

## Tying Up in Thoroughbred Racehorses

BY HEATHER SMITH THOMAS



COURTESY DR. STEPHANIE VALBERG

Michigan State's Dr. Stephanie Valberg

**MUSCLE PROBLEMS ARE FAIRLY COMMON** in athletic horses. Muscle pain and cramping associated with exercise have been recognized for more than 100 years: Various terms have been used to describe the condition (azoturia, Monday morning disease, etc.). In recent years veterinary researchers found there are several forms of this syndrome with different possible causes, and it is generally called exertional rhabdomyolysis.

Dr. Stephanie Valberg, McPhail Dressage Chair in sports medicine, professor, Michigan State University, has been doing research on muscle problems in horses for many years.

“When we first started doing research on tying up in the 1980s, there was a general assumption all horses tied up for the same reason,” she said.

Her research and that of other scientists showed several causes.

“Exertional rhabdomyolysis (ER) is a clinical description of horses that develop muscle damage and pain with exercise,” Valberg said. “Just like the term colic, there can be many different causes.”

ER is basically broken into two categories: sporadic, and chronic. The latter condition is due to specific inherited abnormalities and can be broken down further into two distinct types—polysaccharide storage myopathy (PSSM) in Quarter Horses, Warmbloods, and draft breeds (horses with heavy muscles), and recurrent exertional rhabdomyolysis (RER) in Thoroughbreds, Standardbreds, racing Quarter Horses, and potentially Arabians and Warmbloods.

The prevalence of RER in Thoroughbred racehorses is about 4.9% in the United States, 5.4% in Australia, and 6.7% in the United Kingdom.

“Some horses, including Thoroughbred racehorses, have sporadic muscle damage,” she said. “The muscle is basically normal, but with some exercise regimes or dietary insufficiencies there may be reasons for individual horses to develop muscle pain and cramping. There is probably no underlying abnormality or functional defect in their muscles; there’s just an imbalance that needs correcting. Those horses usually do fine after they get rested and get over the cramping.”

In those instances, the horses merely did something out of the ordinary that day, and it was too much for their conditioning; they might have strained muscles. It might be just one group of muscles, or the whole body—if they were exercising during extremely hot, humid



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weather and have electrolyte disturbances, for instance. This might result in cramping.

“If diet isn’t balanced (not enough vitamin E and selenium, or inadequate salts during hot, humid weather), this can also predispose horses to problems,” she said. “In these cases, after a tying up episode, if you make sure the horse has a regular training regime, the amount of exercise is not excessive, and the diet well balanced (with electrolytes, vitamins, and minerals), and not too high in grain, these horses do fine if they are rested and then put back into training. They won’t have another episode of tying up.

“There are also episodes in Thoroughbreds of simple muscle cramping that is not exertional rhabdomyolysis. A cramp occurs because the nerve fires and the muscle contracts and then

doesn’t relax, but the muscle isn’t damaged. The muscle becomes tense and stiff, but then the horse seems to be able to walk out of it. If you check the muscle enzymes like CK (creative kinase) or AST (aspartate transaminase) three or four hours after the cramping episode, they would likely be normal. Folks at the track will tell you that their horse tied up and then they put it on the walker and the cramping went away. In those circumstances it might be just muscle cramps and pain and not necessarily muscle damage,” said Valberg.

“In my experience the horses that have exertional rhabdomyolysis, with significant elevations of CK and AST in their bloodstream, get worse if you continue to exercise them. There are two different things that can happen—that are easily confused—and the best way to distinguish them is to measure



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## MEDICATION

Some medications can be helpful during early training though they can't be used when racing. Medications that modulate the shifting of calcium from the intracellular storage sites include Dantrolene.

These drugs can be helpful in reducing serum calcium activity, if given about an hour before exercise.

