

HEARTWATER. AN OVERVIEW OF THE CLINICAL SIGNS, SUSCEPTIBILITY AND DIFFERENTIAL DIAGNOSES OF THE DISEASE IN DOMESTIC RUMINANTS

H. E. VAN DE PYPEKAMP⁽¹⁾ and L. PROZESKY⁽²⁾

ABSTRACT

VAN DE PYPEKAMP, H. E. & PROZESKY, L., 1987. Heartwater. An overview of the clinical signs, susceptibility and differential diagnoses of the disease in domestic ruminants. *Onderstepoort Journal of Veterinary Research*, 54, 263-266 (1987).

Heartwater is a frequently fatal tick-borne disease of ruminants caused by *Cowdria ruminantium*. In domestic ruminants the incubation period varies considerably and depends on the route of infection, virulence of the isolate and amount of infective material administered. Adult cattle of all breeds appear to be equally susceptible to heartwater. It is generally accepted that calves up to the age of 3 weeks have a high degree of natural resistance which is not related to the immune status of the dam.

Nervous symptoms are frequently seen in animals affected by the peracute and acute forms of heartwater and can easily be confused with similar signs caused by infectious conditions, toxic plants, acaricide and heavy metal poisonings.

INTRODUCTION

Heartwater is an often fatal tick-borne disease caused by *Cowdria ruminantium* and is regarded as one of the most important diseases of domestic ruminants in southern Africa. The course of the disease ranges from peracute to inapparent forms (Alexander, 1931; Neitz, 1968).

Nervous symptoms are commonly seen in diseased animals (Neitz, 1968). Various other causes of nervous signs have been confused with heartwater in endemic areas including infectious conditions such as rabies (Brückner, Hurter & Boshoff, 1978), toxic plants (Coetzer, Kellerman & Naudé, 1985) and acaricide poisoning (Terblanche, 1968). Clinically it is sometimes impossible to differentiate between heartwater and these conditions.

Despite immunization and specific chemotherapy to *C. ruminantium*, heartwater remains a major threat to the upgrading of stock. Indigenous goat and sheep (e.g. Persian and Afrikaner sheep) breeds possess a higher degree of natural resistance to the disease than exotic goat and sheep (e.g. Merino and Île-de-France) breeds (Spreull, 1922; Alexander, 1931; Du Plessis, Jansen & Prozesky, 1983). It appears that certain indigenous cattle breeds have acquired a strong innate resistance through natural selection. In these breeds *C. ruminantium* manifests itself as a latent infection in the offspring (Du Plessis, Bezuidenhout & Lüdemann, 1984; Bezuidenhout, 1985).

The purpose of this report is to describe the clinical signs of heartwater and to discuss the susceptibility of animals to heartwater and the differential diagnosis of heartwater in endemic areas.

Clinical signs

The incubation period of heartwater is influenced by the species of animal affected, the route of infection, virulence of the heartwater isolate and amount of infective material administered (Alexander, 1931; Neitz, 1968; Uilenberg, 1983).

Cattle develop a fever *c.* 12 d after intravenous (i.v.) inoculation of 10 ml of blood infected with the Ball 3 isolate of *C. ruminantium*, issued as a vaccine by the Veterinary Research Institute, Onderstepoort. The incubation period is reduced by an average of 2-4 d when animals are inoculated i.v. with 5 ml *Amblyomma*

hebraeum nymph suspension, infected with the same isolate (Van der Merwe, 1979; L. van der Merwe, personal communication, 1986). In naturally infected animals this period ranges from 9-29 d with an average of 18 d (Alexander, 1931).

The incubation period in sheep and goats inoculated i.v. with 10 ml of blood infected with a virulent heartwater isolate, varied from 5-35 d (average 9-10 d) and from 7-35 d (average 14 d) in naturally infected animals (Alexander, 1931; Uilenberg, 1983). Sheep injected i.v. with one ground-up *A. hebraeum* nymph or 1/100 of a nymph, infected with the Ball 3 isolate developed a fever 9-14 d later (Bezuidenhout, 1981).

Depending on the age, immune status, individual or breed susceptibility of the animal and virulence of the isolate, the course of the disease may range from peracute to mild (Alexander, 1931; Neitz, 1968).

