When and How to Give a Blood Transfusion

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Take Home Message

Horses experiencing severe anemia, either acutely or chronically may need a blood transfusion on an emergency basis. Therefore, knowledge of when and how to give a transfusion is vital to equine veterinarians attending emergencies, particularly in a referral setting. Veterinary teams are responsible for ensuring proper blood collection, administration, monitoring, maintaining proper donor protocol, and for keeping a detailed medical record.

Indications for Whole Blood Transfusion

There are many factors that go into determining a patient’s need for a transfusion. Physical examination is oftentimes the most telling diagnostic tool for determining the severity of disease as it pertains to tissue oxygenation. Symptoms of severe hypoxia due to anemia can be pale mucous membrane color, tachycardia, tachypnea, depression, anorexia, colic, decreased packed cell volume, and increased blood lactate levels due to poor perfusion of tissues. Anemia can be attributed to acute hemorrhage (trauma, blood loss during surgery), hemolytic disease, or erythropoietic dysfunction. There is not a specific PCV value range that determines a patient’s need for a transfusion; however, a patient with a PCV of <12% in combination with the clinical signs listed above is in need of a transfusion. The decision to transfuse should not be based solely on the PCV value. Rather, the important biochemical parameters are serum lactate, extraction ratio, and SVO2.

A normal SvO2 (the saturation of venous hemoglobin) in an unstressed animal is approximately 75%. This value is measured after the capillary, so after oxygen has diffused off of hemoglobin and into the cell. Before the capillary, the saturation of hemoglobin into the artery (SaO2) is on average 98-99%, which makes sense as the hemoglobin was fully saturated in the lungs and for the most part has not delivered oxygen to the cell. Therefore, about 25% of the oxygen is extracted off of hemoglobin at the cellular level in an unstressed, normal scenario. This represents the extraction ratio, which with a SaO2 of 99% and a SvO2 of 75% would be approximately 25%. Another way to think of this would be that in a given unstressed state, cells only use about 25% of what is available to them by hemoglobin. It is natural to assume that as the body becomes stressed for oxygen, like when anemic, more oxygen would be extracted off of the hemoglobin at the capillary level to account for the decreased hemoglobin delivering the oxygen. It is important to remember that there is a limit to how much oxygen can actually extract off of hemoglobin, and that number is about 50%. So, in a stressed state, the PaO2 would still be ~99%, but the SvO2 would be ~50%, as 50% of the oxygen was extracted off of hemoglobin in the capillary. Therefore, both SvO2 and extraction ratio are good markers to indicate if the body is stressed for oxygen. In a scenario in which it is difficult to decide if an animal should receive a blood transfusion, a patient with a decreased SvO2 and increased extraction ratio is likely in need of a transfusion regardless of the its PCV. Conversely, a patient with a low PCV, but a normal extraction ratio and SvO2, is compensating so well that it is leaving oxygen on hemoglobin at the cellular level, indicating that the need for oxygen is less. In this scenario, a blood transfusion is less indicated.
**Blood Donor**

A favorable donor should be an adult gelding (mares that have been pregnant increase their likelihood of having erythrocyte alloantibodies), test negative for EIA, have a thorough vaccination history, have never been transfused, and are negative for factors Aa and Qa (the two most common alloantigens involved in neonatal isoerythrolysis).

**Crossmatch**

Performing a crossmatch between the donor and the recipient is helpful, but in an emergency situation not always possible. A recipient that has not received a transfusion previously has a decreased likelihood of having an adverse reaction to a single transfusion from an unmatched donor. A purple top (EDTA) and a red top tube should be drawn from each potential donor and from the recipient horse to perform the crossmatch. The major crossmatch involves combining donor red cells with recipient serum. The minor crossmatch involves combining recipient red cells with donor serum. Both sides must be compatible for it to be a true match; however, even under true match conditions there is no guarantee that the patient will not have an adverse reaction to the transfusion.

**Whole Blood Collection Procedure**

Once the crossmatch is complete and the donor horse has been selected, a weight and a PCV/TP from the donor horse should be obtained. The maximum amount of blood that can be collected is 20mL/kg, or about 8% of body weight. During the collection process, the donor should be monitored for signs of hypotension such as a heart rate greater than 60 beats per minute, pale mucous membranes, and poor pulse quality. If such signs are noted, the collection process should be stopped.

