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Original Article
Livestock Diseases

Compressive lesions in the central nervous system of cattle: a retrospective study of 50 cases in the Amazon biome[1]

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ABSTRACT.- Barbosa J.D., Brito M.F., Duarte M.D., Albernaz T.T., Bomjardim H.A., Barbosa C.C., Oliveira C.M.C. & Salvarani F.M. 2022. **Compressive lesions in the central nervous system of cattle: a retrospective study of 50 cases in the Amazon biome.** *Pesquisa Veterinária Brasileira 42:e07057, 2022*. Instituto de Medicina Veterinária, Universidade Federal do Pará, BR-316 Km 61, Saudade II, Cristo Redentor, Castanhal, PA 68740-970, Brazil. E-mail: felipems@ufpa.br

The present study gathered epidemiological and clinical-pathological information about cattle with compressive lesions in the central nervous system (CNS). The retrospective study included observations made in 50 cattle from 1998 to 2021 by reviewing the clinical records of animals with compressive lesions in the CNS treated at the Veterinary Hospital of the Veterinary Medicine Institute of the Federal University of Pará. The animals had clinical signs and were subjected to general and specific clinical examination of the nervous system. Blood samples were collected from 13 animals for complete blood counts, and cerebrospinal fluid (CSF) samples were collected from four animals for physical evaluation. Twenty-nine cattle underwent necropsy. The most affected sites were the T_3-L_3 (46%, 23/50), C_1-C_5 (22%, 11/50), C_6-T_2 (14%, 7/50), sacrococcygeal vertebrae, (4%, 2/50), L_4-S_2 (2%, 1/50), brain (8%, 4/50) and cerebellum (4%, 2/50). The age of the affected cattle ranged from 20 days to 16 years, with a higher occurrence in animals younger than 12 months (56%, 28/50). More Females were affected (58%, 29/50) than males (42%, 21/50). The clinical signs varied according to the location of the lesion and were mainly represented by ataxia, paresis or paralysis of the limbs, inability to stand and walk, postural changes, hyperesthesia in the extremities, and loss of skin sensitivity at the location of the lesion. The necropsy findings revealed changes such as abscesses in the vertebral body; intervertebral space in the medullary canal, pituitary and cerebellum; granuloma in the arch of the vertebra; fractures of the body of the vertebrae; subarachnoid haematoma; congenital bone alteration causing spinal cord compression; and spondylitis. Detailed anamnesis and clinical examination of the CNS, associated with necropsy findings, were important to determine the cause of the disease, correlate with the clinical picture and locate the affected segments of the CNS in the cattle. It is important to include these diseases in the list of differential diagnoses in cattle with nervous symptoms.

INDEX TERMS: Central nervous system, bovine, cattle, compressive lesions, neurological clinical signs.

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RESUMO.- [Lesões compressivas no sistema nervoso central de bovinos: um estudo retrospectivo de 50 casos no bioma amazônico.] O presente trabalho reúne informações epidemiológicas e clínicopatológicas de bovinos com lesões compressivas no sistema nervoso central (SNC). O estudo retrospectivo compreendeu as observações realizadas em 50 bovinos durante os anos de 1998 a 2021, por meio da revisão dos arquivos de fichas clínicas de animais com lesões

compressivas no SNC atendidos pelo Hospital Veterinário do Instituto de Medicina Veterinária da Universidade Federal do Pará. Os animais atendidos com sinais clínicos foram submetidos a exame clínico geral e específico do sistema nervoso. Foram coletadas amostras de sangue de 13 animais para realização de hemograma e amostras de líquido cefalorraquidiano de quatro animais para avaliação física. Foram submetidos à necropsia 29 bovinos. Os locais mais acometidos foram as vértebras T_3-L_3 (46%, 23/50), C_1-C_5 (22%, 11/50), C_6-T_2 (14%, 7/50), sacrococcígea (4%, 2/50) e L_4-S_2 (2%, 1/50); cérebro (8%, 4/50) e cerebelo (4%, 2/50). A idade dos bovinos afetados variou de 20 dias a 16 anos, com maior ocorrência em animais com menos de 12 meses (56%, 28/50). As fêmeas foram mais acometidas (58%, 29/50) do que os machos (42%, 21/50). Os sinais clínicos variaram de acordo com a localização da lesão e foram representados principalmente por ataxia, paresia ou paralisia dos membros, incapacidade de se levantar e de ficar em estação, alterações posturais, hiperestesia nas extremidades, além de perda da sensibilidade cutânea relacionada com a localização da lesão. Os achados de necropsia revelaram alterações como abscessos no corpo vertebral, no espaço intervertebral, no canal medular, para-hipofisário e no cerebelo; granuloma no arco da vértebra, fraturas do corpo das vértebras; hematoma subaracnoide; alteração óssea congênita causando compressão medular e espondilite. Anamnese detalhada e exame clínico do SNC, associados aos achados de necropsia foram importantes para determinar a causa da doença, correlacionar com o quadro clínico e localizar os segmentos acometidos do SNC dos bovinos. Torna-se importante incluir estas enfermidades na lista de diagnósticos diferenciais em bovinos que apresentem sintomatologia nervosa.

