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A Lifeline for Cattle: Importance and Practice of Blood Transfusion

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Abstract:

Blood transfusion is a vital life-saving procedure in cattle, widely used for managing severe anaemia, haemorrhage, and infectious diseases. This article outlines the principles, indications, and clinical relevance of transfusion therapy, with emphasis on blood typing and cross-matching to ensure compatibility and prevent adverse reactions. Despite challenges such as complex blood group systems and field limitations, proper protocols and donor screening significantly improve outcomes. Strengthening awareness and practical application can enhance the effectiveness of transfusion in bovine practice.

Keywords: Blood transfusion, Cattle, Cross-matching, Blood groups, Anaemia

Introduction:

Blood transfusion has been practiced for centuries to save lives in both humans and animals. The first recorded transfusion was performed by Richard Lower in 1665, when he transfused blood in a dog. With the development of modern techniques and equipment after the 1950s, transfusion therapy gained wider application in veterinary medicine (Cotter,1991; Davidow,2013). In recent years, significant advancements have further expanded its use. However, despite improved availability of blood and blood products, transfusion practices have become increasingly complex due to the need for advanced screening, blood typing, and cross-matching procedures for proper donor selection. Blood transfusion is increasingly recognized globally as a life-saving intervention, essential for managing trauma, severe anaemia, surgical blood loss, infectious diseases, and coagulation disorders. This article highlights the importance of blood transfusion in animals, with particular emphasis on blood typing and cross-matching procedures essential for safe and effective therapy.

Indications for Blood Transfusion:

The various components of blood can be used in different conditions as indicated below (Choudhary et al., 2017):

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Component	Description & Storage	Indications / Uses
Fresh Whole Blood	Blood collected and used within 8 hours; not refrigerated; contains all cellular and plasma components	- Severe anaemia, thrombocytopenia, DIC - Acute hemorrhage (trauma, surgery, dystocia) - Preoperative stabilization in anaemic animals
Stored Whole Blood	Blood stored at 1–6°C for up to 28–35 days	- Hemoprotozoan diseases (Anaplasmosis, Babesiosis, Theileriosis, Ehrlichiosis, Trypanosomiasis - Anaemia with hypoproteinemia - Immune-mediated hemolytic anaemia - Parasitism, toxicosis, major surgeries - Volume expansion and oxygen support
Packed RBCs (PRBCs)	Concentrated RBCs (PCV ~80%); stored at 2–6°C for 28–35 days	- Symptomatic anemia (hemorrhage, hemolysis, renal disease, bone marrow suppression) - Improves oxygen-carrying capacity without increasing volume
Platelet-Rich Plasma (PRP)	Prepared by slow centrifugation; stored up to 5 days with agitator or 48 hrs at room temp; not refrigerated	- Severe thrombocytopenia - Bleeding disorders (epistaxis, hematemesis, haematochezia) - Sepsis and DIC
Plasma	Contains immunoglobulins, proteins, and clotting factors; used fresh or frozen	- Failure of passive transfer (FPT) in neonates - Hypoproteinaemia (<3 g/dL), hypoalbuminemia (<1.5 g/dL) - Salmonellosis, parasitism, protein-losing conditions - Volume expansion and coagulation support

Clinical Indications for Various Blood Products Across Species: (Department of Animal Husbandry & Dairying, 2025):

(Standard dose recommendation in ml/kg)

Product	Indication	Dose Range (ml/kg)	Notes
Whole Blood	Hemorrhagic shock, anemia	10–20	Use lower dose for mild cases; higher doses for trauma or surgical blood loss
Packed RBCs (PRBCs)	Normovolemic anaemia	6–10	Helps improve oxygen-carrying capacity; avoid volume overload (especially in small ruminants)
Fresh Frozen Plasma (FFP)	Coagulopathy, hypoalbuminemia	10–20	May be repeated after 12–24 hours based on coagulation status
Platelet-Rich Plasma (PRP)	Severe thrombocytopenia	1–3	Limited availability; short shelf life
Cryoprecipitate	von Willebrand disease (vWD), Hemophilia A	1–2	Rich in clotting factors; used in specific coagulation disorders

Calculation of dose for blood transfusion: The dose was calculated based on the percentage of haemoglobin present in the recipient and the percentage to which it should be raised i.e. upto 75 per cent of the normal level. The amount of blood to be transfused for the animal was calculated according to the formula described by Prathaban (1986).

$$\textbf{Blood (in ml) required to raise Hb level by 1\%} = \frac{\textbf{40} \times \textbf{Body weight in pounds (lbs)}}{\textbf{100}}$$

Blood Types:

Each species has distinct red blood cell surface antigens that determine its blood group systems. In cattle, 11 blood groups are recognized—A, B, C, F, J, L, M, R, S, T, and Z—with **B and J being the most clinically important**. The B system is highly complex, containing over 60 antigens, making donor compatibility difficult. The J factor is not a true erythrocyte antigen but a plasma lipid that can adsorb onto red cells. Cattle lacking the J group but possessing anti-J antibodies may develop transfusion reactions when given J-positive blood (Blackmer, 2002; Stormont, 1991).

a. Mandatory Blood Typing and Cross-Matching:

1. **Blood Typing:** It is a technique by which the surface antigen of the erythrocytes can be identified. It works well to screen the blood donors of the animals before crossmatching and transfusion. They are determined in the laboratory and even blood-typing kits like card-based agglutination assay, immunochromatographic cartridge and gel column diffuse assay are available in the market.

