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Although there is no cure for Exercise Induced Pulmonary Hemorrhage, there are treatment options that can improve the health and performance of horses known as "bleeders." by Michael Mahaffey

hy do some horses bleed internally after exercise? It is a question that has been asked in some form or another for at least the last 300 years. Bleeding in horses was originally spotted when blood ran from a horse's nostrils after performing hard work or running. This condition, called epistaxis, was considered serious, but was never seen as a widespread problem.

According to an article titled "Exercise Induced Pulmonary Hemorrhage" by Todd East of the Equine Pulmonary Lab at Michigan State University's College of Veterinary medicine, less than five percent of horses bleed from the nose and mouth after heavy work—the sign that many horse owners use as an indicator that there is a problem.

It wasn't until well into the 20th century that the real reason behind why horses bleed in this way was discovered.

According to East's article, Exercise Induced Pulmonary Hemorrhaging occurs when blood enters the air passages of a horse's lungs, and EIPH is diagnosed in one of three ways: via endoscopy, tracheal washing or bronchoalveolar lavage (BAL). Each method is capable of giving a tentative diagnosis, but many diagnos-



NENNETH HINGHGLIFF, UNIVERSITY OF MELBUUK

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ticians recommend using multiple methods to determine the nature and severity of a bleeding episode.

Inside Information

While there is currently no reliable treatment that prevents EIPH, researchers have determined that the reason bleeding is so hard to treat is that there is not one single cause behind the problem.

Most evidence indicates EIPH is caused by a radical increase in pressure in the horse's natural high-volume, low-pressure pulmonary system, which is involved in the exchange and delivery of oxygen from the lungs to working muscles. The increase in pressure comes as a direct result of strenuous exercise.

"We know that it's associated with very high vascular pressures in the pulmonary circulation," said Dr. Howard Erickson, a professor of physiology at Kansas State University, who has conducted many studies into the causes and treatment of EIPH. "They approach values of 100 mm of Mercury, which are probably four times normal levels and probably two-fold higher than what you observe in a human athlete when they are exercising.

"It's also associated with other factors as well," he continued. "It may be associated with large changes in airway pressure. It may be associated with impact of the feet on the ground on hard surfaces during racing, so there is not one sole cause."

Dr. Tammi Epp, a fellow researcher at Kansas State University, said the spleenic contraction of the horse may also play a role.

"The horse has a muscular spleen that contracts," she said. "It stores red blood cells, and probably ejects around 12 liters of red cells into the systemic circulation during exercise, which may alter the thickness and the ease with which the horse can pump blood."

Epp also stated that locomotory impact trauma may be a cause. With each footfall of the horse, there are forces that come up the leg and across the chest wall and converge on the dorso-caudal (upper back) region of the lung. Epp said these shockwaves may contribute to capillary ruptures.

Inflammatory airway disease is another major factor, according to Epp.

"The horse is an obligate nasal breather," she said, "so on the airway side, they have to develop tremendously negative pressures to get enough air in and out. They only breathe about 120-140 breaths per minute, which if you do the math, that gives them less than a quarter of a **EIPH Grades**

Grade 1: One or more flecks of blood or two or fewer short and narrow streams of blood are present in the trachea or main stem bronchi **(Image A)**.

Grade 2: One long stream of blood or more than two short streams of blood occupying less than one-third of the tracheal circumference **(Image B)**.

Grade 3: Multiple, distinct streams of blood, covering more than one-third of the tracheal circumference (**Image C**).

Grade 4: Multiple, coalescing streams of blood covering 90 percent of the tracheal surface with blood pooling at the thoracic inlet **(Image D)**.



second to get the air in and less than a quarter of a second to get it back out, so they develop these tremendously negative pressures."

Although Thoroughbred and Standardbred horses have been recognized as having the highest rates of EIPH, with 70 to 90 percent or more bleeding at some point during their lives, it seems that there is no distinction among breeds, with even draft-type horses showing signs of bleeding after heavy work.

Erickson said that 50 to 70 percent of

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Thoroughbred racehorses will show evidence of blood in the trachea after they've run. If you repeatedly scope that same group of horses, probably 80 to 90 percent will show evidence of bleeding at some point.

