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EFFECT OF LONG TERM DEHYDRATION ON SERUM CONSTITUENTS IN EXTREME CLIMATIC CONDITIONS IN CAMEL (*CAMELUS DROMEDARIUS*)

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Abstract : Eight healthy female adult camels were used to study the effect of long term dehydration on serum constituents in extreme climatic conditions viz. cold and hot. The dehydration phases were of 24 days in cold and 13 days in hot conditions. The changes in sodium, potassium, calcium and phosphorus were non significant ($P>0.05$) while in chloride, glucose, total proteins, urea, bilirubin, cholesterol and creatinine were significant ($P\leq0.05$) during dehydration phase. The mean values of all the constituents tended to return to normal as the rehydration phase advanced. Changes in sodium and potassium in dehydrated camels reflected that they were able to maintain the salt balance.

Key words : camel, cold, dehydration, hot, rehydration, serum constituents

INTRODUCTION

Water scarcity is a major problem in arid desert regions. Unusual tolerance of the camel to water depletion of the body and very low rate of water loss are exceptional performances in the desert climate (14) but the ability of camels to live comfortably during restricted water supply depends on the climatic condition. Experiments regarding water deprivation has clinical relevance as they help in understanding the dehydration process which may occur as a consequence of fluid losses due to diarrhoea, haemorrhage, burns or any other reason. To understand the physiological changes taking place during dehydration, determination of blood or serum constituents becomes very significant as they offer protection against dehydration. For better understanding the proper health management of camel an investigation was carried out to study the effect of long term dehydration on serum constituents in extreme climatic conditions.

METHODS

Eight apparently healthy adult female camels (*Camelus dromedarius*) ageing 6 to

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10 years, belonging to National Research Centre on Camel, Bikaner, Rajasthan were used in the present investigation.

The experiment was designed to study effect of long term dehydration on serum constituents in extreme climatic conditions viz. cold (December-January) and hot (May). The same animals were used and each animal served as its own control in both the climatic conditions where the experiment was divided into control (10 days), dehydration (24 days in cold and 13 days in hot) and rehydration (5 days) phases. In the control and rehydration phases water was provided *ad libitum* and in the dehydration phase there was complete water restriction. Serum contituents viz. protein (7); glucose, creatinine, cholesterol and bilirubin (11); urea, sodium potassium, chloride, calcium and phosphorus (17) were estimated during all three phases in cold and hot conditions. The data were expressed as mean ± SE of mean and mean comparison was made by paired 't' test (16).

RESULTS

Mean ± SEM of different serum constituents are presented in Table I for cold and Table II for hot conditions. The control mean values of serum sodium, sodium : potassium ratio, chloride, phosphorus, calcium, proteins, urea and creatinine were higher during hot than cold condition while that of potassium, glucose, cholesterol and bilirubin were higher during cold than hot. Progression of dehydration tended to increase the mean values of sodium, sodium : potassium ratio, chloride, calcium, urea, cholesterol, bilirubin and creatinine and to decrease the mean values of potassium and glucose in both the conditions.

TABLE I : Serum constituents of camels during different phases of dehydration and rehydration in cold condition (Mean ± SEM, N = 8).

