Heartwater

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INTRODUCTION

Heartwater (cowdriosis) is a tick-borne disease of cattle, sheep, goats and some wild ruminants which is caused by a rickettsia, previously known as *Cowdria ruminantium* but recently reclassified as *Ehrlichia ruminantium*. Typically, the disease is characterized by high fever, nervous signs, hydropsicardium, hydrothorax and oedema of the lungs and brain, and death. It is one of the major causes of stock losses in sub-Saharan Africa.


At one time it was thought that *E. ruminantium* was a relatively homogeneous entity, but within the last decade the generation of genetic sequence data has changed this notion. It is now known that there is far more genetic variability among *E. ruminantium* organisms than had ever been suspected.

It has long been stated that different *E. ruminantium* isolates display differing degrees of pathogenicity in different hosts, yet the existence of immunogenic variants was hardly recognized in the past. Today, genetic variation within *E. ruminantium* is recognized to be extensive. It is obviously of crucial importance for the development of vaccines to have an understanding of which genotypes can confer complete or partial cross-immunity in ruminants. Poor cross-protection between isolates, or even none at all, has been shown in several experiments, but several of these experiments included at least one isolate now known to be genetically heterogeneous. Currently, *E. ruminantium* is known to comprise at least eight different 16S ribosomal RNA genotypes.
Light microscopic morphology of *E. ruminantium* in the cytoplasm of endothelial cells of the brain (Brain smear stained with Giemsa)

Electron microscopic morphology of a colony of small elementary bodies of *Ehrlichia ruminantium*

*Ehrlichia ruminantium* is a pleomorphic rickettsia, and colonies containing from one or two to several thousand individual organisms are found in the cytoplasm of endothelial cells. In general the colonies consist predominantly of small (0.4 µm), medium (0.76 µm), large (1.04 µm) or very large (>1.04 µm) organisms, but a number of smaller organisms are also found in colonies of larger organisms, and *vice versa*. Most organisms are coccoid, except for colonies containing very large organisms in which pleomorphic forms (horseshoe-, ring- and bacillary-shaped) may be seen. *Ehrlichia ruminantium* is a Gram-negative bacterium, and stains purplish-blue with Giemsa.

The developmental cycle of *E. ruminantium* in the tick, and the infectivity of successive stages of the tick, is poorly understood. It is thought that after an infected blood meal, initial replication of organisms take
place in the epithelium of the intestine of the tick and that the salivary glands eventually become parasitized. The minimum period required for *E. ruminantium* to be transmitted after ticks have attached to susceptible animals is between 27 and 38 hours in nymphs and between 51 and 75 hours in adults. *Ehrlichia ruminantium* has also been propagated in tissue cultures.

**EPIDEMIOLOGY**

The epidemiology of heartwater depends upon factors relating to the tick vector, the causative organism, and the vertebrate hosts. Important considerations relating to the tick vector are infection rates in the ticks, seasonal changes influencing tick abundance and activity, and the intensity of tick control. As far as the vertebrate hosts are concerned the availability of wild animal reservoirs and the age and genetic resistance of domestic ruminant populations are of importance.
Distribution

Heartwater occurs wherever ticks capable of transmitting the organism are present. The endemic area encompasses most of sub-Saharan Africa, including the islands of Madagascar, Sao Tomé, Réunion, Mauritius, and Zanzibar. The disease is absent from the Kalahari Desert and dry coastal areas of Namibia and South Africa. Heartwater also occurs on the French Antillean islands of Guadeloupe and Antigua in the Caribbean Sea.
Hosts/Reservoirs

*Amblyomma hebraeum* ticks feeding on *E. ruminantium*-infected sheep have been shown to become infected during a period from two days after the commencement of the temperature reaction to two days after the animals have been treated for heartwater. The transmission of *E. ruminantium* by *A. variegatum* feeding on Creole goats in Guadeloupe is apparently somewhat different. Ostensibly healthy ruminant hosts have been shown to remain infective to ticks for long periods, at least 361 days in cattle and 11 months in Creole goats. In the latter case the carrier status could not be detected permanently during the 11-month period, demonstrating the danger which could be posed by the movement of apparently negative carrier animals to areas free from the disease.

Heartwater originated in Africa and African wild ruminants probably constitute the natural reservoir of the disease. It appears that the most important natural ruminant reservoirs in southern Africa may be African buffalo and eland. Although blesbok and black wildebeest are potential reservoir hosts, the natural habitat of these two antelope species is unsuitable for *A. hebraeum*, so it is unlikely that they are important.
reservoirs under natural conditions, except where these hosts are translocated to heartwater-endemic areas.

