



After a horse makes it through colic surgery and wakes from anesthesia, another set of recovery challenges awaits.

COURTESY DR. LOUISE SOUTHWOOD

Equine Studies From Around the World

ERICA LARSON

For veterinarians, staying up to date on the latest research is a key component of ensuring they provide their patients with the best possible care. But some practitioners reside in remote areas and countries without easy access to peer-reviewed journals, conferences, or other forms of education.

So the World Equine Veterinary Association (WEVA) takes its continuing education on the road, visiting a different part of the world to host a veterinary congress every other year. In late 2015 WEVA traveled to Guadalajara, Mexico, to conduct its 14th Congress. During three days of lectures, the veterinarians learned about such topics as mare and stallion management, nutrition, colic, the musculo-skeletal system, maintaining the equine athlete, hoof care, and more. Following are some highlights from the congress. Find more coverage at TheHorse.com/WEVA2015.

What to Expect When Your Horse Comes Home After Colic Surgery

Getting a horse through colic surgery successfully is only half the battle; supporting him through recovery is fraught with its own set of challenges. Louise Southwood, BVSc, MS, PhD, Dipl. ACVS, ACVECC, reviewed what to expect following colic surgery. Southwood is an associate professor of Emergency Medicine and Critical Care at the University of Pennsylvania School of Veterinary Medicine's New Bolton Center, in Kennett Square.

Southwood said she generally administers antimicrobials for 24 hours after surgery and non-steroidal anti-inflammatory drugs (NSAIDs) for three to five days to help prevent infections and keep the horse comfortable, respectively.

Once the horse is ready for hospital discharge, the owner assumes responsibility for monitoring him, along with communicating observations to the veterinarian. As the gastrointestinal tract resumes proper function and the surgical incision in the body wall heals, Southwood said it's crucial to watch for:

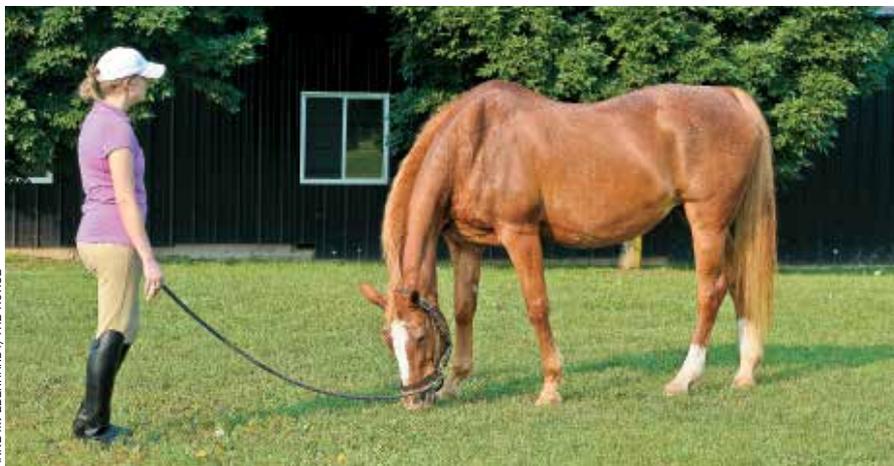
- Incisional infections and other issues, such as hernia formation;
- Additional colic episodes (in up to 20-50% of horses, she said), which tend to be mild and usually do not require hospitalization;
- Laminitis development (in less than 1-2% of cases);

Also be sure the horse maintains:

- A consistent body weight (or weight gain, if the horse lost it in connection with the surgery);
- A normal demeanor (an unusually quiet or depressed attitude could indicate complications); and
- Adequate water and food consumption and manure production.

Southwood recommended keeping the horse stalled, with hand walks and grazing, for the first four weeks following surgery to allow the body wall to heal. Then, she said, the horse can move to a small paddock or a stall with a run-in for another four weeks before resuming his regular turnout routine. Exercise or training can begin after 10-12 weeks if the incision has healed without complications.

Many surgeons use absorbable sutures that don't need to be removed; however, if the surgeon used staples to close the incision, he or she should remove those after 10 to 14 days, Southwood said. Before and after staple removal, she generally doesn't recommend owners clean the incision unless it becomes infected and starts draining. In those cases, she recommended the veterinarian gently open the wound to allow it to drain. She also encouraged practitioners to take a sample for bacterial culture in these scenarios to determine what's causing the infection. If an incision becomes infected, she doesn't generally administer antimicrobials. Rather, she focuses on keeping the wound clean and dry and monitoring it for hernia formation.



ANNE M. EBERHARDT/THE HORSE

Keep horses stalled, with hand walks and grazing, for the first four weeks following colic surgery.

Southwood said most patients can resume a normal diet, generally following a veterinarian-prescribed one for a time after returning home. In some cases, she noted, the surgeon might recommend modifying the diet, perhaps transitioning to a complete feed (reducing the horse's reliance on forage) or adding oil if the horse is losing weight.

Several researchers have evaluated horses' return to work following colic surgery. After six months, Southwood said, 68% of horses in one study had returned to work, with 56% of horses returning to their previous level; after 12 months, 76% had returned to work. She noted, however, that other factors—including additional hospitalization and laminitis development—delayed return to work following surgery.

