Host-parasite relationship: II. Post-helminth infection haematological indices in *Calotes versicolor*

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MS received 27 November 1978; revised 19 July 1979

Abstract. Changes in haematological indices like haemoglobin, iron, red blood corpuscles and white blood corpuscles were studied in *Calotes versicolor* during single and multiple type of helminth infection and single and multiple organ infection. The haemoglobin content, iron content and total count of RBCs decreased during helminth infection, whereas the total count of WBCs increased.

Keywords. Host-parasite; haematological indices; *Calotes versicolor*.

1. Introduction

A number of investigators have studied haematological indices like haemoglobin, iron, total count of RBCs and WBCs during helminth infections (Bercovitz 1935; Balian 1940; Hirvonen 1941; Da Costa Maia 1949; Pessoa and Countinho 1952; Cronk 1955; Sadun *et al* 1965; Sinclair 1965; Roche and Layrisse 1966; Bremner 1969; Tseger and Chaplina 1969; Adams 1973; Jacobson and Kirkpatrick, 1974; Yakuboskaya 1974; Gretillat 1976; Anosa 1977). These investigators have considered single type of helminth infection and single organ infection in experimental helminthiasis. Information regarding influence of multiple organ infection and/or multiple helminth infections is meagre and incomplete.

*Calotes versicolor* is known for multiple helminth and/or multiple organ infection. In this animal liver is infected only with a trematode, *Paradistomoides orientalis* (Narain and Das 1929), intestine with a cestode *Proteocephalus beddardi* (Woodland 1925) and rectum with a nematode, *Thelandros maplestonei* (Chatterji 1933). Hence, the present study was undertaken to investigate such haematological indices as haemoglobin, iron, total number of RBCs and total number of WBCs in naturally infected male *Calotes versicolor* during multiple helminth and/or multiple organ infection.

2. Materials and methods

The hosts of the present study, *C. versicolor*, were caught locally (2 km around the campus), maintained on insect food, starved for a day, pithed and the blood was collected directly from heart. Then they were cut open, screened for the type of
helminth infection they lodged as given in the introduction and assorted into different groups as mentioned in table 1. The animals of uniform body weight were selected and all the experiments were completed in one season to eliminate seasonal variations. The hosts with helminth number in the range of 8–15 in the liver, 3–7 in the intestine and 10–20 in the rectum were selectively used.

The haemoglobin content was estimated by the acid haematin method of Cohen and Smyth (1919). Iron was estimated following the method of San Yin Wang (1923). The blood sample for counting RBCs was sucked into RBC diluting pipette upto 0.5 mark, diluted to 101 mark with Hayem's fluid. The blood sample for WBC count was drawn into a WBC diluting pipette upto 0.5 mark and diluted to 11 mark with Turk's fluid. The counting of RBCs and WBCs was done separately by using a haemocytometer with improved double Neubauer ruling.

Ten samples were analysed in each group. The readings which represent mean ± SE were subjected to student t test. The t values were compared with the tabulated t values (Bailey 1959).

3. Results

3.1. Haemoglobin

The haemoglobin content of normal animals is $8.11 \pm 0.81$ g/100 ml of blood and during helminth infection, there is a definite decrease. During single organ infection, the intestinal infection is most hazardous compared to rectal and liver infection. During multiple organ infection, where two organs are infected at a time the intestinal and rectal infection at the same time is more hazardous; the liver infection coupled with intestinal infection is less hazardous and that of liver and rectum together is least hazardous. When all the three organs are infected simultaneously, the haemoglobin content decreases much compared to single and double organ infection.

3.2. Iron

The normal iron content is $27.61 \pm 2.08$ mg/100 ml of blood. The decrease in the iron content is directly proportional to that of haemoglobin content.

3.3. Red blood corpuscles

The number of RBCs in the blood of normal animals is $0.645$ million/mm$^3$. During helminth infection, there is a significant decrease in the number of RBCs. During single organ infections, the decrease is more in the intestinal infection compared to that of rectum or liver infection. In multiple organ infections, simultaneous intestinal and rectum infection is more pathogenic. When liver infection is coupled with intestine or rectum infection, the former is more pathogenic. When all the three organs are infected simultaneously, the pathogenicity is much more, decreasing half the number of RBCs.