When a pathogenic genotype of *E. ruminantium* infects a susceptible vertebrate host either inapparent or overt disease may develop depending on the pathogenicity of the organism and on the species, breed, age, degree of natural resistance and immune status of the host. Young calves, lambs and goat kids possess a reverse age resistance which is independent of the immune status of the dam. This resistance usually lasts for only the first four weeks of life in calves and the first week in lambs and kids, although it may persist for six to eight months in calves. This age resistance is not absolute as infection of some calves less than three weeks of age and of some lambs and kids less than one week old may result in fatal disease.

The susceptibility of different breeds of cattle varies, Zebu (*Bos indicus*) breeds being in general more resistant than are European (*Bos taurus*) breeds. The resistance of local Zebu breeds, such as the Nguni and Sanga, is probably due to an inherited resistance acquired through years of natural selection. Conglutinin in the serum appears to be involved in non-specific resistance to heartwater in cattle.

Sheep are more susceptible to heartwater than are cattle, and variations in susceptibility between breeds of sheep are less than those in cattle breeds. Angora goats are highly susceptible to heartwater and their immunity is of short duration. Genetic resistance has been demonstrated in some goats. Black-headed Persian sheep possess some natural resistance to heartwater, and lambs and kids of all breeds under one week of age have a degree of innate resistance.

From observations made on game animals infected in captivity it appears that antelope such as young black wildebeest (*Connochaetes gnou*), adult springbok (*Antidorcas marsupialis*) and water buffalo (*Bubalus bubalis*) with low levels of serum conglutinin are susceptible, whereas adult black wildebeest, red hartebeest (*Alcelaphus buselaphus*) and scimitar-horned oryx (*Oryx dammah*) with high levels of conglutinin proved to be highly resistant. Helmeted guineafowl (*Numida meleagris*), leopard tortoise (*Geochelone pardalis*) and scrub hare (*Lepus saxitilis*) have also been proven to harbour *E. ruminantium* subclinically.
Livestock Health, Management and Production › High Impact Diseases › Vector-Borne Diseases › Heartwater

Springbok, when introduced into a heartwater area, often suffer from clinical heartwater

Transmission

Heartwater is transmitted by ticks of the genus *Amblyomma*. Most *Amblyomma* spp. are three-host ticks. Larvae and nymphs become infected when they feed on domestic and wild ruminants and possibly also on certain game birds and reptiles at a time when *E. ruminantium* is circulating in the blood of these hosts. The immature stages of the tick commonly feed on smaller species of domestic and wild ruminants and game birds, while the adults prefer cattle and the larger game animals, such as African buffalo.
(Syncerus caffer) and giraffe (Giraffa camelopardalis), as hosts. Nymphs or adult ticks transmit *E. ruminantium* to susceptible hosts without losing the infection. Intrastadial transmission has been demonstrated, and transovarial transmission was once demonstrated in very heavily infected ticks under laboratory conditions but it is unlikely that it occurs in the field.

Heartwater occurs only where its vectors are present and 10 *Amblyomma* spp. capable of transmitting the organism occurs in Africa. The major vectors are *A. variegatum* and *A. hebraeum*, the latter being the main vector of heartwater in southern Africa. *Amblyomma variegatum* has the widest distribution in Africa and is the only originally African *Amblyomma* species that has established itself successfully outside the continent (on two islands in the French Antilles).

Among the *Amblyomma* spp. native to the USA, *A. americanum* and *A. cajennense* are only marginally susceptible to infection while *A. maculatum*, on the other hand, has long been known to be capable of transmitting the disease and has a vector efficiency in sheep which is similar to that exhibited by *A. variegatum*.

As ticks remain infective for life, a small number of infected ticks could presumably maintain the infection in a particular herd or area. The infection rates of ticks vary according to the season and locality in which they are collected and may be surprisingly low. Surveys in South Africa have found that one to seven per cent of *A. hebraeum* in some parts of the endemic area were infected at any one time, while somewhat higher rates have been determined in Zimbabwe and Senegal.

**PATHOGENESIS**

The pathogenesis of heartwater is not well understood. Vertebrate hosts are infected with *E. ruminantium* organisms through the saliva of attached ticks and/or by their regurgitated gut content. Initial replication of the organisms seems to take place in cells of the mononuclear phagocyte system in the regional lymph nodes, after which they are disseminated via the blood stream and invade endothelial cells of blood vessels in various organs and tissues where further multiplication occurs. In domestic ruminants *E. ruminantium* most readily infects endothelial cells of the brain, and this coincides with the onset of the febrile reaction.

