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Haematological Parameters of Neonate Camels (*Camelus dromedarius*) During the First Week of Life

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Abstract

Haematological parameters were studied in 22 neonate dromedary camels during their first week of life. Blood samples were collected from the jugular vein and for the determination of blood haemoglobin concentration (Hb), blood haematocrit (HCT), total red blood cells count (RBCs), total and differential leukocytes count. The significantly ($P<0.05$) higher mean value for blood- [Hb] of 12.9±0.6 g/dl was observed in neonate camels on the 1st day of life. On the 5th day of life, neonate camels showed a significant ($P<0.05$) higher percentage of HCT (31%) compared to the other days. Erythrocytes and leukocytes count showed a significant ($P<0.05$) higher mean on the 2nd and 7th days of life compared to the other days (8.5×10^6 and $23\times10^3/\mu l$, respectively). Mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) changed significantly ($P<0.05$) with age. Differential leukocytes count was not affected significantly by the age. Neutrophilia was observed in neonate camels during the first week of life. Monocytes showed lower mean values in neonate camels during the first week of life compared to the adult camels. The obtained haematological values were compared to those reported by other investigators in young and adult camels, other animals and humans.

Key words: Neonate camels, haematological parameters, first week of life, reference values

المستخلص

تمت دراسة قياسات الدم في 22 من مواليد الإبل خلال الإسبوع الأول من الحياة. جمعت عينات الدم من الوريد الوداجى لتحديد تركيز الهيموغلوبين (HB)، مكداس الدم (HCT)، العدد الكلى لخلايا الدم الحمراء (RBCs) والبيضاء (WBCs) والعد التمييزي لخلايا الدم البيضاء. أظهر متوسط تركيز الهيموقلوبين (12.9±0.6 g/dl) ارتفاعاً ذو قيمة معنوية ($P<0.05$) خلال اليوم الأول للحياة. أظهرت مواليد الإبل فى اليوم الخامس من الحياه إرتفاعاً ذو قيمة معنوية ($P<0.05$) لمكداس الدم (31٪) مقارنة مع الأيام الأخرى. أظهر متوسط عدد خلايا الدم الحمراء والبيضاء أعلى قيمة معنوية ($P<0.05$) فى اليوم الثانى والسابع للحياة مقارنة بالأيام الأخرى ($8.5\times10^6/\mu l$ و$23\times10^3/\mu l$، على التوالي). أوضحت النتائج أن متوسط حجم الكرية الحمراء (MCV)، متوسط تركيز هيموغلوبين الكرية (MCH)، ومتوسط تركيز هيموغلوبين الكريات (MCHC) إرتبط إرتباطاً معنوياً ($P<0.05$) بالعمر. لم يتأثر العد التمييزي لخلايا الدم البيضاء بشكل ملحوظ بالعمر. لوحظ إرتفاع فى نسبة خلايا الدم البيضاء (العدلات) خلال الإسبوع الإسبوع الأول من الحياة. كما أظهرت خلايا الدم البيضاء (الوحيدة) قيم متوسطة أقل في مواليد الإبل خلال الإسبوع الأول من الحياة مقارنة مع الإبل البالغة. تمت مقارنة قيم معايير الدم التي تم الحصول عليها بتلك التي وردت عن باحثين آخرين في مواليد وصغار الإبل والإبل البالغة وغيرها من الحيوانات والإنسان.

Introduction

Camel population in Sudan exceeds 4.3 million (FAO, 2009), raised mainly in a belt north of 12º N latitude. The most densely populated areas are Kordofan, Eastern Darfur (Western Sudan), followed by other regions in the central, eastern and northern Sudan. The camels are owned

mainly by migratory pastoralists as a source of milk and meat, as well as a pack and riding animal. Therefore, there is upsurge of excitement in the problems related to health and productivity in camels.

