http://www.pjbs.org

PJBS

ISSN 1028-8880

Pakistan Journal of Biological Sciences

ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Pakistan Journal of Biological Sciences 8 (9): 1280-1283, 2005
ISSN 1028-8880

Effects of Repeated Plasma Transfusion on Various Hematological Parameters in Calves

Md. Rafiqul Alam and Md. Akhtar Hossain
Department of Surgery and Obstetrics,
Bangladesh Agricultural University, Mymensigh-2202, Bangladesh

Abstract: Repeated plasma transfusion was performed in 12 indigenous Bangladeshi calves (age: 6-10 months, weight: 35-45 kg) to study its effects on various hematological and clinical parameters and to observe the incompatible reactions associated with plasma transfusion. The pre-transfusion values of Total Erythrocyte Count (TEC), Hemoglobin (Hb) and Packed Cell Volume (PCV) decreased 1 h after transfusion and thereafter started increasing from day-1 and a significant increase ($p<0.05$) was observed at day-3. The Total Serum Protein (TSP) increased 1 h after transfusion and a significant increase ($p<0.05$) was noticed from day-1. The pattern of changes in the hematological parameters in the recipient calves was similar in first and second transfusions. No significant changes were observed in the heart rate, respiration rate and rectal temperature. Plasma transfusion appeared to improve the hematological parameters and repeated transfusions did not produce any adverse reaction in the recipient calves. Plasma transfusion could be an effective tool for the management of anemic and emaciated calves.

Key words: Plasma transfusion, hematological parameters, calves

INTRODUCTION

The administration of blood or plasma or its components can provide the life-saving element for critically ill animals and animals undergoing surgery[1,2]. Transfusion therapy is basically an attempt to replace blood and its components when life is threatened without such restoration[3]. Component therapy entails separating whole blood into its cellular and plasma components and administering the appropriate blood component based on the patient's needs[2]. The use of plasma has emerged as a potential solution to the problems of typing and storage of blood and there is less risk of transfusion reactions. The technique does not require expensive equipment and hence may be practiced in the field condition[2]. Plasma transfusion is indicated in various clinical procedures like traumatic injuries, shock, burns, clotting factor deficiency, hypovolemia, hypoproteinemia, thrombocytopenia, anemia, colostral deprived neonates and coagulation factor deficiency[2,4-7]. Plasma transfusion is reported to be effective for the management of anemia and is free from incompatible reactions[8,9].

The poor body condition of the calves in Bangladesh is mostly due to low intake of colostrums at birth (within 6-12 h), lower nutritional condition with inadequate feeding of milk at growing age. These calves become anemic, debilitated, anorectic, gradually lose weight and eventually succumb causing 15-20% calf mortality in Bangladesh. Calves suffering from malnutrition, parasitism and anemia may not response to the conventional treatments. Plasma transfusion in these animals might be practiced for improving hematological parameters, promoting body immunity and thereby reducing calf mortality. In Bangladesh, large amount of blood is being wasted every year at the abattoir. Therefore, sources of blood are adequate. However, considering the above facts this study was performed to investigate the effects of plasma transfusion on various hematological and clinical parameters and to observe incompatible reactions (if any) associated with repeated plasma transfusion.

MATERIALS AND METHODS

Experimental animals: Twelve indigenous Bangladeshi calves weighing 35-45 kg and 6-10 months of age were used as recipients. All the calves were weak and emaciated. The calves were dewormed and housed in separate calf-pens in the animal shed of the Department of Surgery and Obstetrics, Bangladesh Agricultural University, . They had an *ad libitum* access to feed and water. They were also allowed to graze in the pasture 7-8 h a day.

Corresponding Author: Md. Rafiqul Alam, Department of Surgery, College of Veterinary Medicine,
Chonbuk National University, Jeonju 561-756, Republic of Korea
Tel: +82 63 270 3722 Fax: +82 63 270 3778

Six indigenous non-pregnant healthy heifers were used as blood donors. They were free from infectious diseases and blood parasites and protozoa and had not received any vaccines recently. The blood profile of each donor was assessed before blood collection. Cross-matching of the recipient blood to that with the donors was performed before transfusion.

Collection of blood and separation of plasma: Blood was collected from the donors by means of jugular venipuncture, in the sterile plastic containers containing 3.8% sodium citrate (0.1 mL mL^{-1} blood). The containers were gently agitated during collection of blood to ensure proper admixture of the blood with anticoagulant. Plasma was separated by centrifuging the blood at 2000 g for 15 min immediately after collection.

