Botulism in cattle in the Northern Territory

Botulism has a rapid onset and is usually a fatal disease of livestock in the northern regions of Australia, particularly in areas where pastures experience periods of protein and phosphorus deficiency. It is caused by the botulinum toxin, which is produced by the bacterium *Clostridium botulinum*.

Figure 1: Cow paralysed with botulism

Before the widespread use of vaccination, botulism killed significant numbers of stock in the northern beef industry. In 2010, 78% of Northern Territory producers vaccinated all their cattle against botulism. Although botulism usually affects unvaccinated herds, it can also infect improperly vaccinated herds. Losses of up to 25% due to botulism have been reported in some herds. The disease may also cause persistent but undetected low losses, which may reach 10-20% per annum.

Risk to people

While humans can be infected with botulism, handling infected cattle does not usually pose a risk.

Cause

C.botulinum occurs in soil, water and marine sediments worldwide. It is also a normal inhabitant of gut flora in many healthy horses, cattle and poultry. The bacterium thrives in decaying animal or plant material and produces spores, which can survive in the environment for a long time. The spores germinate in moist, low-oxygen environments such as rotting carcasses or other organic matter. The spores produce botulinum toxin, which leads to intoxication of susceptible animals when consumed.

There are several forms of the toxin, designated by letters A to G. Botulinum toxins of types C and D cause almost all botulism in Australia. The toxin is extremely potent so tiny doses can be lethal. The toxin interferes with the transmission of nerve signals or messages between nerves and muscles, which leads to paralysis, because the muscles cannot move. All animal species can be affected, although there is a wide variation in sensitivity. Cattle are among the most susceptible animals with respect to mortality (death resulting from the disease). Dogs and poultry are also highly susceptible, but are more likely to survive intoxication if they receive supportive medical care.

Bones and carrion of decaying cattle and fly maggots are the main sources of the toxin. Infection has also occurred from drinking water or consuming feed contaminated by animal carcasses. **An outbreak of botulism is most likely to occur in cattle, when unvaccinated stock are kept on a protein and phosphorus-deficient diet, and where carcass chewing is common.**

Susceptibility

The susceptibility of cattle to botulism in Northern Australia depends on 6 factors.

- Protein and phosphorus deficiency

  Lactating cows and growing cattle have a high need for protein and phosphorus. If animals cannot meet these needs from available feed, they may develop a depraved appetite for carrion and bone chewing.

  The availability of phosphorus will vary depending on the soil type and seasonal conditions. Most Territory soils and even green pastures in the mid to late wet season are likely to phosphorus-deficient or marginal. Additionally, the protein in native pastures is often insufficient to maintain live-weight during much of the dry season.

- Carcass and bone chewing

  This is common in the Territory. Once cattle develop this habit, they may continue to chew bones, even when dietary protein and phosphorus are adequate.

- Bacterial distribution

  Bacteria producing toxin types C and D are present in all pastoral regions of the Territory.

- Toxin

  Cattle are very susceptible to the botulinum toxin. Toxin production occurs in an anaerobic (low oxygen) environment, with moisture and an optimum temperature of around 23°C (15-35°C). These conditions are routinely met in a rotting carcass. The toxin can last for a year at 30°C but rapidly inactivates at or above 37°C. Therefore, the amount of toxin is not constant. Although not all rotting carcasses are toxic, the proportion of toxic carcasses in tropical environments can be very high.

- Access to carcasses

  All decaying carcasses are potentially infective, including wild and feral animals and birds. Removal of carcasses from pasture where possible is the best preventative action.

- Susceptible cattle

  Assume that all unvaccinated or improperly vaccinated cattle are fully susceptible. Even fully vaccinated cattle may succumb if the amount of toxin is high enough to overwhelm the immune system. Natural immunity can develop in animals following exposure to small amounts of toxin, with subsequent recovery.

Signs

Figure 2: Tongue in an affected cow. The animal cannot pull the tongue back into the mouth owing to paralysis.

Botulism affects cattle of all ages. The toxin binds to nerve endings and prevents nerve signals activating muscles. This leads to a floppy or flaccid paralysis, which usually progresses throughout the body. Typical signs include hind limb weakness, progressing to paralysis and collapse (downer cattle). Other signs include paralysis of the muscles of the face, jaw and tongue, which results in loss of ability to eat or swallow. Death usually results from respiratory failure between one and 4 days from the beginning of clinical signs, but can take as long as 14 days.

