

Hematological values of *Cebus apella* anesthetized with ketamine

Padrões hematológicos em *Cebus apella*, anestesiados com quetamina

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SUMMARY

Blood samples were collected from 124 captive Capuchin monkeys (*Cebus apella*) at Fundação Parque Zoológico de São Paulo, anesthetized with ketamine (10 mg/kg, IM). Hematological parameters (RBC, WBC, differential count, hematocrit, hemoglobin, MCV, MCH and MCHC) were determined, and influence of sex and age on hematologic values was studied.

UNITERMS: Hematology; *Cebus apella*; Capuchin monkeys.

INTRODUCTION

The Cebidae family embraces around 37 species of New World primates, among them the Capuchin monkey (*Cebus apella*)¹⁵. Since these animals are susceptible to many infections that affect also the human beings, they are often used as biological models in the study of diseases such as tuberculosis⁴ and Chagas^{5,14}.

The *Cebus apella* has also been used in nutritional experiments, specifically in those related to saturated fatty acids metabolism, cholesterol and triglycerids blood levels as well as blood platelet aggregation^{3,11,18}.

The determination of the hematological parameters in this species is important for a correct evaluation on the studies in which *Cebus apella* is used as an experimental animal and also for those who work with wild animals' medicine. For these, it is of great value, since this monkey is one of the most numerous ones in Brazilian zoological gardens, and also often kept as pet animals.

The fact that *Cebus apella* might become very aggressive makes it necessary to use tranquilization most of

the times when it is handled. Due to its safety and because it can be used intramuscularly, ketamine is widely chosen as sedative for monkeys at zoos. With this in mind, the hematological values from monkeys anesthetized with ketamine can be considered as a normal pattern, since rarely these animals can be handled without effect of drugs.

The objective of this study was to determine the hematological parameters of *Cebus apella* anesthetized with ketamine.

MATERIAL AND METHOD

One hundred and twenty four animals (*Cebus apella*) from the Fundação Parque Zoológico de São Paulo, kept in areas from 20 m² to 30 m², fed twice daily, were used. Their meals consisted of banana, papaya, orange, cooked sweet potato, fruits of the season, cooked eggs, ground chicken necks added to raw vegetables. To one of the daily meals peanuts were added.

Every animal was submitted to a previous physical examination and only those that did not present any detectable

¹Ketamina 50 - Holliday - Scott S.A. - Buenos Aires - Argentina

Table 1

Erythrogram of 124 healthy animals (*Cebus apella*) anesthetized with ketamine, according to sex and age, expressed in mean and standard deviation. São Paulo, 1998.

| Parameters | Young females mean ± SD(n) | Young males mean ± SD (n) | Adult females mean ± SD (n) | Adult males mean ± SD (n) |
|----------------------------|--|--|--|--|
| RBC (x10 ¹² /l) | 5.7 ± 0.6 (22) ^{ab} (5.1 - 6.3) | 5.2 ± 0.6 (13) ^b (4.6 - 5.8) | 5.2 ± 0.8 (42) ^b (4.3 - 6.0) | 5.8 ± 0.6 (47) ^a (5.2 - 6.4) |
| Hematocrit (l/l) | 0.43 ± 0.03 (22) ^b (0.40 - 0.46) | 0.40 ± 0.04 (13) ^b (0.37 - 0.44) | 0.42 ± 0.06 (42) ^b (0.36 - 0.47) | 0.45 ± 0.04 (47) ^a (0.42 - 0.48) |
| Hemoglobin (gm/l) | 139 ± 12 (22) ^{ab} (127 - 151) | 130 ± 17 (13) ^b (123 - 147) | 131 ± 18 (42) ^{ab} (113 - 149) | 142 ± 13 (47) ^a (129 - 155) |
| MCV (fl) | 76.3 ± 7.7 (22) ^a (68.6 - 84.0) | 78.6 ± 7.7 (13) ^a (70.9 - 86.3) | 81.4 ± 11 (42) ^a (70.4 - 92.4) | 78.3 ± 6.3 (47) ^a (72.0 - 84.6) |
| MCH (pg) | 24.6 ± 2.8 (22) ^a (21.8 - 27.4) | 25.2 ± 3.0 (13) ^a (22.2 - 28.2) | 25.8 ± 4.3 (42) ^a (21.5 - 30.1) | 24.7 ± 2.7 (47) ^a (22.0 - 27.4) |
| MCHC (gm/l) | 320 ± 21 (22) ^a (299 - 341) | 318 ± 17 (13) ^a (301 - 335) | 317 ± 30 (42) ^a (287 - 347) | 313 ± 26 (47) ^a (287 - 339) |

Values of means within a row with not common superscripts are statistically different (p<0.05).

abnormalities were used.

The animals were divided in groups according to sex and age as young and adult. It was considered young monkeys the ones which had milk teeth and adults those with permanent teeth.

