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Original article

PRELIMINARY OBSERVATIONS ON DIURNAL RHYTHM IN THE HAEMATOLOGICAL PARAMETERS OF MALE AFRICAN GIANT RATS (*Cricetomys gambianus*, Waterhouse)

SANNI A.A.[1]*, OYEDOKUN O.R.[1] AND ALAKA O.O.[2]

[1]Department of Veterinary Physiology and Pharmacology and
[2]Department of Veterinary Pathology University of Ibadan, Ibadan. Nigeria

SUMMARY

The diurnal rhythm of haematological parameters was investigated in the male African giant rat (*Cricetomys gambianus*, Water house). There was a significant difference (P<0.001) between the values of red blood cell count (RBC) obtained during the day (light phase) and at night (dark phase). The lowest value (RBC) was recorded at 12.00hrs, but showed a gradual increase from 12.00 hrs to 24.00hrs, although the differences were not significant. It reached a peak at 21.00 hrs. The packed cell volume (PCV) showed a progressive decline between 9.00 hrs and 24.00hrs. The value obtained at 24.00 hrs was also significantly lower than the values at 9.00 hrs (P<0.01) and 12.00 hrs (P<0.01). White blood cell count (WBC) gradually decreased during the period of the study. The WBC values obtained at 24.00 hrs were significantly lower than the values at 9.00 hrs (P<0.01) and 12:00 hrs (P<0.02).

Keywords: *Diurnal Rhythm, Haematological Parameters, and male African giant rat.*

RESUME

Le rythme duirne des parametres hematologiques a ete observe chez le rat geant d'Afrique (cricetomys ganbienne, maison deau). Il ya eu une difference significante (P<0.05) entre les valeurs de globules rouges (GR) obtenues pendant la journee (phase lumiere) et celles obtenues la nuit (Phase obscure). La valeur la plus base a ete enregistre a 12 Heures et la valeur la plus elevee a 24 Heures avec un niveau de significance de P<0.001. La concentration Hemoglobulaire a ete reduite considerablement (P<0.005) de 9 Heures a 12 Heures. mais a montre une augmentation progressive de 12 Heures a 24 Heures, meme si les differences n' etaient pas significantes. cette concentration a atteint une valeur maximale a 21 heures. Li Hematocrite a montre une baisse progressive entre 9 heures. Li Hematocrite a montre une baisse progressive entre 9 heures et 24 heures. Les valeurs obtenues en 24 heures etaient significamment tres basse que les valeurs a 9 heures (P<0.01) et 12 heures (P<0.01). Le taux des globules blancs diminuait gradueuement pendant la periode d'analyse. les valeurs obtenues a 24 heures etaient notamment plus basse que les valeurs a 9 heures (P<0.01) et a 12 heures (P<0.01).

The African giant rat (*Cricetomys gambianus*, waterhouse) is one of the most striking African rodents. It is different from other known African rodents because of the existence of produced cheeks for which they are often referred to as the pouched rats (Roosevear, 1969).

Reports are available on the haematology of both wild and domesticated African giant rats (Olowookorun, 1974, 1979); Durotoye and Oke, 1990; and Oyewale *et al.*, 1998). Ajayi (1974) worked extensively on the biology of the species. However, to the knowledge of the authors there are no known reports on the diurnal rhythm of haematological parameters in the African giant rats. Diurnal rhythm has been demonstrated in many animals for numerous biological parameters such as metabolic rate and temperature (Mills, 1966); blood glucose level (Pitts, 1943; Pauly and Scheving, 1967), adrenocorticotrophic hormone (ACTH) (Rivets *et al.*, 1983) and haematological values (Mills, 1966; Femandez and O, Dell 1986; Oyewale and Olowokorun 1986; Touitou *et al.*, 1986; Pocock *et al.*, 1989).

The spresent study was intended to provide a baseline for assessing deviation from reported haematological values in the male African giant rat at different periods of the day.

MATERIALS AND METHODS

Experimental animal management

Four healthy adult male African giant rats (*Cricetomys gambianus*, waterhouse) caught from the wild with specially designed metal cages were kept in the animal house of the Faculty of Veterinary Medicine, University of Ibadan, Nigeria. The average weight of the rats was 1.00 ± 0.2 kg. They were fed fresh palm Kernel fruits and mice pellets (21% Protein; 3.5% Fat; 6% fibre; 0.8% Ca; 0.8% Phosphorus; Ladokun

**To whom all correspondence should be directed. E-mail address: ayk.sanni@skannet.com*

Feeds Limited, Ibadan, Nigeria). and water *ad libitum*. The animals were allowed three weeks to stabilise before the commencement of the study.

