Kentucky Equine Research®

World Leaders In Equine Nutrition

TECHNICAL BULLETIN

Nutritional Considerations for Horses with Myopathies

Muscle pain and impaired performance that occurs during or after exercise is known as exertional myopathy and more colloquially as tying-up. In the context of athletic horses, any myopathy has the potential to derail performance, either temporarily or permanently. Some myopathies are so severe that, when left unaddressed, horses are unable to be used for any athletic endeavor, even casual riding.

Over the last four decades, research has led to a more sophisticated understanding of myopathies, including enhanced diagnostic techniques. While genetic testing is available for some myopathies, diagnosis of other diseases depends on microscopic examination of muscle biopsies from horses.

The most common diagnosed myopathies are sporadic and recurrent exertional rhabdomyolysis, polysaccharide storage myopathy, and myofibrillar myopathy. Thoughtful management strategies, including careful attention to nutrition and exercise requirements, relieve clinical signs of disease entirely in some horses, allowing them to perform comfortably.

Sporadic Exertional Rhabdomyolysis

Sporadic exertional rhabdomyolysis usually arises from extrinsic factors such as exercise in excess of fitness, including accelerated training programs, or nutritional imbalances, whereas chronic disease originates from intrinsic abnormalities in muscle function, which may be attributed to a single gene defect, multiple gene flaws, or gene products that arise under certain environmental stimuli.

- **Primary breeds affected:** Thoroughbreds, Standardbreds, Arabians, Quarter Horses, and Warmbloods.
- **Clinical signs:** muscle stiffness, muscle pain over the loin and croup, muscle tremors, shortened hindlimb stride, reluctance to move, anxiety, excessive sweating, and increased respiratory rate.
- **Risk factors:** unfit horses, horses with concurrent viral infections, unbalanced diets, and/or electrolyte imbalances.
- **Diagnosis:** muscle damage can be determined through the measurement of two proteins, creatine kinase and aspartate transaminase, which are released into the bloodstream by damaged muscle.

Nutrient requirements for sporadic exertional rhabdomyolysis

Nutrient requirements vary depending on the horse's size, breed, discipline, and work intensity. Digestible energy requirements, for example, may vary from near maintenance to twice maintenance.

- **Forage:** high-quality forage, preferably grass or grass-legume mixed hays, at 1.5-2% of body weight per day for most performance horses.
- **Energy sources:** concentrate with moderate levels of nonstructural carbohydrate (NSC) (20-30%), fat (4-8%), and fiber (20-30% NDF); horses with sporadic exertional rhabdomyolysis do not benefit from increased dietary fat, so addition of fat should depend on dietary needs.
- **Concentrate:** depends on energy requirement of horse as well as the quality and quantity of forage; if low amounts of concentrate are required (less than 6 lb/day), supplemental protein, vitamins, and minerals may be required in the form of appropriately fortified ration balancer pellets; underweight horses might benefit from stabilized rice bran (1-2 lb/day).
- **Supplements:** natural-source vitamin E such as Nano-E® for antioxidant protection and selenium if serum levels warrant; free-choice access to salt as well as a well-formulated commercial electrolyte supplement such as Restore® SR (depending on sweating, amount of electrolyte may range from 30-150 g/day); when furosemide is given use the specially formulated electrolyte Race Recovery™.

Recurrent Exertional Rhabdomyolysis

Recurrent exertional rhabdomyolysis (RER) is an intermittent form of tying-up in horses that appears to involve an abnormality in the intracellular calcium regulation.

- **Primary breeds affected:** racing horses, such as Thoroughbreds, Standardbreds, Arabians, as well as Warmbloods in training.
- **Clinical signs:** muscle stiffness, muscle pain over the loin and croup, muscle tremors, shortened hindlimb stride, reluctance to move, anxiety, excessive sweating, and increased respiratory rate during or shortly after exercise
- **Risk factors:** fit mares are more commonly affected than geldings and stallions, though no correlation has been observed between episodes of recurrent exertional rhabdomyolysis and estrous cycle; horses with a nervous or high-strung disposition, especially fillies, have a higher incidence of recurrent exertional rhabdomyolysis than calmer horses; younger horses seem more predisposed than older horses (two-year-olds are affected more than three-year-olds, three-year-olds more affected than four-year-olds); and those fed more than 10 lb of concentrate daily.
- **Diagnosis:** though no specific diagnostic test is available, a history of repeated episodes in well-conditioned horses on balanced diets with elevations in serum creatine kinase activity; in some cases a muscle biopsy may reveal certain characteristics of RER.

Nutrient requirements for recurrent exertional rhabdomyolysis

Nutrient requirements vary depending on the horse's size, breed, discipline, and work intensity. Digestible energy requirements, for example, may vary from near maintenance to twice maintenance. Because recurrent exertional rhabdomyolysis occurs most frequently in Thoroughbred and Standardbred racehorses, energy requirements are likely to be high.

