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Case Report

Rhabdomyolysis induced by low voltage extended electric shock in a bovine

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Abstract

Electric fences are great alternatives in the management of cattle pasture; however, they require extra attention when cherishing for the animals' safety. Electric shocks caused by an artificial source are known as eletroplession or electrocution. Cases associated with electric fences often occur due to incorrect handling or even herd dispersion during panic. This study aims to report the epidemiological, clinical, and pathological features of prolonged electric shock in a bovine from Santa Catarina state, Brazil. The animal was found with its pelvic members stuck in the low-voltage electric fence. Twenty-four hours after the incident, the bovine showed clinical signs of apathy, depression, anorexia, and reluctance to move. In 96 hours, it was found in a lateral decubitus, with pedaling movements and nystagmus. After another 48 hours, there was no clinical improvement, and the animal was euthanized due to the unfavorable prognosis. Necropsy was performed, and fragments of all organs were collected for histopathological analysis. Gross and microscopic lesions associated with clinical signs demonstrated acute rhabdomyolysis due to electric shock, which resulted in the animal's recumbency. Histopathological analysis also revealed neurological damage due to the electric shock. Prolonged and low-voltage electrical discharges can cause acute rhabdomyolysis in bovines. This condition should be considered with a reserved to unfavorable prognosis due to the neurological disorders and possible kidney damage.

Keywords: electrical injuries, electrocution, neurological lesions, kidney damage, downer cow syndrome.

Introduction

Livestock plays a massive role in the world's economy, and Brazil is no different. Cattle (*Bos taurus*) are important in milk, leather, and meat production (2). In 2018, global livestock production reached roughly 1.5 billion cattle heads, which 37% of its production was the responsibility of the most significant worldwide livestock producers, such as Brazil, India, the United States, and China (9).

Cattle management is of great importance when it comes to increasing both quantity and quality of production. Among them are pasture-appropriate handling, the inputs' quality, and their sustainable usage (13). Several factors are involved in cattle's efficient management, such as the local geography and terrain, the length to the nearest water source, the correct usage of fences, and the distribution of pasture, which can lead to sub-grazing. Hence, fences are efficacious sources of cattle control. However, they are financially dependent on resources for maintenance and construction and also demand studies and further analysis to lower implementation costs (10).

Electric fences are a cheap and efficient alternative to budget lowering, reaching up to 80% discount compared to barbed wire fences. In the meantime, potential misleading in cattle management, the fence project itself, and its execution may harm the cattle physically (7). Electric currents can originate from natural sources, such as lightning, or manufactured sources, such as electric fences and high-voltage wires. Both

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sources of electrical current can lead to possible cases of electropletion or electrocution (14,17).

After the electric shock, gross lesions may or may not be present, and there may be a late development of clinical signs and more visible lesions, such as burns (4,14,16,17). The lesions observed depend on factors such as the voltage, the heat generated, the length of exposure to the electrical flow, previous physical conditions of the animal, the contact surface, and the path that the current traveled through the animal's body (16).

There are few reports of mortality or injuries in bovines due to low-voltage electrical discharges, even though this condition frequently occurs in Brazil. This paper aims to describe a case report of a long-drawn low-voltage electric shock in a bovine, showing the clinical evolution and pathological findings.

Case description

A 1-year-old female bovine of Charolais breed, roughly 250kg, has been found with her pelvic members attached to an electric fence on a farm in Santa Catarina state, Brazil. The event happened after the property was trespassed by hunters. The cattle suddenly backed away, and this one bovine was found with its pelvic members stuck in the low-voltage electric fence. The animal was assumed to be exposed to two to three hours of electric current section.

After 24 hours of the incident, the bovine showed clinical signs of apathy, depression, anorexia, and reluctance to move. Soon after, it presented itself with incoordination (ataxia) and lameness. In 96 hours, it was found in a lateral decubitus, with pedaling movements and nystagmus. Support treatment with vitamins, calcium, and assistance to get up was performed. Nevertheless, after another 48 hours, there was no clinical improvement, and the animal was euthanized due to the unfavorable prognosis.

Necropsy was performed at the Laboratório de Patologia Veterinária from the Universidade Federal de Santa Catarina (LABOPAVE-UFSC), SC, Brazil, and fragments of all organs were collected (heart, skeletal muscle, lungs, liver, gallbladder, kidneys, urinary bladder, spleen, skin, pancreas, adrenal glands, lymph nodes, central nervous system, pre-stomachs, abomasum, and intestines), fixed in 10% formalin and routinely processed for microscopic examination.

During the necroscopic exam, the bovine had a poor body condition score (emaciated). The heart showed signs of serous atrophy of the epicardic fat, characterized by its gelatinous and greyish appearance. The skeletal musculature of the pelvic limbs contained extensive pale areas interspersed with macroscopically healthy tissue. Furthermore, the surroundings of the sciatic nerve were embedded in translucent gelatinous material. Gross lesions were not observed in other organs.

