

## EAST COAST FEVER

(Theileriasis, Theileriosis, Zimbabwean tick fever, African Coast fever, Corridor disease, January disease)

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### Definition [top](#)

East Coast fever (ECF), a form of bovine theileriosis, is a tick-transmitted protozoal disease of cattle characterized by high fever and lymphadenopathy. The disease causes high mortalities in breeds nonindigenous to the endemic areas, and is confined to eastern, central, and parts of southern Africa.

### Etiology [top](#)

The causative agent of classical ECF is *Theileria parva*. Some previously recognized separate species and subspecies have been combined with *T. parva* as a result of recent studies on their DNA (1,2).

The life cycle of *T. parva* is complex in its tick and mammalian hosts (2). Sporozoite stages, produced in large numbers in the acinar cells of the salivary glands of the infected tick vector, are inoculated along with saliva during feeding and rapidly enter target lymphocytes, which become transformed after the Theileria schizont is formed. The infected lymphocyte is transformed into a lymphoblast and divides in conjunction with the schizont, giving rise to two infected daughter cells. This process has been termed "parasite-induced reversible transformation" because, if the cells are treated with antitheileria drugs, the transformed cells revert to quiescent lymphocytes (3).

Within the infected lymphocytes, schizonts are associated with microtubules involved in spindle formation during host cell division (2). Clonal expansion of infected cells occurs with an approximate tenfold increase of schizonts every 3 days. Schizonts, traditionally called macroschizonts or Koch's blue bodies vary in size and in the number of nuclei. Early detectable forms are small with nuclei that, when Giemsa-stained, appear as chromatic granules.

From day 14 after tick infection of cattle, individual schizonts undergo merogony to produce merozoites (traditionally called micros schizonts). Merozoites invade the erythrocytes to become piroplasms, which may subsequently undergo limited division also by merogony (4). Piroplasm-infected erythrocytes are ingested by ticks of the larval or nymphal stages and undergo a sexual cycle in the gut of the replete tick to produce zygotes, which in turn develop into motile kinete stages that infect the salivary glands of the next instar, the nymph or adult (5,6).

### Host Range [top](#)

Cattle in endemic areas, particularly the zebu type (*Bos indicus*), appear less susceptible to ECF, as do young animals. In addition, introduced cattle, whether of a taurine, zebu, or sanga breed, are much more susceptible to theileriosis than cattle from endemic areas. The Indian water buffalo (*Bulbalis bulbalis*) is as susceptible to *T. parva* infection as cattle. The African buffaloes (*Syncerus caffer*) are reservoirs of *T. parva* infection, and it has recently been proved that waterbucks (*Kobus spp.*) are also reservoirs (2). Buffaloes may suffer clinical disease from *T. parva* infection, but its effects on waterbuck are unknown. Organisms isolated from buffalo, on repeated passage in cattle, result in a parasite that produces disease characteristics indistinguishable from those associated with ECF (2). Hence, the organism causing ECF is assumed to be a cattle-adapted form of the buffalo parasite causing Corridor disease. Piroplasms can be demonstrated in most wild antelopes in east Africa, but the relationship of most of them to *T. parva* is unclear.

## Geographic Distribution [top](#)

The distribution of ECF is strictly associated with the distribution of the vector tick species. In the case of *Rhipicephalus appendiculatus*, the area extends from southern Sudan to South Africa and as far west as Zaire. The range of *T. parva* is less than the tick vector for *T. parva*-free populations of *R. appendiculatus* occur in Zambia, Kenya, and South Africa. *R. appendiculatus* is found from sea level to over 8,000 feet in areas where there is annual rainfall of over 20 inches (500 mm). Up to three generations of the tick vector can occur per year in favorable areas of east Africa (Lake Victoria Basin), but there is only one generation a year in southern and central Africa because of a behavioral diapause, controlled by photoperiod, in the adult tick (2). This results in a strict seasonal occurrence of the different tick stages on cattle and a seasonal occurrence of ECF. This behavioral diapause allows the tick to survive during the long hot dry seasons occurring in the southern parts of Africa. Tropical theileriosis caused by *T. annulata* infection does not overlap in distribution with *T. parva* and is transmitted by ticks of the genus *Hyalomma*. It is distributed in north Africa, down the Nile Valley to Sudan, southern Europe, the Middle East, and parts of Asia, including the Indian subcontinent and China.

