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NATIONAL DAIRY DEVELOPMENT BOARD
ANAND
GUJARAT

ANIMAL HEALTH UPDATES

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Theileriosis

Introduction

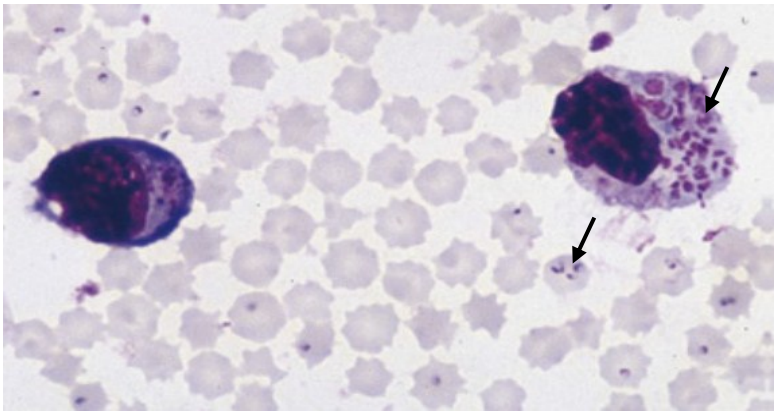
Theileriae are obligate intracellular protozoan parasites that infect both wild and domestic Bovidae throughout much of the world (some species also infect small ruminants). They are transmitted by ***Ixodes*** ticks, and have complex life cycles in both vertebrate and invertebrate hosts. Of the many Theileria species that infect cattle, the two most pathogenic and economically important are ***T. parva* and *T. annulata*.** *T. parva* occurs in sub-Saharan Africa causing East Coast fever (ECF), whilst ***T. annulata* (Tropical/ Mediterranean Theileriosis)** occurs in southern Europe as well as North Africa and **Asia.** Other species cause milder forms of theileriosis in cattle.

Prevalence in India

A review of literature on the incidence of theileriosis in India over the last four decades gives a varied range from **0.2 to 71%** and **3.5-15 %** in **cattle** in **field** and **farm** conditions respectively. The details of the same are provided in the table. Though theileriosis is uncommon in the Himalayan region, an outbreak has been reported in a herd of Holstein crossbred cows maintained at Graphic Era University, Dehradun, Uttarakhand, India, purportedly due to **introduction** of native

Prevalence of theileriosis in cattle in India

No	Source	Year	Location	Place	(%)
1	Gautam, O P	1976	Field		71
2	Kulkarni et.al.	1981	Farm	Andhra Pradesh	4-12
3	Bansal et.al.	1987	Farm	Uttar Pradesh	7 - 15
4	Bandopadhyay et.al.	1992	Field	West Bengal	2
5	Ramesh et.al.	2003	Farm	Karnataka	15
6	Roy et.al.	2004		Chhattisgarh	8
7	Ram et.al.	2004	Field	Western Rajasthan and Haryana	14
8	Raina et.al.	2005	Field	Jammu	3
9	Sandhu, T S	2005	Field	Punjab	26
10	Gupta et.al.	2006	Field	Haryana	0.2
11	Shekhar and Haque	2007	Field	Jharkhand	48
12	Rashid et.al.	2009	Field	MP	22
13	Godara et.al.	2010	Field	Rajasthan	13
14	Godara and Sharma	2010	Field	Jaipur	8
15	Ugalmugle et.al.	2010	Field	Maharashtra	6
16	Panda et. al.	2011	Field	Orissa (coastal belt) Orissa (non-coastal belt)	27 36
17	Singh et.al.	2012	Field	Punjab	15
18	Kohli et. al.	2014	Field	Uttarakhand	27
19	Velusamy et. al.	2014	Field	Tamil Nadu	13
20	Kumar et. al.	2015	Field	Punjab	9



T. annulata schizonts (in WBC) and piroplasms (in RBC) in a blood smear (Giemsa staining)

Source: Varda *et. al.* TRENDS in Parasitology Vol.23 No.9

Red Sindhi cows to the herd. (Kohli *et. al. 2013)*

Transmission

T. annulata is transmitted by ticks of the genus ***Hyalomma***. *(below)*

Unfed hyaloma tick

Engorged hyaloma tick

Ticks can remain infected on the pasture for up to 2 years, depending on the climatic conditions. The disease is not maintained in the absence of these field vectors.

Theileria sporozoites are transmitted to susceptible animals through the saliva of the feeding tick.

Ordinarily, theileria only mature and enter the saliva after the tick attaches to a host. Usually, a tick must be attached for 48–96 hours before it becomes infective. However, if environmental temperatures are high, infective sporozoites can develop in ticks on the ground and may enter the host within hours of attachment.

