Determination of some biochemical parameters in clinically healthy and anemic dromedary camels

Al-Dhalimy A.M. and Al-Hadithy H. AH.
Department of Internal and Preventive Medicine, College of Veterinary Medicine, Baghdad University, Iraq.
E-mail: Harithal.hadithy@gmail.com
Received: 30/12/2015; Accepted: 11/4/2016

Summary

The study was conducted on 150 healthy and 102 diagnosed iron deficient anemic camels to determine serum iron, total iron binding capacity, unbound iron binding capacity, transferrin saturation, copper and cobalt concentrations. The normal (81 males and 69 females) and anemic (48 males and 54 females) groups both aged between 1-15 years in Najaf governorate- Iraq. Blood samples were collected from the jugular veins into plain tubes during the period November 2014 until May 2015, and the separated sera were used for the measurement of studied parameters. Results showed that the ranges and means ± SE in normal and anemic camels were as follows; Serum iron concentration was 7.37-19.48 µmol/L and 12±0.22 µmol/L, 1.52-15.70 µmol/L and 8.43±0.21 µmol/L, respectively, TIBC 73.80-108.47 µmol/L and 89.19±0.7 µmol/L, 93.12-135.32 µmol/L and 111.28±1.02 µmol/L, respectively, UIBC 57.5-95.25 µmol/L and 76.5±0.74 µmol/L, 83.27-125.69 µmol/L and 102±1.06 µmol/L, respectively, TS% 7.80- 24.04 % and 14.3 ±0.27%, 1.22-14.79% and 7.6±0.21%, respectively, serum copper 6.28-16.5 µmol/L and 11±0.2 µmol/L, 3.67-12.40 µmol/L and 7±0.19 µmol/L, respectively and serum cobalt 0.84-6.78 µmol/L and 3±0.13 µmol/L, 0.42-6.42 µmol/L and 2.67±0.16 µmol/L, respectively. However, There was a significant ($P<0.05$) decrease in serum iron, TS% and copper. While, there was a significant ($P<0.05$) increase in serum TIBC and UIBC of anemic camels in comparison with normal control. The cobalt concentrations were almost similar in both groups. The present data recorded reference ranges and mean values of specific biochemical parameters in clinically normal and anemic camels with significant differences between them.

Keywords: Serum Iron, total iron binding capacity, unbound iron binding capacity, transferrin saturation, Copper, Cobalt, Camels.

Introduction

Camelus dromedarius is an important animal which provide a nutrient resources (meat and milk) for humans in several arid and semiarid zones of subtropical and tropical regions, often represents the only protein source. However, camel revealed physiological variations in mineral concentra -tions of plasma, as well as, the peculiarities of mineral metabolism including increase absorption capacity, tolerance for minerals, in addition to the maintenance of enzymatic activity in deficient period (1). Biochemical analysis of blood could often provide valuable information regarding health and sickness of animals, however only a limited information on serum biochemistry and hematology of one humped camel is available, but in most of these studies, the number of animals used were low and animals from different climatic conditions, therefore the obtained values could not be taken as standard in other countries having different climate, Since the camel is an adaptable species, the standard serum biochemical values need to be determined in a large number of animals and in different environmental conditions (2). Essential trace elements are integral components of certain enzymes and in important biological compounds, such as copper in super oxide dismutase, iron in hemoglobin and cobalt in vitamin B12, Trace element deficiencies are common in ruminants, which fed on grass and other natural pastures (3). Trace elements such as copper (Cu) and iron (Fe) are necessary for essential metabolic reactions, and their deficiencies cause different diseases. Furthermore, these elements might causes severe economic loss due to oxidative stress, growth retardation in young animals and anemia (4). The role of iron was a major structural component of hemoglobin and directly required for erythropoiesis. While, other elements were indirectly required for

interaction, metabolism and utilization of iron (5). Iron deficiency anemia could cause low birth weight, preterm delivery and increased oxidative damage to erythrocytes in placenta – fetus unites (6). Iron deficiency (ID) was the most common nutritional worldwide disorder (7). It`s deficiency initiated with reduced normal serum iron level, due to low dietary iron intake, insufficient intestinal iron absorption or increased iron losses, resulting in decreased hemoglobin synthesis (8). Iron deficiency could be divided into three different stages; storage iron deficiency, iron deficient erythropoiesis, and iron deficiency anemia (9). However, Serum iron, TIBC, UIBC and TS% consider essential biochemical tests for diagnosis iron deficiency anemia (10).

