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Study on prognosis and treatment of theileriosis in crossbred cattle

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Abstract

The study revealed that the occurrence of theileriosis was 14.2%. In the present study Holstein Friesian crossbred cattle were more effected than other crossbred cattle. The *Theileria annulata* was identified from blood samples of asymptomatic cases by PCR with an expected amplification size of 785 bp. The *T.annulata* was identified from the blood smears of clinical cases by giemsa staining and field staining. The most prominent clinical signs observed in theileriosis were anorexia, pyrexia, pale mucous membranes, reduced milk yield, lymph node enlargement, depression, ectoparasite infestation, icterus, brown coloured urine, weight loss respiratory distress, diarrhoea and bloody faeces. Haematology showed normocytic normochromic anemia with neutropenia and lymphocytosis. Serum biochemical profile revealed rise in AST, total bilirubin levels and fall in total protein, albumin and glucose. Severe anemia with myocardial involvement (elevation of cardiac troponin I and CKMB) indicates poor prognosis in crossbred cattle with theileriosis. Single dose of buparvoquone @ 2.5 mg/kg BW deep I/M was found to be useful in the treatment of theileriosis in crossbred cattle caused by *T.annulata*. Single dose of buparvoquone @ 2.5 mg/kg BW deep I/M and imidocarb dipropionate@ 1.2 mg/kg BW S/C were found to be useful in the treatment of mixed infection of theileriosis with babesia species.

Keywords: Molecular diagnosis, treatment, theileriosis, crossbred cattle

1. Introduction

Bovine tropical theileriosis, a lymphoproliferative disease caused by *Theileria annulata*, remains one of India's most economically important diseases. The bont-legged tick *Hyalomma anatolicum trans-stadially* transmits the infection (Bhattacharyulu *et al.*, 1975) [1]. The disease is endemic in tropical and subtropical areas of the world, with prevalence spanning Southern Europe and North Africa through the Middle East and Southern Russia into India and Southern China (Uilenberg, 1981; Dolan, 1989; Dumanli *et al.*, 2005; Morrison and McKeever, 2006) [81, 23, 25, 54]. Around 250 million cattle worldwide are at risk of tropical theileriosis (Bishop *et al.* 2004) [13], while in India, (approximately) 39 million crossbred cattle are at risk of *T.annulata* infection (Kolte *et al.*, 2017) [43]. High mortality and morbidity in all age groups of exotics and crossbreeds cattle are hallmarks of theileriosis (Jithendran, 1997; Bishop *et al.*, 2004) [40, 13]. The disease is clinically characterized by pyrexia, anorexia, enlarged superficial lymph nodes, tachycardia, dyspnoea, icterus and pallor of mucous membrane. Occasionally progressive anaemia, respiratory symptoms and gastrointestinal disorders, torticollis, convulsions and other nervous signs are also reported. Abortion, significant loss in milk production and death are other sequelae of this disease (Eamens *et al.*, 2013) [26]. In the absence of specific treatment of infection and tick control measures, a subclinical form of theileriosis is common and cause significant economic loss in developing countries. The casefatality rate of the infection can be as high as 80% in the 1 exotic breeds of cattle; however, the same is about 20% in the indigenous animals (Glass *et al.*, 2003) [30]. The disease is prevalent in most parts of India (Sayin *et al.*, 2003, Panda *et al.*, 2011; Vahora *et al.*, 2012; Chaudhri *et al.*, 2013; Dharanisha *et al.*, 2017) [70, 61, 82, 17, 21]. The diagnosis of *T.annulata* infection in bovines relies on traditional parasitological methods, including microscopy-based detection of piroplasms and macroschizonts in Giemsa-stained thin blood smears and lymph

node biopsy, respectively (Aulakh and Singla, 2006) [10]. Even though the conventional tests are reliable and have high specificity, they fail to detect the pathogens in the asymptomatic carrier animals with low parasitaemia. Further, it is difficult to differentiate the *Theileria* species based on the morphological features (Liu *et al.*, 2010) [45]. The unrealistic time involved with the microscopical detection method, especially for the animals with low parasitaemia, renders it unsuitable for extensive studies. Furthermore, carrier animals are a potential source of infection for vectors and healthy susceptible populations and a means of spreading the disease to new areas (Callow, 1984; Bilgic *et al.*, 2013) [15, 12]. Hence, for sensitive diagnosis of the infection in carriers, molecular assays like PCR will be highly useful, detecting very low levels of parasitemia. The PCR has recently been the most widely used method for detecting *T.annulata* infection in cattle in epidemiological studies. Several investigations have shown that the technique is more sensitive and specific in identifying piroplasm-carrier animals than other traditional diagnostic techniques (d'Oliveira *et al.*, 1995; Vatansever and Nalbantoglu, 2002; Paliwal *et al.*, 2019; Mohmad *et al.*, 2021) [24, 53, 60, 83]. The PCR also provided a more straightforward method to detect infection in the vector ticks for epidemiological studies as the staining of dissected salivary glands of the ticks is cumbersome, mainly when large sample sizes must be processed (Das and Ray, 2003) [20].

Four effective drugs for the treatment of Theileriosis namely, parvaquone, buparvaquone, halofuginone lactate and oxytetracycline were used worldwide (Negumi *et al.*, 1992) [57]. Research work regarding the efficacy of these drugs has shown that buparvaquone, second-generation hydroxynaphthoquinone, is more effective so far. Early treatment with buparvaquone was 100% effective in eliminating the protozoan parasites from the blood and lymph nodes and led to an improvement in the clinical state whereas treatment in the later stages of the disease whilst eliminating the parasites failed to improve the clinical condition of the animal (Salama and Gaabarya., 2007) [66]. Anti theilerial drug buparvaquone @2.5mg/kg BW single dose along with supportive therapy proven most effective in early stages of the disease (Gupta *et al.*, 2020) [36]. Combination of buparvaquone and imidocarb dipropionate is useful in the treatment of mixed infection with Babesiosis (Shah *et al.*, 2019) [71]. Buparvaquone, a major hydroxynaphthoquinone effective against both the schizont and piroplasm stages of the parasite, is the drug of choice for bovine tropical theileriosis (McHardy *et al.*, 1985; Hashemi-Fesharki, 1990; Mhadhbi *et al.*, 2015; Gharbi and Darghouth, 2015) [29, 38, 50, 51]. The study is designed to record the clinical signs, to study the survival and prognostic findings in crossbred cattle with Theileriosis and to assess the efficacy of therapy adopted in crossbred cattle with Theileriosis.