Southwood said many trainers don't believe horses can have successful racing careers after colic surgery, so the New Bolton group compared racehorses' performances following colic surgery to the performances of horses that had not undergone colic surgery; they randomly selected untreated horses from runners in each treated horse's last race before the colic surgery. Key findings included:

- 76% of the study horses—all aged 2 to 5 years old—returned to racing;
- Horses with strangulating obstructions (twisted intestine, for instance) were more likely to return to racing than those with nonstrangulating obstructions (such as enteroliths or impactions); and
- There were no performance differences between case- and age-matched control horses except in the first six months

following surgery; in that time, controls raced and earned more because case horses were still recovering.

Southwood also touched on broodmares that undergo colic surgery. She said studies have shown that 66.7% of mares that undergo surgery while pregnant deliver a live foal, but live foaling rates decrease when the mare undergoes colic surgery early in gestation, when the surgery lasts for more than five hours, or when the mare is 15 years old or older.

Exercise can begin
10-12 weeks
after colic surgery if the
incision healed without
complications

Finally, she offered tips on how to reduce the likelihood of colic:

- Increase time on pasture;
- Decrease grain amount in the diet;
- Ensure the horse has adequate water and good-quality hay;
- Schedule regular dental exams;
- Employ strategic deworming;
- Increase exercise; and
- Make dietary changes slowly.

She also noted that horses that crib and those that live in certain geographic areas could be at higher risk of colicking, so these owners should take extra steps to reduce the chances of their animals developing colic.



Does a Canine Lyme Vaccine

Elicit a Response in Horses?

We have at our disposal vaccines designed specifically for horses to help prevent a number of common ailments, from West Nile virus to influenza. But an equine vaccine that remains elusive is one protecting against Lyme disease—a tick-borne disease veterinarians are diagnosing more and more frequently.

There is, however, a canine vaccine that many veterinarians use off-label for horses in Lyme-endemic areas. But to date, there have been no studies assessing this product's impact on horses' humoral (blood) immune responses. So Kathryn Slaughter, a veterinary student at Western University of Health Sciences, in Pomona, California, and colleagues recently evaluated how 42 healthy horses reacted to it.

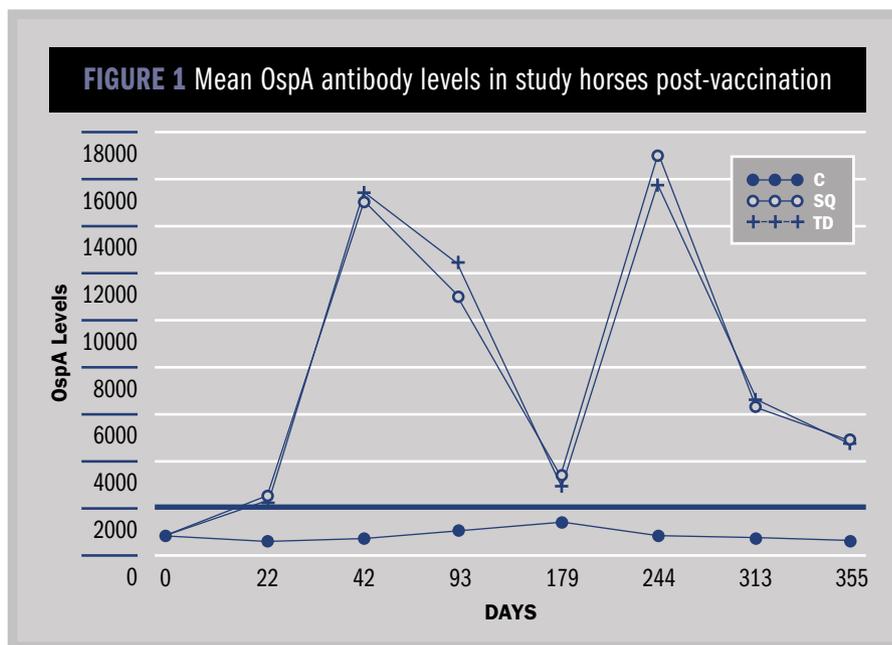
Lyme disease is caused by the bacteria *Borrelia burgdorferi*. Horses are incidental dead-end hosts (meaning they can contract but can't transmit the disease). *B. burgdorferi* transmission from *Ixodes* tick to horse takes 24 to 48 hours, meaning the tick must be embedded in a horse for that time to pass along the bacteria—a fleeting bite won't do it. Clinical signs generally appear two to five months or more after disease transmission.

Clinical signs of Lyme disease are nonspecific in horses and include chronic weight loss, low-grade fever, sporadic or shifting leg lameness, muscle tenderness, and arthritis. Some horses also develop poor performance, sensitivity to touch, behavioral changes, or neurologic signs.

The canine product is an outer-surface protein A (OspA) vaccine designed to provide protection against *B. burgdorferi* by prompting OspA antibody production.

Slaughter and colleagues selected study horses in a desert habitat (making it improbable that they'd had previous contact with *B. burgdorferi*) and tested all the animals' baseline OspA, C, and F levels. Then they split the horses into three groups:

- **Group TD (20 horses)** The team administered ½ mL of the vaccine transdermally (through the skin) over each chest muscle, for a total of 1 mL;
- **Group SQ (19 horses)** The team administered 2 mL of the vaccine subcutaneously (beneath the skin) in the left side of the neck; and
- **Group C (3 horses)** These animals served as unvaccinated controls.