"It also occurs in Quarter Horses," Erickson said. "There have been very few studies of bleeding in Quarter Horses, but those that have been done indicate that bleeding occurs in some 50 percent of Quarter Horses that race."

A study conducted by Dr. Kenneth Hinchcliff

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Grade 0: No bleeding detected.

Lasix–The Performance Enhancer

The rapid amount of fluid and weight loss caused by Lasix is a main reason why its use is illegal in many countries outside North America. Its performance-enhancing properties, as well as its potential to be used as a masking agent for other performance enhancers are other factors.

According to the Merck Veterinary Manual online, studies have shown that Lasix improved the performance of horses equally among bleeders and horses that had never bled, indicating that Lasix improves performance for reasons other than the reduction of bleeding in horses with EIPH.

According to an August 2006 article in the Equine Veterinary Journal Supplement, a study conducted by the Washington State University College of Veterinary Medicine allowed some horses dosed with Lasix to lose weight, while others were burdened with an equivalent amount of weight lost due to drug administration. The findings showed that improvement of performance was due more to weight loss than an improvement in the severity of bleeding.

and associates in Melbourne, Australia, tested 744 2- to 10-year-old Thoroughbreds to determine the effect bleeding had on their performance abilities. They found that, using a five-point scale of bleeding, horses graded 1 or 0 were much more likely to perform better and more consistently that horses with bleeding graded 2–4.

The researchers also found that horses older than 5 years are at an increased risk for showing EIPH, especially if they are just beginning to compete in a speed-related event. The presence of excess tracheal mucous or dirt, and the concentration of airborne particulate matter was also found to have a significant effect, likely due to inflammation caused in the airway and lungs.

Erickson said the frequency and severity of bleeding episodes tends to increase with age, so if a horse has very minor bleeding, it might get more severe with time. But, he said, there is no evidence that all horses that bleed are destined to become Grade 4 bleeders.

The amount of blood in the trachea after intense exercise can vary greatly between horses and even in the same horse over a period of time, so determining the average severity of bleeding in horses is still not easy to accomplish.

According to an article published by the

Animal Health Trust in the United Kingdom, continual bouts of EIPH may cause structural changes in the lungs as a result of the natural repair process, which could explain why bleeding increases with age. The damaged part of the lung becomes harder and more fibrous as it heals.

"Some of those horses, after repeated episodes, will develop exercise intolerance because the lung, the more times it bleeds, tends to scar, so it loses the capability for proper airflow and oxygen exchange," said Dr. Tom Hutchins, a veterinarian at Equine Sports Medicine and Surgery in Weatherford, Texas. "You start to get some fibrosis and scarring of the tissue."

Awareness is Key

"Most people, the first sign that they tell us about is the horse coughing during a run, and feeling like they're sort of waning at the end of a run," Hutchins said.

Hutchins has also owners tell him, "Hey, we ran this horse this weekend, then cooled him off, took him outside of his trailer, and he's got his head down, and suddenly there was blood trickling out of one nostril."

"They bring them to us typically the next day, hopefully," said Hutchins, "if they're not being evaluated right there at the show, to look

The ones that I've had bleed are the ones that really, really run super hard, and then you'll start to be able to tell. They'll get nervous before they run. They'll put their heads down after they run. They'll get a little wild. **–Jolene Stewart**

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In most cases, it is nearly impossible to tell if horses are bleeding simply by looking at them. Knowing a horse's typical behaviors makes it easier to determine if a horse is having a potential bleeding episode.

for traces of blood in the trachea.

"A lot of times, by the next day, you don't see any blood in the upper airway, as far as the blood in the nostril or even in the throat, but you'll see it down in the lower airway in the trachea."

Jolene Stewart, a barrel racing jockey and trainer for Jud Little Ranch in Ardmore, Okla., said one her first experiences with a bleeder came last year when she noticed her then 4-year-old mare, Smooth My Credit, was having trouble at a World Barrel Racing Production's event in Guthrie, Okla.

"I noticed she wasn't really running up to her full potential," Stewart said. "She put her head down a couple of times after I ran her, and after the second run, she put her head down and coughed. She never bled out, but I suspected because she wasn't running all that great. I had her scoped, and she was bleeding."

