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*Review Article*

# A REVIEW ON BLOOD TRANSFUSION IN SMALL ANIMALS: A LIFESAVING MODALITY IN VETERINARY PRACTICE

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**Abstract:** The objective of this review is to provide an updated overview to the reader regarding small animal blood transfusion. The clinical application of blood transfusion in veterinary practice has been increased recently as an emergency lifesaving modality due to easy access to blood products through blood donors or stored blood substitutes. The blood groups in dogs and cats, the standard procedure of cross matching before transfusion, selection of ideal donor, blood collection methods, storage, transfusion procedure and adverse reaction and its management are briefly reviewed in this article.

**Keywords:** Transfusion, Blood, Small animals, Lifesaving and Veterinary.

## Introduction

Blood transfusion has been used as an emergency and life-saving step, since many years in human as well as animals medicine (Davidow, 2013). It is a most common practice to save the critically ill patient having low blood parameters. It is a process of transfer of homogenous blood from one individual to another of same species. Blood is a complex fluid medium of plasma having suspension of living cells, and is a very essence of life (Molison, 1976).Transfusion medicine has gradually become more feasible in small animal practice, with improved access to blood products through collection and transfusion from on-site donors, and the recent advancement of storage facility for whole blood and blood constituents. Separation of specific blood constituents from whole blood helped to increase the storage period and led to the use specific blood constituents for transfusion depending on the requisite. The requirement for transfusion of blood and its components arise to sustain life of anaemic animals by improving the reduced red cell mass, and other cellular and non-cellular components *i.e.,* platelets, leucocytes, circulating hemoglobin level and blood volume that ameliorate most clinical signs.

Although it is a common procedure in clinical therapy, but not without substantial risk associated with live cells transfusion. In the US Blood Shield laws, Zuck (1990) has

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described blood transfusion as “unavoidably, unsafe, and inherently dangerous” procedure. These fatal risks were found to be more common in cats compared to dogs. The blood transfusion depends on several factors like type of anemia, blood group, blood parameters, animal size and blood products to be administered (Lanevschi and Wardrop, 2001). So, while transfusion physician should have thorough knowledge about transfusion medicine as well as its complication and emergency management. This review will help empirically to the practitioner for clinical purpose and reader for their keen knowledge.

**Historical background**

Today what we are following as blood transfusion technique from one animal to another of same species is not a single day achievement but it took long journey and contribution of the various researchers. History begins with the revolutionized discovery of William Harvey's theory of circulation (1628), this made possibilities of advancement in this area. In early 1600, Richard Lower carried out the first canine to canine blood transfusion and studied canine blood groups. Then one effort made by Lower and Denis transfusion between heterologous species lamb, dog and human, they given premise "like transfuses like". In 1667 the Frenchman Prosper Denis transferred the blood of a lamb into a young man but resulted in severe anemia and thus the concept of transfusion fell out of favor.

Karl Lansteiner discovered blood groups in 1900, and emphasized the importance of cross matching prior to transfusion. The method of transfusion from artery to vein in dogs was performed by George Crile (1907). First time citrate was used as anticoagulant for blood and transfused safely in to dogs (Hustin, 1914). Further, the amount of citrate to be transfused safely in dogs as an effective anticoagulant was determined by Richard Lewisohn (1915). The citrated blood can be stored for two days and transfused effectively in anemic dogs and guinea pigs (Weil, 1915). When certain additive is added in citrated blood can be stored up to 14 days and transfused with success (Rous and Turner, 1916). These steps of easier to store for a longer period made development for blood bank and to make transfusion as a routine procedure (Zimmerman and Howell, 1932). The six type of antigenic blood groups were described between years 1937 to 1949. Rubenstein (1968) identified additional blood group.

**Indications**

In case of dogs when blood constituents like packed cell volume (PCV) is 15% or less and haemoglobin is 5 gm per dl of blood or less. While regarding the cats PCV below or equal to 12% and haemoglobin is 4 gm per dl of blood or less are indications of urgent need of blood transfusion (Perman and Schall, 1983).

There are several clinical conditions in which blood transfusion is indicated: 1) Anemia of various causes like due to infection or acute/chronic hemorrhage. 2) Bleeding disorder such as thrombocytopenia or coagulopathies. 3) Poisonings like warfarin. 4) Hypoproteinemia usually parasitic or infectious origin. 5) Burn. 6) To develop specific or non-specific resistant against infections (Bhikane and Kawitker, 2002)

**Blood groups**

The inherent antigen present of surface of RBC is specific for each blood group and used for its typing. Blood group lacking in RBC surface antigen called as universal donor and groups having absence of anti-surface RBC antibodies known as universal recipient. Sometimes body can recognize RBC surface antigen as a foreign material and produce antibody against these antigen results in hemolysis can see in neonatal isoerythrolysis (Tocci, 2010).

