

Article Information

Received: September 7, 2020

Accepted: February 8, 2021

Published: March 8, 2021

Keywords

Canine,
Blood Transfusion,
Transfusion Reactions.

Authors' Contribution

ARD designed and performed the experiments. ARD and CNG wrote and revised the paper.

How to cite

Dadke, A.R., Galdhar, C.N., 2021.
A Review on Canine Blood
Transfusion. PSM Vet. Res., 6(1):
10-15.

***Correspondence**

Anand Rajshekhar Dadke
Email:
anand1441994@gmail.com

Possible submissions



Submit your article 



Scan QR code to visit this journal
on your mobile device.

A Review on Canine Blood Transfusion

Anand Rajshekhar Dadke^{1*}, Chandrakant Narayanrao Galdhar²

¹Department of Veterinary Clinical Medicine, Veterinary Nuclear Medicine including Radio Isotope Laboratory, Mumbai Veterinary College, Parel, Mumbai-400 012, India.

²Maharashtra Animal and Fishery Sciences University, Nagpur- 440 001, India.

Abstract:

Blood transfusion is a lifesaving modality in emergency and critical cases and is being increasingly used in recent times. However, blood transfusion comes with some risks which can be mitigated through skilful management. The present review article describes the basics of blood transfusion, indications, selection of donor, specific Blood products indications, blood groups, cross-matching, administration, transfusion reactions, and management. The review article will help in dispersing updated knowledge about blood transfusion to readers and help in managing emergency clinical cases.

Introduction

Blood is fluid connective tissue made up of various components. Blood transfusion is being used for many years in the management of emergencies in humans as well as animals. The first successful blood transfusion dates back to 1665 by an English physician named Richard Lower (Fasttag, 2013). In dogs transfusion of blood from arteries to veins was first practiced by George Crile. Due to the advent of modernization blood transfusion became more popular in veterinary medicine. The presence of voluntary donors and storage equipment has contributed to the development of blood transfusion. Blood transfusion is lifesaving but is not risk-free. It is described as an “unavoidably, unsafe, and inherently dangerous” procedure (Zuck, 1990). Advanced techniques like blood typing, cross-matching, component therapy have made it more complex and have allowed physicians and veterinarians to point source of transfusion reactions (Cotter, 1991; Hosgood, 1990). Animals with hemostatic disorders often require repeated transfusions of whole blood, red cells, plasma, or platelets (Cotter, 2019). Considering the current unavailability of oxyglobin and blood banks xenotransfusion (transfusion of blood from one species to another) can also be explored (Bovens and Gruffydd-Jones, 2013; Gal *et al.*, 2020). With the knowledge of sources of transfusion reactions, efforts can be directed towards minimizing it.

Indications

- Indications for blood transfusion include alteration in blood parameters like packed cell volume (PCV) 15% or less and hemoglobin is 5 gm per dl of blood or less, anemia, coagulopathy, burn, severe hemorrhage, bleeding disorders due to thrombocytopenia, warfarin poisoning, hypoproteinemia.

Criteria for selection of donor dogs

- Clinically Healthy
- Weight more than 30 kg
- Good temperament fit in condition.
- Up to date vaccination records
- No history of the previous transfusion
- Hemogram with the minimum packed cell volume of 0.40 L/L and absence of hemoprotezoal infection.

Blood should be collected aseptically. Donors should not be sedated with acepromazine to avoid platelet dysfunction. Blood collection should not exceed 15-20 ml/kg bodyweight (B.W) which can be repeated after 6 weeks (Wardrop, 2008). However, in some cases, it may require supplementation of iron. If packed cell volume or Plasma Protein drops significantly after blood transfusion interval between two collections should be increased (Schneider, 1995).

Preservatives

Blood collection can be done from carotid artery or femoral artery aseptically in a sterile plastic bag containing Acid Citrate Dextrose (ACD) or Heparin or Citrate Phosphate Dextrose-Adenine (CPDA) or Citrate Phosphate Dextrose (CPD). CPDA is considered a better anticoagulant as blood can be stored for up to 35 days. Acid Citrate Dextrose allows blood to be stored for 21 days (Lucas *et al.*, 2004; Bucheler, 1994).