COURTESY DR. KATHRYN SLAUGHTER

Both vaccinated groups (SQ and TD) showed an increase in OspA antibodies following the initial vaccination compared to controls (C).

The team inoculated the vaccination groups on Days 0, 22, and 226, and an examiner monitored all study horses for reactions for 24 hours following administration. The team collected blood samples throughout the study to compare the horses' antibody levels with baseline measurements and found that:

- Both vaccinated groups showed an increase in OspA antibodies on Days 42 and 244 following the initial vaccine administration;
 - There was no evidence of variations in OspA levels between age, sex, or breed;
 - There was also no difference in OspA levels based on vaccine administration route, suggesting that the smaller transdermal dose is equally as effective as the higher subcutaneous one; and
 - Minor vaccine reactions (i.e., swelling at the injection site) occurred (47% in TD and 20% in SQ), most commonly in the same horses throughout the study. Also, OspC and OspF levels decreased following vaccination, both of which develop in horses after natural or experimental *B. burgdorferi* exposure.
- "The reductions seen in OspC and OspF antibodies post-vaccination were unexpected, but interesting," Slaughter said. "The protective nature of this vaccine response is yet to be determined and requires further studies."
- Based on their results, the team reported that vaccine administration

followed three weeks later by a booster would conceivably afford the most effective protection against Lyme disease, and the OspA antibody titer levels suggest that vaccination could provide protection for about six months.

"These data may aid in strategic vaccination protocols and the development of a USDA-approved vaccine for horses in the prevention of Lyme disease using the OspA vaccine," Slaughter said.

Managing Limb Lacerations

If your first instinct after discovering a hemorrhaging leg laceration is to call your veterinarian, you're correct (this is preferable to fainting). Chances are, you'll need his or her help to manage a severe leg wound properly. Still, it never hurts to know the steps involved so you can care for your horse until your veterinarian arrives and have an idea of what will happen when treatment begins.

Southwood listed steps veterinarians should take with emergency lacerations:

- With any wound, she said, the first priority should be to stop the hemorrhaging. How easy this will be depends on the severity of the laceration. Common ways to slow bleeding include applying pressure to the affected area with towels or a pressure bandage. "Keep in mind that while stopping hemorrhage is critical, horses do have a lot of blood—about 40 liters (10.5

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— Nancy Koch, Executive Director
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gallons) for an average 500-kilogram

(1,100-pound) horse—and can lose a lot of blood before they exhibit signs of shock, up to 8 to 10 liters,” she said.

- Watch for lameness or gait abnormalities that could indicate damage to an internal structure.
- Southwood said it’s wise for the veterinarian to conduct a physical exam before treating the wound. An increased heart or respiratory rate or pale mucous membranes, for instance, could indicate the horse is in the early stages of shock or suffering from critical blood loss, which could significantly alter a practitioner’s treatment plan.
- She also recommended sedating the horse and/or administering a local anesthetic early in the treatment process.
- Once the affected area is numb and/or the horse is sedated, the veterinarian can begin examining and treating the wound. Southwood suggested applying sterile lubrication to the wound before clipping and preparing the area aseptically (in a sterile fashion). She reminded practitioners to clean the hoof, if applicable, as it can carry substantial bacteria and foreign material.
- Next, the practitioner ligates (ties or closes) the affected area’s blood vessels to prevent further bleeding. “This can be challenging in the standing horse and in a field setting and in some instances may require general anesthesia with good lighting,” she noted. “Referral to a surgical facility may be necessary.”

“While stopping hemorrhage is critical, horses do have a lot of blood ... and can lose a lot of blood before they exhibit signs of shock.”

DR. LOUISE SOUTHWOOD

- The next step—exploring the wound and palpating the leg—is crucial, Southwood stressed. This is where the veterinarian will have the best chance to evaluate, lavage (flush and clean), and debride (surgically remove the dead or damaged tissue around) the wound. “Do this very thoroughly,” she



KIM AND KARI BAKER

After stopping blood flow, the veterinarian will evaluate, lavage (shown here), and debride the wound.

said, to ensure the remaining tissue is healthy and has the best chance to heal. “Any wound on the limb, especially the distal (or lower) limb, may involve a joint, tendon, tendon sheath, or bone,” she said. “Even small puncture wounds that appear insignificant can be life-threatening if a deeper structure is involved and becomes infected.”

- Then it’s time to close the wound, if possible, and apply a bandage.
- She also urged attendees to radiograph the affected area to be sure bone isn’t involved. Even if a fracture or bone chip seems unlikely, it’s best to confirm internal structures are intact.

Following initial treatment, Southwood said she puts patients on stall rest and administers antimicrobials and NSAIDs as needed, urging practitioners to consider the consequences of wound infection.

Prognosis for most lacerations is good to excellent if caught and treated early, Southwood said. It can worsen depending on wound severity, structures involved, infection, and other factors.

Joint Therapies: What to Know

Navigating the formidable array of equine joint therapy options becomes easier when you have a good understanding of each treatment and how it works. Laurie Goodrich, DVM, PhD, Dipl. ACVS, associate professor of surgery and

lameness in the Department of Clinical Sciences and the Orthopaedic Research Center at Colorado State University’s College of Veterinary Medicine & Biomedical Sciences, in Fort Collins, reviewed some common options.