BLOOD SAMPLING

Blood was collected under light ether anaesthesia from the orbital sinus into a bottle containing ethylene diamine tetracetic acid (EDTA) at 2mg/ml of blood as anticoagulant. The animals were bled at 3 hourly interval over a fifteen-hour period between 9.00hrs and 24.00hrs (about 2mls collected each time). The packed cell volume (PCV) was determined by the haematocrit method. Haemoglobin (Hb) values were estimated by the cyammethaemoglobin method (Benjamin, 1961). The red blood cell (RBC) and total white blood cell (WBC) count were estimated using Nauber's Haemocytometer in duplicates and Leukocytes were differentiated microscopically.

Statistical analysis

The mean and standard deviation for all the values were determined. Differences in the mean between the groups were subjected to Null hypothesis. A significance level of $P<0.05$ was taken as significant.

TABLE 1
Haematological values

TIME DAY	9.00 HRS	12.00 HRS	15.00 HRS	18.00 HRS	21.00 HRS	24.00 HRS
PCV (%)	44.3 ± 2.2^{a}	40.8 ± 5.0^{ab}	34.0 ± 3.6^{bc}	31.0 ± 1.4^{c}	30.8 ± 5.1^{c}	28.3 ± 3.6^{c}
RBC * 10^{12}/L)	3.46 ± 6.70^{cb}	3.04 ± 1.00^{c}	3.54 ± 1.29^{cb}	3.37 ± 2.49^{cb}	5.29 ± 1.01^{b}	8.71 ± 0.57^{a}
Hb (gm %)	8.36 ± 0.82^{a}	6.70 ± 0.84^{b}	7.41 ± 1.08^{ab}	8.49 ± 1.46^{ab}	8.76 ± 2.01^{ab}	8.31 ± 1.18^{ab}
MCV (fl)	131.8 ± 26.7^{a}	144.7 ± 48.1^{a}	104.3 ± 1.4^{a}	135.2 ± 84.1^{a}	57.8 ± 14.1^{bc}	36.6 ± 5.3^{c}

TABLES 2
White Blood Cell Count (Total and Differential)

TIME OF DAY	9.00 HRS	12.00 HRS	15.00 HRS	18.00 HRS	21.00 HRS	24.00 HRS
WBC (x 109/L)	23.79 ± 2.77^{a}	21.8 ± 1.89^{a}	20.34 ± 6.07^{ab}	14.80 ± 2.52^{b}	12.49 ± 6.04^{b}	11.2 ± 5.09^{b}
LYMPHOCYTES (%)	63.0 ± 5.29^{a}	68.82 ± 3.86^{a}	66.0 ± 5.10^{a}	67.75 ± 4.99^{a}	70.75 ± 5.91^{a}	70.74 ± 4.43^{a}
MONOCYTES (%)	1^{a}	2^{a}	1^{a}	1^{a}	2^{a}	1^{a}
NEUTROPHILS (%)	36.0 ± 5.29^{a}	30.75 ± 4.11^{a}	33.25 ± 5.91^{a}	31.75 ± 5.44^{a}	28.5 ± 6.76^{a}	28.75 ± 4.99^{a}
EOSINOPHILS (%)	1^{a}	1^{a}	1.50 ± 0.05^{a}	1^{a}	1^{a}	1^{a}

Means along the same row with the same supercripts are not significant
The white blood cell differential - counts did not show any significant difference.

RESULTS

The mean RBC showed significant differences between the values obtained during the day and at night, with the highest value at 24.00 hrs (8.71 ± 0.57 x 10^{12}/L) and lowest value at 12.00 hrs (3.04 ± 1.00 x 10^{12}/L). The mean RBC at midnight (24.00 hrs) was significantly higher than at noon (12.00 hrs) ($P<0.001$); 15.00 hrs (3.54 ± 1.29 x 10^{12}/L) ($P<0.001$) and 18.00 hrs (3.37 ± 2.49 x 10^{12}/L). The RBC at 21.00 hrs (5.29 ± 1.01 x 10^{12}/L) was significantly higher than at 12.00 hrs (3.04 ± 1.00 x 10^{12}/L) ($P<0.02$). There was a significant increase from 21.00 hrs (5.29 ± 1.01 x 10^{12}/L) to 24.00hrs (8.71 ± 0.57 x 10^{12}/L). Hb concentration significantly decreased from 8.76 ± 2.01gm% to 6.70 ± 0.84 gm %. It then gradualy increased although the differences were not significant, it peaked at 21.00 hrs (8.76 ± 2.01 gm %). The packed cell volume (PCV) showed a progressive decrease from 9.00 hrs to 24.00 hrs. There was significant decrease from 9.00 hrs (44.3 ± 2.2%) ($P<0.001$); 12.00 hrs (40.8 ± 5.0%) ($P<0.01$) to 24.00 hrs (28.3 ± 3.6%). White blood cell count (WBC) (total and differential) as shown in table 2, gradually decreased during the period of the present study and it was significantly lowered between 9.00 hrs (23.79 ± 2.77 x 10^{9}/L) ($P<0.01$); 12.00 hrs (21.08 ± 1.89 x 10^{9}/L) ($P<0.02$) and 24.00 hrs (11.29 ± 5.09 x 10^{9}/L).

