

High-Quality Field Care Improves Outcomes in Downer Beef Cattle with Severe Myonecrosis Due to *Senna obtusifolia* Poisoning

João P. da S. Cavasani

Federal University of Mato Grosso

Fernanda Norberto Viana

Federal University of Mato Grosso

Lucas A. D. Pavelegini

Federal University of Mato Grosso

Marlon Ribeiro

Federal University of Mato Grosso

Larissa Sabino

Federal University of Mato Grosso

Fabício A. Gomes

Federal University of Mato Grosso

Wuglenya D. M. Silva

Federal University of Mato Grosso

Luana Dias Nascimento

Federal University of Mato Grosso

Edson M. Colodel

Federal University of Mato Grosso

Fernando H. Furlan

`fernando.furlan@ufmt.br`

Federal University of Mato Grosso

Case Report

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Abstract

Senna obtusifolia poisoning is a cause of prolonged recumbency in grazing cattle in Brazil, but therapeutic management, prognostic indicators, and long-term outcomes is limited. This study aimed to describe long-term outcomes of *S. obtusifolia* poisoning and to evaluate the effectiveness of an intensive field-based care protocol. An outbreak involving beef cattle with permanent sternal recumbency was investigated. Clinical progression was monitored prospectively. One animal was underwent necropsy and histopathological examination. Serum α -tocopherol concentrations and whole-blood glutathione peroxidase activity were determined in selected affected cattle. Affected cattle received supportive care consisting of nutritional and fluid support, appropriate bedding, assisted feeding and hydration, frequent repositioning, and physiotherapy performed three times daily until independent ambulation was achieved. Clinical outcomes were summarized, and the association between progression to lateral recumbency and survival was evaluated using Fisher's exact test. Twenty-six of 58 cattle (44.8%) recovered completely despite severe myonecrosis. The first animals stood unassisted after 20 days, whereas complete recovery required up to 180 days. All recovered cattle subsequently reached slaughter weight. Histopathology revealed severe multifocal monophasic skeletal muscle necrosis. Vitamin E and selenium deficiency were excluded. Progression from permanent sternal to lateral recumbency was invariably fatal (32/32; $P < 0.001$). This study provides the first detailed description of successful long-term field management of severe *S. obtusifolia*-associated toxic myopathy in beef cattle. Intensive supportive care combined with structured physiotherapy substantially improved survival under field conditions and identified permanent lateral recumbency as a reliable prognostic indicator for timely euthanasia decisions in affected cattle.

Background

The colloquial term downer has been used since the 1950s to describe cattle that are too injured, weak, or sick to stand and walk due a special form of parturient paresis or milk fever in dairy cows. More recently, the term downer has commonly denoted cattle that are unable to stand after 24 hours of recumbency but that can maintain sternal recumbency and are alert and responsive (Cox et al., 1982; Poulton et al., 2016a; Stojkov et al., 2016; Stull et al., 2007).

The primary cause of recumbency in cattle is electrolyte imbalance, mainly hypocalcemia (calving paralysis, parturient paresis, milk fever). However, other injuries such as dystocia, musculoskeletal injuries, systemic inflammatory illness, peripheral or central neuropath, intoxications and botulism can cause this condition (Cox, 1982, 1988; Guard et al., 2018; Perez-Solano et al., 2024) Whatever the primary reason for recumbency, the risk of myopathy, neuropathy and complications associated with repeated, unsuccessful attempts to rise increases with time, and with this, the chances of recovery decrease (Cox, 1982; Cox et al., 1982; Guard et al., 2018; Poulton et al., 2019). Although this condition is commonly and widely described in dairy cattle (Cox et al., 1982; Green et al., 2008; Holschbach et al., 2023; Poulton et al., 2016a, 2019; Stojkov et al., 2016; Stull et al., 2007) reports regarding its epidemiology, treatment, and prevention in beef cattle are unavailable in the literature (Perez-Solano et al., 2024).