TERMOS DE INDEXAÇÃO: Sistema nervoso central, bovinos, lesões compressivas, sinais clínicos neurológicos.

INTRODUCTION

There are many aetiological agents responsible for changes in the central nervous system (CNS) of animals. Among the infectious causes, rabies is considered the most important disease because it kills the most cattle in Brazil, followed by poisoning by botulinum toxin and toxic plants, causing great economic losses to Brazilian livestock. However, other causes of CNS changes in production animals are compression injuries caused by abscesses, vertebral fractures and neoplasms (Barros et al. 2006). The clinical signs vary, depending on the injured site, the degree of spinal compression and the involvement of the spinal anatomical tracts (Mackay & Van Metre 2015).

Thus, it is necessary to perform an accurate neurological examination to determine the affected site. A complete neurological examination is based on anamnesis and evaluation of brain integrity, spinal cord and peripheral nerves. Complementary tests such as cerebrospinal fluid (CSF) analysis, simple or contrasted radiography (myelography), electroencephalography, computed tomography and magnetic resonance imaging are also important to aid in the diagnosis of diseases that occur with compressive lesions in the CNS (Brewer 1987, Braund 1994, DeLahunta & Glass 2009).

Although CNS compressions are frequent in the veterinary clinic, no reports of their occurrence in the Amazon biome were found in the literature. Thus, the present study describes the epidemiological and clinical-pathological findings in cattle with CNS compressive lesions diagnosed over a period of 23 years at the Veterinary Hospital (HV) of the "Instituto de Medicina Veterinária" (Veterinary Medicine Institute - IMV) of the "Universidade Federal do Pará" (UFPA).

MATERIALS AND METHODS

Case selection and clinical evaluation. The retrospective study included observations made in 50 cattle (numerically identified from 1 to 50) from 1998 to 2021 through the review of clinical records regarding the epidemiological data (age, race, sex and place of origin) and of the clinical-pathological files (clinical signs, clinical evolution, neurological lesion site, necropsy findings) of animals diagnosed with CNS compression injuries during care at the HV-IMV/UFPA. The animals with clinical signs of CNS compression injury underwent general and specific clinical examinations of the nervous system. The symptoms of cattle with CNS compressive lesions were described by segment, as established by Dirksen et al. (2005). All animals included in the study were negative for rabies, which was the main differential diagnosis of neurological disease in cattle.

Complementary tests (haematological and cerebrospinal fluid data and histopathological anatomical findings). Haematological data from 13 animals (Bovines 1, 6, 7, 9, 11, 12, 13, 14, 17, 19, 20, 22 and 29) was extracted for the analysis of blood samples stored in 5 ml tubes with anticoagulant (EDTA); the blood count was performed according to Jain (1993). Data for the CSF analysis was collected from the cisterna magna of three animals with spinal cord injury (Bovines 22, 23 and 37) and in the cisterna magna and the lumbosacral space of a bovine with a pituitary abscess (Bovine 2) for physical evaluation according to Dirksen et al. (2005). In addition, in this retrospective study, the necropsy results of 29/50 (58%) of the bovines (analyses of fragments of the different organs collected and fixed in 10% formalin) were processed by the "Setor de Anatomia Patológica" (Pathological Anatomy Sector - SAP) of the "Universidade Federal Rural do Rio de Janeiro" (UFRRJ) for histopathological examination. The tissue samples were routinely processed, embedded in paraffin, cut at 5 µm and stained using the haematoxylin and eosin (HE) techniques.

RESULTS

Animals and epidemiological data

During the study period of 23 years, 48 bovines belonging to 10 different municipalities of the state of Pará (Abel Figueiredo, Capanema, Castanhal, Rondon do Pará, Santa Luzia, Santo Antônio do Tauá, São Francisco, São Sunday of Capim, Xinguara and Eldorado dos Carajás), one animal (Bovine 16) from the municipality of Açailândia in Maranhão and another (Bovine 7) from the municipality of Amajarí in Roraima were studied. Data referring to the identification of the 50 animals, such as municipality, sex, age, breed, site of lesion in the CNS and cause of understanding in the CNS at clinical examination and necropsy are detailed in Table 1. A higher number of cases was observed in females (58%, 29/50) than males (42%, 21/50). The age of the affected animals ranged from 20 days to 16 years, with a greater number of animals (56%, 28/50) in the age group of up to 12 months. The location of the lesions in the CNS of cattle is described in Table 2. In animals not subjected to necropsy, which represent 42% (21/50), the clinical diagnosis was

Table 1. Identification of the animals, municipality, sex, age, breed, site of lesion in the CNS and cause of understanding in the CNS at the clinical examination and necropsy of 50 cattle treated at the Veterinary Hospital of the IMV-UFPA from 1998 to 2021