Materials and Methods

Blood samples were collected into plain tubes from the jugular veins of 150 clinically normal camels (81 males and 69 females) and 102 clinically suffering from anemia (48 males and 54 females) in Najaf governorate- Iraq. Normal camels were divided into juvenile and young adults aged 1-5 years and adults aged 6–15 years (11). The blood centrifuged for 5-10 minutes at 3000 rpm (12). The separated sera were directly used for the measurement of studied biochemical parameters. The serum iron, copper and cobalt were measured by flame atomic absorption spectrophotometers (13). While, TIBC was measured according to colorimetric method by (14). While TS% and UIBC were calculated according to the following formula: TS% = Serum iron / TIBC × 100 and UIBC=TIBC-Serum iron (15). Data were analyzed using SPSS version 20 (16). The least significant differences test (LSD) was used to determine differences among groups. Data were subjected to analysis of variance statistically using one-way ANOVA. Moreover, significant means were compared by t-test at level ($P<0.05$).

Results and Discussion

The result showed that the ranges and means ± SE values in normal and anemic camels were as follows: Serum iron concentration was 7.37-19.48 µmol/L and 12±0.22 µmol/L in normal, 1.52-15.70 µmol/L and 8.43±0.21 µmol/L in anemic, TIBC 73.80 -108.47 µmol/L and 89.19±0.7 µmol/L in normal, 93.12-135.32 µmol/L and 111.28± 1.02 µmol/L in anemic, UIBC 57.5-95.25 µmol/L and 76.5±0.74 µmol/L in normal, 83.27-125.69 µmol/L and 102±1.06 µmol/L in anemic, TS% 7.80-24.04 % and 14.3±0.27% in normal, 1.22-14.79% and 7.6±0.21% in anemic, serum copper 6.28-16.5 µmol/L and 11±0.2 µmol/L in normal, 3.67-12.40 µmol/L and 7±0.19 µmol/L in anemic, and serum cobalt 0.84-6.78 µmol/L and 3±0.13 µmol/L in normal, 0.42-6.42 µmol/L and 2.67±0.16 µmol/L in anemic. There were significant ($P<0.05$) decreases in serum iron, TS% and serum copper, with a significant ($P<0.05$) increase of TIBC and UIBC in anemic camels compared to that of normal camels. While, there was no significant difference in serum cobalt for both groups (Table, 1).

Table, 1: The biochemical parameters in clinically normal and anemic camels; ranges and means ± SE.

Parameters	Normal (n = 150)	Anemic (n = 102)
Iron µmol/L	7.37-19.48 12±0.22 a	1.52-15.70 8.43±0.21 b
TIBC µmol/L	73.80-108.47 89.19±0.7 b	93.12-135.32 111.28±1.02 a
UIBC mol/L	57.5-95.25 76.5±0.74 b	83.27-125.69 102±1.06 a
TS%	7.80-24.04 14.3±0.27 a	1.22-14.79 7.6±0.21 b
Copper µmol/L	6.28-16.50 11±0.2 a	3.67-12.40 7±0.19 b
Cobalt µmol/L	0.84-6.78 3±0.13 a	0.42-6.42 2.67±0.16 a

Different letters horizontally refers to the presence of significant ($P<0.05$) differences.

The result of the present study indicated significant differences between healthy and anemic values that confirm the finding by (8, 17 and 18). The TIBC and UIBC were significantly higher in iron deficient anemic animals due to the increase of the transferrin molecules which were essential for iron transport from storage sites (19). High TIBC confirm the findings by (20 and 21) of high TIBC in low serum iron. Also, the UIBC increased in iron deficiency anemia due to the increase of the transferrin binding site unbound with iron (22). TS% decrease in iron deficiency anemia could indicate that the

binding site of transferrin was unsaturated (23). Serum iron revealed significant increase in researches (4, 17, 24 and 25) and non-significant increase reported by (1 and 26) in comparison with the findings of the present study. There were 64% of present data lower than the narrow range reported by (27). There were 79.33% of present values less than the range documented by (24). The range of this study located within the extended lower and upper limits of the range by (1). Serum TIBC of this work was significantly higher than that reported by (23, 28 and 29). The range of this study showed 84.66% of the values higher than that of (28). Serum UIBC of the present study showed a significant increase compared with studies by (23 and 29). Serum TS% outcome of the present work was lower than that of (23). Many authors have studied Serum copper in both sexes and age groups. Nazifi *et al.* (4) reported higher values, (3 and 24) recorded low values and a non-significant differences by (1, 2, 30 and 31) in comparison with present study. Other scientist have been studied serum copper range, 123 out of 150 of this data was within (2) range. Only 12 % of present result within the narrow range of (27). While, our range was within the reported ranges (1 and 31). Serum cobalt was significant lower (32), a significant increase (3 and 30) in comparison with this findings. However, the specific biochemicals studied evaluated in both sexes in normal and anemic with the similar findings to the above mentioned relevant groups independent of any subdivision (Table, 2).