The goals of joint therapy center around removing the inciting cause of pain, reducing inflammation, and reaching the best possible outcome for the horse. Goodrich said the ultimate goal is to preserve the internal structures, such as cartilage, which isn’t possible once the horse develops progressive joint disease or severe osteoarthritis.

She said veterinarians rely on symptom- and disease-modifying treatments to achieve this. Symptom-modifying treatments can help the horse feel more comfortable and move easier, but they do not stop disease progression. Disease-modifying treatments, on the other hand, can slow, stop, or even reverse the degenerative process.

She reviewed the following options:

Corticosteroids This group of medications, considered a mainstay in treating equine joint inflammation, has evolved substantially over time, she said. Specific corticosteroids include:

- Triamcinolone, which can reduce lameness and increase range of motion, Goodrich said. Researchers learned that it can help protect cartilage and has both symptom- and disease-modifying effects. She cautioned that it can induce laminitis in some horses; however, she also noted that study results revealed that just three of more than 2,000 horses receiving 40-52 mg of triamcinolone developed laminitis two to three months following administration. So the risk for laminitis development appears to be fairly low.
- Researchers found that administering betamethasone into the joint had no detrimental effects on cartilage or subchondral (beneath the cartilage) bone, so it appears safe to administer to horses whose cartilage has not been damaged.
- Methylprednisolone, on the other hand, does appear to have deleterious effects on cartilage—even at low doses—despite the fact that it can help reduce inflammation, Goodrich said. She advised against using methylprednisolone in horses if their cartilage is still in good shape.

Goodrich said it's crucial to take steroid administration seriously, administering these drugs only when needed. She described one study of 1,911 horses, 392 of which had received intra-articular (IA) corticosteroids. The researchers found a positive association between corticosteroid administration and subsequent musculoskeletal injury; in other words, horses that had IA corticosteroid injections could be more likely to sustain an injury.

Hyaluronic Acid (HA) This is naturally found in horses' synovial (joint) fluid, and veterinarians can also apply it with the goal of decreasing synovitis, a less-damaging type of joint inflammation.

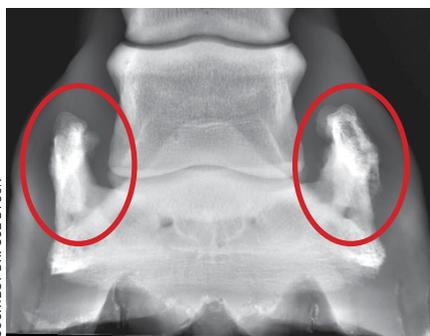
Debate exists over whether high- or low-molecular-weight HA is more beneficial for use in horses' joints. Essentially, high-molecular-weight HA contains larger molecules than low-molecular-weight.

Goodrich said the commercially available intravenous HA product (marketed as Legend) is effective at decreasing joint inflammation in many horses.

Corticosteroids + HA Goodrich said there's not much research to indicate that a combination of these two treatments is better than one alone. In fact, she added, researchers had better results in one study when they used triamcinolone alone than with HA. In another study, administering HA with methylprednisolone did not decrease the corticosteroid's detrimental effects on cartilage.

Polysulfated glycosaminoglycan (PSGAG) Goodrich said early literature showed that intra-articular PSGAG (marketed as Adequan) consistently helped reduce synovial effusion (swelling) and joint capsule fibrosis (scarring). But, she noted, there is a risk of joint infection due to its administration route. Many practitioners opt to use the intramuscular formula, which poses a lower risk of infection, but could be less effective in improving joint problems, she said.

Polyglycan This is made up of hyaluronic acid, chondroitin sulfate, and N-acetyl-D-glucosamine. It's labeled for IA post-surgical lavage and replacement of synovial fluid, but it is not currently marketed or approved as a drug in the United States. Still, many practitioners have found this "device" useful to reduce lameness and increase bone proliferation in ailing joints, Goodrich said. Polyglycan appears most useful in horses that still have full-thickness cartilage, she added.



COURTESY DR. SUE DYSON

Horses with ossified ungular cartilages could be at risk of developing lameness.

Goodrich stressed that veterinarians should not administer polyglycan intravenously, as it could have detrimental effects.

Pentosan polysulfate This injectable product (marketed as Pentosan), which Goodrich said has been used in Australia and New Zealand for 20 years, is similar to HA, and good anecdotal reports back its use. It is thought to decrease cartilage fibrillation (softening and grooving of joint surface cartilage) and improve cartilage histology (cell makeup), making it a very promising treatment option, she said.

Goodrich said in one unpublished study researchers found that horses receiving pentosan polysulfate appeared

to respond to treatment faster than those receiving PSGAG, and the PSGAG horses returned to their pre-treatment state sooner than those receiving pentosan polysulfate. It is not approved for use in the United States.

Diclofenac sodium Goodrich said she prefers to use this topical NSAID (marketed as Surpass) as an adjunct to other internal joint treatments.

Firocoxib This relatively new non-steroidal (marketed as Equioxx) has a similar pain-reducing effect as phenylbutazone (Bute), Goodrich said. It is less likely to cause gastric ulcers, however, a common side effect of Bute.

Indeed, there are equine joint treatments galore. Your veterinarian can help determine which option is suited for your horse's situation to give him the best chance of returning to soundness or remaining sound.

