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CASE REPORT
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Polioencephalomalacia in Sheep - Clinical and Magnetic Resonance Imaging Findings

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ABSTRACT

***Background*:** Polioencephalomalacia (PEM) is a neurological disease in ruminants, which is characterized by malacia of brain gray matter. Thiamine deficiency and sulfur intoxication are the most common causes of PEM in sheep. Affected animals present signs of cerebrocortical syndrome, including amaurosis, ataxia, head pressing, mental depression, seizures, and opisthotonus. The neurological examination aims to determine the neurolocalization of the lesions and advanced imaging techniques are useful for confirming the affected area(s) in the central nervous system. The aim of this study is to describe clinical features and ante-mortem diagnosis using magnetic resonance imaging (MRI) in a sheep with PEM.
***Case*:** A 18-month-old male Dorper sheep from a flock started receiving concentrate 7 days before. According to the owner, no clinical signs of abnormality were observed on the previous morning. However, in the afternoon, the animal became self-isolated and did not follow the flock to the sheepfold. The following day, he was found in recumbency. Physical examination revealed lateral recumbency, rectal temperature 39.5ºC, 52 bpm, 120 bpm, congested mucous membranes, capillary refill time 1 s, ruminal (4/5 min) and intestinal hypomotility. The assessment of the central nervous system revealed a decreased level of consciousness, focal seizures, opisthotonus, and absence of menace response. The following differential diagnoses were listed: PEM, head trauma, focal symmetrical encephalomalacia, bacterial encephalitis, and rabies. Treatment was composed of dexamethasone [0.2 mg/kg - i.v., SID (1^{st}-3^{rd} day), 0.1 mg/kg, i.v., SID (4^{th}-6^{th} day), and 0.05 mg/kg, i.v., SID (7^{th}-9^{th} day)]; mannitol [1 g/kg - i.v. and diazepam 0.4 mg/kg, i.v. single dose at admission]; vitamin B1 [10 mg/kg - i.m., SID], furosemide [1 mg/kg - i.v., SID for 3 days] and sulfadoxine/trimethoprim [30 mg/kg - i.m., SID for 10 days]. After the initial treatment, the patient showed mild clinical improvement; however, the amaurosis was still present. Magnetic resonance imaging of the brain was performed on the 2^{nd} day of hospitalization, showing a symmetrical hypersignal in the parietal and occipital cortices, in the axial and sagittal sequences weighted in T2 and FLAIR.
***Discussion*:** This study aimed to describe the clinical signs and MRI findings in a sheep with PEM. In this case, the sudden change to the feed composition probably led to ruminal dysbiosis, inhibition of thiamine-producing microorganisms and proliferation of bacteria that synthesize thiaminase. Thiamine therapy proved to be effective and capable of reverting the clinical signs. The decrease in the level of consciousness, cortical blindness, and opisthotonus are due to alterations in the parietal cortex, in the occipital cortex, and in the cerebellum, respectively, which were demonstrated by hypersignal areas in the MRI. Therefore, the neurolocalization of the lesion based on neurologic examination and the MRI findings were related. The physicochemical and cytological evaluations of the cerebrospinal fluid, and dosage of thiamine and the concentration of hydrogen sulphide in the rumen were not performed. However, the response to thiamine treatment associated with the neurologic examination and MRI findings helped in determining the diagnosis. Additionally, MRI can be used as a useful tool for the *ante mortem* diagnosis of PEM.

Keywords: cerebrocortical necrosis, diagnostic imaging, neurology, ruminants, thiamine deficiency.

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INTRODUCTION

Polioencephalomalacia (PEM) is described as necrosis (malacia) of the gray matter of the encephalon of ruminants [6]. The main causes are: thiamine (vitamin B1) deficiency, ingestion by thiamine analogues (amprolium), sulfur (S) intoxication, NaCl intoxication, lead intoxication, infection by bovine herpesviruses 1 or 5 (BoHV-1 or BoHV-5), and *Phalaris* spp. intoxication [2-4,8,11,12]. In sheep, PEM has already been described due to thiamine deficiency [16], ingestion by thiamine analogues (amprolium) [4], S intoxication [8], NaCl intoxication [13], and experimental BoHV-5 inoculation [15]; in addition, focal symmetrical encephalomalacia (FSE) due to the chronic form of enterotoxemia by *Clostridium perfringens* type D was also reported causing central nervous system (CNS) necrosis [9].

