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**Barkha Gupta**

Department of Veterinary Physiology and Biochemistry, Post Graduate Institute of Veterinary Education and Research (PGIVER), Jaipur, Rajasthan, India

**GS Gottam**

Department of Veterinary Physiology and Biochemistry, Post Graduate Institute of Veterinary Education and Research (PGIVER), Jaipur, Rajasthan, India

**Lenin Bhatt**

Senior Veterinary Officer, State Disease Diagnostic Centre (SDDC), Jaipur, Rajasthan, India

**PK Mittal**

Department of Veterinary Physiology and Biochemistry, Post Graduate Institute of Veterinary Education and Research (PGIVER), Jaipur, Rajasthan, India

**AK Pandey**

Department of Veterinary Physiology and Biochemistry, Post Graduate Institute of Veterinary Education and Research (PGIVER), Jaipur, Rajasthan, India

**SK Jindal**

Department of Veterinary Physiology and Biochemistry, Post Graduate Institute of Veterinary Education and Research (PGIVER), Jaipur, Rajasthan, India

**DR Bilochi**

Department of Veterinary Physiology and Biochemistry, Post Graduate Institute of Veterinary Education and Research (PGIVER), Jaipur, Rajasthan, India

**Arvind Mathur**

Senior Veterinary Officer, Zoo, Jaipur, Rajasthan, India

**Corresponding Author:****Barkha Gupta**

Department of Veterinary Physiology and Biochemistry, Post Graduate Institute of Veterinary Education and Research (PGIVER), Jaipur, Rajasthan, India

## Hematological studies in Indian elephants (*Elephas maximus*)

**Barkha Gupta, GS Gottam, Lenin Bhatt, PK Mittal, AK Pandey, SK Jindal, DR Bilochi and Arvind Mathur**

**Abstract**

The Asian elephant (*Elephas maximus*) is an endangered species, due to habitat loss, human overpopulation and increase in poaching. Therefore, it is most important to study intensively to determine the health status of the individuals. The objective of the present study was to evaluate and interpret hematological reference ranges in the Asian elephants. Blood samples from 10 adult female Indian elephants were analyzed to assess the hematological values. Blood samples were collected from the auricular vein. The Complete Blood Count (CBC) was performed using automatic blood analyzer. The Mean  $\pm$  SE of Erythrocyte count (RBC), Total Leukocyte count (TLC), Platelets count (PLT), Hemoglobin (Hb) and Hematocrit value (PCV) in the blood of elephants were  $2.98 \pm 0.10 \times 10^6/\mu\text{L}$  ( $2.38 - 3.36 \times 10^6/\mu\text{L}$ ),  $9.25 \pm 1.11 \times 10^3/\mu\text{L}$  ( $5.31 - 15.34 \times 10^3/\mu\text{L}$ ),  $213.50 \pm 23.15 \times 10^3/\mu\text{L}$  ( $122 - 346 \times 10^3/\mu\text{L}$ ),  $11.94 \pm 0.20 \text{ g/dl}$  ( $11.2 - 13.2 \text{ g/dl}$ ) and  $36.02 \pm 1.47 \%$  ( $28.3 - 42.1 \%$ ), respectively. The Differential Leukocyte Count i.e. The Mean  $\pm$  SE of Lymphocyte, Monocyte, Neutrophil, Eosinophil and Basophil count were  $3.33 \pm 0.64 \times 10^3/\mu\text{L}$  ( $0.477 - 6.585 \times 10^3/\mu\text{L}$ ),  $0.81 \pm 0.30 \times 10^3/\mu\text{L}$  ( $0.274 - 3.427 \times 10^3/\mu\text{L}$ ),  $3.75 \pm 0.67 \times 10^3/\mu\text{L}$  ( $1.309 - 6.801 \times 10^3/\mu\text{L}$ ),  $1.33 \pm 0.33 \times 10^3/\mu\text{L}$  ( $0.187 - 3.835 \times 10^3/\mu\text{L}$ ) and  $0.02 \pm 0.00 \times 10^3/\mu\text{L}$  ( $0.001 - 0.044 \times 10^3/\mu\text{L}$ ), respectively. The results were compared with other adult female Indian elephants; there were no significant differences nearly in all hematological values. Most of the findings of blood analysis are closely similar with the normal values. Therefore, all adult female Indian Elephants seem to be normal and healthy in the present study. The findings suggest that hematological reference ranges are appropriate for assessing the health status of the domestic elephants.

**Keywords:** Indian Elephant, Hematology, Erythrocyte count, Leukocyte count, Platelet count, Hemoglobin, Hematocrit value.