3.4. White blood corpuscles

The number of WBCs in the normal animals is $0.116 \pm 0.01$ million/mm$^3$ and this number increased whenever the hosts are infected by a variety of helminth fauna.
Table 1. Post-helminth infection haematological changes in male *Calotes versicolor* (mean of ten readings ± S.E.).

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<th>Nature of study</th>
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<tr>
<td>Haemoglobin g/100 ml blood</td>
<td>8.11</td>
<td>7.60</td>
<td>4.98</td>
<td>6.39</td>
<td>4.68</td>
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<td>5.97</td>
<td>3.79</td>
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<td>± 0.81 ± 0.69 ± 0.53 ± 0.45 ± 0.78 ± 0.53 ± 0.66 ± 0.51</td>
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<tr>
<td>Iron content in mg/100 ml of blood</td>
<td>27.61</td>
<td>26.01</td>
<td>16.81</td>
<td>21.83</td>
<td>15.89</td>
<td>13.99</td>
<td>20.34</td>
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<td>± 2.08 ± 2.57 ± 1.74 ± 1.73 ± 1.97 ± 1.41 ± 2.25 ± 1.94</td>
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<tr>
<td>RBCs per mm³ in millions</td>
<td>0.645</td>
<td>0.556</td>
<td>0.382</td>
<td>0.456</td>
<td>0.361</td>
<td>0.343</td>
<td>0.411</td>
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<td>± 0.022 ± 0.007 ± 0.023 ± 0.021 ± 0.014 ± 0.017 ± 0.020 ± 0.019</td>
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<td>WBCs per mm³ in millions</td>
<td>0.116</td>
<td>0.262</td>
<td>0.288</td>
<td>0.274</td>
<td>0.299</td>
<td>0.311</td>
<td>0.277</td>
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<td>± 0.001 ± 0.007 ± 0.010 ± 0.002 ± 0.003 ± 0.005 ± 0.001 ± 0.003</td>
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This increase is more during intestinal infection compared to liver and rectum infection. During multiple organ infection, the degree of increase is in the order of intestine and rectum; liver and intestine; and liver and rectum infections. When these three organs are simultaneously infected, the increase is much more.

4. Discussion

The fall in haemoglobin concentration in *C. versicolor* during helminth infection is in accordance with the findings of Pal (1972), Cheng (1974), Hill and Andrews (1942), Germer *et al* (1955) and Belding (1965). This decrease may be due to the non-availability of the raw materials for its formation, especially proteins, iron and porphyrins or large amount of destruction of erythrocytes. The intestinal infection, with cestodes decreases the haemoglobin content which can be attributed to the decreased production of haemoglobin because of the ratio of intestinal volume to the size of cestodes, which lowers the efficiency of the intestinal absorption of the precursors of haemoglobin. Though the decrease is somewhat lesser in rectal infection, it is statistically significant. This decrease may be explained on the basis of the functions of the rectum which is not only an organ of defaecation but also for reabsorption of water and other nutrients. The presence of nematodes which are considerably larger in size may impair the rectal function, thereby leading to the decrease of haemoglobin content. Though the decrease in liver infection is least, it may be attributed to the parasitic excretory products liberated into the bile under heavy infection which may alter the composition of various components of bile. Under such conditions, the absorption of iron by bile may be impaired and thereby affecting the synthetic rate.

The decrease in the iron concentration may be attributed to the decrease in haemoglobin, as the major amount of iron in the blood is associated with haemoglobin and to some extent it is also associated with beta globulin.

Regarding the RBC count, the intestinal infection is more pathogenic. This can be explained on the basis of the phenomenon that during intestinal infection, the worms not only disturb the intestinal functions but also compete with the host for food, which may impair the absorption of haemopoietic factors like vitamin B12 or folic acid (Layrisse *et al* 1967). The multiple infections cause a drastic decrease of the number of RBCs due to the cumulative effect of all the factors.

The leucocytosis is a well-known phenomenon during helminth infection as observed by Rogers and Damin (1946) in hook worm infection, Belding (1965) in *Schistosoma japonicum* infection, Da Costa Maia (1949) in *Strongyloides stercoralis* infection. The physiological mechanism behind the increase is yet to be investigated. A consideration of the functional significance of leucocytes such as phagocytosis, release of globulins, tissue repair and blood clotting justifies the increase during all types of helminth infections.

Acknowledgement

The authors are grateful to the University authorities for the laboratory facilities.
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