Epidemiology

Akabane disease is caused by infection with Akabane virus, which is present in Australia and parts of Asia and Africa. It is closely related to Schmallenberg virus, an emerging disease of cattle and sheep in Europe. A similar clinical syndrome is caused by infection with related bunyaviruses (including Aino, Peaton and Cache Valley viruses). Akabane virus is spread between animals by midges of the genus Culicoides, while other midges and mosquitoes (Anopheles and Aedes spp.) are implicated in transmission of both this disease and other closely related viruses in Africa and Japan. It is not, however, directly contagious. Transmission occurs in utero from an infected pregnant female to the foetus.

Both this virus and its main vectors are absent from New Zealand (Oakley, 2011), but mosquitoes of other genera known to contain vectors are present. However, no species present in New Zealand is known to be a competent vector. MPI conducts annual surveillance for Culicoides midges and for antibody against Akabane and other arboviruses in sentinel cattle herds.

Once a female has been exposed, she is immune for life. Overseas, animals with aborted or affected offspring are usually young or have been moved from areas not usually exposed, to areas where the disease is endemic. The latter areas generally do not experience large outbreaks, as most females there are exposed before they first conceive. Some areas experience periodic outbreaks owing to seasonal conditions that temporarily introduce a vector to naive herds from adjacent areas where the disease is endemic.

As the virus is not present in New Zealand, all native-born animals are naïve, so it is unlikely there would be any variation in the age of stock affected. However, if exposure became endemic in an area, it is expected that only animals brought in from other areas, and perhaps first-parity animals, would likely give birth to affected offspring.

As neither the Culicoides midge nor the virus is present in New Zealand, an incursion could result from the introduction of a very small number of vector insects, in which case the outbreak could be small. Isolated rather than epidemic abortion and arthrogryposis or hydranencephaly may be seen. It is therefore important to consider the possibility of Akabane virus-associated disease (or disease caused by another closely related virus), even if only small numbers of abortions or arthrogrypic/hydranencephalic neonates are seen.

Clinical signs

Generally no clinical disease is seen in adult animals. Animals typically are viraemic for 3–4 days following an incubation period of 1–6 days. The main effect of infection is seen in the foetus if the animal is pregnant, as the virus crosses the placenta soon after infection. This effect varies depending on the age of the foetus at the time of exposure.

In calves and lambs, lesions are caused by viral damage to the central nervous system. Arthrogryposis lesions result from abnormal development of the spinal cord and hence abnormal nerve supply to the musculature, resulting in failure of normal muscular development. Ankylosis of joints as a result of this failure may cause severe dystocia.

Abortion, premature births and stillbirths may occur at the time of infection (which may be some months earlier than the birth of malformed calves or lambs), or later in gestation if severe damage to the foetus renders it unviable. The proportion of the herd or flock affected also depends on the timing of exposure. Exposure later in gestation tends to result in a smaller proportion of affected offspring than is the case with exposure in mid or early gestation.

Depending on the range of gestation stages in the herd or flock at the time of exposure, there may be a variety of different presentations. However, in most New Zealand herds and flocks mating and parturition are highly seasonal, so most animals would be at a similar stage of
gestation at the time of exposure. Therefore it is expected that one type of congenital anomaly, with or without abortion, would be seen.

**CATTLE**
If the exposure occurs when the foetus is between 30 and 105 days’ gestation, hydranencephaly is the likely outcome. If infection occurs between 105 and 150 days’ gestation, arthrogryposis is primarily seen. Animals infected earlier in gestation are likely to have multiple limbs affected, whereas animals infected later may only have a single affected limb. The later in gestation the infection occurs, the less severe the arthrogrypotic lesions. It is rare for animals to show both hydranencephaly and arthrogryposis, but calves infected between days 100 and 120 may exhibit both syndromes.

Calves born with hydranencephaly are generally blind, non-responsive to stimuli and may lack a suckling reflex (“dummy calf syndrome”). On necropsy a range of brain lesions (from small cystic lesions in the cerebrum to completely absent cerebral hemispheres with hydrocephalus) can be seen, although the cerebellum is not usually affected (see Figure 1).

Other lesions such as cataracts, scoliosis, torticollis, pulmonary hypoplasia and brachygnathia are occasionally reported.

