



Review

Bovine spastic paresis: Current knowledge and scientific voids

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ABSTRACT

The aetiology, pathogenesis, diagnosis and treatment of bovine spastic paresis of the gastrocnemius muscle (BSP-G) have been investigated for several decades, but much remains to be elucidated. In some breeds, the proportion of atypical presentations of BSP involving the quadriceps muscle (BSP-Q) and/or several other muscles (mixed presentation, BSP-M) appears to be increasing. Differentiation between BSP-G, -Q and -M is challenging and existing surgical treatments are usually ineffective in cattle affected by one of the atypical forms of the disease. This paper reviews the current knowledge on BSP and addresses several areas where understanding of the disease is incomplete.

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Introduction

Bovine spastic paresis (BSP) is a progressive neuromuscular disease characterised by spastic contractions of one or more muscles of the hindquarters and/or back in standing cattle. With the exception of some breeds, particularly the Belgian Blue and Romagnola, the gastrocnemius muscle is most commonly affected, with spastic paresis causing the animal to repetitively stretch the affected limb in a caudal direction.

BSP was first described by the Professor Joseph Hamoir in 1922 and reported to be a heritable disease originating from the East Friesian bull Elso II (Götze, 1932). Götze (1932) introduced the term 'spastic paresis' to describe the abnormal muscular contractility. Subsequently, the condition has been reported in many breeds of cattle throughout the world. Spastic paresis has also been observed, although infrequently, in goats (Baker et al., 1989).

The physical condition of affected animals deteriorates rapidly, owing to the constant pain and stress evoked by the muscle spasms. This makes effective treatment essential. The first proposed treatment was tenotomy of the spastic muscles (Götze, 1932). This was later modified to avoid hyperflexion of the tarsocrural joint (Pavaux et al., 1985). De Moor et al. (1964) introduced selective neurectomy of the branches of the tibial nerve supplying the gastrocnemius muscles, based on a technique for denervating the gastrocnemius muscle in human beings. Bijleveld (1973) proposed the use of a total tibial neurectomy.

Abnormalities of muscle groups other than the gastrocnemius may be implicated in spastic paresis. Denniston et al. (1968) were the first to show the involvement of multiple muscle groups; this has now been recorded in several breeds of cattle and is generally

referred to as the 'mixed presentation of bovine spastic paresis' (Vertenten, 2006; De Vlaminck et al., 2013b). Spastic paresis, in which only the quadriceps femoris muscle is involved, has been described in Belgian White Blue and Romagnola cattle (Gentile et al., 2002; Touati et al., 2003). To date no suitable surgical treatment exists for animals with spastic paresis of muscles other than the gastrocnemius.

Although research has shed some light on the aetiopathogenesis of BSP, much remains to be elucidated (De Ley and De Moor, 1975, 1977, 1979; Pariset et al., 2013). In this paper we review current knowledge of the condition, identify areas of uncertainty and provide a perspective for future research.

Epidemiology

Spastic paresis was first reported in Friesian cattle in Germany, but since then it has been reported in many breeds of cattle, including Belgian White Blue, Holstein Friesian, Charolais, Romagnola, Brahman crosses, Hereford, Beef Shorthorn, Jersey, Aberdeen Angus, Ayrshire cattle, Meuse-Rhine-Yssel, Groninger, Brown Swiss, Red Danish, Hungarian and Czech Red Spotted, Gelbvieh, Japanese black and Krankrej (Götze, 1932; Formston and Jones, 1956; Wheat, 1960; van Gastel-Jansen and Frederik, 1962; Love and Weaver, 1963; Rasbech, 1963; Roberts, 1965; Bouckaert and De Moor, 1966; Leipold et al., 1967; Denniston et al., 1968; Gadgil et al., 1970; Arnault, 1982; Browning et al., 1986; Thomason and Beeman, 1987; Harper, 1993; Vlaminck et al., 2000; Gentile et al., 2002; Miura et al., 2009).

Even though there is a clear genetic link to the disease, to the best of our knowledge no cattle breed societies have kept or keep records of the prevalence of BSP. Reports suggest that the prevalence is < 1%; for example, Gentile et al. (2002) reported a prevalence of 0.8% in Romagnola cattle, while Ledoux (2001) stated that the prevalence in French cattle was 0.1% and declining. However, without objective epidemiological data, these figures cannot be confirmed.