Senna spp. poisoning is a major cause of downer cattle syndrome in pasture-raised cattle in Brazil. Animals intoxicated by this plant typically develop muscle weakness, a staggering gait, ataxia, and paresis, eventually becoming non-ambulatory, assuming prolonged sternal recumbency, and remaining alert throughout the course of the disease (Carmo et al., 2011; Furlan et al., 2014; Riet-Correa et al., 2024). Outbreaks of *Senna spp.* poisoning are characterized by variable morbidity and mortality; however, recovery is uncommon, resulting in a case-fatality rate approaching 100% (Carmo et al., 2011; Furlan et al., 2014; Riet-Correa et al., 2024). Thus, the objective of this study was to report the epidemiological, clinical, and pathological findings of an outbreak of naturally occurring *S. obtusifolia* poisoning, with particular emphasis on the therapeutic management that resulted in a high rate of clinical recovery among cattle that had remained in prolonged sternal recumbency.

Case Presentation

An outbreak of *Senna obtusifolia* poisoning occurred in January 2021 on a farm located in the municipality of Santo Antônio do Leverger, Mato Grosso, Brazil. The herd consisted of 1,100 crossbred steers ($\frac{1}{2}$ Nelore $\times$ $\frac{1}{2}$ Aberdeen Angus), aged 1.5 years. According to the animal scientist responsible for the farm, a group of 550 cattle was moved to a paddock planted with *Urochloa (Brachiaria) brizantha* that had limited forage availability and was heavily infested with *Senna spp.* (sicklepod). After 15 days in the paddock, 58 cattle fell ill (morbidity, 10.5%); of these, 32 died (mortality, 5.8%; case fatality rate, 55.2%). According to the farm records and the interview with the animal scientist, the affected cattle were maintained exclusively on pasture, and the mineral supplement provided to the herd did not contain ionophore antibiotics. Herbarium specimens of *Senna spp.* were collected, and botanically identified as *Senna obtusifolia*.

Fifty-eight affected cattle underwent clinical evaluation. To standardize the clinical timeline, the day on which each animal was first observed in permanent recumbency was designated Day 0 (D0). On D0, recumbent cattle were moved to a shaded area of the farm and placed on a sand bed, which was replaced every 4 days. Fresh-cut forage was offered 3 to 4 times daily, and water was available *ad libitum*. Animals unable to eat or drink voluntarily received assisted oral administration of water and intravenous glucose solution (approximately 3 L/animal/day). Additionally, blood samples were collected from 10 randomly selected animals from the 58 clinically affected cattle for whole-blood glutathione peroxidase (GPx) and serum α -tocopherol analysis (Paglia and Valentine 1967, Catignani and Bieri 1983). Serum α -tocopherol concentrations ranged from 4.2 to 6.1 mg/L, and whole-blood GPx activity ranged from 325 to 539 U/g Hb among the 10 tested cattle. All values were within the expected reference intervals, making nutritional myopathy associated with vitamin E and selenium deficiency unlikely.

The initial clinical signs included weakness, forelimb and hindlimb paresis, reluctance to move, a staggering gait, ataxia, and frequent falls. Clinical signs first appeared three days before Day 0 (D – 3). By D0, all 58 affected cattle had progressed to permanent sternal recumbency but remained bright, alert, and responsive; treatment was initiated at that time. On Day 0 (D0), most affected cattle were not eating or drinking voluntarily and received water by forced oral administration and intravenous administration of

10% glucose solution (mean, 3 L/animal/day). This treatment was continued until D4, when all cattle resumed voluntary feed and water intake.

Beginning on D4, all recumbent cattle underwent physiotherapy 3 times daily. Each session lasted approximately 40 minutes and was continued until the animal regained the ability to stand and walk without assistance. Physiotherapy was performed by 3 teams, each consisting of 6 people, allowing simultaneous treatment of 3 animals. Each session began with approximately 10 minutes of massage of the forelimbs and hindlimbs while the animal was positioned in right lateral recumbency. The animal was then turned to left lateral recumbency, and the massage was repeated on the contralateral limbs. The animal was subsequently positioned in sternal recumbency. Two wooden poles were placed beneath the body: one across the sternal region immediately caudal to the forelimbs and the other across the ventral abdomen immediately cranial to the hindlimbs (Fig. 1). For people lifted the animal into a supported standing position using the poles, while 2 additional handlers manually flexed and extended the forelimbs and hindlimbs in alternating walking-like movements for approximately 10 minutes for each limb pair (20 minutes in total).