Stewart said the warning signs she looks for to indicate potential bleeding include a horse putting its head down after a run or coughing or suddenly starting to "act funny" during a run, blowing off turns or just running off.

"The ones that I've had bleed are the ones that really, really run super hard, and then you'll start to be able to tell," Stewart said. "They'll get nervous before they run. They'll put their heads down after they run. They'll get a little wild.

"It seems like when they do bleed, their

first barrel, sometimes their second, are pretty good," she said. "Then that blood will get in their lungs, and by the time they get to the third, they're scared and they're just running. Sometimes they'll blow that third barrel. They can't breathe. They get scared."

Stewart said it's easier to tell that a horse is having a problem if you know the horse and have ridden it for a long time.

"There'll be a change if they start bleeding," she said. "It's not, like, major things, but if you pay attention to your horse and you know your horse real well, there is a little bit of a change."

If you do notice your horse is having problems, timely veterinary attention is crucial, because one of the biggest potential complications of a bleeding episode is respiratory infection. Hutchins said blood is a great growth culture medium for bacteria, so repeated bleeding exacerbates the chances of developing serious problems.

"You add on top of that environmental contaminants from dust and that type of deal," he said, "that sets them up for potentially a low grade to a chronic respiratory infection."

Treatment Options

Although there is no cure for EIPH, there are many treatments available to owners and trainers of bleeders that help to minimize, and in some cases greatly reduce, the severity of a bleeding episode.

Furosemide, better known by its brand name, Lasix, is a powerful diuretic and is the most commonly used treatment in the U.S. and Canada. According to the East article, this can have a major effect on a horse, causing it to lose up to 2.4 percent of its total body weight through urine excretion, resulting in lower blood pressures in the horse's system.

Research has shown that Lasix can also help reduce the severity of the bleed, potentially as much as 70 percent—but it does not stop or prevent bleeding.

"In our lab, we found that it was effective, and it's dependent on level of intensity of exercise," Epp said. "At a lower level of intensity, it seems to be more effective than at a higher level of intensity. For example, we found it to be around 90 percent effective at just under maximal exercise, and only 50 percent effective at maximal exercise."

Stewart said she doesn't treat her horses with Lasix unless she suspects they are going to bleed or they have bled previously.



"The ones that have bled before, I don't take any chances," Stewart said. "I always run them on Lasix. As long as they're not showing any other symptoms, I don't have them scoped again. If you're running them on a low dose of Lasix, and you suspect that they may have bled through it, then you'd want to have them scoped again.

"My veterinarian tells me there's no substitute for Lasix, really. If they're bad bleeders, Lasix is always going to work."

Erickson said the main concern most have about the use of Lasix is its potential to cause dehydration in horses, in the short term, as well as its potential to cause depletion of electrolytes.

For Hutchins, the key to using Lasix is to make sure that horses stay well hydrated to counteract the diuretic effect.

Stewart said that as long as her horses drink after racing, there really doesn't seem to be a problem. She gives her horses extra B12 occasionally, but as long as they're eating good, highquality feed, and they get plenty of water, she hasn't seen any side effects from using Lasix.

The use of nasal dilator strips is another treatment option available for those who do not like the idea of injecting their horses with Lasix or other medications.

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Because horses are obligate nasal breathers, they experience some level of nasal collapse during heavy exercise, resulting in a reduction in airway size and causing a horse to work harder to get oxygen.

According to Erickson, nasal strips don't work on the vascular pressure as much as they work on the airway. He said the nasal strip is a valuable alternative for attenuation of EIPH given the purported ergogenic effects of Lasix.

"There's a part of the nasal passage that's not supported by bone, and when a horse inhales, that constricts in," he said. "That creates large negative airway pressures down within the pulmonary circulation, and that tends to cause rupture of the capillaries.

"We have confirmed the benefit in particularly heavy bleeders. Horses wearing the nasal strip returned quicker to competition than horses that did not."

A study published in the November 2001 *Equine Veterinary Journal*, conducted by Kentucky Equine Research, Inc., showed that the external nasal strip appears to lower the metabolic cost of extreme exercise in horses.

