



E-ISSN: 2320-7078

P-ISSN: 2349-6800

JEZS 2017; 5(5): 2019-2022

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Received: 28-07-2017

Accepted: 29-08-2017

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## Haemato-biochemical studies in bonnet macaque (*Macaca radiata radiata*) of 15 cases

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**Abstract**

The study was conducted in 15 cases of either sex of *Macaca radiata radiata* to evaluate haemato-biochemical parameters. Animals were fasted and given safe anaesthetic regimen which was dextomid-100 µg/ml and ketamil-100 mg/ml combination with proper restraining procedures. Blood samples were collected in saphenous or cephalic vein in which haemoglobin, packed cell volume, red blood cells, white blood cells, platelets and differential count were resembled to normal physiological values of bonnet macaque. Biochemical and stress parameters were also evaluated and compared to other studies. The ranges of packed cell volume, white blood cells were decreased with high level of neutrophil and lymphocyte counts. Alkaline phosphatase level was lower but no significant variation observed in plasma cortisol level. Hence, we concluded that the blood parameter data reported here may be used as a template for clinical care and laboratory primate research.

**Keywords:** Bonnet Macaque- Captivity-Haematology- Biochemistry-Cortisol

**Introduction**

India has one of the richest primate diversity. Among the primates, the macaque species were present abundantly. Bonnet macaque (*Macaca radiata*) is named as old-world monkey which is denser and distributed widely among the eight macaque species in India. It is an endemic non-human primate in India even in particular domain which is southern parts of Indian peninsular and Western Ghats (Arora, 2002) <sup>[1]</sup>. Indian bonnet macaque have cap like whirl of hair on their top of head which radiates outward from center. These radiating coils of hair mimic a hat, they have been named as bonnet macaque. It is second to rhesus macaque in population.

Bonnet macaque has different vernacular name such as vellakorangu in Tamil Nadu, kongan in Kerala, kothi in Andhra Pradesh, kappi and manga in Karnataka, pattimakkada in Orissa and makad in Madhya Pradesh. Bonnet macaque live as commensally with humans and are most abundant on the outskirts of human settlements. In those areas, they rely on trash and food generated by villagers and visitors. It has quite sociable character and seen mostly in groups of multi-male and multi-female. Females are philopatric, while males disperse to other social groups. There are two distinct subspecies of bonnet macaque which have been morphologically recognized in India, they are *Macaca radiata radiata* and *Macaca radiata diluta* (Mehu *et al.*, 2006) <sup>[6]</sup> in which their belly is dark and pale respectively. Female largely disperse between groups only in *Macaca radiata diluta* while males disperse in both subspecies with differences in behaviour.

Despite their proliferation rate, the wealth of information on their ecology and behaviour, little attention has been made to their demography or population status. Natural habitat and demographic status of bonnet macaque were largely formed in forest. But unfortunately, the demographic status of the bonnet macaque might have changed due to deforestation and urbanization to human dominated areas. These monkeys depended human habitation where food is offered by villagers, worshippers and tourists. At this point where human monkey conflict start when the monkey seizes the food from houses, shops and crop raiding in cultivated fields (Sharma *et al.*, 2011) <sup>[10]</sup>.

In these scenario bonnet macaques need to be translocated for control of menace and conservation. Trapping and translocation leads to injuries and stress which results in morbidity and mortality.

Hence, translocation from urban/rural area to deeper forest area needs chemical immobilization. Indication of chemical immobilization of bonnet macaque also done for physical examination, cardio-pulmonary evaluation, catheterization, blood collection, radiological evaluation, wound treatment and major surgical procedures. The aim of this study to evaluate the haemato-biochemical parameters of chemically restrained bonnet macaques which will help as reference value for future studies.

### Materials and methods

This study was conducted during April 2014 - March 2015 in 15 clinical cases of dark bellied bonnet macaque (*Macaca radiata radiata*) of either sex with different age groups referred for various diagnostic and surgical procedures such as normal haemato-biochemical studies and cardiopulmonary parameters evaluation and along with population control in case of male followed by relocation to deep forest of their own geographical status from Arignar Anna Zoological Park, Vandalore and Government Veterinary Dispensaries to Madras Veterinary College Hospital, Vepery.

