NOTE *Pathology*

Suprascapular Nerve Paralysis Due to Streptococcal Meningoradiculitis in a Cow

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(Received 30 June 2008/Accepted 15 July 2008)

ABSTRACT. A cow, presenting with lameness with atrophy of the right supraspinatus and infraspinatus muscles, was clinically diagnosed with suprascapular nerve paralysis. Histological examination revealed necrosuppurative lesions with Gram-positive cocci arranged in chains in multiple organs, including the cardiac valves, lungs, muscles, joints, brain, cerebral and spinal meninges. Spinal meningitis progressed into the roots of the right 6th to 8th cervical nerves. The suprascapular nerve showed partial loss of nerve fibers in the periphery, and innervated muscle fibers were atrophied. Bacterial culture of the cerebrospinal fluid revealed the presence of *Streptococcus pyogenes*. From these findings, the suprascapular nerve paralysis in this case was considered to result from meningoradiculitis associated with systemic streptococcal infection. This is a rare bovine case of suprascapular nerve paralysis due to central nerve damage of infectious cause.

KEY WORDS: bovine, meningoradiculitis, Streptococcus, suprascapular nerve paralysis.

J. Vet. Med. Sci. 70(12): 1349–1351, 2008

A 2-year-old female Holstein-Friesian cow presented with lameness of 2 weeks' duration and was referred to the veterinarian. The cow showed abduction of the right forefoot and insufficiency of weight bearing on the affected foot, and the right supraspinatus and infraspinatus muscles were atrophied (Fig. 1). The left tarsometatarsal joint was swollen with warmth. The lameness progressed and subsequently became astasic. This animal was diagnosed with right suprascapular nerve paralysis and infectious tenosynovitis of the left tarsometatarsal joint. Due to the poor prognosis, this animal was sent for necropsy.

Macroscopically, atrophy of the right supraspinatus and infraspinatus muscles was apparent. Traumatic lesions, indicating bruising, were not found on the cranial aspect of the right shoulder. In the heart, vegetative masses, about 4 cm and 1 cm in diameter, were located on the pulmonary and right atrioventricular valves, respectively. The left atrioventricular valves were mildly thickened. In the lungs, there were encapsulated abscesses, 2 cm and 1 cm in diameter, in the left and right caudal lobes, respectively. Multifocal necrosis and discoloration, up to 4 cm in diameter, were found in the cervical longissimus and left semimembranous muscles. Yellowish pus was present in the right carpal and metacarpophalangeal joints and in the tendon sheaths of the left superficial and deep digital flexor muscles at the tarsometatarsal joint.

Histopathologically, fibrinosuppurative proliferations with multifocal necrosis and partial replacement by granulation tissue were formed on the pulmonary and right atrioventricular valves. The left atrioventricular valve was myxomatously thickened. Mild mononuclear cell infiltration was found in the interstitial and subepicardial tissue. Pulmonary abscesses had central necrosis and were encapsulated with fibrous connective tissue. The muscular lesions varied from focal necrosis to fibrosis with loss of muscular fibers. Foci of mild suppurative myositis were also observed. Abscesses were formed in subsynovial tissues of the articular capsules of the right carpal and metacarpophalangeal joints. These necrosuppurative lesions were accompanied by Gram-positive cocci arranged in chains.

In the brain, severe neutrophilic infiltration admixed with lymphocytes, macrophages, fibrin exudation and hemorrhage was present in the subarachnoid and Virchow-Robin spaces, and partially invaded through the pia matter to the parenchyma. In the cerebrum, there was multifocal necrosis with the accumulation of neutrophils, some of which were apparently formed in perivascular regions. The ependyma and subependymal parenchyma of the ventricles also showed necrosuppurative change. Around these necrotic lesions, neutrophils and ischemic neurons were scattered and there was perivascular infiltration of lymphocytes, macrophages and neutrophils. In the spinal cord, fibrinosuppurative inflammation was present between the pia and dura matter, and the parenchyma was not affected. In the 5th cervical to 1st thoracic cords, the inflammation extended to the roots of the right 6th to 8th cervical spinal nerves (Fig. 2). Neutrophils accumulated in the subepineurial space and neutrophils, lymphocytes and plasma cells infiltrated the endoneurium (Fig. 3). Partial loss of nerve fibers and infiltration of phagocytes and neutrophils was also detected. Gram-positive cocci were also present in the lesions of cerebral necrosis and suppurative meningitis (Fig. 4). In the right suprascapular nerve proximal to the cranial border of the scapula, partial loss of nerve fibers and resultant phagocytosis was observed. The supraspinatus and infraspinatus muscles showed mild to moderate muscular atrophy characterized by scattered or small groups of angular atrophied fibers among normal fibers (Fig. 5). Bacterial culture from