"We found that it allows the horses to breathe the same amount of air," Epp said, "but their respiratory muscles don't need to work as hard to do that because of the dilation

of the nasal passages, so that allows more oxygen to go to the working muscles."

Results of a University of California at Davis study conducted by Sandra Valdez found that the heaviest bleeders showed the most improvement when using nasal strips.

"The nasal strip was kind of the opposite of Lasix," Epp said. "It was about 33 percent effective at a lower level of exercise, and as the horses began to work harder, it became about 50 percent effective, so it became more effective as the horses worked harder."

Concentrated Equine Serum, also called Seramune, is a product used to treat Failure of Passive Transfer in foals that many veterinarians are now using to treat EIPH. CES is a product taken from several draft horse donors that contains high levels of immunoglobins and other serum proteins.

CES resulted in a 53 percent reduction of red blood cells and a 32 percent reduction in white blood cells, according to BAL results, Erickson said.

Based on results of a study he conducted at Kansas State, Erickson also found that CES may have an immuno-modulatory effect and anti-inflammatory effects that are beneficial in the reduction of small airway disease, which could be one of the causes of EIPH. It may also improve the healing of lung tissue and reduce scar formation.

According to the study, CES reduces bleeding by about 50 percent, most likely through the reduction of inflammatory airway disease.

However, Epp said CES took between two to three months to have a measurable effect.

"We think there are some things internally that have to occur for that to be beneficial and take effect," she said.

Extended use of CES may be needed before any benefit is seen, and that likely makes it something that most people would choose not to use.

"It's one of those things that sort of becomes an inconvenience issue because it takes a fairly large dose to try to be effective," Hutchins said. "The volume that you need to administer and use, I think, can start to be a costly venture for one, and two can be a hassle."

A more affordable and readily available treatment that can potentially achieve the same effects as CES are feeds that are fortified with the proper concentrations of Omega-3 fatty acids.

"They tend to affect the vascular system,

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Short bursts of intense exercise, during racing or training, can cause a horse to bleed. Some horses will bleed after only moderate exercise.

make vessels more flexible and easier for red blood cells to go through the capillaries, and so forth," Erickson said. "And there's some evidence that this product may help prevent EIPH, as well, so diet might be beneficial."

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Epp said there are several mechanisms through which Omega-3s may work. It may be by reducing inflammatory airway disease, or it may affect saturation of the membrane fluidity of not only the red cells, but maybe the vessels, as well, to make them more elastic instead of more prone to tearing and rupture during high levels of exercise.

Erickson said it wasn't known yet what combination of Omega-3s were most effective.

"You need a certain concentration and a certain ratio of those for it to be effective," Epp said.

Most commercially available feeds designed for performance horses are already rich in Omega-3s, but blindly adding more is not necessarily the best thing an owner could do.

Epp is currently working with a feed company to produce a line of feed with the proper ratios of Omega-3's to solve this problem.

"We found that with some concentrations and ratios, we did not have an effect, and with other ones we did," Epp said, "so that's why the concentration and ratio of the particular Omega-3 fatty acids is critical." Epp said, like CES, the Omega-3s take an extended period of time to have an effect. She said the anti-inflammatory treatments could potentially become a prophylactic use if people started horses on Omega-3s before they went into race training.

"Maybe we could reduce the level that these horses would bleed if they had not been put on these things," she said.

After Lasix, Aminocaproic acid, also called Amicar, is one of the most widely-used treatments for the reduction of EIPH.

It is an anti-fibrinolytic drug, and the idea behind the use is if a horse does have an active bleed, the drug enhances the clotting factor, so horses don't hemorrhage as much.

"It's not really going to change the hemodynamics of the horse until they bleed," he said, "and then it's going to be effective."

One major drawback to using Aminocaproic acid is its short half-life. Hutchins said he has used it on several barrel horses, with no untoward side effects, but riders have to administer it almost every time they run.

Epp said when they studied Aminocaproic acid, they found that it does have anti-inflammatory properties, though it didn't significantly decrease EIPH. There was only a slight reduction in bleeding, one much less significant that was achieved using Lasix or nasal strips.

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"In fact, we had heard from track veterinarians that horses that run on Aminocaproic acid seem to not run as well, and that is what we found in our study," she said.

