Opis przypadku *Case report*

Cauda equina syndrome in cattle: A clinical case study and analysis

ALEKSANDER F. BUTKIEWICZ[1], BARTŁOMIEJ M. JAŚKOWSKI[2], SERHII KULYNYCH[3], JĘDRZEJ M. JAŚKOWSKI[4]

[1]Department of Basic and Preclinical Sciences, Institute of Veterinary Medicine, Nicolaus Copernicus University in Toruń, Lwowska 1, 87-100 Toruń, Poland
[2]Department of Reproduction and Clinic of Farm Animals, Faculty of Veterinary Medicine, Wrocław University of Environmental and Life Sciences, 50-366 Wrocław, Poland
[3]Poltava State Agrarian Academy in Poltava, Skovorody St, 1/3, Poltava, Poltava Oblast, 36003 Ukraine
[4]Department of Diagnostics and Clinical Sciences, Institute of Veterinary Medicine, Nicolaus Copernicus University in Toruń, Lwowska 1, 87-100 Toruń, Poland

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Butkiewicz A. F., Jaśkowski B. M., Kulynych S., Jaśkowski J. M.

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Summary

***Cauda equina* syndrome is a rare phenomenon characterized by a partial or complete paralysis of the spinal nerves of the cauda equina and the organs innervated by them. The cauda equina and the lumbosacral plexus are responsible for innervating most of the muscles of the pelvic limb, pelvic floor, and sphincters. The etiology of this condition can be diverse, often related to injury leading to the narrowing of the spinal canal and compressive paralysis. This case study describes a cow diagnosed with cauda equina syndrome. The animal showed difficulties in standing and moving. Due to the deteriorating condition of the animal, a decision was made to cull it. The description of the case evaluated during veterinary visits was based on clinical, zoometric, and BCS assessments, cleanliness index, necropsy examinations, and laboratory blood analyses. The blood tests included several components, which varied depending on the day of the visit: ALT (15-18.9 U/l), AST (77.3-86.7 U/l), CK (124-270 U/l), and cortisol (10.4-14.5 ng/mL).**

Keywords: *cauda equina* syndrome, cattle, blood analysis

The *cauda equina* syndrome occurs relatively rarely. The disease involves a partial or complete paralysis of the spinal nerves of the *cauda equina* and the organs innervated by them. The *cauda equina* is an anatomical structure that arises due to the spinal cord not keeping pace with the growth of the spine in length. Consequently, the spinal nerves, along with the cord, diverge increasingly parallelly (11). The nerve roots of the *cauda equina* provide sensory and motor innervation to most of the pelvic limb, the pelvic floor, and sphincter muscles (16). In the case of fully developed *cauda equina* syndrome, various sensory disturbances may occur. The etiology of this condition is quite diverse, but it usually results from injury, leading to the narrowing of the spinal canal, which causes a so-called compressive paralysis. Symptoms vary depending on the precise location of the narrowing. Damage to the *cauda equina* can also occur as a result of badly performed epidural anesthesia, leading to local inflammation or degeneration of nerves and perineural infection (6). The narrowing may occur in the region of the lumbosacral plexus. The lumbosacral plexus is a network of sensory and motor nerve fibers originating from the spinal nerve roots of the lumbar and sacral segments. The area supplied by this plexus is significant because it includes the entire pelvic limb, which, depending on the species, consists of approximately 20 muscles and surrounding tissues (11). From a clinical standpoint, the most important nerves originating from this plexus are the sciatic nerve (*n. ischiadicus*), which is the largest nerve in the body. Common disorders in animals include dysfunction of the sciatic nerve due to trauma, tumors, or infectious factors (17). Another important structure from a clinical perspective is the pudendal nerve (*n. pudendus*), which not only participates in micturition, but also plays a significant role in the second stage of labor (3, 5).

In the initial phase, the disease may manifest through colic-like signs. Various degrees of paresis of the pelvic limbs are observed, expressed by excessive flexion of

the hock joints, extension of the fetlock joints, and a swaying gait on widely spaced limbs. At the same time, there is often a weakening of the functions of the anus, rectum, and urinary bladder. During rectal examination, significant fecal filling of the rectum and presence of large amounts of urine in the urinary bladder can be palpated. In isolated cases, limb paresis may quickly progress to complete paralysis, resulting in a characteristic dog-like sitting posture or even a complete loss of the ability to move (6).

Prognosis for cattle is poor. It is recommended to cull affected animals as soon as possible. Treatment is ineffective and consists of administering intrathecal steroid anti-inflammatory drugs. Additionally, antibiotic therapy should be implemented. In the treatment of *cauda equina* syndrome in humans, a neurosurgical approach is used, and the shorter the duration of compression, the greater the chances of full recovery, especially regarding bladder functionality and sphincters. Unfortunately, neurosurgical treatment in cattle is currently economically unfeasible.

This study provides a comprehensive description of a case of *cauda equina* syndrome in cattle, including descriptions of veterinary diagnostic procedures along with periodic blood tests and post-mortem examination (Fig. 5).