Thirty-two cattle subsequently progressed to lateral recumbency and died between D3 and D10. All 32 cattle that progressed from permanent sternal to lateral recumbency died, whereas all 26 cattle that remained in permanent sternal recumbency survived. Thus, progression to lateral recumbency was invariably associated with a fatal outcome in this cohort (Fisher's exact test, $P < 0.001$). The first animals began standing unassisted and walking spontaneously on D20. The duration of physical therapy and the time to complete clinical recovery varied among animals. The earliest recovering animal regained a normal gait by approximately D40, whereas others required physical therapy until D64 and achieved complete clinical recovery by approximately D180. The 26 recovered cattle (44,8%) reached slaughter weight (370 kg) approximately 15 months after complete clinical recovery.

One affected bovine, that was in extremis, was euthanized necropsied. Representative tissue samples were collected for histopathology study. The primary gross lesions were observed in the skeletal muscles. The lesions consisted of multifocal to coalescing pale discoloration affecting portions of individual muscles, entire muscles, or multiple muscle groups. The urinary bladder was distended with dark brown urine. Histologically, the pale areas corresponded to multifocal monophasic skeletal muscle necrosis and myodegeneration (Fig. 2). Additionally, the kidneys showed myoglobinuric nephrosis secondary to skeletal muscle necrosis.

Discussion and Conclusions

Numerous chemical and biological agents have been associated with skeletal muscle degeneration and necrosis in humans and experimental animals. In veterinary medicine, however, naturally occurring toxic myopathies are mainly attributed to the ingestion of ionophore antibiotics or poisonous plants. In cattle, coffee senna (*Senna occidentalis* and *S. obtusifolia*) and ionophores represent the most common causes of toxic myopathy (Uchida and Kobayashi, 2025). Other toxic agents capable of inducing myonecrosis

include gossypol from cottonseed, *Ageratina altissima*, *Isocoma pluriflora*, *Laburnum anagyroides*, *Lupinus* spp., and *Thermopsis montana* (Burrows and Tyrl, 2013; Riet-Correa et al., 2024). Among the plant species associated with toxic myopathy in cattle, only *S. occidentalis* and *S. obtusifolia* are described in Brazil (Carmo et al., 2011; Furlan et al., 2014, Riet-Correa et al 2024).

Nutritional myopathy associated with vitamin E and selenium deficiency, gossypol intoxication, and ionophore toxicosis were considered the principal differential diagnoses because all can produce severe degenerative and necrotizing myopathy in cattle. However, serum α -tocopherol concentrations and whole-blood GPx activity were within the expected reference intervals, indicating adequate vitamin E and selenium status (Backall and Scholz 1979, Ceballos et al. 1999). According to farm records and information provided by the herd manager, the affected cattle were maintained exclusively on pasture and had not received cottonseed or cottonseed-derived products or ionophore-containing mineral supplements before the onset of the outbreak, making gossypol intoxication and ionophore toxicosis unlikely. The botanical identification of abundant *S. obtusifolia* in the affected paddock, together with the epidemiological, clinical, laboratory, and pathological findings, strongly supports *S. obtusifolia* poisoning as the cause of the outbreak (Carmo et al., 2011; Furlan et al., 2014; Riet-Correa et al., 2024).

Because Senna-poisoned cattle remain bright and alert and may continue to eat and drink despite prolonged recumbency, they may be considered "downer cows" (Burrows and Tyrl, 2013). *Senna* spp. poisoning is a major cause of downer cattle syndrome in pasture-raised cattle in Brazil. Although morbidity and mortality vary among outbreaks, recovery is uncommon, with case-fatality rates approaching 100% (Carmo et al., 2011; Furlan et al., 2014). Consequently, the veterinary literature on poisonous plants does not describe any effective treatment for affected cattle (Burrows and Tyrl, 2013; Riet-Correa et al., 2024). In contrast, the intensive field-care protocol implemented in the present study was associated with the recovery of 26 cattle, yielding an overall survival rate of 44.8%.

