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RESEARCH ARTICLE

Exercise and Dehydration Minimized Bleeding Time in Camels (*Camelus dromedarius*): A Clinical Standpoint

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ABSTRACT

The physiological response of hemostatic system, assessed by measuring camel's bleeding time, was determined immediately before, after and during the recovery (post 3, 6, 24 and 48 hours) from 2 hours exercise and 72 hours of dehydration in 5 clinically healthy Arabian dromedary camels. It was observed that both conditions resulted in an activation of blood coagulation cascades as demonstrated by a drastic reductions ($P<0.05$) in the overall means of their bleeding times. Nevertheless, 3 hours post each condition were found sufficient (in exercise: $P=0.22$, in dehydration: $P=0.38$) for retrieval of bleeding time to its normal level. Based upon findings, it may be recommended that short periods of exercise and/or dehydration prior to surgical operations can be practiced to minimize bleeding during surgery. However, further investigations are required to clarify the possible role of different intensity and/or duration of these conditions on other hemostatic measurements.

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INTRODUCTION

Extended periods of high temperature and drought that last for more than 6 months with erratic precipitation and brief eruption of feeding forages clearly describe the climate of any arid environment. One of the highly suitable animals that can inhabit such conditions is the camel. Its adaptive thermophysiological mechanisms have attracted an increasing attention in recent years (Abdoun *et al.,* 2012a, b). One of the camel's unique features is its ability to maintain blood volume promptly and with marked efficiency (Al-Haidary, 2006). Thus, the integrity of their blood circulation is perfectly maintained under the harsh environmental conditions.

The process of hemostasis (coagulation and fibrinolysis) is known to involve highly regulated enzymatic, cellular, and vascular events (Smith, 2003; Smith, 2009; Goggs, 2012). Hemostasis acts basically to protect animals from excessive loss of blood by sealing injuries sites and restoring vascular integrity. Abnormalities of this process are implicated in the pathogenesis of several diseases (George, 2012) and many therapeutic treatments may alter the balance between coagulation and fibrinolysis (Dargaud and Negrier, 2007; Collins, 2011; Lambing *et al.,* 2012).

Until recently, virtually no information was available on the hemostatic profile of the camel. Several studies had evaluated various blood coagulation parameters of camels and the obtained results were compared with human values (Gader *et al.,* 2008; Al-Ghumlas *et al.,* 2008; Abdelgadir *et al.,* 2009). These authors pointed out, in comparison to human, that 1) prothrombin time, activated partial thromboplastin time, peak thrombin generation, and thrombin potential were markedly shorter in the camel; 2) camels have higher factor VIII:C activity; 3) camels platelets are less sensitive to *in vitro* heating, and they respond to ADP and collagen, but not to arachidonic acid, adrenaline, and ristocetin; 4) the ultrastructure of camel platelets was found to be markedly different in many aspects from that of human platelets. Nevertheless, the most interesting findings remains to be the exceptionally very elevated levels of low immunogenic clotting factor VIII in the camel plasma compared to human. The possibility of camel factor VIII to be used as a therapeutic product, similar to porcine factor VIII, in the management of patient with hemophilia who developed inhibitors to human factor VIII is of further interest.

Exercise, in human, has been shown to affect both coagulation and fibrinolysis processes with an altered response related to intensity and duration; such that the higher the intensity and duration of exercise, the more amplified the effect (Szymanski and Pate, 1994). This relationship has its implications in human patients but the mechanism behind this has not been clearly elucidated.

Meanwhile, dehydration was considered as one of the major risk factors for clotting problems. In fact, blood volume is decreased and its viscosity is increased with dehydration (Chan *et al.,* 2002) and consequently, it would be more prone to clot.

To our knowledge, there is no published study on the effect of exercise and/or dehydration on any of the hemostatic parameters in any species of domestic and/or desert animals. Therefore, the purpose of this study was to provide a simple and reliable evidence of the effects of exercise and dehydration on the hemostatic system of dromedary camels and to examine the potential clinical implications of the findings.