The requirement of Blood Volume

The actual requirement of blood volume can be calculated by the below-mentioned formula (Slatter, 2003).

1. For raising PCV by 1% 2.2 ml of blood is required assuming the anti-coagulated donor has a PCV of 40%.
2. Amount of donor whole blood= Body wt. (kg) × Recipient volume (dog 90 ml) × (Desired PCV–PCV of recipient) / PCV of Donor.

Specific Blood products indications

Choice of specific blood product depends on the rate of infusion, the quantity of infusion, missing blood component.

1. Whole blood transfusion is composed of Red Blood Cells (RBCs), White Blood Cells (WBCs), platelets, immunoglobulins, and coagulation factors (Chiaramonte, 2004). Whole blood transfusion is indicated in patients who have lost most of the blood components and hemorrhage is acute. Bleeding disorders in dogs due to hepatic dysfunction, hemophilia, thrombocytopenia, disseminated intravascular coagulation (DIC), and vitamin K antagonist. Rodenticide toxicosis can be considered for whole blood transfusion (Kirby, 1995).
2. Packed red blood cell transfusion is preferable to whole blood transfusion in cases where administration of whole blood may cause hypervolemia. Indications of Packed Red blood cells (RBCs) are chronic hemorrhage, non-regenerative anemia, and hemolytic conditions (Nilsson *et al.*, 1983).
3. Fresh frozen plasma (FFP) is prepared from centrifugation of blood within 8hrs at -18°C and the resultant separated plasma is called fresh frozen plasma. Plasma stored after this time is called Frozen Plasma (FP). Indications of FFP include mainly coagulopathies associated with hepatic dysfunction, rodenticide toxicosis, and

vitamin K deficiency, congenital or hereditary deficiency of coagulation factors. Frozen plasma lacks coagulation factors which can be used in rodenticide toxicosis or hemophilia. Fresh frozen plasma and frozen plasma cannot be utilized as a long-term source of protein for protein-losing enteropathies or protein malabsorption. It can be used in cases of burns that cause acute hypoproteinemia (Shirani *et al.*, 1996).

4. Platelet-rich plasma is less commonly used in veterinary practice and is indicated in thrombocytopenia and in dogs that may undergo surgeries. Limitations of platelet-rich plasma include the short lifespan of platelets, difficulty in obtaining sufficient volume of platelet-rich plasma, and risk of alloimmunization (Mitchell *et al.*, 1994). Platelets depletion occurs after 6 hrs of storage (Day and Kohn, 2012).
5. Blood substitutes- Blood substitutes are commercially available for canines. Blood substitutes are expensive however give advantages such as no requirement for blood grouping, cross-matching (Kumar, 2017). Blood substitutes have a half-life of 18-40 hrs. The product must be discarded if left after 24hrs. Post transfusion assessment should be done based on hemoglobin (Chiaramonte, 2004).

Blood Groups

Antigen present on the surface of Red Blood Cells is used for Blood typing. Universal recipient lacks anti-surface RBC antibodies whereas universal donor lacks RBC surface antigen. For blood groups, currently, Dog Erythrocytic Antigen (DEA) prefix is used. There are seven canine blood groups based on Dog Erythrocytic Antigen (DEA) as DEAs 1.1, 1.2, 3, 4, 5, 6, 7, and 8. The most important blood group

includes DEA-1.1 and DEA 1.2 (Hohenhaus, 2004). Transfusion of erythrocytes from DEA 1.1 to DEA-1 negative canine recipient is not indicated due to reduced life span of RBCs caused by anti-DEA 1.1 alloantibody (Giger *et al.*, 1995). These Dog Erythrocytic Antigens along with plasma proteins may induce immunologic adverse blood transfusion reaction.

