonly identified canine blood types. Because some DEA types are not very prevalent or do not stimulate a strong immune response, blood typing is generally limited to DEA 1.1 and 1.2. Dogs are believed to lack clinically relevant, naturally occurring antibodies against foreign erythrocyte antigens called *alloantibodies.* A first-time transfusion between two untyped dogs is unlikely to incite an acute transfusion reaction, even if they have different blood types. Despite the identification of many DEAs in dogs, the DEA 1 blood group is the most clinically important. In dogs that are DEA 1 negative, naturally occurring isohemaglutinins (antibodies) do not exist. However, transfusion of DEA 1 positive RBCs to a DEA 1 negative dog will result in rapid sensitization and anti-DEA 1 antibody production. Thereafter, a dog with anti-DEA 1 antibodies that subsequently receives a DEA 1 positive RBC transfusion can have a fatal hemolytic transfusion reaction. It is for this reason that all dogs requiring a transfusion should be blood typed prior to the transfusion of any blood components containing RBCs. Canine blood donors must be typed for DEA 1 at minimum because the practice of transfusing untyped canine RBCs is not considered acceptable or safe. Extended DEA typing of canine donors is controversial and must be performed through a commercial laboratory.

Pathogen testing

Pathogens for which testing is recommended met at least three of the following criteria: (1) the pathogen has been documented to cause clinical infection in recipients after blood transmission, (2) the pathogen is capable of causing subclinical infection such that carriers might inadvertently be identified as healthy blood donors, (3) the pathogen can be detected using culture or molecular methods from the blood of an infected animal, and (4) the resultant infection in the recipient has the potential to cause life-threatening illness and be difficult to eliminate with antimicrobial drugs. When screening for bloodborne pathogens in a potential blood donor, the test or tests with the greatest analytical sensitivity should be used. However, in situations where the prevalence of infection is low (as is the case for some pathogens in healthy animals compared with sick animals), positive results are more likely to represent false positives than in regions of high prevalence (low positive predictive value), and consideration should be given to verifying such positive results with a second test.

Identification of parasites on blood smears. Blood parasites are organisms that live in the blood of their animal hosts. These parasites can range from single-celled protozoa to more complex bacteria and rickettsiae. The method of transmission varies, depending on the parasite, but often

they are transmitted through the bites of ticks or flies. The sample (EDTA anticoagulated blood) was kept at room temperature, well-mixed, clot free. Quick Romanowsky type stains (such as Diff-Quik) are modified versions that are inexpensive, robust, fast and easy to use and generally give very good results. Dogs are known to be infected by different haemoparasites viz. *Babesia spp, Trypanosoma spp, Leishmania spp, Hepatozoon spp, Ehrlichia spp, Anaplasma spp, Mycoplasma spp* (*Haemobartonella*) and *Dirofilaria sp* which are transmitted through different arthropod vectors like ticks, lice, triatomines, mosquitoes, tabanids and phlebotomine sand flies and produce illness collectively termed as canine vector borne diseases.

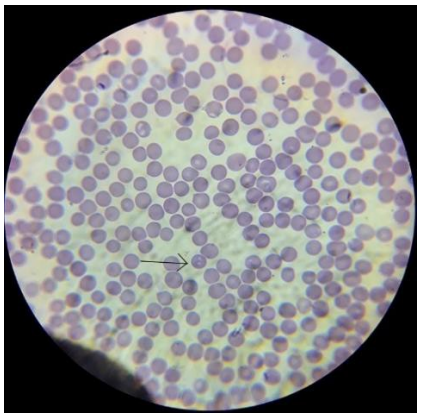

Fig. 3. *Babesia spp*.pear shaped merozoites in pairs, 400x

Microfilarial detection. One ml of blood in ethylene diamine tetraacetic acid (EDTA) was tested by standard filtration test and staining (methylene Blue-Giemsa). The number of microfilariae per millilitre (mf/ml) was calculated as the average of ten counts serially performed on 10 µl of blood samples. The identification of microfilariae was based on their morphology and morphometry.