Males serum iron was significantly higher (32), non-significantly higher (28 and 29) nearly similar (33 and 34) in comparison with males iron serum of the present study. Serum iron in females of this study was close to the values recorded by (35 and 36). While, (32, 23 and 37) reported a significantly higher iron serum compared to this study. However, present range was within the range reported by (37). Serum copper in males was higher (32), and no significant differences (28 and 38) compared with present results. Serum copper in females was higher (32 and 36), lower (39) and close (37) to present results. Moreover, our range was within (37) range in female camels. However, the biochemical tests estimated in both age groups of normal and anemic camels revealed significant differences except in cobalt (Table, 3).

Table, 2: The biochemical parameters of males and females in normal and anemic camels; ranges and means ± SE.

Parameters	Males		Females	
	Normal (n= 81)	Anemic (n=48)	Normal (n= 69)	Anemic (n =54)
Iron µmol/L	7.37 -18.32 12.34 ±0.28 a	4.84 -11.92 8.43 ±0.27 b	7.92 -19.48 13.05 ±0.34 a	1.52 -15.70 8.43 ±0.33 b
TIBC µmol/L	73.80- 106.20 88.61 ±0.98 b	94.9 -130.49 110.47 ±1.38 a	74.45 -108.47 89.88 ±1.01 b	93.12 -135.32 112.01 ±1.48 a
UIBC µmol/L	59.94 -95.25 76.26 ±1.04 b	85.95- 119.43 102.03 ±1.41 a	57.50 -93.79 76.83 ±1.06 b	83.27 -125.69 103.58 ±1.58 a
TS%	7.80 -21.37 14.09 ±0.36 a	4.33 -11.70 7.69 ±0.27 b	8.99 -24.04 14.63 ±0.42 a	1.22 -14.79 7.64 ±0.33 b
Copper µmol/L	6.28 -16.50 11.003 ±0.26 a	3.67 -12.40 7.05 ±0.30 b	6.56 -16.40 11.06 ±0.32 a	4.33 - 12.10 6.95 ±0.23b
Cobalt µmol/L	0.84 -6.78 3.01 ±0.16 a	0.43 -6.12 2.68 ±0.22 a	0.92 -6.78 3.04 ±0.22 a	0.42 -6.42 2.66 ±0.23 a

Different letters horizontally refers to the presence of significant (P<0.05) differences.

The present work showed close values in all age groups of studied biochemical parameters in healthy dromedary camels. While, there was a significant difference between normal and related anemic groups except in cobalt findings. Although, many researchers reported different age groups in males and females already compared with appropriate group of this study. However, the serum iron of the present study was in agreement with (40) who documented that serum iron was not affected by sex or age. The differences in serum biochemical concentrations in clinically normal camels of this study compared to other researchers may be attributed to one or more of the following; type of feed and breeding, absence of scientific feeding program, season, sex or perhaps it may be ascribed to genetic factors (41).

Table, 3: The biochemical parameters for both age groups in normal and anemic camels; ranges and means ± SE.