## Transmission [top](#)

*Rhipicephalus appendiculatus* is the main field vector of ECF, although in certain areas other field vectors occur, such as *R. zembeziensis* in drier areas of southern Africa and *R. duttoni* in Angola. East coast fever is not maintained in the absence of these field vectors. The rhipicephalid vectors are three-host ticks, and transmission occurs from stage to stage; transovarian transmission does not occur. Ticks can remain infected on the pasture for up to 2 years depending on the climatic conditions and the stage of infection, for adults survive longer than nymphs (2). The parasite dies out faster in hot climates and in nymphs compared with adults (2). Normally, for transmission to occur, the infected tick has to attach for several days to enable sporozoites to mature and be emitted in the saliva of the feeding tick. However, under high ambient temperatures, ticks on the ground may develop infective *Theileria* sporozoites, which can be transmitted to cattle within a few hours after attachment (2).

Unlike other *Theileria* species and *Babesia* species, *T. parva* is not easily transmitted experimentally by blood. Schizont-infected lymphoid tissues have been used to initiate infection with variable results.

## Incubation Period [top](#)

Under experimental conditions, using either ticks of known infection or sporozoite stabilate, the incubation period has a medium range of 8 to 12 days. The incubation period may be much more variable in the field owing to differences in challenges experienced by the cattle and may extend to beyond 3 weeks after attachment of infected ticks.

### **Clinical Signs** [top](#)

The first clinical sign of ECF in cattle appears 7 to 15 days after attachment of infected ticks. This is seen as a swelling of the draining lymph node, usually the parotid, for the ear is the preferred feeding site of the vector. This is followed by a generalized lymphadenopathy in which superficial subcutaneous lymph nodes such as the parotid, prescapular, and prefemoral lymph nodes, can easily be seen and palpated (Fig. 50). Fever ensues and continues throughout the course of infection. This rise in temperature is rapid and is usually in excess of 103° F (39.5° C) but may reach 106° F (42° C). Anorexia develops, and loss of condition follows. Other clinical signs may include lacrimation, corneal opacity, nasal discharge, terminal dyspnea, and diarrhea. Before death the animal is usually recumbent, the temperature falls, and there is a severe dyspnea due to pulmonary edema that is frequently seen as a frothy nasal discharge. Death usually occurs 18 to 30 days after infestation of susceptible cattle by infected ticks. Mortality in fully susceptible cattle can be nearly 100 percent. The severity and time course of the disease depend on, among other factors, the magnitude of the infected tick challenge, for ECF is a dose- dependent disease, and on the strain of parasites. Some stocks of parasites cause a chronic wasting disease. A fatal condition called "turning sickness" is associated with the blocking of brain capillaries by infected cells and results in neurological signs.

In recovered cattle, chronic disease problems can occur that result in stunted growth in calves and lack of productivity in adult cattle (17). However, this syndrome tends to be in the minority of recovered clinical cases; in a majority of cases, asymptomatic carriers can be recognized with apparently little or no effect on their productivity (17). A review of the clinical disease is given by Irvin and Mwanachi (11).

### **Gross Lesions** [top](#)

A frothy exudate is frequently seen around the nostrils of an ECF-infected animal. Signs of diarrhea, emaciation, and dehydration may be seen. Lymph nodes are greatly enlarged and may be hyperplastic, hemorrhagic, and edematous (Fig. 51). In acute cases of ECF, lymph nodes are edematous and hyperemic but often become necrotic and shrunken in more chronic disease. Generally, muscles and fat

appear normal but, depending on relative acuteness of infection, fat may become greatly depleted; serosal surfaces have petechial and ecchymotic hemorrhages, and serous fluids may be present in body cavities. Hemorrhages and ulceration may be seen throughout the gastrointestinal tract — particularly in the abomasum and small intestine, where necrosis of Peyer's patches can be observed. Lymphoid cellular infiltration appear in the liver and kidney as white foci that have been referred to as pseudoinfarcts. The most striking changes are seen in the lungs. In most cases of ECF, interlobular emphysema and severe pulmonary edema appear, the lungs are reddened and filled with fluid, and the trachea and bronchi are filled with fluid and froth.