Materials and Methods

The study entitled Study on Diagnosis and Treatment of Theileriosis in Crossbred Cattle was conducted from August 2021 to December 2021 in the Department Veterinary Clinical Complex, College of Veterinary Science, Tirupati and surrounding Veterinary hospitals and Dairy farms in certain parts of Chittoor district, Andhra Pradesh. Ten apparently healthy crossbred cattle were selected as control group for obtaining normal data for comparison of parameters under study. Crossbred cattle presented to the large animal ward, Veterinary Clinical Complex, College of Veterinary Science, Tirupati, surrounding Veterinary Hospitals and Dairy

farms in certain parts of Chittoor district with clinical signs suspected for theileriosis and asymptomatic form of theileriosis were taken up for the present study. Five ml blood was collected from twenty crossbred cattle with theileriosis before initiation of therapy and 14th day post treatment for haematology and serum biochemistry. Five ml blood was collected once from ten apparently healthy crossbred cattle (Group I) for comparative study. Lymphnode aspiration done for detection of schizonts in lymphocytes (Koch's blue bodies). Serum was separated immediately after clotting by centrifugation at 3000 rpm for 3 minutes). Cardiac Biomarkers Cardiac Bio marker cardiac troponin- I was qualitatively assessed by using combo kit which was supplied by CTK Biotech, Inc, USA. Ten crossbred cattle which were positive for *Theileria annulata* and 10 cases of mixed infection with (theileriosis and Babesiosis) were randomly selected into 2 groups (Group II and Group III) and the efficacy of different therapeutic agents were evaluated. A total 10 apparently healthy crossbred cattle were used as healthy control (Group I). Therapeutic agents • Inj. Zubion TM. (Intas pharmaceuticals Ltd., Ahmedabad) Each ml contains Buparvaquone injection IP 50 mg. • Inj. BabimidoTM (Imidocarb dipropionate 12% w/v Zydus AH, Cadila Health Care Ltd.) Each ml contains Imidocarb dipropionate 120 mg. • 3D RedTM (Intas pharmaceuticals Ltd). Each 10 ml contains Ferric Ammonium Citrate eq to Elemental Iron 54 mg, Copper Sulphate 40 mg, Cobalt Chloride 20mg, Calcium Gluconate 140 mg, Niacinamide 18 mg, Biotin 30 mcg, Folic acid 3 mg, Vit B12 125 mcg, Pyridoxine 4 mg.

Clinical examination Crossbred cattle with symptoms suggestive of theileriosis like pyrexia, lymph node enlargement, anorexia, reduced milk yield, depression, anemia and icterus were subjected to thorough clinical examination and recorded in a prescribed proforma. Giemsa staining Peripheral blood smears were fixed with methanol for 1 minute and air dried. The smears were stained by Giemsa staining solution, 1:8 dilution, for 45 minutes, washed under running tap water, air dried and examined for *Theileria annulata* organisms under oil immersion objective of microscope. Field staining Two coplin jars were filled with Field's stain A and B solutions separately. Peripheral blood smears were fixed in methanol for one minute and air dried. This was followed by coupling of stain B and allowing it to act for 30 seconds. After washing the slides in running tap water, stain A was added and allowed to act for 30 seconds. The slides were further washed, air dried and observed under 100 X objective of a light microscope. Polymerase Chain Reaction mic DNA isolation by DNA blood mini kit (Qiagen) DNA isolation was done for 50 blood samples from the suspected cases for the detection of *Theileria annulata*. Oligonucleotide primer sequences used for the identification of *T.annulata* by PCR. Organism Primer sequence pair Product size (bp) Reference *Theileria annulata* Tams 1 F: ATG CTG CAA ATG AGG AT Tspm 1 R: GGA CTG ATG AGA AGA CGA TGA G 785 Kirvar *et al.* (2000).

Evaluation of haemato-biochemical parameters

Haematological parameters such as haemoglobin, packed cell volume, total erythrocyte count, total leukocyte count and differential leukocyte count were estimated as per the standard procedures (Coles, 1986) [19]. Hb (g %) was estimated by acid hematin method, PCV (%) was estimated by microhematocrit method, TEC (106/ μ l) and TLC (103/ μ l) were carried out by haemocytometer method. Blood smear was stained with Leishman's method and DLC was carried out

by battlement method (Omer *et al.*, 2003) [58]. Serum biochemical parameters were estimated by semi auto analyzer using the Assay kits and techniques. Serum total protein was estimated by Biuret method, End point assay using Erba Mannheim ready to use kit and the values were expressed in g/dl (Modi *et al.*, 2015) [52]. Serum albumin was estimated by Bromo cresol green (BCG), end point assay method using Erba Mannheim ready to use kit and the results were expressed in g/dl (Swami *et al.*, 2019) [79]. Total bilirubin was estimated by Jendrassik and Grof method, end point assay using Genix, Proton Biologicals India Pvt. Ltd., ready to use kit and the results were expressed in mg/dl (Goel *et al.* 2017) [31]. AST Serum AST was estimated by International Federation of clinical Chemistry method (IFCC), Kinetic assay using Erba Mannheim ready to use kit and the results were expressed in IU/L (Al-Emarah *et al.*, 2012) [7]. Glucose Serum Glucose was estimated by Trinder's method, end point assay using Erba Mannheim ready to use kit and the results were expressed in mg/dl (Gunes *et al.*, 2016) [33]. Creatinine kinase – MB Serum Creatinine Kinase – MB was estimated by Modified International federation of chemical chemistry method (IFCC), kinetic assay using Biosystems ready use kits and the results were expressed in IU/l (Gupta *et al.*, 2021) [34]. Cardiac Troponin -I Serum Cardiac Troponin – I was Qualitatively assessed by using the combo kit supplied by CTK Biotech, Inc, USA (Gupta *et al.*, 2021) [34].

