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HAEMATOLOGICAL VARIATIONS BEFORE AND AFTER BLOOD TRANSFUSION IN ARABIAN RACING CAMELS (*Camelus dromedarius*)

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ABSTRACT

In this experiment, a haematological comparison has been done before and after whole blood transfusion in 5 racing camels (2 years old). The donated blood withdrawn from only one camel to fix the other variation factor from different blood from different donor camels. The variation was clear in some haematological parameters like red blood cells (RBC), haemoglobin (Hb), haematocrit (HCT), platelets (PLT). The reticulocytes count showed significant steady changes and could rely on this value as an indicator of blood transfusion in Arabian racing camels according to the results of this experiment and many other individual cases outside this experiment. The leukocytes and differential leukocyte percentages did not showed significant changes after blood transfusion. The immunological reactions against antigens on red blood cells of donor camel determine the variation in haematological changes after blood transfusion. However, the immunological reaction becomes with limited values especially in the first time of blood transfusion.

Key words: Blood transfusion, camel haematology, clinical pathology, racing camel

Fresh whole blood transfusion in livestock animals is indicated for the treatment of diseases associated with blood loss (Hunt and Wood, 1999; Divers, 2005). Whole blood transfusion becomes well known practice of camel racing in all Gulf countries last decade.

The benefits of blood transfusions are typically considered short term (Schnappauf *et al,* 1965; Kallfelz and Whitlock, 1973; Kallfelz *et al,* 1978). For example, bovine RBCs labeled with 59Fe decreased to 25% of their original concentration only 4 days after transfusion. After a second transfusion, 75% of the RBCs administered were absent within 30 minutes of administration (Kallfelz and Whitlock, 1973).

Blood transfusion is not always safe and reactions can occur due to improper compatibility, poor storage or faulty administration. In general immediate reactions occur within 2-4 hours post transfusions and delayed reactions may take days to weeks or even months (Sharma *et al,* 2000).

First blood transfusion has no untoward effect in cattle. But second or third transfusions may cause anaphylactic shock in animals (Chakrabarti, 2016). Delayed reactions can occur days to weeks after the administration of blood products. These reactions typically involve haemolysis caused by the formation of antibodies to RBC antigens and occur 3–5 days after transfusion (Hart, 2011). A retrospective study in foals with neonatal isoerythrolysis found that foals treated with more than 4 L of blood products were 19.5 times more likely to develop liver failure than those treated with a lower volume (Polkes *et al,* 2008).

Evaluation of the blood parameters are necessary before blood transfusion, packed cell volume (PCV) (≤ 15-20%) (Hunt *et al,* 1990; Hunt and Wood, 1999; Divers, 2005; Balcomb and Foster 2014) and haemoglobin concentration (Hb)(≤ 7g/dl) (Hebert *et al,* 2011) considered as a strong indication for blood transfusion. Whole blood transfusion is required in horses if packed cell volume (PCV) is less than 12%, haemoglobin concentration less than 8 g/dl, traumatic injury, haemophilia or a heavy infestation of Strongylus (Shatanu *et al,* 2019).

Present study was therefore done to evaluate the haematological parameters of Arabian racing camel before and after the blood transfusion.

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Materials and Methods

This Before-After study (Stewart-Oaten and Bence, 2001) was done in barns close to racing track in Dubai Emirate in UAE in 2020.

1. Donor camel:

Apparent healthy non-racing adult camel (average: 500 kg bw) was used as a donor camel to collect 4.5L blood without complications or health problem after blood collection.

2. Recipient Camels:

Five Arabian racing camels (*Camelus dromedarius*) around 2 years old kept in one camel barn, 2 km away from Camula Veterinary Laboratory in Marmoum, Dubai, UAE. Five ml of blood collected from Jugular vein in EDTA test tube from each camel, soon before blood transfusion. The total 5 test tubes were preserved immediately in ice box and were sent directly to the lab.

After two days from blood transfusion, 5 ml of blood collected from Jugular vein on EDTA test tube and it was sent directly to the lab for testing. The camels did not receive any medications or feed supplements during the two days.

3. Blood collection:

The process of collection and transfusion had been done within short time soon after blood collection.

3.1. Blood collection kit.

Plastic blood bags (450ml) containing CPDA (Mitra Industries Ltd. India).