Parameters	1 –5 years		6 – 15 years	
	Normal (n=93)	Anemia (n =63)	Normal (n=57)	Anemia (n=39)
Iron µmol/L	8.44 -19.48 12.57 ±0.28 a	1.52 -11.92 8.33 ±0.26 b	7.37 -17.79 12.83 ±0.35 a	5.15 -15.70 8.6 ±0.37 b
TIBC µmol/L	73.88 -106.2 89.24 ±0.91 b	93.43 -135.32 111.74 ±1.34 a	73.8 -108.47 89.13 ±1.11 b	93.12 -130.17 110.55 ±1.56 a
UIBC µmol/L	57.5 -95.25 76.67 ±1.0 b	83.27 -125.69 103.41 ±1.38 a	60.91 -91.54 76.29 ±1.09 b	87.79 -124.16 101.95 ±1.68 a
TS%	9.02 -24.04 14.27 ±0.37 a	1.22 -11.01 7.54 ±0.26 b	7.8 -20.45 14.46 ±0.39 a	4.15 -14.79 7.86 ±0.37b
Copper µmol/L	6.28 -16.4 11.12 ±0.26 a	4.23 -12.40 7.2 ±0.24 b	6.56 -16.5 10.88 ±0.34 a	3.67 -12.1 6.68 ±0.29 b
Cobalt µmol/L	0.84 -6.78 2.98 ±0.16 a	0.43 -6.41 2.48 ±0.21 a	0.92 -6.78 3.09 ±0.23 a	0.42 -6.42 2.97 ±0.24 a

Different letters horizontally refers to presence of significant (P<0.05) differences.

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تقدير بعض المعايير الكيموحيوية في الجمال السليمة سريريا والمصابة بفقر الدم

باقر الظالمي أيمن حديد و حارث عبد الهادي الحديثي

فرع الطب الباطني والوقائي، كلية الطب البيطري، جامعة بغداد، العراق.

E-mail: Harithal.hadithy@gmail.com

الخلاصة

أجريت الدراسة لتقييم حديد المصل, السعة الكلية للحديد المرتبط والسعة للحديد غير المرتبط ونسبة تشبع الحديد الناقل وتركيزي النحاس والكوبلت في المصل في 150 من الجمال (81 ذكور و69 أناث) الطبيعية و102 مصابة بفقر الدم الناتج عن نقص الحديد (48 ذكور و54 اناث) تتراوح أعمار المجموعتين بين 1 سنة إلى 15 سنة في محافظة النجف، العراق. جُمعت عينات الدم من الوريد الوداجي في انابيب خالية من مانع التخثر خلال المدة من شهر تشرين الثاني 2014 لغاية شهر ايار 2015 واستعمل المصل لقياس الفحوصات المطلوبة. بينت النتائج ان المديات والمعدلات ± الخطأ القياسي في الجمال الطبيعية والجمال المصابة بفقر الدم كما يأتي: تركيز حديد المصل 7.37- 19.48 مايكرومول/لتر و 0.22±12 مايكرومول/لتر، 1.52-15.7 مايكرومول/لتر و8.43±0.21 مايكرومول/لترعلى التوالي، السعة الكلية للحديد المرتبط 73.8- 108.47 مايكرومول/لتر و 0.7±89.19 مايكرومول/لتر، 135.32-93.12 مايكرومول/لتر و1.02±111.28 مايكرومول/لترعلى التوالي، السعة للحديد غير المرتبط 95.25-57.5 مايكرومول/لتر و0.74±76.5 مايكرمول/لتر، 125.69-83.27 مايكرومول/لتر و1.06±102 مايكرومول/لتر على التوالي، نسبة تشبع الحديد الناقل 7.80-24.04 % و 0.27±14.3 %، 1.22-14.79% و 7.6 ± 0.21 % على التوالي، تركيز النحاس 6.28 -16.5 مايكرمول/لتر و0.2±11 مايكرمول/لتر، 12.40-3.67 مايكرومول/لتر و0.19±7 مايكرومول/لترعلى التوالي وتركيز الكوبلت0.84-6.78 مايكرومول/لتر و0.13±3 مايكرومول/لتر، 0.42-6.42 مايكرومول/لتر و0.16±2.67 مايكرومول/لترعلى التوالي. اظهرت النتائج انخفاض ($P<0.05$) معنوي في تركيز حديد المصل ونسبة تشبع الحديد الناقل ونحاس المصل. في حين لوحظ زيادة ($P<0.05$) معنوية في السعة الكلية للحديد المرتبط وسعة الحديد غير المرتبط في الجمال المصابة بفقر الدم مقارنة بالسليمة، وكانت تراكيز الكوبلت لحد ما متشابهه في المجموعتين السليمة والمصابة. سجلت هذه الدراسة المدى والمعدلات الطبيعية لبعض القيم الكيموحيوية في الجمال الطبيعية والمصابة بفقر الدم مع وجود فروقات معنوية بينهما.

الكلمات المفتاحية: حديد المصل، القدرة الكلية للحديد المرتبط، القدرة للحديد غير المرتبط، نسبة تشبع الحديد الناقل، نحاس المصل، كوبلت المصل، الجمال.