Shivers (Shivering) in the Horse: A Review

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With the increasing popularity of draft and Warmblood horses in North America, the age-old problem of shivers is making a resurgence. Clinical signs include periodic and involuntary spasms of the muscles in the pelvic region, pelvic limbs, and tail that are exacerbated by backing or picking up of the hindlimbs. Suggested causes include genetic, traumatic, infectious, and neurologic diseases. The condition is frequently progressive and debilitating. Authors’ addresses: Department of Clinical Studies, Ontario Veterinary College, University of Guelph, Guelph, Ontario N1G 2W1, Canada (Baird); Department of Clinical Sciences, College of Veterinary Medicine, Oregon State University, Corvallis, OR 97331 (Firshman); and Department of Veterinary Population Medicine, College of Veterinary Medicine, University of Minnesota, St. Paul, MN 55108 (Valberg); e-mail: jbaird@ovc.uoguelph.ca (Baird). © 2006 AAEP.

1. Introduction

Shivers or shivering are the names that have been applied to a chronic nervous or neuromuscular syndrome in horses1–9 that has been recognized for centuries.1,2,10 The condition has been stated to be reasonably common,8,9,11 uncommon,12 rare,6,13–15 and very rare.4 In a comparative neuropathology textbook published in 1962, it was stated that “in the heyday of equine practice,” shivering was “as common as dirt.”11

The syndrome principally affects the draft-horse breeds.2,6–8,12,13,15–25 Shivers has also been reported in Warmbloods,15,26 Warmblood crossbreds,21,26 and occasionally, lighter breeds of horses including light harness horses, hunters, hunter-jumpers, hacks, Quarter Horses, and Thoroughbreds.2,3,7,11,13,14,17,19,21,27–29 In ponies, shivers is considered uncommon11,16 to rare.3,15,27 The condition has an insidious onset,15 it can occur at any age,3,5,6,8,27,30 and reports document horses as young as 1–2 yr of age with shivers.8,17,30,31 Leeney31 stated that “shivering usually comes on in colthood.” In a recent study in Belgian draft horses, no significant difference was observed in the age and sex distribution of horses with shivers from horses without shivers.8

2. Clinical Signs

The clinical spectrum of shivers in horses is very variable in the degree or manifestation of signs.3,4,6,32 The diagnosis of a characteristic case of shivers seldom presents a problem.12,13 However, the signs of shivers may be intermittent, occasional, or latent and very difficult to confirm.2,3 Shivers may be extremely difficult to detect in the early stages,2,5,13,22,27,33,34 and careful observation may be required before the diagnosis can be made.2,13

The disease primarily affects one or both hindlimbs and the tail.2,3,5,7,8,11,13,21,27,33 Shivers is characterized by periodic, involuntary spasms of the
The most characteristic signs of shivers occur when an attempt is made to move the horse backwards.1,2,6,10,11,15,19 Occasionally, a horse will exhibit signs if made to move over suddenly in the stall or box.2,3,13,16,19,27 Shivering may also be seen when lifting or attempting to lift a hindlimb,1,2,3,5,16,19 or when the horse is being shod, especially when the foot is hammered during shoeing.2,3,16,21,27 In the early stages, the owner may notice that the horse snatches up the hindlimbs when they are being picked up for cleaning or shoeing. The condition may progress until the horse becomes impossible to shoe.1,2,3,13,16,19

Muscle mass in the hindlimbs is generally decreased. Shivers may occasionally affect the muscles of the face, eyelids, neck, lips, and cheeks.2,3,19,22,27,33 When the muscles of the head or neck are involved, there is rapid blinking of the eyelids, quivering of the ears, and twitching with spasmodic retraction of the commissures of the lips.3,5,11,13,15,19 With progression of the disease, a gradual and progressive atrophy of the muscles of the thigh occurs,3,24,25,27,35 and this may progress to generalized muscle atrophy.7,24 Hind quarter weakness was present in 11 of 19 (58%) horses with shivers.8 The limbs may become more or less stiff or rigid.1,3,19,24,27,33 Affected animals sleep standing, and their front fetlocks and knees are bruised and disfigured by frequent half-falls.3,27 Affected horses frequently adopt an abnormal stance with a base-wide stance in the hindlimbs.7,24 Excessive sweating has been noted in some cases.7