Animals	Municipalities	Gender	Age	Breeds	Location of the lesion in the CNS	Cause of CNS compression on clinical examination and necropsy
1	Castanhal/PA	Male	12 years	Nellore	Brainstem	Para-pituitary abscess - inflammation at the base of the horn
2	Rondon do Pará/PA	Female	5 years	Crossbred	Brainstem	Para-pituitary abscess -periodontitis
3	Castanhal/PA	Female	20 days	Gir	Brain	Haematoma in the brain
4	Castanhal/PA	Male	12 months	Crossbred	Brain	Haematoma in the brain
5	Novo Repartimento/ PA	Female	3 years	Nellore	Cerebellum	Abscess in the cerebellum - internal otitis
6	Castanhal/PA	Male	7 months	Nellore	Cerebellum	Abscess in the cerebellum - omphalitis
7	Amajarí/RR	Female	6 months	Nellore	C_1-C_5	Lacerative attack lesion by wild feline
8	Castanhal/PA	Female	6 months	Nellore	C_1-C_5	Abscess in the vertebra body
9	Castanhal/PA	Male	8 years	Nellore	C_1-C_5	Fracture of the vertebra
10	Rondon do Pará/PA	Female	1.5 years	Nellore	C_1-C_5	Spinal cord trauma during management
11	Castanhal/PA	Male	1 month	Nellore	C_1-C_5	Abscess in the body of the vertebra - omphalophlebitis, liver abscesses
12	Castanhal-PA	Male	2 years	Crossbred	C_1-C_5	Congenital stenosis of the spinal canal
13	Santa Maria/PA	Female	6 months	Nellore	C_1-C_5	Spinal cord trauma during management
14	Castanhal/PA	Female	6 months	Crossbred	C_1-C_5	Abscess in the body of the vertebra - omphalouraquitis
15	Abel Figueiredo/PA	Female	5 months	Crossbred	C_1-C_5	Abscess of the vertebra body
16	Açailândia/MA	Male	2 months	Crossbred	C_1-C_5	Abscess in the body of the vertebra - omphalophlebitis, liver abscesses
17	Castanhal/PA	Female	2 months	Nellore	C_1-C_5	Abscess in the medullary canal
18	Castanhal/PA	Male	12 months	Nellore	C_6-T_2	Abscess in the vertebra body - omphaloarteritis
19	Castanhal-PA	Female	2 months	Crossbred	C_6-T_2	Abscess in the vertebra body
20	Novo Repartimento/PA	Female	10 years	Nellore	C_6-T_2	Haematoma
21	Santa Luzia do Pará/PA	Female	6 years	Nellore	C_6-T_2	Spinal cord trauma
22	Castanhal/PA	Male	12 months	Nellore	C_6-T_2	Abscess in the medullary canal
23	Castanhal/PA	Female	3 months	Nellore	C_6-T_2	Abscess in the body of the vertebra - omphalophlebitis, liver abscesses
24	Rondon do Pará/PA	Female	2 months	Crossbred	C_6-T_2	Abscess in the body of the vertebra - omphalophlebitis, liver abscesses
25	Castanhal/PA	Male	12 years	Nellore	T_3-L_3	Ankylosing spondylitis
26	Abel Figueiredo/PA	Male	2 months	Jersey	T_3-L_3	Medullary syndrome - posterior paresis - omphaloarteritis
27	Castanhal/PA	Male	6 months	Crossbred	T_3-L_3	Spinal cord trauma during management
28	Eldorado dos Carajás/PA	Male	2 months	Crossbred	T_3-L_3	Abscess in the vertebra disc - omphalophlebitis, liver abscesses
29	Eldorado dos Carajás/PA	Female	2 months	Crossbred	T_3-L_3	Abscess in the vertebra disc - omphaloarteritis
30	Eldorado dos Carajás/PA	Male	2 months	Crossbred	T_3-L_3	Abscess in the vertebra disc - omphaloarteritis
31	Rondon do Pará/PA	Male	2 months	Crossbred	T_3-L_3	Medullary syndrome - posterior paresis - omphalophlebitis
32	Rondon do Pará/PA	Female	10 years	Crossbred	T_3-L_3	Spinal cord trauma during management
33	Abel Figueiredo/PA	Female	6 years	Crossbred	T_3-L_3	Trauma in the medulla during the mating
34	Castanhal/PA	Female	6 years	Nellore	T_3-L_3	Spinal cord trauma during management
35	Capanema/PA	Female	6 months	Crossbred	T_3-L_3	Abscess in the vertebra body - omphaloarteritis
36	Castanhal/PA	Male	6 months	Crossbred	T_3-L_3	Abscess in the vertebra body
37	Castanhal/PA	Female	3 months	Crossbred	T_3-L_3	Abscess in the body of the vertebra - omphalophlebitis, liver abscesses
38	Castanhal/PA	Male	2 years	Nellore	T_3-L_3	Trauma in the spinal cord during transport
39	Castanhal/PA	Female	6 years	Crossbred	T_3-L_3	Spinal cord trauma during management
40	São Francisco do Pará/PA	Male	8 months	Nellore	T_3-L_3	Spinal cord trauma during management