Transfusion of plasma: The recipient calves were controlled in a chute in standing position and fresh plasma was administered to the jugular vein using an intravenous cannula and a blood donor set with a built-in filter. Initially, 50 mL of plasma was administered and the calf was observed for 10 min to monitor signs of adverse transfusion reactions. After that the rest of the plasma was administered at the rate of 10 mL kg^{-1} h^{-1}. In all the calves plasma was transfused at the dose of 10 mL kg^{-1} of the recipients body weight. The second transfusion was performed 21 days after the first transfusion and different donors were used for each recipient.

Blood sample analysis: Analysis of recipient blood was performed after 1 h, 1 day and thereafter on 1, 3, 7, 14 and 21 days post-transfusion. The blood samples (5 mL) were collected from the jugular vein of the recipient calves and were analyzed for the determination of Total Erythrocyte Count (TEC), Hemoglobin (Hb), Packed Cell Volume (PCV), the Total Leukocyte Count (TLC), Differential Leukocyte Counts (DLC), Mean Corpuscular Volume (MCV), Mean Corpuscular Hemoglobin (MCH), Mean Corpuscular Hemoglobin Concentration (MCHC) and Total Serum Protein (TSP). The pre-transfusion values of these parameters were considered as control and were compared to those obtained on different post-transfusion periods.

Clinical parameters: Respiration rate, heart rate and rectal temperature of the recipient calves were recorded before transfusion, during transfusion and immediately after transfusion of plasma.

The data obtained in the present investigation were analyzed using repeated measures analysis of variance and students t-test. $P<0.05$ or less was considered as statistically significant.

RESULTS

Effects of plasma transfusion on TEC, Hb and PCV: In both transfusions (1st and 2nd) the pre-transfusion control values of TEC, Hb and PCV decreased 1 h after transfusion and thereafter started increasing progressively from day-1 and the significant increases were recorded from day-3 ($p<0.05$). The elevated values of TEC, Hb and PCV were sustained throughout the experimental period (Table 1 and 2).

Effects of plasma transfusion on MCV, MCH and MCHC: No significant changes in the values of MCV, MCH and MCHC were observed at different post-transfusion periods as compared to the pre-transfusion control values (Table 1 and 2).

Effects of plasma transfusion on TLC and DLC: The TLC values recorded on different post-transfusion periods did not show any significant change. A mild change in the differential leukocyte counts were noticed during the experiment. The number of lymphocytes increased progressively throughout the experimental period but this was not statistically significant (Table 1 and 2).

Effects of plasma transfusion on TSP: The control values of TSP increased 1 h after transfusion and a significant increase in the values were observed on day-1 ($p<0.05$). The elevated TSP values persisted throughout the experimental period (Table 1 and 2).

Effects of plasma transfusion on clinical parameters: Respiration rate and heart rate, showed a mild initial increase 5 min after onset of the transfusion, thereafter gradually returned to normal. The rectal temperature during transfusion remained almost unchanged (Table 3).

DISCUSSION

Total blood volume of animals is about 8% of the body weight and that of the plasma is about 5%. Acute loss of 20 to 25% of the blood volume results in marked clinical signs of anemia, including tachycardia and maniacal behaviour[10]. In the present study, volume of plasma administered to the recipient calves was 10 mL kg^{-1} and the rate of administration was 10 mL kg^{-1} h^{-1} which is in agreement with the previous reports[10-12]. However, a calf may safely receive transfusions at a faster rate of 40 mL kg^{-1} h^{-1} [10]. Administering plasma too quickly is the usual cause of circulatory overload. If the blood volume is increased too rapidly, the heart may be unable to cope and as a result pulmonary congestion may develop. The expected signs

Table 1: Effects of first plasma transfusion on various hematological parameters in calves (results presented as mean±SE)

