AN IN-DEPTH LOOK AT MANAGING WILD HORSES PAGE 14

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the HORSE

YOUR GUIDE TO EQUINE HEALTH CARE

YOUR GUIDE TO THE

2014 AAEP CONVENTION

FEATURING

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AND MUCH MORE ...

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Celebrating 60

STEPHANIE L. CHURCH, *Editor-in-Chief*

Every American Association of Equine Practitioners' (AAEP) Convention has its "thing," its memorable aspect that you vividly recall when someone mentions the convention city. "Oh, San Antonio—the one with the Foundation Celebration at the saloon with a riding arena," or "Sure, I remember Nashville—when we didn't actually leave the building for four days!" Or, "Yes, Baltimore—the one with the party at the Aquarium."

I've spent some time thinking about the 2014 AAEP Convention, held Dec. 6-10, as far as what its "thing" was. I'm convinced that this time it was not a particular session, social event, or setting (though the mountainous backdrop of Salt Lake City, Utah, is memorably stunning): The organization celebrated its 60th convention. Sixty years is nothing to sneeze at.

I've only been around (at *The Horse)* for a quarter of those conventions, but even over those 15 years I've seen a number of things that encourage me, even as a layperson editor and horsewoman, about the direction of equine veterinary medicine and make me incredibly proud of the organization:

- ***There's an increasing focus on client education and communication*** in addition to its commitment to educating veterinarians. I see this at the farm in the time my vet spends explaining something to me beside the truck.
- ***The Convention Proceedings***, which includes presentation abstracts and full studies in many cases, is a whole 223 pages thicker than it was back in 1999. That shows an increased emphasis on finding out the hows and whys behind our horses' care and a commitment to better their lives.
- ***Veterinarians' increased focus on working equids around the world*** that don't get the standard of care many of their clients' horses do here in the United States. Many practitioners have taken "Equitarian" trips, where they travel to treat working equids throughout the world and educate the animals' owners about care and welfare. Some veterinarians even have their own U.S. clients "adopting" working equids in other countries and donating for the effort.

This year's AAEP educational sessions ranged from new ways to pinpoint the cause of difficult lamenesses to novel therapy approaches for age-old problems. I see the application already: One of our freelancers retired her horse five years ago due to navicular syndrome and sold all the tack that fits him. With the FDA approval of a new drug described in several studies at the convention, he's undergoing treatment and getting sound again—time to find some new tack!

Equine practice has come a long way, even in the past 15 years of conventions. I can't even imagine what the next 15 will hold, but I'm eager to find out.

theHORSE

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MORE FROM THE CONVENTION

- Many more articles and blog posts on the latest news in equine veterinary medicine.
- Compilations of the top tweets from each day's sessions.
- Downloadable convention coverage report. ***Sponsored by Merck Animal Health***

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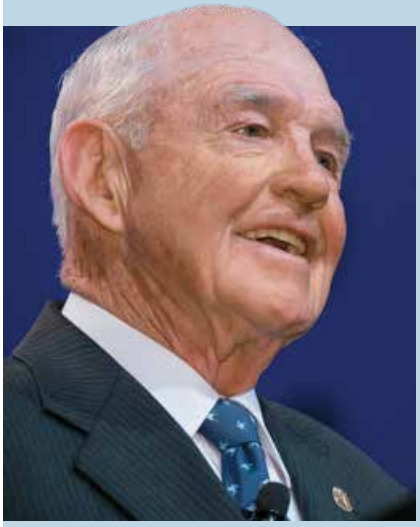
BY the NUMBERS

5,534

veterinary professionals, guests, students, and exhibitors from around the world attended the convention.

Veterinary legend **Dr. G. Marvin Beeman** was the keynote speaker, offering quips and wisdom from 60 years of farm to Olympic practice.

TheHorse.com/35298



COURTESY AAEP

7 of the awards presented at the President's Luncheon:

Distinguished Life Member: ***Dr. Terry Swanson***

Distinguished Service: ***Drs. Larry Bramlage and Wayne McIlwraith***

Distinguished Educator: ***Dr. Terry Blanchard***

Inaugural Research: ***Dr. Donald Knowles***

President's: ***Dr. Rick Arthur***

George Stubbs: ***Dell Hancock***

AAEP Equine Welfare (Lavin Cup): ***Robbie Timmons, CANTER USA***

$150,000

Amount donated to the AAEP Foundation for its outreach programs.