The clinical signs resulting from the lesion of PEM are of cerebrocortical syndrome and include cortical blindness, ataxia, head pressing, decreased level of consciousness, compulsive walking, opisthotonus, and convulsions [8]. The main differential diagnoses in sheep are head trauma, pregnancy toxemia (females), FSE, bacterial encephalitis, and rabies [8,18].

The neurological examination aims to determine the location of the lesion in the CNS [1]. In this sense, advanced imaging examinations, such as magnetic resonance imaging (MRI) and computed tomography, are options to correlate the location of the lesion in the CNS with the findings of the neurological examination and thus refine the clinical diagnosis of ruminant CNS diseases [5,7,10,14,17].

The objective of this study was to report a case of PEM in a sheep, describing the clinical findings and the use of the MRI technique as an aid in the *ante mortem* diagnosis.

CASE

In a flock of 15 Dorper sheep raised semi-extensively on *Brachiaria brizantha* pasture, concentrate had been introduced into the diet [Ração Ovinos 18% - crescimento e engorda - Fanton® for 7 days]. The animals were handled twice a day and in the early afternoon, the farmer noticed that 1 of the animals (18-month-old male weighing 18 kg) was out of the pasture and did not accompany the flock when it returned to the sheepfold. The next morning, the animal was in lateral decubitus and was referred to the Large Animal Internal Medicine Service of São Paulo State University (Unesp). The herd had access to water (from artesian well) and mineral salt (suitable for sheep), and the others showed no clinical signs.

On physical examination, lateral decubitus, rectal temperature: 39.5ºC, tachypnea (52 bpm) and tachycardia (120 bpm), congested mucous membranes, capillary refill time 1 s, non-reactive lymph nodes and ruminal (4/5 min) and intestinal hypomotility were observed. Neurological examination revealed lateral decubitus, decreased level of consciousness, focal seizures, opisthotonus, and cortical blindness (absence of response to visual menace, symmetrical pupils with normal diameter and preserved pupillary reflexes).

Therefore, PEM, head trauma and rabies were listed as the main differential diagnoses. Treatment was instituted with dexamethasone[1] [Dexaflan® - 0.2 mg/kg, i.v., SID (1st-3rd day), 0.1 mg/kg (4th-6th day) and 0.05 mg/kg (7th-9th day)]; mannitol[2] [1.0 g/kg, i.v.] and diazepam[3] [0.4 mg/kg, i.v., both single dose on the first day of hospitalization]; vitamin B1[4] [Monovin B1® - 10 mg/kg, i.m., SID] and furosemide[5] [Diurax® - 1.0 mg/kg, i.v., SID for 3 consecutive days] and sulfadoxine/trimethoprim[6] [Borgal® - 30 mg/kg, i.m., SID for 10 days]. Additionally, maintenance fluid therapy with lactated Ringer's solution[7] was administered in the first 2 days of hospitalization. After the initial treatment, the sheep was able to remain in quadrupedal position, but cortical blindness continued.

On the 2nd day of hospitalization, brain MRI was performed under general inhalation anesthesia. The MRI images were obtained in dorsal, sagittal, and transverse sections in a low-field equipment (Vet-MR Grande 0.25 T[8]), including T1-, T2- and FLAIR-weighted scans. The images were analyzed in a digital medical imaging system (Synapse® PACS[9]). Hypointense areas detected by spin-echo T1-weighted sequence, symmetrical hyperintense areas detected by T2-weighted sequence, and FLAIR sequences were found to be distributed homogeneously in the cerebral cortex region (parietal and occipital) in transversal and sagittal sequences, compared to an unaffected brain tissue (Figures 1, 2 & 3).

In the 6 subsequent days, the sheep presented the clinical parameters within the reference range for the species and returned to voluntary feeding. However, cortical blindness remained as a sequela of PEM. After

