Hematological Value of Captive Elephants (*Elephas maximus*) Around Chitwan National Park, Sauraha, Nepal

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Abstract

Veterinary hematology serves as an important screening procedure to assess general health condition, diagnosis, and treatment of disease. The study was aimed to interpret and establish a set of hematology reference range for Asian elephants kept under private and government facilities of Nepal as no major work has been done till now. Blood samples from 50 elephants around Chitwan National Park, Sauraha was collected and hematological parameters like total erythrocyte count and total leukocyte count were determined. The results showed that the majority of hematological value was in line with the value previously published by different authors. The mean erythrocyte and leukocyte count was reported as $3.32 \pm 0.93 \times 10^6$ cell/ μ L and 10448 ± 335.49 cells/ μ L respectively. No sex-associated significant difference was observed in the case of total erythrocyte count whereas total leukocyte counts varied significantly within sex. Our finding revealed no significant difference in hematological parameters between governmental and privately owned elephants. The hematological value of our study can be used as a reference value for assessing the health condition of elephants in Nepal. Further research work should be conducted to evaluate the factors affecting hematological parameters.

1. Introduction

Out of two species of elephant alive today under order Proboscidea, Asian elephants (*Elephas maximus*) are the largest of all mammals in Nepal. Wild elephants in Nepal occur in four isolated populations – the eastern population in Koshi Tappu Wildlife Reserve and Jhapa district; the central population in Chitwan National Park and Parsa National Park; western population in Bardia National Park and adjoining municipalities; and far-western population in Suklaphanta National Park and adjoining municipalities (Pradhan, Williams, & Dhakal, 2008). Being mega-herbivore and having long-range dispersing behavior, there is frequent of wild elephants with human beings in the course of their movement. So, there is a greater chance of human-wildlife conflict and wild elephants pose a great problem to the local communities because of the destruction of private property, crop destruction, attack, and injury (Shrestha, 2007). On the contrary, captive elephants have restricted freedom and have no independent grazing time.

Captive elephants i.e. working elephants are prone to various health problems including swelling of the eye by foreign body pricks, the opacity of the cornea, lameness due to sole pricks, and contusion by banging in rocks and logs. The infection of the sole may occur due to pricks. Various equipment used while controlling the animal and the pressure of Hauda and Gaddi on the back while carrying guests and other loads can cause wounds. Ecto and endo parasitism is also a common problem seen in captive elephants. The major infectious disease affecting the elephant are Anthrax, Hemorrhagic septicemia, FMD, Rabies, Tuberculosis, Tetanus, Encephalo-myocarditis, Pox, Salmonellosis, herpes virus infection etc. Other parasitic diseases affecting blood cells include Babesiosis, Anaplasmosis, Trypanosomiasis and Ehrlichiosis (Miller et al., 2015). The majority of Captive elephants are found in and around Chitwan National park and are used for patrolling and tourism purposes. As the majority of captive private elephants are used for tourism purposes, they are economically important which increases the need for

proper veterinary care to improve their health status. Hematology is defined as the study of components of blood (RBC, WBC, Platelets) for diagnosis and monitoring disease(Ramirez, 2007). There is a broad variation in how animals respond to captivity when raised under different conditions of management practices. In general, captive elephants are raised under good management conditions like proper health care, good dietary plan so they are often healthier than free-ranging wild elephants.

Knowing the normal hematological value plays a major role in the proper diagnosis, treatment, and interpretation of diseases. Precise hematological reference intervals and normal blood values are useful for evaluating the health status of animals, monitoring the course of the disease, proper diagnosis, and to know the treatment efficacy(Janyamethakul et al., 2017; Silva & Kuruwita, 1993). Although normal hematological values exist for Asiatic elephants, they may not be relevant because these values are affected by different genetic and non-genetic factors. So, elephants under different geography or different condition of feeding, housing practices may differ in hematologic value. Stress due to daily duty and activity, clinical condition, temperature, sex can make significant differences in hematological values(Addass, David, Edward, Zira, & Midau, 2012; SWENSON, 1984; Yaqub, Kawu, & Ayo, 2013). As no major work has been done in Nepal till now to establish the hematological parameter for captive elephants, the study was aimed to evaluate and devise a set of hematology reference range for Asian elephant used in the private sector as well as governmental sector.