The 61st Annual Convention will take place DECEMBER 5-9, 2015, in Las Vegas, Nevada

PROTAZIL®

ANTIPROTOZOAL PELLETS (1.56% diclazuril)

FOR ORAL USE IN HORSES ONLY

For the treatment of equine protozoal myeloencephalitis (EPM) caused by Sarcocystis neurona in horses.

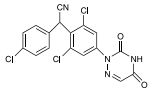
CAUTION

Federal (U.S.A.) law restricts this drug to use by or on the order of a licensed veterinarian.

NADA #141-268 Approved by FDA

DESCRIPTION

Diclazuril, (±)-2,6-dichloro-α-(4-chlorophenyl)-4-(4,5 dihydro-3,5-dioxo-1,2,4-triazin-2(3H)-yl) benzeneacetonitrile, has a molecular formula of $C_{17}H_9Cl_3N_4O_2$, a molecular weight of 407.64, and a molecular structure as follows:



Diclazuril is an anticoccidial (antiprotozoal) compound with activity against several genera of the phylum Apicomplexa. PROTAZIL® (diclazuril) is supplied as oral pellets containing 1.56% diclazuril to be mixed as a top-dress in feed. Inert ingredients include dehydrated alfalfa meal, wheat middlings, cane molasses and propionic acid (preservative).

INDICATIONS

PROTAZIL® (1.56% diclazuril) Antiprotozoal Pellets are indicated for the treatment of equine protozoal myeloencephalitis (EPM) caused by Sarcocystis neurona in horses.

DOSAGE AND ADMINISTRATION

Dosage: PROTAZIL® (1.56% diclazuril) is administered as a top dress in the horse's daily grain ration at a rate of 1 mg diclazuril per kg (0.45 mg diclazuril/lb) of body weight for 28 days. The quantity of PROTAZIL® necessary to deliver this dose is 64 mg pellets per kg (29 mg pellets/lb) of body weight.

Administration: To achieve this dose, weigh the horse (or use a weigh tape)). Scoop up PROTAZIL® to the level (cup mark) corresponding to the dose for the horse's body weight using the following chart:

Weight Range of Horse (lb)	mLs of Pellets	Weight Range of Horse (lb)	mLs of Pellets
275 - 524	20	1275 - 1524	60
525 - 774	30	1525 - 1774	70
775 - 1024	40	1775 - 2074	80
1025 - 1274	50	-	-

One 2-lb bucket of PROTAZIL® will treat one 1100-lb horse for 28 days. One 10-lb bucket of PROTAZIL® will treat five 1100-lb horses for 28 days.

CONTRAINDICATIONS

Use of PROTAZIL® (1.56% diclazuril) Antiprotozoal Pellets is contraindicated in horses with known hypersensitivity to diclazuril.

WARNINGS

For use in horses only. Do not use in horses intended for human consumption. Not for human use. Keep out of reach of children.

PRECAUTIONS

The safe use of PROTAZIL® (1.56% diclazuril) Antiprotozoal Pellets in horses used for breeding purposes, during pregnancy, or in lactating mares has not been evaluated. The safety of PROTAZIL® (1.56% diclazuril) Antiprotozoal Pellets with concomitant therapies in horses has not been evaluated.

ADVERSE REACTIONS

There were no adverse effects noted in the field study which could be ascribed to diclazuril. To report suspected adverse reactions, to obtain a MSDS, or for technical assistance call **1-800-224-5318**.

CLINICAL PHARMACOLOGY

The effectiveness of diclazuril in inhibiting merozoite production of Sarcocystis neurona and S. falcatula in bovine turbinate cell cultures was studied by Lindsay and Dubey (2000).[1] Diclazuril inhibited merozoite production by more than 80% in cultures of S. neurona or S. falcatula treated with 0.1 ng/mL diclazuril and greater than 95% inhibition of merozoite production (IC_{95}) was observed when infected cultures were treated with 1.0 ng/mL diclazuril. The clinical relevance of the in vitro cell culture data has not been determined.