Animals	Municipalities	Gender	Age	Breeds	Location of the lesion in the CNS	Cause of CNS compression on clinical examination and necropsy
41	Castanhal/PA	Male	2 years	Simmental	T_3-L_3	Spinal cord trauma during management
42	Castanhal/PA	Female	16 years	Guzerá	T_3-L_3	Ankylosing spondylitis
43	Castanhal/PA	Male	1.5 years	Nellore	T_3-L_3	Spinal cord trauma during management
44	Castanhal/PA	Male	12 months	Crossbred	T_3-L_3	Spinal cord trauma during management
45	Xinguara/PA	Female	2 years	Nellore	T_3-L_3	Spinal cord trauma during management
46	Rondon do Pará/PA	Female	8 months	Nellore	T_3-L_3	Spinal cord trauma during management
47	Castanhal/PA	Female	6 years	Crossbred	T_3-L_3	Granuloma in the vertebral body
48	Abel Figueiredo/PA	Female	2 years	Nellore	L_4-S_2	Spinal cord trauma during management
49	Castanhal/PA	Female	7 years	Crossbred	Sacrococcygeal	Spinal cord trauma during management
50	Rondon do Pará/PA	Female	4 years	Crossbred	Sacrococcygeal	Spinal cord trauma during management

CNS = central nervous system.

Table 2. Location of CNS lesions at clinical examination and necropsy of 50 cattle treated at the Veterinary Hospital of the IMV-UFPA from 1998 to 2021

Location of the lesion in the CNS	Number of animals	Percentage
Brain	2	4%
Brainstem	2	4%
Cerebellum	2	4%
Spinal cord (C1-C5)	11	22%
Spinal cord (C6-T2)	7	14%
Spinal cord (T3-L3)	23	46%
Spinal cord (L4-S2)	1	2%
Spinal cord (after S2)	2	4%
TOTAL	50	100%

CNS = central nervous system.

established by epidemiological data and by the general and specific clinical examination of the nervous system.

Clinical pathology, microbiology and anatomical histopathological findings

The results of the complete blood count of the 13 cattle showed leukocytosis by neutrophilia. In the macroscopic examination of the CSF of the four animals with compressive lesions in the spinal cord, Bovines 22 and 23 had turbid CSF with a flocculent deposit that coagulated a few seconds after collection. In Bovine 2, a cow with a pituitary abscess, the CSF showed variation in macroscopic appearance according to the collection site, being yellow and coagulated in the cisterna magna and clear in the lumbosacral space.

In the brain, lesions were observed in the two telencephalic hemispheres (Bovines 3 and 4), with bridges and bulb lesions (Bovines 1 and 2) and in the cerebellum (Bovines 5 and 6). In the animals with brain injury, the clinical signs observed were decreased alertness and lateral decubitus with pedalling movements. In cattle with lesions in the bridge and bulb, the clinical signs consisted of loss of balance, rotational or vertical nystagmus and decreased consciousness. In animals with compression in the cerebellum (Fig.1-2), the clinical signs were intention tremors, ataxia, hypermetria, loss of balance and falls.

In the animals with spinal cord injury in the C_1-C_5 segment (Bovines 7 to 17), the clinical signs presented were ataxia, inability to remain stationary, spastic paresis of the extremities of the four limbs, especially the pelvic and spinal pain reflexes hyperreactive in the extremities and loss of superficial sensitivity in the cutaneous areas related to the lesion. Bovine 9 presented mild paresis only in the pelvic limbs.

Bovines 18 to 24, with lesions in the cervical intumescence (C_6-T_2), presented ataxia, inability to remain stationary and decreased flexor reflex in the thoracic limbs and increased in the pelvic limbs. An exception was made in two animals (Bovines 19 and 23), which showed only flaccid paralysis in the thoracic limbs, with no changes in the pelvic limbs.

Bovines 25 to 47 presented lesions in the medullary segment T_3-L_3; however, they did not exhibit neurological changes in the thoracic limbs but exhibited a hyperreactive flexor reflex, ataxia and inability to remain stationary (Fig.3-4), with the exception of Bovine 37, in which the clinical signs were flaccid paralysis of the pelvic limbs, spastic paralysis of the thoracic limbs and inability to remain stationary (Fig.5-6). According to data obtained from the owner, Bovine 47 exhibited mild motor incoordination for seven months, which worsened over time. Upon clinical examination at the HV-IMV/UFPA, the animal had severe incoordination of the pelvic limbs (Fig.7-8), which caused it to lie down or fall.

Only one animal (Bovine 48) was diagnosed with a lesion in the L_4-S_2 segment, which exhibited unchanged pain reflexes in the cranial segments and decreased in the caudal segments, ataxia and flaccid paresis of the pelvic limbs. In two animals (Bovines 49 and 50) there was a lesion in the sacrococcygeal region; these showed the absence of tail movement, decreased sensitivity in the perineal region and decreased anal sphincter tone.

