

Serum Biochemical Profile Alterations in Cattle with Clinical Babesiosis

Patteda Dhanamjayam¹, Bhavanam Sudhakara Reddy¹, Bollam Shobhamani² and Sirigireddy Sivajothi^{3*}

¹Department of Veterinary Medicine, College of Veterinary Science, Proddatur – 516360, Sri Venkateswara Veterinary University, Andhra Pradesh

²Department of Veterinary Medicine, College of Veterinary Science, Tirupati – 517502, Sri Venkateswara Veterinary University, Andhra Pradesh

³Department of Veterinary Parasitology, College of Veterinary Science, Proddatur – 516360, Sri Venkateswara Veterinary University, Andhra Pradesh

Abstract

The report presents the serum biochemical findings from a study involving 28 adult cattle infected with clinical babesiosis. Present study was conducted in the YSR district of Andhra Pradesh from January to December 2023, the study identified babesiosis infected cattle based on a history of fever, hemoglobinuria, and tick infestation, as well as positive results from microscopic examination of stained peripheral blood smears. Serum biochemical analysis was done by using the automatic serum analyzer with commercially available kits. The serum biochemical profiling revealed the following range in cattle with babesiosis i.e. Serum total protein (g/dL) averaged 5.37 ± 0.29 , ranging from 5.03 to 5.68; albumin (g/dL) averaged 2.12 ± 0.12 , ranging from 1.89 to 2.27; aspartate transaminase (IU/L) averaged 310.8 ± 20.8 , ranging from 288 to 332; total bilirubin (mg/dL) averaged 2.26 ± 0.07 , ranging from 2.19 to 2.32; direct bilirubin (mg/dL) averaged 0.63 ± 0.10 , ranging from 0.52 to 0.74; blood urea nitrogen (mg/dL) averaged 58.18 ± 2.08 , ranging from 56 to 60.8; creatinine (mg/dL) averaged 2.93 ± 0.91 , ranging from 1.89 to 3.88; calcium (mg/dL) averaged 8.18 ± 0.51 , ranging from 7.65 to 8.62; phosphorous (mg/dL) averaged 3.48 ± 0.44 , ranging from 3.02 to 3.85; sodium (mEq/L) averaged 132.1 ± 4.08 , ranging from 128.6 to 136.23; potassium (mEq/L) averaged 4.01 ± 0.38 , ranging from 3.76 to 4.39; chloride (mEq/L) averaged 91.13 ± 3.13 , ranging from 88.09 to 94.52.

Comparing affected cattle to apparently healthy ones, a significant reduction ($P < 0.01$) was observed in serum albumin, calcium, phosphorous, sodium, potassium, and chloride levels, while a significant elevation ($P < 0.01$) was noted in aspartate transaminase, bilirubin, blood urea nitrogen and creatinine levels. Assessing the serum biochemical analyses in infected cattle proves beneficial for understanding the individual host's internal organ function and the metabolic processes crucial for maintaining animal health and optimal productivity during and post infection.

Keywords: Cattle, Babesiosis, Serum biochemical analysis, Protein

*Correspondence

Author: Dr. Sirigireddy Sivajothi
Email: sivajothi579@gmail.com

Introduction

Babesiosis, caused by intra-erythrocytic apicomplexan parasites belonging to the *Babesia* genus, is predominantly transmitted through blood-sucking ticks. The parasites can also spread via blood inoculation, mechanical transmission by insects, surgical procedures, and intrauterine infection. In India, the most common mode of transmission is by *Rhipicephalus* ticks, favoured by the climatic conditions conducive to tick multiplication and propagation [1]. Economic losses to livestock due to babesiosis in India are projected to reach approximately 84.7 million US dollars [2]. Crossbred cattle show a higher susceptibility rate compared to zebu and buffaloes, which primarily act as carriers of the disease. During infection, significant changes occur in serum biochemical profiles due to the dysfunction of lymphoid and reticuloendothelial cells. Understanding these alterations in acutely infected animals is crucial for diagnosis, prognosis, therapy, and assessing the severity of infection [3, 4]. In this study, we investigated these parameter changes to gain insights into the pathogenesis of babesiosis in cattle.

