

## GENERAL CONSIDERATIONS OF BLOOD BANKING AND TRANSFUSION IN DOG: A REVIEW

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### **Abstract**

*This review is a practical aspect of transfusion therapy for dogs and of the blood banking process and transfusion standards. Many of these aspects are based of the current veterinary and human standards.*

*The first documented transfusion occurred in 1665, and was made by withdrawing blood from one dog and replaced it with blood from another dog. Since then veterinary transfusion medicine has made remarkable progress, following close to our human contra parts.*

*Whole blood refers to blood that has not been separated. Blood products are composed from blood components and these are prepared either by centrifugation or by apheresis. The use of blood components allows several patients to benefit from one donation and reduces the risk of transfusion reactions to unnecessary components.*

*Both whole blood and blood components may be used shortly after the collection or after storage, Blood banking allowing the user access to both blood and blood components immediately. This procedures may be feasible to obtain and process blood on demand. However for emergency clinics with a large requiring caseload of transfusion therapy, blood banking is essential.*

**Key words:** *transfusion, blood, blood banking, donor, blood group.*

## **INTRODUCTION**

Transfusion is defined as an intravenous therapy with blood products or whole blood. Blood banking allows immediate access to whole blood and blood components in any cases (Abrams-Ogg, 2000; Gibson, 2007)

The blood banking procedures that must be followed refer to the blood donors, the dog blood groups, the blood typing, cross-matching anticoagulant ( preservative solution ), the blood donation procedure, collection systems, the blood product preparation and storage, transfusion of dog whole blood and blood components. (Abrams-Ogg, 2000; Gibson, 2007).

## **Blood donors**

The source of blood donors may be obtained from clinic owned donors (depending on the anticipated needs), from a donor program (client owned pets that donate for benefits ), animal controlled facilities ( animal shelters or pounds that may allow stray dogs to donate ), terminal donors ( animal that are being euthanized for behavior problems or medical disorders that do not affect the quality of the donated blood ). (Gibson, 2007; Abrams-Ogg, 2000; Wardrop, et al., 2005; Slichter, et al., 1986)

An ideal blood donor should be clinically normal, large breed with normal weight (25 – 28kg), friendly and has easily accessible veins

and a universal blood type, has to be current on the vaccination status, free of parasites and infectious disease (depending on the geographical location) and do not suffer of other disorders (immune mediated, cancer, systemic disorders, organ failure) and did not receive any drug therapy or had previous transfusions. (Gibson, 2007; Palmer, et al., 2014; Abrams-Ogg, 2000; Palmer, et al., 2014; Chervier, et al., 2012; Horgan, et al., 2009; Hackner, 2015)

### ***Blood groups***

The definition of blood groups are made by the inherited antigens of the RBC surface. They are of crucial importance in the transfusion medicine because of the risk of hemolytic reactions that occur when there is an antibody directed against a blood group antigen, depending on the complement activation by IgM and IgG. (Abrams-Ogg, 2000; Slichter, et al., 1986; Lynel, et al., 2009).

The blood groups are classified in the DEA (Dog Erythrocyte Antigen) and there are six antigens (DEA 1.1, 1.2, 3, 4, 5, 7) defined by the current standardization antisera and a new antigen Dal, but 20 or more specificities have been described. DEA's have not been extensively characterized for composition and structure. (Corato, et al., 1997; Abrams-Ogg, 2000; Gibson, 2007; Blais, et al., 2007).

### ***Blood typing***

The compatibility of donor recipient should be considered when selected a donor. To prevent DEA incompatibility is to blood type the donors using antisera. The antisera is produced by allow-immunizing a dog negative for a given DEA. Blood typing is not performed at a regular basis in veterinary medicine because of the prices and is performed on a small number of donors. The universal blood donor is negative to DEA 1.1, 1.2, 3, 5 and 7 and the minimal requirement to prevent a moderate or a severe DEA

hemolytic reaction needs a minimum for the donor to be negative for DEA 1.1. (Lynel, et al., 2009; Abrams-Ogg, 2000; Gibson, 2007).