Cross-matching

To minimize the risk of blood transfusion cross-matching must be carried out before blood transfusion. However during emergencies in dogs first blood transfusion can be carried out without cross-matching. There are two types of cross-matching i.e. Major and Minor. Process for cross-matching involves

1. Centrifuge the whole blood (Red-top vacutainer)
2. Washing of RBCs – resuspend 0.25 ml of RBCs in 4 ml of saline and centrifuge for 1 min, discard the supernatant and repeat the procedure twice, remove the supernatant.
3. Prepare 2% and 4% RBC solution by resuspending 0.1 to 0.2ml of RBC in 4.8ml of saline
4. Prepare three tubes as Major, Minor, and Mixed as discussed below
 - a. Major Cross-matching – Major cross-matching can be done by the addition of 2 Drops of the patient's serum + 1 drop of RBC solution of the donor. Control for major cross-matching is 1 drop of patient RBC solution and 2 drops of serum.
 - b. Minor Cross-matching- Minor cross-matching involves the addition of 1 drop of patient RBC solution and 2

drops of donor's serum. Control for minor cross-matching is 1 drop of donor RBC solution and 2 drops of donor serum

5. Incubate tubes 15 min at 37°C.
6. Centrifuge tubes 15s
7. Read the results.

Results

Note for the alteration of color or hemolysis. Gently resuspend the red cell button into the overlying serum layer and note for the presence of agglutinating clumps. Next, place a drop of resuspended RBCs on a slide, apply coverslip, and read at 100X and 400X. If compatible, the RBCs should be dispersed separately. Incompatible samples could be noticed as hemolysis or agglutination (Weiss and Wardrop, 2011).

Blood administration to the recipient

Blood should be transfused aseptically to the recipient using a commercially available infusion set. Blood can be transfused intravenously however in emergency conditions intraperitoneal or intramedullary routes can be used. The maximum rate of blood transfusion in a normovolemic animal is 10-20 ml/kg b. w. per hour. For hypovolemic animal rate is 20-60 ml/kg b.w. per hour and in dogs with cardiac illnesses it is 4 ml/kg b. w. per hour.

Transfusion reactions and their Management

Based on the onset of illness transfusion reactions can be divided into two groups as immediate reactions and delayed reactions. Immediate reactions occur within 1 to 2 hr following transfusion and delayed reaction may occur in days, months, or years later (Harrell *et al.*, 1997). These reactions may occur due to faulty storage, improper

cross-matching, or administration. The most common reactions are allergic reactions, fever, hemolytic reaction, and anaphylactic shock. The hemolytic reaction is the most serious immunological reaction which can be prevented by clinical management. This reaction occurs when the recipient has circulating antibodies for the donor's erythrocytes. Hemoglobinuria, renal ischemia, and vasoconstriction are common manifestations. The acute hemolytic reaction is rare in the dog, due to the low prevalence of naturally occurring anti-erythrocytes antibodies in this species (Lanevski and Wardrop, 2001).

Delayed complications include delayed hemolytic reaction, immunogenic or non-immunogenic reactions, citrate toxicity, hypothermia, and heart failure (Lanevski and Wardrop, 2001; Bhikane and Kawitkar, 2002). The average life span of canine red blood cells is less than 4 days so repeat transfusion after 4 days may result in anaphylactic shock (Bovens and Gruffydd-Jones, 2013). The risk of adverse reactions can be minimized by proper collection and administration of the product, aseptic collection, processing, and storage of blood and donors are healthy animals of known blood groups, screening tests must be performed.

In case of adverse reaction antihistaminic or corticosteroid can be used to manage allergic and anaphylactic reactions, for pyrexia, antipyretics can be used and epinephrine is a drug of choice for adverse transfusion reactions. In case of citrate toxicity, intravenous calcium can be administered.

Conflict of interest

All the authors have declared that no conflict of interest exists.

References

Bhikane, A.U., Kawitkar, S.B., 2002. Blood transfusion and fluid therapy. In: Hand book of veterinary

clinicians. 1st edn. Krishna pustakalaya, Latur, 325-329.

Bovens, C., Gruffydd-Jones, T., 2013. Xenotransfusion with canine blood in the feline species: review of the literature. *J. Feline Med. Surg.*, 15(2): 62-67.

Bücheler, J., 1994. Storage of feline and canine whole blood in CPDA-1 and determination of the posttransfusion viability. Research Abstract Program of the 12th Annual ACVIM Forum; Jun 2; San Francisco, CA, p 120.