Cattle: Heavily pregnant *Bos taurus* breeds such as the Jersey, South Devon, Charolais, Limousine and Friesland are particularly prone to develop peracute heartwater. This form of the disease has also been reported in 6-18-month-old animals of different breeds (Henning, 1956; Van der Merwe, 1979). Pyrexia develops suddenly and animals die in a few hours without overt clinical signs or may show paroxysmal convulsions and die within 36-48 h. Oedema of the lungs is common and gives rise to marked respiratory distress (Alexander, 1931; Neitz, 1968).

Acute heartwater is the most common form of the disease in endemic areas and affects mainly animals 3-18 months of age. It is characterized by a fever of 40 °C or higher that usually remains high with small fluctuations and drops subnormally shortly before death. In a few febrile animals clinical symptoms may be absent for 1-9 d (Alexander, 1931; Uilenberg, 1981).

Initially animals appear clinically normal before they gradually show inappetence and eventually stop feeding. Petechiae are visible on the mucus membrane of the conjunctiva (Fig. 1) of most animals (H. Krige, personal communication, 1987).

Nervous symptoms ranging from a mild inco-ordination to pronounced convulsions occur in the majority of acutely affected animals (Alexander, 1931). They are hypersensitive when handled or exposed to sudden noise or bright light. Slight tapping on the head will often evoke a severe blinking reflex. Calves may wander around aimlessly, walk into fences and can be approached with ease. Occasionally animals will remain standing, hold their heads low, chew constantly, and sometimes push against objects. Diseased animals often

⁽¹⁾ State Veterinarian, Private Bag X82087, Rustenburg 0300, RSA

⁽²⁾ Section of Pathology, Veterinary Research Institute, Onderstepoort 0110, RSA

Received 10 July 1987—Editor



FIG. 1 Petechiae are visible on the conjunctiva of a bovine

show a peculiar high stepping gait that is usually more pronounced in the front limbs.

Affected cases may suddenly fall down in lateral recumbency, with opisthotonos and legs extended or making pedalling movements (Fig. 2). Most animals weaken rapidly and death usually follows soon after the convulsive attacks.



FIG. 2 A bovine in lateral recumbency with extended legs

The incidence of the mild form of heartwater is difficult to determine because symptoms are rarely seen in field cases. Calves less than 3 weeks of age (Uilenberg, 1981), animals infected with an isolate of low virulence (Neitz, 1968), and heartwater-immune animals that are reinfected (Alexander, 1931) develop a mild form of the disease. Apart from a fever, apathy and slight tachypnoea the animals appear normal. Most cases recover within a few days (Camus & Barré, 1982).

Diarrhoea is infrequently seen in animals with heartwater (H. van de Pypekamp, unpublished data, 1987). Diseased animals are usually 4–8 months old and it appears that certain breeds such as the Friesland, Jersey and Simmentaler are often affected. Animals sometimes show an involuntary flow of faeces without even attempting to lift the tail (L. van der Merwe, personal communication, 1986). In adult Afrikaner and Jersey cattle particularly, a profuse, often haemorrhagic diarrhoea may be the only clinical sign. Contrary to our findings, diarrhoea is considered by other workers as a constant clinical sign in cattle (Alexander, 1931; Da Graça, 1964, Uilenberg, 1981).

Sheep and goats: The peracute form of the disease is rather common in exotic goat breeds. Most animals collapse suddenly and die after a few paroxysmal convulsions (Uilenberg, 1983). Sometimes they appear dull, and show inappetence prior to death (Karrar, 1960). Young Boer goats 2–6 months old appear to be very susceptible to the peracute form of heartwater. Diseased animals bleat and twitch their tails continuously; respiration is forced; they urinate and defecate at regular intervals; and nystagmus, pedalling and chewing movements are sometimes seen (Spreull, 1922).

Acute heartwater is the most common form of the disease in sheep. The majority of animals show nervous symptoms, but these are generally less pronounced than in cattle (Alexander, 1931). Affected sheep show a progressive unsteady gait initially, and often stand with their legs apart, head down, ears drooping and they appear to be listless. They eventually go down in lateral recumbency and show continuous galloping and chewing movements, licking of the lips and nystagmus (Alexander, 1931).