Fig. 1. A Belgian mare exhibiting signs of shivers while backing up. Note the elevated tailhead, hyperflexion of the hindlimb, exaggerated flexion of the croup, and forward extension of one forelimb. Muscle mass in the hindlimbs is generally decreased.
3. Clinical Pathology
There is no significant difference in baseline serum creatine kinase (CK) and aspartate aminotransferase (AST) activities in horses with shivers compared with those without. The mean CK in 19 Belgian draft horses with shivers was 289 ± 203 U/L (reference range = 108–430 U/L), and the mean AST was 412 ± 321 U/L (reference range = 259–595 U/L). In the same study, there was also no significant difference in serum selenium and serum vitamin E concentrations in horses with shivers compared with those without.8

4. Differential Diagnosis
Stringhalt is the condition most often confused with shivers. Stringhalt occurs in all breeds of horses and may occur at any age. Stringhalt is characterized by a spasmodic and excessively rapid flexion of one or both hindlimbs that occurs when the horse is made to move. It is best seen in the slower paces and particularly, in turning or backing. In stringhalt, the hocks are suddenly markedly flexed with a violent jerk toward the abdomen and are then brought forcibly and noisily back to the ground as in stringhalt. There are reports of spinal-cord disease as a result of equine protozoal myeloencephalitis (EPM) that causes a stringhalt-like gait. This disease may be ruled out on absence of antibodies directed against both isoforms of glutamate decarboxylase, GAD65 and GAD67, which are the enzymes that catalyze the conversion of glutamate to GABA. Only 2 of 8 SHS horses had elevated GAD antibodies compared with values measured in normal horses. In 7 of 8 SHS horses, electromyographic (EMG) findings showed persistent motor-unit activity in the axial and gluteal musculature that persisted for minutes before tapering off gradually. These EMG findings were considered to be strongly suggestive of SPS.

Equine motor neuron disease (EMND) is clinically characterized by progressive weight loss despite a good appetite, symmetrical muscle wasting, muscle fasciculations, excessive sweating, tucked-up abdomen, abnormal gait, excessive recumbency, and an abnormally low head carriage. There are some similarities between the clinical signs of shivering and EMND. Bizarre stringhalt-like movement of a front or rear leg has been observed in some chronically affected EMND horses. Subacute to chronic EMND cases frequently have an abnormal elevation of their tail, which is caused by denervation atrophy and contracture of the sacrocaudalis dorsalis medialis muscle.

There are rare reports of spinal-cord disease as a result of equine protozoal myeloencephalitis (EPM) that causes a stringhalt-like gait. This disease may be ruled out on absence of antibodies in the serum and/or in the cerebrospinal fluid (CSF).

5. Pathology
No documented lesions have been found in horses with shivers. No histopathological lesions were detected on detailed examination of the brain, the cervical, thoracic, and lumbar portions of the spinal cord, the dorsal and ventral spinal roots obtained from the cervical and lumbar sacral intumescences, the associated spinal ganglia, or the peripheral nerves of two Belgian geldings with shivers syndrome.

6. Etiology
The etiology of shivers and the pathophysiologic alterations associated with the clinical signs have not been determined.

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logical, myopathic, genetic, infectious, and traumatic causes have been postulated. There are also reports stating that horses may show signs of shivering after a long rail or road journey.2,16

**Neurological Cause**

The hyperkinesia that characterizes shivering in horses has been considered to be suggestive of basal nuclei lesions.46 It has also been suggested that shivers probably involves motor and reflex hypertension of flexor and/or extensor muscle of the pelvic limbs, back, and tail.9,32 Lesions in the sensory or motor pathways anywhere from the brain stem to the affected muscles and associated joint and tendon sensory receptors potentially could initiate the abnormal muscle tone and movements observed in shivers.9,32 Others have suggested that the muscle atrophy and weakness seen in severe advanced shivers in draft horses are typical of a progressive neuromuscular disease.7,22 It has been stated that “it will likely take a very thorough, detailed and expensive pathological investigations of freshly harvested central and peripheral nervous system tissues on many cases to unravel the mystery of shivers.”32 It is possible that neurotransmitter defects may be responsible.9

**Myopathic Cause**

In one study17 involving a yearling Clydesdale gelding with a clinical diagnosis of shivers, muscle biopsies showed decreased carbohydrate content in type II muscle fibers. It was thought that horses with shivers may have less stored glycogen, and thus, they deplete their stores more rapidly. This may lead to localized muscle cramping, manifesting itself when the horse was forced to move backwards.17 It has also been suggested that the underlying cause of shivers may be a metabolic myopathy resulting in muscle weakness and cramping.7 However, it was stated that if shivers was the result of an underlying myopathy, it would seem that there is little correlation between the severity of clinical signs and the severity of histologic findings.7