Increased vascular permeability with transudation is responsible for effusion into body cavities and tissue oedema, and this is particularly noticeable in the lungs, pericardial sac and pleural cavity. Oedema of the brain is responsible for the nervous signs, hydropericardium contributes to cardiac dysfunction during the terminal stages of the disease, and progressive pulmonary oedema and hydrothorax result in eventual asphyxiation.

It has been demonstrated that antibodies do not control the course of the disease. As *E. ruminantium* is an intracellular parasite it would be expected that both CD8⁺ cytotoxic T-cells and CD4⁺ helper T-cells
would be important in the development of protective immunity. The antigen of *E. ruminantium* which is currently the best characterized is the immunodominant MAP1, a protein of about 32kDa which varies in size from isolate to isolate.

**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)](image)

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.

Cow in lateral recumbency exhibiting opisthotonus and leg-pedalling

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 lung oedema associated with heartwater (bovine)

Brain oedema associated with 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.

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.

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.

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.

**CONTROL / PREVENTION**

Tick control has long been advocated as a means of controlling heartwater. Even after the infected blood-based vaccine was developed, tick control was still advocated as a supplementary or alternative means of control. Tick control can be either intensive or strategic, but intensive tick control has largely fallen into disuse. The main disadvantage is that animals may lose all immunity to tick-borne diseases because of the lack of a natural challenge. Strategic tick control implies the control of tick numbers so that natural infection of livestock occurs and high levels of immunity are maintained. The aim is to achieve an
epidemiologically stable situation with respect to heartwater by the regulation of the numbers of ticks present so as to prevent the debilitating effects of severe tick infestations. Economic studies have demonstrated that strategic tick control is both a more economical and a more practical option for limiting losses from heartwater and other tick-borne diseases.

Several drugs have been used to treat animals suffering from heartwater but the tetracyclines, especially oxytetracycline, are the most widely used. Short-acting formulations of oxytetracycline are most commonly used at a dosage rate of 10 to 20 mg/kg body weight, either administered intramuscularly as a single dose, or half the calculated dose is given intravenously and the other half intramuscularly. This treatment is usually repeated 24 hours later. A long-acting oxytetracycline preparation has been shown to be equally effective. Doxycycline has been used successfully at a dose rate of 2 mg/kg body weight in the treatment of experimentally-induced heartwater in sheep.

When treatment with tetracycline is instituted during the incubation period of heartwater in cattle (before approximately eight days after infection) the course of the disease is usually altered; animals usually develop no fever or other clinical signs, except that, in a few, a low-grade transient febrile response will result. In these animals no, or at best only a partial, immunity develops. Treatment of sheep and goats during the incubation period may also give rise to a delayed febrile reaction (it may be as long as 20 to 25 days after infection compared to the more usual nine to ten days in untreated animals), and the reaction may be so severe that additional treatment is required. Supportive therapy in clinical cases of heartwater is often inefficient because of the poor understanding of the pathogenesis of the disease. Various anti-inflammatory agents have been used.

Routine oxytetracycline injections may be used to protect susceptible animals against heartwater when they are introduced into an endemic area. In goats it is advocated that short-acting oxytetracyclines be administered at a dosage rate of 3 mg/kg body weight on days 10, 20, 30, 45 and 60 after their introduction, and that the animals should not be dipped until day 60. Injections of a long-acting oxytetracycline in cattle are sufficient to protect them from contracting heartwater, while at the same time allowing them to develop a natural immunity. The dosage is 10 to 20 mg/kg body weight given on days 7, 14 and 21, or days 7, 12 and 17, or even on days 7 and 14. The animals should be kept under close scrutiny and given appropriate treatment if they do develop overt disease. The success of this regimen depends upon the animals becoming naturally infected during the time that they are protected by the drug. Slow-release treatment with doxycycline has also been advocated, in the form of a tablet implanted behind the ear. In practice this is most often used as part of an immunization-and-treatment regimen.