Animals were fasted 12 hours prior to sample collection and administration of anaesthetics. These animals were under chemical restraining procedure with safe anaesthetic regimen which was Alpha-2 adrenergic agonist of Dexmede to midine (Dextomid-100 µg/ml, Neon labs) and dissociative anaesthetic of Ketamine (Ketamil-100mg/ml, Helium labs) combination which was provide anaesthesia to perform complete clinical studies and surgical procedure with moderate effect on the haemato-biochemical and cardiopulmonary and stress parameters and minimal alteration in homeostasis in bonnet macaques.

Animals were confined with the range of 15 feet distance which could be effectively darted with blow-gun to administer the anaesthetic cocktail drug. The length of blow gun was determined by the distance was projected and length varies with long tube permitting greater accuracy (Fowler, 1986) [5]. Because of their silent projection with fewer traumas to the patient as well as surroundings can be easily sighted had no mechanical parts requiring for maintenance. Immediately after induction the capillary refilling time in seconds were recorded and 4 ml blood sample were collected from cephalic or saphenous or femoral vein in which 2 ml of blood

transferred into a tube containing no anticoagulant for submitting serum biochemical analysis. For biochemical parameters evaluation, the venous blood was collected in the serum tube and evaluated Blood urea nitrogen, creatinine, alkaline phosphatase, serum total protein, albumin, globulin, serum phosphorus, sodium, potassium and blood glucose were estimated using fully automated serum biochemical analyser (Brammer *et al.*, 1991) [3].

The remaining of collected blood drawn to the tube containing EDTA anticoagulant mixed by rotating the tube containing blood in forward and backward manner for 3-4 times and placed in icebox for further haematological analysis. By this procedure, Haemoglobin count, red blood cell count, white blood cell count, packed cell volume and platelets count were evaluated. Complete blood count estimation was carried using fully automated auto analyser. For differential count the thin tongue shaped blood smear was prepared from peripheral vein most preferred from tip of ear or tail tip and was manually evaluated after Leishman staining procedure. The statistical analyses were carried out using SPSS 21.00 for windows using ANOVA.

### Results and discussion

The apparently healthy 15 bonnet macaque blood sample after evaluation the results were expressed in mean± S.E of haematological parameters such as haemoglobin, packed cell volume, red blood cell, white blood cell, platelets and differential count were listed in table I. The observed mean value of RBC, PCV, Hb, WBC and Platelets were 5.54±0.15 (million/µL), 36.74±0.96 (%), 12.00±0.37 (g/dL), 18225.0±1239 (Thousands/µL) and 4.24±0.19 (lakhs/µL) respectively. These results were resembled to normal physiological blood values of bonnet macaques. 95 percent of total white blood corpuscles count comprises neutrophils and lymphocytes remaining eosinophil, monocyte and basophils were very meagre. The higher range of PCV and Hb values were might be due to haemoconcentration which is attributed by dehydration in free range area. The observed serum biochemical values of creatinine, BUN, Glucose, total protein and alkaline phosphatase were 20.42±1.26 (mg/dL), 20.42±1.26 (mg/dL), 69.17±1.36 (mg/dL), 7.01±0.12 (g/dL) and 189.75±8.05 (mmol/dL) respectively.

Table 1: n=15

| S. No | Parameters                      | Minimum range | Maximum range | Mean ± S. E  |
|-------|---------------------------------|---------------|---------------|--------------|
| 1     | Red blood cell (million/µL)     | 4.76          | 6.62          | 5.54±0.15    |
| 2     | Packed cell volume (%)          | 31.7          | 41.0          | 36.74±0.96   |
| 3     | Haemoglobin (g/dL)              | 9.2           | 13.8          | 12.00±0.37   |
| 4     | White blood cell (Thousands/µL) | 9400          | 27700         | 18225.0±1239 |
| 5     | Platelets (lakhs/µL)            | 2.92          | 5.31          | 4.24±0.19    |
| 6     | Neutrophils (%)                 | 68.46         | 76.16         | 70±0.31      |
| 7     | Basophils (%)                   | 1.33          | 1.73          | 1.60±0.14    |
| 8     | Eosinophils (%)                 | 0.05          | 0.20          | 0.10±0.40    |
| 9     | Lymphocytes (%)                 | 24.93         | 26.76         | 26.1±0.15    |
| 10    | Monocytes (%)                   | 1.55          | 1.85          | 1.60±0.07    |

The mean±S.E of the biochemical parameters were listed table II.