In cattle subjected to necropsy, abscesses were observed in the cerebellum (Bovine 5, with cerebellar abscess and internal otitis), vertebral body, intervertebral disc, spinal cord and vertebral canal. In two animals, a pituitary abscess was observed; one was associated with an inflammatory process of the corneal base (Bovine 1), and the other was associated with periodontitis (Bovine 2). Ankylosing spondylitis of the thoracolumbar segments (Bovines 25 and 42), submeningeal haematoma in the brain, spinal cord and a haematoma in the C_6 -T_2 segment (Bovine 20), a fracture in the C_1-C_5 segment (Bovine 9), a medullary syndrome with posterior paresis due to injury to the first cervical vertebra (Bovine 12) and a granuloma in the body of the 11th thoracic vertebra projecting

into the vertebral canal (Fig.7-8), resulting from tuberculosis (Bovine 47) were also observed. Additionally, omphalitis, omphalophlebitis with multiple abscesses in the liver (Bovines 11, 16, 23, 24, 28 and 37), omphaloarteritis (Bovines, 18, 29, 30 and 35) and omphaloarchitis with thickening of the bladder mucosa and urine were found with the presence of purulent exudate (Bovine 14).

DISCUSSION

The study showed a large variation in the age of cattle treated with CNS compressive injuries. The predominance of young animals up to one year of age (56%, 28/50) and females (56%, 28/50) as the most affected, observed in this study, was similar to the data reported by Borges et al. (2003), who described a higher occurrence (56.4%, 22/39) of vertebral fractures in animals aged up to 12 months and a predominance of injuries in female animals (64.1%, 25/39). However, the studies differ regarding the cause of the injuries that determined the CNS compression, being characterized mostly in the present retrospective study by spinal cord abscesses, compared to the fractures described by Borges et al. (2003).

In cattle aged less than 12 months (69%, 20/29) subjected to necropsy, the causes of CNS compressions were abscesses compressing the spinal cord and the different segments of the brain, possibly all of infectious origin. As discussed and reinforced by Barros et al. (2006), specifically for abscesses that compress the spinal cord, most infections originate from haematogenous osteomyelitis of the vertebral body,

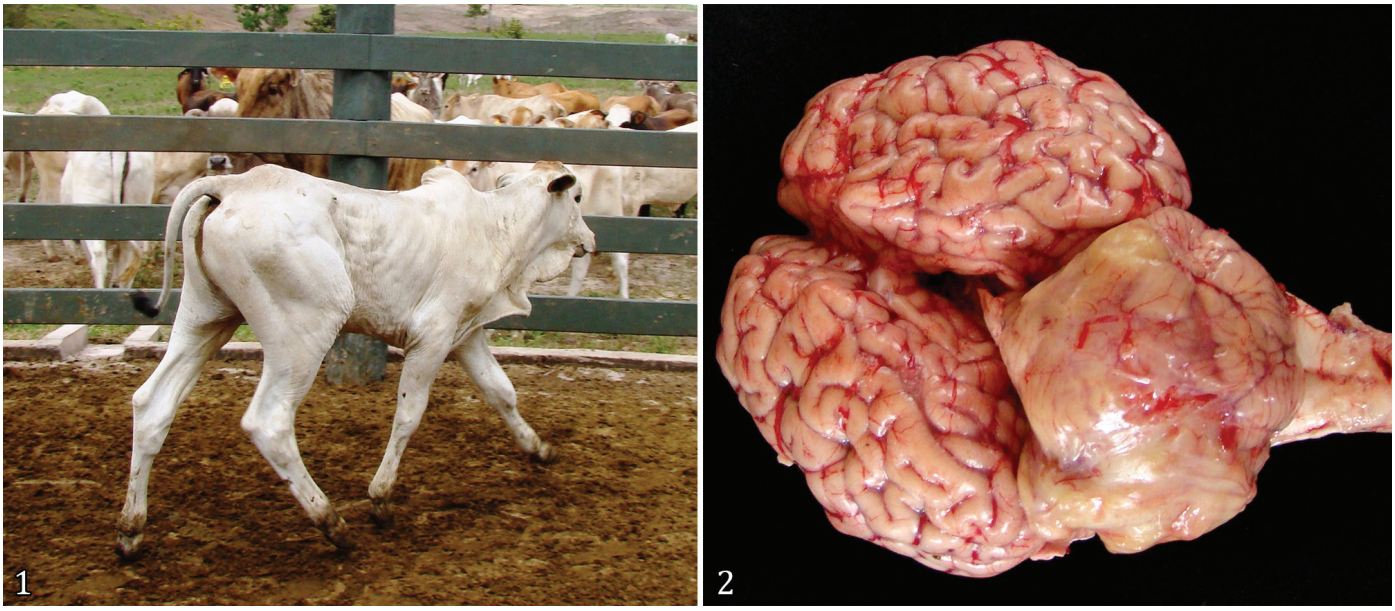

Fig.1-2. (**1**) Seven-month-old, Nelore calf (Bovine 6) with proprioceptive deficit with ataxia and hypermetria. (**2**) Brain of the bovine of Figure 1 with abscess in the cerebellum.