Materials and Methods

The research was conducted in the YSR district of Andhra Pradesh, with samples collected from various veterinary dispensaries from January 2023 to December 2023. A total of 240 samples were gathered, out of which 28 samples were identified as positive for acute infection and were selected for the study. The selection criteria for these samples included clinical signs (**Figure 1**) and symptoms and tick infestation (**Figure 2**). Confirmation of babesiosis was

achieved through microscopic identification of the piroplasmic stage of *Babesia* spp. by preparing three thin blood smears from each sample. These smears were fixed in methanol for 5 minutes and stained with Geimsa stain (1:10 dilution) for 30 minutes. The slides were then examined under an oil immersion objective lens to confirm the presence of piroplasmic stages. To ensure comparability, ten samples were randomly selected from healthy individuals [5].

All samples utilized in this study consisted of whole venous blood. Aseptic collection of approximately 6 ml of blood from the jugular vein of suspected animals was conducted. Blood samples collected in vials without EDTA were centrifuged at 2000xg for 10 minutes. The resulting serum was then transferred to sterilized vials, appropriately labeled, and stored at -20°C. Serum was used for estimating serum parameters, including total protein (TP), albumin, aspartate transaminase (AST), bilirubin, blood urea nitrogen (BUN), creatinine, calcium (Ca), phosphorous (P), sodium (Na), potassium (K), and chloride (Cl), using commercially available kits and a serum automatic analyzer [6]. The obtained results were subjected to statistical analysis using SPSS version 23.00. Results are presented as mean \pm standard error (SE). Student's t-test was employed to compare the means of infected and non-infected groups for changes in the biochemical profiles during infection.



Figure 1 Cattle with pale mucus membranes



Figure 2 Cattle with tick infestations

Results and Discussion

The present study reveals an 11.67% prevalence of babesiosis in cattle based on stained peripheral blood smear examination. Serum biochemical parameters (Table 1) were as follows: serum total protein (g/dL) averaged 5.37 ± 0.29 , ranging from 5.03 to 5.68; albumin (g/dL) averaged 2.12 ± 0.12 , ranging from 1.89 to 2.27; aspartate transaminase (IU/L) averaged 310.8 ± 20.8 , ranging from 288 to 332; total bilirubin (mg/dL) averaged 2.26 ± 0.07 , ranging from 2.19 to 2.32; direct bilirubin (mg/dL) averaged 0.63 ± 0.10 , ranging from 0.52 to 0.74; blood urea nitrogen (mg/dL) averaged

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Table 1 Serum biochemical examination in cattle with babesiosis

| S. No. | Parameter | Apparently healthy cattle (10) | Cattle with babesiosis (28) | P value |
|--------|-------------------------------|--------------------------------|-----------------------------|---------|
| 1. | Total protein (g/dL) | 6.31 ^b ±0.15 | 5.37 ^a ±0.29 | 0.022* |
| 2. | Albumin (g/dL) | 2.44 ^b ±0.09 | 2.12 ^a ±0.12 | 0.043* |
| 3. | Aspartate transaminase (IU/L) | 67.28 ^a ±3.09 | 310.8 ^b ±20.8 | 0.001** |
| 4. | Total Bilirubin (mg/dL) | 1.01 ^a ±0.08 | 2.26 ^b ±0.07 | 0.001** |
| 5. | Direct Bilirubin (mg/dL) | 0.25 ^a ±0.09 | 0.63 ^b ±0.10 | 0.001** |
| 6. | Blood Urea Nitrogen (mg/dL) | 16.31 ^a ±0.98 | 58.18 ^b ±2.08 | 0.029* |
| 7. | Creatinine (mg/dL) | 1.06 ^a ±0.32 | 2.93 ^b ±0.91 | 0.017* |
| 8. | Calcium (mg/dL) | 10.88 ^b ±0.33 | 8.18 ^a ±0.51 | 0.034* |
| 9. | Phosphorous (mg/dL) | 5.03 ^b ±0.18 | 3.48 ^a ±0.44 | 0.029* |
| 10. | Sodium (mEq/L) | 138.9 ^b ±6.11 | 132.1 ^a ±4.08 | 0.021* |
| 11. | Potassium (mEq/L) | 4.55 ^b ±0.41 | 4.01 ^a ±0.38 | 0.037* |
| 12. | Chloride (mEq/L) | 98.29 ^b ±1.04 | 91.13 ^a ±3.13 | 0.048* |

