

## ***Trypanosoma evansi* infection and the influence of some hormones on haematological indices in albino rats**

M LEMALATHA, L NARASIMHA RAO and M KAMESWARI

Department of Zoology, Kakatiya University, Warangal 506 009, India

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**Abstract.** Changes in the haematological indices like haemoglobin, mean corpuscular haemoglobin, colour index, iron, total red blood corpuscles, white blood corpuscles and blood glucose in albino rats during *Trypanosoma evansi* infection and the influence of some hormones like hydrocortisone, insulin and thyroxine on these changes have been investigated.

**Keywords.** Haematological indices; *Trypanosoma evansi*; hormone changes.

### **1. Introduction**

Haemoflagellates cause several alterations in the haematological indices. The degree of changes in these is of significance in understanding the degree of pathogenicity. Therefore, from veterinary and medical point of view, they are of much importance and have received much importance in recent years. Haematological changes in trypanosomiasis were reported by a number of workers (Yorke 1910; Nausa and Yorke 1911; Fenyvessy 1926; Kligler *et al* 1929; Andrews *et al* 1930; Muniz and Freitas 1945; Moulder 1948; Von Brand *et al* 1955; Edwards *et al* 1958; Sen *et al* 1959; Richardson and Kendall 1963; Srivastava 1965; Naylor 1971; Jatkar *et al* 1973; Mackenzie and Cruikshank 1973; Woodruff *et al* 1973; Jatkar and Mohan Singh 1974; Jennings *et al* 1974; Mamo and Holmes 1975; Woo and Kobayashi 1975; Kobayashi *et al* 1976; Rickman and Cox 1979; Damayanthi 1982).

Effect of hormones on the haematological changes during trypanosome infection have also been studied (Knowles and Dasgupta 1927; Sherman and Ruble 1967; Seed *et al* 1972).

### **2. Material and methods**

Albino rats of Wistar strain were procured from the National Institute of Nutrition, Hyderabad and maintained in the laboratory under uniform environmental conditions and diet for about a week. *Trypanosoma evansi* were collected from the naturally infected cattle and maintained in the laboratory by syringe passage on every 3rd day into albino rats. A constant dosage of parasites ( $25 \times 10^6$  trypanosomes per ml of blood) was inoculated intraperitoneally into experimental animals. Experimental studies were carried out when the parasitemia was at peak.

The hormone dosages used in all the studies were 0.33 mg of hydrocortisone (obtained from Russel Pharmaceuticals of India, Bombay), 1.33 units of insulin (obtained from Boots Company, Bombay) and 0.08 mg of thyroxine (obtained from Cadilla chemicals, Ahmedabad) per 100 g of body weight. Each dose was administered starting from two days prior to infection and throughout the period of experiment

everyday. From different hosts, blood samples were obtained by cutting the tip of the tail and various parameters were assayed by the following procedures.

Haemoglobin content was determined colorimetrically by acid haematin method of Cohen and Smith (1919). The haemoglobin (Hb) percentage was calculated by taking 15 g of haemoglobin per 100 ml blood as 100%.

The mean corpuscular haemoglobin (MCH) was determined by the equation

$$\text{MCH} = \frac{\text{Hb in g/100 ml} \times 10}{\text{Red cells in million/cubic mm}}$$

Colour index (CI) which indicates the proportion of Hb present in each red blood cells (RBCs) was calculated by the formula,

$$\text{CI} = \frac{\text{Percentage of Hb}}{\text{Percentage of RBCs}}$$

Total iron content was estimated by the method of Wong San Yin (1923). Total number of red blood cells and white blood cells (WBCs) were counted separately by a haemocytometer with double neubauer ruling. The percentage of red cell count of the sample was determined by taking a count of 5 million red cells per cubic mm as 100%.

Blood glucose was determined following the method of Folin and Wu (1929).

### 3. Results

#### 3.1 Hb

The Hb content of the control rat is 96%. It is reduced by about 30% in infected rats. Mere treatment with hydrocortisone and insulin decreased the Hb level by about 7 and 2%, respectively, whereas thyroxine increased it by 4%. In hydrocortisone, insulin and thyroxine treated and infected albino rats the Hb content decreased significantly by about 40, 29 and 23%, respectively.

#### 3.2 MCH

The MCH of control rats is  $6.47 \pm 0.59$   $\mu\text{g}/100$  ml of blood and it increased by 165% during *T. evansi* infection. MCH values decreased by about 6% in hydrocortisone treatment but increased in insulin and thyroxine treated rats by about 7 and 15%, respectively. The MCH level significantly increased by about 225% and 31% in hydrocortisone and thyroxine treated and infected groups respectively; but decreased by about 5% in insulin treated and infected group.

#### 3.3 CI

The CI of control animals is  $0.21 \pm 0.02$ . It raised by 171.42% upon *T. evansi* infection. Mere treatment by hydrocortisone reduced it by 5% but insulin and thyroxine insignificantly increased by about 10 and 19%, respectively. But CI in the hydrocortisone treated and infected group has risen significantly to 233.33%. This increase is insignificant in insulin and thyroxine treated and infected groups.

### 3.4 Iron

Iron content of control rats is  $47.03 \pm 2.71$  mg/100 ml of blood and it decreased by about 30% in *T. evansi* infected rats. Hormone treatment insignificantly lowered the iron content but trypanosome infection of treated rats significantly decreased it.