**1. Introduction**

Authentic hematologic references are useful for appraising the health status of animals and for proper diagnosis of disease and evaluation of treatment efficacy. Apart from free-living population of Indian elephants found in several protected areas, domesticated and trained elephants are being used for drought purpose by forest department, in circus and in temples for religious occasions in India. Asian elephants are one of two species of elephant alive today. They are endangered, due to human overpopulation, diminishing and poaching<sup>[1]</sup>. Blood hematology serves as the important screening procedure for diagnosis and treatment during diseased condition<sup>[2]</sup>. The Asian elephants have been living in human society since the time of ancient India as they play significant role in country's history, culture and tourism. In Rajasthan State, they are important economically as most domestic elephants are primarily used for tourism. The manifestation of illness of working elephants many a times is ignored on account of lack of awareness. Blood hematology serves as the important screening procedure for diagnosis and treatment during diseased condition. A very few studies have been conducted on hematological reference ranges in Asian elephants. Therefore, in present study, an attempt was made to evaluate, interpret and establish hematological reference ranges in the Asian elephants for improving disease diagnosis, leading to better veterinary care of an endangered species.

**2. Materials methods**

**2.1 Animals:** A ten adult domestic female Asian elephants (aged about 15-40 years approximately) were screened to know the health status, from Hathi – gaon, Amber, Jaipur, Rajasthan, India.

**2.2 Blood sample collection:** Blood samples were collected from the auricular vein of these elephants during annual health checks, mostly in the morning before activities. Blood was collected into EDTA tube and gently mixed. The samples were stored at refrigerator temperature till processing. Blood samples were analyzed by the Auto Hematology Analyzer (Spincell 5 compact Vet Mode) and the Complete Blood Count (CBC) was performed.

**2.3 Statistical Analysis:** The data were recorded and statistical analysis was performed using Microsoft Excel-2007.

### 3. Results and Discussion

The results of the present study are depicted in Table 1. The Mean  $\pm$  SE of Erythrocyte count (RBC), Total Leukocyte count (TLC), Platelets count (PLT), Hemoglobin (Hb) and Hematocrit value (PCV) in the blood of elephants were  $2.98 \pm 0.10 \times 10^6/\mu\text{L}$ ,  $9.25 \pm 1.11 \times 10^3/\mu\text{L}$ ,  $213.50 \pm 23.15 \times 10^3/\mu\text{L}$ ,  $11.94 \pm 0.20 \text{ g/dl}$  and  $36.02 \pm 1.47 \%$ , respectively.

The Differential Leukocyte Count i.e. The Mean  $\pm$  SE of Lymphocyte, Monocyte, Neutrophil, Eosinophil and Basophil count were  $3.33 \pm 0.64 \times 10^3/\mu\text{L}$ ,  $0.81 \pm 0.30 \times 10^3/\mu\text{L}$ ,  $3.75 \pm 0.67 \times 10^3/\mu\text{L}$ ,  $1.33 \pm 0.33 \times 10^3/\mu\text{L}$  and  $0.02 \pm 0.00 \times 10^3/\mu\text{L}$ , respectively where as Mean  $\pm$  SE values of Lymphocyte, Monocyte, Neutrophil, Eosinophil and Basophil count percentage were  $35.63 \pm 6.04\%$ ,  $11.43 \pm 5.81\%$ ,  $39.20 \pm 4.45\%$ ,  $13.49 \pm 2.44\%$  and  $0.28 \pm 0.05\%$ , respectively.

In the present study, most of the findings of blood analysis are more or less similar with the research findings of various investigators [3, 4 and 5]. The reference ranges of all the analyzed parameters of the present study are also in agreement with the reference ranges [6, 7]. Therefore, all adult female Asian Elephants seem to be normal and healthy. The findings suggest that the ranges are appropriate for assessing the health status of the domestic elephants.

In the Elephant, the Red Blood Cells/ Erythrocytes are large in size, having a mean diameter slightly greater than  $9 \mu\text{m}$ . Therefore, lower red cell count is present in elephants than in other mammals. High red cell counts may possibly be indicative of habitat induced cardiovascular disease or be caused by sampling errors or stress where as low counts in pregnant animals.

Reticulocytes are typically absent from the blood of apparently healthy but may be observed in the blood of anemic elephants.

Analysis of WBC found that segmented neutrophils and lymphocyte predominated as in previous reports [3, 8] and more eosinophils than monocytes [8] which were similar with our findings. Monocytes were the main WBC in juvenile elephants [9]. The variation of blood parameters of each study might be prejudiced by various of laboratory error such as pre-analytical error; for instance, blood collecting method, blood sample preserving procedure before handling to laboratory, storage period until examination, and sample

transportation. Process before handling to lab and storage period until examination is also important due to damaged erythrocytes may swell during storage and transport, and this can increase the MCV which measured by automatic counters [8].

Mean Cell Volume (MCV), Mean Cell Haemoglobin (MCH) and Mean Cell Haemoglobin Concentration (MCHC) has been calculated in our study which is in close agreement with other hematological studies in Asian Elephants.

