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Blood TRANSFUSIONS

The Technician's Guide to *How* and *Why*

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Figure 1: *pRBC properly stored in refrigerator*

The goal of a blood transfusion is to get the blood product into a patient safely and effectively. As a veterinary technician, it is important to understand why we give certain blood products to patients in need and proper storage for blood products. We need to be able to understand what can go wrong when giving blood products, how to correct it, and more importantly, how to prevent it. This article will give you the understanding of these products and the necessary steps to take before administering blood products and how to properly monitor for life threatening reactions.

As a veterinary technician, our job is to advocate for our patients. We need to understand when patients need certain treatments and what to expect during the treatment process. When it comes to transfusions, it starts by understanding common blood products we use in veterinary medicine and the situations when we would start a transfusion in a patient. Proper storage techniques and proper administration techniques are ideal for a successful transfusion.

Fresh Whole Blood

Fresh whole blood (FWB) is considered "fresh" if collected properly and given to a patient within 6 hours of collection. This product can be used in patients with marked hemorrhagic episodes where platelets and other clotting factors may be needed, such as patients with clotting factor diseases; rodenticide toxicity, von Willebrand's disease, disseminated intravascular coagulation, and other factor diseases. FWB can also improve oxygen delivery in severely anemic patients and improve oncotic pressure in patients with protein losing diseases. FWB does not store well and only remains as FWB when stored for less than 6 hours at a temperature between 2-24 degrees Celsius. After storage of greater than 6 hours, it loses its platelets and clotting factors and no longer useful in patients when these benefits are needed.

Stored whole blood (SWB) is blood that has been stored longer than 6 hours. After 6 hours of storage, SWB loses the clotting factors and platelets, but has similar benefits of FWB which improves oncotic pressure and oxygen delivery. SWB can be stored for up to 28-45 days with proper collection and storage at 4 degrees Celsius. Both FWB and SWB can be useful in patients with hemolysis, blood loss, non-regenerative anemia and protein-losing diseases.

Packed Red Blood Cells

Packed red blood cells (pRBCs) is whole blood that has been separated from plasma to leave mostly red blood cells (RBC). This product is useful in treating patients with anemia. In patients with anemia related tissue hypoxia, pRBCs should be considered. pRBCs are especially useful in patients that are at increased risk for fluid overload, such as patients with cardiac disease or renal disease due to less transfusion volume being needed to acquire results. Patients that require anesthesia or surgery need adequate oxygen carrying capacity. A packed cell volume of at least 20% should be required for all patients planned for anesthesia or surgery to ensure a safe procedure, so a transfusion of pRBC can be beneficial preoperatively for these patients with a low PCV. Storage for pRBCs is similar to that of SWB in which it is stored for 28-45 days at 4 degrees Celsius *(Figure 1, above)*.

Fresh Frozen Plasma

Fresh frozen plasma (FFP) is plasma that has been separated and frozen within 6 hours of collection. FFP is used in veterinary medicine to treat hypoproteinemia, although it is most commonly used to treat coagulopathies that can lead to severe bleeding. Coagulopathies can be corrected with FFP because this product contains all clotting factors that are normal in a patient to prevent hemorrhage. It is useful in treating patients with sudden hemorrhage due to therapeutic uses of heparin or warfarin, although this could also be corrected by treating with vitamin k. Some clotting factors; VII, VIII, and von Willebrand's factor have a short half-life and could require 2-4 treatments per day. Less severe coagulopathies may only require daily treatment. However, it is recommended to continue FFP treatments for 1-3 days after hemorrhage has been controlled in order to prevent future bleeding episodes. FFP needs to be properly stored at -20 to -40 degrees Celsius for up to 1 year.

Frozen Plasma

Frozen plasma is plasma that has been separated and frozen 6 hours or longer after collection or FFP that has been stored for longer than 1 year. After 1 year of storage, FFP loses the coagulation factors and becomes frozen plasma. Frozen plasma is used to treat hypoproteinemia in patients with protein-losing nephropathy or protein-losing enteropathy, along with critically ill patients with low albumin. Frozen plasma needs to be stored the same as FFP at -20 to -40 degrees Celsius for 1-2 years.

