PARAFILARIASIS IN CATTLE

Definition top

Parafilariasis is a vector-borne parasitic infection of cattle and buffalo caused by the filaroid nematode *Parafilaria bovicola*. The disease is characterized by hemorrhagic nodules on the skin of cattle and subsequent bruise-like lesions in subcutaneous and intramuscular tissues of affected carcasses (1,2,3,4).

Etiology top

The parasite species *P. bovicola* belongs to the family Filariidae, subfamily Filariinae, genus *Parafilaria* (1). The parasite female is 5 to 6 cm long and 500 mm wide, and the male is half that size.

Host Range top

No age, sex, or breed preference of cattle and buffalo has been noted in cases

exposed to *P. bovicola*. Bleeding points are more easily recognized in light-colored breeds like the Charolais, and therefore positive cases are reported more often in these breeds.

Geographic Distribution top

Parafilaria bovicola was first described in 1934 by M. A. Tubangui from the Philippines (6) and has since been identified on all the major continents except Australia and South America. Parafilariasis in cattle has also been reported from India (1934); U.S.S.R. (1941); Tunisia and Morocco (1935) (7); French-speaking west Africa, Nigeria, and east Africa (8); Rwanda (1949); Burundi, South Africa (1964); Romania (1949); Bulgaria and France (9); Sweden (5,10); and most recently from Pakistan (20). The source of introduction in Sweden was probably Charolais cattle imported from France in 1969 and 1970, for the parasite was earlier recovered from Charolais cattle imported from France into Canada in 1966 (5,21,22). The parasite was not transmitted from the imported cattle to indigenous cattle in Canada (21,22). *P. bovicola* has not been reported in the United States.

Transmission top

Vector-borne diseases, such as parafilariasis in cattle, are restricted to certain geographical regions that coincide with those of their vectors. Although the parasite is not presently known in the United States, a real threat exists to the beef industry, because of the presence of the face fly, *Musca autumnalis*. Experimental transmission studies carried out in Sweden demonstrated that face flies obtained from the United States are capable of serving as biological vectors of *P. bovicola*, as is the European face fly (15).

Investigations in South Africa have shown that the licking flies, *Musca xanthomela*, *M. lusoria*, and *M. nevilli* species are vectors of *P. bovicola* (7,11,12,13). A preliminary research note from India suggests another licking fly, *M. vitripennis*, may also act as a vector for *P. bovicola* (14).

Results of experimental transmission in calves indicated that positive cases were observed following inoculation by the intraconjunctival route, whereas calves exposed by the subcutaneous route did not develop lesions (15). This correlates with reported findings that *M. autumnalis* feeds primarily on eye secretions (11,18). However, experimental infections and intraconjunctival routes have been reported by others (9,11).

The spread of *P. bovicola* to new localities may occur in several ways. Infected

vectors may move actively or passively (livestock trade) to new sites, or the infected bovine may be moved to virginal geographic areas (16,17,29).

The developmental period of the parasite extends from the time vector flies feed on bleeding points of parafilaria-affected cattle during the pasture season to the time bleeding points first appear in February (3,15). Later in the year, only sterile or calcified nematodes, or both have been found in healing or healed lesions (3). Also, forth-stage larvae from new infections are found (5). These observations indicate that adult parasites seem to die off after oviposition and do not survive into the next season and that affected animals are newly infected every year (5,28). This is an important fact when considering parasite control (Fig. 85).

Life Cycle top

The life cycle of *P. bovicola* begins when flies feed on the bleeding points of parafilariasis-affected cattle and ingest infective microfilariae (first-stage larvae). These flies then become the intermediate host.

After 11 days in South Africa (11) and 20 days in Sweden (15), the microfilariae develop in the fly into infective third-stage larvae (12). These larvae are infective for cattle on which the vector flies subsequently feed. The developmental period in cattle from the infective third stage larvae to mature adult *Parafilaria* is 9 to 10 months under Swedish conditions. This is comparable to the 7 to 10-month period reported from South Africa (7), which suggests that the prepatent period of the parasite under Swedish conditions might be longer than in South Africa owing to differences in climate (5,15,19) (Fig. 82).