### **Morbidity and Mortality [top](#)**

Morbidity and mortality depend on, among other factors, the magnitude of the infected tick challenge and susceptibility of the host and strain of parasite. East Coast fever in susceptible cattle, which are not indigenous to the enzootic area, is very severe with a mortality approaching 100 percent. Animals that recover are often unthrifty and sickly. Zebu cattle residing for many generations in endemic areas become infected (100 percent morbidity), but only a minor proportion succumb; however, many become carriers, and early infection with *T. parva* can affect their growth and productivity (17).

### **Diagnosis [top](#)**

#### **Field Diagnosis [top](#)**

East coast fever is only found in association with its known tick vectors, *Rhipicephalus appendiculatus*, *R. zembeziensis* and possibly *R. duttoni* and *R. nitens* (2). A febrile disease with signs of enlarged lymph nodes associated with infestation by tick vectors is suggestive of ECF. An acute disease with high mortality on farms, where tick control is not effectively applied, also is suggestive of ECF. In many epidemiological situations, high mortality occurs only in calves; the adult cattle represent immune survivors.

In the field, diagnosis is usually achieved by finding Theileria parasites in Giemsa-stained blood smears and lymph node needle biopsy smears (Fig. 52).

#### **Specimens for the Laboratory [top](#)**

Specimens consisting of buffy coat smears air-dried and fixed in methanol; lymph node impressions air-dried and fixed in methanol; lymph nodes, spleen, lung, liver, and kidney samples for histopathology; and serum should be collected.

## Laboratory Diagnosis [top](#)

The demonstration of schizont-infected cells in lymph node samples is diagnostic of ECF. Small piroplasms in erythrocytes are suggestive of ECF, but diagnosis must be confirmed by the detection of schizonts. Schizonts can be detected in sections but are best seen in smears

Antibody in the mammals can be detected by a variety of serological tests of which the most widely used is the indirect fluorescent antibody test employing cell culture schizont antigen. Enzyme-linked assays have been developed using whole parasite lysates or specific antigens isolated by monoclonal antibodies (14). Because of the often acute nature of the disease, serological tests are useful in detecting a changed immune status of recovered animals within an exposed herd. Now DNA technologies can be applied to material from cattle and ticks, including the use of probes and the polymerase chain reaction (1,2,15,16).

## Differential Diagnosis [top](#)

Identification of schizonts in lymphoid cells is considered to be pathognomonic of ECF. However, it must be realized that in an area such as Kenya, five species of *Theileria* have been recognized in cattle (*T. parva*, *T. mutans*, *T. velifera*, *T. taurotragi* and *T. buffeli*) and it is possible for an individual animal to harbor all these parasites at once (2). Also, all these species produce schizonts which, except for those of *T. mutans*, are not morphologically distinct (2). Piroplasms of *Theileria* spp. have similar morphology and thus are difficult to differentiate on blood slides. In addition, recovered animals, particularly in areas with endemic stability, become carriers of parasites and may show both *T. parva* schizont and piroplasm stages without clinical ECF (2).

*Theileria parva* derived from African buffalo (*Syncerus caffer*), which causes Corridor disease in cattle, is characterized by production of low parasitosis and parasitaemia in cattle although it can result in high fatality rates (2). Because enzyme-linked immunosorbent assay antibody and antigen tests and DNA probes are being developed for this range of *Theileria* species, it will become easier to differentiate them in the field. Other species tend to either be of low pathogenicity (*T. mutans*, *T. taurotragi*, *T. buffeli*) or avirulent (*T. velifera*) in cattle.

*T. annulata* is the cause of Mediterranean or tropical theileriosis, which is also a severe disease of cattle; although it is endemic in northern Africa, there is no evidence that its distribution overlaps with that of *T. parva* (2).