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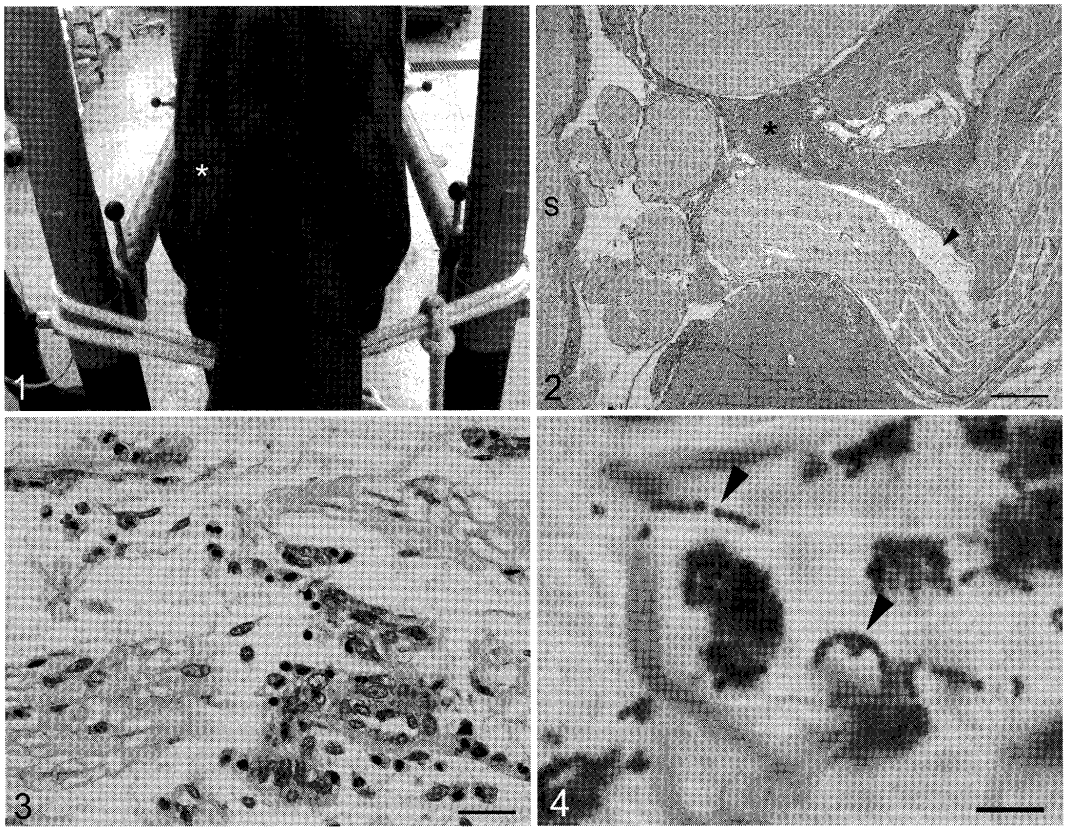

Fig. 1. Photograph of the dorsocranial aspect of the affected cow, demonstrating atrophy of the right supraspinatus muscle (asterisk).

Fig. 2. Photomicrograph of the right 7th cervical nerve root. A great number of inflammatory cells accumulated in the subarachnoid to subepineurial space (asterisk). Arrowhead indicates partial loss of nerve fibers. Hematoxylin and Eosin (HE) stain. S, spinal cord, Bar=400 μm.

