PRACTICAL CANINE
Blood Transfusion

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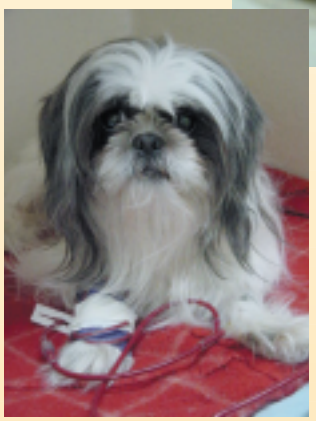
Are you prepared to offer transfusion support to patients? Do you know what products are available for use? Transfusion has matured from an emergency technique used only in academia to an everyday practice tool. Blood banks and repositories exist in almost every community. Advanced component medicine is available in your practice, either through a local source or by overnight courier. Quality transfusion medicine involves selecting the correct component, calculating a dosage, determining potential immune reactions, avoiding transmission of infectious disease, and careful administration of the blood component.



Q. Where Do Blood Products Come From?

National blood banks provide state-of-the-art components. Contact information for national blood banks in the United States is provided in **Aids & Resources**. Most blood banks offer 24-hour consultation, product use recommendations, and a complete line of blood components available from a local repository or by overnight shipment. Blood banks use restricted-access colonies of animals, volunteer owned pets, or a hybrid of both types of animals. Owned-pet volunteer canine donors make up the largest part of the blood donor base.

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HOW TO PERFORM BLOOD TRANSFUSION IN DOGS

Q. How Do I Calculate the Dosage for Transfusion?

Transfusion requires planning and dosage calculation. Because it is often done in an emergency situation, a transfusion worksheet (see www.cliniciansbrief.com) helps to ensure that vital data are collected and an accurate dose is given.

Q. How Can I Determine Whether an Immune-Related Reaction Will Occur?

To avoid immune-related reactions, blood typing and crossmatching are required (**Table 1**). In vitro reactions predict the likelihood of in vivo immune-related reactions in the recipient. A major crossmatch is done before transfusion using packed red blood cells. A minor crossmatch is done before transfusion using plasma products.

Q. How Can I Avoid Transmitting Infectious Disease?

Screening for infectious disease in the donor (**Table 2**) is the most commonly overlooked step in transfusion. (See Capsules, page 20, for recent consensus statement on donor screening.) Weakened or immunocompromised recipients may be particularly susceptible to blood-derived transfer of infectious disease. The need for adequate screening requires that donors be selected on a nonemergency basis. Certain breeds, such as greyhounds, are more likely to have vector-borne diseases like *Babesia canis*.

Blood Typing of Donors & Recipients

In dogs, complete blood typing allows the selection of "universal donors." A universal donor carries the dog erythrocyte antigen (DEA) 4 only and may be used without risk of erythrocyte incompatibility in 98% of the dog population. Approximately 15% of the canine population in the United States are universal donors. Inclusion of the card blood typing results for recipients allows a broadening of the potential donor pool to include donors that are DEA 1.1 positive without causing an immune reaction to an erythrocyte antigen in the recipient. Using the available card blood-typing test to recognize DEA 1.1 in the recipient dog allows the use of donors that are DEA 1.1 positive, 4 positive. This will increase your canine donor pool by 40%. Complete blood typing of the donor and DEA 1.1 typing of the recipient provide the greatest protection against reaction due to a mismatch of erythrocyte antigens while maximizing the donor pool.

1. Avoiding Immune-Based Reactions in Transfusion

Blood Product	Major Crossmatch	Minor Crossmatch	Blood-Typing Donor/Recipient
Packed red blood cells	Recommended if multiple transfusion or pregnancy history	Not recommended	Full DEA/card test
Plasma derivatives	Not recommended	Recommended if multiple transfusion or pregnancy history	Not necessary when using plasma products as long as red blood cell contamination is minimized
Platelets	Not recommended	Not recommended	Donor should be typed only if red blood cell contamination in end product

DEA = dog erythrocyte antigen

2. Infectious Disease Screening for Blood Donors

Infectious Disease	Recommended Screening Assay	Comments
Babesia canis *Babesia gibsoni*	PCR , genomic level, IFA	Prevalent in pit bulls and greyhounds; both testing methods recommended
Ehrlichia canis	ELISA, IFA, genomic level, PCR	
Mycoplasma haemocanis	PCR	Previously *Hemobartonella canis*
Leishmania donovani	IFA	Prevalent in foxhounds

ELISA = enzyme-linked immunosorbent assay; IFA = immunofluorescent antibody; PCR = polymerase chain reaction

BRIEF OVERVIEW OF PERFORMING A MAJOR CROSSMATCH

- Wash donor red blood cells using 0.9% NaCl or PBS.
- Make a 4% red blood cell solution by taking 0.8 ml washed red blood cells and mixing with 2 ml saline.
- Place serum from the recipient in a test tube.
- Make a reaction mixture using a ratio of 1 part red blood cell solution to 2 parts recipient serum.
- Incubate at 37° C for 15 minutes, centrifuge the tubes, and evaluate for hemolysis and/or agglutination.

Q. What Blood Components Are Available for Use?

Various blood products are available. Whole blood, while often a simple and readily available source, may not be the best choice for the recipient. Component therapy provides an efficient means of supplying oxygen-carrying capacity, primary and secondary coagulation capability, and/or oncotic proteins to a critical patient while minimizing immune-related reactions and infectious disease exposure. After centrifugation, whole blood is separated into packed red blood cells and plasma in the plasma press.

