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Popular Article

Bovine Tropical Theileriosis in Cattle: Epidemiology, Diagnosis, and Control Strategies with a Focus on the Scenario in India

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Abstract

Bovine tropical theileriosis is a tick-borne protozoan disease affecting cattle posing a significant threat to the livestock industry in India. Caused by *Theileria annulata*, the disease leads to severe economic losses due to decreased productivity, increased mortality, and the costs associated with treatment and control measures. This article explores the epidemiology, clinical manifestations, diagnosis, treatment, and control strategies of theileriosis in cattle, with a specific focus on its prevalence and impact in India. Recent studies, facts, and advancements in the management of the disease are discussed to provide a comprehensive understanding of the current scenario and future directions.

Keywords: Bovine tropical theileriosis, protozoan disease, tick-borne, India

Introduction

Theileriosis is a debilitating disease that affects cattle, caused by protozoan parasites belonging to the genus *Theileria*. The primary species responsible for this disease is *Theileria annulata* which causes bovine tropical theileriosis. The transmission of this disease occurs through ixodid ticks, primarily from the genera *Hyalomma*. Theileriosis significantly impacts cattle health and productivity, particularly in tropical and subtropical regions where climatic conditions favour tick proliferation. *Theileria annulata* is endemic to regions including Southern and Eastern Europe (e.g., Portugal, Spain, Italy, Greece, Bulgaria, and Turkey), East and North Africa (such as Mauritania, Morocco, Algeria, Tunisia, Egypt, Sudan, South Sudan, and Ethiopia), and parts of Asia (including India, China, the Middle East, and Central Asia) (George *et al.*, 2015). Bovine tropical theileriosis, caused by *T. annulata*, imposes significant economic burdens on livestock sector of India. While comprehensive state-specific economic loss data are limited, national estimates provide insight into the financial

impact of the disease. Narladkar (2018) projected annual losses due to tropical theileriosis in India at approximately US$1,295 million (₹8,426.7 crore). In India, ticks and tick-borne diseases pose a substantial challenge to the livestock production system, with the annual cost of managing these diseases, including theileriosis, estimated at approximately US$498.7 million. These figures underscore the substantial economic challenges posed by bovine tropical theileriosis across various regions of India. Although comprehensive state-level economic data on losses due to bovine tropical theileriosis remain limited, some regional estimates have been documented. Narladkar (2018) projected economic losses associated with theileriosis in crossbred cattle across five Indian states. Gujarat reported the highest loss at ₹309.65 crore, with a per-animal loss of ₹1,785.62, followed by Tamil Nadu at ₹343.02 crore and ₹627.38 per animal. Karnataka recorded losses of ₹231.26 crore, with ₹854.20 per animal, while Kerala and Uttarakhand reported losses of ₹86.12 crore and ₹91.35 crore, with per-animal losses of ₹772.16 and ₹2,191, respectively.

The disease presents a major challenge to the livestock sector, affecting both dairy and beef cattle which remains as a significant obstacle for the livestock industry in India. The climatic conditions of the region, combined with traditional grazing practices and inadequate tick control measures, create an environment conducive to the spread of the disease. Recent studies have highlighted a high prevalence of theileriosis in various states of India, with significant economic losses reported due to decreased milk production, increased treatment costs, and high mortality rates. Milk production losses are a major concern for dairy farmers in India as the disease causes a substantial drop in milk yield due to its debilitating effects on the animal health.

