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Research Article

Serum biochemistry of the Asian elephant

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Abstract

Keywords

Elephant,
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Indicators

Elephants have been associated with human activities in India from time immemorial, their management and husbandry practices have been a challenge with numerous variations in the biological features of elephants a lot of confounding factors that causes variations in their serum biochemical values, however a guiding value should be marked as this will be helpful in taking critical and maybe even life saving decisions. The variation in sex may or may not have arbitrary difference in the values obtained that can be critical factors while assessing health. The serum biochemistry values of elephants have been estimated and the values are compared with universal standards in order to formulate baseline values. Further specific control conditions are required to find the true lining values.

Introduction

Elephants are always a specialty to the world. Elephant husbandry dates to very old times were in the kings used elephants in the battle field. From their free ranging style to captivity lot of factors change in correspondence to their activity patterns, feeding ecology, social behavior, walking, foraging and parenting with respect to matriarchy. Establishment of normal serum biochemical values is prerequisite for proper interpretation, diagnosis and treatment of diseases as these animals live longer, therefore the organ functionality and blood metabolite profile is essentially important. There may be confounding factors that contribute to the difference in biochemical variables between captive and wild elephants. This paper aims at providing concrete knowledge on the normal blood biochemical values in elephants which will be useful for veterinarians who play a

pivotal role in the conservation of elephants by assessing the health status both in the wild as well as in captivity. Further the values recorded will be useful in enriching the health related database in these mega herbivores. The veterinary aspects of metabolic and organ functions can be closely analyzed for better and effective management.

Materials and Methods

2.1 Place of study:

The study was carried out in various temples having elephants, Circuses, biological parks and forest camps wherein captive elephants were maintained.

Asiatic elephants were included in this study.

Place	Males	Females
Circus	4	1
Banerghatta biological park	8	4
Temple elephants	2	15
Forest camp elephants	18	16
Total	32	36

The study was carried during the month of September 2014. Samples were collected from elephants once during the study period. The animals were all apparently healthy and grouped into two, males and females. All the animals involved in the study were apparently healthy and the females were non pregnant as the individual physiological status alters the biochemical values.

2.1.3 Blood collection

Blood was collected from the superficial vein located at the external aspect of the ear, using a clean, sterile 16 G disposable hypodermic needle into a sterile serum vial. (BD Vacutainer^R). (Jain 1986)

2.1.4 Blood biochemistry

All the biochemical parameters were quantified from the serum using standard techniques. Blood urea nitrogen (BUN) was estimated as per Diacetylmonoxime method (crocker 1967), Serum Creatinine was estimated by alkaline

picrate method (Bauer et al. 1982), Total bilirubin (Jendrassik and Grof 1938), and direct bilirubin (Powell 1994), the difference between them provided the value for indirect bilirubin, glucose was done by Orthotoluidine method (cooper,1973), total protein by biuret method (Doumas, 1975), Albumin was estimated by dye binding method (Doumas et. al 1971), Globulin was estimated by the difference between total protein and albumin, A/G ratio was calculated and serum Cholesterol was also done (Wybenga and Pilegg's , 1970).All statistical analysis was done by non- paired "t" tests.

Results

The data that was enumerated during the investigation of serum biochemistry parameters namely, Blood urea nitrogen (BUN), Creatinine, Total bilirubin, direct bilirubin, indirect bilirubin, glucose, total protein, Albumin, Globulin, A/G ratio, Cholesterol (Table 1,2)

Table 1

Sex	BUN mg/dl	Creatinine mg/dl	Total bilirubin mg/dl	Direct bilirubin mg/dl	Indirect bilirubin mg/dl
Male	15.89±0.98	1.29±0.28	0.73±0.03	0.11±0.06	0.04
Female	13.47±0.89	1.96±0.39	0.69±0.07	0.09±0.09	0.06
"t" test	3.21 ^{NS}	2.74 ^{NS}	0.22 ^{NS}	0.65 ^{NS}	0.13 ^{NS}

Table 2

Sex	Glucose mg/dl	Protein g/dl	Albumin g/dl	Globulin g/dl	A/G ratio	Cholesterol mg/dl
Male	79±2.66	6.71±0.42	2.49±0.55	4.22±0.17	0.59±0.04	58±5.25
Female	72±3.15	7.36±0.36	2.137±0.44	4.99±0.14	0.47±0.05	62±4.31
"t" test	3.21 ^{NS}	2.15 ^{NS}	0.84 ^{NS}	2.75 ^{NS}	0.09 ^{NS}	0.19 ^{NS}

Discussion

4.1 Blood Urea Nitrogen (BUN)

The findings of increased BUN value during the study in young elephant group was indirectly supported by Hill and

Smith (1990) who observed that urea and cholesterol values were highest in the young group of elephants. Despite the presence of difference in the BUN level between the two groups. The variation in the feed regimen could be attributed as a cause for difference in the BUN level in between age group of elephants investigated during

the study; Brown et al. (1978) quoted that reduced dietary protein intake during the dry season was the cause for the low levels of blood urea in elephants; The presence of highly significant decrease in adult elephants of this study is in agreement with the reports given by Mikote et al. (1994) who stated that values of BUN decreased with age in Captive African elephants.