PHARMACOKINETICS IN THE HORSE

The oral bioavailability of diclazuril from the PROTAZIL® (1.56% diclazuril) Antiprotozoal Pellets at a 5 mg/kg dose rate is approximately 5%. Related diclazuril concentrations in the cerebrospinal fluid (CSF) range between 1% and 5% of the concentrations observed in the plasma. Nevertheless, based upon equine pilot study data, CSF concentrations are expected to substantially exceed the in vitro IC_{95} estimates for merozoite production (Dirikolu et al., 1999)[2]. Due to its long terminal elimination half-life in horses (approximately 43-65 hours), diclazuril accumulation occurs with once-daily dosing. Corresponding steady state blood levels are achieved by approximately Day 10 of administration.

EFFECTIVENESS

Two hundred and fourteen mares, stallions, and geldings of various breeds, ranging in age from 9.6 months to 30 years, were enrolled in a multi-center field study. All horses were confirmed EPM-positive based on the results of clinical examinations and laboratory testing, including CSF Western Blot analyses. Horses were administered PROTAZIL® (1.56% diclazuril) Antiprotozoal Pellets at doses of 1, 5, or 10 mg diclazuril/kg body weight as a top-dress on their daily grain ration for 28 days. The horses were then evaluated for clinical changes via a modified Mayhew neurological scale on Day 48 as follows:

0. Normal, neurological deficits not detected.
1. Neurological deficits may be detectable at normal gaits; signs exacerbated with manipulative procedures (e.g., backing, turning in tight circles, walking with head elevation, truncal swaying, etc.).
2. Neurological deficit obvious at normal gaits or posture; signs exacerbated with manipulative procedures.
3. Neurological deficit very prominent at normal gaits: horses give the impression they may fall (but do not) and buckle or fall with manipulative procedures.
4. Neurological deficit is profound at normal gait: horse frequently stumbles or trips and may fall at normal gaits or when manipulative procedures were utilized.
5. Horse is recumbent, unable to rise.

Each horse's response to treatment was compared to its pre-treatment values. Successful response to treatment was defined as clinical improvement of at least one grade by Day 48 ± conversion of CSF to Western Blot-negative status for S. neurona or achievement of Western Blot-negative CSF status without improvement of 1 ataxia grade.

Forty-two horses were initially evaluated for effectiveness and 214 horses were evaluated for safety. Clinical condition was evaluated by the clinical investigator's subjective scoring and then corroborated by evaluation of the neurological examination videotapes by a masked panel of three equine veterinarians. Although 42 horses were evaluated for clinical effectiveness, corroboration of clinical effectiveness via videotape evaluation was not possible for one horse due to missing neurologic examination videotapes. Therefore, this horse was not included in the success rate calculation.

Based on the numbers of horses that seroconverted to negative Western Blot status, and the numbers of horses classified as successes by the clinical investigators, 28 of 42 horses (67%) at 1 mg/kg were considered successes. With regard to independent expert masked videotape assessments, 10 of 24 horses (42%) at 1 mg/kg were considered successes. There was no clinical difference in effectiveness among the 1, 5, and 10 mg/kg treatment group results.

Adverse events were reported for two of the 214 horses evaluated for safety. In the first case, a horse was enrolled showing severe neurologic signs. Within 24 hours of dosing, the horse was recumbent, biting, and exhibiting signs of dementia. The horse died, and no cause of death was determined. In the second case, the horse began walking stiffly approximately 13 days after the start of dosing. The referring veterinarian reported that the horse had been fed grass clippings and possibly had laminitis.

ANIMAL SAFETY

PROTAZIL® (1.56% diclazuril) Antiprotozoal Pellets were administered to 30 horses (15 males and 15 females, ranging from 5 to 9 months of age) in a target animal safety study. Five groups of 6 horses each (3 males and 3 females) received 0, 5 (5X), 15 (15X), 25 (25X) or 50 (50X) mg diclazuril/kg (2.27mg/lb) body weight/day for 42 consecutive days as a top-dress on the grain ration of the horse. The variables measured during the study included: clinical and physical observations, body weights, food and water consumption, hematology, serum chemistry, urinalysis, fecal analysis, necropsy, organ weights, gross and histopathologic examinations. The safety of diclazuril top-dress administered to horses at 1 mg/kg once daily cannot be determined based solely on this study because of the lack of an adequate control group (control horses tested positive for the test drug in plasma and CSF). However, possible findings associated with the drug were limited to elevations in BUN, creatinine, and SDH and less than anticipated weight gain. Definitive test article-related effects were decreased grain/top-dress consumption in horses in the 50 mg/kg group.