Dr. Erica McKenzie of Oregon State University has been looking at muscle tying up problems in Thoroughbreds and other horses, and the use of Dantrolene as a possible treatment. Dantrolene is a drug that acts on the calcium-release channel in the muscle. In most horses, tying up is related to a calcium regulation disorder—a dysfunction in the way the muscles handle calcium.

“We started looking at this in 2002,” she said. “Dantrolene works on reducing calcium release within the muscle cells. We performed treadmill trials and did find a positive impact with this drug if we administered it to the horses before exercise.

“Since then, I’ve been looking at Dantrolene in terms of how much to give, whether a person should give it before feeding or not, etc. The most important thing to recognize is that the vast majority of research over the past decade has indicated a lot of these horses can be effectively managed through diet and appropriate exercise regimens. Today this is what we recommend for treating these horses.

“Dantrolene has its niche for treating the horses that are severely affected and can’t be managed adequately through typical

regimes. It is an expensive drug, and dosage depends on the size of the horse. It is fairly short-acting, with some degree of action for about four to six hours. We know it works in Thoroughbred horses,” McKenzie said.

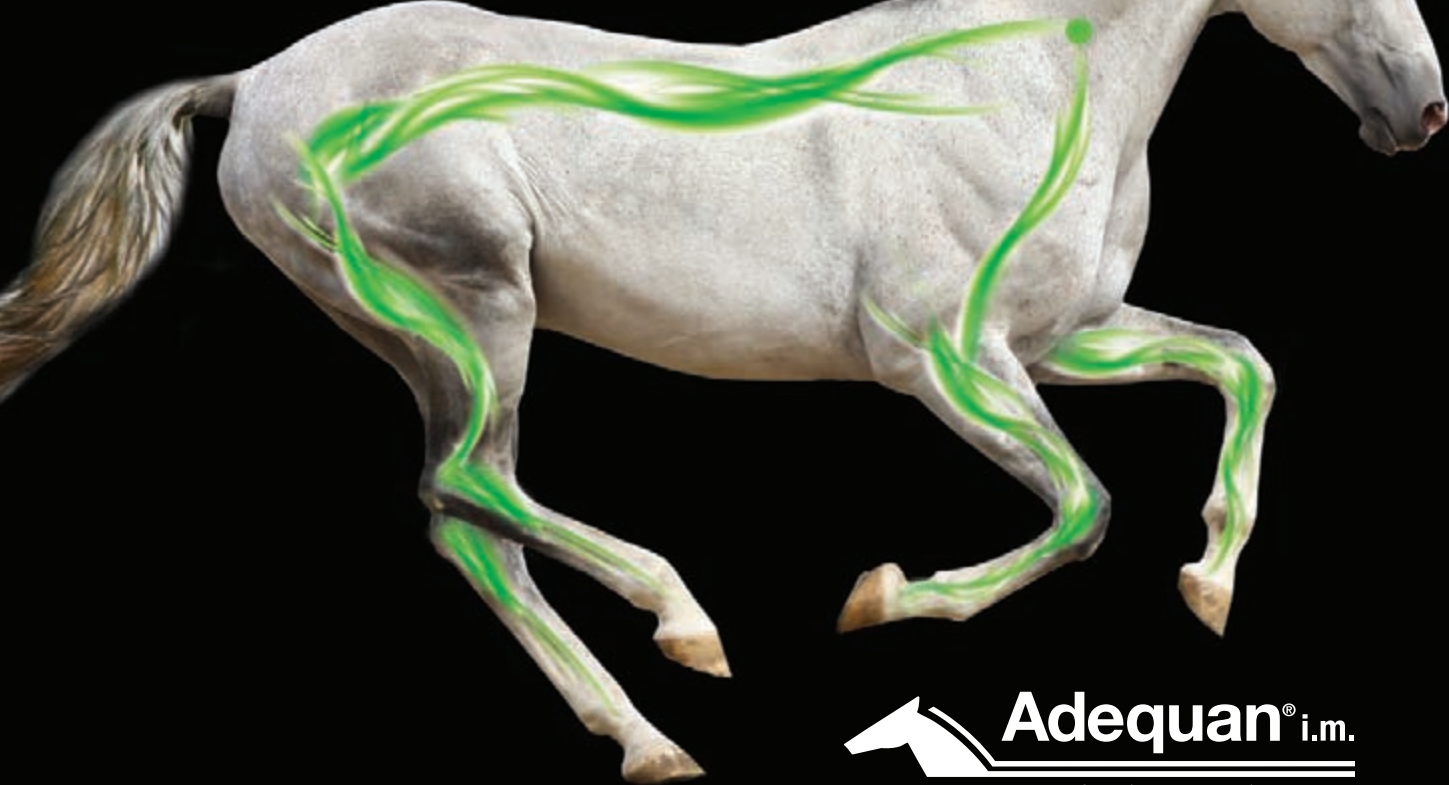
Her recommendation for horses that tie up is to follow the diet and exercise regimes. Dantrolene is not a drug that should be used as a convenient fix.

