HAEMATOLOGICAL AND VITAL SIGNS EVALUATION AND MONITORING OF BLOOD TRANSFUSION THERAPY IN ANAEMIC AND DONOR DOGS OF BASRAH PROVINCE

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ABSTRACT

The present study was conducted at College of Veterinary Medicine, University of Basrah by screening of 30 adult male dogs with weight range 10.3- 12.6 Kg and ages ranged 3-6 years old. The hematological status of dogs was evaluated to separate anaemic dogs (recipients n=6) and other healthy dogs (donors n=6). Blood group types test was done for the donor and recipient dogs using commercial agglutination-based reaction (CARD) test procedure. Cross match test (major and minor) was done to determine the presence of recipients' antibodies against donor antigens. Blood group typing test for the donors' dogs,referred to dog erythrocyte antigen (DEA 1.1) was positive, cross match test (major and minor) showed no agglutination and this was ensured by microscopic examination. Evaluation and monitoring of donor dogs after blood infusion revealed significant decrease in RBC, PCV and HB during 24 hours after donation of blood to recipients and gradually recovery for the normal values after 72 hours of infusion. While recipient dogs showed improvement in their blood components values after 24 hours of infusion and then gradually declined to subnormal values for RBC, PCV and HB. The comparison between donors and recipient dogs along 72 hours of blood transfusion revealed a significant difference between the two groups in values of blood components. However, the 48 and the 72 hours results showed decrease in recipients' blood component values compare to donors group.The mean of dogs' temperature, respiratory and pulse rate showed significant ($p<0.05$) increase in recipient dogs before and after blood transfusion (24 hours) when compared to donor dogs in the same period. Whereas,vital signs disappeared between the studied groups of dogs after 48-72 hours of infusion.

***Key words*:** Blood transfusion, donor and recipient dogs, blood components

Introduction

Anaemia is a common condition in dogs which is caused primarily by blood loss, hemolysis, or decreased erythropoiesis (Proulx and Waddell, 2012), during which the number of red blood cells or their oxygen carrying capacity is insufficient to meet physiologic needs (Cunningham, 2002). Anaemia leads to insufficient oxygen delivery to vital organs, and subsequent decrease in aerobic metabolism, energy production, and tissues function (Schaer and Gaschen, 2016). There are evidences of an increase in anaemia cases among local dogs' breeds (Stray Dogs) of Basrah province that is probably attributed to trauma or injury to blood vessels, heavy infestation of blood parasites, and tumors and/or other nutritional deficiencies (Hantoosh and Saleem, 2018).

Blood transfusion has become more prominent tool in veterinary medicine for different reasons such as acute blood loss, parasite infestation, and emergency therapy (Jenny, 2014). Despite the increase of using whole blood transfusion in supporting of anaemic dogs among veterinarians, there are some concerns in regards to donors' health, recipients' side effect, blood component, storage, and transmitting infections (Roux *et al.,* 2008). The whole blood includes all blood components such as RBC, WBC, platelets, albumin and all coagulation factors (Chiaramonte, 2004). In case of acute or chronic anaemia, transfusion of whole blood is critical for the veterinarians to reduce mortality among animals. To ensure appropriate blood transfusion for animals, there are several protocols that praise the group typing and cross matching procedures to reduce the risk of cross reactions and to obtain a great benefit from the process of transfusion. Nonetheless, the effect of transfusion on donors' or recipients' blood components and vital signs of body organs need more investigation. Especially in Iraq, the process of blood transfusion to dogs suffering from anaemia is considered to be a very recent procedure among veterinarians, who lack the facilities and equipment to separate blood components and transfer them to the patients. Therefore, whole blood transfusion procedure is an urgent necessity for the practicing veterinarian in Iraq who started to perform all forms of medical interventions in small and large animals.

The present study was designed to evaluate the effect of whole blood transfusion in the anaemic dogs and monitor changes on the donor and recipient dogs' blood components in addition to vital signs of body organs.

