

## THEILERIOSIS AND BABESIOSIS IN CATTLE: HAEMOGRAM AND SOME BIOCHEMICAL PARAMETERS

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### ABSTRACT

A total number of 43 of field cases of cattle of both sexes were clinically and laboratory investigated in this study. 15 cattle of both sexes out of this number were found clinically healthy free from both internal, external and blood parasites. Clinical and laboratory examination revealed that about 20 animals were found suffering from theileriosis and 8 animals were found suffering from babesiosis.

Blood smears were prepared directly from ear vein for all animals and lymph smears were prepared from suspected cases of theileriosis. The blood smears were used for differential leucocytic count, while lymph smears were used for observation of Koch's blue bodies. Two blood samples from both clinically healthy and diseased cattle were collected from jugular vein, one with anticoagulant for examination of haematological picture and the other without anticoagulant for separation of serum which used for biochemical analysis.

Clinical examination revealed enlargement of superficial lymph nodes, fever, congested mucous membranes, corneal opacity and emaciation were found in cases of theileriosis, while fever, paleness of mucous membranes and brown coffee urine were common clinical findings in cases of babesiosis. Haematological findings revealed that cattle suffered from theileriosis showed normocytic hypochromic anemia, while those suffered from babesiosis showed normocytic normochromic anemia. Biochemical findings revealed that cattle infected with theileriosis and babesiosis showed decreased serum levels of albumin and total proteins with increased serum globulins. The serum level of glucose was significantly decreased in cattle suffered from theileriosis and babesiosis. Serum level of aspartate aminotransferase (AST) showed significant increase in both theileriosis and babesiosis, while the Serum level of alanine aminotransferase (ALT) was significantly increased only in case of babesiosis. Serum level of gamma glutamyltransferase (GGT) was significantly increased in both theileriosis and babesiosis. Cattle infected with theileriosis showed significant decrease in serum level of iron only, while those suffered from babesiosis showed significant increase of both iron and copper serum levels. The serum level of Total iron binding capacity was significantly decreased in theileriosis.

We can conclude from our study that theileriosis and babesiosis are associated with impairment and alteration of liver function.

**Keywords:** cattle; theileriosis; babesiosis; clinical findings; haemogram; biochemical parameters

## INTRODUCTION

Theileriosis and babesiosis are considered the important blood parasites of cattle which caused by *Theileria annulata* and *Babesia bovis* respectively and they are still representing a serious problem especially in tropical and subtropical areas. The importance of theileriosis and babesiosis is due to severe economic losses and their effect on the immune status of the body (Urquhart et al., 1996).

The most marked clinical signs of theileriosis in cattle are enlargement of the lymph nodes in the area draining the site of tick attachment followed by fever, depression, anorexia and drop in milk production. In later stages, there may be nasal and ocular discharges, dyspnea, and generalized lymph node enlargement. Severe cases may be associated with diarrhea and dysentery (Radostits et al., 2000). Cows with theileriosis showed systemic changes, lateral recumbency (Stockham et al., 2000). The most clinical signs of babesiosis in cattle were fever, anorexia, dark brown urine (Yeruham et al., 2003).

Marked anemia, anisocytosis, pikiocytosis and Leucopenia were commonly observed in bovine theileriosis (Ceci et al. 1997).

Sharma et al. (2000) mentioned that haemoglobin (Hb), packed cell volume (PCV), differential leucocytic count (DLC), total leucocytic count (TLC) and total erythrocytic count (TEC) were significantly decreased in bovine babesiosis and this might be due to the intravascular haemolysis.

Non-significant decrease in levels of total proteins, albumin and glucose reported by Sandhu et al. (1998), however, marked decrease in total serum proteins, albumin, serum immunoglobulin and albumin-to-globulin ratio in *Theileria* infected crossbred calves observed by Singh et al. (2001).

Levels of total serum proteins and blood glucose were declined during the hemolytic phase of *Babesia* infected cattle (Fujinaga, 1981), while Pandey and Misra (1987) found the protein profile normal.

The goal of this work designed to study the effect of natural infection with theileriosis and babesiosis in cattle on the clinical animal health condition, haemogram and some biochemical parameters.

## MATERIALS AND METHODS

### I-Materials

#### A-Animals

A total number of 43 cattle aging from two to four years old were admitted to veterinary teaching hospital of faculty of veterinary medicine. The chief complaints of 28 animals were persistent fever and anorexia. The other animals were admitted for pregnancy diagnosis and appeared clinically healthy, therefore used as a control group.