The packed cell volume (PCV) averages around 35-37% and ranges from 25% to 45%, similar to domestic livestock. It has been reported that an increased PCV due to splenic contraction and stress is unlikely as the splenic capsule has been reported to be fibrous similar to a cow. Increased PCV due to stress and splenic contraction has not been documented in the elephant.

White blood cells count in the studying female elephants are clearly lower than the values suggested for African and Indian elephants [10, 11]. The variable figures for lymphocytes in the differential count reflect the confusion which has arisen because of the presence of a peculiar type of bilobed lymphocyte in elephant blood. In several studies it has been concurred that a lymphocyte-like cell is the dominant white cell in elephants [6]. Some authors, including ourselves, have chosen to count this cell as a lymphocyte giving a total lymphocyte count. Others have counted it separately and placed it in a class of its own.

The variation of blood parameters of each study might be prejudiced by various of laboratory error such as pre-analytical error; for instance, blood collecting method, blood sample preserving procedure before handling to laboratory, storage period until examination, and sample transportation. Process before handling to lab and storage period until examination is also important due to damaged erythrocytes may swell during storage and transport, and this can increase the MCV which measured by automatic counters [8].

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It has probably been included amongst monocytes by yet other authors [12] giving an elevated value to the monocyte count. Cell as a monocyte on the convincing basis of a positive peroxidase reaction but the fact remains that typical monocytes also occur in elephants [13]. Basophils occur in both living elephant species but are present in low numbers and have not been found by all authors.

**Table 1.** Hematological Parameters in Indian Elephants (*Elephas maximus*)

| S. N. | Parameter | Unit                | MEAN±SE        | RANGE         |
|-------|-----------|---------------------|----------------|---------------|
| 1.    | WBC       | 10 <sup>3</sup> /μL | 9.25 ± 1.11    | 5.31 – 15.34  |
| 2.    | LYM%      | %                   | 35.63 ± 6.04   | 8.84 – 66.86  |
| 3.    | MON%      | %                   | 11.43 ± 5.81   | 2.95 – 63.47  |
| 4.    | NEU%      | %                   | 39.20 ± 4.45   | 14.74 – 61.69 |
| 5.    | EOS%      | %                   | 13.49 ± 2.44   | 3.47 – 27.73  |
| 6.    | BASO%     | %                   | 0.28 ± 0.05    | 0.02 – 0.49   |
| 7.    | LYM#      | 10 <sup>3</sup> /μL | 3.33 ± 0.64    | 0.477 – 6.585 |
| 8.    | MON#      | 10 <sup>3</sup> /μL | 0.81 ± 0.30    | 0.274 – 3.427 |
| 9.    | NEU#      | 10 <sup>3</sup> /μL | 3.75 ± 0.67    | 1.309 – 6.801 |
| 10.   | EOS#      | 10 <sup>3</sup> /μL | 1.33 ± 0.33    | 0.187 – 3.835 |
| 11.   | BASO#     | 10 <sup>3</sup> /μL | 0.02 ± 0.00    | 0.001 – 0.044 |
| 12.   | RBC       | 10 <sup>6</sup> /μL | 2.98 ± 0.10    | 2.38 – 3.36   |
| 13.   | HGB       | g/dL                | 11.94 ± 0.20   | 11.2 – 13.2   |
| 14.   | HCT       | %                   | 36.02 ± 1.47   | 28.3 – 42.1   |
| 15.   | MCV       | fL                  | 121.08 ± 1.71  | 112.8 – 129   |
| 16.   | MCH       | pg                  | 40.49 ± 1.47   | 33.7 – 48.18  |
| 17.   | MCHC      | g/dL                | 33.57 ± 1.40   | 27.8 – 40.7   |
| 18.   | RDW CV    | %                   | 34.43 ± 0.80   | 30.9 – 38.3   |
| 19.   | PLT       | 10 <sup>3</sup> /μL | 213.50 ± 23.15 | 122 – 346     |
| 20.   | MPV       | fL                  | 3.49 ± 0.44    | 2 – 5.4       |
| 21.   | PDW       | fL                  | 5.83 ± 0.16    | 5.1 – 6.4     |
| 22.   | PCT       | %                   | 0.07 ± 0.01    | 0.02 – 0.13   |
| 23.   | P_LCC     | 10 <sup>3</sup> /μL | 107.80 ± 24.73 | 28 – 251      |

Values are mean ± SE of 10 animals.

#### 4. Conclusion

Hematologic reference intervals are very useful in health assessment and diagnosis of disease in endangered species. For many species, however, such reference intervals are lacking, as they are based on few samples, are produced from an inadequately described population of animals, and/ or do not report laboratory methodologies. Though elephant blood has been studied for many years, the original reference intervals of elephant hematology were often generated from post - mortem samples with extensive transport times in the heat. Caution must be used when examining older reports or citations.

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