Evaluation of the physiological status of the animals has been traditionally accomplished with the analysis of the blood and serum parameters to describe the relationship between the physiological and pathological status of the animal. Therefore, many investigators have used haematological parameters in camels as an indicator for animal health (Bogin, 2000). Earlier study conducted by Petrelli *et al.* (1982) has observed many variations in blood parameters in relation to the age, particularly of the erythrocytic series. Elias and Yagil (1984) showed significant alterations in the haematological parameters of suckling camel calves, aged 1-30 days. Furthermore, Albusadah and Osman (2000) have determined the normal values for haematological parameters of young camels aged between 3-12 months. They reported lower mean values of haemoglobin (Hb), haematocrit (HCT), red blood cells (RBCs), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) in young camels compared to adult camels. Hussein *et al.* (1992) studied the haematological profile of camel calves between 1-12 months of age. They reported significant increase in RBCs, HCT, Hb, MCH and MCHC with age, and a relative reduction in MCV.

However, the published data have not reported the haematological parameters of neonate camels during their first week of life. Therefore, the objective of the present study was to monitor haematological values by sequential measurements from the 1st day of life to the 7th day of life, and compare the results to reference intervals for young and adult camels, other animals and humans.

Materials and Methods

Animals and management

A total number of 22 neonate dromedary camels during their first week of life were used in the current study. Neonate camels belong to the Camel Research Centre, Faculty of Veterinary Medicine, University of Khartoum. The animals were housed in an outdoor environment in a shaded corral and allowed to suckle milk from their mothers. They had free access to fresh water.

Sample collection and laboratory analysis

Blood samples were collected using plastic syringes (7.5 ml, Pirmvetta®, Laboratory Technique, GmbH, Germany) into clean tubes containing heparin as anticoagulant. Haematological parameters were determined by standard haematological techniques described by Weiss and Wardrop (2010). Blood- [Hb] in g/dl was determined by the cyano-methaemoglolin method. Blood HCT was determined as percentages by the microhaematocrit method using plain capillary tubes. The capillary tubes were filled with the blood to about 3/4 and one end was sealed by cristaseal. Then the tubes were centrifuged at 12000 r.p.m for 5 min in a micro-haematocrit centrifuge (Hawksley, London). The RBCs ($\times 10^6/\mu l$) and WBCS ($\times 10^3/\mu l$) were counted manually using the improved Neubauer haemocytometer. The values of MCV, MCH and MCHC were calculated according to Weiss and Wardrop, (2010). The ratios of lymphocytes, neutrophils, monocytes, eosinophils and basophils were determined microscopically from a count of

100 leukocytes in thin Giemsa- stained blood smears.

Statistical analysis

Statistical analysis was performed by using SPSS for Windows version 20. The distribution of the individual data was determined by using a One-Sample Kolmogorov-Smimow adjustment test. The haematological parameters were estimated using descriptive statistics procedures of the same programme. ANOVA tests (Levine's Test and Post Hoc Test) were used to assess the possible significant differences between the mean values in different groups. The mean difference was considered significant at $P \leq 0.05$.

RESULTS

The statistical data for the haematological parameters of neonate dromedary camels during the first week of life are shown in Table 1. The reference ranges for erythrocyte parameters such as total erythrocytes count, blood- [Hb] and blood HCT were 5 –15 $\times 10^6$/ µl, 9 –13 g/dl and 21 – 32%, respectively. Haematological indices MCV, MCH and MCHC showed reference ranges of 19 – 47fl, 10 –18pg and 31– 48g/l, respectively. The reference range of leukocytes for neonate dromedary camels was 13 – 22×10^3/µl. Differential leukocytes count indicated that neutrophils represented higher percentage of circulating leukocyte in neonate camels (60-78%) compared to the percentage of lymphocytes (14-32%) The ratios of eosinophils, monocytes and basophil showed reference ranges of 1 – 9%, 1 – 8% and 0 – 1%, respectively.