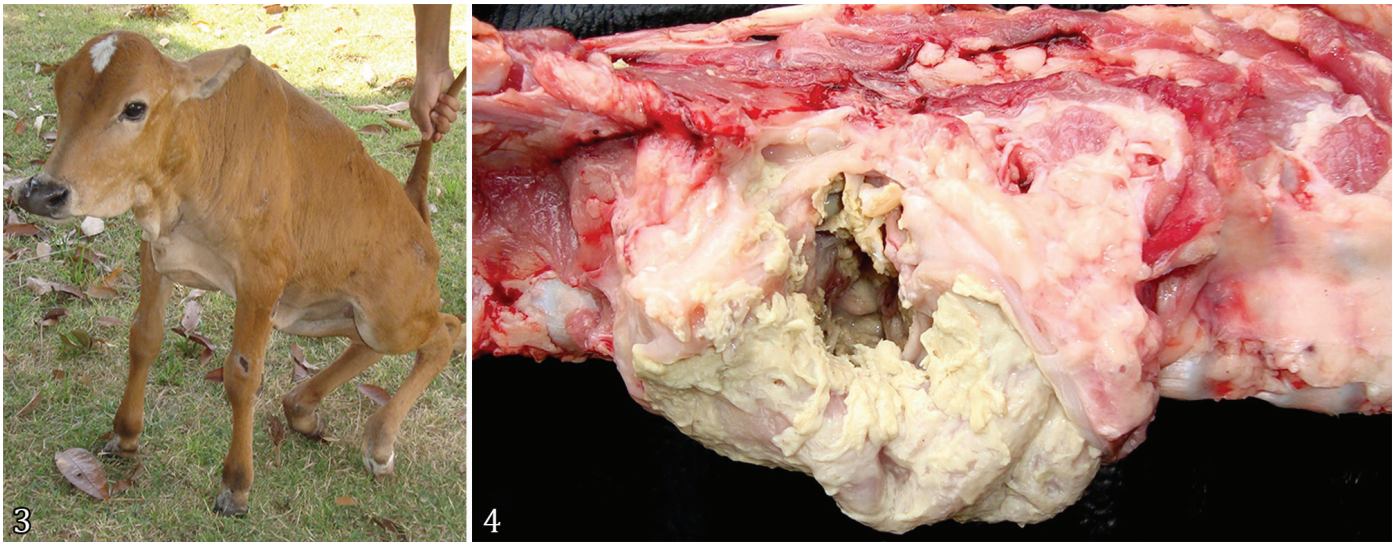

Fig.3-4. (**3**) Six-month-old, mixed breed (Bovine 35) with paresis and proprioceptive *deficit* of the pelvic limbs. (**4**) Abscess in the spine between the 12th and 13th thoracic vertebrae of the calf in Figure 3.

and the possible sources of infection in newborn calves are omphalophlebitis and in older cattle include endocarditis and reticulitis. In four necropsied animals older than one year of age, compressive lesions were also suspected to have an infectious origin, characterized by a granuloma in the arch of the 11th thoracic vertebra in an animal with tuberculosis lesions in the lungs and in the mediastinal and parotid lymph nodes (Bovine 47), by para-pituitary abscess (Bovine 1 and 2) and cerebellar abscess (Bovine 5); possibly these abscesses in the CNS occurred by extension of the adjacent suppurative lesions, in the corneal base, in the third premolar tooth and in the inner ear, as according to Riet-Correa et al. (1998) and Radostits et al. (2000). In general, there are four main pathways for the arrival of an infectious agent in the CNS, which are by extension of an adjacent suppurative lesion, by direct penetrating lesions, by centripetal lesions via the peripheral nerve and the haematogenous pathway. Regarding the non-infectious causes observed in cattle over 12 months of age necropsied, ankylosing spondylitis of the thoracolumbar segments was found in two animals, a 12-year-old male and a 16-year-old female (Bovines 25 and 42); haematoma in segment C_6-T_2 in a 10-year-old female (Bovine 20); fracture in segment C_1-C_5 in an 8-year-old male (Bovine 9); and a medullary syndrome in a 2-year-old male, with posterior paresis due to injury to the first cervical vertebra (Bovine 12). The highest occurrence of animals (46%, 23/50) diagnosed with lesions between the T_3-L_3 vertebrae in this study was also observed by Mackay & Van Metre (2015), in calves in the thoracolumbar segment caused by abscesses, and by Borges et al. (2003) in cattle with vertebral fracture. This higher frequency of lesions in the regions between T_3 and L_3 can be explained by Hahn et al. (1999), who describe the

Fig.5-6. (**5**) Three-month-old, Nellore calf (Bovine 37) with extensor stiffness or hypertonia of the thoracic limbs and hypotonic paralysis of the pelvic limbs. (**6**) Necropsy findings of the animal in Figure 5, showing compression of the spinal cord between the T_9 and T_{10} vertebrae.