Storage, Handling, and Administration of Blood Products

In combination with storage, handling and administration of blood products is important as well. All blood products should be assessed daily to monitor storage temperatures, examine blood products for discoloration, and rotated regularly. Blood products that appear discolored, expired, or at an inadequate temperature should be thrown away to avoid complications to the recipient.

FFP and frozen plasma need to be slowly thawed before administration. Plasma products should be thawed using a slow, continuous warm water bath, never exceeding a temperature of 39 degrees Celsius. Warming of plasma takes about 1 hour to thaw, if thawed too rapidly it can promote the growth of microorganisms and break down the components of plasma that would allow for a successful transfusion. Red blood cell products such as packed red blood cells, fresh whole blood, or stored whole blood do not require warming and should be transfused when removed from the refrigerator. Warming of red blood cell products also promote bacterial growth and can cause rapid deterioration of the red blood cells. It is important to never over warm blood products or use a microwave to warm products. If hypothermia is a risk to the patient, such as post-surgical or neonate patients, warming of the patient is preferred over warming of the blood products. Blood products that have been thawed or warmed to room temperature should never be re-cooled. Blood products should be fully administered to a patient within 4 hours of warming or opening of product, whereas plasma products should be administered within 6 hours. If a smaller amount of a blood product is warranted, the desired amount can be drawn from the bag either into a syringe or dry bag and given to the patient while the remainder can be refrigerated and used within 24 hours.

Figure 2: *Iris preparing to donate blood prior to clipping hair and cleaning donation site*

Before administering any blood transfusions, blood typing and cross-matching should be considered for each patient. Felines have three different well known blood types: A, B, and the rare type of AB. Cats have naturally occurring alloantibodies; therefore, type A blood reacts to type B and vice versa. All feline patients should be blood typed to avoid severe transfusion reactions. Canines have more than a dozen blood group systems *(Figure 2)*. These systems are known as DEAs but can be broken down into negative or positive type. A positive blood type can safely receive negative type blood, but that is not true for the later. DEA 1.1 negative is considered a "universal" blood type and can be safely given to a patient with lower risk of transfusion reaction. Unlike felines, canines do not have naturally occurring alloantibodies. The first "mis-matched"

Figure 3: Blood typing in a canine

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blood transfusion will sensitize a patient but will not typically react. Cross-matching a patient detects the serologic compatibility of the patient and the potential donor blood. Cross-matching in the feline patient is recommended if blood typing is unavailable. Cross-matching should occur in all canine patients that have been previously transfused more than 4 days prior and it is recommended to always cross-match a canine patient with unknown previous history. Even with a compatible cross-match in a canine patient, it does not prevent sensitization. These patients should be cross-matched again if another transfusion from the same donor is expected 1-2 weeks after the initial transfusion.

Once typing and/or cross-matching a patient is complete, the blood product transfusion can be started. Whole blood is administered at a dose of 10-20mL/kg. Packed red blood cells is administered at a dose of 5-10mL/kg, and plasma products at a dose of 10-20mL/kg. It is generally not recommended to premedicate with antihistamines or glucocorticoids prior to administration because it could potentially mask signs of a reaction to the transfusion or delay signs of a reaction. Baseline vital signs should be obtained and recorded; temperature, pulse, respiration (TPR), capillary refill time (CRT), patient mentation, pulse oximetry, and blood pressure are recommended. Blood products are best administered intravenously (IV), although an intraosseous (IO) catheter can be used when access to a vein is unobtainable. All blood products need to be administered with a filter, most commonly an in-line microfilter and administration set. Blood products should never be administered in conjunction with other fluids or medication, with the exception for 0.9% saline. All transfusions should be started at slower rate of 0.5mL/kg for the first 15-30 minutes to monitor for severe reactions. If no reactions occur, the rate of transfusion can be increased so as to complete the transfusion within 4 hours. After 4 hours, the blood product is at higher risk for bacterial contamination. A normal transfusion rate is 5-10mL/kg/hr but can be increased to 20mL/kg/hr in unstable or very hypovolemic patients. In severely critical patients, the blood product can be administered as rapidly as possible. In patients at risk for potential volume overload, a lower rate of 1-4mL/kg/hr is recommended. Throughout the transfusion, TPR should be obtained 5 minutes after the transfusion begins. Vital signs should then be monitored every 15 minutes for the first hour, and then every 30 minutes until the transfusion is complete. When transfusion is completed vital signs should then again be assessed 1-hour post transfusion as well as checking a packed cell volume 2-hours post transfusion.

