

Exotic deer diseases of importance

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The outbreak of foot and mouth disease (FMD) in the United Kingdom (UK) has focussed attention on exotic disease prevention and control, and on questions such as

Can we keep FMD and other exotics out of New Zealand?

Are we prepared for an outbreak here?

Would we detect it early enough if it did get in?

Would we handle an outbreak better or worse than the UK has?

The aim of this paper is to give an overview of the more important deer diseases that are exotic to New Zealand. Practitioners play a vital role in early detection and in assisting with responses. It is the responsibility of all veterinarians to maintain awareness of major exotic diseases and to include them in their differential diagnoses when this is appropriate.

I would like to acknowledge the work of Colin Mackintosh in his review in the NZVA Deer Branch proceedings of 1988. I am not an expert on deer diseases – my recent experience before coming to New Zealand was in the Northern Territory of Australia, where some of the major species I dealt with were cattle, crocodiles and camels – so I have relied on various sources such as Colin's review.

Exotic viral diseases of deer

Foot and mouth disease (FMD)

FMD is a virus disease of all cloven-hoofed animals. Pigs act as amplifiers, excreting large quantities of virus, cattle act as sentinels, showing more obvious clinical signs, while sheep act as reservoirs, showing mild disease only and acting as carriers. FMD also affects goats, deer, camelids, and cloven-footed zoo and feral animals. It is endemic in many regions of the world, particularly in Asia, Africa, the Middle East and South America.

Some countries, like Chile and Japan, have a long history of freedom from disease. Japan had an outbreak of type O Pan-Asia strain FMD last year. They detected it early and successfully eradicated it. Other recent outbreaks in previously free regions have been in Taiwan in 1997 and 1999, South Africa in 2000 and the UK and Europe in 2001.

A number of other countries have also had recent outbreaks with significant impacts, such as Taiwan, South Africa, Argentina and of course the UK and Europe at the moment. This year there have also been outbreaks in Kuwait, Argentina, Uruguay, Brazil, Qatar, Saudi Arabia and Mongolia – and very recently in Bolivia, Turkey and Kazakhstan.

The disease is highly contagious, spreading directly from animal to animal, on fomites (equipment, vehicles, humans), in meat and meat products, unpasteurised milk, and on the wind, reportedly over large distances. It has a short incubation period, as little as 3-4 days, and infected animals may excrete virus for several days before clinical signs are apparent.

Clinical signs are similar in all species, but vary in severity. Vesicles (blisters) develop in and around the nose, mouth and hooves, and around the teats of dairy cattle. Over the course of a few days these erupt, burst and heal. Infected animals are febrile, off food, lame and depressed. They are likely to show a drop in milk yield and weight gain.

Signs in some animals and some species may be mild. This applies to deer, which may simply show a loss of appetite, salivation, mild lameness, mild brief pyrexia and more subtle vesicles. There are anecdotal reports of severe clinical effects being seen in some species of deer. In the current UK FMD outbreak, sheep have generally shown only mild disease. This has made it difficult to diagnose.

or rule out FMD infection, especially when footrot is a common cause of lameness in sheep, and the two diseases might occur simultaneously in a flock or in individual animals.

A practitioner seeing vesicular lesions should look for similar vesicles on hooves or in mouths in other animals in the mob. If in doubt, call the exotic diseases hotline on 0800 80 99 66. Ascertaining the age of lesions by their appearance helps to establish the earliest date from which a mob of animals could have been infected and is very valuable for tracing purposes.

Because the signs of FMD in deer may be relatively mild, presence of FMD in wild deer could be a real concern for New Zealand, if FMD was able to sustain itself in wild deer populations. In California in 1924, 22,000 deer were slaughtered to control FMD in the Stanislaus National Forest over a 12-month campaign. Ten per cent of these were reported to show lesions. By contrast, the UK apparently succeeded in eradicating FMD in the 1968 outbreak, despite a decision not to attempt eradication from infected wild deer. No re-infection of farmed livestock from the infected deer appeared to occur. It is uncertain whether the same decision could be made successfully today. There are now four times as many deer in Britain as there were in 1968, with different population densities, and the different distributions of deer and FMD infection.

The impact of FMD is largely economic. Mortalities are generally low, except young animals. Animals recover, particularly sheep and deer which are less seriously affected than say cattle and sheep.

In an outbreak, 40% of New Zealand's export income would immediately cease, as we would not be able to sell meat, dairy products and probably wool to our major customer countries. Meat and dairy producers would be hardest hit – New Zealand exports 95% of its dairy products and 90% of its meat.