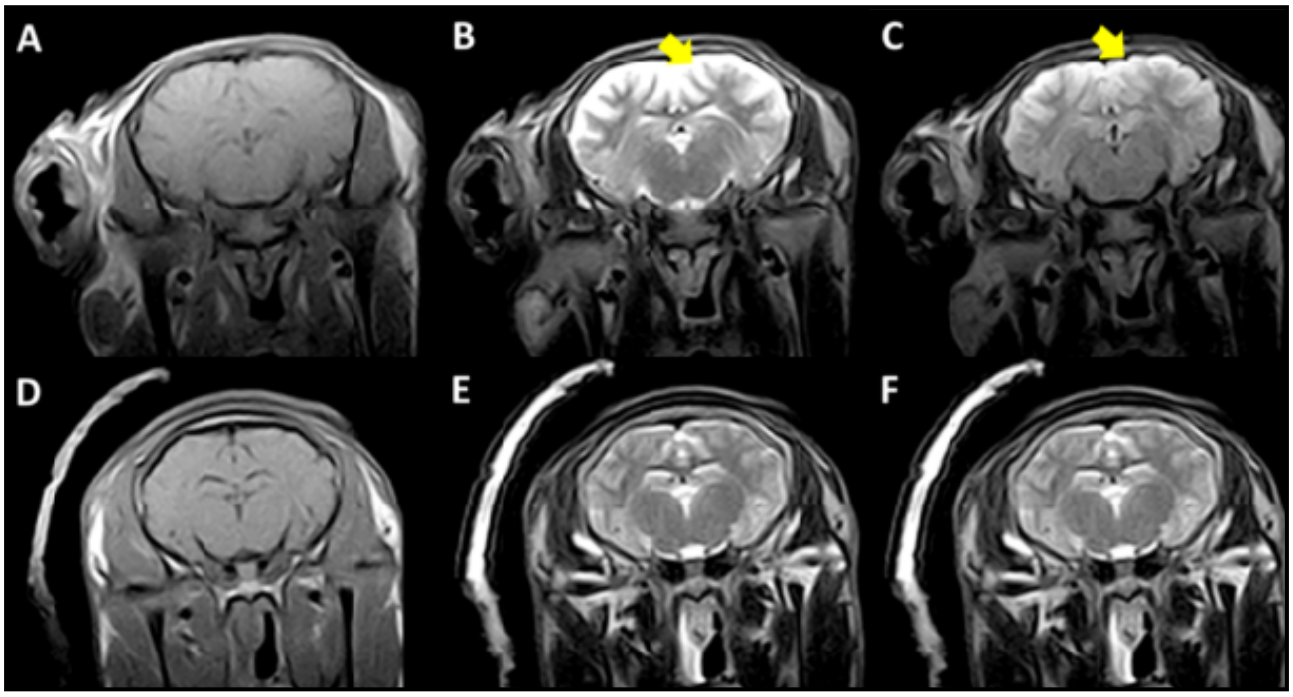

Figure 1. Parietal cortex. Sheep with PEM: A- Cross section in T1-weighted sequence. B- Cross section in T2-weighted sequence, arrow indicates hypersignal area. C- Cross section in FLAIR sequence, arrow indicates hypersignal area. Control sheep: D- Cross section in T1-weighted sequence. E- Cross-sectional T2-weighted sequence. F- Cross section in FLAIR sequence.