Epidemiology of Theileriosis

Bovine tropical theileriosis is a widespread disease prevalent in tropical and subtropical regions worldwide, including India where subclinical *T. annulata* infections result in a persistent carrier state in cattle, serving as a reservoir of infection for ticks. A systematic review and meta-analysis conducted by Krishnamoorthy *et al.* (2021) analyzed studies from 1984 to 2019, encompassing 70,688 samples, and found an overall prevalence rate of 20%. The study revealed considerable regional variations in the prevalence of bovine tropical theileriosis across India. Puducherry recorded the highest prevalence at 71%, followed by Assam with 49%. Haryana and Kerala both reported a prevalence of 39%. In contrast, lower prevalence rates were observed in Telangana (2%), West Bengal (7%), and Andhra Pradesh (8%). Serological surveys conducted indicated that 30-60% of crossbred cattle were positive for antibodies to *T. annulata* piroplasms, all over India, except in Himalayan regions, where climate is not favourable for tick activity. The prevalence of *T. annulata* infection varies based on host population parameters, including age, gender, and breed of cattle. Young cattle (≤1.5 years) exhibited a

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significantly higher prevalence compared to adult cattle (>1.5 years). A gender-based analysis revealed a greater susceptibility to infection in female cattle than in males. Additionally, cattle breed showed a significant correlation with the prevalence of tropical theileriosis. Crossbred cattle exhibited the highest rates of *T. annulata* infection, followed by exotic breeds, with the lowest prevalence observed in indigenous cattle breeds. The high density of the cattle population, combined with traditional grazing practices and inadequate tick control measures, contributes to the widespread transmission of theileriosis. Additionally, the movement of cattle for trade and agricultural purposes facilitates the spread of the disease across different districts.

Clinical Manifestations

The clinical manifestations of theileriosis vary depending on the species of *Theileria* involved and the immune status of the host. Bovine tropical theileriosis caused by *T. annulata* typically presents with acute and sometimes fatal symptoms. The incubation period ranges from 7 to 20 days post-infection. Tropical theileriosis is typically marked by severe pyrexia, lethargy, progressive weight loss, altered appetite, conjunctival petechiae, lymphadenopathy, unilateral or bilateral exophthalmia, as well as nasal and ocular discharges accompanied by mild to moderate anaemia. Infected dairy cows experience a significant drop in milk yield. Studies have reported a reduction of up to 30% in daily milk production during the acute phase of the disease (Deka *et al.*, 2020). In severe cases, lateral recumbency, diarrhoea, dysentery, respiratory distress, corneal opacity, neurological signs, and occasionally, abortion may be observed. Mortality rates can be high, particularly in naive cattle populations and young calves. Mortality rates among infected cattle, especially young calves and naive adult cattle can be as high as 20-30% in severe outbreaks (Das *et al.*, 2019). Chronic infections can lead to persistent ill-thrift, reduced weight gain, and lowered milk production, significantly impacting the economic viability of affected herds. Subclinical infections are also common, where cattle may carry the parasite without showing overt clinical signs, acting as reservoirs for transmission to other animals.

Diagnosis

Accurate and timely diagnosis of theileriosis is crucial for effective management and control of the disease. Microscopic examination of Romanowsky-stained blood smears for identifying piroplasms and lymph node aspirate smears for detecting schizonts (Koch's blue bodies) of *T. annulata* is regarded as the gold standard diagnostic method for routine application. This technique is valued for its robustness and ease of use but is primarily effective in acute clinical cases with high parasitaemia. Conversely, it is unsuitable for detecting carrier or chronic stages of theileriosis and cannot distinguish piroplasms of other *Theileria* species due to their morphological similarity.

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To address the limitations of routine microscopic examination, various immunological assays, including the complement fixation test (CFT), indirect fluorescent antibody test (IFAT), and enzyme-linked immunosorbent assays (ELISA), are widely utilized for epidemiological surveys of theileriosis. These assays detect circulating antibodies by employing piroplasms or cultured macroschizonts as antigens. According to the World Organization for Animal Health (OIE), IFAT is considered the gold standard serological test; however, ELISA is globally favoured due to its ease of execution and high throughput capabilities and provides information on the exposure status of cattle.