Materials and Methods

This study was conducted at College of Veterinary Medicine, University of Basrah, by screening of 30 adult male dogs with weight range 10.3- 12.6 kg and ages ranged 3-6 years old which had been obtained from Karmatali area, Basrah governorate. The haematological status of dogs was evaluated by using auto-analyzer haematology device (Genex Laboratories, count 60) to separate anaemic dogs (recipients n=6) and other healthy dogs (donors n=6). Blood group types test was done for the donor and recipient dogs using commercial agglutination-based reaction (CARD) test procedure (DMS laboratories, Flemington, NJ). One drop of buffered saline was added to the dried reagent on the card and one drop EDTA- anticoagulated whole blood was added

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and mixed by rotating the card. The presence of macroscopic agglutination indicated which blood type is present in response to Dog Erythrocyte Antigens DEA 1.1 reaction with the used monoclonal antibody (Giger, 2000). Cross match test (major and minor) was done to determine the presence of agglutinating and/or hemolytic antibodies in the recipients against donors' antigens(Brown and Vap, 2006). Blood transfusion was done according to Abrams-ogg (2000) by direct infusion of blood to the recipient dogs. The volume of the administered blood was calculated by using recommended whole blood dosage (20 ml/kg) to increase PCV 10%) (Thrall *et al.,* 2012). Hematological indices (RBC, PCV, Hb, PLT, WBC, rectal temperature, pulse and respiratory rate were recorded and monitored throughout 72 hours after transfusion process. The statistical analysis was applied by one-way ANOVA and the mean differences were significant at the level of P<0.05 using statistical package for social science SPSS program.

Results and Discussion

Blood group typing test for the donors' dogs referred to DEA 1.1 positive, cross match test (major and minor) showed no agglutination and this was confirmed by microscopic examination.

Blood component parameters in donor dogs before and after transfusion for 3 days is represented by Table 1. The table revealed significantly higher values (p<0.05) for RBC, PCV and Hb in donor dogs before blood transfusion compared to the same animal after transfusion. There was a drop in blood components during 24 hours after transfusion. However, they showed drifting to become more closely to the values of blood component before infusion.

This table also showed a non-significant (p<0.05) effect in donor dogs on platelets and total WBC count throughout 72 hours after transfusion compared to animals before blood transfusion. However, slight elevation in WBC values for the 24 and 48 hours of transfusion was noticed.

Values of blood components of recipient dogs were monitored and showed a significant (p<0.05) elevation of RBC,PCV and HB values after 24 hours of blood transfusion compared to the values before transfusion, Table 2. Whereas, during the 48 and 72 hours period after transfusion a significant (p<0.05) decline in RBC, PCV and Hb have been noticed but still significantly higher (p<0.05) than the period before transfusion. In contrast, platelets and total WBC count had no significant change during the period after the transfusion.

When compared, values of blood components between the donor and recipient dogs, before blood transfusion process, (as listed in Table 3), there was a significant difference (p<0.05) in RBC, PCV and Hb values. While after 24 hours of blood transfusion the RBC and PCV showed non-significant (p<0.05) changes. However, the Hb values were significant between donor and recipient dogs. The 48 and 72 hours periods of blood transfusion process showed regression in RBC and Hb values of recipient dogs when compared with donor dogs that showed significant (p<0.05) elevation in their values. Whereas, the platelets and total WBC count showed non-significant (p<0.05) differences between donor and recipient dogs throughout the period of study.

The mean of dogs' temperature, respiratory rate and pulse rate are illustrated in Table 4. The results revealed a significant (p<0.05) increase in temperature, respiratory and pulse rate of recipient dogs before and during blood transfusion when compared to donor dogs in the same period. While after days of blood transfusion the significance of difference (p<0.05) for all of vital signs disappeared between the studied groups of dogs.

The results of the present study revealed a positive DEA 1.1 group type for all the studied dogs, this means no alloantibodies against RBC antigen would develop in the future. Mismatch of group types in dogs after receiving blood could induce alloantibodies which could produce acute hemolytic transfusion in case of repeated transfusion (Giger, 2000). These results agree with cross match test results that showed no agglutination for RBC of recipient and serum of donor and vice versa (major and minor) which considered as approval for blood transfusion (Thrall *et al.,* 2012).

Blood transfusion was done immediately after collecting blood from donors. The volume of blood was estimated as described by Thrall *et al.(*2012) and the mean was reported to

Table 1: Blood component values for donor dogs before and after donation of blood.

Period	RBC x10³/µl	PCV %	Hb g\dl	PLT x10³/µl	WBC x10³/µl
Donor dogs before transfusion	7.13 ±0.78A	55.9±3.89A	15.83±0.92A	153.6±10.41	5.9±0.84
After 24 hrs. of transfusion	6.00±0.58B	43.30 ±2.06B	13.96±1.21B	161.13±15.88	7.43±0.87
After 48 hrs. of transfusion	6.80±0.67B	44.86±3.46B	14.3±0.85B	162.06±13.66	7.27±0.91
After 72hrs. of transfusion	7.06 ±0.80 B	46.7±3.05 B	14.87±1.64 B	159±11.35	6.43±1.25

Capital letter referred to a significant difference at (p< 0.05).