Table 2: n=15.

| S.No | Parameters                     | Minimum range | Maximum range | Mean±S.E    |
|------|--------------------------------|---------------|---------------|-------------|
| 1    | Blood urea nitrogen (mg/dL)    | 12.90         | 27.98         | 20.42±1.26  |
| 2    | Creatinine (mg/dL)             | 0.918         | 1.780         | 1.21±0.08   |
| 3    | Serum glucose (mg/dL)          | 59.0          | 74.50         | 69.17±1.36  |
| 4    | Serum total protein (g/dL)     | 6.13          | 7.73          | 7.01±0.12   |
| 5    | Serum albumin (g/dL)           | 3.01          | 4.38          | 3.56±0.11   |
| 6    | Serum globulin (g/dL)          | 2.82          | 4.31          | 3.45±0.12   |
| 7    | Alkaline phosphatase (mmol/dL) | 149           | 242           | 189.75±8.05 |
| 8    | Calcium (mg/dL)                | 8.69          | 11.60         | 10.50±0.24  |
| 9    | Phosphorus (mg/dL)             | 2.93          | 4.56          | 3.69±0.11   |
| 10   | Sodium (mmol/dL)               | 123           | 152           | 138.67±2.34 |
| 11   | Potassium (mmol/dL)            | 3.40          | 4.84          | 4.09±0.10   |
| 12   | Serum cortisol (µg/dL)         | 16.8          | 28.8          | 24.11±0.69  |

Though the results of this study were similar to the studies of Pierre *et al.*, 2011 [8], Ramasamy *et al.*, 2006 [9] and Palanivelrajan *et al.*, 2015 [7], the range of white blood count was very high in present study which may be due to short captive period and minimal exposure to acute infection. Drastic significant change in alkaline phosphatase level in Palanivelrajan *et al.*, 2015 [7] study which might be due to young age group and acute capture stress. Normally Indian

macaque species in 12 hour fasting condition the blood glucose level ranges from 45 to 80 mg/dL which was related to our findings. Chen *et al.*, 2009 [4] and Xie *et al.*, 2013 [11] found haematobiochemical parameters in rhesus of *Macaca mullata* and *Macaca fascicularis* respectively were concurred to the findings of our bonnet macaque studies.

The comparative haemato-biochemical evaluation of bonnet macaques in different authors listed in table III and IV.

Table 3

| Parameters                               | Hb (g/dL) | PCV (%) | RBC (million) | WBC (Thousand) | Neutrophil (%) | Lymphocyte (%) | Monocyte (%) | Basophil (%) |
|--|-----------|---------|---------------|----------------|----------------|----------------|--------------|--------------|
| Ramasamy <i>et al.</i> , 2006(n=10)      | 12.4      | 41.4    | 4.78          | 11.21          | 47.8           | 42.4           | 2.60         | 1.5          |
| Pierre <i>et al.</i> , 2011 (n=10)       | 12.8      | 40.3    | 5.78          | 10.36          | 49.6           | 45.1           | 4.73         | 0.0          |
| Palanivelrajan <i>et al.</i> , 2015(n=6) | 10.6      | 42.0    | 6.83          | 15.67          | 50.5           | 45.3           | 1.70         | 2.2          |
| Study result (n=15)                      | 12        | 36.7    | 5.54          | 18.22          | 69.4           | 26.9           | 1.62         | 1.6          |