Viljoen (9) has subsequently shown that the third molt takes place about 7 days after infection and the fourth molt at approximately 65 days after infection. After 135, days the fifth-stage larva is adult; oviposition starts about 240 days after infection (9). The parasites produce subcutaneous nodules in the superior parts of the body, particularly the head and neck, the withers, the shoulders, and the sides of the body. Several hours after the appearance of the nodule, the female makes an opening about 0.5 to 1 mm in diameter on the summit. Generally, the nodules develop rapidly and within a few hours exude blood that coagulates, matting the hair in the region. The bleeding stops within 24 to 48 hours, and another nodule may develop in the vicinity of the first one and produce the same sequence of events (Fig. 83). Later in the year, only sterile or calcified nematodes, or both are found in healing or healed lesions (3). These observations indicate that adult parasites seem to die off after oviposition and do not survive into the next season, and that affected animals are newly infected every year (5,28).

The reservoir of infection in Sweden is the infected cow herd, where the presence of infection does not present an economic problem for the farmer, because there are few condemnation losses of cows at slaughter owing to the minimal lesions caused by the parasite in adult cattle (5,26). Direct economic losses exist for beef producers who have limited their production to raising young bulls and steers for market. These become infected on initial pasture exposure to flies containing *P. bovicola* infective larvae. At this time the cattle weigh from 300 to 400 kg and are 1 to 2 years of age. Three to nine months later (December through July) the infections result in a high percentage of condemnations and substantial economic losses. However, these animals are not important as reservoirs of infection under the present Swedish meat production system, for they do not normally survive through two subsequent pasture seasons (29).

Clinical Signs top

Clinical signs are mild and rather characteristic. Female *P. bovicola*, which live in the subcutaneous tissue, lay eggs on the surface of the skin, reaching this position by penetrating the dermis and epidermis. As the female pierces the skin at the neck and back of the bovine, a trickle of bleeding becomes visible for some minutes or even hours. In the live animal the condition is characterized by the appearance of swollen, painful hemorrhagic nodules on the skin (40 mm in diameter and 10 mm in depth) as a result of the female penetrating the skin. Before penetration by the female, the nodules are 12 to15 mm in diameter and 5 to7 mm in height (9) (Fig. 84).

Lesions and cutaneous bleeding points caused by the parasite appear in a seasonal pattern in the Northern Hemisphere, starting in December and February, respectively, and lasting through the first half of the calendar year. After this they gradually disappear (3,5). In the Southern Hemisphere, on the African continent, this reportedly occurs in a similar but reversed seasonal pattern in the period from June to January (23). The developmental period of the parasite to sexual maturity coincides with vector fly activity during the pasture season (May to September) in Sweden, and results in this seasonal occurrence of bleeding points and lesions detected at slaughter.

Gross Lesions top

Subcutaneous lesions on the carcasses of affected cattle look remarkably like bruises caused by handling and transport before slaughter (Fig. 85). Acute lesions have an opaque yellow-green appearance. Edematous areas are intermingled by clearer areas with petechiae in the subcutaneous tissue, on the fascia, and in the superficial muscle layers (Fig. 86). Chronic lesions have a greenish, dirty brown

appearance because of eosinophilic infiltration of the inflammatory tissue (2,5,15,24,25).

Morbidity and Mortality top

Retrospective studies in Sweden revealed parafilarial lesions at slaughter in 35 percent of the young cattle from herds exposed to face flies on pasture during the year preceding slaughter. However, parafilarial lesions were not found in cattle from herds managed indoors and not exposed to face flies (15).

Diagnosis top

Field Diagnosis top

A provisional diagnosis is usually made by clinical examination (cutaneous bleeding points) in endemic areas. However, many bleeding foci remain undetected, and therefore, many of infected animals are not diagnosed (Fig. 87).

Specimens for the Laboratory top

To help confirm a diagnosis of parafilariasis in cattle, collect blood for serum and blood (fresh or dried) from a cutaneous bleeding point of a suspicious case into a suitable container holding 1 ml of 0.85 percent saline solution. The specimens should be kept cool during transport to the laboratory. In addition, a biopsy of a skin lesion can be submitted in 10 percent formalin.

Laboratory Diagnosis top

The blood collected from the cutaneous bleeding point should be transferred to a centrifuge tube and centrifuged at 400 gravities for 10 minutes. The pellet should then be examined microscopically for the characteristic eggs containing microfilariae or free microfilariae, or both, which are 200 to 300 mm wide.

A serologic enzyme-linked immunosorbent assay (ELISA) test has been developed (26) and evaluated (27) to diagnose *P. bovicola* infection reliably in living animals. Significant diagnostic titers appear approximately 3 months after exposure.

