Diet and Management Can Help Prevent Tying Up

BY HEATHER SMITH THOMAS

ARIANNA SPADONI/NYRA

The stress of racing can trigger recurrent exertional rhabdomyolysis (RER)

WHEN HORSES EXERT STRENUOUSLY, muscles work hard to do their jobs. When all systems work correctly, the muscles rarely have problems, but sometimes certain situations result in soreness or muscle cramps.

Severe muscle pain and cramping associated with exercise have been recognized for centuries, but in recent times researchers have found several different forms of this syndrome, with several plausible causes.

Severe muscle cramping is called tying up or rhabdomyolysis, a term referring to a dissolution of skeletal muscle with exercise that causes leakage of proteins into the bloodstream.

Some horses have a sporadic form of tying up (often due to being not quite in shape for the exertion asked of them), with no underlying abnormality in muscle function, whereas others continue to tie up because of a genetic defect in which the muscles collect an abnormal amount of sugar. This genetic problem (polysaccharide storage myopathy or PSSM type 1 or type 2) is an inherited condition in some heavy-muscled horses such as Quarter Horses, draft horses, and warmbloods.

Another type of tying up occurs frequently in young Thoroughbreds (primarily fillies) in race training. In most horses, tying-up episodes can be prevented or minimized by changes in management and diet. Feed and management can make a difference; many of these horses respond positively to a high-fiber, high-fat, low-starch, low-sugar diet.

More of the energy needed for exercise can be provided by fat and digestible fiber and less from starch and sugar. Diet definitely plays a role in tying up, especially in instances where horses only sporadically tie up, because most of those episodes are due to a feeding error where the energy levels or electrolytes or antioxidants are out of whack.

Dr. Kathleen Crandell, an equine nutritionist with Kentucky Equine Research, says the type of muscle problem most common in Thoroughbred race horses (particularly young horses in training) is called recurrent exertional rhabdomyolysis (RER).

"This occurs in 5-10% of racehorses," she said. "A racehorse can also experience sporadic tying up, especially if the horse is not quite fit enough for what it is doing or if electrolytes are out of balance. However, if tying up happens when the horse is fit, it is most likely caused by a genetic predisposition for RER.

"We don't know exactly what is causing RER, like we do with PSSM (polysaccharide storage myopathy), but we do know that it is due to a dysregulation of calcium in the muscle cells; the calcium release is affected. When the muscle is contracted, it releases calcium (the release of calcium causes the muscle to contract), and when the calcium is brought back into storage, it lets the muscle relax; calcium goes in and out through the muscle cell membrane. When a horse is having problems, it seems to have trouble with this sequence. Release of calcium is excessive, and the system of bringing it back in is not functioning correctly."

The calcium is stored in membranous sites within the cell. When released, it in-

teracts with contractile proteins to make the cell contract; then it has to get pumped back into the storage sites so the muscle can relax. This happens many times a second when the horse is moving. As muscles contract and relax, the calcium is moving in and out of these storage sites.

It is thought that in a horse with RER, this is where the abnormality occurs—in the way the muscle cell is moving calcium back and forth. This becomes a vicious cycle and the muscle can't relax, so it starts cramping.

What researchers believe is going wrong in the muscle is an abnormality inside the cell—within those small compartments where calcium is shuttling back and forth. This is not related to dietary calcium and has nothing to do with blood calcium concentration, but rather a glitch in the movement of calcium back and forth inside the compartments in muscle cells. When too much calcium is released into one of the compartments where contractile proteins are located, the muscle contracts but doesn't relax. This eventually sets off the process that damages the muscle cell. In horses that suffer from RER, the damage occurs when there is a lot of stress, stress hormones, etc.

"A person might think the horse needs more calcium, or less calcium in the diet, but there is no correlation," Crandell said. "Blood tests to check calcium levels in the blood also don't tell us anything because the blood levels have nothing to do with this problem in the muscle tissues.

"A muscle biopsy is better at diagnosing PSSM than RER. The only thing in a biopsy that might distinguish an RER horse from normal muscle cells is the appearance of centrally located nuclei. RER is most commonly diagnosed by looking at the horse's symptoms and history.

"The diet changes that help horses with RER the most are changes that have some effect on the temperament of these

COURTESY OF DR. KATHLEEN CRANDELL

Equine nutritionist Dr. Kathleen Crandell

horses. Other management strategies are geared toward reducing stress. We know that stress can trigger the manifestation of this abnormality in the muscles."

Thus, a change in environment and handling of these horses, and using feeds that are less apt to make them "hyper" can make a difference.

"Some racehorses, especially young ones that are not yet accustomed to the track environment, don't like spending a lot of time in a stall," Crandell said. "Other things that upset them may be that they don't like the horse next to them, or maybe they don't like having a horse next to them, or some other aspect of their housing situation.

"Moving the nervous, upset horse to the last stall in the row might help, or if the horse craves more companionship, it may help to provide a goat in the stall, or having a horse they like living right next to them—whatever helps that particular individual to decrease stress.