3.2. Blood collection from the donor camels (Whole blood)

Blood was collected from the jugular vein of donor camel using 16G needle and blood collecting kit (450 ml). Ten bags were collected from donor camel. Donated blood preserved in isolated box

4. Blood transfusion process:

At the time of blood collection for the transfusion process a complete aseptic procedures were adopted. Blood was maintained at 37°C before transfusion. Blood was transfused intravenously through I/V filtering sets. Each camel received 2 bags (900 ml).

5. Blood Samples and Haematological tests

Total 10 blood samples, i.e. 5 samples immediately before blood transfusion and 5 samples after 2 days of blood transfusion were subjected to the haematological analysis by Advia®2120i haematology analyser (Semins Company, Germany). The blood samples were analysed for red blood cells (RBCs), haemoglobin (Hb), packed cell volume (PCV), mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC), reticulocyte deviation width (RDW), reticulocyte per cent (Retic. %), reticulocyte number (Retic. No.), platelets (PLT), mean platelet volume (MPV), platelets deviation width (PDW), plateletcrite (PTC), mean platelet concentration (MPC), white blood cells (WBCs), neutrophil % (Neut. %), lymphocyte % (Lymph. %), monocyte % (Mono. %), eosinophil % (Eos. %), basophil % (Baso. %).

6. Statistical Analysis

The obtained results of 5 camels were collected in excel sheet (Microsoft Office 10). The data was analysed using a statistical software programme (SPSS, version 16, USA). Paired sample repeated measure ANOVA was used to express means and standerd deviation and to evaluate for significant differences ($P < 0.05$) between before and after sample.

Results and Discussion

The changes in haematological parameter after blood transfusion were controlled by multiple factors including the volume of donated blood, which was represented by the equation:

Total Volume (TV) (Donated Blood) = Volume of Distribution of Blood (VDB) (Total circulating blood) x Body Weight (BW) kg x (Desired Packed Cell Volume (PCV) % - Recipient (PCV) % / Donor (PCV) % (Luethy *et al,* 2017).

Other factor like duration after blood transfusion plays an important role in the haematological changes. In this experiment, other factors were fixed (Donated blood from one donor camel, duration after transfusion (two days), avoiding using any medications or supplements).

Blood volume in camels is 93 ml per kg of body weight (Djegham and Belhadj, 1986), which is a higher value than that observed in most other domestic species. The stock blood volume must increase as we add 900 ml to the total volume.

There was no clinical finding after blood transfusion of all recipient racing camels within two days monitoring till collecting blood samples for testing the haematological parameters.

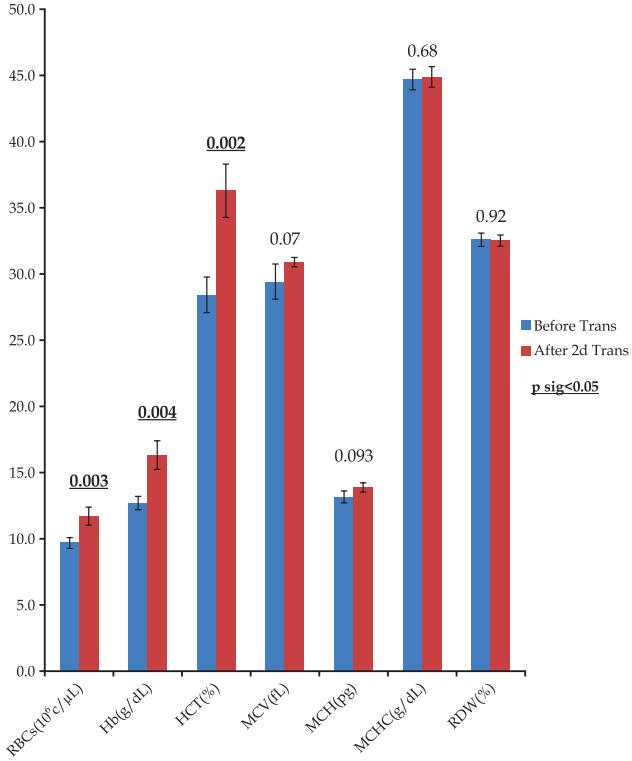

Fig 1. Haematological parameters (RBCs)—Comparison before blood transfusion and after 2 days in camels under the study.