Selection criteria for inclusion into therapeutic trials

- Clinical signs suggestive of Theileriosis,
- Blood smear positive for *Theileria annulata* and
- PCR confirmed cases of *Theileria annulata* infection in asymptomatic forms.
- Mixed infection with Babesiosis

Therapy

Group II: The crossbred infected with theileriosis cattle in this group-II were treated with Inj. Buparvoquone @ 2.5 mg/kg BW I/M as single injection (Gupta *et al.*, 2020) [36].

Group III: The crossbred cattle infected with theileriosis and Babesiosis in group-III were treated with Inj. Buparvoquone @ 2.5 mg/kg BW I/M as single injection and Imidocarb dipropionate @ 1.2 mg/Kg BW, S/C as single dose. (Shah *et al.*, 2019) [71] The cattle in both groups (II, III) were received the following supportive therapy for 5 days

- 3D Red @ 50 ml/animal orally SID.
- Meloxicam @ 0.5 mg/Kg BW I.M SID

Evaluation of therapeutic efficacy

The crossbred cattle under the therapeutic trials were monitored for a period of 14 days. The treatment regimens were evaluated at 14 days period based on the improvement in clinical signs, haemato-biochemical profile and disappearance of *T.annulata* from the blood.

Statistical analysis: Statistical analysis was performed by using one way ANOVA and correlation analysis by using software called IBM- SPSS (Software Packages for Social Sciences) version 22.0.

Results and Discussion

In the present study crossbred cattle with clinical signs of theileriosis presented to the large animal ward, Veterinary Clinical Complex, College of Veterinary Science, Tirupati, surrounding Veterinary Hospitals and dairy farms in certain

parts of Chittoor districts, Andhra Pradesh were screened. The most prominent clinical signs observed in crossbred cattle with theileriosis were anorexia, pyrexia, pale mucous membranes, milk yield, lymph node enlargement, depression, ectoparasite infestation, icterus, brown coloured urine, weight loss respiratory distress, diarrhoea and bloody faeces. The present findings were in accordance with earlier studies of Aulakh and Singla (2006) [10]; Osman and Al-Gaabary (2007) [59]; Col and Uslu (2007) [18]; Hussein *et al.* (2007) [39]; Masare *et al.* (2009) [49]; Al-Hosary *et al.* (2010) [8]; Qayyum *et al.* (2010) [62]; Khan *et al.*, (2011) [42]; Sumathi and Veena (2012) [78]; Singh *et al.* (2014) [75]; Ayadi *et al.* (2016) [11] and Singh *et al.* (2017) [74]. Anorexia could be attributed to persistence of fever. More over the enlargement of Lymphnode could be explained by lymphoid hyperplasia in early stages of the disease that occurs due to proliferation of schizonts inside the mononuclear cells and causes inflammatory reaction inside the infected lymph nodes (Anon (1997) [9] and Ugalmugle *et al.* (2010) [80]. In the present study pyrexia is due to the liberation of endogenous pyrogens attributed to cellular lysis and parasitemia leading to the stimulation of thermoregulatory center in the hypothalamus as reported by Glass *et al.* (2003) [30]. Increase in respiratory rate might be due to accumulation of edematous fluid inside the lung and thoracic cavity Muraguri *et al.* (2006) [55]. The depression and reduced milk yield may be due to inappetence, fever, anemia and deteriorating effect of parasite on body of the animal. Diarrhoea and bloody faeces seen in infected crossbred cattle can be explained as a result to inflammatory reaction and ulceration of abomasum and intestinal tract (Radostitis *et al.* (2007) [63]. In the present study the crossbred cattle showed pale mucus membranes with a similar finding in studies of Col and Uslu (2007) [18]; Hussein *et al.* (2007) [39]; Masare *et al.* (2009) [49]; Singh *et al.* (2014) [75]; Madhukar *et al.* (2016) [46]; Singh *et al.* (2017) [74] and Goud and Vijayakumar (2020) [32]. They explained that the paleness of mucus membranes exhibited the development of anemia and reduction of the haemoglobin concentration and total erythrocytic count was due to destruction and removal of infected erythrocytes by reticuloendothelial system. Persistent loss of blood causing by persistent blood sucking ticks could play a role as well. The removal of piroplasms infected erythrocytes by macrophages and in the organs of reticuloendothelial system has been suggested as a cause of anemia (Singh *et al.* (2001) [73]. The normocytic normochromic anemia observed in crossbred cattle with *T.annulata* attributed to the toxic metabolites of which has harmful effects on the bone marrow as they interferes the process of erythropoiesis. Boulter and Hall (2000) [14], mentioned that Tumor Necrosis Factor α has been implicated in the pathogenesis of anemia in theileriosis by suppressing haemopoietic progenitus. In infected crossbred cattle icterus mucus membranes which are a yellowish discoloration examined on eye conjunctiva which is a result of increased level of total bilirubin. The jaundice of conjunctival mucus membranes is similarly found by Col and Uslu (2007) [18]; Hussein *et al.* (2007) [39]; Masare *et al.* (2009) [49]; Ugalmugle *et al.* (2010) [80]; Singh *et al.* (2014) [75]; Madhukar *et al.* (2016) [46] and Singh *et al.* (2017) [74]. The icterus observed in affected animals may be due to the reason that, infected and even uninfected red blood cells were destroyed mainly in the liver and spleen, resulting in progressive haemolytic anaemia, the number of infected erythrocytes increases drastically and phagocytosis by reticuloendothelial cells of parasitized erythrocytes lead to development of haemolytic anaemia and icterus as reported