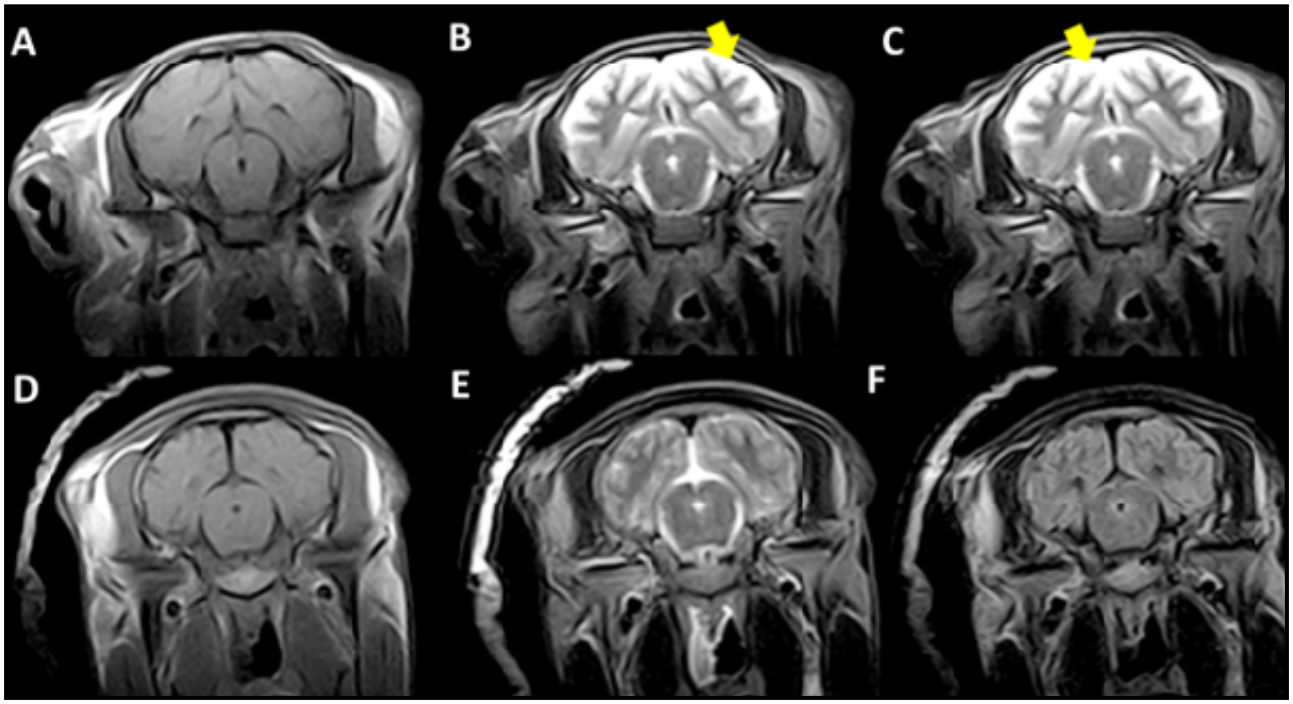

Figure 2. Occipital cortex. Sheep with PEM: A- Cross section in T1-weighted sequence. B- Cross section in T2-weighted sequence, arrow indicates hypersignal area. C- Cross section in FLAIR sequence, arrow indicates hypersignal area. Control sheep: D- Cross section in T1-weighted sequence. E- Cross-sectional T2-weighted sequence. F- Cross section in FLAIR sequence.

nine days of hospitalization, the animal was discharged and returned to the farm of origin, and according to the owner, the animal did not present neurological signs 14 days after hospital discharge.

DISCUSSION

According to the anamnesis, PEM was probably a consequence of thiamine deficiency by ruminal dysbiosis caused by the sudden introduction of