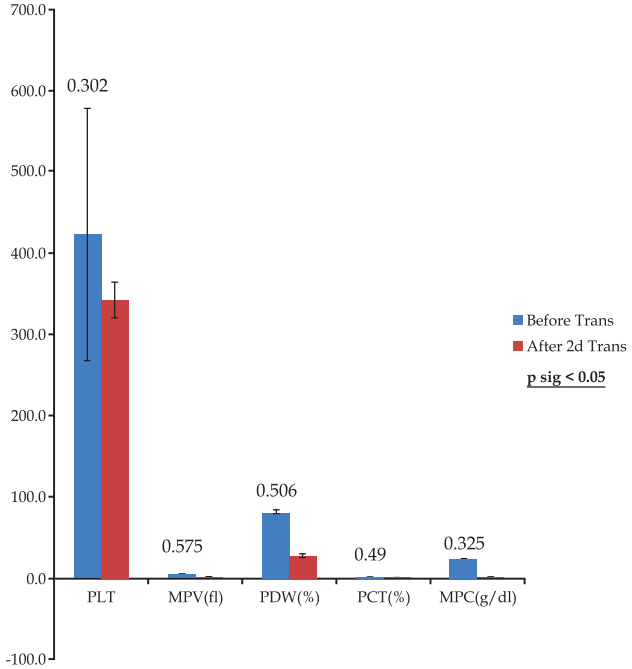

Fig 3. Haematological parameters (platelets)—Comparison before blood transfusion and after 2 days in camels under the study.

Our findings was astonishing, it demonstrated that the significant changes were clear obviously in the RBCs, Hb, HCT, Plt and reticulocytes (Tables 1, 2 and 3).

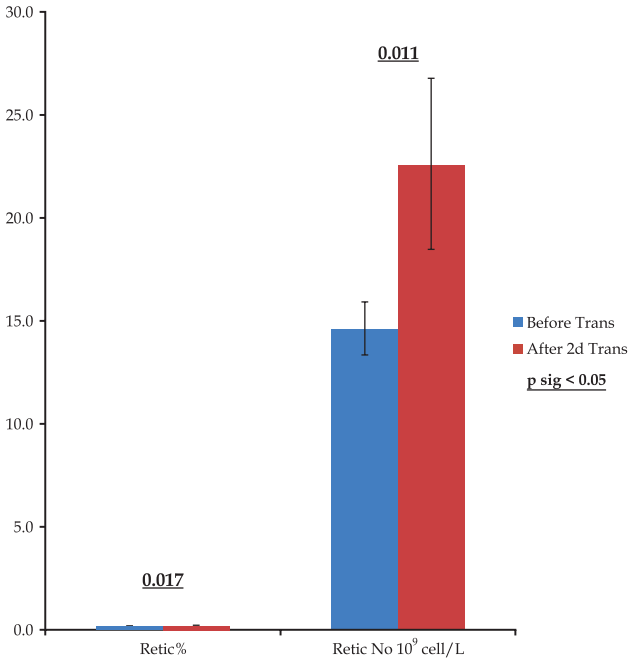

Fig 2. Haematological parameters (Reticulocytes)—Comparison before blood transfusion and after 2 days in camels under the study.

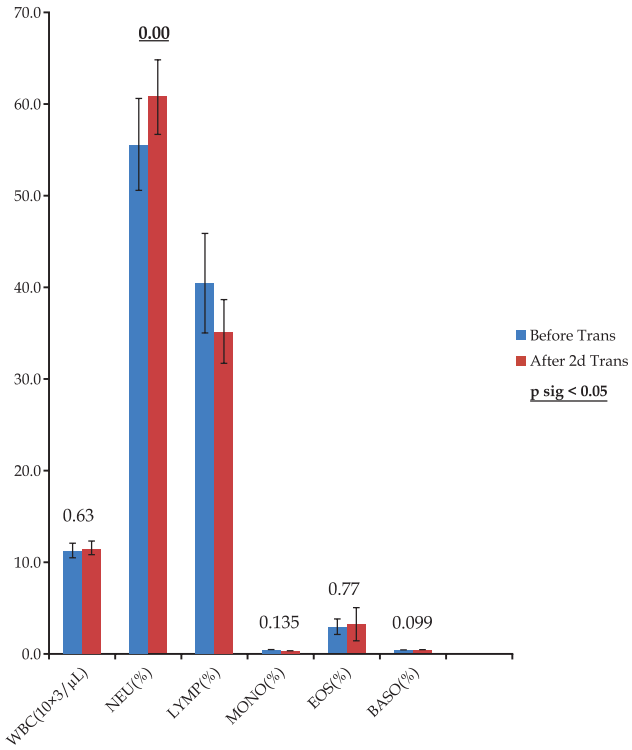

Fig 4. Haematological parameters (WBCs)—Comparison before blood transfusion and after 2 days in camels under the study.

