

TYING-UP IN HORSES

Research Leads to Dietary and Exercise Management Strategies

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Tying-up, at the turn of the 20th century, was a fairly common occurrence in work horses, especially draft horses. After resting on Sunday, horses began their work routines Monday morning. Within 30 minutes, some horses developed signs of stiffness, cramping, and pain in rear leg muscles. They could become so stiff they were unable to move. This syndrome became known as "Monday Morning Disease" or "Tying-up," describing the knotted, painful muscles.

Today, horses are used primarily for race, show, and pleasure. Despite the changes in breeds and usage, tying-up still persists as the most common muscle problem in horses. This syndrome has also been called azoturia, set fast, paralytic myoglobinuria, and chronic exertional rhabdomyolysis. Hyperkalemic Periodic Paralysis (HYPP), which occurs in descendants of one Quarter Horse stallion, is a completely different muscle function disorder.

Energy Metabolism

Horses produce energy in muscle using two pathways - aerobic and anaerobic. Aerobic metabolism occurs with light exercise (walk, trot, canter), when oxygen is plentiful at the muscular level. Anaerobic metabolism occurs during maximal exercise (galloping), when the body cannot deliver oxygen to the muscles fast enough. Lactic acid is a by-product of anaerobic metabolism and must later be broken-down into non-acidic compounds in the muscle.

In early investigations of draft horses, the cause of recurrent tying-up was thought to be an accumulation of excess glycogen (sugar) in muscles during the rest day. When horses were exercised the next day, the glycogen was thought to be rapidly metabolized anaerobically (without oxygen). The cause of tying-up was suggested to be excessive amounts of lactic acid forming in the horses' muscles. The lactic acid was believed to cause muscle damage. Current research has proven this to be incorrect in all forms of tying-up that have been studied. Horses often tie-up during aerobic exercise, long before their muscles are functioning anaerobically. In fact, very little lactic acid is found in the muscles of horses that tie-up.

Symptoms of Tying-up

Classic tying-up symptoms include sweating, stiffness, and reluctance to move forward. Some horses with chronic tying-up may learn to resent exercise because of the pain it produces. These symptoms are all manifestations of pain due to muscle damage that is most severe in the rear legs. Severe muscle damage results in a break-down of muscle protein, producing a compound that causes the urine to turn dark brown.

Tying-up is not a single disease, but a collection of clinical signs or symptoms that may have several causes. Horses may have similar symptoms, but the actual cause of muscle cramping may be different in each horse. A number of specific causes for tying-up have already been identified and more are on the research horizon.

Clinically, horses can be classified as having either a sporadic or chronic form of the syndrome. The sporadic form is seen in horses that have always exercised normally, but suddenly exhibit signs of tying-up. These horses usually recover with rest and treatment, and go on to perform successfully. A smaller proportion of horses can be classified as having chronic tying-up. From a very young age, horses with chronic tying-up have continual tying-up problems even when exercised lightly.

SPORADIC TYING-UP

Sporadic tying-up can occur:

When a horse is exercised in excess of training - Muscle damage can occur when a horse is required to exercise longer or more strenuously than its muscle condition level allows, especially after an idle period of a few days to months. Similarly, a working horse may have its training program accelerated too quickly, overstepping its fitness level.

During exhaustive exercise - Exhaustive exercise may include long trail rides or endurance competitions especially on hot, humid days. These horses may tie-up even though they are fit enough to perform the required task. Long-term exercise leads to high-body temperatures, loss of necessary electrolytes (salts) in sweat, and depletion of energy stores. These losses create metabolic imbalances that lead to muscle dysfunction and damage.

When trauma has occurred - Physical trauma is the third major cause for sporadic tying-up. When involved in a struggle; for example, when caught in a fence, a horse may struggle so fiercely that muscles are torn. Physical trauma can cause muscle stiffness and signs consistent with tying-up for several days after the incident.

After respiratory infections - Horses should not be exercised if they have a fever, acutely develop a cough, and have a nasal discharge. Tying-up seems more common after viral infections have spread through a barn.

During surgery - Horses that lie on their side for several hours during surgery are prone to develop muscle damage due to inadequate blood circulation.

CHRONIC TYING-UP

Unfortunately, some horses continue to develop muscle stiffness even though all management recommendations for treatment are followed. Chronic tying-up or chronic exertional rhabdomyolysis (ER) is seen in young horses that have continual tying-up

problems, even after light exercises. This syndrome has been described in many breeds and, in some cases, new evidence has described a specific cause.

Diet appears to play a role in some forms of ER. Horses' dietary needs vary, and a nutrient imbalance can cause ER. Key electrolytes, minerals that function primarily in body fluids and tissues, include sodium, potassium, and chlorine. Other key minerals include calcium, phosphorus, and selenium. In some athletic horses, a normal diet of oats and hay may not provide sufficient minerals to fulfill demands placed on the muscle. Simply supplementing the ration with a balanced vitamin/ mineral mixture including salt may resolve or alleviate the symptoms.

Unfortunately, the majority of horses with ER do not respond to mineral supplementation and a more thorough investigation into the cause of ER is necessary. These evaluations necessitate the cooperation of the horse owner/trainer, their veterinarian, and often consultation with a veterinary medical specialist. A "work-up" for ER involves evaluation of urine and serum electrolytes and minerals, measurement of muscle enzymes released into the serum pre- and post-exercise, and evaluation of muscle biopsies.

