

# Untying issues related to tying up

Muscle condition in horses can be managed with exercise and diet

BY JOE D. PAGAN, PH.D.

**T**YING UP is a generic term commonly used to describe muscle disease in racehorses or other performance horses. Other terms often used interchangeably with tying up include exertional rhabdomyolysis, azoturia, and Monday morning disease.

For years, horses that tied up after exercise were thought to suffer from the same disease. However, treatment and prevention protocols that worked on some horses did not work on others. As a result, confusion and sometimes controversy developed regarding the cause and treatment of tying up.

Clinical signs of tying up include a stiff gait, reluctance to move, firm and painful muscles, profuse sweating, accelerated heart rate, and increased respiratory rate. In addition to clinical signs, horses that tie up will have moderate to marked elevations in blood levels of myoglobin, creatine kinase (CK), lactate dehydrogenase (LDH), and aspartate aminotransferase (AST). Such



Tying up causes horses to suffer a variety of symptoms that include cramping muscles, profuse sweating, and increased heart rate, but the disease can be treated with effective management and proper nutrition

individual better conditioned to sit behind a desk.

For horses that actually tie up, muscle soreness is much more severe and is typically accompanied with elevated muscle proteins in the bloodstream and myoglobinuria (coffee-colored urine). The darkening of the urine is a result of the kidneys filtering myoglobin (a muscle protein) from blood, an indication of severe muscle damage. The most frequent causes of sporadic tying up are exercise that exceeds a horse's level of training, electrolyte imbalances, hyperthermia, and strenuous exercise while suffering from a respiratory disease.

Sporadic tying up should be considered a veterinary emergency if horses are sweating profusely, reluctant to move, or have dark urine.

Veterinarians may administer medicine to relieve anxiety and muscle pain. In addition, corrections in hydration are made to account for fluid losses and myoglobinuria that may impair kidney function. Further treatment strategies include stall rest followed by hand walking and turnout once initial muscle stiffness has resolved. Grain intake should be drastically reduced or eliminated because these horses are likely to be on a reduced exercise

elevations indicate muscle cell damage and are considered a diagnostic tool to detect tying up.

Researchers only recently have

begun to classify and study the many different disease conditions that result in the common symptoms of tying up. Initial classification of tying up is now based on frequency of the disease symptoms following exercise. Horses that tie up only a few times in their lifetime are classified as "sporadic," while those horses that tie up on a repeated basis are termed "chronic."

The following is a brief discussion of both sporadic and chronic tying up and steps that can be implemented to help prevent the disease. Much of the research involving the disease itself and treatment and prevention protocols has been con-

ducted by a group led by Stephanie Valberg, D.V.M., Ph.D., at the College of Veterinary Medicine at the University of Minnesota.

### Sporadic tying up

Many horses experience some muscle soreness and strain associated with exercise. These horses often are mistakenly thought to be suffering from a specific muscle disease. Inadequate warm-up, pre-existing lameness, exercise to the point of fatigue, and insufficient training can result in muscle soreness and injury. A similar human scenario might be overexertion from strenuous physical activity for an

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program. The amount of time the horse must remain out of training has not been firmly established, however any training regime following an episode of tying up should be resumed gradually and consistently to prevent further muscle damage.

Sound management practices and training may help prevent tying up. Learning not to overexert unfit horses and remembering to fortify the diet with salt on a daily basis as well as electrolytes prior to heavy sweat loss are logical strategies.

Adjusting the amount of grain fed to satisfy the energy needs of the horse is also tremendously important. For example, horses should not be overfed carbohydrates (grain) as this may be a potential cause of tying up.

Feeding grain concentrates fortified with fat and necessary antioxidant vitamins and minerals will provide energy while supplying the building blocks to protect muscle tissue. The combination of these strategies will often prevent healthy horses from having another bout of tying up.

## Chronic tying up

When horses have repeated episodes of tying up, the disease is considered chronic. Many different breeds of horses have been reported to have chronic bouts of tying up, including Thoroughbreds, Quarter Horses, Standardbreds, Paints, Morgans, Arabians, and various breeds of draft and warmblood horses.

The proposed causes of chronic tying up include electrolyte imbalances, hormonal imbalances, hypothyroidism, vitamin E deficiency, and selenium deficiency.

While chronic episodes of tying up are frustrating and painful for both horses and their owners, it is the study of these chronic cases that has advanced the knowledge of the causes, treatment, and prevention of the problem.

Three specific causes of chronic tying up have recently been identified in the horse. These causes include a muscle contraction disorder (recurrent exertional rhabdomyolysis or RER) and two forms of a disorder in carbohydrate storage and utilization (polysaccharide storage myopathy or PSSM).

## Recurrent exertional rhabdomyolysis

RER is common in nervous fillyies of Arabian, Standardbred, and Thoroughbred breeding. These individuals often develop the condition when they are excited, stressed, or have had a period of stall rest preceding exercise. Preliminary genetic research and breeding trials point to this condition as an inherited trait in Thoroughbred and Standardbred horses.