Sheep and goats with a strong natural resistance to heartwater, such as Persian sheep, young animals and animals that have previously been exposed to *C. ruminantium*, are particularly inclined to develop the mild form of heartwater. Apart from a fever response the animals are asymptomatic (Alexander, 1931; Uilenberg, 1983).

Complications of heartwater

Complications manifest in a low percentage of non-fatal cases of heartwater. Recumbent animals may develop a hypostatic pneumonia and rumen stasis. A few animals become permanently blind, sheep may shed their fleece and calves and kids can develop a torticollis (Fig. 3) (Spreull, 1922; Alexander, 1931; Karrar, 1960; Van der Merwe, 1979; H. van de Pypekamp, unpublished data, 1986).



FIG. 3 An animal that has recovered from heartwater developed a torticollis

Morbidity and mortality

The morbidity and mortality rates are largely influenced by the species, breed and age of the animal, the virulence of the heartwater isolate, immunization and tick control programmes on the farm, specific chemotherapy and the season (Haig, 1955; Uilenberg, 1981; Bezuidenhout, 1982; Camus & Barré, 1982).

Cattle: As a rule the losses sustained when cattle are newly introduced into an endemic area are high, but less than in sheep and goats (Henning, 1956). It appears that adult cattle of different breeds are equally susceptible to heartwater and the incidence of fatal cases increases with age until maturity is reached (Du Plessis *et al.*, 1984; Haig, 1955; Bezuidenhout, 1985). Neitz & Alexander (1945) claimed that there was no difference in the susceptibility of heartwater between adult Afrikaner, Aberdeen Angus and Hereford cattle. Contrary to their findings other workers (who immunized 11 115 adult cattle with the Ball 3 vaccine) concluded that *Bos indicus* breeds were more resistant to the disease than *Bos taurus* breeds (Van der Merwe, 1979; R. de la Rey, personal communication, 1986).

It is generally accepted that calves up to 3 weeks of age have a high degree of natural resistance (innate resistance) which is not related to the immune status of the dam (Neitz & Alexander, 1941; Uilenberg, 1981). The period may, however, vary between different breeds (Du Plessis *et al.*, 1984). Zebu calves have a strong innate resistance compared to calves of European breeds, and animals less than 3 weeks can be immunized without danger with the Ball 3 vaccine. In contradistinction, European breed calves may develop clinical symptoms and have to be treated after vaccination (Neitz & Alexander, 1941; J. D. Bezuidenhout & H. van de Pypekamp, unpublished data, 1985).

Sheep and goats: It has been established beyond doubt that the Persian breed has a strong natural resistance to *C. ruminantium* (Lounsbury, 1904). This resistance is also reflected in Persian crossbred and indigenous Afrikaner breeds (Alexander, 1931). The Angora goat is considered to be the most susceptible domestic ruminant to heartwater followed by the Boer goat, Merino and Merino crossbred breeds (Spreull, 1922).

Depending on the virulence of the heartwater isolate, the mortality rate in the Merino breed varies from 5–95% (Neitz, 1964). Alexander (1931) inoculated 162 Merinos i.v. with blood infected with 8 different isolates. Seventy-four per cent of the animals died of the disease over a 10 month period.

Lambs younger than 8 d and kids up to 6 weeks of age are markedly resistant to heartwater (Neitz & Alexander, 1941; Thomas & Mansvelt, 1957). However, when kids are inoculated with the Ball 3 vaccine a few animals may have to be specifically treated (Thomas & Mansvelt, 1957; Camus & Barré, 1982).

It was found recently that 25% of Guadeloupe native goats, removed from heartwater endemic areas many years ago, were resistant to the disease (Matheron, Barré, Camus & Gogué, 1986). In a population that was not exposed to *C. ruminantium* for 10 years, 54% of the animals were protected against heartwater and in a flock continually exposed to heartwater 78% of the animals were immune to *C. ruminantium*. It was concluded that the goats possess a marked natural resistance to heartwater, probably associated with a recessive sex-linked gene.