In a second target animal safety study, PROTAZIL® (1.56% diclazuril) Antiprotozoal Pellets were administered to 24 horses (12 males and 12 females, ranging from 2 to 8 years of age). Three groups of 4 horses/sex/group received 0, 1, or 5 mg diclazuril/kg body weight/day for 42 days as a top-dress on the grain ration of the horse. The variables measured during the study included physical examinations, body weights, food and water consumption, hematology, and serum chemistry. There were no test article-related findings seen during the study.

STORAGE INFORMATION

Store between 15°C to 30°C (59°F to 86°F).

HOW SUPPLIED

PROTAZIL® (1.56 % diclazuril) Antiprotozoal Pellets are supplied in 2-lb (0.9 kg) and 10-lb (4.5 kg) buckets.

REFERENCES

1. Lindsay, D. S., and Dubey, J. P. 2000. Determination of the activity of diclazuril against Sarcocystis neurona and Sarcocystis falcatula in cell cultures. J. Parasitology, 86(1):164–166.
2. Dirikolu, L., Lehner, F., Nattrass, C., Bentz, B. G., Woods, W. E., Carter, W. E., Karpiesiuk, W. G., Jacobs, J., Boyles, J., Harkins, J. D., Granstrom, D. E. and Tobin, T. 1999. Diclazuril in the horse: Its identification and detection and preliminary pharmacokinetics. J. Vet. Pharmacol. Therap. 22:374–379.

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MILNE Lecture

Infectious disease and neonatal discoveries that changed equine and human health

Gumshoe SLEUTHING

COURTESY AAEP

NANCY S. LOVING, DVM

When John Madigan, DVM, MS, Dipl. ACVIM, ACAW, professor and researcher in medicine and epidemiology at the University of California, Davis, School of Veterinary Medicine, began practicing in California in the 1970s, he treated a very sick horse with a puzzling illness. He wasn't satisfied with simply treating the horse symptomatically, so he kept looking for answers.

He described his discovery process during the Frank J. Milne State-of-the-Art Lecture. The disease he studied for many years after that case affects not only horses but also humans and other animals: tick fever, or granulocytic anaplasmosis, caused by *Anaplasma phagocytophilum*.

Anaplasmosis

Madigan's sleuthing began when on microscopic examination of the horse's blood he noticed strange-looking inclusion bodies (structures indicating infection) within the neutrophils—white blood cells important for clearing infection. This led him to further investigation and, finally, answers. It turned out this was a bacterial disease caused by *Ehrlichia equi* and transmitted by the same ticks that infect humans and animals with Lyme disease. In this case, one sick horse led to the discovery of a significant human disease—granulocytic erhlichiosis—caused by the same bacteria; this proved instrumental in stimulating development of horse and human treatment protocols.

> "Never theorize before you have data because, invariably, you'll end up twisting facts to suit the theories instead of developing theories to suit the facts."
>
> DR. JOHN MADIGAN

Madigan and others identified the vector and disease using evidence-based medicine. Their field observations led to more scientific inquiry and study. "Never theorize before you have data because, invariably, you'll end up twisting facts to suit the theories instead of developing theories to suit the facts," he said.

Another Enigma to Chase

Madigan next explored Potomac horse fever (PHF), which was first identified in 1979 in Maryland and Virginia and has since occurred in 44 states near freshwater streams and rivers. Affected horses exhibit severe diarrhea and colic. About 30% die due to severe laminitis.

Once again, in the 1980s, practitioners were trying to diagnose a mysteriously sick horse. It was apparent *Ehrlichia* caused the infection, but it took longer to

determine the infection route. Initially, veterinarians thought ticks were responsible, but this proved incorrect.

The sleuthing continued for 15 years. While local practitioners had been aware of this disease for at least 25 years and knew it responded to tetracyline, they still didn't know its cause or what it was.

Investigators recognized DNA similarities between this agent and what causes salmon poisoning in dogs (in which dogs ingest raw salmon containing cercaria—a fluke's larval stage released by freshwater snails—that contain this agent and subsequently develop fever and small intestine inflammation). So, Madigan's team wondered if the PHF agent might be linked to freshwater snails. Next, they identified active colitis (colon inflammation) in horses along Northern California's Shasta River, collected 400 snails from streamside pastures, and found the PHF agent's DNA in the snails.