by Radwan *et al.* (2013) [64]. Leukogram showed significant decrease in total leukocyte count and Neutrophils while the lymphocytes showed significant increase in comparison with control group. Such changes in the leukogram might be attributed to persistent harmful effect of *T.annulata* effect on haemopoietic organ especially on bone marrow and their interference with the process of leukogenesis and due to proliferation of lymphocytes in the lymphoid organ as defensive response to invading parasites. Relative increase number of lymphocytes and monocytes reflects compensating mechanism as target cells in response to their invasion with *T.annulata* as reported by Sarma *et al.* (2016) [67]. Similar results were observed in theileriosis infected crossbred cattle Lamiaa *et al.* (1997) [44]. In the current work the mean values of total protein, albumin, glucose values revealed significant decrease in crossbred cattle infected with theileriosis when compared with control group. In contrary, Total serum globulin, total bilirubin and AST showed significance increase in mean values of the infected crossbred cattle. These results were in agreement with Omer *et al.* (2003) [58]; Col and Uslu (2007) [18]; Hussein *et al.* (2007) [39]; Alam and Nasr (2011) [6] and Modi *et al.* (2015) [52]. The above significant biochemical changes probably indicate inflammatory - changes in hepatic cells which in turn effect their functions (Singh *et al.* (2001) [73]. Changes in protein may be due to harmful effect of theileria toxic metabolites on liver cells. These results were supported by Stockman *et al.* (2000) and Yeruham *et al.* (2003) [84]. Low serum total protein concentration in crossbred cattle naturally infected with *T.annulata* was probably due to hypoalbuminemia arising from liver failure as reported by Omer *et al.* (2003) [58]. Hyper gamma globulinemia was mentioned as a major cause of increase in globulin level as consequence of immune response against infection with theileriosis Singh *et al.* (2001) [73] and Fujinaga (1981) [28]. Positive results with qualitative cardiac troponin I test and significant increase of Creatinine Kinase MB levels in two infected crossbred cattle might be due to anemia and parasitemia which contributed to the pathophysiology of myocardial damage as reported by Fartashvad *et al.* (2013) [27] and Sarma *et al.* (2016) [67]. Increase in AST level in theileriosis infected crossbred cattle indicate the hepatic tissue damage that included coagulation necrosis, damage of hepatic cords with heavy infiltration of lymphocytes in peripheral areas indicating severe damage to hepatobiliary system due to hypoxia resulting from anemia and jaundice (Singh *et al.* (2001) [73]; Hasanpour *et al.* (2008) [37]; Alam and Nasr (2011) [16] and Al-Emarah *et al.* (2012) [7]. In the present study lower levels of blood glucose, might be attributed to anorexia and metabolic disturbances of diseased animals (Pandey *et al.* (1987). The findings were in line with the Col and Uslu (2007) [18] they reported that the decreased serum glucose concentration due to utilization of glucose by theileriosis in the blood and hepatic disfunction as a result of theileria infection. In the present study microscopic examination of 141 giemsa stained peripheral blood smears from crossbred cattle 15 crossbred cattle were positive for *T.annulata* (10.56%) infection the findings were in agreement with previous reports of Sharma and Sohanpal (2001) [72]; Ahmed *et al.*, (2002) [4]; Aktas *et al.*, (2006) [5]; Quyyum *et al.* (2010); Nair *et al.*, (2011) [56]; Abdela and Bekele (2016) [2] and Acharya *et al.* (2017) [3]. Out of 50 blood samples 5 were positive for asymptomatic form of *T.annulata* infection by PCR with an expected amplification size of 785 bp. The present findings were in agreement with the studies of Quyyum *et al.* (2010); (Abdela and Bekele, 2016) [2] Acharya

et al. (2017) [3] and Goud and Vijayakumar (2020) [32]. The PCR is superior method over the traditional method (Blood smear) to diagnose the asymptomatic form of *T.annulata* infection. 94 Microscopic examination of 141 giemsa stained blood smears revealed Theileria species in ten cattle and ten cattle revealed babesia species infection mixed with theileria spp. Piroplasms of theileria spp. are characterized by various morphological appearance, thin and thick rod shaped or annular with light staining trialing cytoplasm in the lymphocytes, histocytes and erythrocytes in giemsa stained smears (Sharma and Sohanpal (2001) [72]; Ahmed *et al.*, (2002) [4]; Aktas *et al.*, (2006) [5]; Qayyum *et al.* (2010) [62]; Nair *et al.*, (2011) [56]; Abdela and Bekele (2016) [2] and Acharya *et al.* (2017) [3]. So, all these forms could be detected in giemsa staining smears maximum of signet ring forms, this clearly indicate that the prevalence of pathogen has been unaltered in the state to despite extensive treatment and control strategies adopted especially in dairy cattle sector. Babesia organisms are round to pyriform, amoeboid form occurring in the erythrocytes as reported by Soulsby (2012) [76]. Even though the routine diagnosis of *T.annulata* infection is based on light microscopy, this method is not sensitive enough or sufficiently specific to detect chronic carriers. So molecular techniques such as PCR enables sensitive and specific detection of *T.annulata*. Hence, the results of the present study highlighted the need to rule out the existence of carrier status in dairy cattle, before introducing any stressful condition like transportation or vaccination. It is confirmed that PCR test is more sensitive in detecting low grade of infection in carrier animals as compared with microscopic examination. Similar observations were made by d'Oliviera *et al.* (1995) [24]. Appropriate tick control strategies are also to be adopted for containing infection at reduced level in herds in endemic areas. In the present study 2 Holstein Friesian crossbred cattle with theileriosis infection died due to severe anemia and involvement of myocardium. These findings were in agreement with Razavi *et al.* (2015) [65]; Gupta *et al.* (2018) [35] and Gupta *et al.* (2021) [34]. The present study revealed severe anemia with involvement of myocardium are poor prognostic indicators in two crossbred cattle with theileriosis. In the present study clinical cases showed signs of improvement after 3rd day of treatment in both the groups. After 14th day of treatment clinical signs resolved and the clinical condition of the animals improved and disappearance of *T.annulata* organisms from blood. So, the animals returned to feeding and rumination. It was observed that there was significant increase in Haemoglobin, PCV, TEC values in both the groups after 14 days post treatment. The post treatment mean values of Total protein, serum albumin, blood glucose significantly increased and post treatment mean values total bilirubin and AST were significantly decreased in both the groups. These findings were in agreement with earlier studies of Omer *et al.* (2003) [58]; Aulakh and Singla (2006) [10]; Col and Uslu (2007) [18]; Durrani *et al.* (2010); Quyyum *et al.* (2010); Panda *et al.* (2011) [61]; Modi *et al.* (2015) [52]; Gunes *et al.* (2016) [33]; Kachhawa *et al.* (2016) [41]; Khan *et al.* (2017); Singh *et al.* (2017) [74]; Gupta *et al.* (2018) [35] and Swami *et al.* (2019) [79]. In the present study 2 clinical cases of crossbred cattle with theileriosis were died before attempting the treatment the blood samples biochemical profile from these two cattle revealed the elevation in CKMB and positive for qualitative test cardiac troponin I indicates myocardial degeneration in crossbred cattle Fartashvad *et al.* (2013) [27] and Gupta *et al.* (2018) [35]. The improvement in clinical condition and elevation of Hb,