DISCUSSION

In the present study on the male African giant rat, the mean red blood cell count (RBC) fluctuated during the daytime and steadily increased reaching its peak at midnight. There were significantly higher mean RBC at night (21.00 hrs) $P<0.02$); (24.00 hrs) ($P<0.001$) than at noon 12.00 hrs. The mean RBC obtained in the present study are not significantly different from the values reported by Oyewale *et al.*,

(1998) (5.90 ± 1.56 x 10^{12}/L) except for the two extreme values- the lowest at 12.00 hrs and highest at 24.00 hrs. This is probably due to the fact that the African giant rats are nocturnal, and they become very active at night at about 24.00 hrs (as was observed during the present study) and exercise is known to increase the number of circulating red blood cells (Swenson, 1984). Since the animals were relatively inactive during the day, this may be responsible for the high mean RBC at night and low mean RBC at noon. Oyewale and Olowookorun (1986) in a study on diurnal variation in the haematological values of the West African dwarf (WAD) goat, compared various values reported for mean RBC in the WAD goat by different authors and suggested that differences may be due to climate, which may also account for the differences observed in the present study (viz-a-viz the time of the year study was conducted). They also reported a weak increase in the mean red blood cell count (RBC) through the daytime and night; the mean haemoglobin (Hb) concentration was significantly higher at night than in the morning, while the mean haematocrit value fluctuated being highest at noon but showed a weak increase through the day and night. Pocock *et al.*, (1989) reported a diurnal rhythm showing a weak declining trend in the mean RBC, Hb concentration and haematocrit in humans.

Hb concentration in the present study showed a trend similar to that reported by Oyewale and Olowookorun in the WAD goat. The Hb concentration in the present study gradually increased from 12.00 hrs and reached a peak at 21.00 hrs, this trend is similar to the mean recorded for RBC in this study (mentioned above). The increase in Hb concentration at night is related to the increased activity (physical and metabolic) at night and as a result there will be increased oxygen consumption. Hb is known to have an important physiological relationship with oxygen (Swenson, 1984) especially in the transport of oxygen to the cells, this is probably why the mean Hb concentration and RBC are higher at night. The Hb concentration and haematocrit values obtained in the present study are comparable to those of Oyewale *et al.*, (1998). The haematocrit showed a gradual decrease from the morning until night. The values obtained at 9.00 hrs (44.3 ± 2.2) and at 12.00 hrs (40.8 ± 5.0%) in the present study are similar to those reported by Durotoye and Oke (1990) (41.8 ± 2.38%) and Oyewale *et al.*, (1998) (48.43 ± 3.93%) (these are believed to be daytime values) in the African giant rat and there are no significant differences between the values. If the haematrocrit is really a reflection of the total red cell volume,it then becomes difficult to correlate decreasing haematrocrit with increasing mean RBC in a normal physiological state. Although, Sturkie and Newman (1951), confirming an earlier report by Gibbs (1929) who showed that drawing multiple samples greatly decreased haematocrit values, also reported that multiple sampling/bleeding of chickens caused decreased packed cell volume (PCV) of about 7.4% between two samples collected over a period of 16.00 hours (3.00 - 4.00 p.m. and 9.00 a.m.) an increased blood volume was also observed (in which the plasma had increased). They suggested that multiple sampling resulted in haemodilution that was responsible for the decreased PCV. It is hoped that further studies will throw more light on this.

In the present study on African giant rats, the mean white blood cell count (WBC) showed a declining trend through the daytime and night, while an increasing trend was reported in humans (Pocock *et al.*, 1989), confirming an earlier observation by Chamberlain *et al.*, (1952), a similar observation was reported for WAD goat (Oyewale and Olowookorun, 1986). The mean WBC observed in this study were significantly higher than those reported by Durotoye and Oke (1990) and Oyewale *et al.*, (1998), this maybe due to existence of subclinical parasitic infections as reported by Oduye, (1976) in the WAD goat. The white cell differential counts are similar to those earlier reported (Durotoye and Oke, 1990; and Oyewale *et al.*, 1998) and did not show any significant difference between day and night.

CONCLUSION

The mean RBC and Hb concentration showed a diurnal rhythm that conforms to the nocturnal nature of the African giant rat. Although the haematocrit values showed significant differences between day and night, they may not be due to response to diurnal rhythm rather it may have been caused by multiple sampling of the animals (Strurkie and Newman, 1951). Further studies will be carried out to either substantiate or refute this claim.

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