Recent studies have reported survival-to-discharge rates ranging from 37% to 55% for downer dairy cattle treated in veterinary hospitals (Holschbach et al., 2023; Puerto-Parada et al., 2021). Survival rates for downer dairy cattle treated on farms range from 11% to 50% (Green et al., 2008; Poulton et al., 2016a; Stojkov et al., 2016). Information on downer beef cattle is considerably more limited. To our knowledge, only one study has evaluated downer beef cattle treated in a veterinary hospital, reporting a survival-to-discharge rate of 19% (Perez-Solano et al., 2024).

Whatever the primary reason for recumbency, the risk of myopathy, neuropathy, and complications from repeated unsuccessful attempts to rise is well documented. According to Cox (1982), compartment syndrome is the most important complication of primary metabolic, neurologic, or musculoskeletal diseases that result in prolonged recumbency in adult cattle, including *Senna* spp. poisoning, as observed in the present study. Ischemic injury results from sustained pressure on a limb during prolonged recumbency. Increased external pressure on soft tissues leads to increased vascular permeability, resulting in extracellular fluid accumulation and tissue swelling. When the surrounding fascia restricts tissue expansion, intracompartmental pressure rises, potentially exceeding the external

pressure that initiated the process. The resulting tissue hypoxia causes cellular injury and inflammation, which further increase intracompartmental pressure, creating a self-perpetuating cycle. These changes ultimately lead not only to muscle necrosis but also to injury of the peripheral nerve branches traversing the affected tissues. Consequently, involvement of the sciatic nerve and its distal branches, the common fibular (peroneal) and tibial nerves, appears to be particularly important in recumbent cattle because it has a major influence on prognosis and functional recovery (Cox, 1982, 1988; Cox et al., 1982; Guard et al., 2018; Poulton et al., 2016b, 2019). Therefore, preventing these secondary complications is critical. Appropriate nursing care, including comfortable housing, frequent repositioning, adequate bedding, nutritional and fluid support, and physical rehabilitation, can minimize pressure-induced muscle and nerve injury, thereby improving the likelihood of functional recovery (Poulton et al., 2016a; Stojkov et al., 2016; Stull et al., 2007). The intensive nursing care provided in the present study exceeded that typically feasible under field conditions. The favorable outcome observed in the 26 surviving cattle suggests that early implementation of intensive supportive care and physical rehabilitation, before progression to lateral recumbency, may have limited secondary neuromuscular injury and contributed to successful long-term recovery.

The flotation tank is currently the most widely used method for the physical rehabilitation of downer cattle (Holschbach et al., 2023; Perez-Solano et al., 2024; Puerto-Parada et al., 2021). Our rehabilitation protocol was inspired by the principles of flotation therapy but required a substantial workforce to manually support and mobilize the animals. Consequently, the protocol was labor-intensive and costly, which may limit its practical application under field conditions.

The favorable outcome observed in this study may also have been influenced by the breed composition of the herd. All affected cattle were $\frac{1}{2}$ Aberdeen Angus $\times$ $\frac{1}{2}$ Nelore crossbreeds, whose temperament generally facilitates handling during prolonged nursing care and physical rehabilitation. The rehabilitation protocol required repeated manual handling by multiple people several times daily over a period of weeks, making animal temperament an important practical consideration. In contrast, implementation of such an intensive protocol would likely be more challenging in herds composed predominantly of purebred Nelore cattle, which generally exhibit greater reactivity to human handling and restraint than *Bos taurus* breeds or their crossbreeds (Burrow, 1997).

The survival rate achieved in the present study exceeded that previously reported for hospitalized downer beef cattle and fell within the range described for downer dairy cattle, despite being achieved entirely under field conditions. These findings highlight the potential of intensive supportive care as a practical management strategy for downer beef cattle with *Senna* spp. poisoning. Nevertheless, veterinarians should assist owners in making appropriate decisions regarding euthanasia of nonambulatory cattle. Such decisions should be made in a timely manner and should involve appropriate methods that ensure a rapid and humane death (Stull et al., 2007). In the present study, progression from permanent sternal to lateral recumbency was invariably associated with a fatal outcome. Accordingly, cattle with *Senna* spp. poisoning that progress to permanent lateral recumbency should be considered to

have an extremely poor prognosis, and euthanasia should be strongly considered to avoid unnecessary suffering.