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Packed red blood cells are the erythrocytes, leukocytes, and platelets separated from plasma by centrifugation. These blood cells are typically mixed during processing with a red blood cell–saving solution, such as Optisol (Terumo Medical Corporation, Somerset, NJ), Adsol (Baxter Healthcare Corporation, Fenwal Division, Deerfield, IL), or AS-3 (Haemonetics Corporation, Braintree, MA). Preserved in this fashion, packed red blood cells have an extended shelf life of 35 to 45 days compared with whole blood collected on just anticoagulant (CPDA or ACD-A). Packed red blood cells

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3. Types of Plasma Components

Component	Description	Shelf Life
Fresh frozen plasma	The anticoagulated clear portion of centrifuged whole blood is separated and frozen at –18° C within 8 hours of collection. This product is the source of all components of the coagulation cascade, complement pathways, and fibrinolytic system. In addition, oncotic proteins (albumin), immunoglobulins, lipids, and electrolytes are found in this product.	1 year from the time of collection
Frozen plasma	The anticoagulated clear portion of centrifuged whole blood separated no more than 5 days after expiration of the whole blood unit. This product contains all nonlabile coagulation factors (II, VII, IX, X), oncotic proteins, immunoglobulins, lipids, and electrolytes.	5 years from the time of collection
Cryoprecipitate	Prepared by a controlled thaw of fresh frozen plasma, resulting in a concentration of the cold insoluble portion of plasma containing approximately 50% of the factor VIII in the "parent" unit,[1] 20% of the fibrinogen, and some factor XIII, vWF, and factor VIII: c.	1 year from the time of collection ("parent" fresh frozen plasma unit)
Cryoprecipitate-poor plasma or cryoprecipitate supernatant	The resulting clear plasma portion from cryoprecipitate preparation. Final product volume in the dog, prepared from a 210-ml fresh frozen plasma unit, equals approximately 150 ml. Albumin, immunoglobulin, and most of the nonlabile clotting factors (II, V, VII, IX, and X) are found in this product.	1 year from time of collection ("parent" fresh frozen plasma unit)[1]

General Guidelines for Storing & Transferring Blood and Blood Components

- Venting of a product (entering the bag with a syringe, needle, or IV drip set) leads to expiration of the product in 4 hours from the time of the event, 24 hours if it is held at 1° C to 6° C. Canine and large animal products are collected in a closed system, which provides some protection from bacterial contamination. If transfusion is predicted to take longer than 4 hours, separate and store separate aliquots at 1° C to 6° C.
- Frozen components are fragile! Be very careful to store them in a shipping container or in a well-protected area of the freezer. Storing blood in a freezer used to store other things commonly results in breakage.
- Warm blood products (except platelets) to 30° C to 37° C, and mix thoroughly before use. Carefully evaluate color, consistency, and package integrity. Inspect unit for gross hemolysis or bacterial contamination as indicated by flocculent material or red-to-brown color change. Do not use suspect products. Warm platelets to 25° C to 28° C.
- When warming blood products in a water bath, protect them in a watertight plastic container or bag to avoid contamination of outlet ports.
- Document all transfusion-related reactions, including the unit ID number; detailed account of the recipient reaction, including temperature, pulse, respiration, and hematocrit (pre- and posttransfusion); Gram stains of transfused unit, recipient sample, and catheter tip; and clinical history of the recipient.

collected on anticoagulant alone have a maximum expiration of 28 days. Products containing red blood cells are stored at 1° C to 6° C until use.

Plasma (i.e., the liquid supernatant resulting from centrifugation of whole blood) is stored frozen (< –18° C). Depending on processing, plasma may contain labile and nonlabile clotting factors, immunoglobulins, oncotic proteins, and electrolytes. See **Table 3** for a description of the most common plasma components offered. Once frozen, plasma has a shelf life of 1 to 5 years. Fresh frozen plasma

containing labile clotting factors has a shelf life of 1 year; without labile clotting factors it has a shelf life of 5 years. **Table 4** shows your best choice of blood component for basic disease processes.

Platelet are produced either through a slow-speed centrifugation of whole blood or through apheresis, an automated collection technique used frequently in human transfusion medicine. We are currently unable to type and crossmatch canine platelets; thus, they should only be used in an attempt to control life-threatening hemorrhage.

See Aids & Resources, back page, for references, contacts, and appendices.

4. Component Selection in Some Common Disease Processes

Disease Process	Whole Blood	Packed Red Blood Cells	Fresh Frozen Plasma	Frozen Plasma or Cryoprecipitate-Poor Plasma	Cryoprecipitate	Colloid	Platelet Concentrate
Regenerative anemia		Best					
Nonregenerative anemia		Best					
Anemia with hypoproteinemia	Okay	Best		Okay		Best	
Anemia with hypovolemia	Okay	Best		Okay		Best	
Anemia with coagulopathy	Okay	Best	Best				
von Willebrand's disease			Okay		Best		
Pretreatment before invasive procedure (von Willebrand's disease, hemophilia A)			Okay		Best		
Hypoproteinemia				Okay		Best	
Low immunoglobulin			Okay	Okay			
Hemophilia A or factor VIII deficiency			Okay		Best		
Hemophillia B or factor IX deficiency			Okay	Okay			
Disseminated intravascular coagulopathy	Okay if anemia is present or platelets are required		Best	Okay			Okay if life-threatening hemorrhage is found
Pancreatitis					Best		
Liver disease with coagulopathy				Best			
Thrombocytopenia with life-threatening hemorrhage	Okay; in the absence of platelet specific product						Best

Best = best product choice when more than one product can be used
Okay = blood products that can be used