By examining the electrolyte content of blood and urine samples taken at the same time, a deficiency of salts may be detected. Serum levels of creatine kinase (CK) and aspartate aminotransferase (AST) document muscle damage and its relationship to mild and extensive exercise. Muscle biopsies can document chronic and acute muscle damage and, in some cases, can be used to diagnose a specific cause of ER.

Polysaccharide Storage Myopathy

One cause of chronic ER in Quarter Horse-related breeds, Draft horses and Warmbloods is a metabolic defect called polysaccharide storage myopathy (PSSM). This is the most common cause of ER in Draft and Quarter Horse-related breeds and one of two forms of ER in Warmbloods.

Like the early descriptions of Monday Morning Disease, horses with PSSM have been found to store an excess of glycogen (sugar) in their muscles. Microscopic examination shows that a proportion of the glycogen is stored in an abnormal fashion and is not available for energy production. Recent research shows that horses with PSSM have a greater sensitivity to insulin, a hormone that increases transport of sugar into skeletal muscle.

Horses with PSSM have an increased supply of sugar or glycogen in the muscle, which accumulates, and if horses are rested for long periods this situation is made even worse. The excess sugar and sugar byproducts disrupt the balance of energy metabolism, and the muscles of these horses cramp and become stiff. However, the lactic acid level in these horses, when they are tied-up, is actually very low. Treatment of horses with PSSM involves supplying them with feed that maintains low blood sugar and low blood insulin concentrations.

Grains and sweet feeds are high in starch and sugar and should be avoided. Fats are calorically dense and provide energy without increasing blood glucose and insulin levels. The use of high fat supplements, such as stabilized rice bran (20% fat), instead of grain in the diet of these horses can be very beneficial. Fats become the primary source of concentrated energy, and grass hay provides additional energy as well as the necessary amount of fiber. The amount of fat to feed depends on the horse's body condition.

Easy keepers should be kept slim by feeding hay and about 2lb of rice bran/day. Picky eaters may prefer pelleted rice bran products. Without additional changes in the daily exercise routine, horses with PSSM will continue to have problems, with or without a fat supplemented diet. To prevent muscle stiffness, horses with PSSM should be turned-out as frequently as possible and exercises regularly. If they have been laid-up for more than a few days, they should be returned to work very gradually. Stall rest or an irregular exercise program may result in another episode of tying-up.

Horses with mild to moderate clinical signs of PSSM may be able to return to full athletic performance with careful dietary management and regular daily exercise without extended periods of inactivity.

Recurrent Exertional Rhabdomyolysis (RER)

Other breeds of horses, such as Arabians, Standardbreds, some Warmbloods, and Thoroughbreds, may tie-up for completely different reasons. Current research indicates another cause of tying-up exists in these breeds that is related to an abnormality in the way the muscle cells regulate intracellular calcium during muscle contraction. This form of tying-up has been called recurrent exertional rhabdomyolysis (RER). Energy metabolism in horses with RER appears to be normal, and no excessive glycogen storage or polysaccharide accumulation has been found.

Recurrent exertional rhabdomyolysis occurs most commonly in Arabian, Standardbred, and Thoroughbred horses. It occurs in about 5% of racing Thoroughbreds, especially in young, nervous fillies. Episodes of muscle stiffness usually occur when exercise and excitement combine such as at a horse show, after a steeplechase, or when being held back to a slower pace than the horse desires. In Standardbreds, tying-up often occurs after 15 minutes of jogging. The most practical approach to treating these horses is to organize their routines to minimize excitement and stress and decondition them to excitable stimuli. Provision of daily turnout and daily exercise with little time spent standing in a stall also helps keep horses calm.

One of the challenges of feeding horses in heavy training that are predisposed to RER is maintaining enough calories without feeding so much grain that they become high-strung. Keeping grain (sweet feed) to a maximum of 5 lb/day and supplying extra energy in the form of fat has been proven to decrease episodes of tying-up with RER. Four lb of stabilized rice bran, 2 cups of corn oil, or newly developed feeds designed for horses with RER are good energy sources for horses in moderate to heavy training.

Conclusion

In recent years, dramatic advances have occurred in the characterization of tying-up and other muscle diseases in horses. Continual research is needed to develop the best diagnostic tests and treatments for various forms of tying-up. New information provides treatment options, such as diet manipulation, that can be directed toward alleviating the specific cause of the muscle disorder in an individual horse. Investigators are hopeful that research information will help owners and trainers deal with these often frustrating and painful muscle conditions.

MANAGEMENT SUGGESTIONS FOR TREATING ACUTE TYING-UP

- Stop exercising the horse and move to a box stall. Do not force the horse to walk.
- Call your veterinarian.
- Blanket the horse if weather is cool.
- Determine if the horse is dehydrated due to excessive sweating. Pinched skin will normally spring back and saliva should be wet, not tacky.
- Provide fluids: small, frequent sips of water. Electrolytes (potassium, sodium, and chlorine) may be added to drinking water, if palatable to the horse. Plain water should always be available as an alternative. If the horse is dehydrated, intravenous fluids may be needed. Once cool, the horse may have free access to water.
- Relieve anxiety and pain. Drugs may be prescribed by your veterinarian
- Remove grain. Feed only hay until symptoms subside.
- Use small paddock turnout once the horse walks freely, usually in 12-24 hours.
- Slowly recondition the horse to the previous work level.
- If the problem reoccurs have the horse evaluated for a specific cause of ER.
- Modify the diet - less grain, more fat and ensure mineral intake is adequate and balanced.