Parameters	Pre-transfusion values (control)	Post-transfusion values					
		1 h	Day-1	Day-3	Day-7	Day-14	Day-21
TEC (million μL^{-1})	4.0±0.01	3.86±0.03	4.09±0.03	4.62±0.09*	5.30±0.09*	5.49±0.11*	5.01±0.06*
TLC (million μL^{-1})	12.24±0.48	11.78±0.44	12.85±0.61	13.54±0.60	13.40±0.59	12.41±0.34	11.84±0.33
Hb (g%)	7.96±0.90	7.66±0.80	8.00±0.10	8.76±0.90*	9.33±0.19*	9.26±0.12*	8.86±0.14*
PCV (%)	22.66±0.33	21.66±0.33	22.66±0.33	24.83±0.30*	26.50±0.22*	26.16±0.30*	25.16±0.30*
MCV (fl)	55.97±0.62	56.05±0.60	55.39±0.87	53.81±1.34	49.99±0.60	47.67±0.70	50.23±1.00
MCH (pg)	19.67±0.18	19.84±0.22	19.55±0.21	18.99±0.45	17.92±0.44	16.91±0.56	17.69±0.36
MCHC (%)	35.15±0.13	35.39±0.28	35.29±0.44	35.31±0.34	35.20±0.55	35.47±0.82	35.41±0.46
TSP (g%)	4.16±0.07	5.05±0.09	5.25±0.08*	5.50±0.09*	5.66±0.11*	5.49±0.08*	5.21±0.08*
Lymphocyte	6955.99±2.78	6969.04±2.13	7774.25±1.23	8619.56±0.61	8442.00±1.23	8066.50±0.93	7577.60±1.21
Monocyte	612.00±1.03	510.07±0.83	514.00±0.60	609.30±0.42	580.22±0.76	475.30±0.87	453.47±0.83
Neutrophil	3978.00±2.74	3729.54±0.84	4025.90±0.42	3835.88±0.55	3685.00±0.80	3812.75±0.67	3235.87±0.66
Eosinophil	692.78±0.66	568.97±1.04	534.56±0.98	473.90±0.22	691.44±0.79	454.20±0.42	571.87±0.47

*Significant ($p<0.05$) difference with the control, SE= Standard Error

Table 2: Effects of second plasma transfusion on various hematological parameters in calves (results presented as mean±SE)

Parameters	Pre-transfusion values (control)	Post-transfusion values					
		1 h	Day-1	Day-3	Day-7	Day-14	Day-21
TEC (million μL^{-1})	5.01±0.06	4.54±0.10	5.05±0.17	5.49±0.07*	6.16±0.10*	5.98±0.10*	5.61±0.11*
TLC (million μL^{-1})	11.84±0.33	11.69±0.53	12.51±0.40	12.96±0.34	11.99±0.20	12.24±0.47	12.30±0.11
Hb (g%)	8.86±0.14	8.46±0.09	8.70±0.12	9.46±0.11*	10.43±0.16*	10.26±0.14*	9.80±0.16*
PCV (%)	25.16±0.30	23.66±0.48	24.66±0.42	27.00±0.36*	28.66±0.33*	28.66±0.42*	27.16±0.30*
MCV (fl)	50.23±1.00	51.87±1.62	50.56±1.24	49.20±0.77	48.25±2.27	47.99±1.04	48.33±0.98
MCH (pg)	17.69±0.36	18.68±0.50	17.83±0.38	17.24±0.21	16.89±0.24	17.14±0.25	17.42±0.31
MCHC (%)	35.41±0.46	35.83±0.42	35.28±0.38	35.07±0.36	36.28±0.55	35.83±0.51	36.07±0.44
TSP (g%)	5.21±0.08	5.85±0.09	6.01±0.10*	6.33±0.13*	6.38±0.14*	6.38±0.09*	6.16±0.12*
Lymphocyte	7577.60±1.21	7578.62±1.70	8506.80±1.39	8898.33±0.88	8333.05±0.84	8526.38±0.76	8506.68±0.79
Monocyte	453.47±0.83	506.17±0.84	416.58±0.61	409.53±0.83	419.65±0.71	428.40±0.80	28659.0±0.42
Neutrophil	3235.87±0.66	3175.00±1.24	3252.60±0.68	3260.73±1.01	2877.60±1.06	2977.99±0.55	3136.50±1.05
Eosinophil	571.87±0.47	427.85±0.55	332.760.71	388.80±0.44	378.88±0.30	306.00±0.42	369.00±0.36

*Significant ($p<0.05$) difference with the control, SE = Standard Error

Table 3: Effects of plasma transfusion on various clinical parameters in calves (results presented as mean±SE)

Parameters	Pre-transfusion values (control)	Values during transfusion				1 h transfusion
		5 min	10 min	15 min	20 min	
Heart rate	70.11±0.81	75.77±0.99	74.88±0.93	74.33±0.90	72.44±0.75	69.55±0.75
Respiration rate	27.77±0.58	32.22±0.60	32.66±0.62	31.66±0.54	30.44±0.54	28.55±0.38
Rectal temperature	101.98±0.05	10198±0.04	102.01±0.04	102.11±0.06	102.14±0.06	102.03±0.03

SE: Standard Error

of circulatory overload include a dry cough, vomiting, dyspnea, urticaria and eventual possibility of developing pulmonary edema[10]. In this experiment, plasma was transfused to the recipient calves in standing position. The incompatibility reactions in the recipients in standing position are easily visible than that in the casting position[11-13].