Absorption of this drug is better in fed versus fasted horses. Giving proper dosage one hour before exercise to RER-susceptible horses fed high-grain diets has been shown to lower significantly serum CK activity, an indicator of muscle damage.

Dr. Stephanie Valberg, McPhail Dressage Chair in sports medicine, professor, Michigan State University, said this might help, when trying to get these horses into training and settled into the environment at the track—to ease them through the early training period when you are trying to get a nervous, excitable horse calmed down so it won’t experience tying up episodes.

“This drug interacts with the calcium release channel in the muscle cells, so that each time the muscle contracts, a little less calcium is released from that storage site,” she explained. “Thus, you don’t get what we believe to be the initiating onset of RER (recurrent exertional rhabdomyolysis), which is an excessive amount of release through that channel—induced by stress. It just steps it down a notch.”

—By Heather Smith Thomas



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muscle enzymes CK and AST. These usually peak in the blood about four hours after an episode, so the best time to check them is not immediately but about four hours after the cramping, to see if there has actually been muscle damage. This narrows down what you are looking at.

“With classic tying up, horses intermittently have peaks and elevations of CK that indicate muscle damage,” she said. “There are differences between the Quarter Horses with PSSM and Thoroughbreds that tie up repeatedly. One big difference is that Thoroughbreds usually don’t start tying up until they are in race training. They tend to be 2- and 3-year-olds; young horses have more problems than mature ones. It’s usually the more nervous individuals that are affected, and usually fillies, particularly if they have a nervous disposition.”

Recurrent exertional rhabdomyolysis is often associated with excitement.

“There seem to be very strong links with that particular disorder with nervous horses kept in stressful environments,” Valberg said. “When they get out of their stalls and start to exercise, they are hyper and easily stressed. At the track, episodes of RER commonly occur when these horses are just galloping (rather than racing or breezing), because they are being held back; they become upset at being held back, fighting the rider. If they are coming back to the barn and want to jog instead of walk and you try to make them walk, they may tie up. Or if something happens that gets them really excited, they are more likely to have problems.”

In Australia and New Zealand, racehorses that tie up are often trained in a more relaxed environment. In these situations the horses are kept in paddocks rather than stalls.

“They have shelter, so they are comfortable but not as closely confined,” said Stephen Duren, PhD, an equine nutritionist for Performance Horse Nutrition. “They are turned out for exercise and always with a companion horse. This daily exercise in a small paddock and moving each other around reduce stress and

also decrease the tying up symptoms.”

Daily exercise, along with feeding changes, can make a big difference.