Histopathological analysis revealed lesions in skeletal musculature, characterized by myocytes with hypereosinophilic cytoplasm, that at times presented fragmentation (floccular necrosis) (Fig. 1A) and multifocal calcification confirmed by Von Kossa stain (Fig. 1B). At the ischiatic nerve, vacuolation of the myelin sheath (hydropic degeneration) was observed, associated with the thickening of the epineurium by amorphous eosinophilic material (edema).

Kidneys showed tubular cells presenting vacuoles in their cytoplasm, vesicular nuclei, and some even projected themselves toward the lumen (tubular degeneration). Sometimes, there was eosinophilic amorphous material in tubules (Fig. 1C). Occasionally, pyknotic nuclei and loose cells in the interior of renal tubules were seen. In the liver, it was observed hydropic degeneration and fatty degeneration.

In addition, mild to moderate vacuolation of the myelin sheath and axonal swelling were observed in the brain. These lesions were seen in the cerebellum, occipital and frontal cortex, hippocampus, thalamus, midbrain, cerebellar peduncles, and obex. In the thalamus region, moderate neuronophagia was present (Fig. 1D). There were no significant microscopic lesions in the other analyzed organs.

Discussion

According to the literature, animals die suddenly in most cases of electrical discharges (14,15). However, animals can survive the electrical discharge, often developing neurological disorders (3, 4) characterized by vestibular signs and cerebrocortical necrosis with visual impairment (4, 16).

A study by Boevé et al. (4) describes the clinical signs of 18 bovines that survived lightning-induced electrical discharge. After the incident, eight of the animals showed an unsteady, swinging gait, and, in four days, all bovines analyzed presented depression, ataxia, and anorexia. Some animals also demonstrated neurological signs such as loss of vision and nystagmus. In our study, the findings were similar. There was lameness, apathy, and anorexia at the 24-hour mark. At hour 96, the animal was in decubitus and showed neurological signs, such as nystagmus and pedaling movements.

Gross and histopathological lesions may be absent or mild in electrical discharges. When present, skin burns and subcutaneous hemorrhage usually occur (14, 16). Acute internal injuries, such as vertebral or pelvic fractures, can also be observed in high-voltage electrical discharges. Furthermore, cases with delayed internal injuries related to neurological disorders are seen in animals that survive. Microscopic analysis of a bovine with neurological disorders after electrical discharge showed lesions in the central nervous system characterized by edema, activation of endothelial cells, astrocyte swelling, and areas of necrotic neurons (4). In our report, microscopic lesions similar to those described in the literature were observed in the central nervous system, such as white

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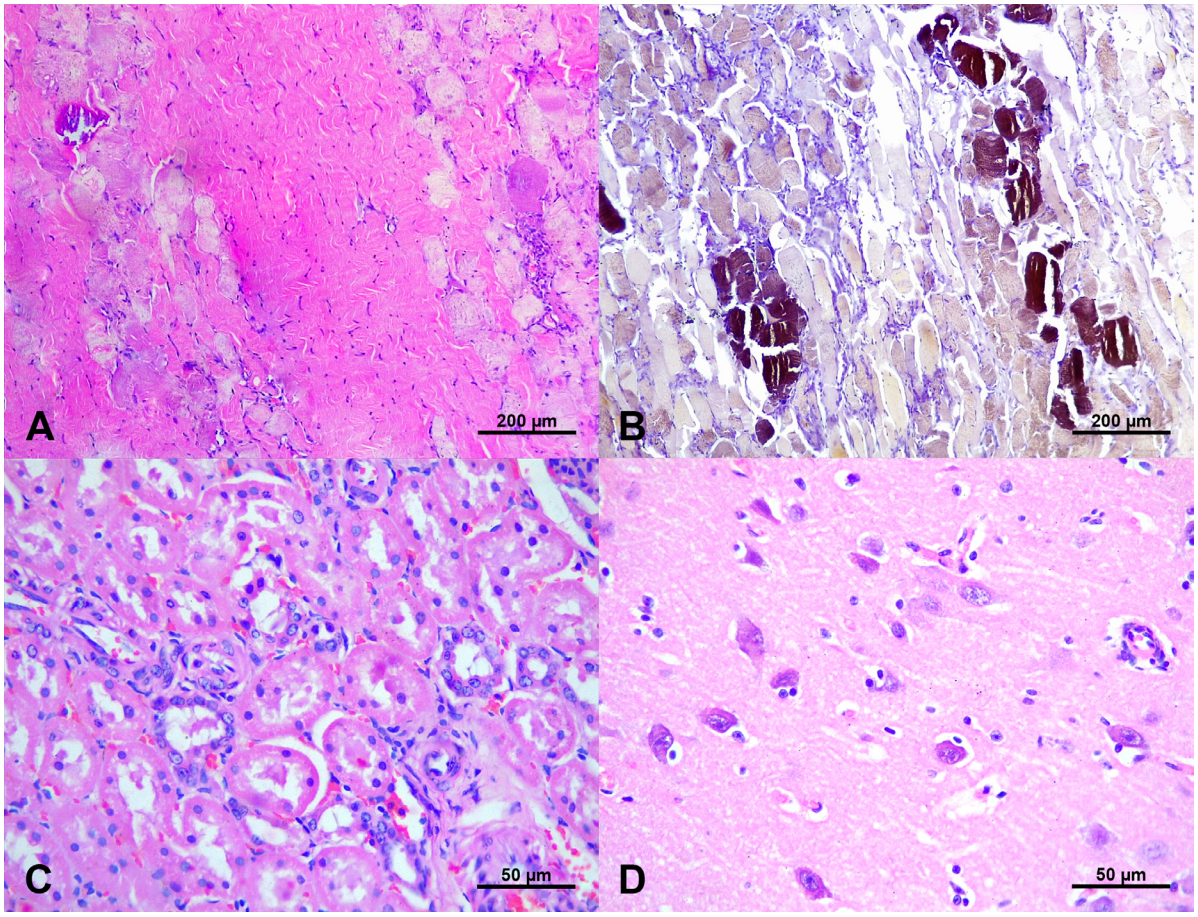