Scientists determined that when river water warms, snails release motile cercaria. Offering cercaria-ridden water to horses and standing horses in this water didn't elicit disease. But injecting specific snail portions intravenously into mice and horses caused clinical signs.

Investigators found that caddisfly and other aquatic insect larvae serve as natural vectors, picking up infected cercaria, then emerging from water as flying insects.

Finally, after a few decades, the team could explain the complete life cycle: Bats and adult birds eat the insects and develop infected flukes, flukes carry the infectious agent, bats or birds defecate, and this gets into the water and the snails. Then the snails release cercaria, the aquatic insects pick them up, and these contaminate water, pasture, and hay.

To date, Madigan notes that PHF vaccines are not very effective. This is in part because horses get infected orally, yet the systemic vaccine goes into the muscle without stimulating intestinal mucosal immunity. Cercaria bind to the intestinal lining, directing the agent to the gut.

Neonatal Septicemia

Madigan then described a disease that can occur within the first two weeks of life, causing fever, diarrhea, and risk of death. Eight foals at one Central California farm (with 150 broodmares) developed neonatal septicemia and three died. Madigan identified *Salmonella* Type C-1 in the foals' joints, blood, and diarrhea, and in pregnant mares' normal feces.

Even after moving pregnant mares to a new site with different hay and water, subsequent foals born also got sick. The farm implemented intensive biosecurity measures and tested their broodmare mineral mix, finding it negative for *Salmonella*.

The next step was to reassess what was already known. The team noticed the next foal licking the dam where the afterbirth had hung, contaminated with her feces. Newborns have an open gut to enhance absorption of colostral (first milk) antibodies; they're also at risk of absorbing bacteria and viruses. Caretakers began separating foals and dams immediately after birth and bottle-feeding foals colostrum. They bathed mares, draining water away into gutters. Foals also received antibiotics and antibody-rich plasma.

They reduced pathogen load significantly. By giving ampicillin for just three days, *Salmonella* wouldn't develop antibiotic resistance. Ultimately, earlier batches of the mineral mix tested *Salmonella*-positive.

This case demonstrates the importance of starting from the beginning to assess facts, as well as the importance of observing horse behavior closely.

CONVENTIONTWEET

Ernie Martinez DVM
@emartinezdvm

"A good vet needs to be a good detective and use gumshoe sleuthing to solve the case and treat the horse." Dr. Madigan

Dummy/Maladjusted Foals

Madigan began his final sleuthing exercise by describing what we all witness but perhaps have never pondered: Foals are quiet in the uterus and don't start running or playing until a few hours after birth.

"Pressure in the birth canal tells the foal to transition to the outside world," he said. Yet, "dummy" foals (those born with neonatal maladjustment syndrome) enter the world wandering aimlessly, neither recognizing the dam nor seeking the udder. Generally, 80% recover in five to seven days, especially with early recognition and supportive care. Investigators wondered what goes wrong with these foals' transition to full consciousness at birth.

Madigan said the central nervous system and mental state of the normal fetus are depressed, and he is nourished almost entirely via the placenta. This physiologic state is similar to that of dummy foals. It turns out that innate neurosteroids anesthetize the foal in a chemically induced "sleep." Eight factors contribute to unconsciousness, particularly through progesterone hormone derivatives.

The scientists considered a common-sense explanation—as the foal proceeds through the birth canal, squeezing immobilizes him while triggering a neurosteroid reduction. Once the foal exits the birth canal, the neurosteroids have dissipated from his system or at least are gone within hours; he comes out awake. In contrast, a dummy foal becomes somewhat "somnambulant," or reverts to fetal consciousness, after appearing normal for a few hours. Researchers have found that plasma progestins (another type of hormone) in these foals remain quite high, mimicking the foal's *in utero* conditions.

When you hold a foal's body too tightly, he drops to the ground and goes quiet. Swaddling infants has a similar effect. Transition of fetal consciousness studies could have implications for human health—in particular, autistism studies—as scientists know that deep touch pressure can calm an autistic child. Other scientists have shown "kangaroo care," or holding infants skin-to-skin for hours, can reduce premature infant mortality.