**SHEEP**
Lesions generally occur if infection occurs between 28 and 48 days’ gestation and are often similar to those in cattle. However, while infection in early pregnancy (days 28 to 36) is likely to result in cerebral lesions with the hydranencephaly-type presentation, these may be observed throughout the risk period, unlike in cattle. Affected flocks may also show increased incidence of foetal mummies along with abortions.

**Differential diagnosis**
There are numerous endemic causes of abortion, and arthrogryposis and hydranencephaly can be caused by pestivirus infection (bovine viral diarrhoea virus or border disease virus), toxin exposure or genetic conditions. Schmallenberg virus infection can cause a similar syndrome, as described in a previous report (Smith, 2012), but differs in that clinical illness in adult animals may also be seen.

**ARTHROGRYPOSIS/HYDRANENCEPHALY**
- Environmental teratogens (including plant toxins);
- pestivirus (BVDV, border disease);
- genetic (autosomal recessive in Corriedale sheep; arthrogryposis multiplex, principally in Angus and Angus crosses);
- vitamin or mineral deficiencies; and
- plant toxins (e.g. lupins).

---

Figure 1: Calf brain showing hydranencephaly as the result of Akabane infection (A), compared with normal calf brain (B). Photos: Peter Kirkland
Good-practice tips for investigating abortion and neonatal deformity

Contact your veterinary diagnostic laboratory or MPI for advice if uncertain. Routine specimens that should be collected when investigating abortion or hydranencephaly/arthrogryposis, and which would also assist with a diagnosis of Akabane virus, include:

**Adults:**
- Serum and EDTA from the affected animal and at least 15 in-contact animals (indicate which, if any, have aborted or produced abnormal offspring).

**Neonates/foetuses:**
- Serum (preferably before first colostrum feed) or heart blood;
- pericardial or pleural fluid collected in a sterile fashion into sterile containers;
- EDTA blood;
- brain (whole in formalin, plus a small fresh specimen for culture);
- spinal cord in formalin (arthrogrypotic animals may have spinal cord lesions without brain lesions);
- extensor muscles in formalin;
- 20–30 plucked whole hairs with roots (for genetic testing);
- other fresh and fixed tissue samples for histology and bacteriology: fresh placenta, stomach contents, liver, lung and spleen, fixed placental cotyledons, brain, heart, lung, liver, spleen and kidney; and
- while a placenta sample is often forgotten or difficult to obtain with abortions that occur in animals at pasture, it can hold vital clues as to the cause of the abortion syndrome and should be included whenever possible.

**ABORTION**
- Pestivirus (BVDV, border disease);
- leptospirosis;
- salmonellosis;
- chlamydophila;
- toxoplasmosis;
- campylobacteriosis;
- listeriosis;
- fungal infection;
- neosporosis; and
- plant toxins.

**OTHER EXOTIC CAUSES OF A SIMILAR SYNDROME**
- Closely related viruses such as Aino, Schmallenberg and Cache Valley virus;
- bluetongue virus.

**Diagnosis of Akabane disease**

Akabane virus infection can be diagnosed by serology (virus neutralisation test) on the female and her in-contact herd or flock. Serology and virus isolation on the affected neonate or foetus/abortus can also be useful in confirming infection. These tests are available at MPI’s Animal Health Laboratory. Where the disease is endemic, serology on adult animals is not diagnostic, as animals may have been previously exposed, so serology on neonates prior to first colostrum or serology/virus isolation on foetuses is required for diagnosis.

As this disease is not present in New Zealand, serology on both adults and neonate/foetus can be used. A diagnostic workup for suspect Akabane virus infection would also involve exclusion of endemic causes of the syndrome by serology, bacteriology and histopathology. MPI meets the cost of diagnostic testing (including for endemic diseases) that we request as part of an exotic disease investigation. Contact the exotic pest and disease hotline (0800 80 99 66) if:
- you observe multiple cases of arthrogryposis or hydranencephaly (dummy calves) in a herd;
- you observe multiple late abortions or stillbirths;
- the usual endemic causes have been excluded or seem unlikely in an abortion investigation; or
- the incidence of non-arthrogrypotic congenital defects is increasing, or if you observe repeated occurrences over multiple years.
REFERENCES


Jaimie Frazer
Incursion Investigator
Investigation and Diagnostic Centre
Ministry for Primary Industries
jaimie.frazer@mpi.govt.nz