Brucella ovis infection in deer

Brucella ovis infection in deer generally mimics the disease in sheep. The prevalence of infection in New Zealand deer is not known but is likely to be low. Individual farms risk reduced reproductive performance if breeding stags contract the disease.

Brucella ovis is primarily a pathogen of sheep and has been reported in flocks from most parts of the world but not the UK[1]. The organism invades the reproductive tract resulting in reduced fertility in rams and, rarely, abortion in ewes or neonatal deaths in lambs. A range of animals, including cattle, laboratory animals and goats[2][3][4], have been infected experimentally but natural infection has not been reported in these species. Experimental infection of white-tailed deer has been reported in USA[5] but it was not until infection was discovered in a red deer stag in New Zealand in 1996 that the organism was recognised as a potential pathogen for deer. This case was an incidental finding when semen collected for artificial breeding was seen to be flocculent. On culture it yielded a pure growth of *B ovis*[6]. Subsequent case studies identified further infections in farmed deer in New Zealand[7][8].

Prevalence and geographical distribution in farmed deer

The table shows the results of testing 1074 deer serum samples submitted to diagnostic laboratories specifically for testing for *B ovis* infection. This number represents less than 0.1% of the New Zealand farmed deer population. Positive or suspicious reactions to the *B ovis* CFT used for sheep were recorded in 118 serum samples from 11 properties. Infection has been confirmed on five of these properties by culture of reproductive organs[8]. Of the 768 serum samples submitted from the five properties, 106 had positive or suspicious CFT titres. The other 12 positive or suspicious samples were from six properties where no attempt has been made to confirm the presence of infection by bacteriological culture.

Of 1498 deer serum samples submitted to diagnostic laboratories for other reasons and tested in the *B ovis* CFT, six were positive but at least four of these were considered to be false-positive reactors[9].

Since 1998 only one new case of *B ovis* infection in deer has been detected by serological testing and no new cases have been confirmed by bacteriological culture. Scrotal palpation of stags to detect lesions of epididymitis, with subsequent investigation of any lesions identified, is a routine postmortem inspection procedure at deer slaughter premises. While the exact prevalence of *B ovis* infection in the New Zealand farmed deer population is unknown, it is likely to be low. However, on individual farms there is the risk that stags may contract the disease from infected rams or introduced infected stags.

Case studies

Five cases of *B ovis* infection in New Zealand farmed deer have been documented[7][8][10][11][12]. Infection rates of up to 88% based on serological testing were reported in some groups of stags. The source of infection was not determined in any of these cases but contact with infected rams or infected stags was suspected.

Transmission

Experimental studies have demonstrated transmission of *B ovis* from stag to stag[13][14] and from ram to stag[15] when animals are grazing in the same paddock. Thus the naturally occurring cases reported in New Zealand probably originated either in infected rams on the property or from introduction of an infected stag. In a trial

Prevalence and distribution of deer serum samples positive to *B ovis* as at 30 June 2000

Region	Estimated number of farmed deer as at 30 June 2000	Number of serum samples tested from deer	Number of positive or suspicious serum samples	Number of properties from which serum samples were tested	Number of properties tested with positive or suspicious serum samples
Northland	35,995	0	0	0	0
Auckland	33,848	0	0	0	0
Waikato	189,876	21	14	3	1
Bay of Plenty	89,279	14	0	2	0
Gisborne	30,742	0	0	0	0
Hawkes Bay	134,445	97	0	1	0
Taranaki	17,424	0	0	0	0
Manawatu-Wanganui	183,717	8	1	2	1
Wellington	33,848	3	0	1	0
Tasman	43,390	4	0	2	0
Marlborough	25,636	3	0	1	0
West Coast	42,060	0	0	0	0
Canterbury	534,780	787	80	7	3
Otago	185,770	95	19	4	4
Southland	472,190	39	4	4	2
TOTAL	2,053,000	1074 (0.05% of total farmed deer population)	118 (11% of deer tested)	27 (0.5% of total deer farming properties)	11 (41% of properties tested)

Source: Statistics New Zealand, New Zealand Game Industry Board, AgriQuality Serology

in which infected stags were grazed with non-infected rams for a 10-month period, transmission from stags to rams did not occur[14]. Experimental evidence suggests that transmission is unlikely when animals are not in direct contact, for example grazing paddocks that have just been vacated by infected animals or grazing in adjacent paddocks[16][17][18][19].

Infection of stags via the vagina of hinds has been demonstrated (A Ridler, unpublished observations). This implies that transmission between stags during the mating period is possible when a hind is mated by an infected stag and then by a non-infected stag. This method of transmission has been demonstrated in rams[20].

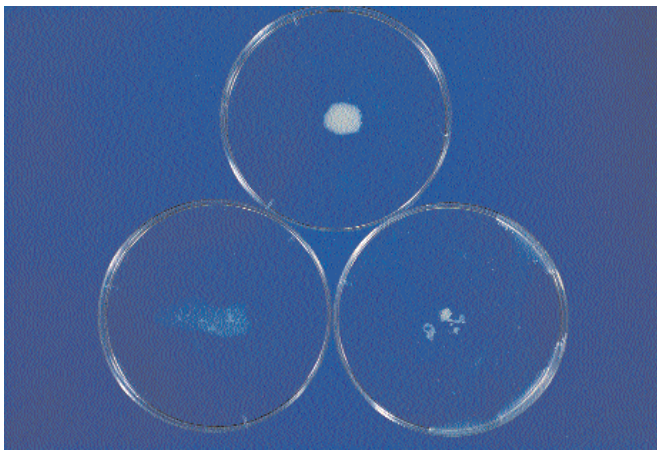
During experimental work, transmission of *B ovis* between stags and from rams to stags occurred during the breeding season of red deer, suggesting that sexual activity plays an important role in transmission[14][15]. Stags have been infected by experimental inoculation of the conjunctival, nasal and rectal mucous membranes so transmission may result from infected semen coming in contact with any of these mucous membranes (A Ridler, unpublished observations).