The only vaccine currently commercially available is a cryopreserved preparation of blood from a sheep infected with virulent *E. ruminantium* organisms of the Ball 3 strain. The blood is injected intravenously in animals to be immunized, the rectal temperature is monitored daily, and antimicrobial treatment is administered at the proper time. The infective blood must be preserved on dry ice or in liquid nitrogen and thawed shortly before inoculation, and the whole procedure must be supervised by trained staff. The duration of immunity is uncertain, and because live organisms are involved the procedure cannot be used
in non-endemic areas. The procedure is used successfully to protect susceptible animals against the disease, especially when they are first introduced into endemic areas, or if they are particularly valuable.

The Ball 3 strain, which was originally isolated in the Limpopo Province of South Africa, was chosen as the vaccine stock because it produces an early temperature rise several days before any other serious clinical signs appear. This makes it relatively easy to decide when to treat. Unfortunately the Ball 3 vaccine does not protect against all the isolates circulating in the field. Although the Welgevonden isolate offers a wider spectrum of cross-protection than other strains, its virulence makes it difficult to control and therefore unsuitable for an infection and treatment immunization procedure.

Immunization of calves under the age of one month and lambs and kids younger than seven days old does not generally result in clinical disease, but the animals develop immunity. While it is advisable to monitor their rectal temperatures twice daily for a period after immunization, as is advised in the case of older animals, this is still the method with the lowest risk of losses due to fatal heartwater reactions after inoculation.

In the absence of periodic stimulation of the immune system, resulting from the bites of infected ticks, the duration of immunity after immunization varies greatly between different domestic animal species, and also perhaps between individuals within species. In sheep, the immunity may wane after six months, but in some cases it may remain sufficient to protect animals against a fatal outcome for at least four years. The duration of immunity in goats following immunization is poorly documented. In Angora goats the degree of immunity seems to depend largely on the time at which the animals are treated therapeutically during the reaction subsequent to the immunization. The duration of immunity in cattle after immunization in the absence of challenge appears to be approximately two years.

After the vaccine is administered to the animal a definite fever usually develops which, if not treated, may be fatal. Inoculated animals are treated early in the course of the disease, but if treatment is effected too early no immunity will result. It is advisable to immunize individuals or small groups of animals because large groups present serious management difficulties.

Starting on the day following vaccination, the rectal temperature of each animal is recorded daily. On the first day of the temperature reaction the rectal temperature will usually be 1 °C or more above the average. This can be expected nine to 14 days after inoculation in the case of small stock and 14 to 18 days in cattle. A rise in the early morning rectal temperature to above 39,5 °C in cattle and goats, and 40 °C in sheep, is usually regarded as an immunization reaction.

It is not necessary to treat as early as the first day of the reaction, except in rare cases where, after a sudden rise of 1,5 °C or more, a temperature of 41,5 °C is reached. Treatment should be given only if the temperature on the second day of the reaction equals or surpasses that on the first day. Should the temperature on the second day be lower than the previous day, there are two possibilities, i.e. the animal is either resistant or partially immune, in which case the temperature on the third day will again be lower than on the first day and treatment would be unnecessary. Occasionally the temperature on the third day
is much higher than on the second day and even higher than on the first day. If this occurs the animals should be treated immediately.

Treatment consists of an intramuscular injection of tetracycline at 10 mg/kg body weight, and short or long-acting formulations can be used. The recording of temperatures must be continued after treatment and if the temperature 48 hours after treatment equals or surpasses that on the day of treatment, a second treatment should be given. A high temperature within 24 hours after treatment can be ignored, unless the animal shows other clinical signs such as listlessness and lack of appetite, in which case it should be treated a second time without delay.

Relapses of vaccine-induced heartwater may occur after treatment. It is therefore advisable to monitor the rectal temperatures, especially of valuable animals, for an additional period of two weeks after the last treatment.

The block method of immunization, also known as ‘systematic treatment’, is widely practised in South Africa, especially when immunizing large numbers of kids and lambs. In this method the vaccine is administered and this is followed by treatment as described above on a predetermined day without recording daily rectal temperatures. Treatment is recommended on the following days, assuming that vaccination has taken place on day 0: exotic *Bos taurus* cattle breeds and their crosses, day 14; indigenous *Bos indicus* cattle breeds and their crosses, day 16; sheep and Angora goats, day 11; Boer and crossbreed goats, day 12. Care must be taken, however, as the procedure has some disadvantages. In older animals durable immunity only follows after the animal has developed a febrile reaction. Treatment performed too early in the incubation period results in failure to develop immunity and if treatment is given too late heavy mortalities can result.