### ***Cross-matching***

The cross-matching procedure test for anti-RBC antibodies through hemolysis and agglutination. Cross-matching is an adjunct to blood typing and is not a substitute, but probably is the only incompatibility test available. (Lynel, et al., 2009; Abrams-Ogg, 2000).

There are numerous cross-matching procedures, but two of these methods are adapted into the general practice, the rapid slide method and the tube method. Both of these methods function on the agglutination and hemolysis process. (Beth, 2013; Abrams-Ogg, 2000; Gibson, 2007).

### ***Blood donation system***

The estimated blood volume that can be donated safely it is between 15% and 20%, the maximum donation it is about 16-18 ml/kg. Determine for a standard donation in the dog is 450ml referred as a canine unit of blood. Dogs can donate every month as long as they receive a good nutrition and iron supplementation in the diet. In case of the client own dogs the usual donation period it is every two months and does not require a nutritional supplementation. (Gibson, 2007) (McMichael, 2015) (Abrams-Ogg, 2000).

In the recent studies, guidelines have not been established of how frequently a dog could donate plasma or pellets if the RBC are returned to the donor. The standard suggestion is that we should use the whole blood donation guidelines. (McMichael, 2015) (Abrams-Ogg, 2000).

### ***Collection system***

The collection system refers to the standard human blood collection packs and they are the most suitable collection packs, using a closed system that has no potential for environmental contact with the blood as it flows from the

vein to the container. The same collection packs are also available for preparation of blood components, these bags having satellite bags for the extraction of the erythroconcentrate. In an emergency, if the regular systems are not available they can be collected using a 60ml syringes collected to an infusion kit. (Gibson, 2007) (Abrams-Ogg, 2000).

The blood collection procedure is made with a venipuncture of the jugular vein, cephalic vein (large breed dogs) or the femoral artery also can be used, but technically the femoral artery puncture is the most difficult and it has an increased chance of hematoma formation and scarring of the vessels. (Abrams-Ogg, 2000).

The blood collection procedure has a minimum requirement of four people: a phlebotomist, two restrainers and another person to handle the collecting bag. (Abrams-Ogg, 2000).

After care of the donor, refers to the observation of the dog for 15 to 30 minutes for weakness, pale mucous membranes, weak pulse or other signs of hypotension. In case of hypotension we can replace the volume with saline or a similar crystalloid solution after the donation. It is most necessary to apply moderate pressure over the vein puncture sight for about five minutes and to apply a neck bandage. (Gibson, 2007) (Abrams-Ogg, 2000).

### ***Blood product preparation and storage***

Whole blood packed RBC, fresh frozen plasma and frozen plasma are the most important blood products. Collected blood can be given for transfusion as fresh whole blood, stored or transferred into various components to be used fresh or refrigerated. (Abrams-Ogg, 2000).

The latest veterinary and human blood banking practices requires that only the blood collected in the closed system should be used for storage or blood product preparation and this should be standardized to minimize the

risk of microbial growth. (Abrams-Ogg, 2000) (Gibson, 2007).

The open collection system should be only used for immediate transfusions or emergency transfusion procedures. The requirements of blood product preparation after the collection of the blood refers that the pack should be held at room temperature while awaiting the separation into the components. (Mollison, 2000); (Abrams-Ogg, 2000); (Gibson, 2007). Every blood product should be labeled with the type of product, the donor, the blood type if it is known and the collection and expiration dates. (Gibson, 2007); (Abrams-Ogg, 2000).

RBC products are represented by: whole blood and packed RBC.

Whole blood is the most common used blood product and should be kept under refrigeration at 1 to 4 degrees Celsius and should be kept on a dedicated refrigerator. (Abrams-Ogg, 2000).

The principal indication of whole blood, fresh or stored is for acute hemorrhage and for replacement of RBC plasma in case if volume deficit appears. The whole blood volume that should be transferred it is estimated on ongoing future losses. The usual dosage that should be administrated is between 10 and 22 ml/kg and the volume should not be modified or exceed unless the outgoing losses are severe, in this case we should consider using massive transfusion. (Jutkowitz, 2015) (Gibson, 2007).

Packed RBC. There are two principals to obtain packed RBC from fresh whole blood: centrifugation or sedimentation.