Are Ossified Ungular Cartilages Clinically Significant?

Horses have some special cartilages—yes, like the tough, flexible tissue that makes up your nose—on either side of the coffin bone in each foot. They're thought to aid in shock absorption, support of the

Flunixin vs. Firocoxib After Colic Surgery

After your horse undergoes colic surgery, he'll likely receive medication to reduce inflammation and relieve pain associated with the procedure. But does it matter which anti-inflammatory the veterinarian reaches for to keep your horse comfortable?

Prof. Kerstin Fey, Dr. Med. Vet., Dipl. ECEIM, an equine internal medicine specialist at the Justus Liebig University, in Giessen, Germany, worked with Julia Wiegand, DVM, to study this topic. Fey said veterinarians often use non-steroidal anti-inflammatory drugs (NSAIDs) following colic surgery, but there are only a few studies evaluating their effects on horses' pain levels and no comparative studies after colic surgery, she said.

So Fey, Wiegand, and colleagues compared how well two commonly used NSAIDs—flunixin meglumine (Banamine) and firocoxib (Equioxx)—accomplished this.

They studied horses of mixed breeds and ages admitted to a German equine veterinary clinic for colic surgery from December 2012 through February 2014. They excluded broodmares in late gestation, very young horses, and horses with long surgical durations, extended recovery times, and additional complications.

One study group received firocoxib, while the other received flunixin before general anesthesia and six, 12, 20, and 32 hours after surgery. Trained personnel used a pain scoring system based on behavioral and clinical parameters.

Ultimately, the team found no significant differences in how firocoxib and flunixin relieved pain following surgery, and both drugs reduced horses' pain scores similarly with a "remarkable reduction in the first 12 hours after surgery," Fey said.

She noted that the study was not blinded and there was no placebo control group to which they compared the drugs' efficacy for ethical reasons, and that additional studies on pain score data are needed in the future.—Erica Larson

back of the foot, and in blood circulation.

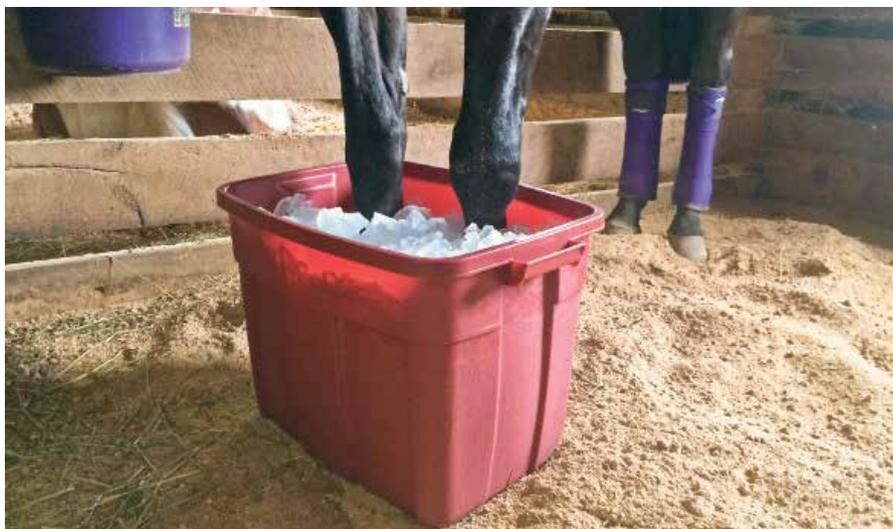
Sometimes these cartilages ossify, or harden, which veterinarians know can increase a horse's risk of injuring the nearby collateral ligament and other structures, along with predisposing the horse to injury due to a reduced ability to dissipate ground reaction energy. But, all told, they haven't known just how important ossified cartilages are to a horse's risk for future lameness and injury.

Sue Dyson, MA, VetMB, PhD, DEO, FRCVS, head of clinical orthopaedics at Newmarket's Animal Health Trust Centre for Equine Studies, in England, presented the results of a study to determine if ossified ungular cartilages are a clinically significant finding in horses—in other words, she and her colleagues wanted to find out if these structures cause lameness.

Dyson and Laura Jones, BVSc MRCVS, a junior clinician at the Centre, reviewed radiographs of 1,255 front feet and narrowed the study field to 386 hooves in 271 horses. All the included feet had ungular cartilages that scored 2 or higher on a 0 to 5 scale (with 0 being no ossification and 5 being the most severe). During their evaluation, Dyson and Jones determined the shape of the ossified cartilage, as well as which radiographic views were best for evaluating them and any other abnormalities. They also noted any significant associations between the ungular cartilages and lameness and other abnormalities.

They determined that:

- 42 horses had injury causing lameness directly related to the ungular cartilages (seen with scintigraphy or MRI), and 27 (64%) of these ossified cartilages were Grades 4 or 5;
- 32/131 horses (24.4%) that underwent MRI had Grade 4 or 5 ossification of an ungular cartilage, but the primary cause of lameness was related to other lesions;
- Fractures were most common in Grade 4 or 5 ossified cartilages;
- Feet with Grades 4 or 5 were more likely to have additional bone modeling (the process in which bone adds to itself) and other adaptive changes than those with Grades 2 or 3;
- Feet with abnormally shaped cartilages were more likely to have bone modeling and other adaptive changes than those with normally shaped cartilages; and
- Bone modeling and adaptive changes were often associated with lameness



ERICA LARSON

Submerging acutely laminitic horses' lower limbs and feet in an ice water slurry can help prevent further damage to the lamellae.

caused by bone trauma or fracture.