The initial decrease in TEC, Hb and PCV immediately after transfusion might be due to a mild hemodilution after transfusion of plasma as plasma does not contains the cellular elements[8]. Another thing is that the vessel permeability may also be increased to accommodate the volume or the tissue perfusion may also be increased. The increase of TEC values thereafter may be associated with stimulation of erythropoiesis after plasma transfusion. The sudden expansion and dilution in the blood volume and the erythropoietin content of the transfused plasma may stimulate erythropoiesis in the recipient calves[14]. The plasma also contains the proteins and mineral elements required for erythropoiesis. The increase in the Hb and PCV is associated with the increase in the TEC. The values of TSP were observed to be increased 1 day after transfusion. The donor's plasma was rich in plasma proteins and this in turn bring about a rise of TSP values in the recipient calves after transfusion[8,11]. Plasma transfusion in calves appeared to improve hematological parameters and thereby might play a significant role in controlling anemia. It may also be an effective tool to promote calf health and control calf mortality.

ACKNOWLEDGMENT

The authors would like to thank the Ministry of Science and Technology, Government of the People's Republic of Bangladesh for financing the research.

REFERENCES

1. Howard, A., B. Callan, M. Sweney and U. Giger, 1992. Transfusion practices and cost in dog. J. Am. Vet. Med. Assoc., 201: 1697-1701.
2. Kirby, R., 1995. Transfusion therapy in emergency and critical care medicine. Vet. Clin. North. Am. Small Anim. Pract., 25: 1365-1386.
3. Schalm, O.W., N.C. Jain and E.J. Carroll, 1975. Veterinary Haematology. 3rd Edn., Lea and Febiger, Philadelphia, pp: 1-50, 602-636.
4. Ciaravino, V., T. McCullough, G. Cimino and T. Sullivan, 2003. Preclinical safety profile of plasma prepared using the intercept blood system. Vox Sanguinis, 85: 171-182.
5. Kerl, M.E. and A.E. Hohenhaus, 1993. Packed red blood cell transfusion in dog: 131 cases. J. Am. Vet. Med. Assoc., 202: 1495-1499.
6. Logan, J.C., M.B. Callan, K. Drew, K. Marryott, D.A. Oakley, L. Jefferies and U. Giger, 2001. Clinical indications for use of fresh frozen plasma in dogs: 74 dogs (October through December 1999). J. Am. Vet. Med. Assoc., 218: 1449-1455.
7. Turgut, K., A. Basglu, M. Sevinc, I. Sen and M. Yildiz, 1998. Plasma transfusion in calves with failure of passive colostral transfer. Turk. Vet. Hayv. Derg., 22: 123-130.
8. Srivastova, N.K. and N.N. Pandey, 1992. Biomedical responses to plasma transfusion in anemic calves. Indian Vet. J., 69: 601-604.
9. Thompson, M.F., J.C. Scott-Moncrieff and M.B. Brooks, 2004. Effect of a single plasma transfusion on thromboembolism in 13 dogs with primary immune-mediated hemolytic anemia. J. Am. Anim. Hosp. Assoc., 40: 446-454.
10. Hunt, E. and B. Wood, 1999. Use of blood and blood products. Vet. Clin. North Am. Food Anim. Pract., 15: 641-662.
11. Durham, A.E., 1996. Blood and plasma transfusion in the horse. Equine Vet. Edu., 8: 8-12.
12. Fecteau, G. and M. Palmer, 1996. Use of plasma transfusion in the bovine neonate. LeMed. Vet. du Quebec, 26: 73-76.
13. Sand, G. and G. Nyman, 1986. Plasma bank for horses. Svensk Vet., 38: 411-414.
14. Swenson, M.J., 1977. Dukes' Physiology of Domestic Animals. 9th Edn., Comstock Publishing Association: A Division of Cornell University Press, Ithaca and London, pp: 14-35.