Differential Diagnosis top

In live cattle, the focal cutaneous hemorrhages resemble injury by thorns, wire, biting flies, or ticks. Identification of microfilariae in cutaneous bleeding lesions

establishes the diagnosis of parafilariasis. Subcutaneous lesions on carcasses of affected cattle resemble bruises due to trauma. Parafilaria-induced lesions can easily be differentiated from bruises by the presence of an eosinophilic infiltrate and by isolating the nematode.

There are other nematodes belonging to the *Filarioidea* superfamily that cause tissue lesions in cattle, namely the *Onchocerca* species. However, in contrast to *Parafilaria*, the *Onchocerca* species cause neither extensive edema and discoloration of subcutaneous tissues nor intermuscular and intramuscular lesions (5). *O. gutturosa* causes a green-colored inflammation, but this is mainly restricted to the nuchal ligament and knee-joint tendon (5).

Treatment top

Ivermectin has been used successfully in the Union of South Africa to reduce the number and surface area of *Parafilaria* lesions and the weight of tissue trimmed from affected carcasses (31-34). Similar results have been reported from Pakistan (11) as well as from Burundi (35) and Sweden (30,34). A single dose of 200 µg/kg reduced the number of subcutaneous lesions by 88.2 percent, the total lesion area by 98.7 percent and the mass of tissue trimmed from carcasses by 98.8 percent at slaughter 83 days posttreatment (30).

Nitroxynil is an effective anthelmintic at a dose of 20 mg/kg repeated 3 days later. Lesion area was reduced by 95 percent and visible carcass lesions by 90 percent. High doses of levamisole and fenbendazole given daily for 4 to 5 days have also been used (23,24,36).

Control and Eradication top

Elimination of infective *P. bovicola* from cattle before they leave the exporting country would be the method of choice in preventing the entry of parafilariasis into free areas such as the United States. Availability of the diagnostic serologic ELISA test makes possible testing of cattle in *P. bovicola* endemic areas (26,27). Cattle on pasture should be tested about 3 months after the pasture season ends. If tested earlier, a retest should be done at least 3 months after the pasture season ends. Seropositive animals should be considered to have been infected with *P. bovicola* during the previous pasture season. The following recommendations are offered for buyers and sellers of livestock in Sweden (30):

1. Calves should be sold during the period October 1 to April 30 if they are born between October and March.

2. The trade of young livestock and older cattle can take place according to the following alternatives:

a. Serological control.

The animal can he sold during the period December 1 to April 30 if the animal tests negative on serology. If the animal tests positive, the animal can be sold if treated according to alternative b.

b. Treatment with Ivermectin.

During the period May 1 to November 30, the animal can be sold if it is treated with ivermectin in the herd of origin (seller) in conjunction with the sale and is treated in the herd of destination (buyer) 1 month before being released onto pasture. This later treatment can be abolished if serologic testing of a sample taken between December 1 and April 30 is negative.

c. Animals kept stabled for the entire pasture season.

Animals can be traded during the period October 1 to April 30 if it can be guaranteed that the animal has not been on pasture during the previous pasture season.

Experience from South Africa indicated that treatment with ivermectin reduces bleeding points 14 days after a single treatment using 200 µg/kg. These trials indicated that ivermectin has a substantial effect on the reduction of *Parafilaria* lesions — most probably as the result of activity against the adult worm. Further work is required to ascertain whether this activity includes the preadult stages (31).

For import into a *P. bovicola*-free area such as the United States, where the vector fly *M. autumnalis* is abundant, it is highly recommended that animals be serotested in the country of origin before export. Specific guidelines regarding live animal trade between endemic and *P. bovicola*-free areas have been developed in Sweden (30). Guidelines are constantly being updated as changes in the disease situation occur.

Vector control measures against *M. autumnalis* as a method to control *P. bovicola* have had limited success in breaking the infection cycle in endemic areas. Because this fly occupies vast areas and remains for only a short time at the host, control has been inadequate with conventional methods of repeated application of

insecticidal sprays as well as the use of self-application devices such as dust bags and oilers. Good vector control over the entire period of *P. bovicola* transmission will lead to control of the parasite, as reported by Nevill et al. (34). They used weekly to fortnightly dipping of all cattle with a pyrethroid spray-wash containing 2.5 percent m/v delmethrin. All cattle were sprayed with 50 ppm delmethrin in a spray race weekly from August to April (9 months). Another approach of using pyrethroid-impregnated eartags or spot treatments with pyrethroids aimed at control of the face flies found around the head has been reported from Sweden (34), where *Parafilaria bovicola* control was achieved in a 260 km2 area by treating all 2,600 cattle with a fenvalerate-impregnated eartag in each ear. The use of insecticide-impregnated cattle eartags reportedly reduces the number of face flies around tagged livestock (18,37-39).