The team determined that horses with extensive ossification, together with bone modeling and adaptive changes, were at risk for lameness associated with injury to either of the ossified ungular cartilages or the coffin bone.

Dyson also briefly reviewed diagnostics. She explained that ossified cartilages are firm to palpate on affected horses (in contrast to healthy cartilages, which yield to gentle pressure) and affected horses can appear lame; however, many horses with ossified cartilage injuries often don't show significant signs of a problem. Affected horses have a variety of hoof conformations, and lameness is usually mild even when cartilages fracture. Lameness is generally most visible on a circle, and in some cases horses are only lame when ridden.

She said veterinarians should use nerve blocks to localize pain and then radiograph the affected area using several views.

"Ossified ungular cartilages can be of clinical significance," Dyson said. "Valuable information about the ossified ungular cartilages, such as a fracture at the base, may be missed without oblique images of a flexed foot," meaning the veterinarian should include projections taken on a slanting plane (neither from the front nor the side) in their radiographic studies to gain the most information.

Tips for Managing Acute Laminitis

A horse with acute laminitis is generally exceedingly painful—think about the classic, rocked-back laminitic horse that

is reluctant to move—and it's up to the veterinarian and farrier to help control that pain and start the animal on his road to recovery.

Steve O'Grady, DVM, MRCVS, a veterinarian, farrier, and the owner of Virginia Therapeutic Farriery, in Keswick, reviewed how to handle such cases. He first described how laminitis follows a sequence of stages:

- The developmental stage, when the internal damage to the lamellae (interlocking leaflike tissues attaching the hoof to the coffin bone) occurs, ending with the onset of clinical signs, such as pain, an increased digital pulse, and a laminitic stance;
- The acute stage, which generally affords the horse's caretakers a small window—24 to 72 hours or until the coffin bone begins to displace from its normal position in the hoof capsule—to intervene, halt, and/or reverse the internal damage; and
- The chronic stage, which usually begins within 72 hours after the acute stage starts and during which time the coffin bone continues to move within the hoof capsule and clinical signs continue.

Despite this relatively uniform series of events that takes place with all laminitis cases, they are challenging to manage.

"There is no proven or consistent treatment for laminitis," O'Grady said.

All treatments focus on controlling the horse's pain and minimizing damage to the lamellae, and they should begin as soon as possible during the acute phase for the best chance of recovery. Establish

a treatment team that includes the horse's owner/manager, veterinarian, and farrier.

The veterinarian should make sure the owner understands the risks associated with severe acute laminitis, he said. Horses with this disease generally don't have a good prognosis. Therapy can be time-consuming, prolonged, and expensive, and the disease's course is unpredictable.

There's a substantial amount of information a veterinarian must ascertain with these cases. "We know there's pathology present, but what's the extent of this damage?" he said. "Have we missed the window for resolution?"

Further, a thorough history can help him or her determine whether the laminitis likely developed due to systemic disease, carbohydrate overload, medications (e.g. corticosteroids), or whether it's an idiopathic (has no apparent cause) case.

A detailed exam is mandatory in acute laminitis cases, O'Grady said. He encouraged attendees to pay attention to the horse's stance, the degree of lameness, the intensity of the digital pulse, whether there's heat in the hooves, the coronary

bands (checking for depressions, which could indicate the coffin bone is already displaced to some degree), and hoof size and conformation. The veterinarian should always use hoof testers to find tender areas.

After a complete exam, it's time to develop a treatment plan. He discussed several medical options:

■ **Non-steroidal anti-inflammatory drugs**

Veterinarians can use these medications to help keep the horse comfortable because they have both analgesic (pain-killing) and anti-inflammatory properties. He advised using NSAIDs at their label doses and avoiding administering more than one at a time. O'Grady stressed that veterinarians should use NSAIDs judiciously to help the horse "respect" his feet—if you provide too much, the horse might move around enough to cause additional damage.

■ **Vasodilators** Theoretically, vasodilators (medications designed to increase blood flow, in this case to the hoof) could help ensure continued perfusion of the foot. However, O'Grady

cautioned that most vasodilators have not been studied in laminitic horses.

■ **Dimethyl sulfoxide (DMSO)** An anti-inflammatory, diuretic, and oxygen radical (a byproduct of inflammation) scavenger, DMSO could also aid in vasodilation, making it seem like a logical treatment option. But again, there's currently no proof of its efficacy in treating laminitis-related pain, he said.

■ **Cryotherapy** Submerging horses' lower limbs and feet in an ice water slurry can help prevent further damage to the lamellae, O'Grady said. He encouraged attendees to use a tub filled with ice and water and to submerge horses' limbs up to their knees or hocks for best results.

O'Grady also described imaging options useful for gaining information about what's going on inside the horse's hooves. Taking baseline radiographs (a minimum of two views for each hoof—from the side and front to assess structural damage in the hoof capsule) is beneficial, along with subsequent serial X rays to monitor treatment progress.