As a veterinary technician, it is our job to monitor a patient throughout the transfusion process and observe for signs of a transfusion reaction *(Figure 3)*. Transfusion reactions can be broken down into two categories, and then two sub-categories. The two types of transfusion reactions can be either immunologic or nonimmunologic, which can then be broken down further to acute or delayed. Acute reactions can occur usually within minutes up to 48 hours post transfusion. Delayed reactions are classified as reactions that take place anywhere from a few days to several weeks after a transfusion is given.

Acute Immunologic Reactions

Acute immunologic reactions typically occur within 2 days of a blood transfusion being given. Acute hemolytic transfusion reaction is considered an immunologic reaction and occurs when a patient has antibodies to donor red blood cells, or in other words the patient has an incompatible blood type. Another immunologic reaction type is nonhemolytic febrile reaction and this occurs when the patient has antibodies against the donor's protein antigens or leukocytes. Patients can present with anaphylaxis, fever, vomiting, urticaria, and pruritis. Additional symptoms can be tachypnea, weakness, tremors, hemolysis, and pigmenturia. These types of reactions can typically be treated by slowing down the transfusion. If symptoms persist or worsen with a slower transfusion rate,

then discontinuing the transfusion may be warranted. If anaphylaxis occurs then it is recommended to administer antihistamines and glucocorticoids and the transfusion can usually be restarted at a slower rate. Severe reactions normally occur during or shortly after a blood product transfusion.

Acute nonimmunologic reactions can be classified as reactions from contamination of the blood product, in-vitro hemolysis, and volume overload. Contamination of transfused products occurs when blood products are improperly collected; lack of aseptic technique, stored *(Figure 4)*, or given to the patient; greater than 4-hour transfusion time. It can cause the patient to become septic, and presents with fever, vomiting, tachycardia, and weak pulses. In-vitro hemolysis occurs when the donor blood product is improperly collected causing damage to the cells. Patients typically present with vomiting when this occurs. Volume overload is a known risk to patients with cardiac or renal disease. These patients need to be carefully monitored for dyspnea, tachypnea, tachycardia, and coughing. Transfusion should be stopped in these situations, and if fluid overload is suspected intravenous diuretics can be given and supplemental oxygen if severe.

Delayed reactions can occur a few days to several weeks after a transfusion is given. Immunologic reactions happen when the recipient of a blood product develops antibodies that can shorten the lifespan of RBCs. If this occurs in a patient, they may require another transfusion if the patient becomes severely anemic again. Nonimmunologic reactions that are delayed typically occur when there is transmission of diseases that were unknown in the donor prior to collection.

Although reactions are considered rare, it is important to try and reduce the risk of transfusion reactions as well as knowing the signs to look for should a reaction occur. Key points to remember that may reduce the risk of reactions; blood type all feline patients, cross-match all canine patients, use proper collection, administration, and storage techniques, and carefully monitor the patient throughout the entire transfusion process.

Technicians play a key role when it comes to transfusion medicine. Having a better understanding of the transfusion process from beginning to end ensures our patients will have the best chance for a successful transfusion. J

Figure 4: *Trixie being monitored every 15 minutes during transfusion*

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