There are 7 strains of virus and numerous substrains. Vaccines are only effective against the particular strain. In an outbreak situation, countries are reluctant to use vaccine as a control tool as it can mask infection and trading partners take much longer to recognise that eradication has been successful.

Vesicular stomatitis (VS)

VS has been seen in North and South America only. It affects cattle, horses and pigs, and occasionally sheep, goats and deer. Because the signs of VS are very similar to those of FMD, FMD-free countries usually treat VS in the same way as FMD. It is not as contagious but does show high morbidity and rapid spread in infected herds.

Chronic wasting disease of deer (CWD)

Strictly speaking, CWD is a prion disease, not a viral disease.

CWD causes a fatal spongiform encephalopathy of deer. It occurs sporadically in deer and elk, mainly in captive deer, in the USA. Transmission is horizontal, by contact and possibly vertical. Affected animals show progressive weight loss, behavioural changes, salivation, polydipsia, polyuria and severe pneumonia.

CWD was first recognised in the 1960s in USA. Although it is a prion disease, in the family of transmissible spongiform encephalopathies (TSEs), its origin is unknown. There is no clear association with other TSEs. It has been seen in mule deer, white-tailed deer and elk. An outbreak in deer at Toronto Zoo (Canada) in late 1970s resulted in death of the entire group of animals. CWD is an emerging problem in farmed deer herds in Saskatchewan, Canada. A paper elsewhere in these proceedings (see Woodbury) provides an update on CWD in North America.

What appears to be bovine spongiform encephalopathy (BSE) has been seen in various antelope species in British zoos, associated with feeding of contaminated feedstuffs. Signs in these animals were similar to the signs of CWD.

Aujeszky's disease

Aujeszky's disease, due to a herpesvirus, causes nervous signs and mortality in young pigs. It can also cause pruritis in cattle, sheep and other ruminants including deer. It does not appear to transmit between ruminants. Although only recently eradicated from pigs in the North Island, no cases have been seen in deer in New Zealand. Deer are unlikely to be the first animals affected if an outbreak of Aujeszky's disease occurred in New Zealand.

Bluetongue

Bluetongue, due to an orbivirus (or arbovirus), is present in all tropical countries, is transmitted by biting midges known as *Culicoides*. It affects all ruminant species, but particularly sheep, which exhibit fever, hyperaemia of the buccal and nasal mucosae, salivation and nasal discharge. Severe cases in sheep present with lips and tongue swollen, face oedematous, diarrhoea, pneumonia, inflammation and haemorrhages on coronary band.

The main reservoir is cattle – signs in cattle are generally mild. Goats and elk may also act as reservoirs. Bluetongue disease in deer is likely to be mild or subclinical, although it has been reported to cause severe disease in white-tailed deer in the USA. Bluetongue is present in northern Australia but is generally innocuous because the distribution of the vector tends to cover cattle-raising rather than sheep-raising areas. In North America, bluetongue is found in the southern USA and occasionally moves up through the western States into Canada.

The likelihood of bluetongue entering and establishing in New Zealand is negligible. Infected animals are viraemic for only a short period, so ruminants can safely be imported from infected areas after a spell in a vector-free area. *Culicoides* vectors are not present in New Zealand so establishment would not occur even if the virus were introduced.

Two diseases closely related to bluetongue are epizootic haemorrhagic disease (EHD) and Ibaraki disease. Like bluetongue, the EHD virus is present in Australia where it appears to cause no associated disease. Its worldwide distribution is much more restricted than that of bluetongue.

Rabies

Rabies is caused by a lyssavirus, from the family of rhabdoviruses. It affects all warm-blooded animals, causing fatal encephalitis. Two epidemiological cycles are recognised: in urban rabies, dogs are the main reservoirs, while in wildlife rabies, foxes, racoons and bats are common sources of infection. If rabies was to enter New Zealand, species that could act as important reservoirs could be dogs, stoats and weasels.

Rabies is found in most regions of the world, except for many countries of the western Pacific region. Closely related lyssaviruses are present in Europe and Australia.

Signs of rabies in deer are similar to those shown by cattle: depression, salivation, throat muscle paralysis, nervousness, excitability, progressive paralysis, recumbency and death.

Rabies in New Zealand is unlikely to be first diagnosed in deer. For diagnosis (in any species) it is best to submit whole brain to the laboratory to check for rabies, and also chronic wasting disease and BSE. Euthanase the animal rather than shooting it. Contact the laboratory first as they may prefer to get the whole head or the entire animal if this can be submitted fresh. Although the likelihood of rabies entering New Zealand is low, bear in mind that rabies is fatal in humans. Approach any animal showing signs consistent with rabies with extreme caution.