Table 1: Erythrocyte and leukocyte parameters of neonate camels (*Camelus dromedarius*) during the first week of life (n=22)

Erythrocyte parameters	m± s	[1]reference range	Leukocyte parameters	m± s	[1]reference range
TEC ($\times 10^6$/µl)	8.9 ±3.8	5 –15	**TLC ($X10^3$/µl)**	20 ±5	13 – 22
Blood- [Hb] (g/dl)	9.5 ±1.8	9 –13	**Lymphocytes (%)**	23 ±4.8	14 – 32
Blood HCT (%)	28 ±3.3	21– 32	**Neutrophils (%)**	68 ±7	60 – 78
MCV (fl)	28±0.5	19 – 47	**Eosinophils (%)**	4 ±3	1 – 9
MCH (pg)	10 ±2	10 –18	**Monocytes (%)**	4 ±2.7	1 – 8
MCHC (g/l)	47.8 ±3	31– 48	**Basophils (%)**	0.3 ±0.5	0 – 1

[1]m± s×1.96 indicated the lower and the upper limits (mean± standard deviation)

Brackets ([ ]) donate concentration

TEC: Total Erythrocytes count, TLC: Total leukocytes count

The detailed results shown in Figure 1 indicate that neonate dromedary camels on their 1st day of life showed a significantly ($P<0.05$) higher mean value for blood- [Hb] compared to the other days. Then the blood- [Hb] decreased gradually until day 7. Blood HCT fluctuated during the first week of life (Figure 2). However, this pattern was not statistically significant except on the 5th day of life; neonate camels showed a significant ($P<0.05$)

higher percentage of HCT (31%) compared to the other days (Figure 2).

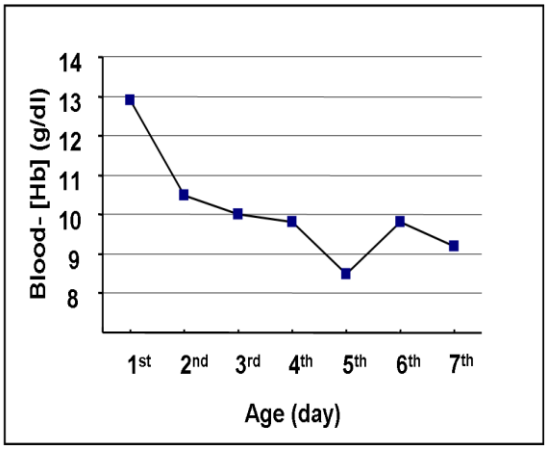

Figure 1. Blood- [Hb] (g/dl) of neonate camels (*Camelus dromedarius*) during the first week of life (n=22)

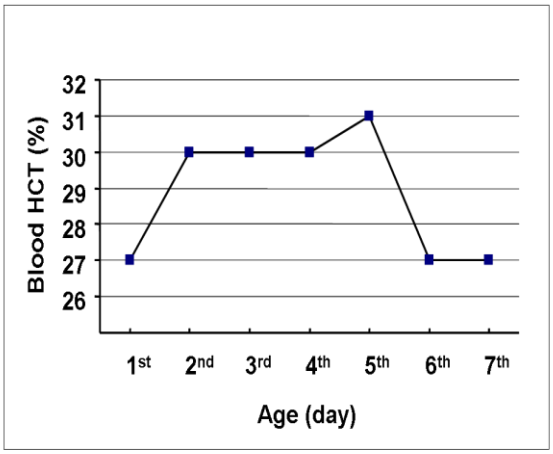

Figure 2. Blood HCT (%) of neonate camels (*Camelus dromedarius*) during the first week of life (n=22)

Figures 3 and 4 indicate that erythrocytes (RBCs) and leukocytes (WBCs) count showed significant ($P<0.05$) higher mean values on the 2nd and 7th days of life compared to the other days (8.5×10^6 and 23×10^3/µl, respectively).

Neonate camels on the 1st day of life showed significant ($P<0.05$) lower mean values for MCV and MCH, whereas the higher mean values were observed on the 5th day of life (Figures 5 and 6). Then MCV and MCH values increased gradually until day 7.