It was impressive that the number of red blood cells RBCs showed clear and significant increase from 9.7 to 11.7 (10^6/µL) (Table 1), with average percent 20.6% (P-value 0.003) (Fig 1) The increase of RBC

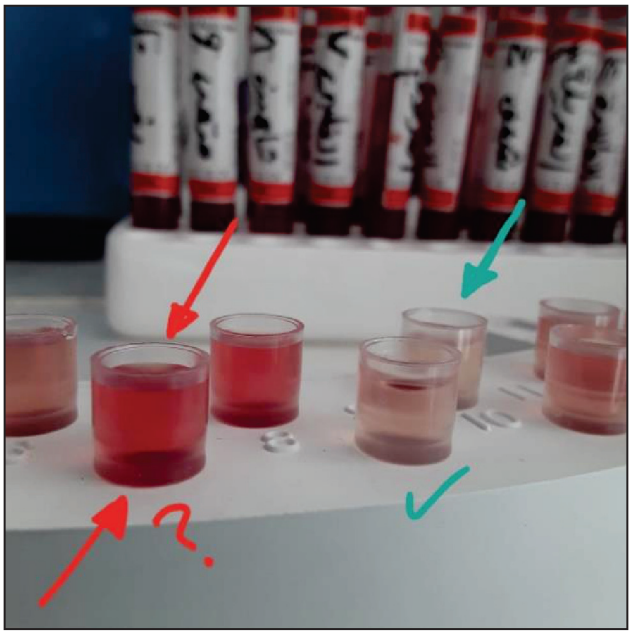

Fig 5. The image shows the difference in colour between the serum from different blood samples.

sometimes do not remain stable for long time because of short lifespan (Kallfelz and Whitlock, 1973) as the intravascular haemolysis lead to gradual decrease the total number of RBC, which was obviously clear in the colour of serum of blood samples coming from recipient Camels as shown (Fig 5), the image shows the difference in colour between the serum from different blood samples of recipient camels.

Table 1. Haematological parameters comparison before blood transfusion and after 2 days in camels under the study.

Parameter	Unit	Average Normal	Before Transfusion	After Transfusion	P-Value
RBCs	10^6c/µL	7 – 10	9.7 ± 0.43	11.7 ± 0.68	0.003
Hb	g/dL	10 – 15	12.7 ± 0.49	16.3 ± 1.1	0.004
HCT	%	25 – 33	28.4 ± 1.36	36.3 ± 2.04	0.002
MCV	fL	26 – 35	29.4 ± 1.32	30.9 ± 0.33	0.07
MCH	pg	12 – 17	13.1 ± 0.46	13.9 ± 0.34	0.093
MCHC	g/dL	40 – 50	44.7 ± 0.75	44.9 ± 0.82	0.68
RDW	%	30 – 33	32.6 ± 0.5	32.6 ± 0.42	0.92

Another cases in our study showed very high increase in all parameters related to RBCs. Additionally, the HCT percentage exceeded 45%. The trials failed to decrease the RBCs parameters and these remained within optimum range by using the fluid therapy and oral electrolytes to overcome the haemo-concentration. The response of immune system of recipient camel to the antigens on the surface of RBCs of donated blood determined the haematological values after blood transfusion.

Regarding HCT, our results showed significant increase from 28.4± 1.36% to 36.3± 2.04% (Table 1) which way around 28% more than the increased values in RBCs, because of increased values in the MCV, the changes in MCV probably related to the osmolarity changes of the blood related to dehydration (haemo-concentration) and rehydration (Yagil *et al*, 1974). Haemoglobin values recorded significant increase (exceeded 28%, P-value 0.004) (Fig 1), which may be related to intravascular haemolysis and this interfere with photometric method of Hb calculation by the analyser (Mezzou *et al*, 2006).