MATERIALS AND METHODS

Five clinically healthy Arabian one humped camels *(Camelus dromedarius*) of hybrid breed with mean body weight of 470±18.3kg and 2-3 years of age were used in the current study. Camels were housed, throughout the study, as a group in a semi-free (large, outdoor and relatively shaded) area at the Experimental Farm Station affiliated to the Department of Animal Production, College of Food and Agriculture Sciences, King Saud University, Riyadh, Kingdom of Saudi Arabia. Camels were fed at their maintenance level on a balanced ration and had free access to clean tap water except during the dehydration period.

This study was divided into 2 periods; exercise and dehydration, with 3 weeks apart. Each period was further subdivided into 3 stages; pre-treatment (48 hours duration), treatment (exercise and/or dehydration) and post-treatment stage (48 hours duration). In the exercise period, camels were exercised for 2 hours at an average speed of 10 km/h in a circular lane. Meanwhile, water was withheld for 72 hours during the dehydration period. It is worth mentioning that no apparent discomfort was observed in animals during both exercise and dehydration periods. Study design in addition to handling and restraining of camels were pre-approved by the faculty ethics committee, King Saud University.

Before 1 day of study commencement, a 5x5 cm area was shaved in shoulder and hip regions of each animal as a site for measurement of bleeding time (BT) (Al-Busadah, 2007). Animals' BT test was perfumed, on a restrained animal, by making two minor and uniforms incisions (5 mm long by 2 mm deep) within the shaved areas using disposable bleeding devices. Thereafter, blood was collected periodically (every 20 seconds) onto filter paper without touching the incisions. The mean time (min) that took for the incision to stop bleeding in both regions was recorded using a stopwatch. Animals' BT were measured immediately before (pre), immediately after (post 0 hours), and during the recovery (post 3, 6, 24 and 48 hours) of both study periods.

Data of animals' BT were analyzed using Proc GLM; the general linear models procedure for analysis of variance (ANOVA) of the Statistical Analysis Software (SAS Institute Inc., Cary, NC, USA). Completely randomized design was used to analyze the experimental data. The statistical model included the influence of study animals and treatments in addition to the interaction. Statistical means were compared, thereafter, using Duncan's multiple range test. Overall level for statistical significance was set at $P<0.05$. All values were expressed as statistical means± SE, unless otherwise specified.

RESULTS

The physiological response of hemostatic system before, after and during recovery from the exercise period, assessed by measuring camel's BT, was similar to the response observed in the dehydration period.

In the present study, both conditions resulted in a drastic reduction ($P<0.05$) in the overall mean of camel's BT (Table 1). The recovery of camel's BT was followed up for 48 hours (Fig. 1). Three hours post each condition was found to be sufficient (in exercise: $P=0.22$, in dehydration: $P=0.38$) to return the measured BT to their pre levels. Nevertheless, camel's BT decreased ($P<0.05$) after 6 hours of both exercise and dehydration periods. In exercised animals, BT returned ($P=0.35$) to its pre values gradually after 24 hours and more ($P=0.65$) after 48 hours, while it appeared to require more than 48 hours to return in dehydrated animals (Fig. 1).