1.1 Crossmatching: Ensures compatibility between donor and recipient blood to prevent transfusion reactions. The major cross matching should always be compatible at room temperature and at 37^0C. The end reaction to being noticed is hemolysis and agglutination.

Table: Type of cross-match and their interpretation are provided in tabular format

Type of Cross-Match	Combination	Purpose	Procedure (Brief)	Interpretation
Major Cross-Match	Recipient Plasma + Donor RBCs	Detect recipient antibodies against donor RBC antigens	Mix recipient serum + donor RBC suspension (2–4%) → incubate 30 min at 37°C → centrifuge (1500 rpm, 2 min) → examine	Agglutination/hemolysis = **Incompatible**
Minor Cross-Match	Donor Plasma + Recipient RBCs	Detect donor antibodies against recipient RBCs	Mix donor plasma + recipient RBC suspension → incubate 30 min at 37°C → centrifuge (1500 rpm, 2 min) → examine	Agglutination/hemolysis = **Incompatible**
Recipient Control	Recipient Serum + Recipient RBCs	Detect auto-agglutination	Mix and examine as above	Should show **no agglutination**

Transfusion Reactions and Sequelae:

Transfusion reactions may be **acute or delayed**. Acute reactions, usually due to incompatibility, can cause intravascular hemolysis leading to hemoglobinemia and hemoglobinuria. Release of thromboplastic substances may result in disseminated intravascular coagulation (DIC), while vasoactive mediators can trigger hypotension, shock, acute renal failure, and even death. Delayed reactions typically occur **2–14 days post-transfusion**, characterized by a drop in PCV. These are more common in previously transfused animals with low antibody titers undetectable during cross-matching. Delayed (extravascular) hemolysis may lead to hyperbilirubinemia and bilirubinuria (Kumar, 2017)

In most animals, the **first blood transfusion is generally safe**, as naturally occurring antibodies are absent or present in low levels. Similarly, initial transfusions in cattle carry a low risk; however, transfusing J-positive blood to J-negative recipients can trigger adverse reactions. A second transfusion within four days, especially with J-antigen mismatch, may result in haemolytic reactions (Drivers, 2005). Fever is a common transfusion reaction, often due to immune responses against leukocyte or platelet antigens or bacterial contamination. Allergic reactions in cattle, dogs, and horses are typically associated with sensitivity to plasma proteins or cellular components. Citrate toxicity can occur in hypocalcaemia cattle, while prolonged storage of blood may lead to ammonia toxicity, particularly in animals with liver disorders (Wardrop, 2008; Hurcombe et al., 2007).

Additionally, blood-borne parasites and viral infections must be considered, especially when blood is stored for extended periods or transfused slowly. Therefore, strict donor screening, proper health evaluation, and careful handling and storage of blood are essential to minimize transfusion-related risks (Wardrop et al.,2005).

Success Case Story:

A 450 kg cow was presented with a history of anorexia, severe weakness, recumbency, dehydration, and heavy tick infestation. On clinical examination, the animal exhibited pale mucous membranes, a rectal temperature of 105°F, tachycardia, and a weak pulse. Hematological evaluation revealed a significantly elevated total leukocyte count (TLC) and severe anemia, with hemoglobin levels below 5 g/dL. Blood smear examination confirmed **Babesiosis**.

Treatment was initiated promptly with imidocarb dipropionate at 1.2 mg/kg subcutaneously (single dose). Supportive therapy included vitamin B-complex (10 ml IM daily), normal saline (1000 ml IV daily for 5 days), flunixin meglumine (1 mg/kg IV), and oral haematinic boluses (ferrous fumarate) administered twice daily for 21 days.

The animal showed mild improvement initially; however, the rise in hemoglobin levels remained slow. The persistent severe anemia resulted in marked weakness, and the animal continued to remain recumbent. Considering the critical condition, whole blood transfusion was performed, and approximately

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1 liter of blood (calculated as per standard transfusion formula) was administered. Remarkable clinical improvement was observed within 24 hours post-transfusion. By the third day, hemoglobin levels increased from 4.2 g/dL to 5.12 g/dL, mucous membrane color improved, and the animal regained sufficient strength to stand, albeit weakly.

Fig. Demonstrate A case of blood transfusion in cattle was successfully managed by Dr. Peyi Mosing and her team at Bareilly

This case highlights the **life-saving potential of whole blood transfusion** in field conditions, particularly in cases of severe hemoprotozoan-induced anemia. Even a relatively small volume of transfused blood significantly enhanced oxygen-carrying capacity, accelerated clinical recovery, restored vital and hematological parameters toward normal physiological ranges, and reduced the convalescence period. **This successful intervention underscores the critical role of transfusion medicine as an emergency therapeutic tool in veterinary practice.**

Conclusion:

Blood transfusion in cattle has emerged as a vital, life-saving intervention in modern veterinary practice, particularly in cases of severe anemia, hemorrhage, and infectious diseases. Despite challenges such as complex blood group systems and limited field facilities, its timely application can dramatically improve survival and recovery. Increasing awareness among veterinarians and livestock owners, along with adherence to proper transfusion protocols, is essential to maximize its benefits and minimize risks.

Future Prospects:

The future of bovine blood transfusion lies in advancing accessibility and precision. Development of field-friendly blood typing kits, establishment of organized veterinary blood banks, and improved screening technologies will make transfusion safer and more practical, even in rural settings. Additionally, growing interest in component therapy and regenerative approaches like platelet-rich plasma (PRP) holds promise for expanding therapeutic applications. With continued research and innovation, blood

transfusion is set to become an even more powerful tool in enhancing cattle health and productivity.

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