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Platelet indices of the dromedary camel (*Camelus dromedarius*)

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ABSTRACT

This communication describes platelet indices including platelet count (PLT), mean platelet volume (MPV), plateletcrit (PCT) and platelet distribution width (PDW), along with parallel red blood cell parameters, in samples from 27 dromedary camels of both sexes. The overall mean values of the platelet parameters were: PLT 319.71 ± 38.6 ($x10^9$/L); MPV 5.51 ± 0.08 fL; PCT 0.14 ± 0.02% and PDW 19.50 ± 0.62%. A highly significant correlation was found between PLT and PCT ($P \leq 0.001$) in male, female and all camels and a significant correlation between MPV and PDW ($P < 0.05$) in male and all camels. The correlation between platelet parameters and parallel red blood cell parameters, namely: hematocrit (HCT), mean corpuscular volume (MCV) and red cell distribution width (RDW), revealed no significant correlation between RBC and PLT, PCT and HCT or MPV and MCV. However, a highly significant correlation was found between PCT and RDW in all camels ($P \leq 0.005$).This is the first report of MPV, PCT, PDW and RWD in dromedaries.

Key words: platelet count, mean platelet volume, plateletcrit, platelet distribution width

Introduction

Studies on the haemostatic parameters of the dromedary camel (*Camelus dromedarius*) have indicated that this animal has significantly shorter bleeding times and higher clotting factor activities, especially factor VIII clotting activity, than humans; these features might be part of the physiological adaptations that protect camels from excessive fluid loss and dehydration during desert life (HUSSEIN et al., 1992a). Another unique feature of the

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camel is that its blood platelets are resistant to temperature and exhibit minimal structural and functional changes during *in vitro* heating at temperatures (>44 °C) exceeding those required to destroy human platelets (AL GHUMLAS et al., 2008). Limited studies on the aggregation and ultrastructure of camel platelets were also reported (LEWIS, 1976; ABDEL GADER et al., 2006; ABDEL GADER et al., 2008). However, apart from some scattered data on platelet counts (PLT), no information is available on the camel's platelet parameters. The physiological, diagnostic and prognostic relevance of platelet indices, such as mean platelet volume (MPV), plateletcrit (PCT) and platelet distribution width (PDW) is becoming increasingly recognized in human medicine (WIWANITKIT, 2004; AMIN et al., 2004; KAITO et al., 2005) and veterinary medicine (SEGURA et al., 2007; YILMAZ and YESILBAG, 2008; YILMAZ et al., 2008; KIM et al., 2008; HAROLD et al., 2008; NALBANT et al., 2008), and these parameters are currently routinely measured by automated hematology analyzers as part of a complete blood count.

The purpose of this study was to obtain baseline information on platelet indices of the dromedary camel, which might be useful as additional aids for studying platelet functions in this species.

Materials and methods

Twenty-seven dromedary camels (10 males and 17 females), aged 2-4 years, were used. These were Saudi camels of the indigenous Najdi breed, common in the central region of Saudi Arabia. The animals were housed in a commercial camel farm in Riyadh, and were fed on a ration of lucerne, hay and sorghum grains with free access to water. Sampling was carried out in exactly the same manner on two visits to the farm during February 2009. Ten mL blood samples were collected from the jugular vein of each camel into EDTA-K_2 vacutainer tubes (Becton, Dickinson and Co., USA). Following collection, each tube was gently inverted 3-4 times to ensure mixing of the sample, and promptly transported to the laboratory. Using an automated hematology analyzer (VetScan HM2; Abaxis Veterinary Diagnostics), the samples were analyzed within 1 hr of collection for PLT, PCT, MPV and PDW, as well as RBC, hematocrit (HCT), mean corpuscular volume (MCV) and red cell distribution width (RDW).

The results were statistically analyzed using the SAS 8.1 program for Windows. The Shapiro-Wilk normality test was used to test for normality and Spearman correlations were used to determine correlations among the platelet indices and between the latter and parallel red cell parameters.

Results

All camels were clinically normal and none of them had a previous history of hematological disorder. Also none of the female camels were pregnant at the time of

sampling. Testing for normality showed that all the studied parameters were normally distributed. The means, standard errors and ranges for the platelet and RBC parameters are given in Table 1. The PLT and MPV were not significantly different in male when compared to female camels, while PCT was significantly higher ($P<0.05$) and PDW significantly lower ($P\leq0.005$) in male versus female camels. On the other hand, HCT and MCV were significantly lower ($P\leq0.005$) while RDW significantly higher ($P\leq0.001$) in male when compared to female camels.