Veterinarians treating dummy foals now rely on a simple procedure: They place ropes with a bowline around the foal's chest and under one front leg and multiple half hitches over the back. Then they squeeze the foal for about 20 minutes by pulling on the rope's long end. This replicates the canal signal. The foal goes into slow-wave sleep for a short time and awakens when the pressure is relieved.

Take-Home Message

Madigan showed that with creative thought and perseverance, veterinarians can solve seemingly unsolvable problems. In a nutshell, "unorthodox thinking is essential to overcoming the most persistent challenges in global health," he said. To read the Milne lecture in full, see TheHorse.com/35297.

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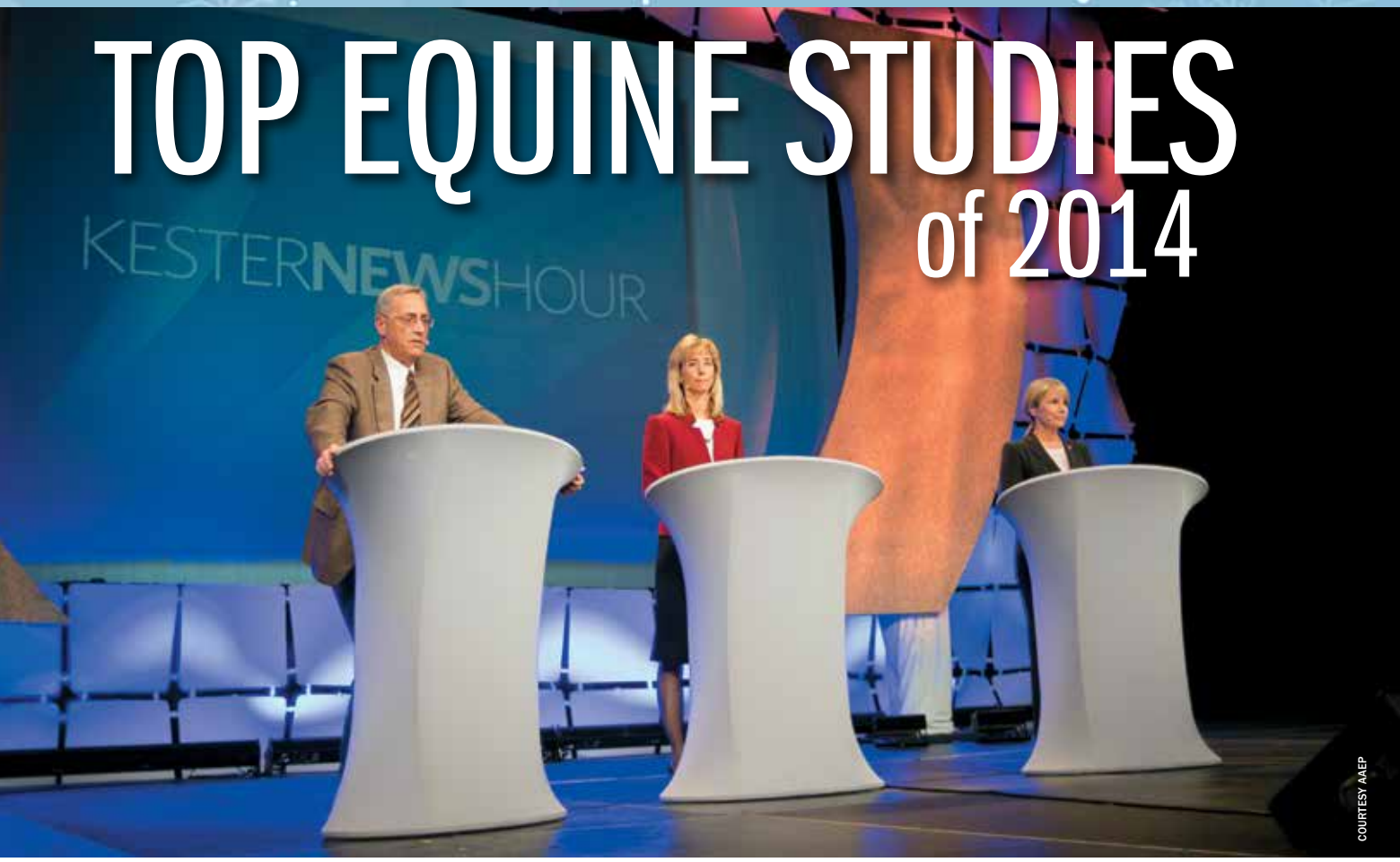
TOP EQUINE STUDIES of 2014