Table 2: Blood component of recipient dogs before and after blood transfusion

Period	RBC x10³/µl	PCV %	Hb g\dl	PLT x10³/µl	WBC x10³/µl
Anemic dogs before transfusion	4.0 ± 0.66C	36.97±2.46C	10.67±1.12C	153.63 ±16.83	6.30 ± 1.51
After 24 hrs.of transfusion	6.21± 0.82A	45.3 ± 3.87A	14.85±0.82A	157.3 ± 14.36	7.23 ± 1.05
After 48 hrs.of transfusion	6.06 ± 0.93AB	43.96± 2.0AB	13.77±0.76AB	159.53 ± 19.66	7.5 ± 0.96
After 72 hrs.of transfusion	5.16 ± 0.75B	41.03 ± 2.89B	13.13 ± 1.31B	154.1 ± 18.31	6.65 ± 1.11

Capital letter referred to a significant difference at (p<0.05).

Table 3: Comparison of blood component values between donor and recipient dogs before and after blood transfusion

Period	Dogs	RBC x10³/µl	PCV %	Hb g\dl	PLT x10³/µl	WBC x10³/µl
Dogs before transfusion	Donor	7.13 ±0.78*	55.9±3.89*	15.83±0.92*	153.6±10.41	5.9±0.84
	recipient	4.0 ± 0.66	36.97±2.46	10.67±1.12	153.63 ± 16.83	6.30±1.51
After 24 hrs. of transfusion	Donor	6.00±0.58	43.30 ±2.06	13.96±1.21	161.13±15.88	7.43±0.87
	recipient	6.21± 0.82	45 ± 3.87	14.85±0.82	157.3 ± 14.36	7.23 ±1.05
After 48hrs. of transfusion	Donor	6.80±0.67*	44.86±3.46	14.3±0.85*	162.06±13.66	7.27±0.91
	recipient	6.06 ± 0.93	43.96± 2.06	13.77±0.76	159.53 ±19.66	7.5±0.96
After 72hrs of transfusion	Donor	7.06 ± 0.80*	46.7±3.05	15.87±1.64*	159±11.35	6.43±1.25
	recipient	5.16 ± 0.75	41.03 ± 2.89	13.13±1.31	154.8±18.31	6.6.5±1.11

*Referred to significant values between donor and recipient dogs for the same period at (p<0.05).

Table 4: Vital signs of donor and recipient dogs before and after blood transfusion

Vital signs	Dogs	Initial read	During infusion	After 24 hrs infusion	After 48 hrs Infusion	After 72 hrs infusion
Rectal temp./˚C	Donor	36.8± 1.3	37.4± 2.5	37.5±2.3	37.2± 2.5	37.6± 1.4
	recipient	39.4±1.2*	39.6±2.4*	39.3±2.1	38.4± 3.6	37.8± 2.5
Resp. rate/min.	Donor	23.4±2.7	25.3± 3.4	25.3±2.8	24.7± 2.6	23.7± 2.3
	recipient	31.5± 2.0*	32.7±2.6*	27±2.4	25.4± 3.2	24.6± 2.8
Pulse rate/min	Donor	92.4±6.3	98.6± 7.3	95.9±5.6	94.4± 4.8	93.2± 5.3
	recipient	127±8.4 *	118±6.7 *	104±4.0*	97±3.5	95±4.6

*Referred to significant values between donor and recipient dogs for the same period at ($p<0.05$)

be around 200 ml to be administered to anaemic dogs when PCV is desired 45%. Therefore, donor dogs showed significant decrease in RBC, PCV and HB and full recovery after 72 hours of donation especially for haematocrit and haemoglobin concentration. In donors, transfusion one unit of whole blood could reduce blood components immediately (Ziegler *et al.,* 2015) and this means reduction in plasma volume which need 48 hours to be restored (Calbet *et al.,* 2006). Haematocrit and haemoglobin concentration take a long time to be restored and may persist for many weeks to return back for baseline values (Pottgiesser *et al.,* 2008). Foy *et al.* (2015) found lower hematocrit and reticulocyte count in blood donor dogs and then would affect on RBC count and haemoglobin concentration. The preparation and restraining of animals for blood collection led to increase in Platelets and total WBC count although the animals donated blood (Rui *et al.,* 2014) In the same study, it was reported that there was a significant increase in platelet and total WBC count values after blood donation. While the results of the present study showed non-significant increase in platelets and WBC count whether in donors and recipient dogs. This probably wasdue to the volume of blood donated was less than 10% of total blood volume and this did not affect their values. This may be due to the volume of blood donated or received were insensible for platelets and WBC count to changes in a significant value. A study of blood transfusion in dogs also reported non-significant differences between donor and recipients dogs and they attributed these results to depletion of platelets after storage for more than 6 hours (Luis *et al.,* 2011).