Public Health top

Humans are not known to be susceptible to *P. bovicola*.

GUIDE TO THE LITERATURE top

1. SOULSBY, E.J.L. 1982. Helminths, Arthropods and Protozoa of Domesticated Animals. 7th ed, Bailliere,and Tindall,eds., Philadelphia: Lea and Febiger, . p. 313

2. PIENAAR, J.G., and VAN DEN HEEVER, LOO. 1964. *Parafilaria bovicola* (Tubangui 1934) in came in the Republic of South Africa. J. S. Afr. Vet. Med. Assoc., 35:181-184.

3. BECH-NIELSEN, S., SJOGREN, V., and LUNDQUIST, H. 1982 *Parafilaria* bovicola (Tubangui 1934) in cattle: Epizootiology — disease occurrence. A. J. Vet. Res. 43:945-947.

4. SOULSBY, E.J.L.1965. Nematodes of the Skin of Cattle -*Parafilaria bovicola*. In: Textbook of Veterlnary Clinical Parasitology, Vol. l. Helminths, Blackwell Scientific Publications, p. 755-758.

5. LUNDQUIST, H. 1983. *Parafilaria bovicola* (Tubangui 1934) established in Sweden. Nord. Vet. Med., 35:57-68.

6. TUBANGUI, M.A. 1934. Nematodes in the collection of the Philippines. Bureau of Science. II. Filarioidea. Philipp. J. Sci., 55:115-122..

7. NEVILL, E.M. 1975. Preliminary report on the transmission of *Parafilaria bovicola* in South Africa. Onderstepoort J. Vet. Res., 42:41-48.

8. SCHILLHORN VAN VEEN,T.W. 1982. Michigan State University, personal communication.

9. VILJOEN, J.H. 1982. The parasitic life cycle of *Parafilaria bovicola* and its pathogenesis in cattle, Ph.D. thesis. Department of Parasitology, Faculty of Veterinary Science, University of Pretoria, Pretoria, South Africa.

10. NILSSON, N.G. 1978. *Parafilaria bovicola* rapport fran en arbetsgrupp (in Swedish). Sven. Veterinartidning (Stockholm), 30:785-787.

11. NEVILL, E.M. 1979. Experimental transmission of *Parafilaria bovicola* to cattle using *Musca* species (Subgenus *Eumusca*) as intermediate hosts. Onderstepoort J. Vet. Res., 46:51-57.

12. NEVILL, E.M.: The development of *Parafilaria bovicola* in *Musca xanthomelas* and *Musca lusoria*. Onderstepoort J Vet Res 48:207-213, 1981.

13. NEVILL, E.M., and SUTHERLAND, B. 1987. The colonization and life-cycles of *Musca lusoria*, *Musca Xanthomelas* and *Musca nevilli*, vectors of *Parafilaria bovicola* in South Africa. Onderstepoort J. Vet. Res., 54:607-611.

3. BECH-NIELSEN, S., SJOGREN, V., and LUNDQUIST, H. 1982 *Parafilaria* bovicola (Tubangui 1934) in cattle: Epizootiology — disease occurrence. A. J. Vet. Res. 43:945-947.

4. SOULSBY, E.J.L.1965. Nematodes of the Skin of Cattle -*Parafilaria bovicola*. In: Textbook of Veterlnary Clinical Parasitology, Vol. l. Helminths, Blackwell Scientific Publications, p. 755-758.

5. LUNDQUIST, H. 1983. *Parafilaria bovicola* (Tubangui 1934) established in Sweden. Nord. Vet. Med., 35:57-68.

6. TUBANGUI, M.A. 1934. Nematodes in the collection of the Philippines. Bureau of Science. II. Filarioidea. Philipp. J. Sci., 55:115-122..

7. NEVILL, E.M. 1975. Preliminary report on the transmission of *Parafilaria bovicola* in South Africa. Onderstepoort J. Vet. Res., 42:41-48.

8. SCHILLHORN VAN VEEN,T.W. 1982. Michigan State University, personal communication.

9. VILJOEN, J.H. 1982. The parasitic life cycle of *Parafilaria bovicola* and its pathogenesis in cattle, Ph.D. thesis. Department of Parasitology, Faculty of Veterinary Science, University of Pretoria, Pretoria, South Africa.