“We can give daily exercise if the horses are in stalls, but those horses cannot have a day off,” Duren said. “They need to go out, preferably under tack rather than just on walking machines. This will decrease the stress. In Japan, however, the racing industry has serious issues with tying up because of mandatory days off for staff. Most horses will have at least one day each week that they don’t get out of their stalls at all. The next day those horses are very excitable, and the ones that are prone to tying up (with the genetic tendency) will reach that trigger point because they are very excited. We see a lot of tying up on certain days in Japan, and it is expected.

“Because of their labor system, there is not much they can do to change this, and it is frustrating,” he continued. “Those horses have to be managed differently and some of them end up at smaller private training centers where they can be given the daily exercise they need. Horses at U.S. tracks and in racing jurisdictions in Hong Kong and Singapore have the same issues, but if they are sent to private training facilities, those horses have more opportunity for daily exercise. This has a calming effect that may help alleviate that trigger point.”

## GENETICS

Initially a lot of the research focused on trying to find one genetic marker that could be identified for recurrent exertional rhabdomyolysis.

“We haven’t been able to find one specific genetic disorder in Thoroughbreds,” Valberg said. “In Quarter Horses one mutation has been found for PSSM 1 and another that causes malignant hyperthermia. These mutations both cause tying up in Quarter Horses. But in Thoroughbreds one genetic mutation has not been identified through genome mapping, and we think that RER is due to a number of different factors that are interacting to increase susceptibility to tying up. One of those factors seems

to be susceptibility to stress.

“When you take those same horses and turn them out or they are trained at home in a less stressful environment, they often do quite well,” she said. “But when you move them into a higher stress environment, like a training center, feed them more carbohydrates so they are even more easily stressed, and then have intermittent exercise without the ability to blow off a lot of steam with turnout, those susceptible horses tend to develop RER.

“This is a two-edged sword. Years ago when people were breeding fast horses, they were trying to combine this amazing athletic ability (which might set them on the fine edge to be more easily inclined to tying up) with a more nervous, aggressive, hyper temperament (rather than mellow and laid-back) to see if that combination produced better speed. One of the things that inadvertently came along with that combination was a higher susceptibility to tying up.”

## MUSCLE CELL PROBLEMS

“What we think is going wrong in the muscle under those circumstances is an abnormality inside the cell within the small compartments where calcium is shuttling back and forth,” said Valberg. “This is not a defect in terms of dietary calcium and has nothing to do with blood calcium concentration but rather a glitch in movement of calcium back and forth inside those compartments in the muscle cells. When too much calcium is released into one of the compartments where the contractile proteins are, the muscle contracts but doesn’t relax. This eventually sets off a process that damages the muscle cell. In these horses the damage occurs when there is a lot of stress, stress hormones, etc.”

The calcium is stored in membranous sites within the cell.

“When it is released, it interacts with the proteins to make the cell contract, and then it has to get pumped back into the storage sites so the muscle can relax,” she said. “This happens many times a second when the horse is moving. As the

muscles contract and relax, the calcium is moving in and out of these storage sites. We think this is where the abnormality lies in these horses—when the muscle cell is moving calcium back and forth. This becomes a vicious cycle.”

## MANAGEMENT

“When trying to keep these horses from tying up, we don’t have any one thing we can do to prevent it, but we try to break the cycle—doing all the things we can do for that individual horse, to decrease the amount of stress,” Valberg said. “It’s been clearly shown that young (2- and 3-year-old) nervous fillies have a much higher incidence of tying up than geldings do, and that may be in part due to temperamental influences.”

Older horses have a much lower incidence of tying up although certain individuals are much more susceptible

to RER even as they get older.

“Often, however, if those horses are taken off the track and used for other purposes such as hunters, jumpers, eventers, etc., they don’t have another episode of tying up. The lifestyle change helps.

“Our recommendation, which can be difficult at the track, is to try to find a situation and a trainer who can accommodate that horse’s needs, housed in the least stressful area possible,” said Valberg. “It often helps to stall the horse next to one they are compatible/comfortable with, so they are not fussing with the horse next door. It also helps if they are stalled in a quiet area—where they are not watching horses going back and forth, since that stresses them. They should be exercised first, so they are not watching all the other horses and having to wait for their turn. If they are out exercising with other horses, choose buddies

that can keep them calm.”