Main effects	*Sodium m mol/l*	*Potassium m mol/l*	*Chloride m mol/l*	*Na/K Ratio*	*Phosphorus mg/dl*	*Calcium mg/dl*	*Glucose mg/dl*	*Total protein g/l*	*Urea mg/dl*	*Cholesterol mg/dl*	*Bilirubin mg/dl*	*Creatinine mg/dl*
Control phase	166.50 ± 3.703	5.74 ± 0.228	110.75 ± 01.729	29.158 ± 0.664	4.375 ± 0.287	10.225 ± 0.406	122.822 ± 2.455	74.50 ± 0.866	21.75 ± 1.436	41.625 ± 2.382	0.5112 ± 0.070	1.357 ± 0.062
Dehydration phase 8 days	169.50[a] ± 3.900	5.537[a] ± 0.230	112.324[a] ± 1.499	30.785[a] ± 0.721	4.38[a] ± 0.256	10.487[a] ± 0.395	110.375[b] ± 3.11	75.036[a] ± 0.707	40.375[b] ± 4.640	48.5[a] ± 2.22	0.577[a] ± 0.069	2.289[b] ± 0.108
16 days	171.75[a] ± 4.113	5.281[a] ± 0.246	116.00[b] ± 1.802	32.762[b] ± 0.815	4.125[a] ± 0.268	10.875[a] ± 0.376	98.315[b] ± 3.046	78.05[b] ± 0.374	65.25[b] ± 7.544	55.375[b] ± 2.104	0.6562[a] ± 0.056	3.350[b] ± 0.065
24 days	175.12[a] ± 3.800	5.093[b] ± 0.235	120.375[b] ± 1.400	34.641[b] ± 0.845	3.86[a] ± 0.28	11.25[a] ± 0.373	81.75[b] ± 3.452	70.146 ± 0.767	94.37[b] ± 7.977	61.125[b] ± 1.259	0.706[a] ± 0.070	4.255[b] ± 0.084
Rehydration phase 1/2 hour	160.50[a] ± 3.380	5.00[b] ± 0.230	108.125[a] ± 1.705	32.301[b] ± 0.978	3.325[a] ± 0.17	10.40[a] ± 0.40	77.625[b] ± 3.39	68.187[b] ± 0.427	74.37[b] ± 10.818	65.1075[b] ± 1.952	0.532[a] ± 0.071	3.71[b] ± 0.088
24 hrs	161.62[a] ± 3.401	5.312[a] ± 0.222	107.625[a] ± 1.879	30.67[a] ± 0.998	3.05[b] ± 0.123	9.975[a] ± 0.375	100.50[b] ± 3.458	67.912[b] ± 0.186	25.00[a] ± 2.514	46.375[a] ± 2.017	0.5162[b] ± 0.070	1.878[b] ± 0.071
96 hrs	166.00[a] ± 3.380	5.85[a] ± 0.226	112.75[a] ± 2.10	28.538[a] ± 0.710	4.23[a] ± 0.255	9.675[a] ± 0.323	120.25[a] ± 2.388	71.474[b] ± 0.244	24.50[a] ± 1.475	40.83[a] ± 1.998	0.4612[a] ± 0.070	1.680[b] ± 0.042

Subclass means within a given parameter superscribed by letter 'a' do not differ significantly (P>0.05) and by letter 'b' differ significantly (P≤0.05) from control means

TABLE II : Serum constituents of camels during different phases of dehydration and rehydration in hot condition (Mean ± SEM, N = 8).

Main effects	*Sodium m mol/l*	*Potassium m mol/l*	*Chloride m mol/l*	*Na/K Ratio*	*Phosphorus mg/dl*	*Calcium mg/dl*	*Glucose mg/dl*	*Total protein g/l*	*Urea mg/dl*	*Bilirubin mg/dl*	*Cholesterol mg/dl*	*Creatinine mg/dl*
Control phase	170.50 ± 3.831	5.536 ± 0.227	115.75 ± 2.281	30.97 ± 0.717	4.637 ± 0.276	10.737 ± 0.418	117.87 ± 2.27	75.675 ± 0.700	31.216 ± 1.408	0.35837 ± 00.059	31.625 ± 2.382	1.797 ± 0.093
Dehydration phase 5 days	173.50^{a} ± 4.097	5.307^{a} ± 0.237	120.50^{a} ± 2.345	33.04^{a} ± 0.812	4.67^{a} ± 0.246	10.875^{a} ± 0.443	95.00^{b} ± 2.163	77.312^{a} ± 0.647	42.25^{b} ± 3.105	0.4112^{a} ± 0.055	36.875^{a} ± 2.111	3.40^{b} ± 0.081
9 days	176.75^{a} ± 4.374	5.112^{a} ± 0.253	125.59^{b} ± 2.918	34.90^{b} ± 1.090	4.48^{a} ± 0.163	11.262^{a} ± 0.454	89.125^{b} ± 1.875	77.875^{b} ± 0.880	61.25^{b} ± 4.75	0.4812^{a} ± 0.058	43.75^{b} ± 2.730	4.433^{b} ± 0.133
13 days	181.875^{a} ± 4.947	4.85^{a} ± 0.261	131.25^{b} ± 3.653	37.97^{b} ± 1.505	4.26^{a} ± 0.24	11.662^{a} ± 0.490	75.75^{b} ± 2.209	74.724^{a} ± 0.673	93.255^{b} ± 4.625	0.525^{b} ± 0.059	47.625^{b} ± 2.952	5.300^{b} ± 0.139
Rehydration phase 1/2 hour	161.125^{a} ± 4.282	4.225^{a} ± 0.404	112.25^{a} ± 3.83	35.48^{b} ± 1.222	4.398^{a} ± 0.20	10.675 ± 0.505	71.25 ± 0.07	70.50 ± 0.731	83.25^{b} ± 4.011	0.45^{a} ± 0.056	29.00^{a} ± 2.934	4.98^{b} ± 0.171
24 hrs	165.125^{a} ± 3.356	4.812^{a} ± 0.212	109.00^{a} ± 2.434	34.61^{b} ± 1.141	3.92^{a} ± 0.448	10.425^{a} ± 0.480	93.75^{b} ± 2.75	71.72^{b} ± 0.539	44.75^{b} ± 5.60	0.417^{a} ± 0.050	34.875^{a} ± 2.116	3.691^{b} ± 0.131
96 hrs	168.625^{a} ± 3.406	5.40^{a} ± 0.235	112.12^{a} ± 2.348	31.47^{a} ± 0.933	4.47^{a} ± 0.15	10.525^{a} ± 0.421	118.00^{a} ± 1.982	73.525^{a} ± 0.467	31.25^{a} ± 1.423	0.3680^{a} ± 0.051	33.00^{a} ± 2.160	2.199^{b} ± 0.058