Case report

A total of three veterinary visits were conducted (on Feb. 6, Mar. 1, and Apr. 16, 2024), which included basic neurological examinations of the cattle and blood tests to assess the activity of alanine aminotransferase (ALT), aspartate aminotransferase (AST), creatine kinase (CK), and cortisol concentration (Tab. 1). The biochemical tests were performed using a MINDRAY BS-120 automatic analyzer (Shenzhen Mindray Bio-Medical Electronics Co., Ltd.) with reagents. The cortisol level was determined by the immunoenzymatic method with a INSIGHT V-IA® PLUS VET (Woodley Equipment Company Ltd.).

The cow affected by *cauda equina* syndrome calved for the third time on December 5, 2023. The animal was kept in tethered housing, and the conditions in the barn designed for 140 dairy cattle were considered poor. A significant dirtiness of the cows was noted. The culling rate was at 45% annually. The lying areas were slippery, of medium length, and bedded with straw. Noticeable cow soiling was observed, which could indicate infrequent manure scraping. The feeding system on the farm was based on total mixed ration (TMR). According to the staff, the defect was observed before calving, on the day of the change in the production group. Paralysis initially affected only the left pelvic limb. The animal husbandry staff described the last calving as easy. Soon afterwards, paralysis of the right pelvic limb was observed. On February 6, 2024, a veterinary autopsy was conducted along with blood collection for AST, ALT, CK, and cortisol levels. Central paralysis of the hind limbs was confirmed. The cow's Body Condition Score (BCS) was assessed at 2.5. The cleanliness of the animal was rated on a five-point scale proposed by Reneau et al. (18) at 3.4. Additionally, a heavy soiling of the animal was noted, which could indicate prolonged lying, as confirmed

Tab. 1. Laboratory test results for the cow described compared to the norms (2, 15)

Test	Result	Norm
Alanine aminotransferase (ALT)	Feb. 6, 2024 – 15 U/l Mar. 1, 2024 – 15.6 U/l Apr. 16, 2024 – 18.9 U/l	20-70 U/L
Aspartate aminotransferase (AST)	Feb. 6, 2024 – 85.1 U/l Mar. 1, 2024 – 77.3 U/l Apr. 16, 2024 – 86.7 U/l	< 30 U/L
Creatine kinase (CK)	Feb. 6, 2024 – 124 U/l Mar. 1, 2024 – 133 U/l Apr. 16, 2024 – 270 U/l	< 50 U/L
Cortisol	Feb. 6, 2024 – 10.4 ng/ml Mar. 1, 2024 – 11.1 ng/ml Apr. 16, 2024 – 14.5 ng/ml	< 10 ng/ml

Fig. 1. The position in which the animal was found during the first visit. Excessive flexion of the fetlock joint and flexion of the hock joint can be observed (photo B. M. Jaśkowski)

Fig. 2. The lowering of the heel bulb and bending of the limb axis at the fetlock during the first visit (photo B. M. Jaśkowski)

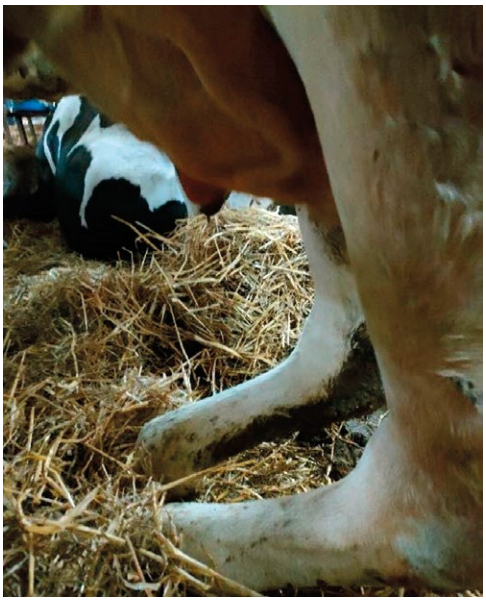

Fig. 3. A photo from the veterinary visit on March 1, 2024 (photo B. M. Jaśkowski)

Fig. 4. Photos from the veterinary autopsy conducted on April 16, 2024 (photo B. M. Jaśkowski)

by the farm staff. The veterinarian found the cow standing. Due to fatigue, the cow „sat" on the paralyzed limbs and then rose again (Fig. 1, Fig. 2, Fig. 3, Fig. 4). Effort was noticeable in maintaining the standing position. The cow lay down abruptly, throwing itself onto the ground with its entire body. This was accompanied by audible signs of pain. Furthermore, the cow showed no willingness to stand up. A consequence of the sudden lying down was an injury in the form of a soft fluctuating abscess, approximately 20 cm in diameter, located on the left side of the body in the elbow area. The cow sometimes defecated and urinated while lying down. The cow's milk yield was 11,000 liters per year. The cow's biometric measurements were as follows: height at the withers 1.37 m, width between the tuber coxae 65 cm, width between the tuber ischiadicum 32 cm.