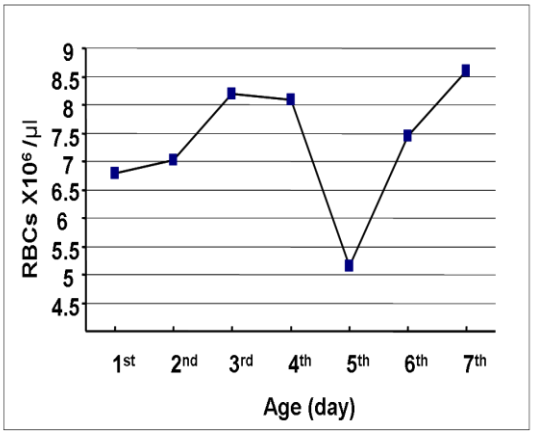

Figure 3. Total red blood cells count (RBCs ($X10^6$/µl) of neonate camels (*Camelus dromedarius*) during the first week of life (n=22)

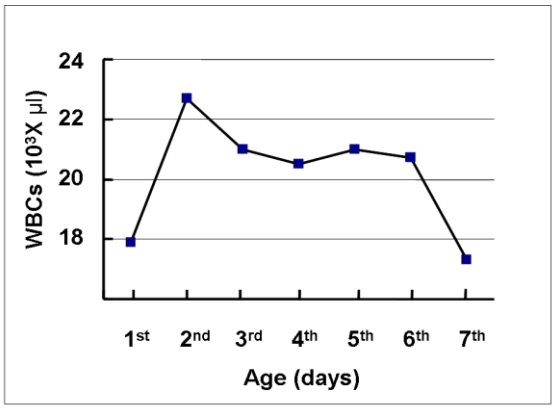

Figure 4. Total white blood cells count (WBCs ($X10^3$/µl) of neonate camels (*Camelus dromedarius*) during the first week of life (n=22)

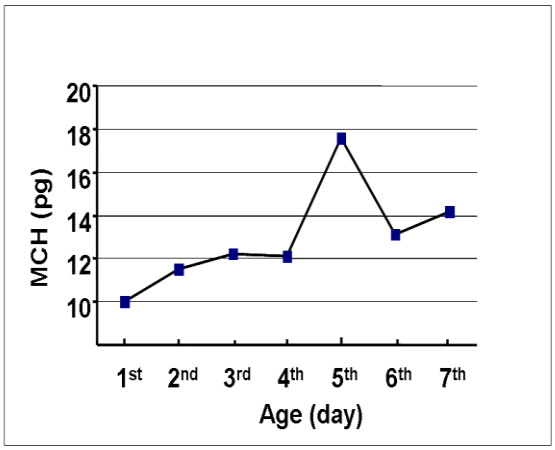

Figure 5. Mean corpuscular haemoglobin (MCH) (pg) of neonate camels (*Camelus dromedarius*) during the first week of life (n=22)

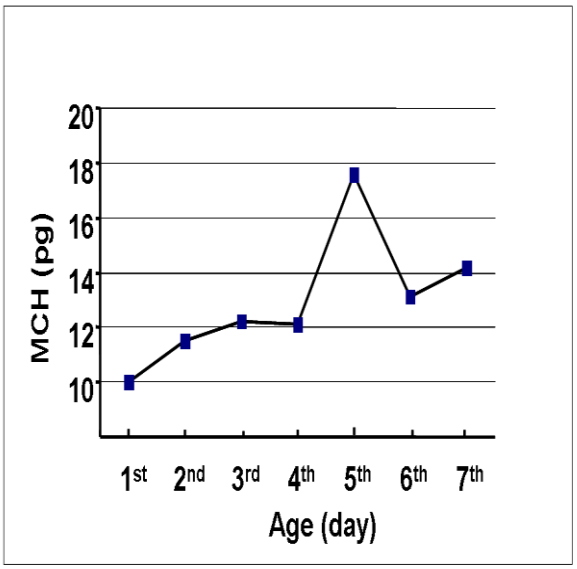

Figure 6. Mean corpuscular haemoglobin (MCH) (pg) of neonate camels (*Camelus dromedarius*) during the first week of life (n=22)