Diagnosis

Diagnosis of botulism is based on clinical signs and exclusion of other causes. In some cases where the animal is still alive, the tongue will remain extended when pulled out from the mouth. If a post-mortem is conducted, evidence of carcass consumption may be found in the forestomaches (rumen or reticulum), in the form of hide, bones or maggots.

Botulinum toxin levels in the blood of affected animals are usually too low to be detected with laboratory tests. Antibody testing of surviving cattle during and after an outbreak of disease is of limited value, but may be used to assess herd vaccination status.

Treatment

Once an animal has absorbed the toxin, there is no curative medical treatment available to improve recovery. Most cases develop quickly and death nearly always follows. Mildly affected animals may recover with good nursing and veterinary care. If nursing is attempted, the animal must not be drenched through the mouth, because it cannot swallow.

Most affected cattle die from respiratory failure. However, complications can develop in cattle that cannot stand, and sometimes the best option is euthanasia on animal welfare grounds.

During an outbreak, it is important to prevent further access to skeletons, carcasses, rubbish dumps and burn piles, to reduce the likelihood of more cases.

Prevention

Three steps are recommended for the prevention of botulism.

- Vaccinate cattle with bivalent (type C and D) botulism vaccine, following the manufacturer's directions.
- Provide supplementary feed with phosphorus and protein, or non-protein nitrogen, such as urea.
- Remove all carcasses and bones from pasture. This is not always possible under extensive conditions where paddocks are large and checking of stock is infrequent. However, removal of carcasses from areas of high stock traffic (such as around water points) is important. Burn, bury, lock up carcasses in a turkey nest enclosure or drag them a considerable distance away.

Vaccination

Vaccination with bivalent type C and D botulism vaccine is the most effective long-term prevention strategy. Different vaccines are commercially available, which involve either 2 initial doses administered 4 weeks apart, or a single initial dose followed by an annual booster. An alternative long-acting vaccine requires a single initial dose followed by a booster every 3 years. Herd immunity levels are similar with both types of vaccine, so the brand selected will depend on cost and management practices.

Calves can be vaccinated from one month of age. Properties that conduct early weaning (60+kg) should vaccinate calves at this time. Protective maternal antibodies, absorbed from the colostrum in the first few days of life, are depleted by 6 months of age.

Vaccination failure

In 2015, a survey of 19 Territory properties found that approximately 30% of supposedly vaccinated animals had no protection against botulism. Many factors can contribute to vaccination failure, the most common being:

- stress at vaccination
- inadequate attention to the 'cold chain' process for storing and using the vaccine
- cattle missed at mustering
- concurrent diseases, such as pestivirus, interfering with vaccine reactions
- poor nutritional status of the animals
- stock vaccinated too young (maternal antibody may interfere with vaccination).

To reduce the risk of vaccine failure, follow all manufacturer's instructions around storage, handling and injecting recommendations.

- Store vaccines in a cool room or fridge at 4°C.
- Keep vaccines in an esky with ice in the yards. Wrap vaccine bottles in flexible ice packs while in use.
- Inject vaccines under the skin on the neck or behind the shoulder.
- Avoid injection sites close to the rumen, particularly the rumen fossa (triangular area under the hip), as the vaccine is destroyed if injected into the rumen.

Livestock Biosecurity Branch contact details

Darwin Region

Veterinary Officer
P: 08 8999 2035, M: 0427 003 600

Regional Livestock Biosecurity Officer
P: 08 8999 2034, M: 0401 115 802

Katherine Region

Veterinary Officer
P: 08 8973 9716, M: 0437 527 372

Regional Livestock Biosecurity Officer
P: 08 8973 9767, M: 0467 740 233

Livestock Biosecurity Officer
P: 08 8973 9765, M: 0427 604 002

Tennant Creek Region

Principal Livestock Biosecurity Officer
P: 08 8962 4458, M: 0401 113 445

Regional Livestock Biosecurity Officer
P: 08 8962 4492, M: 0457 517 347

Alice Springs Region

Veterinary Officer
P: 08 8951 8181, M: 0401 118 181

Regional Livestock Biosecurity Officer
P: 08 8951 8125, M: 0401 118 125