Veterinary examination (Mar. 1, 2024). The cow's body condition score (BCS) was assessed at 1.5. A strong soiling of the hind pastern with fresh feces was noted, while the remaining areas of the body showed a moderate amount of dried feces. Hairless areas were also noticeable, suggesting intensive cleaning of the animal by the staff. The angle between the hock and the pastern immediately after rising from the lying position was 90 degrees for the right limb and 96 degrees for the left (compared to previous values of 88 degrees for the right and 120 degrees for the left). A decrease in these angles may indicate a lowering of the cow's position. The forelimbs were in a camped under position, and the back of the animal was significantly arched.

Shortly before slaughter, the animal developed clinical mastitis (SCC = 9473). After the decision to cull, the cow was moved to a pen. During observation, it noticeably struggled to rise and after being in the cow pen, it moved with difficulty, although the movements remained symmetrical, without visible signs of lameness. As a result, the owners eventually decided to cull the animal. It continued to defecate and urinate in a lying position. During this time, an additional rectal examination was performed, revealing no pathological changes in the area of the pelvic cavity. The uterus was not enlarged, and a well-developed corpus luteum was found on the right ovary. The animal's condition on April 16, 2024, was assessed at around 1.2 on the BCS scale. Postmortem examination revealed a narrowing of the spinal canal and congestion in the area of the sacrum.

Fig. 5. The cow in post-mortem autopsy: the narrowing of the spinal canal in the area of the occipital bone of the sacrum and congestion suggestive of past trauma (photo A. Butkiewicz)

Discussion

Cauda equina syndrome in cattle is often considered a complication of past trauma. Factors predisposing to injuries include overcrowding, grouping of animals with significant differences in size, slippery floors, short standing areas, and insufficient bedding (19). Another reason for the occurrence of this condition are neoplastic changes. Lymphosarcoma is the most com-

mon neoplastic process that can affect the spinal cord in cattle. Lymphosarcoma tumors typically develop outside the meninges, exerting pressure on the spinal cord (compressive paralysis). In this case, clinical signs will vary depending on the location of the lesion and the degree of compression on the cord (10). Literature reports also mention paragangliomas, tumors originating from paraganglionic cells (14). There are reports suggesting that cauda equina syndrome is a complication of tail amputation surgery. Although there is insufficient data confirming the most common etiological factors, there is a risk of *Clostridia* spp infection (7). Figueiredo et al. (8) describe a clinical case involving two calves with chronic purulent arthritis in the L6-S1 region, leading to central paralysis of the limbs. It was found that *E. coli* was responsible for the infection, possibly due to complications from a badly performed tail amputation with the use of a constricting band.

In the clinical description of this case, attention should be paid to the high level of cortisol in the blood. Cortisol is a sensitive indicator of stress, as evidenced by numerous facts. Cortisol levels immediately after hoof trimming correction in lame cows were 90 ng/ml (12). Cows that were stunned had cortisol levels up to 31.5 ng/ml. Elevated cortisol levels were also observed during transportation (4). Short-term, moderate heat stress resulted in an increase in cortisol levels to 55.6 ng/ml (13). In contrast, cows with ketosis had low cortisol levels, below 4.17 ng/ml (9). Considering the available data, it appears that the cortisol level in the cow described here was slightly elevated, suggesting that the stress level was moderate. This may be because the cow was not forced to move, and the barn was operated in a tethered housing system. It can be cautiously inferred that the increase in cortisol concentration resulted from discomfort experienced by the animal during routine procedures rather than from acute stress associated with pain or additional effort. It seems that a more reliable indicator of prolonged stress would be cortisol levels measured in feces or hair (21). The elevated creatine kinase activity also deserves attention. Creatine kinase is found in greater amounts in skeletal and smooth muscles, among others. Its activity significantly increases after physical exertion, muscle tissue damage, acute inflammatory states of the uterine mucosa, and during thermal stress (1). For example, in cows exposed to low and high temperatures, CK activity was 76.8 U/L and 82.4 U/L, respectively. In cows affected by downer cow syndrome, it was 140.3 U/L (1). In this case, the CK activity in the blood of the cow was at least twice as high. Elevated levels of AspAT and ALAT were also noted. However, their increased activity is not specific solely to muscle tissue. The narrowing of the spinal canal most likely occurred after a past injury, and the observed signs were likely due to the compression paralysis of specific branches of the cauda equina and lumbosacral plexus nerves.

The delay in the owner's reaction, due solely to the economic value of the cow (its high productivity) prolonged the suffering of the animal. This confirms the recommendation to promptly cull animals with the so-called cauda equina syndrome.

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Corresponding author: Prof. Dr. Jędrzej M. Jaśkowski, Department of Diagnostics and Clinical Sciences, Institute of Veterinary Medicine, Nicolaus Copernicus University in Toruń, Lwowska 1, 87-100 Toruń, Poland; e-mail: jmjaskowski@umk.pl