Management is a huge key.

“Try to limit the amount of time these horses are standing still,” she said. “We found in treadmill exercise trials that susceptible horses tend to have more problems with tying up if they’ve been standing in a stall for two days and then you take them out and exercise them. It’s better to get them out every day and not give them days off. Try to provide opportunities throughout the day to get them out of the stall. They should be given as much time as they need to blow off steam.”

All these things seem to make a difference.

“If in the beginning of training they need to be tranquilized to decrease some of the stress, we recommend that,” she explained. “A low dose of tranquilizer prior to exercise, during that early phase



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of training when trying to get the horses settled down, makes them a little more calm and mellow until they adjust to the training.”

Let them jog on their way to the track to train if they want to, rather than insisting that they stop their nervous behavior, creating a fight with the horse.

“It really helps if the horse has a patient, sympathetic person working with them,” she said. “These tactics may help enough that these horses can be trained,” she said.

“If you can get them started racing, we’ve found that it doesn’t affect their racing performance at all—if you can get past the tying up episodes when starting training. And much of getting past it is just getting them calmed down and accustomed to being in training—and used to being at the track.”

#### DIET MANAGEMENT

Another thing that seems to help is diet changes.

“These horses get very excited on high-grain diets,” Valberg said. “They tend to be very nervous horses, so they burn calories easily and it’s hard to keep weight on them. We’ve found that if you substitute fat for part of the grain, it helps take the nervous edge off and they are calmer.”

Duren said feed and management make a difference; many of these horses (but not all) seem to respond to a high-fiber, high-fat, low-starch, low-sugar diet.

“We know diet plays a role in tying up, especially in instances where horses only occasionally/sporadically tie up, because most of these episodes are due to a feeding error where the energy levels or electrolytes or antioxidants are out of whack,” he said. “On the other hand, we know there are genetic causes in most of the cases where a horse chronically or repeatedly shows tying up symptoms. These horses have an increased ability to store muscle glycogen, so you need to keep their blood sugar low—so they don’t keep packing those cells full of sugar.

“Somewhere between 5% and 10% of racehorses will experience RER at some point in their racing career,” he continued. “We can usually manage them with diet and a change in environment. The special diets (high-fat, high-fiber) work to prevent most problems. If it’s a racehorse, however, actively training and competing, you still need to provide enough energy for the work being done.

“The key is stress. Diet can indirectly be a stress factor because it seems to influence activity and behavior of horses. A high-starch diet, for instance, tends to

make horses more hyper and excitable, which can be a trigger point to cause a tying up episode. Thus dietary management is important.

“Typically these horses should be fed good-quality hay, and the fat can be added by feeding it over an alfalfa pellet or beet pulp rather than over grain,” Duren said. “Alfalfa and beet pulp are both high-fiber feeds. In the western U.S. most people tend to put the horse on a grass hay rather than alfalfa (thinking in terms of fewer calories) but most grass hays in the western U.S. have more sugar than alfalfa hay. You can’t look at hay and determine sugar content; you have to analyze it. So if a horse is very sensitive, test the hay. Some modifications may be necessary in the hay portion of the diet as well.”

With some horses all you need to do to halt the tying-up episodes is greatly reduce the grain portion of the diet.

“Horses with mild symptoms will respond to just removing grain and replacing it with a vitamin/mineral supplement (since they still need the vitamins and minerals that were being supplied by the grain),” he said. “But horses with severe symptoms may need their hay changed as well.”

Horses in strenuous careers need additional calories besides adding fat.

“You can’t just feed hay and fat. You’ll have to top dress the fat over something that has more energy than hay,” he said. “Beet pulp is a great option. When you soak it and dump the water off, this takes away the sugar. Even if it is beet pulp with molasses added, if you soak it and rinse it off, there goes the sugar.