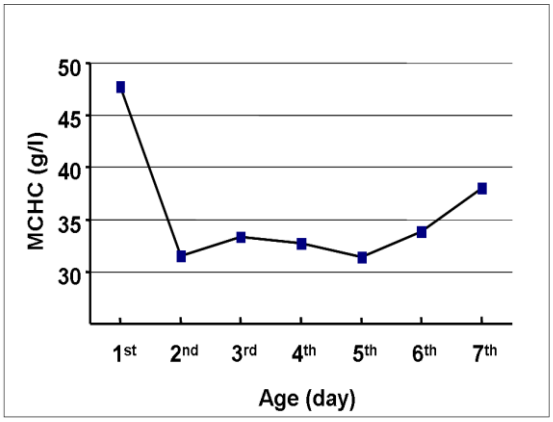

Figure 7. Mean corpuscular haemoglobin concentration (g/dl) of neonate camels (*Camelus dromedarius*) during the first week of life (n=22)

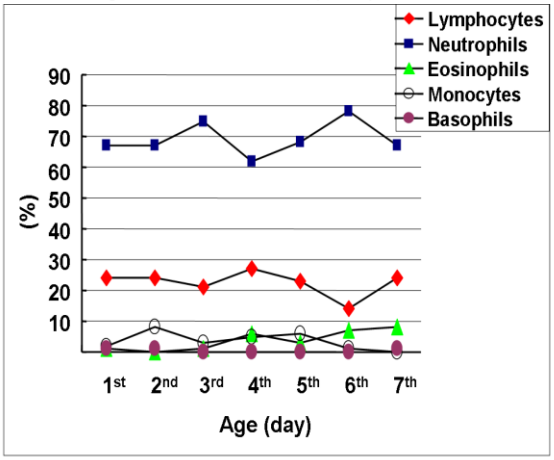

Figure 8. Differential leukocytes count (%) of neonate camels (*Camelus dromedarius*) during the first week of life (n=22)

Figure 7 indicates that the significant ($P<0.05$) higher mean value for MCHC was observed on the 1st day of life compared to the other days; then MCHC decreased gradually until day 7. Differential leukocytes count was not affected significantly by the age (Figure 8). However, neutrophilia was observed in neonate camels during the first week of life. Eosinophils and monocytes showed lower mean values in neonate camels during the first week of life.

Discussion

The results obtained in the present study show that neonate camels on their first day of life are characterised by higher mean values of most haematological parameters compared to the other days (2-7 days). The results confirmed that most of haematological parameters of neonate camels differ from those of young and adult camels. Previous studies on the haematology of dromedary camels were mainly concerned on young and adult animals (Abdalla *et al.*, 1988; Haroun *et al.*, 1996and Bogin, 2000). Albusadah and Osman (2000) reported that normal values for haematological parameters of young camels aged 3-12 months. Furthermore, Hussein *et al.* (1992) studied the haematological profile of camel calves between 1-12 months of age. Consequently, the present study measured a reference range for haematological parameters in neonate dromedary camels during their first week of life for subsequent use in order to avoid misleading if used to characterise values from young animals. The data indicate that neonate dromedary camels show a variation in the

haematological parameters with increasing age from the 1st day to the 7th day of life, which should be taken in consideration on their management programs.

The reference range for blood- [Hb] obtained in the present study for neonate dromedary camels (9–13 g/dl, Table 1) was lower than that reported for young camels (Haroun *et al.*, 1996, 11-15 g/dl) and adult camels (Bogin, 2000, 8-16 g/dl). The mean value of blood- [Hb] reported for neonate camels (9.5 ±1.8 g/dl) was similar to mean value reported for young camels aged 1-3 months (Albusadah and Osman, 2000, 10±0.8). However, it was lower than the mean value of 11.5±1.3 g/dl reported by Omer *et al.* (2008) in 2 years old growing camels in Sudan and mean value of 12 g/dl reported by Hussein *et al.* (1992) in one year old young camels.

The reference range for blood HCT obtained in the present study for neonate dromedary camels (21-32%, Table 1) was lower than that reported for young and adult camels (Haroun *et al.*, 1996, 25-35%; Bogin, 2000, 24-35%). However, the mean value of blood HCT reported for neonate camels during their first week of life (28%) was higher than the mean value reported for young camels at the age of 1-3 months (Albusadah and Osman, 2000, 23%) and growing camels (Omer *et al.*, 2008, 26%).