Rams and stags grazing together; a risk for ram-to-stag transmission of *Brucella ovis*

Infection in stags

The pathogenesis and pathology of *B ovis* infection in rams has been well documented[21][22][23] and appears to be similar in stags. The organism localises in the epididymes, seminal vesicles and ampullae of infected stags causing characteristic histopathological lesions with lymphocytic infiltration into the lamina propria of these organs and spermatic granuloma formation in the epididymes. In chronic infections the lesions tend to be mild (A Ridler, unpublished observations).

In about 10 to 20% of infected stags, gross enlargement of the tail of the epididymis is evident by scrotal palpation. At necropsy, small abscess-like lesions may be present within the epididymes. *Brucella ovis* can be cultured from the epididymes, seminal vesicles and ampullae of infected stags (A Ridler, unpublished observations).



Semen from a non-infected stag (top) and from two infected stags (bottom)

Infection results in reduced semen quality in the majority of infected stags. Of nine artificially infected 16-month-old stags from which semen was collected monthly during the three-month breeding season, six had purulent material grossly evident in the semen sample, sperm motility of 20% or less and large numbers of abnormal sperm. Eight of the stags had white blood cells and cellular debris present in semen[24].

In rams, *B ovis* infection is believed to persist for long periods and it has been reported that many infected rams can excrete infected semen for longer than four years[25]. In contrast, in most stags the infection persists for less than a year. Thirteen of 15 artificially infected stags ceased to excrete the organism in semen 100 to 350 days after infection, and the remaining two continued excreting for at least 18 months (A Ridler, unpublished observations).

Infection in hinds

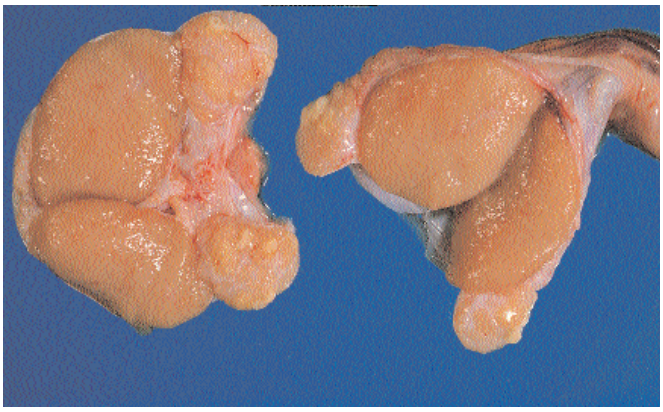
Reproductive losses due to *B ovis* infection in ewes are uncommon and infection probably also has little impact on hinds. A trial investigating 30 infected hinds found no significant effect on reproductive performance (A Ridler, unpublished observations).

Diagnosis

Serum from 1498 deer, presumed to be non-infected, tested in the *B ovis* CFT gave a specificity of 99.6%[9]. Similarly, during experimental studies, 221 serum samples from 104 non-infected deer tested in the *B ovis* CFT, and 109 samples from 59 non-infected deer tested in the *B ovis* ELISA, showed test specificities of 99% and 100%, respectively (A Ridler, unpublished observations). These figures are similar to those reported for the CFT and ELISA in sheep (99.3% and 98.6%, respectively)[26].

A total of 78 deer have been experimentally infected with *B ovis* by a variety of routes, and their serum has been tested in the *B ovis* CFT and ELISA. Samples from 24 stags inoculated intravenously, 45 hinds and stags inoculated on to mucous membranes and nine stags infected by contact with infected stags or rams, gave a sensitivity in the CFT and ELISA of 99% and 95%, respectively, in the acute stages of infection. However, *B ovis* antibody titres in deer decline

more rapidly than those in sheep. From data obtained from 20 artificially infected stags, and using the serological cut-off titres described for sheep, titres of infected stags in the *B ovis* CFT and ELISA tended to decline to 'negative' levels 200 to 300 days after infection. After this titres tended to fluctuate at a low level so that on some sampling times they were in the positive or suspicious range (A Ridler, unpublished observations).



Epididymitis in the tail of the epididymis from an acutely infected stag

Serological testing is a practical and low-cost method of diagnosing *B ovis* infection and, where the history suggests that infection is likely to be recent, serodiagnosis should be accurate. Where the infection is likely to be chronic, use of the CFT and ELISA in parallel, and careful interpretation of results in conjunction with herd history and clinical findings, is recommended. Bacteriological culture of semen or reproductive organs is definitive but it is essential that samples are collected as cleanly as possible because the slow-growing *B ovis* organisms are rapidly overgrown by contaminating organisms.

Conclusions

Experimental results suggest that many aspects of *B ovis* infection in deer mimic the disease in sheep. Transmission can occur between animals that are in direct contact. The organism invades the male reproductive tract resulting in characteristic pathological changes and subsequent decreases in semen quality; the impact on females appears to be low. In contrast to rams, most stags appear to eliminate the infection within a year of becoming infected. The prevalence of *B ovis* in deer is probably low and the overall impact of the disease on the deer industry is likely to be minor but individual farms risk reduced reproductive performance if breeding stags contract the disease from infected rams or introduced infected stags.

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