Rinderpest

Rinderpest is a highly contagious disease of cattle in Africa, the Middle East and south Asia. Close animal contact required for transmission, so outbreaks often follow introduction of infected animals into susceptible populations. Affected animals exhibit a high fever, necrotic stomatitis, gastroenteritis, mucosal oedema, haemorrhage and necrosis. Signs are similar to those of mucosal disease, but distinguished by high mortality and rapid spread.

While rinderpest may infect deer, this appears to be unusual. Rinderpest is unlikely to enter New Zealand because of effective controls over ruminant imports, and unlikely to be first seen in deer.

Other exotic viral diseases of deer

There are many other exotic bacterial diseases that could be mentioned here. Some, like bovine herpesvirus 1 and cervine herpesvirus 1, have not been included because their signs are so mild and uncharacteristic that it is unlikely a practitioner would suspect them. This would apply also to skin papillomas and fibromas, and to Rocky Mountain spotted fever. In fact, the question could be asked, can we be sure these are absent from New Zealand?

Louping ill, caused by an arbovirus, is unlikely to occur in New Zealand because of the absence of a suitable vector. This situation would change if Ixodid ticks managed to enter New Zealand.

Exotic bacterial diseases of deer

Anthrax

Anthrax is caused by the spore-forming bacterium *Bacillus anthracis*. It can affect most warm-blooded animals, including cattle, sheep, horses, pigs and deer, although infection in deer appears to be uncommon.

Anthrax causes sudden death, with discharge of blood from the orifices. Splenomegaly is a common feature.

It is present in many countries including Australia, and is readily controlled in developed countries by vaccination. In endemic areas its distribution appears to be related to soil type. Even in endemic areas it tends to occur irregularly.

The incubation period is short (hours to several days) so quarantine procedures are usually effective at excluding anthrax and entry of anthrax into New Zealand is unlikely.

Humans may be infected through broken skin, producing "malignant carbuncles". Even more rarely, a fatal lung disease can follow inhalation of anthrax spores.

Avoid opening the carcasses of suspect anthrax cases as the extremely resistant spores are formed on contact with air.

Brucellosis

Brucellosis, a bacterial infection due to *Brucella abortus*, causes abortions in cattle and deer, although infection is usually subclinical in deer. It also affects elk, bison and moose – moose may be severely affected, with deaths due to brucellosis. Brucellosis infection is not usually sustainable in wild populations due to lower population densities.

The organism is transmitted at time of abortion or infected calving, by ingestion of foetal material and fluids.

Brucellosis is zoonotic, causing undulant fever in humans.

New Zealand's Import Health Standards require that imported animals come from free regions or countries, or are tested for brucellosis. The probability of entry of brucellosis into New Zealand is low.

Note that *Brucella ovis* is present in New Zealand deer. Its presence causes cross-reactions when deer are tested serologically for *B. abortus*, and complicates the interpretation of reactions found in pre-export testing.

Haemorrhagic septicaemia

Haemorrhagic septicaemia is an acute form of pasteurellosis caused by particular serotypes of *Pasteurella multocida*. It affects a wide species range, especially cattle and buffalo, and particularly in Asia, Africa, some parts of southern Europe and the Middle East. There is a high mortality rate in

susceptible populations. Animals show acute or peracute signs with death within 24 hours, oedema, haemorrhages and hyperaemia.

P. multocida has caused epidemics of haemorrhagic septicaemia, with swollen heads and necks and sudden death in deer in the UK, and has been the apparent cause of acute pneumonia in reindeer calves.

Exotic strains of endemic bacterial diseases

Scotland may have a strain of *Mycobacterium paratuberculosis*, the cause of Johne's disease, that is particularly virulent in deer.

More virulent strains of avian tuberculosis (*M. avium*) are reported in UK deer.

Other exotic bacterial diseases of deer

Lyme disease, due to the spirochaete *Borrelia burgdorferi* is unlikely to occur in New Zealand because of the absence of a suitable Ixodid tick vector. Some other diseases like tularaemia (due to *Francisella tularensis*) and Campylobacteriosis (*C. hyointestinalis*) are not covered here as the deer is an incidental host.

Exotic protozoal diseases of deer

Anaplasmosis

Anaplasmosis affects ruminants in tropical and subtropical regions, including northern Australia, causing progressive anaemia, jaundice, loss of condition, enlarged spleen and death. It is transmitted by many tick vectors, all exotic to New Zealand.

Babesiosis

Babesiosis causes fever, anaemia, jaundice, weight loss and redwater in ruminants. The tick vectors include *Haemaphysalis* spp. - *H. longicornis* is present in New Zealand but is unlikely to transmit babesiosis. The world distribution of babesiosis is similar to that of anaplasmosis.