Clip the catheter site and aseptically prepare. Administer 2cc of Carbocaine subcutaneously at the insertion site of the catheter. The catheter site should be lower on the neck than a traditional catheter site. Catheters can be placed with the needle end pointed either cranial or caudal. When the catheter is placed away from the heart, blood flow tends to be faster, but it is difficult to place and to maintain patency. Once the catheters are in place, they should be flushed thoroughly with heparinized saline. This will also be required throughout the collection process to maintain adequate blood flow into the collection bag. Commercial whole blood collection kits make the collection process easier: these kits may contain one sterile collection bag with one bag of the anticoagulant sodium citrate attached, and one blood administration set (with attached filter).

Once catheterized, the anticoagulant sodium citrate solution is added into the large collection bag and it is attached. The collection bag is placed lower than the IV catheter to increase flow rate and the bag should be continuously and gently rocked during the collection process in order to keep the blood and anticoagulant mixed. When the collection bag is full, it is removed, and the next collection bag is attached (only if more blood is needed). The blood is now ready to be administered to the recipient horse. Approximately, 2 liters of blood can be collected in 12 minutes.

A number of useful tips may be aid in the process and include:

- The donor horse may need to be sedated to aid in restraint. Placing the donor in stocks or cross ties is also helpful.
- Flushing the IV catheter after each collection bag is filled will help maintain optimal flow.
- You can collect blood from both catheters at the same time if necessary.
If the donor horse requires IV fluids post transfusion, it is simple to administer them if one of your IV catheters is placed with the needle end pointing towards the heart.

If you are unable to determine if the blood is still flowing into your collection bag, feel the solution set – it should be warm – if it is cool, this means you have not had any flow – the IV catheter and/or line should be flushed and reconnected.

The donor horse should have his IV catheters removed as soon as they are no longer needed.

If blood is collected and not used immediately, it may be stored in the refrigerator for up to 6hrs. If stored blood is to be used, it should be placed in a warm water bath until it reaches room temperature, it is then ready for administration.

Administration of Whole Blood to Recipient

The recipient horse should have an IV catheter placed. Like the donor horse, the recipient may have two IV catheters utilized simultaneously. Close monitoring of the heart rate, respiratory rate, temperature, and overall demeanor of the recipient should occur throughout the entire transfusion to aid in detecting an adverse reaction. The rate of transfusion should start at a slow drip and the bag should be gently and constantly agitated to remain mixed with the anticoagulant. Every two minutes vitals should be assessed. If there is no change after 15 minutes, the transfusion rate can be doubled, and the process repeated until a rate of an open bolus is achieved. If slight changes occur in the vital parameters, the transfusion rate should be decreased. Transfusion reactions can include sweating, muscle fasciculations, increases in heart and respiratory rates, increase in temperature, restlessness, urticaria, piloerection and anaphylaxis. If a reaction is suspected, the transfusion should be stopped immediately. On occasion, a recipient may develop a fever post transfusion. Most reactions will resolve on their own, however, some will require the administration of an NSAID to decrease inflammation, and severe reactions may require the administration of Epinephrine.

Anemic horses should be transfused with 10-20mL of blood/kg which will likely result in an increase in PCV; however, PCV is not a completely reliable source for determining how effective the transfusion is. Horses that have a PCV value within the low to normal range that receive a transfusion may not have a notable increase in value. One should take into consideration the improvement of abnormal clinical signs the horse displayed prior to receiving the transfusion. Transfused whole blood will last in the horses’ system anywhere from a few days to 2 months; therefore multiple transfusions may be necessary to sustain the patient until the bone marrow can keep up with the loss of red blood cells on its own.

Post Donation

When the donor horse has either reached his maximum limit for donation or the recipient is no longer in need of blood, he should be housed in the ICU for monitoring. If donation exceeds 10mL/kg of blood (500kg horse = 5L blood), the donor should receive a 20 liter bolus of a sterile, balanced electrolyte solution IV for replacement. The donor should also have access to free choice hay and water. Detailed documentation in the donors chart is essential. Everything should be included from the initial PCV/TP, physical exam and weight, site of IV catheterization, time of removal, and location of the horse following donation for frequent evaluation. The donor horse should also be clearly labeled that they donated blood so they are not used prematurely for another donation. A minimal interval of four weeks between collections for each donor horse is required.