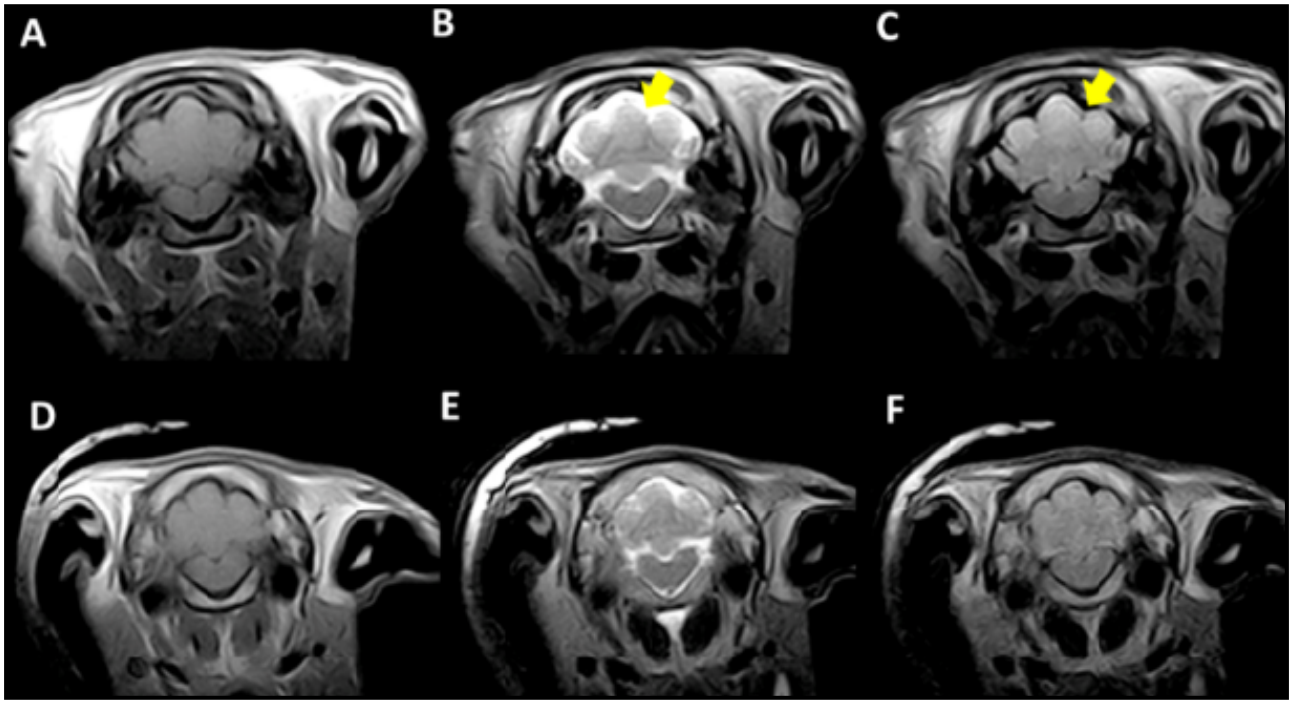

Figure 3. Cerebellum. Sheep with PEM: A- Cross section in T1-weighted sequence. B- Cross section in T2-weighted sequence, arrow indicates hypersignal area. C- Cross section in FLAIR sequence, arrow indicates cerebellum retraction with CSF accumulation. Control sheep: D- Cross section in T1-weighted sequence. E- Cross-sectional T2-weighted sequence. F- Cross section in FLAIR sequence.

concentrate to the diet, which leads to rumen acidification, inhibition of thiamine-producing microorganisms and proliferation of bacteria that synthesize thiaminase [3]. The utilization of furosemide, mannitol, dexamethasone, and vitamin B1 replacement was capable of reverting the clinical signs caused by edema of the gray matter [3,8,13], except for cortical blindness during hospitalization, which is generally the most prevalent and the last clinical sign to disappear in animals affected by PEM, or even persisting as a sequela [8]. The neurological signs observed are indicative of alterations in the cortex (parietal and occipital) [1] and corroborate with the physiopathogeny of PEM, in which there is hydropic degeneration owing to a failure in the Na^+/K^+ pump mediated by a lack of energy due to a reduction in the activity of the transketolase caused by thiamine deficiency [3]. The presence of hyperintense areas by T2 and FLAIR sequences in the parietal and occipital cortices, are associated with edema and/or degeneration of the gray matter in these regions.

Imaging alterations in the parietal cortex explain the decrease in the level of consciousness, while the presence of cortical blindness is compatible with hypersignal in occipital cortex region. Although mild, the increased intensity in the cerebellum, combined with a possible elevation of the intracranial pressure, justifies the opisthotonus. The correlation between the results of neurological examination and MRI allowed the specific localization of lesions compatible with PEM. In addition, the response to treatment helped in determining the diagnosis [8], even without the physicochemical and cytological evaluations of the cerebrospinal fluid (CSF), and dosage of thiamine and the concentration of hydrogen sulphide in the rumen [4,6]. Sulfur intoxication is one of the causes of PEM [4,8], but because there was a supply of commercially food (feed and mineral salt), the excess of S was not considered as one of the possible causes for PEM, so the determination of sulfide in the rumen was not performed.

Magnetic resonance imaging is reportedly efficient in detecting focal neurological lesions in sheep with listeriosis [10]. In this situation, asymmetric hyperintense areas were observed on T2-weighted sequences in the brainstem. In our study, MRI examination revealed alterations homogeneously distributed in the cortex region (parietal and occipital), as well as in a 2-month-old female Boer goat, in a 2-month-old female mix-breed calf, and in a 3-month-old female goat with histologic findings consistent with PEM. In these cases, MRI findings were the presence of areas of hypersignal on T2-weighted sequences, homogeneously distributed

in the cerebral cortex, except in the frontal lobes, limiting the gray matter [5,14,17].

The absence of CSF analysis is one of the limitations of this report, although two cases of PEM, with MRI and histopathologic findings, did not demonstrate CSF alterations [5,14]. In animals with intoxication by NaCl, the determination of Na^+ in the CSF may confirm the underlying cause [3]. Additionally, the evaluation of the thiamine content in the rumen of other animals and the affected sheep would collaborate in the clinical investigation [3]. The absence of this information and *post mortem* alterations made it impossible to confirm the diagnosis of PEM. However, the set of clinical signs, MRI findings, and response to treatment with thiamine are indications that the clinical case described was PEM.

This report describes the changes observed in a sheep with PEM via MRI, relating the neurolocalization of the lesions based on the neurological examination and the MRI findings. The findings are useful for the *ante mortem* diagnosis of PEM.

MANUFACTURERS

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Declaration of interest. The authors report no conflict of interest. The authors alone were responsible for the content and writing of paper.

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