PCV, TEC, Total protein, albumin and glucose and reduction in total bilirubin AST, CKMB and disappearance of *T.annulata* organism from the blood in the group II might be attributed to Theilericidal action of buparvoquone Quyyum *et al.* (2010); Carter (2011) [16]; Sumathi and Veena (2012) [78]; Digraaskar *et al.*, (2012) [22]; Sarma *et al.* (2014) [68]; Sarmah *et al.* (2015) [69] and Kachhawa *et al.* (2016) [41]. 96 The disappearance of babesia species organisms from group III might be attributed to interference of imidocarb with the production or utilization of polyamines and prevention of inositol into erythrocytes containing the babesia species (Zahid *et al.* (2005) [85]; Maharana *et al.* (2016) [47] and Shah *et al.* (2019) [71]. A single therapeutic dose of imidocarb dipropionate @ 1.2 mg/Kg bwt S/C was used to treat the mixed infection of babesia species in crossbred cattle. A complete host immune response is usually necessary for elimination of pathogens. A single therapeutic dose of buparvoquone @ 2.5 mg/kg bwt ddep I/M was used to treat the clinical cases of *T.annulata* infection in cattle and an uneventful recovery was noticed in the clinical cases of theileriosis treated with buparvoquone in group II and mixed infection treated with buparvoquone and imidocarb dipropionate in group III. In the present study results showed that the survival rate in group II and group III was 100% and 100% respectively. The survival rate in Group II animals with theileriosis was in agreement with the findings (Digraaskar *et al.*, (2012) [22]; Bipin Kumar *et al.*, (2013); Maiti *et al.*, (2013) [48]; Sarma *et al.* (2014) [68]; Sarmah *et al.* (2015) [69]; Abdela and Bekele, (2016) [2] and Kachhawa *et al.* (2016) [41]. The survival rate in group III animals with mixed infection theileriosis and babesiosis were in agreement with Zahid *et al.* (2005) [85]; Maharana *et al.* (2016) [47] and Shah *et al.* (2019) [71].

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Author's Contribution

Not available

Conflict of Interest

Not available

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References

- Bhattacharyulu Y, Chaudhri RP, Gill BS. Transstadial transmission of *Theileria annulata* through common ixodid ticks infesting Indian cattle. *Parasitology*. 1975;71(1):1-7.
- Abdela N, Bekele T. Bovine theileriosis and its control: a review. *Advances in Biological Research*. 2016;10(4):200-212.
- Acharya AP, Panda SK, Prusty BK. Diagnosis and confirmation of *Theileria annulata* infection in cattle in Odisha, India. *Journal of Entomology and Zoology Studies*. 2017;5(4):1543-1546.
- Ahmed JS, Rehbein G, Schein E. Characterization of *Theileria annulata*-infected lymphoblastoid cells. *Zeitschrift für Parasitenkunde*. 2002;70:819-821.
- Aktas M, Altay K, Dumanli N. A molecular survey of bovine *Theileria* parasites among apparently healthy cattle and with a note on the distribution of ticks in eastern Turkey. *Veterinary Parasitology*. 2006;138(3-4):179-185.
- Alam TH, Nasr SM. Hematological and biochemical investigation in bovine babesiosis and theileriosis. *Benha Veterinary Medical Journal*. 2011;22(2):118-126.
- Al-Emarah GY, Khudor MH, Daham HR. Clinical, haematological and biochemical study in cattle naturally infected with *Theileria annulata* in north of Basrah province. *Al-Qadisiyah Journal of Veterinary Medicine Sciences*. 2012;11(1):54-62.
- Al-Hosary A, Abdel-Rady A, Ahmed LS, Mohamed A. Comparison between using of buparvaquone and other compounds in treatment of bovine theileriosis. *International Journal for Agro Veterinary and Medical Sciences*. 2010;4(1):3-7.
- Anonymous. Annual Report of Veterinary Service. Ministry of Animal Resources. Antitheilerial activity of buparvaquone: a comparison with parvaquone. *Research in Veterinary Science*. 1997;39(3):29-33.
- Aulakh GS, Singla LD. Clinico-haematobiochemical observations on bovines naturally infected with *Theileria annulata*. *Journal of Veterinary Parasitology*. 2006;20(1):49-52.
- Ayadi O, Gharbi M, Elfegoun MCB. Milk losses due to bovine tropical theileriosis (*Theileria annulata* infection) in Algeria. *Asian Pacific Journal of Tropical Biomedicine*. 2016;6(9):801-802.
- Bilgic HB, Karagenç T, Simuunza M, Shiels B, Tait A, Eren H, Weir W. Development of a multiplex PCR assay for simultaneous detection of *Theileria annulata*, *Babesia bovis* and *Anaplasma marginale* in cattle. *Experimental Parasitology*. 2013;133(2):222-229.
- Bishop R, Musoke A, Morzaria S, Gardner M, Nene V. *Theileria*: intracellular protozoan parasites of wild and domestic ruminants transmitted by ixodid ticks. *Parasitology*. 2004;129:271-283.
- Boulter N, Hall R. Immunity and vaccine development in the bovine theilerioses. *Advances in Parasitology*. 2000;44:41-97.
- Callow LL. Protozoan and rickettsial diseases. In: *Animal Health in Australia*. Canberra: Australian Government Publishing Service; 1984;5:121-216.
- Carter P. Assessment of the efficacy of buparvaquone for the treatment of benign bovine theileriosis. *Meat and Livestock Australia Limited*; 2011.
- Chaudhri SS, Bisla RS, Bhanot V, Singh H. Prevalence of haemoprotozoan infections in pyretic dairy animals of eastern Haryana. *Indian Journal of Animal Research*. 2013;47(4):344-347.
- Col R, Uslu U. Changes in selected serum components in cattle naturally infected with *Theileria annulata*. *Bulletin of the Veterinary Institute in Pulawy*. 2007;51(1):15.
- Coles EH. *Veterinary Clinical Pathology*. Philadelphia: W.B. Saunders Company; 1986:5-87.
- Das G, Ray D. PCR-based evaluation of *Theileria annulata* in ticks collected from fields in West Bengal. *Journal of Veterinary Parasitology*. 2003;17(1):11-14.
- Dharanisha NK, Giridhar P, Byregowda SM, Venkatesh MD, Ananda KJ. Seasonal prevalence of blood parasitic diseases in crossbred cattle of Mysore and its surrounding districts of Karnataka. *Journal of Parasitic Diseases*. 2017;41(3):773-777.
- Digraaskar SU, Muley VD, Narladkar BW. *Theileria annulata* infection in fifteen days old Holstein Friesian