2. Materials And Methods

2.1 Blood Sample Collection

Blood samples from 50 elephants from around Chitwan National park, Sauraha were collected from the auricular vein of elephants in the morning time period. Blood is divided into two separate tubes:

- 1) EDTA tube and
- 2) Serum tube where serum will be separated by centrifugation at 1500 rpm for 5 min.

Sample is submitted to NTNC-BCC molecular lab, Sauraha, Chitwan and hematology was performed within 2 hours of blood collection. Total RBC count and WBC count were determined using Hemocytometer (Neubaur Counting Chamber).

2.2 Data Analysis

Statistical analysis was done using SPSS Version 20. The reference interval with 95% confidence intervals for each parameter was calculated. P values were determined using student T-test was used to determine differences of blood parameters between males and females and comparison with feeding habit and exercise of animals. The level of statistical significance was set at $\alpha < 0.05$.

Note

We performed RBC and WBC counts manually using hemocytometer because blood cells in elephants are larger and rouleaux formation occurs in elephants RBC which differ from human blood cells due to which an automated human hematology analyzer can lead to unreliable results (Dutton, 2008).

3. Results And Discussions

The data recorded during the investigation of hematological parameters like total erythrocyte count, total leucocytes count were subjected to statistical analysis and P-value was obtained using student T-test to determine differences of blood parameters between males and females.

The total erythrocyte count and total leukocyte count of 50 elephants were obtained as:

From our study, the number of captive female elephants was found to be significantly greater than captive male elephants in Sauraha. The aggressive behavior of male makes it difficult to control under captive condition and aggressiveness further increases during breeding season. In the private sector where elephants are primarily used for tourism purposes, only female elephants were kept because they are docile and human friendly. But in the governmental sector, few male elephants were kept for patrolling purposes. Our study showed that reference hematological values fall within the range published by other authors for Asian elephants.

From our study the average erythrocyte count in male elephant was found to be $(3.21 \pm 0.15) \times 10^6$ cells/ μ L ranging from 2.40×10^6 cells/ μ L - 3.16×10^6 cells/ μ L. In the case of a female elephant, erythrocyte count ranges from 2.04×10^6 cells/ μ L - 4.95×10^6 cells/ μ L with an average of $(3.34 \pm 0.11) \times 10^6$ cells/ μ L. No sex-associated clinically significant difference was observed in elephants from our study. The range of erythrocyte count in both male and female during our study were in line with the value reported by Janyamethakul et al., (2017) and slightly lower than values reported by Debbie & Clausen, (1975) in African elephants. The mean value of erythrocyte was found in line with the value reported by Brown & White, (1980) but greater than the value reported by earlier researchers during their study (Gromadzka-Ostrowska, Jakubów, Zalewska, & Krzywicki, 1988; Lewis, 1974; Woodford, 1979). Comparably the overall mean value of total erythrocyte count was found to be lower than the mean value reported by Young & Lombard, (1967) in African elephants. The red blood cells are biconcave discs and are large, possibly larger than in any other mammal in African and Indian elephants, having a mean diameter (MD) slightly greater than 9 μ m ($1 \mu\text{m} = 1 \times 10^{-12}$ m) (Brown & White, 1980). The larger size of elephant red blood cells was further reported by Jarernsak Salakij et al., (2005) and Gromadzka-Ostrowska et al., (1988). Despite the large size, the total RBC count in elephants is lower than other mammals. Low erythrocyte count seen in elephants suggests that the erythrocytes are still in the primitive state compared with the other mammals and have not attained the efficiency in the transportation of blood gases that results from a reduction in size to facilitate numerical increase (Nirmalan, Nair, & Simon, 1967). The lower erythrocyte count in elephants than other species was supported by values reported by Benjamin, (1978) and Egbe-Nwiyi, Nwaosu, & Salami, (2000) in species like sheep, goat, cattle, dog, cat as well as finding of Windberger, Bartholovitsch, Plasenzotti, Korak, & Heinze, (2003) in different mammalian species including

horse and rabbit. Lewis, (1974) also reported that the total erythrocyte value of elephant was lower than human. A significant effect of sex was observed in hematological values in numerous species(Etim, Enyenihi, Williams, Udo, & Offiong, 2013). But our study showed no sex-associated significant difference in the erythrocyte count. Janyamethakul et al., (2017) also found no sex-associated significant difference in total RBC count in Asian elephants. This finding was further supported by the findings of earlier researchers (Salakij et al., 2005; Silva & Kuruwita, 1993).