Sullins12 found it difficult to positively attribute the signs of shivers to glycogen-storage abnormalities, because so many asymptomatic draft horses have these abnormalities. In a recent study8 involving 103 Belgian draft horses, 31 had polysaccharide storage myopathy (PSSM) but did not have shivers, 13 had shivers but did not have PSSM, 6 had both PSSM and shivers, and 53 did not have PSSM or shivers. No significant association was found between a diagnosis of PSSM and a diagnosis of shivers. The mean muscle-glycogen concentration for horses with PSSM but not shivers (207 ± 56 mmol/kg) was significantly higher than the mean concentration for horses with shivers but not PSSM (122 ± 40 mmol/kg). The conclusion was that PSSM and shivers were common but unrelated disorders in Belgian draft horses.8

**Genetic Cause**

Many have suggested that shivers is inherited or has a hereditary pre-disposition,1,2,3,10,13,19,20,31,36 and although this has not been proven,1,3,15 a familial tendency is suspected.15 In some countries, it is recommended that stallions with this disease not be used for breeding purposes.15 In the United Kingdom, shivering has been classified as an hereditary disease under the Horse Breeding Act of 1918.16

**Infectious Disease**

Some have suggested that the occurrence of shivers may be preceded more or less remotely by an attack of influenza, strangles, or other systemic infections.3,5,12–14,16,22,27,45 This led to the suggestion that shivers is connected with neuropathic lesions produced by infection or toxins derived from an antecedent disease.3

**Trauma**

Cases of shivers have also been attributed to accidental injuries like those incurred from a severe fall.2,4,16 However, the connection, if any, has not been determined.3,16 In the 1930s, it was stated that “a horse which is a shiverer will always show some evidence of osteoarthritis, often clinically, but certainly on post-mortem examination.”30 The investigator contended that shivering was caused by osteoarthritis affecting the vertebral column and that the varying site of muscular spasm depends on the nerve roots implicated.30,47 The greater frequency of signs in the hindlimbs was attributed to the peculiar anatomical relationship of the intervertebral foramina associated with the last three lumbar nerves that form the lumbo-sacral plexus.30

**7. Treatment**

There is currently no effective treatment for shivers.3,5,6,10,12–16,19,22,27,30,45 Occasionally, the signs improve or regress after long periods of rest3,6,11,13,15,22,25,27,33 but the condition returns when work is resumed.17 It has been suggested that dietary treatment of affected draft horses with a high-fat, low-carbohydrate feed may be beneficial if instituted early in the course of the disease.4 However, the clinical signs of shivers in horses did not resolve when affected Warmblood or Warmblood-cross horses were fed grass hay and a high-fat supplement instead of dietary grain. These dietary recommendations were combined with a gradually increasing daily exercise program and maximal turnout.26

**8. Course of the Disease**

In many horses, the clinical signs of shivers may remain static.25 However, in almost all cases, the condition is a slowly progressive and debilitating disease.1,2,3,6,7,10,12–15,19,20,22,27,33,36 Horses that are slight “shiverers” may work satisfactorily for many years, but eventually, the spasms increase both in frequency and severity.2,3,7,25,27 Hunting horses...
that are occasional shiverers may hunt and jump for several years without problems, but eventually, they lose power behind; although able to gallop and willing to jump, they are unable to clear the obstacle with the hindlimbs or rise sufficiently to jump a moderate fence.\textsuperscript{1,11,15,16,21,27} It has been stated that shivering involving the forelimbs seldom interferes with an animal’s capacity to work.\textsuperscript{3} The signs gradually increase in severity and intensity until the horse is eventually rendered useless.\textsuperscript{27}

9. Prognosis

The prognosis for affected individuals is generally unfavorable\textsuperscript{5,6,12,13,16,23,27} to poor,\textsuperscript{22,28} because the disease is usually progressive.\textsuperscript{2,12,22} In a horse with shivers, the tendency is for the spasms to increase both in frequency and severity.\textsuperscript{1,15,16} The long-term prognosis for athletic function is grave.\textsuperscript{15} Eventually, shivers symptoms may result in death or euthanasia because of profound weakness, muscle wasting, and apparent discomfort and incapacitation associated with episodic muscle cramping.\textsuperscript{15,19,24}

References

2. McCall JR. “Stringhalt” and “shivering,” in Proceedings. 28th General Meeting of the National Veterinary Association 1910;23–56.