Fig. 3. Higher magnification of the right 7th cervical nerve root. Inflammatory cells, including neutrophils, lymphocytes and plasma cells, infiltrate the endoneurium. Swelling of the capillary endothelial cells was also noticed. HE stain. Bar=40 μm.

Fig. 4. Photomicrograph of cocci arranged in chains in the suppurative exudate in the subarachnoid space of the 2nd cervical spinal cord. Gram stain. Bar=5 μm.

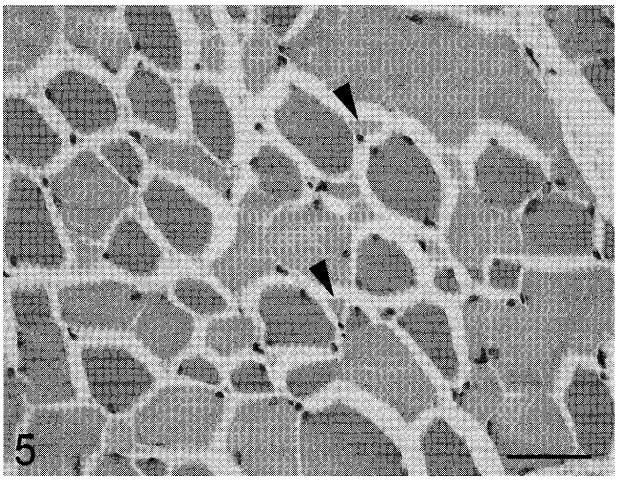

Fig. 5. Photomicrograph of transverse section of the right infraspinatus muscle showing a difference in muscle fiber diameter and presence of angular atrophied fibers (arrowheads). HE stain. Bar=50 μm.

cryopreserved cerebrospinal fluid was performed in a diagnostic laboratory using GAM, blood and chocolate agar as primary media, and *Streptococcus pyogenes* was solely isolated. From these findings, it was considered that clinically-observed suprascapular nerve paralysis in the present case was due to damage to the spinal roots of the suprascapular nerve by suppurative inflammation associated with streptococcal infection, and subsequent depression of the innervated muscles.

The suprascapular nerve originates from the 6th and 7th cervical nerve roots, runs through the brachial plexus and innervates the supraspinatus and infraspinatus muscles, which function to extend the shoulder joint and support the lateral aspect of the joint [2, 6]. Suprascapular nerve paralysis is one of the causes of forefoot lameness and usually associated with trauma to the shoulder region [3, 7]. Physical damage to the suprascapular nerve results in dysfunction of the innervated muscles. In this case, the absence of lesions indicating physical impact to the affected shoulder region confirmed that the pathogenesis was not due to direct

nerve damage.

This animal had systemic suppurative lesions with intralesional Gram-positive cocci in chains. Considering the result of bacterial culture of the cerebrospinal fluid, histologically detected cocci were possibly *S. pyogenes*, also known as group A streptococcus (GAS), which is one of the most important pathogens in humans [1]. The bacterium is a major cause of acute pharyngitis and can evoke a variety of cutaneous and systemic infections, including bacteremia and suppurative meningitis. In GAS bacteremia in adults and children, cutaneous lesions are suspected at bacterial entry sites, and the outcome varied from transient and relatively benign to fulminant [1]. Meningitis occurs in less than 2% of all patients with systemic GAS infection and can be a high-mortality form in both children and adults [5]. Neurological symptoms can also be present in patients with GAS meningitis. Meningitis usually follows upper respiratory infection, including sinusitis or otitis. *S. pyogenes* is defined as an unusual pathogen responsible for diseases in animals, except bovine mastitis, in which bacterial transmission from humans has been suspected and contaminated milk has a risk for upper respiratory diseases in humans [4]. In this cow, the exact source of infection could not be ascertained. Systemic bacterial lesions, including valvular endocarditis and perivascular localization of bacterial lesions in the cerebrum, indicated the hematogenous spread of the organism, i.e. sepsis. The absence of lesions in the spinal parenchyma further indicated that cerebral meningitis extended caudally to the spinal meninges. The roots of the suprascapular nerves seemed to be incidentally involved; however, this was a rare clinical case of suprascapular nerve paralysis due to central nerve injury, possibly associated with systemic infection with *S. pyogenes*.

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