#### B-Samples

Whole blood and lymph smear were obtained for microscopical examinations, while serum samples was obtained for biochemical analysis of ALT, AST, GGT, Total proteins, albumin, glucose, iron, copper and total iron binding capacity (TIBC).

## II -Adopted methods

### A-Clinical Examination

Clinical examination of all cattle was carried according to Rosenberger (1990).

### B- Hematological Examination

Haematological examination was done including red blood cells count (RBCs) and white blood cells count (WBCs), haemoglobin (Hb), and packed cell volume (PCV) manually (Coles, 1986). In addition, mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) were calculated mathematically, while differential leucocytic count was determined by four field meander method (Kelly, 1984).

### C-Biochemical Assay

Biochemical serum analysis of total proteins, albumin, glucose, ALT, AST, GGT, Iron, Copper, and total iron binding capacity (TIBC) were estimated spectrophotometry using commercial chemical kits supplied by Randox.

### D-Statistical Analysis

The obtained data were statistically analyzed by means of computer based statistical program (Borenstein et al., 1997).

## RESULTS

### A-Clinical Findings

Clinical findings of cattle suffering from theileriosis and babesiosis are listed as in table (1).

**Table 1.** Main clinical findings in clinically healthy cattle and diseased ones:

| Clinical Findings | Healthy cattle   | Theileriosis   | Babesiosis                               |
|-------------------|--|--|--|
| Body condition    | Good   | Emaciated  | Thin                                     |
| Mucous membranes  | Bright red, moistened no lesions and filled episcleral blood vessels | Congested with obvious Lacrimation and corneal opacity also evident. | Pale and empty episcleral blood vessels. |
| Temperature       | 38.7°C   | 40.6°C   | 40.1°C                                   |
| Pulse             | 57 beats / minute  | 76 beats / minute.   | 89 beats / minute.                       |
| Respiration       | 21 respiratory cycle / minute  | 36 respiratory cycle / minute.                                       | 39 respiratory cycle / minute.           |
| Lymph nodes       | No swelling, movable, hotless, painless                              | Greatly swollen, painful and hot during palpation.                   | No swelling, movable, hotless            |
| Urine             | Light yellow   | Straw yellow   | Dark brown to coffee in color.           |

### B-Haematological Findings

The mean values of haemoglobin (Hb), red blood cells count (RBCs), packed cell volume (PCV), mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC), white blood cells count (WBCs) and differential leucocytic count are listed in table (2).

**Table 2.** Mean values<sup>#</sup> of haemogram in health cattle and diseased ones:

| Parameters             | Healthy cattle              | Theileriosis                            | Babesiosis                   |
|------------------------|-----------------------------|---|------------------------------|
| <b>RBCs (T/l)</b>      | 7.67±0.43<br>5.69–11.60     | 6.07±0.19**<br>5.58–7.50                | 3.09±0.38***<br>2.15–5.30    |
| <b>Hb (g/l)</b>        | 118.93±3.07<br>95.00–150.00 | 87.60±7.18***<br>59.00–130.00           | 45.37±0.98***<br>40.00–50.00 |
| <b>PCV (%)</b>         | 36.47±0.75<br>28.00–40.00   | 33.40±2.007<br>26.00–48.00              | 14.25±1.28***<br>10.00–20.00 |
| <b>MCV (fl)</b>        | 49.11±2.29<br>32.76–64.00   | 55.31±2.45 <sup>NS</sup><br>43.70–65.00 | 49.46±4.57<br>22.64–64.93    |
| <b>MCH (Pg)</b>        | 16.19±0.82<br>10.17–21.89   | 14.66±1.41<br>9.07–23.30                | 16.21±1.62<br>8.49–21.64     |
| <b>MCHC (%)</b>        | 32.96±0.69<br>30.70–40.00   | 26.36±1.74***<br>18.75–36.10            | 33.48±2.48<br>23.50–45.00    |
| <b>WBCs (G/l)</b>      | 7.25±0.42<br>4.55–11.00     | 5.00±0.36***<br>3.90–7.55               | 6.77±0.67<br>4.35–8.40       |
| <b>Neutrophils (%)</b> | 32.33±1.31<br>23.00–40.00   | 18.40±1.19***<br>12.00–23.00            | 23.62±1.31***<br>18.00–30.00 |
| <b>Lymphocytes (%)</b> | 61.53±1.49<br>52.00–72.00   | 70.60±1.11***<br>64.00–76.00            | 68.75±1.38**<br>64.00–75.00  |
| <b>Eosinophils (%)</b> | 3.133±0.31<br>2.00–5.00     | 3.00±0.33<br>2.00–4.00                  | 2.50±0.27<br>1.00–3.00       |
| <b>Basophils (%)</b>   | 0.00±0.00<br>0.00–0.00      | 0.00±0.00<br>0.00–0.00                  | 0.00±0.00<br>0.00–0.00       |
| <b>Basophils (%)</b>   | 0.00–0.00<br>2.93±0.28      | 0.00–0.00<br>7.40±0.69***               | 0.00–0.00<br>5.12±0.35***    |
| <b>Monocyte (%)</b>    | 1.00–5.00                   | 5.00–12.00                              | 4.00–7.00                    |