In anaemic dogs, surge was noted in all the blood components after blood transfusion and there were significant differences compared with animals before blood transfusion. This is probably due to increase in blood volume and its components in the circulation of animals and thus compensating the lost volume and the blood components. These results were also noted by (Lanevschi and Wardrop, 2001) when several blood components were needed and to restored oxygenation of tissuesof anemic dogs that had lost about 50% of its total blood volume. Anaemia could lead to reduction in RBC count in response to the destruction of circulating erythrocytes by auto antibodies that are directed against infected or mutilated red blood cells resulting in intravascular or extravascular haemolysis (Irwin, 2005). The reduction in RBC combined with the decline in haemoglobin and haematocrit levels depends on the causes of anaemia that animal suffered from (Vial and Gorenfelot, 2006).

The main causes of anaemia in local dogs of Basrah province were concluded by Hantoosh and Saleem (2018) study where he investigated 30 local dogs of Basrah province and found that causes of anaemia to be gastroenteritis (34%) and blood parasite (32%), whereas the remaining causes were attributed to an undefined cause.

As indicated in the results, the recipient dogs showed improvement in their blood components after the 24 hours of blood transfusion, but their components return to decline again after the 48 and 72 hours of blood transfusion.The concepts above may explain the decline of RBC count, PCV and haemoglobin values in recipients dogs after 72 hours of blood transfusion compared with 24 hours for the same animals. In addition to chronic diseases or long-term nutrients deficiencymay also led to long or slow recovery from anaemia (Chaudhuri *et al.,* 2008). Wiciński *et al. (*2020) indicated the effect of chronic diseases on anaemia induction by decreasing hematocrit, Hb and RBC count. Therefore, severity of anaemia has been linked to the intensity of these diseases like chronic inflammation, autoimmune diseases, cancer, and renal failure. In addition, nutrients like iron deficiency (the main cause of anaemia), folate and vitamin B12 deficiencies and low vitamin C intake are common causes of anaemia in dogs. Thus, the recovery from anaemia might be a complex process and may need long time if the primary causes are not treated (Dinaz *et al.,* 2012). These consequences agree with the present study when comparing blood components between donor and anemic dogs through the study periods, which indicated the reduction of blood components of recipient dogs after the 48 and 72 hours of transfusion process than donors values.

The increase in temperature, respiratory rate, and pulse rate of anemic dogs was correlated with oxygen demands due to less RBC and Hb values that reduced volume of circulating oxygen around the body tissues and cells. As a compensatory mechanism, heart rate and respiratory rate increase following anaemia (Kisielewicz *et al.,* 2014).

Anaemic animals for short- or long-termshow impairment in the oxygen carrying capacity and could produce a state of hypoxia (Carson and Hébert, 2009). The oxygen requirement of vital organs of the body act as a stimulation factor for the sympathetic innervation and epinephrine secretion to increases respiratory, pulse rate and cardiac output (Weiss *et al*., 2010). After the causes of anaemia were removed by whole blood transfusion in this study, blood volume restored its capacity to carry oxygen and hence re-established normal pulse and heart rate.

Conclusion

Evaluation and monitoring of blood components for donor and recipient dogs during 72 hours of blood transfusion highlighted the need of donors for 72 hours to recover blood components to its baseline values. In contrast, recipient dogs need additional time and to remove the causes of anaemia to avoid regression and collapse of blood components values.

References

Abrams-ogg A (2000) Practical Blood Transfusion. In: Day MJ *et al.* (Eds), BSAVA Manual of canine and feline haematology and transfusion medicine, Gloucester,U.K.: British Small Animal Veterinary Association. pp. 263-307.

Brown Diane and Vap Linda (2006) Principle of blood transfusion and cross matching. Chapter 15. Veterinary Hematology and Clinical Chemistry,Blackwell Publishing. pp. 197-211.

Calbet JA, Lundby C, Koskolou M and Boushel R (2006) Importance of haemoglobin concentration to exercise: acute manipulations. *Resp. Physiol. Neurobiol*. **151**(2-3):132-40.