The doxycycline implant method entails that animals are inoculated and at the same time doxycycline tablets are implanted under the skin, usually behind the ear, using a special applicator. Slow release of the active ingredient means that the animal does not become clinically ill, but at the same time develops immunity. Since the animal is handled only once and daily temperatures are not recorded, this method is suitable for the immunization of large numbers of animals at one time. As the dosage is critical, the body weight of the treated animals must be known, since an inadequate amount of the antimicrobial drug will not prevent fatal heartwater, while an excess will prevent the subsequent development of immunity.

**MARKETING AND TRADE / SOCIO-ECONOMICS**

The occurrence of heartwater is frequently taken for granted in the endemic areas and definitive diagnoses are not often performed. This leads to the prevalence rates of the disease being under reported. In the endemic area in South Africa mortalities from heartwater are three times greater than those from babesiosis and anaplasmosis combined. Goats are especially threatened, and in some parts
of the rural farming sector it is believed that up to 30 per cent of goats become infected with heartwater annually. The economic impact of heartwater is difficult to quantify, both because of the under reporting noted above and because the actual occurrence of the disease may be partially suppressed by a range of factors. These include the use of acaricides, antimicrobial prophylaxis, immunization by infection and treatment, the resistance of certain animal breeds to the disease, and endemic stability.

Heartwater is a major obstacle to the introduction of high-producing animals into sub-Saharan Africa to upgrade local stock and is of particular importance when susceptible animals are moved from heartwater-free to heartwater-infected areas. The possibility of heartwater spreading from the Antillean islands to the American mainland, where a suitable tick vector is present, is an ever-present threat to the livestock industry there.

An economic model for the prevalence of heartwater and impact under various farming systems has been developed. The conclusion was reached that a control strategy based on vaccination would be the most cost effective way of combating the disease.

IMPORTANT OUTBREAKS

Outbreaks usually occur in endemic areas following the introduction of susceptible animals from a non-endemic area. Outbreaks may also occur in endemic areas where the tick population is not high enough to reliably ensure exposure of all young animals during the period in which they exhibit non-specific immunity to infection, or after droughts are broken by good rains. During the drought environmental conditions are unfavourable to ticks and the tick population therefore decreases. Calves, lambs and kids may therefore not be exposed at a very young age and are therefore fully susceptible. Once the drought is broken and conditions become favourable for ticks, the expanding tick population leads to a high level of transmission and outbreaks of disease may occur.

FAQ

1. Can heartwater be cured?

   Yes; both short-acting and long-acting formulations of oxytetracycline or doxycycline can effect clinical cure, provided treatment is implemented early during the course of the disease, especially before the onset of nervous signs.

2. Can one vaccinate animals as a preventative measure?
Yes. The vaccine consists of blood from sheep infected with live, virulent parasites of the Ball 3 strain and can be used to vaccinate cattle, sheep or goats.

3. **Is the vaccine safe to use in all animals?**

   No. The vaccine contains virulent parasites, but the particular strain of parasite does not cause peracute infection. Therefore, susceptible animals usually develop a temperature reaction lasting several days, which allows for timeous treatment, provided the animals are monitored. Since the vaccine needs to be administered intravenously, some animals may also develop an anaphylactic shock reaction following vaccination.

4. **Can animals react to the vaccination by showing clinical signs?**

   Yes. Calves up to the age of 6 weeks and lambs and kids up to the age of 3 weeks seldom develop clinical signs of disease following vaccination. Older animals are likely to develop clinical signs of disease and should be observed and monitored for temperature reactions.

5. **Does the vaccination have to be repeated?**

   No. As this is a live vaccine, one vaccination should be sufficient. As one would only vaccinate in areas where there is natural challenge, infection through tick transmission will act as a booster.

6. **Is heartwater a notifiable disease in southern Africa?**

   No. Heartwater is widespread in southern Africa, and there are no statutory requirements for controlling or eradicating the disease. However, member countries of the OIE must report it in their biannual reports to the OIE.

7. **Which species of livestock or wildlife harbour the infection?**

   Cattle, sheep and goats. Several small and large wild ruminant species may also harbour the infection, as may some small wild mammal species and even ground-frequenting birds. These latter species may act only as temporary hosts.

8. **Is eradication of ticks required to control the disease?**

   No. An endemically stable situation is the ideal.

9. **Can you inject other vaccines with blood vaccines?**

   It depends on the vaccines. Check with your veterinarian.

10. **Can you inject heartwater and redwater vaccines at the same time?**

    No, because animals react differently to the vaccines and require different treatments.
REFERENCES