- crossbred calf. Indian Veterinary Journal. 2012;89(4):68-70.
23. Dolan TT. Theileriosis: a comprehensive review. Revue Scientifique et Technique (Office International des Epizooties). 1989;8(1):11-78.
 24. d'Oliveira C, Van der Weide M, Habela MA, Jacquet P, Jongejan F. Detection of *Theileria annulata* in blood samples of carrier cattle by PCR. Journal of Clinical Microbiology. 1995;33:2665-2669.
 25. Dumanli N, Aktas M, Cetinkaya B, Cakmak A, Koroglu E, Saki CE, Altay K. Prevalence and distribution of tropical theileriosis in eastern Turkey. Veterinary Parasitology. 2005;127(1):9-15.
 26. Eamens GJ, Bailey G, Jenkins C, Gonsalves JR. Significance of *Theileria orientalis* types in individual affected beef herds in New South Wales based on clinical, smear and PCR findings. Veterinary Parasitology. 2013;196(1-2):96-105.
 27. Fartashvand M, Nadalian MG, Sakha M, Safi S. Elevated serum cardiac troponin I in cattle with theileriosis. Journal of Veterinary Internal Medicine. 2013;27(1):194-199.
 28. Fujinaga T. Bovine babesiosis in Japan: clinical and clinicopathological studies on cattle experimentally infected with *Babesia ovata*. Japanese Journal of Veterinary Science. 1981;43:803-813.
 29. Gharbi M, Darghouth MA. Control of tropical theileriosis (*Theileria annulata* infection in cattle) in North Africa. Asian Pacific Journal of Tropical Disease. 2015;5(7):505-510.
 30. Glass EJ, Craigmile SC, Springbett A, Preston PM, Kirvar E, Wilkie GM, Brown CD. The protozoan parasite *Theileria annulata* induces a distinct acute phase protein response in cattle that is associated with pathology. International Journal for Parasitology. 2003;33(12):1409-1418.
 31. Goel P, Charaya G, Neelam, Rakha NK, Jhambh R, Virmani P. Investigations into the haemato-biochemical profile and oxidative stress indices in cattle naturally infected with bovine tropical theileriosis. Haryana Veterinary Journal. 2017;56(2):129-134.
 32. Goud KS, Vijayakumar K. Molecular diagnosis and therapeutic management of concurrent infection with theileriosis and babesiosis in Holstein Friesian crossbred cattle. 2020.
 33. Gunes N, Arsoy D, Aktas M, Ozubek S, Ozuicli M, Aydin L, Selcuk O. Changes in some biochemical parameters in small ruminant theileriosis. Bulgarian Journal of Agricultural Science. 2016;22(2):303-307.
 34. Gupta KK, Srivastava M, Gupta N. *Theileria annulata*-induced secondary hypoxia causes ischemic myocarditis in cattle calves. The Indian Journal of Veterinary Sciences and Biotechnology. 2021;17(3):62.
 35. Gupta KK, Srivastava M, Sudan V, Singh SK, Choudhury S, Shanker D. Variation in cardiac markers and electrocardiographic alterations in young calves naturally infected with bovine tropical theileriosis. Tropical Animal Health and Production. 2018;50(6):1227-1230.
 36. Gupta R, Agrawal A, Pathak M, Singh R, Rai V, Singh A. Efficacy of buparvaquone in bovine theileriosis in Haryana. Journal of Entomology and Zoology Studies. 2020;8:1146-1147.
 37. Hasanpour A, Moghaddam GA, Nematollahi A. Biochemical, hematological, and electrocardiographic changes in buffaloes naturally infected with *Theileria annulata*. The Korean Journal of Parasitology. 2008;46(4):223.
 38. Hashemi-Fesharki R. Control of *Theileria annulata* in Iran. Parasitology Today. 1990;4:36-40.
 39. Hussein AH, Mohammed NAES, Mohammed HK. Theileriosis and babesiosis in cattle: haemogram and some biochemical parameters. In: Proceedings of the XIII International Congress of the International Society of Animal Hygiene. 2007:143-150.
 40. Jithendran KP. Blood protista of cattle and buffaloes in Kangra Valley, Himachal Pradesh. Indian Journal of Animal Sciences. 1997;67(3):207-208.
 41. Kachhawa JP, Kumar S, Sharma A, Singh AP, Ahuja A. Studies on alterations of clinical and haemato-biochemical parameters before and after treatment in calves naturally infected with theileriosis. Veterinary World. 2016;9(12):1381-1385.
 42. Khan IA, Khan A, Hussain A, Riaz A, Aziz A. Hemato-biochemical alterations in crossbred cattle affected with bovine theileriosis in semi-arid zone. Pakistan Veterinary Journal. 2011;31(2):137-140.
 43. Kolte SW, Larcombe SD, Jadhao SG, Magar SP, Warthi G, Kurkure NV, Shiels BR. PCR diagnosis of tick-borne pathogens in Maharashtra state, India indicates fitness cost associated with carrier infections is greater for crossbreed than native cattle breeds. PLOS ONE. 2017;12(3):e0174595.
 44. Lamiaa Abo-El-Hassan M. Clinico-pathological study of theileriosis in New Valley. M.V.Sc. Thesis, Department of Animal Pathology and Clinical Pathology, Faculty of Veterinary Medicine, Assiut University, Egypt; 1997.
 45. Liu A, Guan G, Liu Z, Liu J, Leblanc N, Li Y, Luo J. Detecting and differentiating *Theileria sergenti* and *Theileria sinensis* in cattle and yaks by PCR based on major piroplasm surface protein (MPSP). Experimental Parasitology. 2010;126(4):476-481.
 46. Madhukar NM, Kasaralikal VR, Sharma P, Patil NA, Ravindra VG. Prevalence, molecular diagnosis and therapeutic studies on bovine theileriosis. In: Proceedings of the 34th Annual Convention of ISVM and National Symposium on Newer Approaches in Diagnosis and Management of Animal Diseases for Sustainable Health and Production. 2016:8-9.
 47. Maharana BR, Tewari AK, Saravanan BC, Sudhakar NR. Important hemoprotozoan diseases of livestock: Challenges in current diagnostics and therapeutics: an update. Veterinary World. 2016;9:487.
 48. Maiti SK, Sahu S, Naik BS. Therapeutic management of acute theileriosis in a heifer. Intas Polivet. 2013;14(1):74-75.
 49. Masare PS, Bhikane AU, Syed AM, Ghoke SS, Awaz KB. Epidemiological and clinico-therapeutic studies on theileriosis in calves. Intas Polivet. 2009;10(2):289-292.
 50. McHardy N, Wekesa LS. Buparvaquone BW 720C: A new antitheilerial naphthoquinone—its role in therapy and prophylaxis of theileriosis. In: Irvin AD, editor. Immunization against Theileriosis in Africa: Proceedings of a Workshop Held in Nairobi, Kenya, 1-5 October 1984. Nairobi: International Laboratory for Research on Animal Diseases; 1985:88.
 51. Mhadhbi M, Chaouch M, Ajroud K, Darghouth MA, Ben Abderrazak S. Sequence polymorphism of cytochrome b gene in *Theileria annulata* Tunisian isolates and its