# = Mean ± Standard error

NS=Non significant

\*\* = P < 0.01

\*\*\* = P < 0.001

### C-Biochemical Findings

The serum levels of total proteins, albumin, globulins, albumin-globulin ratio (A/G ratio), glucose, AST, ALT, GGT, iron, copper and total iron binding capacity (TIBC) are listed in table (3).

**Table 3.** Mean values<sup>#</sup> of some biochemical parameters in healthy cattle and diseased ones:

| Parameters                   | Healthy cattle | Theileriosis    | Babesiosis      |
|------------------------------|----------------|-----------------|-----------------|
| <b>Total proteins (gm %)</b> | 6.92±0.15      | 5.58±0.33***    | 5.82±0.28***    |
|                              | 6.00–8.00      | 4.14–7.50       | 4.46–7.10       |
| <b>Albumin (gm %)</b>        | 3.64±0.0085    | 1.58±0.0093***  | 1.86±0.16***    |
|                              | 3.10–4.30      | 1.00–2.00       | 1.45–2.67       |
| <b>Globulins (gm %)</b>      | 3.28±0.0098    | 4.00±0.30*      | 3.96±0.38*      |
|                              | 2.70–4.10      | 2.60–5.81       | 2.75–5.62       |
| <b>A/G ratio</b>             | 1.13±0.003     | 0.41±0.004***   | 0.54±0.009***   |
|                              | .90–1.37       | 0.25–0.59       | 0.26–0.91       |
| <b>Glucose (mg %)</b>        | 71.31±3.48     | 54.99±4.09**    | 32.71±3.12***   |
|                              | 55.00–100.00   | 26.00–66.90     | 20.74–44.00     |
| <b>AST (U/l)</b>             | 28.34±1.6      | 59.98±5.81***   | 130.26±10.62*** |
|                              | 18.00–41.00    | 31.34–93.19     | 93.19–171.70    |
| <b>ALT (U/l)</b>             | 13.78±0.70     | 14.99±0.73      | 26.08±1.14***   |
|                              | 7.00–18.00     | 11.20–19.89     | 19.89–31.04     |
| <b>GGT (U/l)</b>             | 9.91±0.97      | 13.01±0.66**    | 13.79±0.44**    |
|                              | 4.44–19.60     | 9.63–15.70      | 11.85–15.90     |
| <b>Copper (µg/dl)</b>        | 98.34±2.15     | 97.69±2.03      | 273.50±16.66*** |
|                              | 86.96–107.04   | 92.17–104.35    | 222.10–320.00   |
| <b>Iron (µg/dl)</b>          | 188.25±15.49   | 64.29±5.57***   | 245.95±15.45*   |
|                              | 138.00–273.68  | 54.40–85.30     | 210.04–298.56   |
| <b>TIBC (µg/dl)</b>          | 506.78±30.33   | 198.62±18.21*** | 412.41±13.86    |
|                              | 334.5–671.00   | 175.79–271.01   | 372.42–453.63   |

# = Mean ± Standard error

\* = P < 0.05

\*\* = P < 0.01

\*\*\* = P < 0.001

## DISCUSSION

### A–Clinical findings

The observed clinical findings in cattle with theileriosis such as anorexia, corneal opacity, enlarged superficial lymph nodes. These findings were in agreement of Shehata et al. (1984), Sandhu et al. (1998) and Radostits et al. (2000). Anorexia could be attributed to persistent fever; moreover the enlargement of superficial lymph nodes could be explained by lymphoid hyperplasia in early stage of the disease. The corneal opacity was explained by Irvin and Mawmachi (1983) as a result of white blood cells infiltration.