Chiaromonte, D., 2004. Blood-component therapy: selection, administration and monitoring. *Clin. Tech. Small Anim. Pract.*, 19(2): 63–67.

Cotter, S.M., 1991. History of transfusion medicine. In Cotter SM (ed): *Comparative Transfusion Medicine. Advances in Veterinary Science and Comparative Medicine*, vol36. San Diego, CA, Academic Press, p. 1.

Cotter, S.M., 2019. Blood Transfusions in Animals. *MSD Veterinary Manual*.

Day, M.J., Kohn, B., 2012. *BSAVA Manual of Canine and Feline Haematology and Transfusion Medicine*, 2nd Edition. BSAVA British Small Animal Veterinary Association. p. 348.

Fastag, E., Varon, J., Sternbach, G., 2013. Richard Lower: the origins of blood transfusion. *J. Emerg. Med.*, 44(6): 1146-1150.

Gal, A.L., Thomas, E.K., Humm, K.R., 2020. Xenotransfusion of canine blood to cats: a review of 49 cases and their outcome. *J. Small An. Pract.*, 61(3): 156-162.

Giger, U., Gelens, C.J., Callan, M.B., Oakley, D.A., 1995. An acute hemolytic transfusion reaction caused by dog erythrocyte antigen 1.1 incompatibility in a previously sensitized

- dog. J. Am. Vet. Med. Assoc., 206(9): 1358-1362.
- Harrell, K., Parrow, J., Kristensen, A., 1997. Canine transfusion reactions. Part 1. Causes and consequences. *Compend Contin. Educ. Pract. Vet.*, 19:181-189.
- Hohenhaus, A., 2004. Importance of blood groups and blood group antibodies in companion animals. *Transfus. Med. Rev.*, 18(2): 117–126.
- Hosgood, G., 1990. Blood transfusion: A historical review. *J. Am. Vet. Med. Assoc.*, 197: 998.
- Kirby, R., 1995. Transfusion therapy in emergency and critical care medicine. In: Kristensen AT, Feldman BF, eds. *Canine and Feline Transfusion Medicine*. *Vet. Clin. North Am. Small Anim. Pract.*, 25(6): 1365-1386.
- Kumar, R., 2017. Blood transfusion in veterinary medicine. *Hematol. Transfus. Int. J.*, 4(4): 116–122.
- Lanevski, A., Wardrop, K.J., 2001. Principles of transfusion medicine in small animals. *Can. Vet. J.*, 42(6):447-454.
- Lucas, R., Lentz, K., Hale, A., 2004. Collection and preparation of blood products. *Clin. Tech. Small Anim. Pract.*, 19(2): 55–62.
- Mitchell, S.G., Hawker, R.J., Turner, V.S., Hesselewood, S.R., Harding, L.K., 1994. Effect of agitation on the quality of platelet concentrates. *Vox Sang.*, 67(2): 160-165.
- Nilsson, L., Hedner, U., Nilsson, I.M., Robertson, B., 1983. Shelf-life of bank blood and stored plasma with special reference to coagulation factors. *Transfusion.*, 23 (5): 377-381.
- Schneider, A., 1995. Blood components. Collection, processing and storage. In: Kristensen AT, Feldman BF, eds. *Canine and Feline Transfusion Medicine*. *Vet. Clin. North Am. Small Anim. Pract.*, 25: 1245-1261.
- Shirani, K.Z., Vaughan, G.M., Mason, A.D., Pruitt, B., 1996. Update on current therapeutic approaches in burns. *Shock.*, 5(1): 4-16.
- Slatter, D.H., 2003. *Textbook of small animal surgery* (Vol. 1). 3rd Revised edition. Elsevier Health Sciences.
- Wardrop, K., 2008. Transfusion medicine. In: Morgan RV editors. *Handbook of Small Animal Practice*. 5th ed. St. Louis, USA: Saunders Elsevier; p. 707–713.
- Weiss, D.J., Wardrop, K.J., 2011. *Schalm's veterinary hematology*. John Wiley & Sons.
- Zuck, T.F., 1990. Legal liability for transfusion injury in the acquired immunodeficiency syndrome era. *Arch. Pathol. Lab. Med.*, 114(3): 309–315.