Differential diagnosis

Heartwater is characterized clinically by a wide spectrum of symptoms. Nervous symptoms feature prominently in a large percentage of heartwater cases and the differential diagnoses listed here include only important causes of nervous signs in endemic areas.

Cattle: Infectious conditions: Rabies (Brückner *et al.*, 1978; Barnard, 1979; Kaplan, Turner & Warrell, 1986), the nervous form of malignant catarrhal fever (Plowright, 1964), cerebral babesiosis (De Vos, Imes & Cul-

len, 1976), cerebral theileriosis (De Vos, 1982; De Vos, Bessenger & Banting, 1981) and meningitis and encephalitis caused by various bacteria (Jubb, Kennedy & Palmer, 1985).

Plant poisonings: *Albizia versicolor*, *A. tanganiensis*, *Sarcostemma viminalis*, *Solanum kwebense*, *Cynanchum* spp. and *Euphorbia mauritanica* poisoning (Coetzer *et al.*, 1985).

Pesticides: Chlorinated hydrocarbon and organic phosphate poisoning (Terblanche & Minné, 1968; Terblanche, 1968).

Heavy metals: Lead poisoning (Clarke & Clarke, 1970).

Sheep and goats

Infectious conditions: Abscessation of the hypophysis in goats is clinically indistinguishable from heartwater (L. Prozesky, unpublished data, 1986). A meningo-encephalitis caused by a wide range of bacteria should also be considered as a differential diagnosis in sheep and goats.

Plant, and heavy metal poisons and pesticides: With the exception of *S. kwebense* poisoning the differential diagnosis is the same as for cattle.

REFERENCES

- ALEXANDER, R. A., 1931. Heartwater. The present state of our knowledge of the disease. *17th Report of the Director of Veterinary Services and Animal Industry, Union of South Africa*, 89–149.
- BARNARD, B. J. H., 1979. Simptome van hondsdolheid by huis- en plaasdiere in Suid-Afrika en Suidwes-Afrika. *Journal of the South African Veterinary Association*, 50, 109–111.
- BEZUIDENHOUT, J. D., 1981. The development of a new heartwater vaccine using *Amblyomma hebraeum* nymphae infected with *Cowdria ruminantium*. *Proceedings of an International Conference on tick biology and control, Rhodes University, Grahamstown, Republic of South Africa*.
- BEZUIDENHOUT, J. D., 1982. Diseases of the central nervous system of cattle under tropical conditions. *Proceedings of the 12th World Congress of Cattle, Amsterdam, The Netherlands*.
- BEZUIDENHOUT, J. D., 1985. The epizootiology and control of heartwater and other tick borne diseases of cattle in South Africa. *Onderstepoort Journal of Veterinary Research*, 52, 211–214.
- BRÜCKNER, G. K., HURTER, L. R. & BOSHOFF, J. N., 1978. Field observations on the occurrence of rabies in cattle in the Magisterial Districts of Soutpansberg and Messina. *Journal of the South African Veterinary Association*, 49, 33–36.
- CAMUS, E. & BARRÉ, N., 1982. La cowdriose (heartwater). *Revue générale des connaissances. Institut d'Élevage et de Médecine Vétérinaire des Pays Tropicaux, Maisons-Alfort*.
- CLARKE, E. G. C. & CLARKE, MYRA, L., 1970. *Garner's Veterinary Toxicology*. London: Baillière, Tindall & Cassell.
- COETZER, J. A. W., KELLERMAN, T. S. & NAUDÉ, T. W., 1985. Neurotoxicoses of livestock caused by plants and fungi in southern Africa. *Technical Communication, Department of Agriculture and Water Supply, Republic of South Africa* No. 199.
- DA GRAÇA, H. M., 1964. Sur la localisation de *Cowdria ruminantium* dans l'épithélium bronchique. *Bulletin of the Office of International Epizootics*, 66, 751–756.
- DE VOS, A. J., 1982. The identity of bovine *Theileria* spp. in South Africa. *M. med. Vet. Thesis, University of Pretoria, South Africa*.
- DE VOS, A. J., BESSENGER, R. & BANTING, L. F., 1982. *Theileria taurotragi*: A probable agent of bovine cerebral theileriosis. *Onderstepoort Journal of Veterinary Research*, 48, 177–178.
- DE VOS, A. J., IMES, G. D. & CULLEN, J. S. C., 1976. Cerebral babesiosis in a new-born calf. *Onderstepoort Journal of Veterinary Research*, 43, 75–78.
- DU PLESSIS, J. L., BEZUIDENHOUT, J. D. & LÜDFMANN, C. J. F., 1984. The immunization of calves against heartwater: subsequent immunity both in the absence and presence of natural tick challenge. *Onderstepoort Journal of Veterinary Research*, 51, 193–196.
- DU PLESSIS, J. L., JANSEN, B. C. & PROZESKY, L., 1983. Heartwater in Angora goats. I. Immunity subsequent to artificial infection and treatment. *Onderstepoort Journal of Veterinary Research*, 50, 137–143.
- HAIG, D. A., 1955. Tick-borne rickettsioses in South Africa. *Advances in Veterinary Science*, 2, 307–325.