The observed clinical findings in cattle with babesiosis such as fever, dark brown to coffee urine, pale mucous membranes with empty episcleral blood vessels with reduced appetite could be attributed to severe haemolytic process associated the presence of *Babesia sp.* inside the red blood cells. Fujinaga (1981) and Georgi et al. (1990) supported this view.

### **B–Haematological findings**

The normocytic hypochromic anemia observed in cattle with theileriosis (table 2) could be attributed to the toxic metabolites of *Theileria sp.* which have harmful effect on bone marrow as they interfere with the process of erythropoiesis. Persistent loss of blood caused by permanent blood sucking ticks could play a role as well. Boulter and Hall (2000) mentioned that Tumor necrosis factor- $\alpha$  (TNF-  $\alpha$ ) has been implicated in the pathogenesis of anemia in bovine theileriosis by suppressing haemopoietic progenitors.

Leucogram showed significant decrease ( $P < 0.001$ ) in total leucocytic count and neutrophils while the lymphocytes and monocytes showed significant increase ( $P < 0.001$ ) in comparison with healthy control ones. Such changes in Leucogram might be attributed to persistent harmful effects of toxic metabolites of *Theileria* on the haemopoietic organs especially bone marrow and their interference with the process of leucogenesis. Relative increase in numbers of lymphocytes and monocytes reflects compensatory mechanism as target cells in response to their invasion with *Theileria* protozoan. Similar results were observed in *Theileria* infected cattle by Lamiaa (1997).

Normocytic normochromic anemia observed in cattle with babesiosis which could be attributed to intravascular haemolysis of red blood cells. Pandey and Misra (1987) supported this view. Insignificant changes in total leucocytic count in total leucocytic count in cattle with babesiosis, while there was significant increase in lymphocytes and monocytes associated with significant decrease ( $P < 0.001$ ) in neutrophils. This could be explained as the breakdown of red blood cells by *Babesia sp.* stimulates the phagocytic cells such as lymphocytes and monocytes to clean up the body from the toxic remnants of ruptured red blood cells. This is in agreement with both Guglielmone et al. (1996), who reported that *Babesia* infection lead to stimulation of body defense mechanism to produce antibodies against *Babesia* antigen, and Court et al. (2001), who mentioned that the significant increase in monocytes in primary *Babesia* infection could be attributed to their role as active mediators in the innate immune response.

### **C–Biochemical findings**

Theileriosis and babesiosis infected cattle showed significant increase in AST, GGT hypoproteinemia, hypoalbuminemia, and decreased A/G ratio. This may indicate the harmful effect of toxic metabolites of *Theileria sp.* and *Babesia sp.* on liver cells. These results were supported by Stockham et al. (2000) in *Theileria* infected cattle and Yeruham et al. (2003) in *Babesia* infected calf. The significant increase in serum globulins in both theileriosis and babesiosis could be attributed to the immune response against *Theileria* and *Babesia*. Both of Singh et al. (2001) and Fujinaga (1981) supported this view in theileriosis and babesiosis respectively. The observed hypoglycemia in both theileriosis and babesiosis could be attributed to persistent feverish condition associated theileriosis and babesiosis resulting in anorexia consequently hypoglycemia. This view supported by Sandhu et al. (1998) in *Theileria* infected cattle and Fujinaga (1981) in *Babesia* infected cattle. Serum level of iron was significantly decreased ( $P < 0.001$ ), while copper showed insignificant change. The drop in serum level of iron may be due to anaemia which leads to excessive withdrawal of serum iron to be utilized for erythropoiesis. Omer et al. (2003) reported decrease serum iron and copper concentrations in cattle naturally infected with *Theileria annulata*. The increased serum levels of iron and copper in babesiosis could be attributed to haemolysis associated *Babesia* infection. Pandey and Misra (1987) adopted similar view where they explained the increase in serum iron and copper in *Babesia* infected cattle to intravascular haemolysis.

We can conclude that deteriorated body condition, fever, and anorexia are common clinical findings in cattle infected with theileriosis and babesiosis, however enlargement of lymph nodes and corneal opacity are associated clinical findings with theileriosis, while red brown to coffee

urine and pale mucous membranes are associated clinical findings with babesiosis. Normocytic hypochromic anaemia is associated with theileriosis, while normocytic normochromic anaemia is associated with babesiosis. Phagocytic cells lymphocytes and monocytes are commonly increased in *Theileria* and *Babesia* infected cattle. Theileriosis and babesiosis have harmful effect on the liver function in cattle.

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