Subclass means within a given parameter superscribed by letter 'a' do not differ significantly ($P>0.05$) and by letter 'b' differ significantly ($P\leq0.05$) from control means

The mean values of phosphorus and proteins initially increased and thereafter decreased as the dehydration progressed.

DISCUSSION

(i) Sodium : The mean value was in agreement with the corresponding values reported earlier in camels (12, 20). In the hot period the effect of dehydration was profound causing hypernatraemia (9) which helped the camel to hold water and emphasised the role of aldosterone in enhancing sodium and water reabsorption from kidney and large intestine in dehydrated camel (4).

(ii) Potassium : Earlier it was reported (3, 19) that potassium metabolism was more affected during dehydration in camels, however, our results showed that serum potassium remained unaffected by the dehydration. Probably decreased thyroid hormone concentrations during dehydration made the renal tubules less sensitive to aldosterone (18), therefore potassium excretion was not much affected and less changes occurred in potassium concentration.

(iii) Sodium : Potassium Ratio : A lower Na:K ratio in control camels was observed than the previous reports in camels (19).

(iv) Chloride : The mean value of serum chloride in camels was in agreement with that obtained by other workers (13) in camels. Changes in serum chloride followed the serum sodium concentration to maintain the electrolyte balance. The excretion, absorption and distribution of chloride are passive and accompany sodium levels.

(v) Phosphorus : The mean values in present study were in agreement with the earlier reports on camels (20). A decline during rehydration was presumably due to dietary deficiency as feed intake was reduced during dehydration.

(vi) Calcium : The mean values in present investigation were close to the reported values (13, 20) in camels. Calcium level increased during dehydration probably due to an increased activity of parathyroid gland thereby increasing the retention of calcium in the blood (1). Upon rehydration the mean values decreased due to dilution of blood with water in both conditions.

(vii) Glucose : The mean values of serum glucose were in agreement with the reported values by other workers (10) in camels. Progression of dehydration lowered the serum glucose concentration due to reduction in feed intake. Upon rehydration the values returned back to normal levels because camels stared eating normally.

(viii) Proteins : The mean values were in agreement with the earlier reports (15, 20) in camels. However, higher value was observed during hot in contrast to the higher values in cold (6). This could have been a normal variation. In the present study after an initial rise a lowering in mean values was possibly due to decrease in plasma volume, less feed intake and high cortisol concentration leading to breakdown of proteins.

(ix) urea : Serum urea levels were in agreement with the previous repots (13) in camels. The higher levels indicated the camel's ability to utilise urea nitrogen at times of poor grazing, dehydration (10) and as a part of well adapted system for water conservation.

(x) Cholesterol : The men value in present study were lower than the reported values (20) in camels. The mean value in cold was higher due to higher demand of energy for thermoregulation and homeostasis. The higher serum cholesterol concentration with the advancement of dehydration could be related to decrease in thyroid hormone during dehydration (8).

(xi) Bilirubin : The elevation in the serum bilirubin level was attributed to the reduced feed intake during dehydration as fasting increases blood bilirubin levels (2) constipation. In last phase of dehydration in the camels rumen motility was tremendously decrease leading to severe impaction.

(xii) Creatinine : A rise in creatinine during cold and hot dehydrations corroborated the earlier findings (20). Increased concentration of serum creatinine could be the outcome of decreased GFR and increased muscle breakdown during dehydration in camels (2).

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