

IONOPHORE TOXICOSIS

Clinic 5 - Legendairy Veterinary Hospital

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CASE SCENARIO

The Oleson Dairy is a 500 milking Holstein herd with 75 heifers and 65 calves. The family dog, Rosie 6yr FS Lab, presented with acute diarrhea and an ascending flaccid paralysis. Soon after, the calves on milk began scouring and dying.

OVERVIEW

Ionophores are a class of antimicrobial that prevents a microorganism from maintaining appropriate metabolism. Classes of ionophores include monensin, lasalocid and salinomycin commonly. Ionophores are utilized extensively in beef and dairy cattle industries to prevent coccidiosis infections and improve feed efficiency. They are mixed into rations or milk replacers and approved for use in a variety of species including, cattle, chickens, goats and turkeys. While ionophores are safe and effective in the target species they are often fatal in large doses or in off target species. Horses, dogs, sheep, goats and cats are particularly sensitive to ionophore toxicosis. In cases of ionophore toxicosis the heart, neurons and skeletal muscle are the primary organs effected. While the liver and kidneys can also be damaged. These tissues are very metabolically active. Ionophores will inhibit the cells ability to maintain ion concentration gradients and cellular damage/necrosis will follow.

DIAGNOSIS

Diagnosis of ionophore toxicosis is achieved through clinical signs and history of the patient. Clinical signs can often mimic toxic plants, vitamin, or mineral deficiencies that cause similar types of damage. Animals that die of ionophore toxicosis will have evidence of heart failure and histopathology consistent with ionophore toxicosis in the heart, skeletal muscle and nervous tissue.

CLINICAL SIGNS

CATTLE

- Loss of appetite, reduced feed intake
- Diarrhea
- Dullness and lethargy
- Weakness
- Ataxia
- Tachypnea
- Recumbency
- Sudden death within 3-14 days of consumption

DOGS

- Weakness
- Ataxia
- Cardiomyopathies
- Myoglobinuria
- Respiratory distress
- Polyneuromyopathy
 - Ascending flaccid paralysis

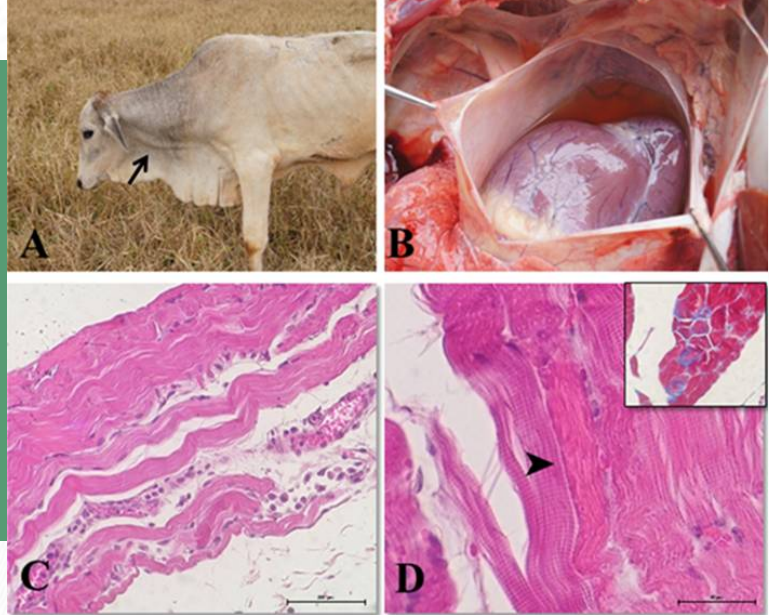
HORSES

- Colic
- Exercise intolerance
- Tachycardia
- Respiratory distress
- Sudden death

EXAMPLE LESIONS

To the right are expected lesions with ionophore toxicosis. In cattle (secondary to heart failure that occurs with myocardial necrosis) you may see distended jugular veins. Upon necropsy, there will be pale streaks of mineralization within the myocardium which will appear as myodegeneration and necrosis on histopathology.

Photo credit: E.S.A. Brito, T.G. Andrade, C.H.S. Oliveira, and V.M.B.D. Moura. Outbreak of monensin poisoning in cattle due to supplementation error. Cienc. Rural 50 (11). 2020.



TREATMENT

The prognosis of ionophore toxicosis is grave. There is no specific treatment or antidote. Supportive and palative care are recommended. The lesions in the cardiac and skeletal muscle are non regenerative. Animals frequently suffer from chronic heart failure, muscle damage and nerve damage.

- No specific treatment or antidote
- Unfortunately, once there is myopathy of cardiac or skeletal muscle the fibers will not repair and will be replaced by fibrous tissue or mineralization putting the calves in a state of chronic heart failure.
- Supportive care
- IV fluid therapy: lactated ringers with bicarbonate mixed in
- Tube feeding with electrolytes
- Scours: Bismuth 3-4 ounces PO as needed
- Discomfort/pain: Banamine 2 ml SID or 1 ml BID

PATHOPHYSIOLOGY

Ionophores are capable of transporting ions across cell membranes, resulting in a disruption of ion gradients and cell death. This is particularly apparent in cells like muscle and neurons, which require an ion gradient for their physiological functions. When the cardiac muscle is impacted, chronic necrosis of muscles occurs, leading to congestive heart failure. Ultimately, animals will die of shock and decreased perfusion to vital organs. Other impacts on neurons cause neuronal cell damage, leading to the neurologic signs and flaccid paralysis associated with acute disease. The liver and kidneys may also exhibit some signs of necrosis, however these usually develop more chronically and animals are less likely to live long enough to show signs of dysfunction on bloodwork.

DIFFERENTIAL DIAGNOSES

- White snake root toxicity
- Gossypol toxicity
- *Thermopsis montana* (false lupine) toxicity
- Selenium deficiency
- Selenium toxicity

FUN FACT

Monensin is another commonly used ionophore that can cause toxicity, especially in sensitive species like dogs and horses

RESOURCES

Skeletal Muscle 1, Ionophore Toxicity. Beth A. Valentine, in Pathologic Basis of Veterinary Disease (Sixth Edition), 2017.

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