- association with buparvaquone treatment failure. PLOS ONE. 2015;10(6):e0129678.
52. Modi DV, Bhadesiya CM, Mandali GC. Hematobiochemical changes in crossbred cattle infected with *Theileria annulata* in Banaskantha district of Gujarat. International Journal of Scientific and Research Publications. 2015;5:1-4.
 53. Mohmad A, Saravanan BC, Manjunathachar HV, Chandra D, Ahmad SF, Malla WA, Maqbool I. A multi-copy nucleic acid-based diagnostic test for bovine tropical theileriosis. Acta Parasitologica. 2021:1-7.
 54. Morrison WI, McKeever DJ. Current status of vaccine development against *Theileria* parasites. Parasitology. 2006;133(S2):S169-S187.
 55. Muraguri GR, Ngumi PN, Wesonga DN, Dungu SG, Wanjohi JM, Bang K, Fox A, Dunne J, McHardy N. Clinical efficacy and plasma concentrations of two formulations of buparvaquone in cattle infected with East Coast fever. Research in Veterinary Science. 2006;81:119-126.
 56. Nair AS, Ravindran R, Lakshmanan B, Kumar SS, Tresamol PV, Saseendranath MR, Ghosh S. Haemoprotozoa of cattle in northern Kerala, India. Tropical Biomedicine. 2011;28(1):68-75.
 57. Ngumi PN, Younus AS, Lampard D, Mining SK, Ndungu SG, Kariuki DP, Williamson SM. Further evaluation of the use of buparvaquone in infection and treatment method of immunizing cattle against *Theileria parva* derived from African buffalo. Veterinary Parasitology. 1992;43(1-2):15-24.
 58. Omer OH, El-Malik KH, Magzoub M, Mahmoud OM, Haroun EM, Hawas A, Omar HM. Biochemical profiles in Friesian cattle naturally infected with *Theileria annulata* in Saudi Arabia. Veterinary Research Communications. 2003;27(1):15-25.
 59. Osman SA, Al-Gaabary MH. Clinical, haematological and therapeutic studies on tropical theileriosis in water buffaloes (*Bubalus bubalis*) in Egypt. Veterinary Parasitology. 2007;146(3-4):337-340.
 60. Paliwal S, Shanker D, Sudan V, Kumar S, Srivastava M, Gupta KK. Comparison of different PCR protocols and respective primer sets from pool of TAMS 1 gene for diagnosis of calf theileriosis from semi-arid India. Biologicals. 2019;57:50-54.
 61. Panda SK, Sahu B, Ranjan R, Acharya AP, Rath SK. Prevalence and clinicopathological study of theileriosis in bovines in coastal areas of Orissa. 2011.
 62. Qayyum M, Farooq U, Samad HA, Chaudhry HR. Prevalence, clinicotherapeutic and prophylactic studies on theileriosis in district Sahiwal (Pakistan). Journal of Animal and Plant Sciences. 2010;20:266-270.
 63. Radostits OM, Gay CC, Hinchcliff KW, Constable PD. Veterinary Medicine. 10th ed. Philadelphia: W.B. Saunders Company Ltd.; 2007.
 64. Radwan ME, Hamied OA, Ali AF. Evaluation of erythrocyte antioxidant mechanism in bovine babesiosis and current advances in treatment in Kaliobe Governorate. American Journal of Infectious Diseases and Microbiology. 2013;1(4):59-63.
 65. Razavi SM, Nazifi S, Hasani S, Rakhshandehroo E. Bovine tropical theileriosis: effects on the cardiovascular system on the basis of serum analysis. Comparative Clinical Pathology. 2015;24(1):29-33.
 66. Salama AO, Gaabary MHA. Clinical, haematological and therapeutic studies on tropical theileriosis in water buffaloes (*Bubalus bubalis*) in Egypt. Veterinary Parasitology. 2007;146(3-4):337-340.
 67. Sarma K, Prasad H, Das G, Behera P, Behera SK, Rajesh JB, Borthakur SK. Theileriasis in crossbred cows and its therapeutic management: first report from Lushai Hill district of Mizoram. Journal of Parasitic Diseases. 2016;40(3):605-610.
 68. Sarma K, Prasad H, Das G, Behera P, Behera SK, Rajesh JB, Borthakur SK. Theileriasis in crossbred cows and its therapeutic management: first report from Lushai Hill district of Mizoram. Journal of Parasitic Diseases. 2014.