- **Forage:** high-quality forage, preferably grass or grass-legume mixed hays, at 1.5-2% of body weight per day for most performance horses; anecdotal reports suggest some horses fed alfalfa may have more frequent episodes of exertional rhabdomyolysis, so alfalfa should be avoided on an individual basis; horses predisposed to gastric ulcers may benefit from alfalfa hay.
- **Energy sources:** substitution of fat for NSC in energy-dense rations significantly reduces muscle damage in exercising horses; specialized feed such as RE-LEVE® that contributes no more than 20% of daily digestible intake as NSC and between 20-25% of daily digestible intake as fat.
- **Concentrate:** for racehorses, concentrates should contain 12-18% NSC and 10-13% fat; these feeds often contain alternative energy sources such as highly digestible fiber (beet pulp, soy hulls); some racehorse trainers that feed low-starch, high-fat feeds prefer to supplement with a titrated amount of grain three days prior to a race to potentially boost liver glycogen and increase energy during the race.
- **Supplements:** underweight horses might benefit from stabilized rice bran (1-2 lb/day); free-choice access to salt as well as a well-formulated commercial electrolyte supplement such as Restore SR (depending on sweating, amount of electrolyte may range from 30-150 g/day); when furosemide is given, use the specially formulated electrolyte Race Recovery; selenium and natural-source vitamin E if serum levels warrant.

Polysaccharide Storage Myopathy

Polysaccharide storage myopathy (PSSM) is characterized by the presence of abnormal polysaccharide inclusions in muscle biopsies. This disease is divided into two classifications.

Type 1 polysaccharide storage myopathy (PSSM1)

Type 1 polysaccharide storage myopathy (PSSM1) is caused by a distinctive genetic mutation that results in elevated glycogen synthase activity and higher muscle glycogen concentrations in skeletal muscle. The enzyme mutation enhances synthesis of glycogen and appears to disrupt metabolism of this energy substrate.

- **Breeds affected:** stock-type breeds (Quarter Horses, Paints, Appaloosas) and drafts (Percherons and Belgians primarily).
- **Clinical signs:** muscle stiffness, painful hindquarter muscles, shortened hindlimb stride, reluctance to move, anxiety, sweating,

and increased respiratory rate; severity of clinical signs vary from asymptomatic to complete incapacitation.

- **Risk factors:** light exercise, particularly after the horse has been rested for several days beforehand; diets high in NSC.
- **Diagnosis:** genetic testing performed on whole blood or hair root samples or muscle biopsy.

Nutrient requirements for PSSM1

Because many horses with PSSM are easy keepers, meeting but not exceeding their caloric requirement for optimal body condition is an important consideration, as are regular turnout and daily exercise. Even 10 minutes of daily exercise is beneficial in reducing muscle damage.

- **Forage:** hay with 12% or less NSC, as higher levels raise insulin and stimulate the already overactive enzyme glycogen synthase in the muscle, fed at 1–1.5% of body weight per day; pasture restriction often necessary through the use of a grazing muzzle or drylot; sourcing appropriate hay will likely require forage analysis.
- **Energy sources:** carefully selected forage based on forage analysis and fat sources such as oil (soybean, canola) with appropriate carrier.
- **Concentrate:** low-starch, high-fat feeds with less than 15% NSC; if calories are needed 10–12% fat can be included if concentrate intake is low (less than 4.5 lb) and may be vegetable oil or stabilized rice bran; hydrated beet pulp as a carrier for vegetable oil; balancer pellet to satisfy protein, vitamin, and mineral requirements. RE-LEVE is the original, research-proven feed for horses with PSSM1 that require additional calories in their diet, such as those in hard work.
- **Supplements:** a nanodispersed, natural-source vitamin E such as Nano-E and coenzyme Q10 in the form of Nano-Q10™ will provide superior antioxidant protection to horses fed high-fat diets; free-choice access to salt as well as a well-formulated commercial electrolyte supplement such as Restore SR (depending on sweating, amount of electrolyte may range from 30–150 g/day).

Type 2 polysaccharide storage myopathy (PSSM2)

Type 2 polysaccharide storage myopathy (PSSM2) is a histopathologic designation that indicates the presence of abnormal polysaccharide in muscle biopsies of horses lacking the genetic mutation found in horses diagnosed with PSSM1. The term PSSM2 does not indicate a specific etiology since no common genetic mutations or biochemical aberrations have been observed in these horses.

- **Breeds affected:** Quarter Horses and related breeds (Paints, Appaloosas, etc.), other light breeds (Morgans, Arabians, Standardbreds, Thoroughbreds), some Warmbloods.
- **Clinical signs:** in Quarter Horses and related breeds, elevated muscle glycogen concentrations in addition to traditional clinics signs, such as muscle stiffness, painful hindquarter muscles, shortened hindlimb stride, and reluctance to move, increased serum creatine kinase and aspartate transaminase; in Warmbloods, exercise intolerance or poor performance rather than overt clinical signs and occasional increased serum creatine kinase and aspartate transaminase.
- **Diagnosis:** muscle biopsy.

Nutrient requirements for PSSM2

For Quarter Horses diagnosed with PSSM2, the dietary recommendations given for PSSM1 are appropriate. For Arabians and Warmbloods that show normal glycogen concentrations and no sign of myofibrillar myopathy on muscle biopsy, a low-NSC diet may not be necessary.