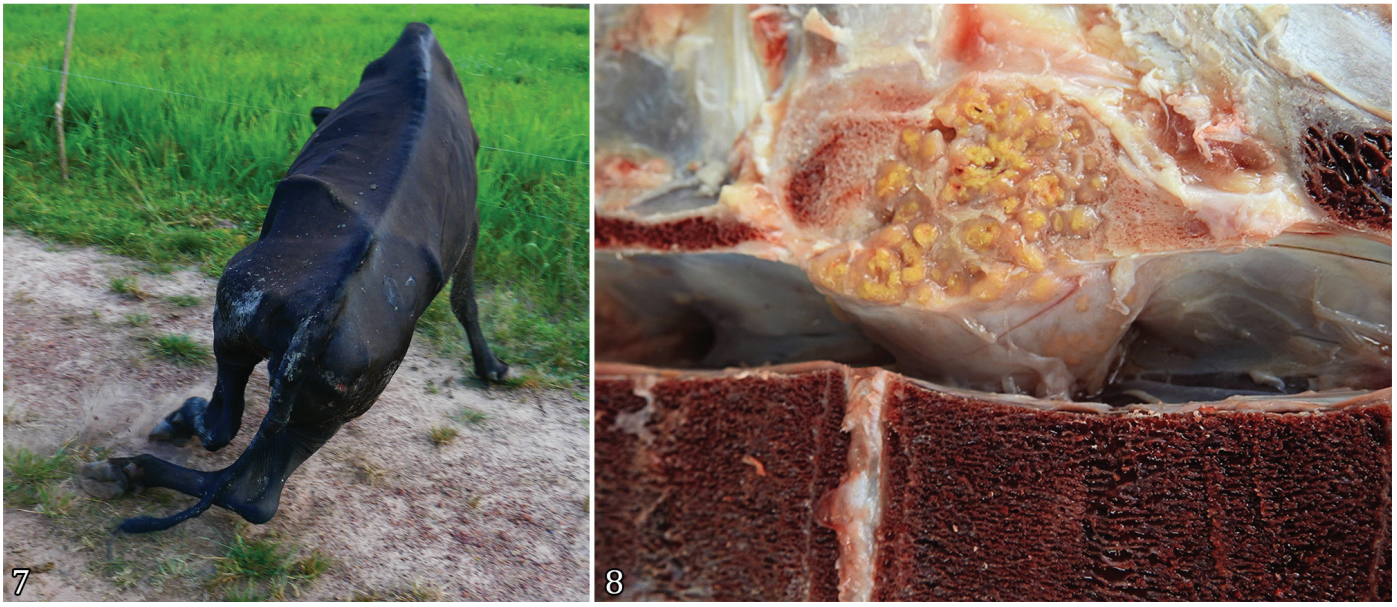

Fig.7-8. (**7**) Six-year-old, crossbred cow (Bovine 47) with paresis and proprioceptive deficit of the pelvic limbs. (**8**) Tuberculous granuloma in the arch of the 11th thoracic vertebra projecting into the medullary canal of the cow in Figure 7.

thoracic region as having greater dorsoventral movement, in addition to being the main site of body weight support, which confirms the predisposition of this anatomical region to the occurrence of CNS compressive injuries. In turn, the cervical region between C_1-C_5 in this study was the second most compromised, with an occurrence of 22% (11/50), unlike the data presented by Borges et al. (2003), who diagnosed only 12.8% (5/39) with cervical lesions, and Mackay & Van Metre (2015), who reported a very small number of calves with lesions in this anatomical cervical segment.

The clinical signs presented by animals with lesions in the brain, brainstem and cerebellum, according to Riet-Correa et al. (2002) and Borges et al. (2003), occur due to the loss of functions in the nuclei and pathways that regulate these activities in these regions. The spinal cord injuries varied according to the segment affected and the intensity of the injury. In general, they caused ataxia, paresis or paralysis of the limbs, inability to stand and walk, postural changes, increased spinal reflexes, and loss of skin sensitivity related to the location of the lesion. These signs are consistent with those reported by several authors (Riet-Correa et al. 2002, Borges et al. 2003, Rissi et al. 2010, Câmara et al. 2014), who mention the same anatomical and clinical correlations of CNS lesions. Bovine 9, with spinal cord injury between C_1-C_5 , presented only ataxia in the pelvic limbs, and according to Riet-Correa et al. (2002) and Borges et al. (2003), these injuries occurred due to the more superficial positioning of the motor tracts related to the pelvic limbs compared to the thoracic limbs. In Bovines 19 and 23 with lesions in the cervical intumescence (C_6-T_2), it was expected that they exhibited severe changes in both the thoracic and pelvic limbs, but according to Riet-Correa et al. (2002) and Borges et al. (2003), when the lesion occurs in the cervical intumescence region, it affects only the lower motor neurons, and only flaccid paralysis is observed exclusively in the thoracic limbs, which explains the clinical conditions presented by these two animals.

The pathogenesis of the lesion of Bovine 37, with extensor stiffness or hypertonia of the thoracic limbs and hypotonic paralysis of the pelvic limbs (Fig.5-6), is explained by spinal cord injury in the region between T_3 and L_7, where the fascicle is proper to the medulla, which contains the nerve fibres of the border cells, which physiologically inhibit the thoracic extensor muscles. When these cells are damaged, they cease to inhibit the thoracic extensor muscles, which causes spasticity characteristic of the Schiff-Sherrington syndrome (DeLahunta & Glass 2009).

