Popular Article

THEILERIOSIS IN LARGE ANIMALS: A COMPREHENSIVE REVIEW

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Abstract

Theileriosis is an economically significant haemoprotozoan disease of cattle and buffaloes, primarily caused by Theileria annulata in tropical and subtropical regions. Characterized by high fever, lymphadenopathy, anaemia, and rapid deterioration, the disease results in considerable losses through mortality, reduced productivity, and treatment costs. This review summarizes the epidemiology, pathogenesis, clinical signs, diagnostics, treatment strategies, and modern approaches—including nano-molecule supplementation and immunometabolic management—aimed at improving therapeutic outcomes.

Introduction

Theileriosis is a tick-borne intracellular protozoan infection that affects millions of bovines globally, with India being one of the most affected countries due to its warm climate and high tick burden. The disease is caused mainly by *Theileria annulata*, though *T. orientalis* and related species are reported in certain regions. Theileriosis poses a major threat to dairy and beef industries, leading to reduced milk production, weight loss, reproductive failure, mortality, and costs associated with treatment and preventive measures.

The disease is transmitted mainly through Hyalomma and Rhipicephalus spp. ticks. Its impact is particularly severe in crossbred cattle, which exhibit low innate immunity and higher susceptibility compared to indigenous breeds. Seasonal peaks are observed during hot and humid months when tick populations proliferate. Theileriosis is recognized for its acute onset, rapid progression, and potential for creating long-term carrier states in apparently recovered animals.

Etiology and Transmission

Theileria species are apicomplexan protozoa possessing a complex life cycle involving both vertebrate hosts and tick vectors.

Key Causal Species

•*Theileria annulata* — predominant in India and responsible for tropical theileriosis

•*Theileria parva* — causes East Coast fever in Africa

•*Theileria orientalis* — leads to oriental theileriosis in certain regions

•*Theileria equi* — infects horses (previously classified under Babesia)

Mode of Transmission

Ticks acquire the parasite when feeding on infected animals and transmit infective sporozoites during subsequent blood meals. Transstadial transmission is

common, ensuring persistence across tick life stages.

Environmental factors such as temperature, humidity, pasture vegetation, and host availability influence tick density and consequently disease incidence

Pathogenesis

The pathogenesis of theileriosis involves two major parasitic stages:

1. Schizont stage in leukocytes
2. Piroplasm stage in erythrocytes

1. Schizont Transformation

Once sporozoites enter the animal, they invade macrophages and B-cells. Inside these cells, they undergo schizogony, producing schizonts that can manipulate host cell pathways.

Key pathological events include:

•Leukocyte transformation mimicking cancer-like behaviour

•Uncontrolled proliferation and dissemination of infected cells

•Cytokine release, responsible for pyrexia and immune dysregulation

•Lymph node enlargement (a hallmark sign)

•Splenomegaly, due to parasite multiplication and immune hyperactivity

2. Erythrocytic Phase

The merozoites released from schizonts invade red blood cells, forming piroplasms.

Consequences:

•Extravascular haemolysis

•Rapid decline in packed cell volume

•Risk of severe anaemia <4 g/dL, warranting blood transfusion

•Weakness, hypoxia, collapse

Clinical Signs

Clinical symptoms vary with parasite load, host immunity, and breed susceptibility.

Acute Theileriosis

High fever (often non-responsive to antibiotics) Enlarged lymph nodes near tick bite sites, Anaemia and jaundice, Respiratory distress, Loss of appetite, dullness, Reduced milk yield, Nasal discharge, Swelling over the face and neck

Complications

Severe anaemia, Cachexia, Reproductive failure in pregnant animals, Secondary bacterial infections, Terminal collapse due to hypoxia

Carrier State

Recovered animals may harbour low levels of parasites, serving as reservoirs for future outbreaks.

Diagnosis

Early detection greatly improves treatment success.

Clinical Examination

The combination of fever, lymphadenopathy, and anaemia often suggests theileriosis.

Microscopic Examination

- Lymph node aspirate smear — schizonts in leukocytes
- Blood smear — piroplasms inside RBCs
- Buffy coat smear — increases sensitivity

Molecular and Serological Tests

- PCR / RT-PCR panel tests for Theileria, Anaplasma, Babesia, Trypanosoma
- ELISA for antibody detection
- Immunofluorescence assays PCR is considered the most reliable method for early and accurate detection.

Treatment Approaches

Chemotherapeutic Agents

The following drugs remain the primary line of treatment:

•Buparvaquone

•Parvaquone

•Halofuginone

These drugs are effective only when administered early in the course of infection. Late detection often results in poor therapeutic response and persistence of carrier state.

Supportive Therapy

•Blood transfusion when PCV falls critically

•NSAIDs to control fever

•Fluid therapy for dehydration

•Liver tonics, antioxidants

Nano-Methylene Blue (N-MB): A Novel Adjunct

Emerging studies show that supplementing N-MB for 4–5 days after buparvaquone enhances recovery by:

•Improving intracellular parasite clearance

•Reducing oxidative stress

•Supporting erythrocyte stability

N-MB's nanoparticle form (~50 nm) has better bioavailability and longer circulation time than conventional methylene blue.

Management of Cytokine Imbalance

Severe inflammatory response (cytokine storm) can worsen disease. Modulation of immune pathways, including inhibition of excessive TNF-α and NO release, is being explored as an adjunct therapeutic approach.

Immunity and Host Resistance

Cell-Mediated Immunity: Protection against Theileria largely depends on:

•Activated T-cells

•Interferon-γ release

•Effective macrophage response

However, over activation may lead to tissue damage, highlighting the need for balanced immunomodulation.

Breed Susceptibility

Indigenous Indian breeds (Gir, Kankrej, Sahiwal) show better resistance than exotic and crossbred animals. Selective breeding programs can support long-term disease control.

Prevention and Control

Tick Management: Regular acaricide treatments, Pasture rotation, Use of tick-resistant animal breeds, Maintaining clean housing systems

Vaccination: Live attenuated T. annulata vaccines are available in India but require strict cold-chain maintenance. They offer partial immunity and reduce disease severity.

Reducing Carrier States: PCR screening and strategic treatment programs help minimize hidden infections in herds.

Economic Impact

Theileriosis leads to: Reduced milk production, High treatment and labour cost, Loss of draught power, Mortality of calves and high-value adults, •Hidden losses from chronic carriers.

In high-prevalence regions, total economic losses amount to several thousand crores annually.

Future Perspectives

Research is now focusing on:

•Genetically engineered vaccine candidates

•Long-acting nanomedicines

•Cytokine-focused therapy

•Quantitative parasite load detection

•Selective breeding for tolerance

Integration of molecular diagnostics, targeted therapeutics, and nutritional immunomodulation will shape the next phase of control strategies.

Conclusion

Theileriosis remains a major challenge in bovine health, particularly in tropical regions. Understanding its complex life cycle, early diagnosis, and timely use of effective treatments are crucial for limiting losses. Novel approaches such as nano-methylene blue, immunometabolic support, and rumen-bypass glucogenic nutrition offer promising improvements over conventional therapies. A combination of preventative strategies, improved diagnostic tools, and sustainable tick management is essential for long-term disease control.