Centrifugation procedure requires a 5000G`'s for 5 minutes at 4 degrees Celsius. On slower centrifuges 2000G`'s for 10 minutes and the plasma should be removed with a plasma extractor and kept on a designed refrigerator for a maximum of 30 days.

The sedimentation process for whole blood it's obtained by vertically suspension of the blood pack in a refrigerator for a minimum of 12 hours, procedure that lasts from 3 days to 2 weeks. To speed up the process we should

consider the addition of a synthetic colloid that would maximize the RBC and plasma separation. (Gibson, 2007).

The RBC transfusion is indicated in cases of anemia without hypovolemia or deficits in other blood components, but has the benefits of not overloading the circulatory system. (Abrams-Ogg, 2000).

Plasma products are obtained the separation of RBC from the whole blood product. This could be processed into various products. (Abrams-Ogg, 2000).

Fresh plasma and fresh frozen plasma. The fresh frozen plasma is the plasma that has been separated and placed at -18 degrees Celsius in maximum 8 hours from the collection. Keep in mind the time restrictions, this product should be normally prepared by centrifugation. (Hackner, 2015); (Abrams-Ogg, 2000).

The transfusion of fresh frozen plasma has an interval between 10 to 30 ml/kg and it should be supplemented if a hemorrhage or a coagulation deficit persists.

Frozen plasma. Liquid plasma should be stored under 1 to 6 degrees Celsius refrigeration and the maximum storage time is approximately 6 weeks. (Abrams-Ogg, 2000) (Gibson, 2007).

### ***Transfusion of whole blood and blood products***

The whole blood and blood components that had been refrigerated should be warmed before administration. The requirement is to warm the products gradually to room temperature during the administration, but to proceed with extreme caution because the excessive warming may decrease the RBC viability and increase the risk microbial growth. (Abrams-Ogg, 2000).

The whole blood should be mixed by a gentle inversion before the transfusion. The canine packed RBC's that had been stored in CPDA1 has a PCV of approximately 70-80% and a very high viscosity that makes the product difficult to transfuse, even allows the

formation of RBC clumps. To reduce this problem we should add 100ml of NaCl at 37 degrees Celsius, to facilitate the transfusion process. (Abrams-Ogg, 2000) (Gibson, 2007). Frozen plasma should be reheated in an incubator or a water bath at 37-38 degrees Celsius for approximately 30 minutes per unit of canine plasma. Frozen plasma products may be more rapidly defrosted even in a microwave oven (Hurst et al. 1987); (Abrams-Ogg, 2000).

### ***Transfusion rates***

The initial transfusion rate of whole blood and its components should be 0.25ml/kg/hour for the first 30 minutes and then should be transfused at a rate of 5 to 10 ml/kg/hour. For the cardiac patient it should not exceed 0.3 to 3 ml/kg/hour. (Gibson, 2007).

The maximum rate of transfusion should not exceed 22 ml/kg/hour used in emergency situations except the situations where massive transfusion is required, at a maximum of 90 ml/kg/24hours. (Jutkowitz, 2015); (Gibson, 2007).

It is recommended that during the higher transfusion rates that the patient should be connected to a monitor and it should be monitored during the transfusion. In the presence of the increased risk of volume overload the transfusion rates must be slowed down. To minimize the bacteria proliferation in the RBC and plasma products the veterinary and human transfusion standards recommend that every transfusion should be completed in a maximum of 4 hours. (Abrams-Ogg, 2000); (Jutkowitz, 2015); (Abrams-Ogg, 2000).

### ***Delivery***

The delivery of whole blood and its components in most veterinary clinics is by gravity and it is recommended that we use infusion pumps for an accurate dosage. Alternatively the blood product may be gently

drawn of the bag in 60ml syringe and then slowly administered. (Abrams-Ogg, 2000). Record keeping of each transfusion should be kept for each transfusion and also it would have to contain general information from the blood product recipient, the date of the transfusion and transfusion reaction if they appear. A highly visible notation should be added to the medical record to show that the patient received the transfusion. (Abrams-Ogg, 2000); (Gibson, 2007).

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