Declarations

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Author Contributions

All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by João Paulo da Silva Cavasani, Larissa Sabino, Luana dias do Nascimento, Lucas Avelino Dandolini Pavelegini, Wuglenya Daislla Martins da Silva, Fabrício Andrade Gomes, and Marlos Ribeiro. The first draft of the manuscript was written by Edson Moleta Colodel and Fernando Henrique Furlan and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Statement of Animal Ethics

The study was based on cattle with naturally occurring disease examined during routine field veterinary practice. Clinical management, treatment, and monitoring were performed exclusively for therapeutic purposes. The manuscript reports the clinical evolution and outcomes of these cases without any experimental intervention.

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Figures



Figure 1

Illustration of the lifting technique used as part of the physiotherapy protocol for nonambulatory cattle with *Senna obtusifolia* poisoning.

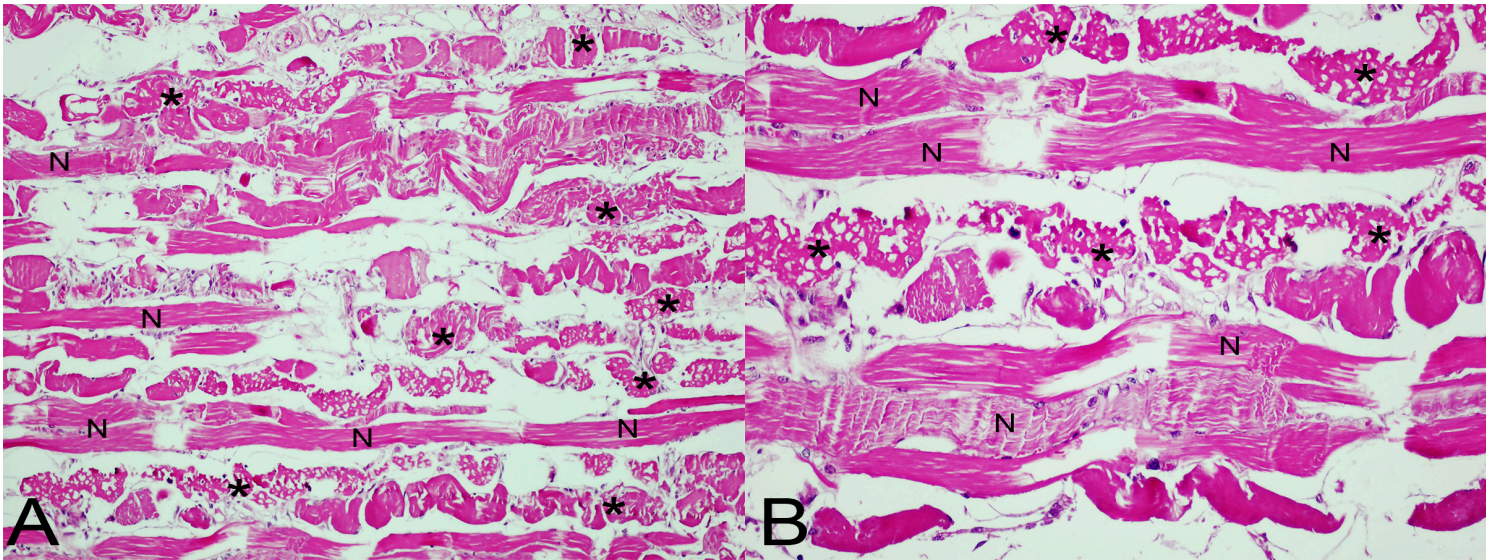


Figure 2

Histologic section of the quadriceps femoris muscle from a crossbred steer ($\frac{1}{2}$ Nelore $\times$ $\frac{1}{2}$ Aberdeen Angus) euthanized due to *Senna obtusifolia* poisoning. Hematoxylin and eosin. **A** – Normal myofibers (N) interspersed with multifocal skeletal muscle necrosis (asterisks), Obj. 5x. **B** – Monophasic skeletal muscle necrosis and vacuolar degeneration (myodegeneration) (asterisks), characterized by swollen myofibers, hypereosinophilic sarcoplasm, loss of cross-striations, and myofiber fragmentation, interspersed with normal myofibers (N), Obj. 20x.