Concerning the immature RBCs, our data demonstrated significant changes in reticulocytes number and percentage and the changes were steady for long time after blood transfusion (Table 2); (Fig 2). Reticulocytes may provide useful information as they are present in the case of regenerative anaemia. Raisinghani *et al* (1981) observed no reticulocytes in healthy animals. However, in animals inoculated with *Trypanosoma evansi*, the reticulocyte rate may reach 6% after 88 days of infestation (Raisinghani *et al*, 1981) and even more than 11% in some cases (Jhatkar and Purohit, 1971). The trypanosomiasis is accompanied by hyperplasia of the bone marrow (Raisinghani *et al*, 1981), in consequence of the above-mentioned intravascular haemolysis, which explains the appearance of immature red blood cells in the peripheral circulation (Jhatkar and Purohit, 1971). The average total number of reticulocyte is (14.6±1.29) $\times 10^9$ cell/L in normal condition before blood transfusion, the total number increased in all camels in this experiment and many other individual cases exceed 20× 10^9 cell/L (Table 2). The increase in the total number of reticulocytes remains steady for long time and this could be used as indicator to the racing camels which received donated blood.

Table 2. Haematological parameters (Reticulocytes) – Comparison before blood transfusion and after 2 days in camels under the study.

Parameter	Unit	Average Normal	Before Transfusion	After Transfusion	P-Value
Retic	%	0 – 0.7*	0.15 ± 0.01	0.2 ± 0.03	0.017
Retic. No	10^9 cell/L	NA	14.6 ± 1.29	22.6 ± 4.17	0.011

* (Higgins and Kock, 1984)

Platelets count decreased significantly (thrombocytopenia) from (424 ± 156) to (342 ± 22)

cells x10^3/µL (Table 3) around 19% (P-value 0.302) (Fig 3) due to coagulation factors (Sharma *et al,* 2000). However, we can't judge this fact without monitoring for long time. The changes on PLT count usually vary according to the immunological reaction after blood transfusion. There is direct proportional between the intravascular haemolysis and platelets count at beginning due to adaptation of bone marrow to stop the RBCs loss, later on change to inverse proportion because of depletion of platelets related to intravascular coagulation and exhaustion of bone marrow production of new platelets (Satue *et al,* 2017). The other platelets parameters did not show significant changes (Table 3; Fig 3).

Table 3. Haematological parameters 9 (platelets)_Comparison before blood transfusion and after 2 days in camels under the study.

Parameter	Unit	Average Normal	Before Transfusion	After Transfusion	P-Value
PLT	10^3 cell/µL	150 – 500	424 ± 156	342 ± 22	0.302

On the other hand, our findings showed no significant differences in the leukocytes and its deferential cell percentages (Table 4; Fig 4). as we mentioned before that the reaction to a first transfusion is low (Divers, 2005; Andrews and Penedo, 2010; Balcomb and Foster, 2014). This exactly matches with the same results in this experiment, because this is the first time for these camels to receive donated blood. However, in some individual case outside this experiment showed sever changes in WBCs (leukocytosis) and deferential percentage accompanied with severe neutrophilia (Table 4; Fig 4).

Table 4. Haematological Parameters (WBCs)—Comparison before blood transfusion and after 2 days in camels under the study.

Parameter	Unit	Average Normal	Before Transfusion	After Transfusion	P-Value
WBC	10^3 cell/µL	8 – 15	11.2 ± 0.83	11.5 ± 0.69	0.63
Neut	%	40 – 60	55.6 ± 5.04	60.8 ± 4.09	0.00
Lymph	%	25 – 45	40.4 ± 5.42	35.2 ± 3.49	0.117
Mono	%	0 – 8	0.5 ± 0.08	0.3 ± 0.11	0.135
Eosino	%	0 – 6	3 ± 0.81	3.2 ± 1.83	0.77
Baso	%	0 – 1	0.4 ± 0.05	0.4 ± 0.09	0.099

*Optimum values of female Arabian racing camel (2 years old) (Elhag *et al,* 2016).

The haematological parameters showed significant changes in some parameters after blood transfusion of Arabian racing camels. RBCs, Hb, HCT showed significant increase (20%, 28.4% and 28%, respectively). While platelets count showed significant decrease around (19%). The leukocytes and its deferential cell percentages did not show any significant variation. Blood transfusion in Arabian racing camels required more scientific trials to determine the blood grouping and more understanding of the immunological reaction after blood transfusion. The blood transfusion must be with very limited veterinary practice in severe cases of anaemia and must be under direct supervision of veterinarian.

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