Transovarial transmission **does not occur** with either *T. parva* or *T. annulata*.

Inside the host, theileria sporozoites undergo a complex life cycle involving the replication of schizonts in leukocytes and piroplasms in erythrocytes. Cattle that **recover** from theileria infections usually become **carriers.**

Infection source

Sporozoites in **salivary glands** of infected *Hyalomma* ticks are the **main** infection source. In tropical theileriosis infected cattle, schizonts occur in spleen, lymph nodes, liver and whole blood (mononuclear cells) and transmission occurs **readily** by inoculation of schizonts.

However such transmission is **erratic** in ECF infected animals.

East Coast Fever (ECF)

ECF has **not** been reported in **India** and therefore is not being discussed here.

Tropical theileriosis

It is caused by *T. annulata (T. disper)* and is reported **in India.** It is **highly virulent** for **European dairy cattle.** Infection in **zebu** cattle is often **subclinical** due to **endemic stability,** which is a state of interaction between the host, tick vector and pathogen, whereby calves are infested with contaminated ticks, exhibit non-acute or mild clinical disease, which further develops into a high level of immunity in adult cattle with **absence of clinical disease.**

T. annulata affects cattle and is transmitted trans-stadially (remains infected through different life stages).

In endemic areas, virtually all adult animals are infected, but case fatality is about 10-20% and is confined mainly to **calves. Recently** introduced exotic animals may have **20-90 % mortality.** The disease occurs when there is much tick activity, mainly during summer. But even a **single tick** can cause fatal infection.

T. annulata infects cattle, camel and yak, with milder infections usually seen in water buffalo. The water buffalo is considered to be the **natural host** in which the parasite evolved.

Risk Factors for tropical theileriosis

The normal state is that of **endemic stability.** This balance is disturbed when exotic animals are introduced and heavier losses occur. Recovered animals show a solid, long lasting immunity, but they remain as a **carrier. Buffaloes** may also act as **carriers.** Immunity is mainly cell mediated but is poor in calves that die from the disease.

Economic importance

The disease is a major constraint to livestock improvement programme in many parts of the Middle East and **Asia.** The economic impact of *T. annulata* in **India** was estimated to be **800 million USD** , based on direct losses due to mortality and production losses (milk yield, growth rate, meat, infertility, abortion, calving interval and hides) and the indirect costs of control measures (dipping, vaccination, chemotherapy, veterinary legislation and monitoring) .

Pathogenesis

Sporozoites of *T. annulata* are injected into the bovine host by the tick through its saliva. Ticks must feed for 2-4 days before sporozoites in their salivary glands will mature and become infective to cattle. **One tick** can transmit **sufficient** sporozoites to cause a **fatal** infection in a susceptible animal. The damage is caused by both schizonts in lymphocytes and piroplasms in erythrocytes. Consequently, there is lymphadenopathy and panleukopenia on one hand, and **haemolytic anaemia** with **icterus** on the other. Over **90%** of erythrocytes may be parasitized, each by one or more merozoites. Immunosuppression may occur in the acute phase.

Piroplasms of most species of theileria may **persist** for months or years in recovered animals, and

may be detected intermittently in subsequent examinations; however, negative results of microscopic examination of blood films **do not exclude** latent infection.

Clinical Pathology

Examination of smears of blood and lymph node biopsy will reveal **piroplasms** in **erythrocytes** and **schizonts** in **lymphocytes**. **Anaemia** is a significant feature of tropical theileriosis, and is associated with bilirubinemia, haemoglobinuria, and bilirubinuria. Animals dying from the disease show persistent and severe lymphocytopenia.

Clinical findings

In a stable endemic situation, (**endemic stability**) there may be **no clinical disease** in local zebu cattle. There may be **enlargement** of lymph nodes in the area draining the site of tick attachment. There is **drop in milk yield** in dairy animals.

In later stages, there may be **nasal and ocular discharges**, dyspnoea, generalized lymph node enlargement and splenomegaly. **Frothy nasal discharges** may occur **terminal-**

Enlarged body lymph node

ly. Occasionally **brain involvement** occurs and is characterised by circling, hence called **turning sickness** or **cerebral theileriosis.**

Clinical signs in exotic cattle are similar to those in ECF, but the course is longer and may last for weeks before death. **Anaemia** develops within a few days. **Petechiae of** mucous membranes which may occur which may later become **icteric.**

Scleral lesions

Other signs include pyrexia, anorexia, depression, cornel opacity, diarrhoea and weight loss. Rarely there may be small subcutaneous nodules containing schizonts.

Unlike **ECF**, which is characterised by massive infection of **lymphocytes**, tropical theileriosis primarily causes **macrophage** infection.