Table 4

| Parameters                               | BUN   | Creatinine | Glucose (mg/dL) | TP (g/dL) | Albumin (g/dL) | Globulin (g/dL) | ALP | Na (mmol/dL) | Ca (mg/dL) |
|--|-------|------------|-----------------|-----------|----------------|-----------------|-----|--------------|------------|
| Ramasamy <i>et al.</i> , 2006 (n=10)     | 17.87 | 1.02       | 63.06           | 7.44      | 3.49           | 3.95            | 104 | 143          | 10.19      |
| Pierre <i>et al.</i> , 2011(n=10)        | 30.30 | 0.76       | 75.50           | 7.33      | 3.60           | 3.74            | 942 | 144          | 10.77      |
| Palanivelrajan <i>et al.</i> , 2015(n=6) | 16.5  | 0.92       | 60.30           | 7.34      | 4.00           | 3.10            | 549 | 147          | 9.32       |
| Study result(n=15)                       | 20.42 | 1.21       | 69.17           | 7.01      | 3.56           | 3.45            | 189 | 138          | 10.51      |

Hence, we concluded, in haematology results, the ranges of packed cell volume increased and white blood cell counts were decreased. Neutrophils and lymphocytes were predominantly found cells in differential leukocyte count. Alkaline phosphatase level was lower range when compared to other studies. The plasma cortisol value in this study fluctuated between 23.26±0.65 to 25.98±0.62 µg/dl, which is concurrent to the study of Benston *et al.*, 2003. Though, the haemato biochemical parameters of bonnet macaque was not significantly altered when compared to other studies, but, the cortisol level was significantly lowered (24.11±0.69) to the study of Benston *et al.*, 2003 [2] (26.52±0.78), which was due to decreased stress during capture. This study could be used to emerge new anaesthetic regimen for different surgical and diagnostic procedure in bonnet macaque.

## References

1. Arora BM. Reproduction in Wild Mammalia and Conservation. Association of Indian Zoo and Wild Life Veterinarians, 2002.
2. Benston KP, Capitano JP, Mendoza SP *et al.* Cortisol responses to immobilization with telazol or ketamine in

baboons *Papio cyncephalus/anibis* Rhesus macaques *Macaca mullata*. Journal of Medical Primatology. 2003; 32:148-160.

3. Brammer DW, Doerning BJ, Chrisp CE, Rush HG *et al.* Anesthetic and nephrotoxic effects of Telazol in New Zealand white rabbits. Laboratory Animal Science, 1991; 41(5):432-435.
4. Chen Y, Qin S, Ding Y, Wei L, Zhang J, Li H, Cheng J *et al.* Reference values of clinical chemistry and hematology parameters in Rhesus monkeys *Macaca mulatta*. Xenotransplantation, 2009; 16(6):496-501.
5. Fowler ME. Zoo and Wild Animal Medicine. Edn 2, Saunders, Philadelphia, USA, 1986.
6. Mehu M, Huynen MC, Agoramoorthy G *et al.* Social relationship in a free-ranging group of Bonnet macaques in Tamil Nadu, India. Primate Report 2006; 73:49-55.
7. Palanivelrajan M, Jayarthangaraj MG, Sridhar R, Thirumurugan MPR *et al.* Serum bio-chemical indices in captive Bonnet macaques *Macaca radiata*. Indian Journal of Veterinary and Animal Sciences Research. 2015; 44(1):42-45.
8. Pierre PJ, Sequeira MK, Corcoran CA, Blevins MW, Gee

- M, Laudenslager ML *et al.* Hematological and serum biochemical indices in healthy Bonnet macaques *Macaca radiata*. Journal of Medical Primatology, 2011; 40(5):287-293.
9. Ramasamy V, Perumal N, Ravi Sanka R, Subeer SM *et al.* Haematologic and serum biochemical value in aged female Bonnet macaques *Macaca radiata* anaesthetized with ketamine hydrochloride. Annual Meeting of Japanese Association for Laboratory Animal Science, 2006; 45:45-48.
10. Sharma G, Ram C, Rajpurohit LS *et al.* Study of man-monkey conflict and its management in Jodhpur, Rajasthan India. Journal of Evolutionary Biology Research. 2011; 3(1):1-3.
11. Xie L, Xu F, Liu S, Ji Y, Zhou Q, Wu Q, *et al.* Age-and sex-based hematological and biochemical parameters for *Macaca fascicularis*. PLoS One, 2011; 8(6):e64892.