"Turnout is also important for de-stressing, to help these horses blow off steam that can help release those feelings of tension and stress. Having a regular schedule that the horse is comfortable with can also help, which includes daily turnout so they can move around. A regular routine and work schedule without too many days off without exercise is also important," she said.

"If they do have a tying-up episode, it helps if they can get back to work as soon as possible. The longer they are resting, the more likely they will tie up the next time they start into work."

With RER some horses will do fine for a while as their training progresses, and then when they get really fit, another episode happens.

"It seems to happen more often when they are stressed," she said. "Many of them are nervous horses, and may have an episode when the rider is holding them back during training. Fighting the rider, wanting to go faster than the rider will let them, creates more stress for them."

It helps to try to avoid creating a fight with the horse. It really helps if the horse has a patient, sympathetic person working with it.

Anything that upsets the horse might be a trigger for tying up, so it helps to avoid changes in routine and work and minimize anything that might create stress. In some situations a mild tranquilizer might be used to decrease some of the stress when first getting nervous young horses accustomed to new situations and started in training.

"A low dose of tranquilizer prior to exercise, during that early phase of training when trying to get the horses settled down, can make them a little more calm and mellow until they adjust to the train-

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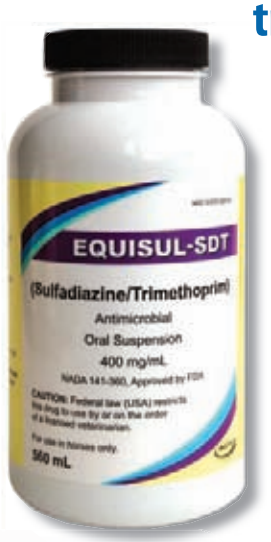

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MESSAGE FROM THE GRAYSON-JOCKEY CLUB RESEARCH FOUNDATION

COLIC RESEARCH UPDATE

Two-year study shows improved survival rates in horses treated with firocoxib

BY DR. ANTHONY BLIKSLAGER

Colic is one of the most dangerous disease syndromes of horses. Approximately one in 10 colicking horses need surgery to correct an intestinal strangulation, the most severe form of colic, in which a portion of the gut is cut off from blood supply, injuring the gut barrier and allowing leakage of intestinal bacteria and toxins into the bloodstream. These toxins entering the body can lead to shock, often termed endotoxemia, and organ failure, which can be fatal.

The intestine can repair itself after injuries, but veterinarians continue to see high rates of death after surgery due to these complications.

For that reason researchers at North Carolina State University, Michigan State University, and the New Bolton Center at the University of Pennsylvania sought to evaluate postoperative management of colic patients to ensure that horses have the best possible chance of fully recovering. Recent studies have shown that when injured intestine is recovered in the lab, flunixin meglumine paradoxically slows down the repair process and allows increased leaking of bacterial toxins through the gut wall, even though it is a first-line effective pain reliever.

This is the most common non-steroidal anti-inflammatory drug (NSAID) used in horses to control pain and inflammation after surgery.

Similar lab studies have shown that a newer NSAID, firocoxib (Equioxx®) allows for better recovery of injured tissue because it targets the enzyme (COX-2) that promotes inflammation but does not block COX-1 that promotes intestinal repair. Therefore, the researchers believe that firocoxib would be a better choice than flunixin meglumine to manage pain and inflammation after colic surgery to reduce complication rates and ultimately improve survival.

In a two-year study funded by The Grayson-Jockey Club Research Foundation, horses that had surgery to correct small intestinal strangulating colic were given either flunixin meglumine or firocoxib during their recovery in the hospital in a randomized clinical trial. Fewer horses given firocoxib had high levels of a blood marker of inflammation related to leakage of bacterial toxins from the gut as compared to those given flunixin meglumine.

Importantly, both NSAIDs effectively treated surgical pain to the same degree. There was not a major difference in survival rates, but this study included 56 horses, and the researchers feel that studying more colic patients would reveal improved survival rates in horses treated with firocoxib. This study shows that firocoxib might be a better first-line medication than flunixin meglumine to treat colicking horses.

In addition, this GJCRF-supported study shows how bigger and better clinical studies can be performed by linking veterinary hospitals to find optimal treatment for horses. We are also particularly grateful for the Elaine and Bertram Klein Career Development Award to the lead investigator, Dr. Amanda Ziegler, an up-and-coming equine veterinary researcher. Dr. Ziegler is completing her PhD, in part using this work, under our direction at NC State University. BH

Dr. Anthony Blikslager, is a professor of equine surgery and the associate director of Comparative Medicine Institute, College of Veterinary Medicine at North Carolina State University.

ing, or during a change in venue when that horse might be more stressed," Crandell said.

Sometimes people resort to drug medications during early training, though they can't be used when racing. Medications that modulate shifting of calcium from intracellular storage sites include dantrolene.