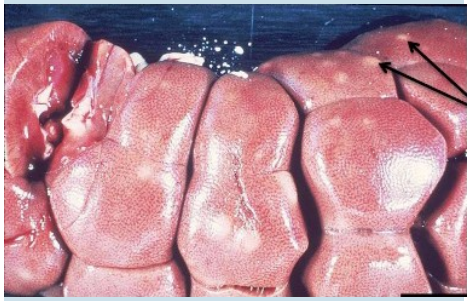
Corneal opacity

Necropsy findings

Massive **pulmonary oedema**, hyperaemia and **emphysema**, along with **hydrothorax** and **hydropericardium** may be seen. **Copious froth** is present in **airways**. The carcass is emaciated and **haemorrhages** are evident in a variety of tissues and organs. The liver, kidney, lung and alimentary tract may contain **lymphoid nodules. Ulceration** may occur in abomasum and intestines. The **mucous membranes** are **pale** with **yellowish** discoloration of tissues. Some lymphoblasts contain schizonts, which are better seen in impression smears stained with Giemsa stain.

Yellowish discolouration of tissues

Petechiae in lymph node



Lymphoid nodules on kidney (arrows)

Specimens to submit

Blood/buffy coat, impression smears from lung, spleen, kidney and lymph node, air-dried and fixed in methanol, for demonstration of schizonts and, serum for antibody detection.

Diagnosis

Theileriosis should be suspected in tick–infested animals having fever and enlarged lymph nodes. In **en-**

demic areas, the **mortality** rate may be **high** only in **calves.**

In the field, diagnosis is usually achieved by finding *theileria* parasites in Giemsa-stained blood smears and lymph node needle biopsy smears, but species specific diagnosis is difficult as most theilerial piroplasms are morphologically identical. Moreover, schizonts are not always present in the superficial lymph nodes during the course of the disease.

Piroplasms can sometimes be found in the blood of **carrier animals.**

Laboratory Diagnosis

The OIE prescribed test for international trade is **Agent Identification.**

In **live animals,** theileriosis is diagnosed by the identification of **schizonts** in thin smears from blood and lymph node. At necropsy, schizonts may be found in **impression smears** from most internal organs. However, there is considerable **similarity** between schizonts of other theileria parasites.

The **most widely** used test is Immuno Fluorescent Assay (**IFA**). Both schizont and piroplasm antigens may be used. **IFA** is sensitive, fairly specific, and usually easy to perform but cross–reactions can occur with other species of *Theileria.*

Enzyme-linked immunosorbent assays (**ELISAs**) have been successfully adapted for the detection of antibodies to *T. annulata*, and have been shown to detect antibodies for a **longer period** of time than the IFA. Serological tests however **may not** be sensitive enough to detect all infected cattle.

A number of **PCR methods** can also be used to detect *T. parva* and *T. annulata.*

Differential Diagnosis

Babesiosis , Trypanosomosis, Ehrlichiosis (Heartwater), Anaplasmosis, Malignant Catarrhal Fever (MCF), Contagious Bovine PleuroPneumoniae (CBPP). The species of *theileria* must also be differentiated from each other.

Prevention and Control

1. Tick Control: It is an **important** step in the control of Theileriosis.

2. Vaccination : For *T. annulata*, the vaccine is prepared from schizont-infected cell lines. The vaccine must remain frozen until shortly before administration. Indian Immunologicals Limited (IIL) is the **only** manufacturer of this vaccine in India. Cattle above 2 months of age can be vaccinated. Vaccination is for **lifetime** if animals are constantly **exposed to ticks. Revaccination** is recommended **every 3 years** if animals are maintained in a **tick free** environment.

Significant animal diseases reported to OIE (Jan–Mar'15)

No	Disease Outbreak	Countries reporting
1	Low pathogenic avian influenza (poultry)	Belize
2	Highly pathogenic avian influenza	Canada, China (New host-Tiger)
3	Sheep & goat pox	Kazhakhstan
4	Bovine spongiform encephalopathy (Sub-clinical)	Norway Source: www.oie.int

Treatment

1. Buparvaquone - **2.5 mg / Kg body weight** deep intramuscularly. This has high efficacy when used in the early stages of the disease and less effective if treatment is delayed.
2. Oxytetracycline (Long Acting)- **20 mg/Kg body weight** deep intramuscularly but has only moderate efficiency.

Animals that recover following treatment often remain unproductive for several months.

Zoonotic implications

Theileria microti is a parasitic blood-borne piroplasm transmitted by deer ticks. It was previously classified as *Babesia microti*. *T. microti* is responsible for **human theileriosis,** similar to babesiosis, a malaria-like disease which also causes fever and hemolysis.

Sources

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