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Jenny qualified from R(D)SVS in 1998 - she worked in mixed practice for 4 years before moving into the field of small animal emergency and critical care

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Red blood cell transfusions – when, what and how to do it!

Red cell transfusions are now a relatively common intervention in veterinary practice in the UK and help in the treatment of many patients. This is largely due to the availability of blood products, such as Packed Red Blood Cells (PRBC), from blood banks supplying directly to practices. After donation, red cells are separated from plasma into a concentrated packed cell form, a nutrient extender is then added to them. This allows the red cells to be stored for up to 42 days before being transfused into patients. DEA 1 blood typing prior to transfusion is essential and cross matching should be performed for second transfusions. Blood products are administered through a filtered giving set and patients monitored closely for transfusion reactions. Transfusion reactions are thankfully rare but potentially life threatening.

Key words: Canine, Packed Red Blood Cells (PRBC), transfusion, blood typing, cross matching, transfusion reactions

Clinical presentation

Without doubt, blood transfusions can be one of the most rewarding interventions in veterinary medicine, as increasing red cell numbers and the associated improved oxygen carriage makes an obvious and immediate difference to the patient.

In many instances these transfusions preserve life and many of the advances in veterinary medicine and surgery would not be possible without the ability to transfuse patients.

As with any intervention, there are multiple considerations and with transfusions these must be carefully considered.

Firstly blood is not *'just another fluid'*, but a complex, physiologically balanced, biological mixture. An understanding of its content is important when considering administering transfusions. Red cells are living cells and need to be carefully looked after before administration to the patient which leads to practical storage and transport requirements for these products.

Secondly, blood products are a very precious and limited resource. All blood available for transfusion is donated and so the health and wellbeing of the donor should always be considered. It is also important that these products are used respectfully and rationally, in patients with fair prospects of making a recovery, so that the benefit of this resource can be maximised. Used with forethought and care, the ability to give transfusions is a great addition to the veterinary therapeutic armoury and with the progression of blood banking in the UK, easily within the realms of possibility for all small animal practitioners.

Banked canine PRBC are readily available in the UK and this article primarily covers PRBC transfusion in the dog. However, the general principles of transfusion medicine apply to all of our companion animal species and many exotic species. For specific species, Pet Blood Bank UK (PBB) can guide you on blood collection and banking advice or refer you to an external advisor who has experience with that species.

Red cell products

Red cell products available in the UK are Canine Packed Red Blood Cells (PRBC), Fresh Whole Blood (collected and administered within 4-6 hours) and Stored Whole Blood. Fresh Whole Blood has the advantage of containing platelets but the number and function decline 4-6 hours after collection. Stored Whole Blood is uncommonly used, as platelet numbers and levels of Von Willebrand factor (vWF) and coagulation factors I (Fibrinogen), V and VIII decline quickly. Stored Whole Blood has a shelf life of 21-28 days depending on the anticoagulant used. If blood is to be stored, then separating the plasma and freezing it as Fresh Frozen Plasma (FFP) (Figure 1), and then resuspension of the



Figure 1: PRBC and Fresh Frozen Plasma (FFP)

red cells in a nutrient solution (SAG-M) allows the most efficient use of the whole unit of blood. This extends PRBC shelf life to 42 days and plasma products have a frozen shelf life of up to five years.

Table 1 illustrates the utility of the PRBC versus whole blood, and Table 2, specific differences in their content. If plasma is frozen within 24 hours of collection of the whole blood unit, Fresh Frozen Plasma (FFP) is produced, the use of which is outside the scope of this article but is discussed in more detail in Kit Sturgess's article on fresh frozen plasma (Sturgess 2014).

Indications for red cell transfusions

Patients with a wide variety of conditions causing symptomatic anaemia will benefit from red cell transfusions alongside treatment of their underlying condition. If a diagnosis has not been reached, transfusion can enable further diagnostic tests to be performed safely. Put simply, red cell transfusions are indicated for any patient developing clinical signs of low tissue oxygenation due to anaemia, which usually manifests as weakness and lethargy, pale mucous membranes, tachycardia and tachypnoea on examination. The speed at which the anaemia develops will also impact on the need for transfusion. If red cell numbers fall slowly, for example a chronic anaemia secondary to bone marrow disease, then adaptive mechanisms such as increased 2,3-diphosphoglycerate improve the efficiency of oxygen carriage leading to a delay in the development of clinical signs. Conversely if red cell numbers fall quickly, for example blood loss secondary to a road traffic accident, there is no time for adaptation and the clinical need for transfusion may occur with relatively modest blood loss.

The causes of anaemia are wide ranging but can be broadly defined into three aetiological groups:

- Loss of red cells (e.g. haemorrhage)
- Destruction of red cells (e.g. immune mediated disease)
- Failure of production of red cells (e.g. bone marrow disease)

When to transfuse

A precise trigger point or 'magic number' in terms of red cell number, haemoglobin content or Packed Cell Volume (PCV) for when to transfuse a specific patient cannot be given. Each and every individual patient,

Table 1: The indications for using whole blood and packed red blood cells

Disease Process	Whole Blood	Packed Red Blood Cells
Regenerative anaemia	◆	★
Non regenerative anaemia	◆	★
Pancytopenia	Fresh	
Anaemia with hypoproteinaemia	◆	★
Anaemia with hypovolemia	◆	★
Anaemia with coagulopathy	◆	★
DIC	◆	◆
Liver disease with anaemia	◆	◆
Thrombocytopenia	Fresh	
Thrombocytopathia	Fresh	
Neonatal isoerythrolysis		★

◆ Indicates suitable blood products that can be utilised in treating the disease process.

★ Designates the superior product choice when more than one suitable product can be utilized. (Courtesy of Dr Anne Hale).

their clinical presentation and diagnosis has to be considered before making a decision whether to transfuse or not.

In human medicine, detectable changes in tissues at the cellular level start to occur secondary to reduced oxygenation at a PCV of 30% or less and the same is likely true in our patients. On a clinical level in animals (especially with chronic anaemias), clinical signs are not often seen until PCV drops to a much lower value. Symptomatic anaemias typically present as a weak, tachypnoeic, tachycardic patient with altered mucous membrane colour. Pale mucous membranes are consistent with anaemia, but can also be seen in severe shock. Icteric mucous membranes can be seen in animals with pre-hepatic jaundice secondary to red cell destruction.

In acute instances, transfusion should be considered where whole blood loss is demonstrated to be the cause of clinical symptoms. This should be regardless of the red cell numbers as the PCV recorded may reflect total blood loss without an adjustment in blood volume to allow the PCV to drop. Chronic anaemias in canines are usually relatively well compensated and tend only to cause significant symptoms once PCV drops to less than 20% and occasionally much lower values.

The purpose of a red cell transfusion in companion animals would be to alleviate clinical signs but not to remove stimulus for the patient's own red cell production (if this capacity still exists in the recipient). As a rough guide, in canines capable of regeneration, transfusion to a stable end point of 25-30% PCV would be suggested. In those incapable of regeneration, aiming for mid-range of normal PCV (35%-55%) may be beneficial.

The average lifespan of a canine red cell is usually stated as 120 days. Cellular life expectancy may be reduced due to the collection and storage process, although a consensus as to what degree this impact is has not been reached. The red cells in each unit of transfused blood will be of variable age and as a result the effect of a transfusion will wane over time. Response to transfusion is also dependant on the host response to the red cells and the underlying disease process.

Diagnostic tests

Diagnostic tests useful for the evaluation of anaemic patients include:

Packed Cell Volume (PCV) and Total Solids (TS)

PCV should be measured using a percentage reader and TS should be measured