A total of seven globally accepted canine blood group is identified and classified as dog erythrocyte antigen system (DEA). This DEA used as an acronym and while numerical value as a type of blood during grouping. DEAs 1.1, 1.2, 3, 4, 5, 6, 7, and 8 have been recognized, and antisera of typing is available for all, except DEA 6 and DEA 8 (Hale, 1995; Hohenhaus, 2004). Beyond DEA system a new Dal antigen is identified (Blais, 2007). The DEA 1.1 and DEA 1.2 are most common important clinically in dogs and DEA 1.1, 1.2 and 7 are the most antigenic blood types (Tocci, 2010).

In cats total three type of blood has been recognized, A, B, and AB. Out of three type A is most common. Type B is having strong inherent antigenicity against type A while type A is weak antigenic for type B (Auer and Bell, 1981; Giger *et al.,* 1991). The screening of blood type can carried out by using typing card.

**Cross matching**

Before transfusion of blood and its products, cross matching of recipient and donor blood should be carried out to minimize the risk of transfusion reaction. During emergency in dog first transfusion can be done without cross matching but for cats, each transfusion should follow cross matching. Cross matching is similar to blood typing, except that specific antisera are not used, and consists of a major and minor part. The major cross matching involves the cross matching of donor RBCs with recipient serum, whereas, the minor matching is the cross matching of recipient RBCs with donor serum. Incompatibility could be noticed as hemolysis or agglutination (Weiss and Wardrop, 2011).

**Selection of ideal donor**

The animal should be healthy (neutered male or spayed female are preferred) and capable to provide enough blood volume. A dog weighing at least 65 pounds and must be free from infectious disease especially dirofilariasis, and brucellosis, while Cat having at least 10 pounds weight and should free of *Hemobartonella* and feline leukemia virus are selected as a donor. The PCV of dogs and cats should be greater than 40% and 35% respectively. Hemoglobin concentration should be more than 13% in dog and 11% in cat (Chakrabarti, 2006; Slatter, 2003).

**Blood collection**

Blood can be collected from femoral or carotid artery in: 1) Sterile autoclaved saline glass bottles. 2) Sterile Plastic bag containing Acid Citrate Dextrose (ACD) @ 49ml/350ml blood or Citrate Phosphate Dextrose-Adenine (CPD-1) @ 75ml/500ml of blood or Citrate Phosphate Dextrose (CPD) or Heparin@ 3.0 ml / 500 ml of blood anticoagulant. The maximum volume can collected from donoris: Canine @ 20 ml/kg b. w. and feline @ 10 ml/kg b. w. (Chakrabarti, 2006; Bhalerao, 2002).

**Adjustment of blood volume**

The actual requirement of blood is calculated by using either of the following formula (Slatter, 2003):

1) Blood required raising PCV by 1% is 2.2 ml when assumed anticoagulated donor PCV 40% for dog and 30% for cat.
2) Amount of donor whole blood

$$= \text{Body wt. (kg)} \times \text{Recipient volume (dog 90 ml or cat 66 ml)} \times \frac{(\text{Desired PCV} - \text{PCV of recipient})}{\text{PCV of Donor}}$$

**Blood administration to recipient**

It has been recommended that blood should be transfused preferably using a commercially available infusion set. The sufficient gravity flow is required for easy administration. The preferred route of transfusion is slow intravenous but sometimes intraperitoneal or intramedullary can also be used. Maximum rate of transfusion in normovolemic animal @ 10-20 ml/kg b. w. per hour, hypovolemic animal @ 20-60 ml/kg b. w. per hour, in cardiac failure animal is 4 ml/kg b. w. per hour. (Chakrabarti, 2006). After blood transfusion, the PCV level of 25% to 30% in dog and 20% to 25% in cats are desirable (Slatter, 2003).

**Transfusion reaction and its managements**

Adverse reaction during transfusion of blood and its products are very frequent phenomenon and occur in about one of hundred transfusions in human (Delaney, 2016). A similar type of reactions also happens frequently in small animals but they are not well documented. These reaction may occur due to improper cross matching, faulty storage or administration. The most common adverse consequences occur immediately or while transfusion are acute hemolytic reaction, anaphylactic or allergic reactions. Some of the complications are seen later such as: delayed hemolytic transfusion reaction, immunogenic or non-immunogenic reactions, hypothermia, citrate toxicity and heart failure (Lanevschi and Wardrop, 2001; Bhikane and Kawitker, 2002; Chakrabarti, 2006).

The prevention and management of adverse reaction include various steps like: selection of ideal donor, proper cross matching and blood storage, eagle monitoring of recipient during transfusion, stop immediately if any adverse reaction is seen, antihistaminic or corticosteroid usage to control allergic and anaphylactic reactions, epinephrine is the drug of choice for adverse transfusion reaction, antipyretic if fever and intravenous administration of calcium preparation in citrate toxicity.

**Conclusion**

The blood transfusion is a very useful and lifesaving step in critically ill patient, compromised with lower oxygenation capacity of blood due to decrease in its volume or cellular content. But still, transfusion is not without risk of adverse reaction. We can reduce these reaction by taking various mentioned precautions prior or during blood transfusion. There is a need of advancement in blood transfusion practices in small animal with safety and proper protocol.

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