In overall mean value of BUN in the elephants under study however, was found to be in agreement with the reports given by Mikote et al. (1994) in the female Asian elephants; It was stated by Nirmalan and Nair (1971) that the BUN value were higher in non-lactating adult females when compared to the tuskers and lactating females; However, in the study only one male was encountered which was in younger age group.

The overall mean value reported in the study animals was found to be less than the value reported by Sastry (1989), Wallach and Boever (1983) in African elephants and Lewis (1974) in Asian elephants. The overall mean value obtained in this study was in agreement to the range of BUN value reported by Silva and Kuruwita (1993) in domesticated elephants.

4.2 Creatinine

Difference in the serum Creatinine constituent of Asian elephant blood was observed during the study were supported by Sassendran (1994) and Nirmalan and Nair (1971); Further, the seasonal variation in the serum Creatinine level may be revealed by Brown et al. (1978). Though a highly significant increase was noticed in the mean value of serum Creatinine in case of adult elephants were however; found to be within the normal range reported by different authors; Increased in weight and dietary factors might be attributed for this significant raise in study animals. Osborne et al. (1972) stated that the quantity of Creatinine produced depends on skeletal muscle mass and a non-protein nitrogenous substance which was formed during metabolism of muscle creatin and phosphocreatin and advantage over estimation of BUN was that the Creatinine was influenced by fewer non renal variables than BUN; Elevation of Creatinine concentration may be caused for renal system disorders, increased Creatinine indicates reduction in the glomerular filtration rate. In the difference in serum Creatinine observed during the study was also supported by reports from Niemuller et al. (1990) who opined that muscle mass one factor influencing Creatinine concentration and it was therefore interest to find that higher Creatinine concentration in wild African elephant during dry season when food and fluid readily not available. The mean value of overall serum Creatinine in the elephants under study was found to be in agreement to the value reported by Nirmalan and Nair (1971) in Indian elephants and value reported by Fowler (1986); Silva and Kuruwita (1993) also quoted the Creatinine level in free-ranging

Asian elephants was 1 to 1.3 mg per dl, which was similar to those found in domesticated Asian elephants. Altered renal function during the period of water shortage may cause change in serum Creatinine constituent of elephants (Brown and White, 1980).

4.3 Total bilirubin, direct and indirect bilirubin

The overall mean value of total bilirubin obtained in the study was agreement to the findings of Silva and Kuruwita (1993) in free-ranging Asian elephants. The overall total bilirubin value in the study was little higher than the value reported by Lewis (1974) but lesser than the value reported by Niemuller et al. (1990) in Asian elephants; However, the mean value of direct bilirubin was in agreement with the range reported by Silva and Kuruwita (1993) in free-ranging Asian elephant blood. The mean values of indirect bilirubin in young and adult elephants groups were non-significant. Age did not exert any influence on indirect bilirubin value. The overall mean value of indirect bilirubin in the study was little higher than reports given by Silva and Kuruwita (1993) and also little lower than value reported by Niemuller et al. (1990). The overall mean value of total bilirubin obtained during the study in the elephants under investigation was found to be higher, when compared to the total bilirubin values reported by Benjamin (1997) in species like cattle, sheep, goat, pig, dog and cat; however, the overall mean total bilirubin value in the study elephants falls within the range quoted for horses. The reasons for the presence of such high total bilirubin concentration in these study animals could be attributed to the anatomical fact that gall-bladder absent in elephants like horses; Because of the absence of gall bladder in this large mammal of our present times, there is continuous secretion of bile material from the hepatic tissues and this might be attributed as a causal factor for the presence of high concentration of total bilirubin in elephants. This was in agreement with the reports given by Silva and Kuruwita (1993). Interpretation on results associated with liver function and possible renal activity need to be made cautiously, if samples are obtained from male Asian elephants near or in musth (Niemuller et al., 1990) and a hypothesis that a direct connection between high testosterone concentration and alternative in some of the biochemical parameters indicative of liver function was attributed as a cause for this; However, except from one male animal in the young elephant group, all other samples were obtained from female elephants only, during this course of study.