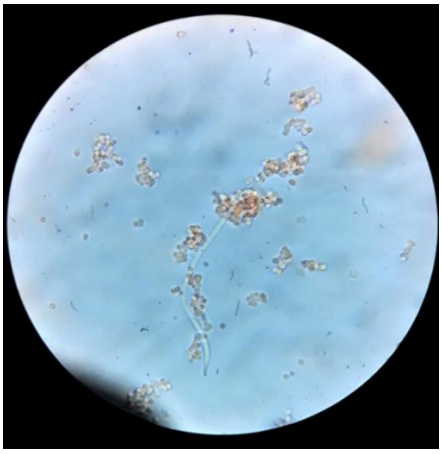

Fig. 4. Presence of microfilaria in blood smear examined on optical microscope. 400×

Vector borne pathogens detection. The 4Dx snap test (IDEXX) in the veterinary world is a blood test that is run in the clinics and provides results in few minutes. The test is a screening

process for six vector-borne diseases: heartworm, *Lyme, Ehrlichia canis, Ehrlichia ewingi, Anaplasma phagocytophilum* and *Anaplasma platys*.

Fig. 5. Preparation of 4Dx snap test (IDEXX)

The Crossmatch test

Crossmatching reveals the presence of naturally occurring isoantibodies or antibodies generated in response to a previous incompatible transfusion. Crossmatching does not prevent sensitization of the patient to future transfusions. In fact, even though a specific blood donor is crossmatch compatible with the patient, if five or more days have elapsed since the first transfusion, another crossmatch must be performed if more blood products are to be administered and especially when the same donor blood products will be used.

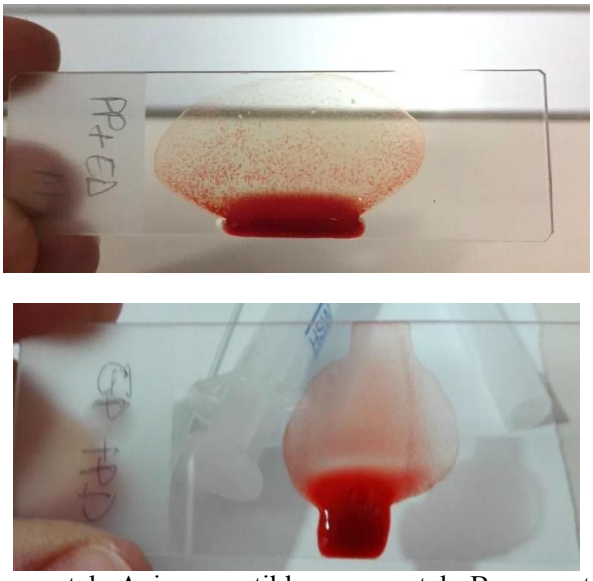

Fig. 6. Major crossmatch. A. incompatible cross-match; B. compatible cross-match

Crossmatching is a simple technique that can be performed with standard laboratory equipment. The major crossmatch should always be compatible at room temperature and at 37 degrees Celsius (°C). The purposes of compatibility testing are to detect: irregular antibodies; errors in ABO

grouping, and clerical errors in patient identification and result recording. The crossmatch will detect the recipient antibodies directed against antigens on the donor red blood cells. The mixture of erythrocytes and serum are observed for hemolysis or microscopically for agglutination. Any evidence of hemolysis/agglutination indicates an incompatible cross-match. Negative results are taken to indicate compatibility.

Conclusions

Canine blood transfusions are lifesaving interventions that have taken on an essential role in veterinary patient management. Pre-transfusion testing of the recipient, including blood typing and crossmatching, should be performed with the ultimate objective of preventing an immune-mediated transfusion reaction.

Optimizing patient safety in transfusion medicine is multifaceted and fatal consequences can occur if steps are omitted. Pre-transfusion testing is just one aspect to ensure the safety of a transfusion. The purpose of blood typing and crossmatching is to prevent incompatible RBC transfusions that could lead to potentially fatal immune-mediated transfusion reactions. Mandatory performance of pre-transfusion testing for all RBC-containing blood components will improve patient safety when transfusions are part of the canine patient management. Today, point-of-care pre-transfusion testing is readily available for dogs. As such, pre-transfusion testing is no longer reserved for specialized veterinary centers and it should be the standard of care before all canine transfusions.

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