In the morning, after 12 hours fasting, previously to blood collection, ketamine (10 mg/kg)* was used intramuscularly.

Two milliliters of blood were collected from each animal through puncture of the right and/or left femoral vein. Disodium salt of ethylenediamine tetracetate was used as anticoagulant. The following hematological values were analysed: red blood cells count (x 10¹²/l), white blood cells count (x10⁹/l), hematocrit (l/l), hemoglobin (gm/l), mean corpuscular volume (MCV) (fl), mean corpuscular hemoglobin (MCH) (pg) and mean corpuscular hemoglobin concentration (MCHC) (gm/l) and differential count of white blood cells. The hemograms were made according to Birgel².

The general linear model procedure of the Statistical Analysis System (SAS Institute, 1985) was used to analyse the differences between the groups' means.

RESULTS

The results of the erythrogram and leucogram are presented, respectively, in Tab. 1 and 2.

DISCUSSION

Some studies on hematological values of primates species are exposed in the literature^{4,10,15,23}, however the majority of them in genus *Macaca*^{12,16,19}. On the other hand, hematological parameters of *Cebus apella* were determined only once⁷. The authors studied 41 monkeys but made no remarks on stress level or whether some kind of drug was used for the handling of the monkeys. It is known that the ketamine may cause some alterations in the hematological and biochemical blood values of the primate *Macaca mulatta*^{1,12}, what might be true for *Cebus apella* as well. Because *Cebus apella* might become very aggressive, it is necessary to be tranquilized when it is handled. For this reason, the hematological values from anesthetized monkeys can be considered as a normal pattern, since these animals can rarely be handled without effect of drugs.

Hematological parameters of *Macaca mulatta*^{12,16,19,21} as well as of *Macaca fascicularis*, *Papio cynocephalus* (Baboon) and *Saimiri sciurea* (Squirrel monkey)²⁰ are presented, but the authors do not make any reference to the use of any kind of drug to perform the blood collection. Otherwise Lumb; Jones¹³ indicate ketamine at doses of 10-15 mg/kg, intramuscularly, in most of primates to obtain immobilization for performing physical examination, blood collection, treatment of wounds, tattooing, and tuberculosis testing.

Table 2

Leucogram of 124 healthy animals (*Cebus apella*) anesthetized with ketamine, according to sex and age, expressed by mean and standard deviation. São Paulo, 1998.

| Parameters | Young females mean ± SD (n) | Young males mean ± SD (n) | Adult females mean ± SD (n) | Adult males mean ± SD (n) |
|---------------------------|---|---|---|--|
| WBC (x10 ⁹ /l) | 5.76 ± 3.25 (22) ^a (2.50 - 9.02) | 7.26 ± 3.99 (13) ^a (3.27 - 11.25) | 6.20 ± 2.57 (42) ^a (3.62 - 8.77) | 6.32 ± 2.89 (47) ^a (3.43 - 9.21) |
| Total neutrophils(%) | 3.18 ± 2.86 (21) ^a (3.21 - 6.04) | 4.58 ± 3.09 (13) ^a (0.49 - 7.67) | 3.32 ± 1.90 (41) ^a (1.42 - 5.23) | 3.53 ± 3.38 (47) ^a (1.57 - 6.91) |
| Band neutrophils (%) | 0.07 ± 0.09 (21) ^{ab} (0.00 - 0.16) | 0.12 ± 0.18 (12) ^a (0.00 - 0.30) | 0.06 ± 0.09 (41) ^{ab} (0.00 - 0.15) | 0.05 ± 0.09 (47) ^b (0.00 - 0.14) |
| Mature neutrophils (%) | 3.10 ± 2.83 (21) ^a (2.68 - 5.94) | 4.46 ± 2.98 (12) ^a (1.48 - 7.44) | 3.26 ± 1.88 (41) ^a (1.39 - 5.14) | 3.49 ± 3.35 (47) ^a (0.14 - 6.84) |
| Eosinophils (%) | 0.01 ± 0.03 (21) ^a (0.00 - 0.04) | 0.01 ± 0.04 (12) ^a (0.00 - 0.05) | 0.10 ± 0.28 (41) ^a (0.00 - 0.38) | 0.02 ± 0.39 (47) ^a (0.00 - 0.55) |
| Basophils (%) | 0.02 ± 0.06 (21) ^a (0.00 - 0.08) | 0.03 ± 0.06 (12) ^a (0.00 - 0.09) | 0.03 ± 0.05 (41) ^a (0.00 - 0.09) | 0.03 ± 0.07 (47) ^a (0.00 - 0.01) |
| Lymphocytes (%) | 2.83 ± 1.30 (21) ^a (1.52 - 4.13) | 2.67 ± 1.18 (12) ^a (1.48 - 3.85) | 2.51 ± 1.33 (41) ^a (1.18 - 3.85) | 2.83 ± 1.23 (47) ^a (4.06 - 5.45) |
| Monocytes (%) | 0.15 ± 0.19 (21) ^a (0.00 - 0.34) | 0.15 ± 0.12 (12) ^a (0.03 - 0.27) | 0.22 ± 0.21 (41) ^a (0.00 - 0.43) | 0.20 ± 0.22 (47) ^a (0.00 - 0.42) |