The clinical-epidemiological diagnosis was performed in all 50 cattle with neurological signs. Some of the cases were confirmed by necropsy (58%, 29/50), and the other diagnoses were performed by clinical, epidemiological and laboratory exploration (42%, 21/50). Of these, 38% (8/21) of the bovines were aged 12 months or less (Bovines 7, 13, 26, 27, 31, 40, 44 and 46). In the clinical examination of Bovine 7, a lacerative lesion was observed in the C_1-C_5 region suggestive of an attack by a wild cat. These attacks are frequently mentioned by cattle farmers in the region, as the extensive cattle raising areas replaced the cats' natural habitat as described by Azevedo & Murray (2007). In Bovines 13, 27, 40, 44 and 46, according to anamnesis data, spinal cord trauma occurred during vaccination management in which young animals were kept together with adult animals. When the adult animals are not separated from the juveniles, during the management of vaccines and/or vermifuges, they are exposed to trampling and/or being run over, which results in various traumas, including spinal cord injury, which was the clinical picture presented by these calves. Inflammation of the external umbilicus and internal structures, such as the umbilical vein and/or arteries, occurred in two calves (Bovines 26 and 31). These clinical findings are widely discussed in the literature and constitute one of the main causes of abscesses in the CNS.

In cattle older than one year (58%, 13/21) subjected to spinal cord necropsy, trauma occurred during management for vaccination and/or deworming or during containment (Bovines 10, 12, 25, 32, 34, 39, 41, 42, 43, 45, 47, 48, 49 and 50). In most cases, these accidents occurred in Nellore cattle and their crossbred cattle, with aloof behavior, many of them try to jump over corral fences, or when placed in the containment trunk they fall and hit each other, which often causes fractures, including injury to the spinal cord. In Bovine 38, the trauma occurred during transport in a cage, when the animal lay down or fell and was trampled by the others. These accidents culminate in economic losses, and the outcome is not always slaughter, given a lack of logistics. According to the data obtained, the cow (Bovine 21) was healthy on the day of the visit and on the following day was prostrate and unable to get up. In this case, it was not possible to clearly establish the cause of the trauma, which may have occurred due to a fight with other animals. The cow (Bovine 33) showed clinical signs after being mounted by a bull as a result of oestrus. In this case, some hypotheses can be suggested as causes, such as, for example, the weight of the bull, because it was an animal above 800 kg; the floor of the facility, which was smooth due to the accumulation of faeces, urine and mud, favoring the fall of the animal; and the possible bone fragility resulting from phosphorus deficiency (Barbosa Neto et al. 2007). In the cow (Bovine 48) with spinal cord injury between L_4 and S_2 and in the cows (Bovine 49 and 50) with injury in the sacrococcygeal region, the traumas indicated action against the corral structures.

Based on the sudden appearance of clinical signs in clinically healthy animals and the observation of traumas during management for vaccination and/or deworming, infectious diseases were excluded from the possible causes of the clinical conditions observed, especially rabies and botulism, which also produce clinical signs similar to those found in spinal cord compressions, abscesses and granulomas associated with vaccination for foot-and-mouth disease that require injections near the vertebrae (Ubiali et al. 2011, Marques et al. 2012, Brito 2017) and neoplastic masses in the vertebral canal caused by the enzootic bovine leukosis virus (Braga et al. 1998).

The neutrophil leukocytosis found in 13 animals (Bovines 1, 6, 7, 9, 11, 12, 13, 14, 17, 19, 20, 22 and 29) in this study was similar to that described by Marques et al. (2004) and Dirksen et al. (2005) in animals with abscesses in the CNS and umbilical infection. However, this is a nonspecific finding, as it can be observed in several other diseases. Conversely, turbidity with flocculent deposition and rapid coagulation of the CSF after a few seconds of collection, observed by macroscopic examination in two animals with spinal cord injury (Bovines 22 and 23), coincide with the findings of Barros et al. (2006).

They found that in inflammatory processes, such as spinal abscesses, meningitis and brain abscesses, the CSF may be turbid and viscous and coagulate upon exposure to air, as observed in the two cases studied. In Bovine 2, with a pituitary abscess, the CSF sample collected in the cisterna magna was yellowish, and the sample collected in the lumbosacral space was clear, which demonstrates the importance of the correct choice of the collection site, which should be the closest to the site of the lesion in the CNS.

CONCLUSIONS

Compressive lesions in the central nervous system (CNS) in cattle occur in routine veterinary practice. The main clinical signs observed were ataxia, paresis or paralysis of the limbs, inability to stand and walk, postural changes, hyperesthesia in the extremities, and loss of skin sensitivity related to the location of the lesion.

The causes of CNS compression in cattle observed were mainly abscesses in the vertebral body, intervertebral space, vertebral canal, para-pituitary space and cerebellum. Additionally, but less frequently, CNS compression was caused by granuloma in the vertebral arc, vertebral body fractures, subarachnoid haematoma and congenital bone alteration.

Finally, in younger animals, compression was the main consequence of omphalopathies, and in adult animals, it was the result of trauma during animal management.

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