Carson JL and Hébert P (2009) Anaemia and Red Blood Cell Transfusion. In: Simon TL *et al*. (Eds), Rossi's principles of transfusion medicine, Oxford: Wiley-Blackwell, pp. 131-148.

Chaudhuri S, Varshney JP and Patra RC (2008) Erythrocytic antioxidant defense, lipid peroxides level and blood iron, zinc and copper concentrations in dogs naturally infected with *Babesia gibsoni*. *Res. Vet. Sci.* **85**(1): 120-124.

Chiaramonte D (2004) Blood-component therapy: selection, administration and monitoring. *Clin. Tech. Small Anim.Pract.***19**: 63-67.

Cunningham JG (2002) Textbook of Veterinary Physiology. 3rd ed. Sanders, U.S.A. p.575.

Dinaz Z Naigamwalla, Jinelle A Webb and Urs Giger (2012) Iron deficiency anaemia. *Can. Vet J*. **53**(3): 250-256.

Foy DS, Friedrichs KR and Bach JF (2015) Evaluation of iron deficiency using reticulocyte indices in dogs enrolled in a blood donor program. *J. Vet. Intern. Med*. B:1376-1380.

Giger U (2000) Blood typing and cross matching to ensure compatible transfusions. In: Bonagura JD, ed. Kirk's current veterinary therapy 13th ed. Philadelphia: WB Saunders Co, pp. 396-399.

Hantoosh and Sinan Saleem (2018) Prevalence of anaemia in dog of Basrah Province High Diploma study, department of Internal and Preventive Medicine/College of Veterinary Medicine-University of Basrah.

Irwin PJ (2005) Babesiosis and Cytauxzoonsis. Arthropode-Borne Infectious Diseases of Dogs and Cats, Manson Publishing Ltd., Barcelona, Spain, 1st ed. 63-72.

Jenny Helm (2014)Canine and feline blood transfusion in practice. *Vet. Ireland J.* **4**(10): 525-529.

Kisielewicz C, Self I and Bell R (2014) Assessment of clinical and laboratory variables as a guide to packed red blood cell transfusion of euvolemic anemic dogs. *J. Vet. Intern. Med.* **28**(2): 576-582.Published online 2014 Jan 13. doi: 10.1111/jvim.12280.

Lanevschi A and Wardrop KJ (2001) Principles of transfusion medicine in small animals. *Can. Vet. J.***42**: 447.

Luís F Godinho-Cunha, Rui mRF Ferreira and Ana C Silvestre-Ferreira (2011) Whole blood transfusion in small animals: indications and effects. *Anais da Academia Brasileira de Ciências*. **83**(2): 611-617.

Pottgiesser T, Specker W, Umhau M, Dickhuth HH, Roecker K and Schumacher YO (2008) Recovery of haemoglobin mass after blood donation. *Transfusion*. **48**(7):1390-7.

Roux FA, Deschamps JY, Blais MC, Welsh DM, Delaforcade-Buress AM and Rozanski EA (2008) Multiple red cell transfusions in 27 cats (2003-2006): indications, complications and outcomes. *J. Feline Med. Surg.***10**: 213-218.

Rui RF Ferreira, Rafael R Gopegui, Maria Manuela RC Araujo and Augusto JF de Matos (2014) Effects of repeat blood donations on iron status and haematologic variables of canine blood donors. *J. Am. Vet. Med. Assoc.* **244**(11):1298-303.

Schaer M and Gaschen FP (2016) Clinical Medicine of the Dog and Cat. 3rd ed. CRC Press. p.1160.

Thrall MA, Weiser G, Allison R and Campbell T (2012) Veterinary hematology and clinical chemistry. John Wiley & Sons. Balckwell Publishing.

Vial HJ and Gorenflot A (2006) Chemotherapy against babesiosis. *Vet. Parasitol*.**138**: 147-160.

Weiss DJ, Wardop K and Schalm OW (2010) Schalms veterinary haematology, Iowa, Wiley-Blakwell.

Wiciñski Michal, Liczner Grzegorz, Cadelski Karol, Kolnierzak Tadeusz, Nowaczewska Magdalena and Malinowski Bartosz (2020) Anaemia of Chronic Diseases: Wider Diagnostics-Better Treatment? *Nutrients*. **12**(6): 1784.

Ziegler AK, Grand J, Stangerup I, Nielsen HJ, Dela F, Magnussen K and Helge JW (2015) Time course for the recovery of physical performance, blood hemoglobin, and ferritin content after blood donation. *Transfusion*. **55**(4):898-905.