Table 1. Platelet indices and red cell parameters in dromedary camels*

Parameters	Males	Females	Total
Platelet indices			
PLT ($\times10^9$/L)	352.30 ± 56.02 (129.0-606.0)	273.14 ± 48.07 (186.0-550.0)	319.71 ± 38.60 (129.0-606.0)
PCT (%)	0.20 ± 0.03[a] (0.10-0.32)	0.11 ± 0.01[b] (0.10-0.32)	0.14 ± 0.02 (0.10-0.32)
MPV (fL)	5.38 ± 0.10 (4.80-6.00)	5.59 ± 0.11 (4.80-6.40)	5.51 ± 0.08 (4.80-6.40)
PDW %	23.0 ± 0.66[a] (19.50-25.80)	26.63 ± 0.59[b] (20.70-31.20)	25.20 ± 0.62 (19.50-31.20)
Red cell indices			
RBC ($\times10^{12}$/L)	10.37 ± 0.35 (8.85-12.25)	10.37 ± 0.35 (7.85-12.57)	10.37 ± 0.24 (7.85-12.57)
HCT %	24.04 ± 0.84[a] (20.00-28.74)	27.97 ± 0.81[b] (22.62-33.00)	26.43 ± 0.69 (20.00-33.00)
MCV (fL)	23.27 ± 0.33[a] (22.00-25.00)	27.18 ± 0.40[a] (23.00-30.00)	25.64 ± 0.46 (22.00-30.00)
RDW (%)	30.80 ± 0.82[a] (26.30-34.60)	25.11 ± 0.53[b] (22.60-31.80)	27.35 ± 0.70 (22.60-34.60)

a, b - Data in the same row bearing different superscripts are significantly different ($P \leq 0.05$)

Table 2. Correlations between platelet count and platelet indices in dromedary camels

Parameter	PLT ($\times 10^9$/L)	PCT (%)	MPV (fL)	PDW %
Males				
PLT ($\times 10^9$/L)	1	0.90***	0.31	-0.25
PCT (%)	0.90***	1	0.41	-0.20
MPV (fL)	0.31	0.41	1	0.56*
PDW %	-0.25	-0.20	0.56*	1
Females				
PLT ($\times 10^9$/L)	1	0.92***	0.50	-0.10
PCT (%)	0.92***	1	0.20	0.32
MPV (fL)	0.50	0.20	1	0.31
PDW %	-0.10	0.32	0.31	1
Overall				
PLT ($\times 10^9$/L)	1	0.91***	0.31	-0.31
PCT (%)	0.91***	1	0.09	0.20
MPV (fL)	0.09	0.09	1	0.45*
PDW %	-0.31	-0.20	0.45*	1

*P ≤0.05*** P ≤0.001

Table 3. Correlation between platelet indices and parallel red blood cell parameters in dromedary camels

Parameter	PCT (%)	MPV (fL)	PDW %	PLT ($\times 10^9$/L)
Males				
HCT (%)	0.44	-0.10	0.11	0.08
MCV (fL)	-0.32	0.04	0.34	0.22
RDW %	0.80**	0.15	- 0.55	-0.20
RBC ($\times 10^{12}$/L)	0.57	-0.10	-0.03	0.56
Females				
HCT (%)	0.06	-0.32	0.14	0.30
MCV (fL)	0.58	0.51	0.10	0.27
RDW %	0.69**	-0.34	0.08	-0.18
RBC (x10^{12}/L)	-0.29	-0.06	-0.10	-0.56
Overall				
HCT (%)	-0.11	-0.07	0.39	0.33
MCV (fL)	-0.63	0.43	0.41	-0.10
RDW %	0.80**	-0.30	-0.50**	0.11
RBC ($\times 10^{12}$/L)	0.08	-0.07	-0.17	0.15

** P ≤0.005

There was a highly significant (P≤0.001) correlation between PLT and PCT in male, female and all camels and a significant (P≤0.05) correlation between MPV and PDW in male and all camels (Table 2). Correlation between platelet indices and parallel red cell parameters revealed no significant correlation between PLT and RBC, PCT and HCT or MPV and MCV. However, a highly significant (P≤0.005) correlation was recorded between PCT and RDW in male, female and all camels, while a highly significant (P<0.005) inverse correlation was recorded between PDW and RDW in all camels (Table 3).