“It’s important to have the disease diagnosed, before you change the diet. Some horses will tie up occasionally, but there’s no underlying muscle abnormality,” he explained.

If an out-of-shape horse is overworked, he may get some muscle cramping. This is usually just one episode, due to overexertion or muscle strain.

By contrast, the horses that chronically tie up will respond to diet changes. So you need to identify the problem and

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see whether you need to address it with diet change. There are many low-carbohydrate feeds on the market.

“They have more energy than hay but nowhere near the calories of grain and don’t have the sugar content,” Duren said. “Some of those feeds can be used as a base, and then you can add fat to them.”

Horses that tie up are often being fed a lot of grain.

“Some horses require that many calories, but in these instances we need to be more creative in how we provide the calories—using fat calories and fiber calories like beet pulp,” he said. “There are new ingredients in some of the commercial feeds, using super-fibers such as beet pulp and soy hulls that have about the same digestible energy content as an equal weight of oats. We can fuel these horses without all the sugar and starch.

“The energy requirements of a Thoroughbred racehorse are very high, but you are still feeding a low-starch, low-sugar diet trying to control the behavior of the horse,” he said. “Yet you still need to provide enough calories to maintain body weight and provide enough glycogen for normal muscle contraction so these horses don’t run short of fuel to race to their best ability. This gets to be a delicate balance on how much sugar and starch you can feed without triggering the symptoms.”

Some of the newer feeding options are very helpful.

Valberg’s experimental trials with Thoroughbreds found that if they were fed about five pounds or less of sweet feed, it didn’t seem to have an influence on whether they had tying-up episodes.

“But when these horses are fed up to 10 pounds or more of sweet feed in order to keep their weight on and keep them going with enough energy for racing, the ones that were susceptible to RER started to have intermittent episodes of tying up,” Valberg said. “We think that’s because some horses become ‘hotter’ and more excitable on high-starch feeds. Trying to reduce that by giving the same amount of calories with feeds that contain less starch, and adding supplemental fat can be helpful in some horses.”

Trainers mention they have to find a feed that is most palatable to that particular horse because in the racing environment these horses tend to become picky eaters and are also more prone to gastric ulcers. It might take some trial and error to find the right low-starch, high-fat feed that the horse will eat.

“Some trainers also comment their horses just don’t have as much ‘edge’ for racing when they are on those special feeds,” Valberg said. “For those horses we suggest adding back some of the higher-starch feeds for a couple of days prior to a race, just to load the liver with a little more glycogen to give a little more of that energy back again—a little more fuel storage—for that short period of time. Many horses seem to be able to tolerate that.”

Feel your way along with each horse to see what needs to be done to maximize performance without triggering tying up episodes. One really has to know his or her horse, and this might take trial and error to figure out the best feed and management.

It might depend on how many horses are in training and

whether there is enough time to play around with one individual. If a trainer has a large number of horses, it’s easier to treat them all the same.

“For a horse that is susceptible to RER it pays to find a trainer who has the time and patience to get in tune with that horse,” Valberg said.

“Interestingly, as these horses mature and become more familiar with racing and the track environment and associated stresses, many of them tend to acclimate and adapt, with fewer tying up episodes,” said Duren. “Some of them that have serious issues as 2-year-olds and even 3-year-olds will be much more successful later and be able to compete on a traditional diet rather than having to be fed a ‘tying up’ diet.

“We can modify management; we can modify feed and training schedules to enable these horses to mature and continue a racing career while trying to avoid some of those trigger points that predispose a horse to those symptoms,” he said.

Part of the management will be to provide adequate electrolyte therapy and to make sure the horse is fed multiple times each day. Instead of feeding three times daily, divide the ration into four or five feedings. There are a number of ways to help an athletic horse overcome the problems with tying up. **BH**

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