Values of means within a row with not common superscripts are statistically different (p<0.05)

According to Bennet *et al.*¹, decreases in erythrocyte count, hemoglobin concentration, total leucocyte count and lymphocyte count, following ketamine injection in Rhesus monkeys (*Macaca mulatta*), can all be attributed to a reversal of stress or "alarm reaction". Loomis *et al.*¹² and Wall *et al.*²², working, respectively, with Rhesus and Vervet monkeys, also observed a decrease in peripheral erythrocytes and lymphocytes as a result of the redistribution of these cells from the circulating blood to the spleen and extravascular sites, respectively. However, in the present study, adult males presented red blood cells higher than other groups, specially the adult females and young males. This observation may be determined by the bigger muscular mass of the prime.

Comparing the results obtained in the present study to those obtained by Grana *et al.*⁷, some divergent values were noticed. Higher values of red blood cells, hematocrit and hemoglobin than those referred by Grana *et al.*⁷ were found in the present work for adult males. Besides, those authors have observed a significant higher MCV (p<0.05) than the values obtained in this study for young males. Probably these differences might be due to two reasons: a) different employed

procedures, since Grana *et al.*⁷ made their work with electronic counter and in the present study Neubauer hemocytometers and microhematocrit centrifuge were used; it is known that electronic counters are usually calibrated for human blood and require appropriate adjustments according to the animal species studied⁹, and b) diverse stress levels to which the animals were submitted in one and in other study.

Packed cell volume and hemoglobin concentration were higher in adult males than in the other three groups in this study. Age and sex-related influences on the hematological values were evaluated by Stanley; Cramer²¹, who obtained RBC, hemoglobin concentration, and PCV of male monkeys over 3 years greater (p<0.001) than the corresponding values for females monkeys. Mitruka; Rawnsley¹⁷ also have observed erythrocyte counts in male Rhesus monkeys slightly higher than those in females.

Melville *et al.*¹⁶ referred that some colonies of *Macaca mulatta* monkeys have hypochromic erythrocytes, but there is no data in the literature related to *Cebus apella* other than those of Grana *et al.*⁷, to compare with the results obtained in the present report.

The hemoglobin concentration was lower in young females than in adult males; this may be a consequence of greater size of the erythrocytes from young animals and of lower RBC in both young and adult females.

Concerning the global white blood cells count, Grana *et al.*⁷ found significant higher ($p < 0.05$) values for the group of adults, either males and females, than the values found out in the present study.

Still according to Grana *et al.*⁷, the differential white cells count showed higher lymphocytes numbers ($p < 0.05$) for young males than did the present study. On the other hand, the number of neutrophils for this same group was higher ($p < 0.01$) in this work than in that one of Grana *et al.*⁷.

Physiologic factors as fright and emotional disturbances have an immediate effect on leucocyte numbers and can produce changes that often induce an inadequate interpretation. Ives; Dack *apud* Jain⁸ stressed the importance of training monkeys to be handled and bled to avoid the "alarm reaction" that elevates total white blood cells and alters the differential counts of leucocyte types. Fox *apud* Jain⁶ stressed the importance of the circadian variations in white blood cell counts and stated that the neutrophils were mainly responsible for the extreme counts.

It is known that total and differential leucocyte counts

may suffer influences of stress and handling; otherwise the higher neutrophils count presented by young males in this study may reflect a more active hematopoietic system in young animals.

The authors of the present study agree with Stanley *et al.*²¹, who asseverate that individual variations are common in "wild-caught" animals and that the large variation in hematologic parameters obtained by them emphasizes the need to make repeated observations on a large number of animals before the data can be considered a reliable reflection of base line values.

CONCLUSIONS

The results obtained through this study allow concluding that:

- a) the red blood cells count is higher in adult males than in young ones and adult females;
- b) hematocrit is more elevated in adult males than in adult females and both young males and females;
- c) hemoglobin is lower in young females than in adult males;
- d) the band neutrophils, in leucocyte differential count, is higher in young males than in adult ones.

RESUMO

Amostras de sangue foram colhidas de 124 macacos-prego (*Cebus apella*) da Fundação Parque Zoológico de São Paulo, anestesiados com quetamina (10 mg/kg, IM), com a finalidade de determinar os seguintes parâmetros hematológicos: contagens globais de hemácias e leucócitos, contagem diferencial de leucócitos, hematócrito, hemoglobina e índices hematimétricos (VCM, HCM e CHCM), expressos em média e desvio padrão. Estudou-se a influência do sexo e da idade sobre os referidos parâmetros.

UNITERMOS: Hematologia; *Cebus apella*; Macacos-prego.

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