Recent research efforts have focused on understanding the molecular mechanisms of *Theileria* infection and host-pathogen interactions to develop novel therapeutic and control strategies. Studies have identified several parasite proteins and host immune responses that could serve as potential targets for new vaccines and diagnostic tools. For instance, the identification of immunodominant antigens such as the schizont surface protein and merozoite surface antigen has opened avenues for the development of subunit vaccines (Sharma *et al.*, 2023). Advancements in molecular diagnostic techniques, such as polymerase chain reaction (PCR) and loop-mediated isothermal amplification (LAMP), have significantly improved the detection of *Theileria* DNA in blood samples. These methods offer higher sensitivity and specificity, enabling the detection of subclinical infections and mixed infections involving multiple *Theileria* species. Molecular diagnostic assays like PCR and nucleic acid sequencing can be employed for pathogen detection and characterization.

Treatment

The treatment of bovine tropical theileriosis primarily involves the use of antiprotozoal drugs. Buparvaquone is the most commonly used drug for treating bovine tropical theileriosis. It is highly effective in reducing parasitaemia and alleviating clinical symptoms. The recommended dosage is 2.5 mg/kg body weight administered intramuscularly, with a second dose given after 48 hours in severe cases. However, the high cost of buparvaquone and the potential for drug resistance are significant concerns. Other antiprotozoal agents, such as oxytetracycline and halofuginone have also been used, but their efficacy is generally lower compared to buparvaquone. Supportive treatments, including fluid therapy, blood transfusions, and anti-inflammatory drugs, are essential for managing severe cases and preventing secondary bacterial infections. Advancements in genomic and proteomic technologies have provided deeper insights into the biology of *Theileria* parasites, facilitating the discovery of new drug targets and resistance mechanisms. The development of next-generation sequencing techniques has enabled comprehensive genome analysis of *Theileria* strains, revealing genetic variations associated

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with virulence and drug resistance. This information is crucial for designing effective control strategies and monitoring the emergence of resistant strains (Sharma *et al.*, 2023).

Control Strategies

Control strategies for bovine tropical theileriosis rely on a combination of chemotherapy, tick management through the application of acaricides, enhancement of cattle housing conditions, and vaccination. Tick control is a cornerstone of theileriosis management. Regular application of acaricides, such as organophosphates, pyrethroids, and amitraz, can significantly reduce tick infestations. However, the development of acaricide resistance in tick populations necessitates the use of integrated tick management strategies, including rotational use of different classes of acaricides, biological control agents, and environmental management practices. Vaccination is another critical component of theileriosis control. The live attenuated vaccine developed against *T. annulata*, known as the *T. annulata* cell culture vaccine, has been widely used in endemic regions. The vaccine provides long-term immunity and significantly reduces the incidence and severity of the disease. However, challenges such as cold chain maintenance, cost, and vaccine coverage need to be addressed to maximize its effectiveness. Improved management practices, including regular health monitoring, prompt diagnosis and treatment of infected animals, and quarantine measures for newly introduced cattle, are essential for controlling the spread of theileriosis. Educating farmers about the importance of tick control, vaccination, and good husbandry practices is crucial for the sustainable management of the disease.

Efforts to control bovine tropical theileriosis in India have focused on improving tick control measures and promoting vaccination. The Veterinary Department across India, in collaboration with research institutions and international organizations, has been working to enhance the capacity of veterinarians and farmers in diagnosing and managing theileriosis. Training programs, awareness campaigns, and extension services have been implemented to educate farmers about the importance of tick control, vaccination, and good husbandry practices. Despite these efforts, challenges remain in achieving sustainable control of theileriosis. The high cost of vaccines and acaricides, coupled with the development of resistance, poses significant barriers. Additionally, the lack of infrastructure and resources for regular health monitoring and diagnostic services hampers effective disease management.

Conclusion

Bovine tropical theileriosis is a major threat to cattle health and productivity in India, necessitating a comprehensive and integrated approach to control the disease. Advances in diagnostic techniques, treatment options, and control strategies offer hope for effective management of

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theileriosis. However, the successful implementation of these strategies requires coordinated efforts between veterinary professionals, researchers, policymakers, and farmers. Continued research, education, and capacity-building initiatives are essential to address the challenges and ensure the sustainable control of theileriosis in different states of India.

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