- If horses show clinical signs of tying-up with high serum creatine kinase activity, the nutritional recommendations for RER offered herein should be followed.

Myofibrillar Myopathy

Myofibrillar myopathy is a disorder defined by specific histopathology, primarily cytoplasmic aggregates of the cytoskeletal protein desmin in scattered muscle fibers. Within muscle fibers, desmin helps align sarcomeres and tether them to the cell membrane. Arabian and Warmblood horses previously diagnosed with PSSM2 may represent early cases of MFM.

- **Breeds affected:** Warmbloods and Arabians (especially those involved in endurance).
- **Clinical signs:** in Warmbloods, insidious onset of exercise intolerance characterized by lack of stamina, unwillingness to go forward, inability to collect, abnormal canter transitions, and inability to maintain a normal canter, unresolved hindlimb lameness, stiffness, muscle pain; in Arabians, history of intermittent elevations in serum creatine kinase activity after exercise that follows a week or more of rest, signs of exertional rhabdomyolysis (pain, reluctance to move, sweating) that are less severe than RER and occur at the end of endurance races.
- **Diagnosis:** muscle biopsy.

Nutrient requirements for myofibrillar myopathy

Nutrient requirements focus on provision of high-quality protein and supplementation of specific amino acids.

- **Forage:** high-quality forage, preferably grass or grass-legume mixed hays, at 1.5–2% of body weight per day.
- **Energy sources:** although Warmbloods are often fed low-NSC, high-fat diets, horses with myofibrillar myopathy do not necessarily need these diets, as fat, a potential source of oxidative stress, may not benefit them; endurance Arabians are often fed high-fat diets as they depend on fat oxidation during exercise, but myofibrillar myopathy in Arabians is related to oxidative stress, so extremely high fat intake may be counterproductive.
- **Concentrate:** should include higher levels of protein (12–14%), including high-quality amino acids, and moderate levels of NSC (20–30%) and fat (4–8%).
- **Supplements:** because of the increased cysteine requirement, horses with myofibrillar myopathy should be given MFM Pellet™, a supplement that contains cysteine and other key amino acids; when coupled with amino acid supplementation coenzyme Q10 in the form of Nano-Q10 will boost antioxidant protection.

Successful management of horses with myopathies often requires a team approach with cooperation from many professionals, namely veterinarians and nutritionists. Adherence to specific diets and exercise routines can completely change the lives of certain horses diagnosed with a myopathy.

Differential Diagnoses

Other diseases may also cause problems in horses, sometimes by mimicking the clinical signs of the diseases featured in this guide. These include shivers, seasonal pasture myopathy, hyperkalemic periodic paralysis, and myosin heavy chain myopathy, among others. An experienced veterinary specialist can help sort through the clinical signs and diagnostic tests necessary to achieve an accurate diagnosis.

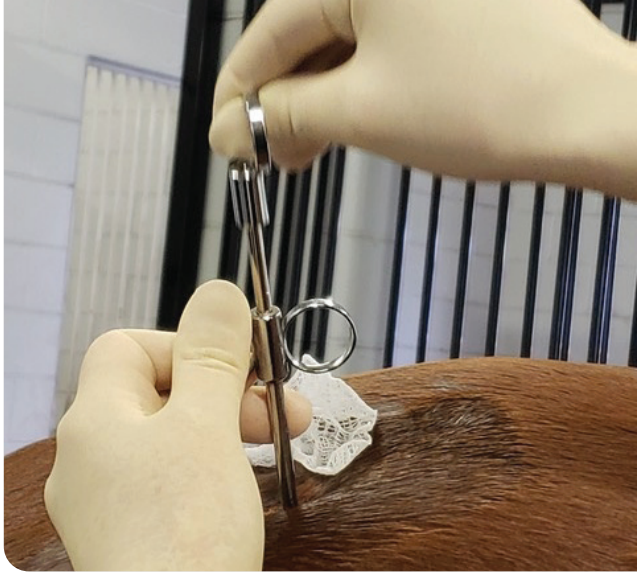
Accurate Diagnosis

Analysis of muscle biopsies can help characterize the cause of a horse's rhabdomyolysis or muscle atrophy. Recurrent exertional myopathy, polysaccharide storage myopathy, and other myopathies have different patterns of damage at the cellular level and can be diagnosed based on the results of the muscle biopsy. Genetic testing is available for certain myopathies. Kentucky Equine Research recommends diagnostic services offered through the Equine Neuromuscular Diagnostic Laboratory at the Michigan State University, College of Veterinary Medicine.

About Kentucky Equine Research

For over 30 years Kentucky Equine Research® has continually developed innovative solutions to the health and nutritional challenges inherent in modern equine management. The results of studies conducted at its research farms, as well as advances in equine nutrition from institutions around the world, are applied and thoroughly tested in the creation of KER products.

KER Targeted Nutrition is a brand of innovative equine health and nutrition supplements developed by Kentucky Equine Research, the leader in equine nutrition technology.



FURTHER READING:

Pagan, J.D., and S.J. Valberg. 2020. Feeding performance horses with myopathies. In: Proc. American Association of Equine Practitioners Convention 66:66-74.

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