*P<0.05; **P<0.01; ^{NS}P>0.05; ^{ab}Columns bearing different superscripts differ significantly

Babesiosis in cattle poses a significant threat as a haemo-protozoan disease, often resulting in considerable morbidity and mortality among affected animals [7]. The disease exhibits seasonal variations, typically aligning with periods of heightened tick activity. Confirmation of the disease, particularly during its acute stage, often relies on the presence of the protozoan within red blood cells [8]. Past research has underscored the detrimental impact of the parasite on cattle health, with documented instances of liver and kidney dysfunction [9]. The severity of the disease and its prognosis are often determined by the extent of damage inflicted by the parasite. Consequently, aggressive therapeutic interventions are warranted to counter parasitemia and mitigate the parasite's damaging effects on vital organs.

During babesiosis, dysfunction of hepatic system leads to decreased albumin synthesis which subsequently impact over the serum total protein levels [10]. Lowered levels of total protein in association with the previous studies by several workers [11, 12]. This reduction in protein levels could be attributed to decreased protein production due to dietary protein deprivation resulting from anorexia and fever accompanying the infection. The serum albumin was significantly lower in babesiosis affected cattle as compared to healthy cattle. Similar findings were recorded by several workers [13, 14, 15, 16]. The decreased value of the albumin is associated with the acute phase of the disease and albumin may be decreased due to decreased protein synthesis capacity of affected liver or prolonged insufficient caloric intake [14]. Low albumin levels may be due to pronounced hemolytic crises, proteinuria associated with renal failure and anorexia in relation to high rise of body temperature.

Present study revealed, significant increase in the activities of serum aspartate aminotransferase in cattle with infected with babesiosis compared to non-infected control group. This elevation in enzyme activities may be attributed to hepatic cell degeneration resulting from extensive hemolysis, which often occurs concurrently with hypoxia, leading to an increase in serum aspartate aminotransferase levels [9]. The mean values of serum bilirubin in babesiosis infected cows was significantly higher as compared to that in healthy cows. In the present study bilirubin level was increased significantly in babesiosis infected cows as compared to healthy cows. A significant increase in total bilirubin in babesiosis is due to hepatic damage and the, presumably hemolytic anaemia.

The mean values of blood urea nitrogen in babesiosis infected cows was significantly higher as compared to that in healthy cows. The observations recorded in the present studies [1, 14, 15]. In the present study, blood urea nitrogen level was increased significantly in babesiosis infected cows which may be attributed to rapid destruction of RBCs by phagocytosis in reticulo-endothelial system and so the massive haemolysis occurred during the period of infection with babesiosis and hypoxia leads to hepatic cell degeneration and glomerular dysfunction resulting in increased level of blood urea nitrogen [14]. The rise in serum creatinine and urea levels could also be attributed to systemic hypotension induced by *Babesia* infection, resulting in kidney vasoconstriction. This vasoconstriction is considered the primary

cause of kidney hypoxia, with systemic hypotension being more culpable than hemoglobinuria in renal tissue damage [9].

The observed hyponatremia in cows infected with babesiosis in this study may result from reduced renal perfusion and hypotension [17]. During *Babesia* infection, persistent hypotension leads to reduced glomerular filtration, stimulating the renin-angiotensin-aldosterone system, and resulting in sodium and water retention. Additionally, the release of antidiuretic hormone in cases of hypotension further reduces water excretion. Despite sodium retention, dilution occurs, leading to hyponatremia. The hypokalemia observed in cows infected with babesiosis compared to healthy non-infected cows could be attributed to potassium loss from the gastrointestinal tract or kidneys, or translocation of potassium into intracellular fluids. Additionally, degenerative and necrotic changes in the renal proximal tubules may contribute to the development of hypokalemia [18].

Conclusion

The present study conducted in the YSR district of Andhra Pradesh reveals an 11.67% prevalence of babesiosis in cattle, accompanied by notable hepatic renal impairments and ultimately leading to significant economic losses.

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