Figure 1. Bovine female, Charolais, 1-year-old. A- Skeletal muscle. Multifocal degeneration and necrosis in skeletal muscle associated to mild mononuclear infiltrate. HE, obj. 10x. B- Skeletal muscle: presence of multifocal mineralization into the muscular fibers. Von Kossa, obj. 10x. C- Kidney. Moderate amount of hyaline material in the lumen of tubules (proteinuria). HE, obj. 40x. D- Nervous system (thalamus). Some neurons show hypereosinophilic cytoplasm and pyknotic nuclei associated with satellitosis (neuronophagia). HE, obj. 40x.

matter vacuolation and neuronal necrosis, which may be associated with the clinical signs.

It should be highlighted that the present report occurred due to low-voltage shock, and internal injuries caused by electric shock are rarely found in low-voltage accidents. However, in prolonged contact with this type of electrical discharge, tissue damage occurs due to cell membrane injury, osmotic edema, and vacuolation myocyte necrosis (16). Damage to striated myocytes can result in rhabdomyolysis, a common complication in surviving animals, and, even with minimal external signs of shock injury, can be serious (16). Rhabdomyolysis also causes intracellular components to be released directly into the circulation, potentially leading to acute renal failure (6, 11). Although mild, initial renal injuries were observed in this case, possibly related to muscle injuries.

Alpers and Jones (1) and Llada et al. (11) describe that the clinical manifestations of rhabdomyolysis can vary amongst weakness, signs of pain, muscle tremors, reluctance to move, and fever. Based on the similar clinical signs observed, it is conjectured that the bovine in this report developed rhabdomyolysis by electric shock, resulting in recumbency. Moreover, it is a fact that in this present report, the lesions due to long-term decubitus coexist with the ones presented by the rhabdomyolysis caused by the electric shock. However, important aspects, such as the animal's history of prolonged exposure to an electrical current, the clinical signs presented shortly after the incident, and kidney injuries, are strong evidence that favor the diagnosis of acute rhabdomyolysis by electric shock.

Additionally, due to the clinical complications reported in this case associated with a non-responsive treatment, an injury to the sciatic nerve and skeletal muscle, and a prolonged decubitus, it is possible to infer a diagnosis of Downer Cow syndrome. Several primary causes may provoke this condition and consist in the permanence of decubitus for more than 12 hours (5). Lesions caused by decubitus may vary in extension degree and severity, with cases lasting longer than one week considered severe (12). Some causes of decubitus in cattle are hypocalcemia, exhaustion, metritis, mastitis, arthritis, poisoning/intoxication, trauma, and musculoskeletal

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diseases (8). However, in this case, the origin was the electric shock, based on solid evidence of clinical history, and anatomopathological and histopathological findings.

In the research by Ohfuji et al. (12), extraneural and extramuscular lesions in cows affected by Downer Cow syndrome were observed only in the liver, characterized as hepatic steatosis, also reported in this work. Furthermore, no kidney injuries were described in these cows, corroborating the diagnosis of rhabdomyolysis resulting from electric shock and not associated with Downer Cow syndrome.

Prolonged low-voltage electrical discharges can cause acute rhabdomyolysis in bovines. This condition should be considered with a reserved to unfavorable prognosis due to the neurological disorders and possible kidney damage. Epidemiological findings, clinical signs, and gross and microscopic lesions are essential for diagnosis, especially in animals with Downer Cow syndrome.

Conflict of Interest

The authors declare no competing interests.

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