10. NILSSON, N.G. 1978. *Parafilaria bovicola* rapport fran en arbetsgrupp (in Swedish). Sven. Veterinartidning (Stockholm), 30:785-787.

11. NEVILL, E.M. 1979. Experimental transmission of *Parafilaria bovicola* to cattle using *Musca* species (Subgenus *Eumusca*) as intermediate hosts. Onderstepoort J. Vet. Res., 46:51-57.

12. NEVILL, E.M.: The development of *Parafilaria bovicola* in *Musca xanthomelas* and *Musca lusoria*. Onderstepoort J Vet Res 48:207-213, 1981.

13. NEVILL, E.M., and SUTHERLAND, B. 1987. The colonization and life-cycles of *Musca lusoria*, *Musca Xanthomelas* and *Musca nevilli*, vectors of *Parafilaria bovicola* in South Africa. Onderstepoort J. Vet. Res., 54:607-611.

26. SUNDQUIST, B., ZAKRISSON, G., BECH-NIELSEN, S., and BIANCO, A.E. 1988 Preparation and evaluation of the specificity of *Parafilaria bovicola* antigen for detection of specific antibodies by ELISA. Vet. Parasitol, 28:223-235, 1988.

27. SUNDQUIST, B., BECH-NIELSEN, S., and ZAKRISSON, G. 1989. Characterization and purification of *Parafilaria bovicola* antigens by chromatofocusing to enhance specificity in serodiagnosis. Vet. Parasitol. 33:309-318.

28. NEVILL, E.M., and VILJOEN, J. H. 1984. The longevity of adult *Parafilaria bovicola* and the persistence of their associated carcass lesions in cattle in South Africa. Onderstepoort J. Vet. Res., 51:115118.

29. BECH-NIELSEN, S., HUGOSON, G., and WOLD-TROELL, M. 1983. Economic evaluation of several control programs for the cattle nematode *Parafilaria bovicola* using benefit-cost analysis. Prev. Vet. Med., 1 :303-320.

30. NORDBLOM, B. 1985. Lantbruksstyrelsen, Jonkoping. Sweden, Rekommendationer for Livdjurshandel med avseende pa infektion med notkreaturparasiten *Parafilaria bovicola*. Veterinary Information Notice 4561796/85.

31. SWAN, G.E., SOLL, M.D., CARMICHAEL, I.H., and SCHRODER, J. 1983. Efficacy

of ivermectin against *Parafilaria bovicola*. Vet. Rec. 113:260.

32. SOLL, M.D., CARMICHAEL, L. H., and BARRICK, R.A. 1991. Ivermectin treatment of feedlot cattle for *Parafilaria bovicola* in cattle. Onderstepoort J. Vet. Res,. 10:251-256.

33. VAN WYK, J.A., GROENEVELD, H.T., and CARMICHAEL, I. H. 1990. Evaluation of the efficacy of anthelmintics against *Parafilaria bovicola* in cattle. Onderstepoort J. Vet. Res., 57:103-108.

34. NEVILL, E.M., WILKINS, C.A., and ZAKRISSON, G. 1987. The control of *Parafilaria bovicola* in South Africa. Onderstepoort J. Vet. Res., 54:547-550.

35. MERKER, M.K. 1985. Treatment with Ivermectin of cattle naturally infected with *Parafilaria bovicola* in Burundi. Trop. Anim. Hlth. Prod., 17:1-2.

36. WELLINGTON, A.C. 1978. The effect of nitroxynil on *Parafilaria bovicola* infestations in cattle. J. S. Afr. Vet. Med. Assoc. 49:131-132.

37. WILLIAMS, R. E. , and WESTBY, E.J. 1980. Evaluation of pyrethroids impregnated in cattle eartags for control of face flies and horn flies. J. Econ. Entomol., 73:791-792.

38. WILLIAMS, R.E., WESTBY, E.J., HENDRIX, K.S., and LEMENAGER, R. P. 1981. Use of insecticide-impregnated eartags for the control of face flies and horn flies on pastured cattle. J. Animal. Sci., 53:1159-1165.

39. WILLIAMS, R.E., and WESTBY, E.J. 1982. Comparison of three insecticide-impregnated cattle eartags for face fly and horn fly control (Diptera:*Muscidae*). J. Kansas Entomol. Soc., 55:335-338.

Steen Bech-Nielsen, D.V.M., Ph.D., Professor, Maglebjergvej 4, 3200 Helsinge, Denmark

---