Post-mortem findings include redwater (not always), swollen spleen and liver, and dark congested kidneys. Diagnosis is by thick and thin blood smears, best taken from the tip of the ear or tail.

Surra

Surra is caused by the protozoan parasite *Trypanosoma evansi*. Disease is most severe in equines, deer, camelids, dogs and cats, but also occurs in cattle and buffaloes. In horses, donkeys and mules the disease is usually fatal, with fever, weakness, lethargy, haemorrhages in mucous membranes, oedema, weight loss, anaemia and jaundice being common signs. Deer show more chronic disease with anaemia, emaciation, oedema and nervous signs. Occasionally surra is seen as a chronic, mild or subclinical disease in sheep, goats, pigs and elephants. Surra is transmitted by biting flies and is mainly found in Northern Africa, the Middle East and Asia. The closest infection to New Zealand is in Timor and Papua New Guinea.

Diagnosis may be from blood smears or inoculation of blood into laboratory rats and mice. Serological tests are available at overseas laboratories including AAHL in Australia.

Other exotic protozoal diseases of deer

Other exotic protozoal diseases include

eperythrozoonosis, described as "generally subclinical . probably unimportant" by Mackintosh (1988)

Besnoitia, which affect reindeer and caribou in Alaska and Canada

Eimeria, which affect elk in Canada

The rickettsial disease heartwater, caused by *Cowdria ruminantium* (an *Ehrlichia*) causes fever, depression, anxiety, anorexia, diarrhoea, sometimes convulsions and death in many ruminant species. It is transmitted by *Amblyomma* spp ticks so is unlikely to occur in New Zealand. It is found mainly in sub-Saharan Africa. *Amblyomma* spp ticks do occur in Australia (the snake tick and the ornate wallaby tick) but only occasionally on cattle.

Ehrlichiosis is another disease with mild, uncharacteristic symptoms.

While New Zealand is free of the most important *Theileria* species, which affect cattle in tropical and subtropical areas of the Old World, *T. orientalis* is present in New Zealand, causing mild disease in cattle especially in Northland. Deer could also be affected by this (non-exotic) organism.

Exotic ectoparasites of deer

Many of the more serious ectoparasites of livestock are exotic to New Zealand. These include

Ixodes, *Boophilus*, *Dermacentor* and *Otobius* ticks, warbles, nasal bots, ked, screw-worm fly, head flies and buffalo flies.

Exotic ticks

The only tick in New Zealand is *Haemaphysalis longicornis*. Exotic ticks include:

Boophilus spp, which carry babesiosis and anaplasmosis,

the Ixodid ticks – *Ixodes*, *Hyalomma* and *Rhipicephalus* spp. *Ixodes holocyclus* is the paralysis tick and is common along the east coast of Australia. *Ixodes ricinus* carries louping ill. *Ixodes*, *Hyalomma* and *Rhipicephalus* ticks all may carry *Ehrlichia* infections which cause tick-borne fevers in various species including dogs and horses.

Any tick that is unusual should be identified.

Screw-worm fly (SWF)

The Old World SWF *Chrysomya bezziana* is found in Africa, the Middle East, and Asia as far east as Papua New Guinea. The New World SWF *Cochliomyia hominivorax* is found in Central and South America. The fly is an obligate parasite of warm-blooded animals, parasitising wounds including those from castration, dehorning, or velvet removal. Although SWF is unlikely to enter and establish in New Zealand, any severe wound, which is maggot-infested, should be checked to identify the maggot species.

Exotic endoparasites of deer

Some exotic endoparasites of deer cause no clinical signs, others affect various body systems including the lung, central nervous system, blood vessels, subcutaneous tissue, liver and bile ducts and intestines. These parasites are likely to be diagnosed by laboratory identification rather than by clinical signs. They are unlikely to enter New Zealand except in imported animals, which must be treated before import to manage the risk. Practitioners should collect samples for laboratory examination from unusual cases, to assist in detection of new diseases and pests.

Reporting suspect cases of exotic diseases

Animals showing disease suggestive of exotic disease should be reported immediately to the MAF Exotic Disease and Pest Emergency Hotline, 0800 80 9966.

The hotline operates 24 hours a day, every day, and takes about 7000 calls annually from veterinarians, laboratories, meat works, farmers and members of the public. Over 300 of these are transferred to the MAF Exotic Disease Response Centre (EDRC), part of the National Centre for Disease Investigation at Wallaceville. The EDRC conducts about 50 animal disease investigations annually – though activity has increased recently due to exotic disease awareness programs. NCDI maintains a comprehensive diagnostic capability, backed by detailed response plans to manage

disease outbreaks and compensation arrangements that are designed to encourage early reporting of disease.

Useful references

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