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O'Grady then touched on the venogram, a procedure veterinarians use to visualize blood flow within the foot. He cautioned that venograms might not be beneficial in the acute stage, as the lamellae is edematous (fluid-filled) and the veterinarian won't be able to see how to alter treatment plans. He also does not like to administer nerve blocks, which are required to perform a venogram, in laminitic horses.

On the farriery side, O'Grady said each horse should be treated individually using biomechanical principles to change the forces on the laminitic foot. These involve redistributing the load on the foot, addressing breakover, and applying heel elevation if necessary, he said.

If a horse in the acute stage is wearing shoes, he recommends removing them early. This, he said, will transfer the horse's weight from the hoof wall and lamellae (as the shod horse's sole and frog do not touch the ground) to the hoof's entire solar surface.

Next, O'Grady suggested trimming the affected toe(s) in moderation from the outer surface to remove excessive length. Don't take anything off the sole, he said. Rather, square and bevel the toe to improve breakover.

O'Grady also noted that deformable bedding, such as sand, can help acutely laminitic horses, as it allows the horse to position his feet as desired. He mentioned the use of cushioned hoof boots for pain relief and noted that while they're convenient, there are mixed reviews regarding their usefulness.

As the horse moves from the acute to the chronic stage, the farrier can choose from several footwear options. Wooden shoes, he said, are useful for chronic cases, but they can even be used in some acute cases. O'Grady recommended using casting material around the perimeter of the hoof for extra support.

Farriers also have many hoof pads and packings at their disposal for managing laminitic horses. While anecdotal evidence might support some of their uses, O'Grady stressed that there is no scientific proof that any pad or packing effectively supports horses with laminitis.

"Unfortunately, many of the treatment regimens, both medical and farriery techniques, used to treat acute laminitis are based on tradition, theoretical assump-

What Impacts Sperm Output?

Stallion semen quantity and quality can vary among individuals. Ed Squires, MS, PhD, Dipl. ACT (hon.), professor at the University of Kentucky's Gluck Equine Research Center, in Lexington, reviewed some of the factors affecting sperm production:

Age "The timing for testicular degeneration varies in stallions and may occur as early as 12 to 15 years or, in some stallions, after 20 years of age," Squires said. In general, semen output decreases with age. Thus, it's important to re-evaluate a stud's book each year to ensure he's not being stretched too thin.

Season "Output in the winter is about half of what it is in late spring and summer," Squires said. "This seasonality is controlled by the length of daylight." Breeders can increase sperm counts in February and March by keeping stallions under artificial light starting in mid-December. Managers generally do not do this because even though the sperm output will increase earlier in the year, numbers will also decline earlier. This could pose a problem for late-season breeding.

Testis size "Testicular volume can be used to determine whether the stallion has normal size testicles for his age and whether he is providing the expected number of sperm in the ejaculate based on his testicular volume," Squires said.

Ejaculation frequency A stallion can only produce so much sperm, so it stands to reason that breeding him too frequently could reduce his counts. For best results, Squires said, researchers have determined that breeders should collect stallions in artificial insemination programs every other day during the breeding season. "For natural mating, the primary factor determining how many times a stallion can be bred per day is the stallion's sex drive," he said. This generally amounts to one to three covers spread throughout the day.

Sex drive So, what controls a stallion's sex drive? Unfortunately, Squires said, researchers and veterinarians aren't sure. "We do know that factors such as using (breeding) a stallion heavily as a 2-year-old, being kicked during mating, pain during mounting, an inappropriate artificial vagina, or the height of the phantom can all negatively affect sex drive," he said.

Understanding all these factors can help managers and veterinarians take steps to help improve a stallion's fertility.—Erica Larson

tions that a given treatment should work, and anecdotal evidence that a certain type of treatment has worked on previous cases," O'Grady said.

What is well-documented, however, are the forces and mechanics of the horse's foot, such as what structures are involved in weight-bearing and which ones deal with tension when the coffin bone rotates or sinks, he said. But even with such knowledge, not every case can be saved.

"With severe cases, we are often unable to rehabilitate the horse to where it has an acceptable quality of life," he said, due to insufficient laminar structures remaining within the hoof to achieve realignment and accept weight."

O'Grady emphasized the importance of knowing when to stop treatment and opt for euthanasia.

"It is unlikely that this disease can ever be fully eliminated, nor is it likely that there will ever be a single drug or other line of therapy to consistently treat acute of chronic laminitis," he said. "So, our clinical and research efforts should be divided between prevention and treatment."

Breeding the Problem Mare

In theory, breeding is simple: Mare plus stallion equals foal. But it's not always that straightforward. From sterile stallions to noncycling mares, veterinarians are often faced with challenging cases that require problem-solving.

Reproduction specialist Patrick McCue, DVM, PhD, Dipl. ACT, described managing the problem mare. He is a professor of equine theriogenology at Colorado State University's Equine Reproduction Laboratory.

Several scenarios can lead to a patient being labeled a "problem mare," he said, including:

- Not becoming pregnant after being bred to a fertile stallion over the course of three estrous cycles;
- Being unable to successfully carry a foal to term;
- Having known reproductive pathology (disease or damage); or
- Having reproduction-related behavior issues.

McCue reviewed conditions that can contribute to these clinical pictures.

Persistent mating-induced endometritis One of the most common causes of reduced fertility in mares, persistent mating-induced endometritis is chronic inflammation of the uterine wall lining after breeding or artificial insemination.