These drugs can be helpful in alleviating the incidence of tying up, by reducing serum calcium activity, if given about 60-90 minutes before exercise. This might help when trying to get these horses settled into the environment at the track—to ease them through the early training period—trying to get a nervous, excitable horse calmed down so it won't experience tying up episodes. Dantrolene interacts with calcium release channels in the muscle cells, so that when the muscle contracts, a little less calcium is released from that storage site. Then we don't get what we think might initiate onset of RER, which is excessive calcium release through that channel. It just steps it down a notch and might help

of reactive oxygen species, which are formed when fat undergoes oxidation.

"The cell membrane is one of the crucial areas where this occurs," she said. "The reactive oxygen species (ROS) break apart the chemical bonds, resulting in free radicals. Vitamin E donates hydrogen to the free radical and stops that cascade of molecules falling apart. In this way it restores health to the cell membrane. Interestingly, vitamin C can restore vitamin E to some extent by replacing the hydrogen.

MARSHALL BLEVINS

Turnout is great for de-stressing a horse

"Vitamin E is also involved in immune function, cell signaling, regulation of gene expression, and other general metabolic processes. Vitamin E is the collective name for a group of compounds that all have this distinctive antioxidant activity. There are eight naturally occurring compounds: four tocopherols and four tocotrienols. When researchers have looked at serum vitamin E, the compound they find in abundance is the alpha-tocopherol," Crandell said.

"In plants we find a variety of all the different forms of vitamin E. The one we focus on in nutrition is alpha-tocopherol, but recently there has been interest in looking at the role of gamma-tocopherol as well. The principal form found in synthetic vitamin E is alpha-tocopherol. If you buy a supplement and it lists 'natural source' on the label, this would be d-alpha-tocopherol. The synthetic form would be listed as dl-alpha-tocopherol or just vitamin E. If it does not specify, it is probably synthetic."

Sources of natural vitamin E include green forages. The greener the forage, the more vitamin E. Lush green grass has more of this vitamin than older, mature, or dry forages.

"Plants lose some vitamin E with maturity," Crandell said. "Grass contains between 30-100 IU per kilogram of dry matter. Hay will have less because once it dries enough to bale, it starts losing appreciable amounts of fat-soluble vitamins."

Harvest conditions make a difference, as well.

"The greener the hay, the more vitamin E.," she said. "Alfalfa, especially when cut before full maturity, while still very leafy rather than mostly stems, usually is a little higher in vitamin E than grass hay. In arid climates where hay can be cut and baled within 24 hours, there will be more vitamin E than in hay made on the East Coast in a humid climate, where it may take several days to dry enough to bale (and you have to keep turning it to get it dry). It takes longer to dry because of the humidity."

Exposure to sunlight oxidizes vitamin E after the plant has been cut, and if hay gets rained on some of this vitamin leaches out. This can be a double problem; if the hay is rained on, it will also take more days to dry before baling.

"A study looking at alfalfa hay after it was baled showed vitamin E losses were almost up to 75% after 12 weeks of storage," Crandell said. "The longer hay is stored, the more vitamin E is lost. We can count on green forage being a good source of this vitamin, but when horses are fed only hay (no pasture), it's a gamble."

It will vary depending on how much vitamin E the hay had to begin with and how long the hay has been stored.

"There is also some vitamin E in grain, but the level is pretty low—about 20-30 IU per kilogram," she said. "It also makes a difference how long the grain has been stored. Grains lose some of their vitamin E over time. Almost all commercial concentrate feeds have some vitamin E added, to compensate for lower levels in the grain and any storage losses, but most of them use the synthetic form. Unless it says natural vitamin E on the label, it will be the synthetic. On the label you can see whether it's d or dl-alpha-tocopherol (d- is natural and dl- is synthetic), but sometimes it's just listed as vitamin E. Natural vitamin E is the most expensive, so if they go to that expense to add it, they will also state it on the label and may charge more for their product.

"If a horse is being fed a commercial concentrate feed, especially a high-quality product, it will be balanced for trace minerals like selenium, copper, iron, zinc, etc.," she continued. "Horses today are rarely short of selenium, especially racehorses, because of the quantities they eat."

We almost take for granted that our horses have adequate trace minerals.

"It amazes me how much this may differ in other countries," she said. "I went to Peru and attended races there, went to the training stables and talked with the people to find out what they fed those horses. I was astounded to find that these racehorses were only fed alfalfa and barley. Many weren't given any salt or minerals. They didn't have any feed products containing vitamin A, selenium, zinc or copper.

"The competitive nature of racing in countries like the U.S., Australia, Japan, or Hong Kong means that we feed our horses whatever they need to optimize performance. A horse on barley and alfalfa wouldn't be able to compete at this level. We've come a long ways in figuring out proper diet for the equine athlete."

Usually when a horse ties up it's not due to just one thing.

"It's generally not just the diet, or stress; it is often due to multiple factors," Crandell said. "The basic problem might be that there is too much starch in the diet, but there could also be too much stress from the environment and perhaps the horse didn't get turned out because the weather was bad. Just one of those factors alone might not result in tying up, but with multiple problems going on, the horse may suddenly reach that threshold and tie up—the culmination of multiple factors." BH

Heather Smith Thomas is a freelance writer based in Idaho.