The present data for total erythrocyte count (TEC) for neonate dromedary camels (reference range of 5-15 $\times 10^6$/ µl, mean value of 8.9 ±3.8) was similar to the results reported in young camels (Haroun *et al.*, 1996, 9.3 ±0.9; Albusadah and Osman, 2000, 9±0.5). However, it was lower than the values reported for adult camels (Bogin, 2000, 6-9 $\times 10^6$/ µl, a mean value of 7.6 ±1.5).

The values of MCV, MCH were approximately similar to those reported in young camels (Albusadah and Osman, 2000) who reported 26 fl and 11 pg, respectively. However, MCHC showed a higher mean value compared to the mean value reported by Albusadah and Osman (2000) who found 42 g/dl.

The reference range of leukocyte count obtained in the present study for neonate dromedary camels (13– 22×10^3/µl) was higher than that reported by Bogin (2000, 11–16×10^3/µl). Similar results have been reported previously in young camels (Albusadah and Osman, 2000, 20×10^3/µl). The increase in WBCs count could be related to the higher percentage of neutrophil observed (Table 1).

Neutrophils represented higher percentage of circulating leukocytes in neonate camels (60-78%, Table 1) compared to values of young and adult camels (Haroun *et al.*, 1996; Bogin, 2000), respectively. Similar results have been reported previously for neonate camels (Elias and Yagil, 1984), calves (Knowles *et al.*, 2000 and Kulberg *et al.*, 2004) and dogs (Toman *et al.*, 2002). The highest mean value of neutrophil observed in neonate camels in the present study, could be related to the higher concentration of foetal adrenocortical hormones. A similar phenomenon was reported in bovine neonates (Brun-Hansen *et al.*, 2006), and it has been suggested that the underlying cause might be the acquisition by the foetus adrenocortical hormones released by its dam in response to the stress of parturition (Schalm *et al.*, 1975).

In the present study, lymphocytes showed lower percentage in neonate camels (14-32%, Table 1) compared to the values reported

previously for young and adult camels (Albusadah and Osman (2000 and Bogin (2000), respectively. This may be due to immature immune system.

The ratios of eosinophils, monocytes and basophil showed reference range approximately similar to young and adult values reported by Bogin (2000) and Albusadah and Osman (2000). However, eosinophils showed higher mean value of 4±3 than a value of 1.5±0.4 reported in young camels (Albusadah and Osman, 2000).

The present results for most haematological parameters support the previous data reported by Elias and Yagil (1984) for neonate camels. The most striking differences in erythrocyte parameters compared to the adult reference range were related to the changes in the cell size (haemodilution). The decreased values of blood HCT and RBCs count observed during the first week of life compared to the adult values were probably the result of haemodilution, whereas the ensuing changes expressed the postnatal maturation events of the erythroid system (Egli and Blum, 1998). Furthermore, the mean value of MCV in the first day of life (18.6 ±0.5) was just below the young and adult reference range, and then increased gradually to a value of 37.3±2 fl on day 7, which is comparable to adult values (Bogin, 2000). A decrease in MCV has been described previously in calves (Brun-Hansen *et al.*, 2006), which reflects the replacement of RBCs containing foetal haemoglobin with smaller RBCs containing haemoglobin A (Egli and Blum, 1998 and Knowles *et al.*, 2000). The lower MCV value reported in the present study (28±0.5 fl) is compensated by the higher RBC number of 8.9 $\pm 3.8 \times 10^6/\mu l$ to maintain a normal Hb concentration.

It is evident from the present study that leukocyte parameters tended to decrease with age from the 1st day of life to day 7, particularly for WBCs count and neutrophils towards adult reference values. The present results clearly indicate that the development of neonate dromedary camel's immune system was immature during the first week of life as indicated by predominating circulating neutrophils compared to lymphocytes.

Conclusion

The present results indicate that several haematological parameters of neonate dromedary camels differ from young and adult reference ranges. Therefore, this age-dependent relationship should be put under consideration when assessing haematological values for neonate camels in order to improve their management and health.

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