Our study revealed the average leucocytes count in male elephant to be 12312.5 ± 729.16 cells/ μL ranging from 8500 cells/ μL – 15500 cells/ μL . In case of female elephant total leukocyte count ranges from 7100 cells/ μL – 16750 cells/ μL with an average of 10092.86 ± 351.60 cells/ μL . Sex-associated clinically significant difference was observed in elephants. The result of our study was in line with the finding of Janyamethakul et al., (2017) and Young & Lombard, (1967). However, our mean value was lower than the value reported by Lewis, (1974) and Brown & White, (1980) in Indian elephant and Debbie & Clausen, (1975) in African elephant. Comparably, the mean value reported during our study was found to be greater than the value reported in African elephants(Woodford, 1979). Our finding revealed a sex-associated clinically significant difference ($p < 0.05$) in elephant WBC count which was in agreement with the reports given by Young & Lombard, (1967) and Salakij et al., (2005). The total leukocyte count of the baby elephant of age up to 5 years of age was found greater than other age groups which are in agreement with findings reported by Nirmalan et al., (1967). However, total leukocyte count in other age groups was found similar. This finding was further supported by Niemuller et al., (1990) where he found that the total leukocyte count in Asian elephants was a constant overtime period and was similar in the different age groups of elephants(Niemuller, Gentry, & Liptrap, 1990). The variation of parameters might be due to different lab errors like sample preparation and transportation, storage, and blood collection method. A non-significant increase in total leukocyte count was found in a pregnant elephant than a non-pregnant non-lactating female elephant during our study. However the high leukocyte count in the pregnant elephant was reported by Ajitkumar et al., (2009).

Our study involved the sample collected within the same season. So the effect of season on hematological value wasn't possible to be determined. However Gromadzka-Ostrowska et al., (1988) reported a slight increase in white blood cell counts and lowered red blood cell counts during the winter season. The lower RBC counts in the winter season may be due to the non-availability of green and poor diet.

Table 1

Reference range of hematology (Total erythrocyte count and total leucocytes count) values for Captive elephants in Sauraha for both sexes)

Parameters	Unit	Range (Male, n = 8)	Range (Female, n = 42)	All elephant (n = 50)
RBC count	$\times 10^6$ cells/ μL	2.40–3.16	2.04–4.95	2.04–4.95
WBC count	cells/ μL	8500–15500	7100–16750	7100–16750

Table 2
Total erythrocyte count and leukocyte count of all captive elephants in Sauraha irrespective of sex (MEAN $\pm$ S.E)

Parameters	Unit	All elephant (n = 50)
RBC count	$\times 10^6$ cells/ μ L	3.32 $\pm$ 0.93
WBC count	cells/ μ L	10448 $\pm$ 335.49
S.E = Standard error		

Table 3
Effect of sex on Hematology of Captive elephants in Sauraha (MEAN $\pm$ S.E)

Parameters		Total RBC count ($\times 10^6$ cells/ μ L)	Total WBC count (cells/ μ L)
Sex	Male	3.21 $\pm$ 0.15	12312.5 $\pm$ 729.16
	Female	3.34 $\pm$ 0.11	10092.86 $\pm$ 351.60
P-value		0.607 ^{NS}	0.014 [*]
Asterisk (*) showed significant difference of blood parameters between sexes (P < 0.05)			
NS = Not significant			

4 Conclusion And Recommendation

In this study, none of the elephants were suffering from health issues. Knowing of normal hematological value is paramount in the proper diagnosis of disease. Further standardization of this value is needed for an accurate diagnosis. Since elephant blood parameters are affected by different factors, further research works should be conducted to evaluate the effects.

Declarations

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Conflict of interest

Authors have no conflicts of interest to disclose.

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Figures

Figure 1

Total Erythrocyte count of elephants with Elephant ID.

Figure 2

Total Leucocyte count of elephants with Elephant ID.

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