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Such data are needed across breeds and countries to better establish the impact of the condition.

Since BSP was first reported, it has been clear that there is an inherited component to the disease, with the animals initially affected being traceable to a single Friesian sire, Elso II (Götze, 1932). Other investigations have also shown a clear genetic link; in affected Polish cattle, Szteyn et al. (1972) showed a link with the genetic line from the Dutch bull Annas Adema. Nevertheless, the mode of inheritance and the penetrance of the responsible genes have not been elucidated. Additionally, although the disease is more frequently observed in male animals, no clear sex predilection has been proven (Arnault, 1982; Vlaminck et al., 2000; Griffiths, 2005).

Clinical characteristics

BSP is most commonly associated with repetitive contractions of the gastrocnemius muscles, although the clinical signs can originate from other muscle groups, such as the quadriceps femoris or from a combination of hind limb muscles (Hamoir, 1922; Touati et al., 2003; De Vlaminck et al., 2013a). A recumbent animal usually will show no overt clinical signs, but spastic contractions become visible as soon as it rises or attempts to rise (Keith, 1981; Harper, 1993; Touati et al., 2003; Vertenten, 2006). The age at which clinical signs become apparent ranges from 1 day up to 3 years (Vlaminck et al., 2000; Touati et al., 2003; C. De Vlaminck et al., unpublished data). Initially, clinical signs are subtle, but they progressively worsen over time. Both unilateral and bilateral hind limb involvement is possible (Touati et al., 2003).

BSP of the gastrocnemius muscle (BSP-G) is characterised by an increased tibiotarsal angle and a hind limb that is stretched caudally. The back is frequently arched and the tail head can be elevated (Keith, 1981; Harper, 1993). When affected unilaterally, the calf will stand on the unaffected limb, while the toe of the extended contralateral limb will not touch the ground. Walking is difficult, since the affected limb is spastically drawn caudally with each step (Fig. 1). When affected bilaterally, the animal will show marked extension of both hind limbs and continuous weight shifting. Upon palpation, increased tone of the gastrocnemius muscle and its tendon may be detected. As the disease progresses and the severity of the clinical signs increases, affected cattle become reluctant to stand up. Chronic cases develop atrophy of the gluteal biceps muscle and remodelling of the calcaneus bone, which tends to incline towards the tibia due to the repetitive strain (Keith, 1981). The epiphysis of the calcaneus may be enlarged and irregular (Frederik and Van 't Hooff, 1962).



Fig. 2. Calf with bovine spastic paresis of the quadriceps muscle (BSP-Q). Both hind limbs are spastically stretched in a cranial direction, resulting in a bent position of the back.

BSP of the quadriceps muscles (BSP-Q) is usually bilateral (Touati et al., 2003; C. De Vlaminck et al., unpublished data). While standing, the animal shifts its weight with a bent back, while the non-weight bearing hind limb is stretched cranially (Fig. 2). Upon palpation, increased quadriceps femoris muscle tone is detectable. When walking, the hind limbs are rigidly advanced with a swinging pendulum motion, resembling the gait of a tin soldier (Touati et al., 2003). When affected unilaterally, the calf will stand on the unaffected limb, with the spastic limb stretched cranially. Even though amelioration of clinical signs has been reported, the condition progressively worsens in most calves (C. De Vlaminck et al., unpublished data).

In recent years, a higher frequency of involvement of multiple muscle groups (BSP-M) has been observed in Belgian Blue calves referred to the large animal clinic of Ghent University (Vertenten, 2006; C. De Vlaminck et al., unpublished data). In these cases, in the standing animal, the spasticity causes a swaying hyperextension of the tibiotarsal joint in cranial, caudal and even lateral directions (Fig. 3). Most calves are bilaterally affected (C. De Vlaminck et al., unpublished data). The identification of the affected muscle



Fig. 1. Zebu with bovine spastic paresis of the gastrocnemius muscle (BSP-G). The left hind limb is stretched in a caudal direction.



Fig. 3. Extremely muscled calf with the mixed presentation of bovine spastic paresis (BSP-M). In this case, the left hind limb is stretched laterally.

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