McCue said mares, especially older ones, are sometimes unable to clear sperm, fluid, and inflammatory debris from the uterus after breeding. "Inadequate or insufficient muscular contractions of the uterus and/or a cervix that failed to relax sufficiently are the most common causes for the retained fluid and persistent inflammation," he said.

Should an embryo enter the uterus that still has inflammatory fluid present, it would be unable to survive, McCue said.

Further, he added, this persistent inflammatory fluid buildup can cause the endometrium to release the hormone prostaglandin, which adversely affects development and function of the corpus luteum, a structure formed after the follicle ovulates, and subsequently decreases progesterone (the so-called pregnancy hormone) production. This can result in low progesterone levels and/or short-cycling.

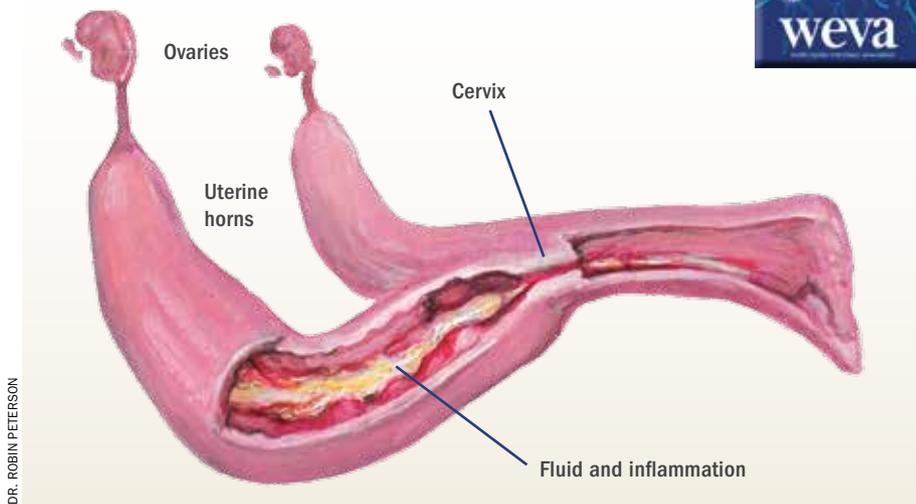
McCue said treatment is focused on reducing the severity and duration of the mare's inflammatory response and clearing her uterus of detrimental substances. He recommended breeding at-risk mares only once during an estrous cycle and timing the breeding to take place immediately prior to ovulation. For additional measures, veterinarians can lavage the mare's uterus with sterile saline or sterile lactated Ringer's solution four to six hours after breeding and/or administer oxytocin, which will help stimulate uterine contractions to remove the fluid.

Bacterial endometritis Uterine inflammation in conjunction with a bacterial infection is another common cause of reduced fertility.

"A majority of young mares eliminate bacterial contamination of the uterus following mating, parturition (foaling), intrauterine manipulations, and other events," McCue said. "In contrast, some older multiparous mares (those that have had many foals) may be unable to spontaneously eliminate pathogenic organisms from their uteri and are considered to be susceptible to bacterial infection."

He said risk factors for developing bacterial endometritis include:

- Contamination during breeding;



Endometritis, defined as an inflammation of the uterine wall lining, is one of the most common causes of reduced fertility in mares.

- Urine accumulation in the vagina and/or uterus;
- Trauma from breeding or giving birth;
- Failure of natural defense mechanisms, such as white blood cell function, local antibody production, etc.; and
- Poor perineal conformation.

"The general principles of a treatment regimen are to remove the source of infection, aid in physical clearance of the uterus, eliminate pathogenic organisms by local infusion with antimicrobial agents, and reduce future contamination by enhanced reproductive management," McCue said.

“Fungal infections ... most commonly occur in older mares with reduced uterine defense mechanisms receiving prolonged antibiotic therapy.”

DR. PATRICK MCCUE

He noted that if poor perineal conformation or decreased vulval muscle tone are a concern, the mare might benefit from a Caslick's procedure (suturing closed the upper part of the vulva) to prevent contaminants from entering the reproductive tract.

Fungal endometritis A third cause of endometritis—and one that is more difficult to diagnose and eliminate—is fungus in the uterus. "Fungal infections

of the uterus most commonly occur in older mares with reduced uterine defense mechanisms receiving prolonged antibiotic therapy," McCue said.

He described a variety of clinical presentations for fungal endometritis, ranging from no clinical signs to severe purulent (producing pus) endometritis with chronic infertility.

Chronic fungal or bacterial infections can cause permanent damage to the endometrium if not diagnosed accurately and treated properly. The chronic inflammation and scar tissue development can lead to markedly reduced fertility.

McCue said fungal endometritis treatment focuses on correcting predisposing factors (including perineal conformational deficits), removing debris via uterine lavage, and using local and systemic antifungal agents.

What if treatment fails? Despite best efforts, treatment doesn't always work. In these cases, McCue recommended veterinarians:

- Take a closer look at the case, re-examining the original diagnostics and considering whether there could be multiple issues at play;
- Consider alternative or complementary therapeutic techniques; and
- Employ advanced reproduction techniques, such as embryo transfer or intracytoplasmic sperm injection.

Finally, he encouraged veterinarians to consider consulting a reproductive specialist, referring the patient for a second opinion, or performing additional diagnostic procedures if the initial treatments are ineffective. 🐾