They found that horses ran to a stage less, or they ran less time or not quite as fast as the horses on control, so they basically confirmed what track veterinarians had suspected.

Erickson and Epp both said researchers believed the clotting and coagulation effects of Aminocaproic acid played a part in the slower times. Erickson said it also helped explain the trend toward earlier fatigue in horses using the drug.

"It's been shown coagulation is not a factor in these exercising horses or in EIPH," Epp said, "so if you're enhancing coagulation, it could cause more problems."

In the same study, Epp said they looked at Conjugated Equine Estrogens, commonly sold under the name Premarin, and found nearly identical results to Aminocaproic acid.

Epp said the conjugated estrogens did reduce inflammation, though it didn't decrease bleeding, and the expense of the conjugated estrogens, tended to make their use prohibitive.

"If you look in the literature on that," Hutchins said, "they do think there is some



Horses that bleed often drop their heads or cough after exercise. A horse with its head down may be trying to tell you that there is a problem.



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YOUR HORSE'S HEALTH

I think rest is important if you have a bleeder. I think a local veterinarian that is caring for the horse should certainly be involved in deciding how long a horse is rested and how it comes back into competition." –**Dr. Howard Erickson**

benefit there to try to help with membrane permeability and to try to reduce those capillary beds from rupturing. We do use a fair amount of it on the racetrack, but not so much for the layperson."

Another more controversial, and potentially dangerous, treatment is the use of nitric oxide gas inhalants.

Nitric oxide works as a vasodilator, giving blood vessels a larger circumference, and as a vascular smooth muscle relaxant. This allows vessels in the lungs to have the capacity to handle the increased pressures in a horse's lungs during strenuous exercise, without the potential tearing or rupturing of capillaries in the lungs.

"We observed that even though the capillary pressure decreased a little bit, the bleeding actually increased," Erickson said.

While Hutchins said his practice never uses nitric oxide, they do use other types of inhalant medications, but usually only to treat the most severe cases of bleeding once they have occurred.

Hutchins said they use inhalant steroids and bronchodilators. A short-acting bronchodilator, containing albuterol, is administered, and then immediately after, they administer inhalant corticosteroids.

"That way you've got the lung dilated," he said. "You've got everything opened up, so the steroid can pass deep into the airway."

He said although the treatments are costly, from \$225 to \$300 per inhaler, they were effective if you had a horse that hemorrhaged significantly, and you wanted to try to get it cleared up quickly.

"Along with administration of antibiotics, those inhalant steroids and bronchodilators are a great tool because it gets the particle size of the medicine down to a small enough particle that it actually gets into those airsacs where a lot of other things don't," he said.

The Simple Things

As the search for better treatment options

and preventative measures continues, the simple things owners and trainers can do on a daily basis may have the most impact in reducing the potential for bleeding.

"First and foremost, make sure the horse is fit," Hutchins said. "Just like with a human athlete, make sure that they've got good respiratory capabilities.

"It's probably not a bad idea to have these horses scoped periodically to make sure that they're not having any sub-clinical indication that there's a problem; excess mucous production, potential low-grade respiratory infection, things like that.

"In general, if you've got a fit horse, I think your chances (of developing EIPH) are reduced," he continued. "Once a horse does bleed, they're probably obviously more prone to bleeding than one that never has."

Erickson said another measure that can be easily taken is to simply give horses that bleed plenty of rest.

"I think rest is important if you have a bleeder," he said. "I think a local veterinarian that is caring for the horse should certainly be involved in deciding how long a horse is rested and how it comes back into competition."

Hutchins said he believed environmental management is equally important, such as managing stalls and minimizing the levels of dust.

"I think that adds to inflammation," he said. "Thus, when you go out and really push on the horse, you've got to move a lot of air, and you're going to create airway resistance. If the lungs are inflamed and irritated, and then your chances of bleeding are higher."

He said keeping the dust levels down by misting the shavings or dampening the hay, and other similar things, can minimize any respiratory irritants and help prevent airway inflammation.

Michael Mahaffey is associate editor of BHN. E-mail comments on this article to bhneditorial@cowboypublishing.com.

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