The exact cause of RER in horses has challenged scientists for several years. RER in racehorses was believed to be similar to lactic acidosis. However, recent research has shown muscle lactate concentrations to be low, not high, in these horses when tying up occurs. Most

recently, RER is thought to be an abnormality in the way muscle contraction is regulated in the horse.

Muscle biopsies from horses with RER have revealed an increased sensitivity to contraction when exposed to various chemicals compared with normal horses. The altered contraction and relaxation of muscle suggests that abnormal intracellular calcium regulation is the cause of RER. This is unrelated to dietary calcium intake.

Treatment of horses experiencing RER requires veterinary assistance and management designed to make the horse comfortable and prevent further stress and muscle damage.

The use of sedatives prior to exercise to calm a nervous horse is also a common practice. Other drugs designed to regulate intracellular sodium and calcium are now being prescribed for horses. Daily exercise for horses diagnosed with RER is essential. Beginning approximately 24 hours after an RER episode, horses should be hand walked or turned out on a daily basis. Prolonged stall rest seems to be counterproductive and may predispose the horse to further episodes of RER once training resumes. A gradual return to full training can begin once serum levels of CK, an enzyme leaked by injured or diseased muscles, have almost returned to normal. Prevention of further episodes of RER is difficult. Controlling the environment of these horses is essential. An environment that is not stressful with a well-established daily routine seems to help.

## Grain intake

High grain intake is associated with tying up in racehorses. Research at the University of Minnesota, in conjunction with Kentucky Equine Research, suggests that replacing the grain in the diet with a low-starch, high-fat feed will significantly decrease the amount of muscle damage in horses suffering from RER.

In a feeding trial, Thoroughbred horses with RER were exercised on a treadmill for five days a week while they consumed hay and a variety of energy supplements. When the daily caloric intake of a high-starch ration was kept low, the horses had lower post-exercise serum CK than when this feed was increased to a level commonly fed to racehorses.

By comparison, if extra calories were provided from the low-starch, high-fat feed Re-leve, no increase in post-exercise serum CK activity occurred. Since these studies were conducted, Re-leve has been used to successfully manage RER in hundreds of Thoroughbred racehorses around the world.

Most horses with RER have medium to high energy requirements and need significant calories supplied above those found in the forage portion of the ration. An appropriate feed should be fortified to be fed at fairly high levels of intake (eight to 13 pounds per day). It should be low in nonstructural

carbohydrates (less than 10%), high in fat (more than 10%), and supply a significant portion of its energy as fermentable fiber.

## Polysaccharide storage myopathy

PSSM is a glycogen (muscle sugar) storage disorder that is characterized by the accumulation of an abnormal polysaccharide in muscles. Horses with PSSM are able to quickly clear sugar from their blood and store 1½ to four times the normal amount of muscle glycogen. Accumulation of an excessive amount of muscle glycogen is not due to the inability of these horses to utilize muscle glycogen for energy production, but instead appears to be the creation of more glycogen as well as an abnormal form of muscle glycogen. The abnormal filamentous polysaccharide may be utilized at a much slower rate by the horse and thus accumulates in the muscle.

PSSM has been identified in Quarter Horses, Paints, Appaloosas, draft horses, warmbloods, and a few Thoroughbreds.

Recent research has identified a genetic mutation in the glycogen synthase 1 gene, which causes the most common form of PSSM (type 1) in Quarter Horses and draft-related breeds. Warmbloods and light breeds have another form of PSSM called type 2. Horses with PSSM are different from horses with RER because they display a calm, instead of a nervous, demeanor. Horses with PSSM typically have a history of tying-up problems associated with the onset of training, while the animal is still relatively unfit. Horses

with PSSM exhibit classic tying-up symptoms including long-term elevated levels of muscle enzymes in serum.

A confirmed diagnosis is based on an examination of muscle biopsies with the distinctive feature of abnormal glycogen storage. Type 1 PSSM can now be diagnosed by genetic testing of hair roots or blood samples at the University of Minnesota Veterinary Diagnostic Laboratory. Treatment of horses with PSSM following a tying-up episode involves many of the same veterinary procedures as with other causes of tying up.

Treatment protocols also attempt to minimize the occurrence of future episodes through dietary manipulation. Horses with PSSM should be fed diets low in sugar (grain) and high in fiber and fat. It is important to completely eliminate grain or sweet feed from the diet of horses with PSSM.

A number of studies at the University of Minnesota have confirmed that PSSM can be successfully managed with Re-leve. Daily activity, such as riding or longeing, along with pasture turnout, is essential in minimizing the occurrence of PSSM tying-up episodes. Confinement in stalls for more than 12 hours per day appears to increase the incidence of tying up. It is very important that PSSM horses are kept fit and have consistent daily exercise and turnout.

Research continues to be conducted on factors involved in the cause and treatment of tying up. With careful attention to feeding and exercise programs, this condition can be managed to allow an active and useful life. ★

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