 69. Sarmah PC, Dewan JN, Bhattacharjee K, Choudhary R, Sarma M, Borgohain R. Oriental theileriosis and surra in Holstein-Friesian cattle shed: herd investigation, haematology and therapeutic management. International Journal of Recent Scientific Research. 2015;6:6536-6538.
 70. Sayin F, Dincer S, Karaer Z, Cakmak A, Inci A, Yukari BA, Nalbantoglu S. Studies on the epidemiology of tropical theileriosis (*Theileria annulata* infection) in cattle in Central Anatolia, Turkey. Tropical Animal Health and Production. 2003;35(6):521-539.
 71. Shah ND, Bhikane AU, Jadhav RK, Chavhan SG, Mohan A. Therapeutic management of babesiosis alone and its mixed infection with theileriosis in cattle. Indian Journal of Veterinary Medicine. 2019;39(2):26-31.
 72. Sharma W, Sohanpal B. Detection of a *Theileria annulata* infection in Haryana and Sahiwal cattle using the polymerase chain reaction. Parasitology. 2001;104(3):243-250.
 73. Singh A, Singh J, Grewal AS, Brar RS. Studies on some blood parameters of crossbred calves with experimental *Theileria annulata* infections. Veterinary Research Communications. 2001;25(4):289-300.
 74. Singh J, Acharya AP, Panda SK, Patra BK, Behera K. Theilerial infection in young bovine calves in Odisha, India. Journal of Entomology and Zoology Studies. 2017;5(5):1201-1204.
 75. Singh SK, Sudan V, Singh AP, Yadav BK. Evaluation of clinical markers for diagnosis of bovine theileriosis: a study of 21 calves. Intas Polivet. 2014;15(1):91-95.
 76. Soulsby EJJ. *Helminths, Arthropods and Protozoa of Domesticated Animals*. 7th ed. London: Baillière Tindall; 2012. p.810.
 77. Stockham SL, Kjemtrup AM, Conrad PA, Schmidt DA, Scott MA, Robinson TW, et al. Theileriosis in a Missouri beef herd caused by *Theileria buffeli*: case report, herd investigation, ultrastructure, phylogenetic analysis, and experimental transmission. Veterinary Pathology. 2000;37(1):11-21.
 78. Sumathi BR, Veena MP. Bovine theileriosis in crossbred cattle. Indian Veterinary Journal. 2012;89(12):82.
 79. Swami SB, Patel JS, Parmar VL, Bilwal AK. Studies on haemato-biochemical changes in *Theileria*-infected Gir cows. International Journal of Current Microbiology and Applied Sciences. 2019;8(11):2097-2101.
 80. Ugalmugle SS, Jayraw AK, Gatne ML. Prevalence and clinical pathology of bovine tropical theileriosis in crossbred population of Ahmednagar district of Maharashtra. Journal of Veterinary Parasitology. 2010;24(2):141-145.
 81. Uilenberg G. *Theileria* species of domestic livestock. In: Irvin AD, Cunningham MP, Young AS, editors. Advances in the Control of Theileriosis. The Hague: Martinus Nijhoff; 1981. p.4-37.
 82. Vahora SP, Patel JV, Patel BB, Patel SB, Umale RH.

- Seasonal incidence of haemoprotozoal diseases in crossbred cattle and buffalo in Kaira and Anand districts of Gujarat, India. *Veterinary World*. 2012;5(4):223-225.
83. Vatansever Z, Nalbantoglu S. Detection of cattle infected with *Theileria annulata* in fields by nested PCR, IFAT and microscopic examination of blood smears. *Turkish Journal of Veterinary and Animal Sciences*. 2002;26:1465-1469.
84. Yeruham I, Avidar Y, Aroch I, Hadani A. Intra-uterine infection with *Babesia bovis* in a 2-day-old calf. *Journal of Veterinary Medicine Series B: Infectious Diseases and Veterinary Public Health*. 2003;50:60–62.
85. Zahid IA, Latif M, Baloch KB. Incidence and treatment of theileriosis and babesiasis. *Pakistan Veterinary Journal*. 2005;25(3):137.

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