Heartwater

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DIAGNOSIS AND DIFFERENTIAL DIAGNOSIS

Clinical signs and pathology

Infected domestic ruminants may manifest a wide range of clinical signs. The incubation period, course, severity and outcome of artificially-induced disease are influenced by the species, breed and age of animal affected, the route of infection, the virulence of the strain of E. ruminantium involved, and the amount and source of infective material administered. Peracute, acute, subacute, and clinically inapparent forms of the disease occur. Death usually follows in animals which show clinical signs if they are not specifically treated for heartwater.

The incubation period in naturally infected cattle ranges from nine to 29 days with an average of 18 days. Cows of Bos taurus breeds, especially when in the advanced stages of pregnancy, are particularly prone to develop peracute heartwater. Peracutely affected animals die within a few hours after the initial development of fever, with or without prodromal signs.

Acute heartwater, the most common form of the disease, mainly affects cattle between the ages of three and 18 months. It is characterized by a fever of 40 °C or higher, which usually persists for three to six days. Certain breeds develop diarrhoea most commonly. A profuse, often haemorrhagic, diarrhoea may be the most prominent clinical sign in some cases of heartwater.

Acute heartwater in a bovine showing nervous signs (incoordination)
During the later stages of acute heartwater, nervous signs occur which range from mild incoordination to pronounced convulsions. The animals are hypersensitive when handled or exposed to sudden noise or bright light. Slight tapping with a finger on the forehead of the animal often evokes an exaggerated blinking reflex. They frequently show a peculiar high-stepping gait that is usually more pronounced in the front limbs. Calves may wander around aimlessly and walk into fences, and some, previously unaccustomed to handling by humans, may be approached with ease. Animals may stand with their heads held low, make constant chewing movements, and push against objects. In the later stages they often fall down suddenly, assume a position of lateral recumbency, and show opisthotonus and either have frequent bouts of leg-pedalling movements or the legs may be extended and stiff. In most cases the animals weaken rapidly and death usually follows soon after the commencement of a convulsive attack.

The subacute form of heartwater is characterized by a fever which may remain high for 10 days or longer. The incubation period in sheep and goats inoculated intravenously varies from five to 35 days (average nine to 10 days), and that of naturally infected animals from seven to 35 days (average 14 days).

Sheep are more susceptible to heartwater than cattle

Heartwater causes serious economic problems in non-indigenous breeds of goats, e.g. Angora goats
Exotic goat breeds, such as the Angora and two-to-six-month-old Boer goats, are commonly affected by the peracute form of the disease. Most animals collapse suddenly and die after a few paroxysmal convulsions without having been observed to be ill.

As is the case in cattle, acute heartwater is the most common form of the disease in sheep and goats. The majority of animals manifest nervous signs, but these are generally less pronounced than in cattle. Initially, affected animals show fever, a progressive unsteady gait and listlessness, and often stand with their legs wide apart with the head lowered and ears drooping. They eventually become prostrate, assume a position of lateral recumbency and show intermittent leg-pedalling, chewing movements, opisthotonus, licking of the lips and nystagmus.

Clinical signs in wild ungulates have not been well studied but are generally similar to those reported in domestic ruminants.

Severe hydropericardium and hydrothorax, and in some cases a degree of ascites, are striking changes in most fatal cases of the disease. However, hydropericardium is usually more pronounced in sheep and goats than in cattle. The transudate is a transparent to slightly turbid, light yellow fluid which may coagulate on exposure to air. Several litres of transudate may be present in the thorax in cattle, while in sheep up to 500 ml and in goats rarely more than 20 ml may be present.
Severe hydropericardium in heartwater (bovine)

A moderate to severe oedema of the lungs occurs in most animals that die of the disease, but it is particularly severe in animals which have suffered from the peracute or acute form. Frothy oedematous fluid oozes from the cut surface of the lungs. The trachea and bronchi are often filled with frothy serous foam occasionally accompanied by a fibrinous coagulum, and their mucous membranes are often congested and contain petechiae and ecchymoses. Oedema of the brain commonly occurs in animals suffering from the peracute and acute forms of heartwater.

Severe hydrothorax in heartwater showing accumulation of transparent transudate (bovine)

Congestion and/or oedema of the abomasal folds are regular findings in cattle but are not as common in sheep and goats. In mice infected with the Welgevonden strain the lesions closely resemble those in cattle, sheep and goats that have died from heartwater.
Laboratory confirmation

The traditional method of making a post mortem diagnosis of heartwater is the demonstration by light microscopy of *E. ruminantium* in the cytoplasm of endothelial cells of blood vessels in stained smears of brain tissue. Organisms may also be found in tissue sections of the brain, or other organs such as the kidneys.

![Removal of the brain for diagnosis of heartwater](image1)

![A special technique to make a brain smear is necessary for the diagnosis of heartwater](image2)

Various stains may be used to demonstrate heartwater organisms, such as Giemsa or CAM's Quick Stain but the former is the stain of choice unless large numbers of organisms are present.

![Brain smear showing numerous colonies of *E. ruminantium* in the endothelial cells of brain capillaries (Giemsa)](image3)

A slight reduction in haemoglobin and haematocrit values is observed in sheep, goats and calves. An anaemia, which is not clinically discernible, is usually normocytic and normochromic. Mild leukopenia,
mainly resulting from a decrease in the number of neutrophils, develops in calves and goats prior to the onset of fever and persists throughout the course of the acute form of the disease.

For the histopathological diagnosis of heartwater in ruminants by the examination of tissue sections, the kidneys and brain are the preferred organs, *E. ruminantium* particularly being sought in endothelial cells of the renal glomeruli or capillaries of the grey matter of the cerebral cortex.

Serological tests such as the indirect fluorescent antibody (IFA) test, enzyme-linked immunosorbent assay (ELISA) and competitive ELISA using a monoclonal anti MAP1 antibody have been developed but these generally give false positive reactions with related *Ehrlichia* spp. In an attempt to overcome the problem the competitive ELISA test has been modified by the use of a fragment of MAP1, designated MAP 1B, in an indirect ELISA format. This has been shown to have a higher specificity for *E. ruminantium* than any other serological test. Although the latter test works well in sheep and goats, in cattle, however, antibody levels against *E. ruminantium* can be very low in heartwater endemic areas, even in cattle that have been vaccinated or are under continuous natural challenge by infected ticks. Care must therefore be taken when using any serological test in cattle, especially if the animals are being tested in order to decide whether it is safe to move them to a non-endemic area, since it is known that they may be tick infective subclinical carriers of heartwater.

**Differential diagnosis**

Nervous signs occur in most animals suffering from heartwater and they must be distinguished from a wide range of infectious and non-infectious conditions that manifest similar signs. In cattle nervous signs may be caused by other infections such as rabies, the nervous form of malignant catarrhal fever, cerebral babesiosis, cerebral theileriosis, chlamydiosis, meningitis and encephalitis caused by various bacteria, especially *Streptococcus* spp., *Pasteurella* spp., *Arcanobacterium pyogenes*, and *Histophilus* spp. In sheep and goats meningitis and encephalitis are caused by a wide range of bacteria, and abscessation of the hypophysis occurs, particularly in goats. In southern Africa nervous signs in cattle may be the result of poisoning with plants.

Lung oedema, hydropericardium and hydrothorax are common necropsy findings in cattle, sheep and goats that have died of heartwater but they are also regular findings in the case of gousiekte (“quick disease”) caused by the ingestion of the rubiaceous plants.