### 3.5 RBCs

RBC count of normal rats is  $22.8 \pm 2.58$  millions per cubic mm of blood and the count decreased by about 70% upon *T. evansi* infection. In hormone treated groups the count decreased by about 4% but the infection of treated rats lowered it significantly by about 77, 38 and 34% in the case of hydrocortisone, insulin and thyroxine, respectively.

### 3.6 WBCs

Leucocyte count of control albino rats was 2218 per cubic mm of blood and decreased by 194% upon *T. evansi* infection. In the albino rats, treated with hydrocortisone, insulin and thyroxine, WBC count was lowered by 3, 16 and 7%, respectively. But the infection of treated rats resulted in their significant rise by about 303, 179 and 171% when treated by hydrocortisone, insulin and thyroxine, respectively.

### 3.7 Blood glucose

The blood glucose content of the control albino rats is 145 mg/100 ml of blood. It decreased by about 58% upon *T. evansi* infection. In all hormone treated rats, the blood glucose content decreased and showed a further decrease upon trypanosome infection.

## 4. Discussion

The decrease in Hb, iron, RBCs and blood glucose and increase in leucocytes, MCH and CI in infected albino rats suggests the drastic pathogenic effect of the presence of *T. evansi* infection.

Anaemia is common feature in mammalian trypanosomiasis, especially in the *Brucei evansi* group. It may be due to the erythrocyte destruction (Mamo and Holmes 1975; Naylor 1971) or unproportional erythropoietic compensation (inefficient Hb synthesis) resulting in the lowered Hb content in infected rats. The haemoglobin content decreased in hydrocortisone and insulin treated rats whereas thyroxine treatment resulted in slight increase. Generally hormone treatment reduces the resistance and this effect is more in hydrocortisone treated and infected group, but less in thyroxine treated and infected groups. Insulin has less effect upon haemoglobin change.

The rise in MCH values upon *T. evansi* infection is possible when the number of RBCs is drastically decreased, but the Hb values showed lesser decrease. Consequently, the ratio of haemoglobin to RBCs is more and each red cell contains more amount of Hb. The number of cells may be less, but each one lodges relatively

higher proportion of Hb. Presumably, the globin part from the haemoglobin of destroyed RBCs is reutilized in the synthesis of new RBCs.

The fall in MCH values of hydrocortisone treated rats indicates that relatively lesser damage is caused to RBCs and in some way, which needs further investigation, Hb content is proportionately lesser to RBCs. Therefore MCH is also reduced. The considerably significant increase in MCH values of hydrocortisone treated and infected rats suggests that compared to insulin and thyroxine, hydrocortisone is a powerful resistance reducing agent. This is evident by drastic increase in the number of trypanosomes in hydrocortisone treated rats (Lemalatha and Narasimha Rao 1985). This point is further corroborated by rise in the colour index of the hydrocortisone treated and infected rats. The rise in the CI suggests the occurrence of hyperchromic type of anaemia which may be due to greater loss of RBC (about 76%), but lesser decrease of Hb (about 40%). In the hydrocortisone treated group, the hyperchromic type of anaemia is considerably higher compared to other two treated and infected groups.

The fall of iron content is proportional to that of Hb as the major amount of iron in the blood is associated with the haemoglobin and to some extent with  $\beta$ -globulins.

Thus, the considerable fall in Hb and iron contents in hydrocortisone treated and infected group suggests that hydrocortisone reduces the resistance of the hosts to infection whereas thyroxine gives protection to rats (Knowles and Das Gupta 1927).

The insignificant decrease of RBC count in treated rats and significant increase in treated and infected rats suggest that hydrocortisone is ineffective to resist the entry of trypanosomes whereas thyroxine is effective to some extent. The lowered RBC count in various groups can be attributed to the rapid multiplication of trypanosomes leading to physical damage, destruction of RBCs either mechanically or chemically due to the release of certain toxic metabolites by the parasites, absence of antibodies, weakening of the animal due to hormone treatment, and inefficient erythropoietic mechanism etc.

The enhancement of WBC count is a well known phenomenon in the infections. It is an established fact that humoral factors, a number of factors from tissue extracts rich in DNA, leucopoietin G of plasma, bacterial pyrogens and adrenocorticosteroids have been found to have leucopoietic property. The remarkable increase in the hydrocortisone treated and infected rats compared to insulin and thyroxine treated and infected rats suggests that hydrocortisone adds to pathogenicity by increasing the growth rate of trypanosomes (causing trypanosomiasis), whereas the latter gives protection to the host. The increase in the leucocyte count during parasitic infections can be justified considering the physiological significance of leucocytes such as phagocytic action, release of toxins and globulins; role in tissue repair, blood clotting etc.

The fall in the blood sugar level of infected animals is evident from the available literature. The decrease in the blood sugar may be due to its absorption by the parasites and competition between the parasite and the host for the available limited resources. The decrease of blood sugar in insulin treated animals can be attributed to the effect of insulin, in enhancing the rate of withdrawal of blood sugar in organs. In the case of other two hormones, it may possibly be due to excessive hormonal or physiological stress, leading to lowered blood glucose level. In treated and infected albino rats, both factors i.e. the competition of the trypanosomes with the host for the nutrients and the hormonal action may act cumulatively, affecting the steep fall in the blood glucose content.

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