Discussion

The red blood cell parameters were within normal ranges for camels, despite differences in some parameters between male and female camels (HUSSEIN et al., 1992b). The platelet count (PLT) was somewhat lower than previously reported in camels (HUSSEIN et al., 1992a) but within normal ranges reported in humans (WIWANITKIT, 2004) and various species of farm animals (FELDMAN et al., 2000) including llamas (SUMMERFIELD et al., 2002). The wide range of variation in the platelet numbers recorded in this study is not unique to camels, since a similarly wide variation has been reported in humans and other species of mammals (JAIN, 1993). No attempt was made in the present study to compare EDTA with citrate anticoagulation for measuring platelet parameters. However, a recent study comparing the use of EDTA with citrate as anticoagulant for measuring canine platelet parameters in whole blood samples (STOKOL and ERB, 2007) recommended using the former as an anticoagulant, since platelet aggregates, probably from activation, occurred when the blood was anticoagulated with citrate, resulting in lower platelet counts and inaccurate results for MPV and mean platelet component concentration (a marker of platelet activation). An earlier study by THOMPSON et al. (1983) also indicated that EDTA offered better conditions of anticoagulation for MPV and PLT measurements than either citrate or heparin.

The overall mean values of MPV, PCT and PDW in camels are nearly half the corresponding values in humans (KIM et al., 1986; WIWANITKIT, 2004) thus confirming earlier observations by LEWIS (1976) that camel platelets are much smaller than human platelets (diameter 1 μm in the camel versus 2-3 μm in humans). By contrast, the camel's RDW is considerably higher than that reported in humans (WIWANITKIT, 2004). On the other hand, mean MPV and PCT values are considerably smaller, while PDW and RDW values considerably larger in camels than in cattle (YILMAZ and YESILBAG, 2008).

The finding of a significant correlation between PLT and PCT in camels concurs with results in humans (WIWANITKIT, 2004) and canines (YILMAZ et al., 2008). On the other hand, the present study revealed no significant correlation between PLT and MPV in camels. Some authors have suggested that platelet size is inversely correlated with platelet

number so that the platelet mass remains constant (THOMPSON et al., 1983). Accordingly, species with high platelet numbers, such as mice, have very small platelets, whereas species with lower platelet numbers, such as cats, have comparatively larger platelets. This inverse relationship between PLT and MPV has been reported in humans (THOMPSON et al., 1983; LEVIN and BESSMAN, 1983) and several other mammals (WEISER and KOCIBA, 1984; EBBE and BOUDREAUX, 1998). However, the camel, like the horse (BOUDREAUX and EBBE, 1998), appears to be an exception to this rule.

Very little has been published regarding the correlation between platelet indices and their parallel red cell indices. WIWANITKIT (2004) stated that no significant correlation occurred between PCT and HCT or between MPV and MCV in humans. The present findings in camels concur with these results, confirming the view that the sizes of red blood cells and blood platelets are independent of each other (WIWANITKIT, 2004). Also in agreement with this author, a significant inverse correlation was found between PDW and RDW in all camels.

To our knowledge, the present study is the first record of platelet indices (MPV, PCT and PDW) and RDW, and hence the correlation between platelet and corresponding red cell parameters, in healthy camels. It is difficult at this stage to speculate on the clinical relevance of these findings and further studies should be undertaken to elucidate their clinical importance in camels.

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SAŽETAK

Opisani su najčešći trombocitni pokazatelji: broj trombocita (PLT), srednji volumen trombocita (MPV), trombokrit (PCT) i širina krivulje raspodjele po volumenu (PDW), kao i pokazatelji crvenih krvnih stanica u 27 jednogrbih deva oba spola. Prosječne srednje vrijednosti trombocitnih pokazatelja bile su za broj trombocita (PLT) 319,71 ± 38,6×10^9/L); za srednji volumen trombocita (MPV) 5,51 ± 0,08 fL, trombokrit (PCT) 0,14 ± 0,02% i širinu krivulje raspodjela (PDW) 19,50 ± 0,62%. Značajna korelacija bila je ustanovljena između broja trombocita i trombokrita (P≤0,001) u mužjaka i ženki te općenito u svih pretraženih deva. Također je bila ustanovljena značajna korelacija između srednjega volumena trombocita i širene raspodjele trombocita (P<0,05). Nije ustanovljena korelacija između trombocitnih pokazatelja i pokazatelja crvenih krvnih stanica, tj. usporedbom hematokrita, srednjega volumena crvenih krvnih stanica i raspodjele po volumenu crvenih stanica nije bila ustanovljena značajna korelacija između broja crvenih krvnih stanica te broja trombocita, trombokrita i hematokrita ili srednjega volumena trombocita i srednjega volumena crvenih krvnih stanica. Međutim, značajna korelacija ustanovljena je između trombokrita i krivulje raspodjele po volumenu eritrocita u svih pretraženih deva (P≤0,005). Ovo je prvo izvješće o srednjem volumen trombocita, trombokritu, raspodjeli po volumenu trombocita te raspodjeli po volumenu crvenih krvnih stanica u jednogrbih deva.

Ključne riječi: broj trombocita, srednji volumen trombocita, trombokrit, širina raspodjele trombocita