4.4 Glucose

Presence of higher serum glucose level in young elephant group was observed during this study when compared to adult elephant group was in agreement with findings reported by Nirmalan and Nair (1969) in Asian elephants. Newborn ruminant calf which is in the preruminant stage, blood serum glucose was reported to be higher than that of

adults. Age advancement and dietary factors in general shall be attributed as the cause of highly significant decrease in the serum glucose level in case of adult elephant group. Saseendran (1994) recorded the decreased glucose level and cause was attributed to the reduced feed intake during musth state. The overall mean serum glucose value of the study elephants falls in the range reported by Fowler (1986) and was lesser than the value reported by Lewis (1974); However, the serum overall mean value obtained in the study elephants falls in the range reported by Wallach and Boever (1983) in African elephants. The mean serum glucose value obtained in this study falls within the range quoted by Benjamin (1997) in horses and the obtained mean value in the study group was in closer level with the mean value reported by Mikote et al. (1994).

4.5 Total protein, albumin, globulin and A/G ratio

The increase in the serum total protein and globulin value observed in the adult elephant group was in agreement with the finding reported by Nirmalan and Nair (1971) who revealed that the plasma of non-lactating female elephants had higher levels of total protein and globulin than baby elephants, as observed in the groups of elephants investigated in this study. Presence of an increase in serum total protein and globulin as the age of animal advances had been reported in other species like cattle, sheep and pigs also. Age advancement might be suggested as the probable cause for the highly significant raise in serum protein and significant raise in globulin in the study animals; additionally the increase occurrence of globulin levels might be attributed to presence of significant viscosity of elephant's blood and Brown and White (1980) reported that elephant serum was found to have higher total protein and lower albumin than that of most other mammals. Nath et al. (1993) stated that determination of total protein, albumin and albumin globulin ratio are very useful analyses for first approximation in the classification of protein dyscrasia which may result from diseases and nutritional imbalances. Similar type of variations as noticed during this study were encountered by Nirmalan and Nair (1971) during the estimation of A/G ratio in Indian elephants and it was stated that Indian elephants were found to have a very low A/G ratio compared to that of other mammals. However, Saseendran (1994) reported the absence of any influence on A/G ratio by factors like age, sex or musth in case of Asian elephants. The mean value of serum total protein observed in the study animals regardless of the group was in agreement with the range documented by Lewis (1974) in Asian elephants and Brown and White (1980) in Indian elephants. Further, as revealed by Sastry (1989), the obtained serum total protein value was higher than total protein value of horse. The presence of albumin in fewer amounts than globulin as observed in this study was in agreement with the reports given by Niemuller et al. (1990) in Asian elephants and by Lewis (1974) in Indian elephants. Benjamin (1997) quoted that albumin predominate over

globulin in species like dog, sheep, goat and man; however a relative amount of albumin and globulin are nearly equal or globulin tends to be in excess of albumin in horse, cattle and pigs. The low A/G ratio encountered in these study animals might be attributed to the presence of increased globulin content than albumin. The mean value of A/G ratio obtained during this study was lower than the value reported by Ostrowska et al. (1988) in the serum samples of Indian elephants. Silva and Kuruwita (1993) documented on the wide range of A/G ratio as 0.17 to 1.05 in domesticated Asian elephants blood, which was lower than free-ranging Asian elephants and quoted that sex did not influence on the A/G ratio of the Asiatic elephants.

4.6 Cholesterol

The mean values of serum cholesterol in young and adult elephant groups were non-significant. Age could not exert any influence on serum cholesterol level. Overall mean value of serum cholesterol obtained during the study falls within the range quoted by Wallach and Boever (1983) in African elephants and was little higher than the value reported by Fowler (1986). The mean serum cholesterol reported in Indian elephants by Nirmalan and Nair (1969) was higher than the values obtained in this study elephants; However, during the study on total serum cholesterol level of elephants by Ratnasooriya et al. (1995), still lower value of serum cholesterol like 43.34 ± 1.81 mg per dl were reported in female elephants. There is a strong direct relationship between total plasma cholesterol level and risk of coronary heart diseases as reported by Connor and Connor (1972).

Conclusion

The serum biochemical values recorded in this study were from apparently healthy elephants and this would definitely form a baseline reference that could be used to diagnose various conditions using serum values as prognostic indicators. The stern strain of clinical diagnosis can be alleviated and precise diagnosis may be attained.

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