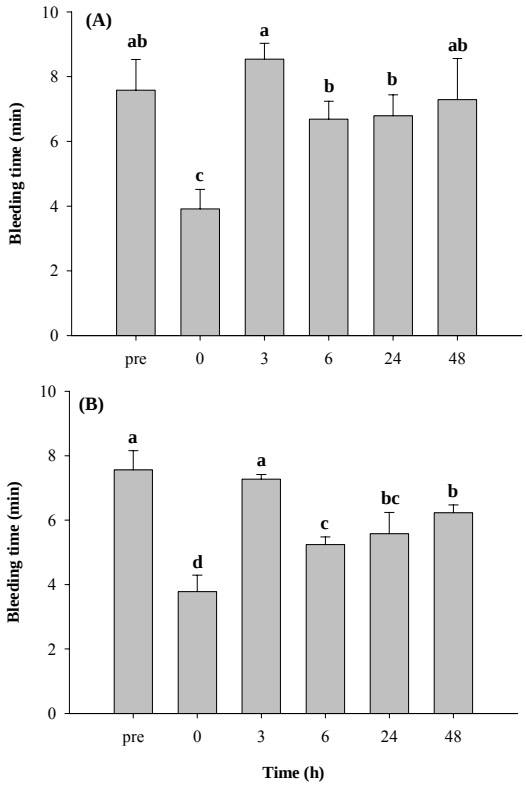

Fig. 1: Post-exercise recovery of bleeding time in exercised (A) and dehydrated (B) dromedary camels (Mean±SD). Mean values bearing different superscripts are significantly different at $P<0.05$.

Table 1: Effect of exercise and dehydration on bleeding time (Mean±SE) in dromedary camels

Parameters	BT		*P value*	
	Pre	Post	Time	Animal
Exercise	7.58±0.47[a]	3.91±0.31[b]	<0.0001	0.74
Water deprivation	7.56±0.30[a]	3.78±0.25[b]	<0.0001	0.57

[a-b] Mean values bearing different superscripts are significantly different at $P<0.05$.

DISCUSSION

The purpose of the BT test is to provide a reliable measure of platelet functions. The mechanisms behind platelet activation during exercise and/or dehydration are not fully understood, but it might be related to the shear stress of blood (Ferguson *et al.,* 1987) as well as to the increase of blood catecholamines (Gonzales *et al.,* 1996). Taken together, endothelial damages and mobilization of active platelets from the reticulo-endothelial system might eventually cause more thrombin generation, which was expressed herein as extremely low BT. These results are important from physiological and clinical standpoints. Depending on the type and duration of surgical operations, animals may lose large amount of blood during surgeries. Hereditary coagulation disorders and abnormalities of hemostatic process might also be implicated (George, 2012). Thus, understanding the effect of exercise and/or dehydration on hemostatic system would give us an insight into how management may help in minimizing the bleeding during surgical operations.

Although there is no published literature in domestic and/or desert animals with which to compare our results, these results came in agreements with several studies in humans. Collectively, these studies demonstrated that blood withdrawn immediately after exercise and dehydration is hypercoagulable. This conclusion was based on the finding that blood samples after both conditions had a reduction in blood clotting time (Ferguson *et al.,* 1987), activated partial thromboplastin time (Hegde *et al.,* 2001), prothrombin and thrombin times (El-Sayed *et al.,* 1999), in addition to the concentration levels of plasma fibrinogen (El-Sayed *et al.,* 1999) and Antithrombin III (Ferguson *et al.,* 1987). Meanwhile, platelet count (Siegel *et al.,* 2001) and the concentration levels of factor VIII (Hegde *et al.,* 2001), thrombin-Antithrombin III complexes (Herren *et al.,* 1992), platelet factor 4 and β-thromboglobulin (Rock *et al.,* 1997) were all found to be elevated immediately after both and/or each conditions.

In summary, current study showed that both exercise and dehydration resulted in a significant reduction of bleeding time in camels. Veterinarian should be aware of the hemostatic changes induced by such conditions. Therefore, we recommend that short periods of exercise and/or dehydration prior to operations can be practiced to minimize bleeding during surgery. Nevertheless, further studies are required to clarify the understanding of how exercise and dehydration can activate blood coagulation cascades. Moreover, investigating the effect of different age and physiological status (athletic vs non-athletic) of animals as well as different intensity and duration of exercise and dehydration on other hemostatic measurements should be undertaken to expand the knowledge of these effects and to clarify its clinical significance.

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