Gross postmortem lesions of ECF may be confused with those of a variety of diseases such as the following:

1. Heartwater because of pulmonary edema and hydrothorax. Examination of brain smears and lymph node or spleen impression smears can differentiate between the two diseases.
2. Trypanosomiasis because of edema, lymphadenopathy, and anemia. Blood and lymph node smear examination will normally differentiate between the two diseases.
3. Babesiosis and anaplasmosis because of anemia. These diseases can easily be differentiated from ECF on examination of blood smears.
4. Malignant catarrhal fever because of lymphadenopathy and corneal opacity. Examination of blood and lymph node smears will clearly differentiate between the two diseases.

### **Treatment** [top](#)

There are currently three effective drugs for the treatment of ECF: parvaquone (Clexon), buparvaquone (Butalex), and halofuginone lactate (Terit). Each of these drugs has been introduced to the market within the last 15 years (2). The availability of a therapeutic means of controlling ECF is a significant development. However, there are two constraints to widespread use of medication: the drugs are too expensive for most African farmers, and rapid, accurate diagnosis is required for effective therapy (2).

### **Vaccination** [top](#)

Methods of immunization using live parasites have been summarized by Cunningham (19). The most successful involves an "infection and treatment method" initially using oxytetracycline and more recently the newer drugs mentioned above. Animals are inoculated with a potentially lethal dose of infective sporozoite stabilate prepared from ticks and treated either simultaneously (tetracyclines, buparvaquone) or subsequently (parvaquone and halofuginone) with a drug. Sporozoite stabilates are produced from adult ticks fed as nymphs on infected cattle; the adult ticks are ground up in a medium after prefeeding on rabbits for 4 days, and the sporozoite suspension is prepared by centrifugation and cryopreserved as a stabilate. Extensive trials have been carried out using infection and treatment immunization in the ECF zones, and this method is now approved for field use by several countries in Africa (2). Problems do occur in the

recognition of suitable antigenic stocks for immunization (2), and any vaccination scheme can only follow after a careful assessment of the local complex of *T. parva* parasites. In any population of *T. parva* parasites in the field, an isolate may constitute several strains. This method of immunization requires a reliable cold chain and extensive monitoring. Recovery from ECF usually results in an excellent immunity to homologous or related stocks of the parasite, lasting for over 3 1/2 years in the absence of reinfection.

The nature of the immunity has been studied in some detail (2,20). Neutralizing antibodies to sporozoites have been recognized and related to a 67Kda antigen on the surface of the sporozoites. This has been synthesized by recombinant technology and has been shown to provide a degree of protection to cattle immunized with it (21). Other potential protective antigens have been recognized associated with the surfaces of sporozoites and schizont-infected cells (2).

### **Control** [top](#)

### **Preventative Measures** [top](#)

The current primary method of controlling ECF in cattle is immunization (see vaccination) and treatment of cattle with chemical acaricides. A number of acaricides, mainly organochlorides and organophosphorus compounds but recently synthetic pyrethroids and amidens, are applied in dips, spray races, or by handspraying. More recently, "pour on" or "spot on" formulations have been introduced. The application is usually on a weekly basis, but this rate has to be increased when the challenge is high. The cost of this control measure is becoming exorbitant, and the farming economies in many countries in Africa are not able to afford it. This may well be an advantage because this level of acaricide exposure leads to resistance of vectors, unacceptable residues in milk and meat, and, where successful, the creation of an epidemic instability with a large proportion of the cattle population becoming susceptible. A more rational approach using integrated control has been suggested by Young et al (18). These measures include effective fencing, pasture management, rotational grazing to reduce the level of challenge, selection of tick resistant cattle, and new methods of immunization; with strategic acaricide application, this approach offers a more satisfactory method of ECF control (18).

Sanitation and disinfection measures other than those associated with tick control are not applicable to ECF .

### **Public Health** [top](#)

*Theilertia* spp. show a high degree of host specificity for both the vector and the mammalian host. *Theileria parva* does not infect man.

## GUIDE TO THE LITERATURE [top](#)

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