HEARTWATER. AN OVERVIEW OF THE CLINICAL SIGNS

- HENNING, M. W., 1956. Animal diseases in South Africa, 3rd edn. South Africa: Central News Agency.
- JUBB, K. V. F., KENNEDY, P. C. & PALMER, N., 1985. Pathology of domestic ruminants Vol. 1. 3rd edn., New York, San Francisco: Academic Press Inc.
- KAPLAN, C., TURNER, G. S. & WARRELL, D. A., 1986. Rabies. The facts. Oxford, New York, Tokyo: Oxford University Press.
- KARRAR, G., 1960. Rickettsial infection (heartwater) in sheep and goats in the Sudan. *British Veterinary Journal*, 116, 1-10.
- LOUNSBURY, C. P., 1904. Persian sheep and heartwater. *Agricultural Journal of the Cape of Good Hope*, 25, 175-186.
- MATHERON, G., BARRÉ, N., CAMUS, E. & GOGUÉ, J., 1987. Genetic resistance of Guadeloupe native goats to heartwater. *Onderstepoort Journal of Veterinary Research*, 54, 337-340.
- NEITZ, W. O., 1964. Tick-borne diseases as a hazard in the rearing of calves in Africa. *Bulletin Office International Epizootics*, 62, 607-625.
- NEITZ, W. O., 1968. Heartwater. *Bulletin Office International Epizootics*, 70, 329-336.
- NEITZ, W. O. & ALEXANDER, R. A., 1941. The immunisation of calves against heartwater. *Journal of the South African Veterinary Medical Association*, 12, 103-111.
- NEITZ, W. O. & ALEXANDER, R. A., 1945. Immunization of cattle against heartwater and control of the tick-borne diseases, redwater, gall-sickness and heartwater. *Onderstepoort Journal of Veterinary Research*, 20, 137-152.
- FLOWRIGHT, W., 1964. Studies on bovine malignant catarrhal fever of cattle. D.V.Sc. Thesis, University of Pretoria, South Africa.
- SPREULL, J., 1922. Heartwater. *Joernaal van die Departement van Landbou*, 11, 1-12.
- TERBLANCHE, H. J. J., 1968. Organophosphate poisoning in farm stock in southern Africa. *Journal of the South African Veterinary Medical Association*, 39, 69-72.
- TERBLANCHE, J. & MINNÉ, J. A., 1968. Thiodan poisoning of cattle. A case report. *Journal of the South African Veterinary Medical Association*, 39, 91-92.
- THOMAS, A. D. & MANSVELT, P. R., 1957. The immunization of goats against heartwater. *Journal of the South African Veterinary Medical Association*, 28, 163-168.
- UILENBERG, G., 1981. Heartwater disease. In: Diseases of cattle in the tropics. The Hague, Boston, London: Martinus Nijhoff Publishers.
- UILENBERG, G., 1983. Heartwater (*Cowdria ruminantium* infection): Current status. *Advances in Veterinary Science and Comparative Medicine*, 27, 428-480.
- VAN DER MERWE, LENTE, 1979. Field experience with heartwater (*Cowdria ruminantium*) in cattle. *Journal of the South African Veterinary Association*, 50, 323-325.