COURTESY AAEP

ALEXANDRA BECKSTETT
ERICA LARSON
NANCY LOVING, DVM

To kick-start the convention's educational sessions, three veterinarians presented their favorite studies from the past year to their peers. Lisa Fortier, DVM, PhD, Dipl. ACVS, (on the right in the image above) professor of Large Animal Surgery at Cornell University, in Ithaca, New York, shared lameness and surgery picks; Carol Clark, DVM, Dipl. ACVIM, (center) of Peterson & Smith Equine Hospital, in Ocala, Florida, presented medicine studies; and Terry Blanchard, DVM, Dipl. ACT, (left) theriogenology professor and researcher at Texas A&M University, in College Station, tackled reproduction topics.

Stem Cells for Treating Stifle Lesions

Fortier began by describing a "landmark paper" evaluating the outcome of horses with meniscal, cartilage, or ligamentous stifle lesions treated with a combination of surgery and intra-articular (in the joint) mesenchymal stem cells (MSCs) and hyaluronic acid injections. She said 44% of all horses returned to work following treatment; of those, 75% with meniscal disease returned to work (compared to 60% of control horses). Her take-home was that MSCs appeared to benefit meniscal lesion cases.

Nerve Block Variability

Next, she described two studies on blocks for the deep branch of the lateral plantar nerve, used to diagnose hind limb suspensory desmitis (inflammation of the ligament). There's a high degree of variability with these blocks, Fortier said; high-volume injections diffused more than low, and analgesia traveled up to 2 cm above and up to 5 cm below the injection site. Additionally, 37% of horses had evidence of analgesia in the tarsal sheath, and 24% of horses in the tarso-metatarsal joint (a low-motion hock joint).

The take-home? Blocks aren't specific. So, if the horse responds favorably, use diagnostic imaging to see what's going on.

CT to Assess Hock Lameness

Next, Fortier described a paper in which scientists retrospectively evaluated CT findings in horses with tarsal lameness. They found a variety of pathologies within the hock, Fortier said, some of which weren't visible on other imaging modalities. Thus, she encouraged practitioners to seek further diagnostic information via a 3-D modality (like CT or MRI) if radiographs and/or ultrasound appear clean in a horse exhibiting hock lameness.

Abnormal Breathing Patterns and Respiratory Disease

Changing gears, Fortier described a study in which researchers evaluated whether abnormal breathing patterns at the canter and gallop are associated with respiratory tract disease. They retrospectively studied 365 horses referred for evaluation due to poor performance or an upper respiratory tract obstruction.

The frequency of abnormal breathing patterns decreased as speed increased. Also, horses with a 2:1 pattern (taking one breath over two strides instead of one breath per stride) at higher speeds were more likely to have upper respiratory tract disease, while horses with abnormalities

at lower speeds could have either upper or lower respiratory tract disease.

Fortier's take-home: While not every horse with an airway obstruction will have a 2:1 breathing pattern, all affected horses warrant further upper and lower respiratory tract investigation.

Impact of Head and Neck Position

Moving on, Fortier described a group of studies on the impact of horses' head and neck positions while working.

First, she touched on one showing that three of four head and neck positions (including hyperflexion, or rollkür) resulted in a decreased pharyngeal diameter; the exception was natural, unrestricted head carriage. She said this indicated that all non-natural head and neck positions decrease pharyngeal diameter.

The next study she reviewed showed that while there's been some improvement in eliminating hyperflexion from upper-level dressage, it's not enough: "These findings support the hypothesis that, in recent years, (Fédération Equestre Internationale) dressage judges have not penalized horses for a head position behind the vertical," the study authors wrote.

Fortier then described a study in which scientists sought to determine if artificial head and neck positions led to increases in conflict behavior and/or stress. They found that a raised-neck position with the bridge of nose near the vertical increased all stress parameters and conflict behavior; those stayed elevated for 30 minutes after exercise. Fortier said hyperflexion was a "close second," and unrestrained was the most favorable position.

Dynamic Laryngeal Collapse

Fortier stayed on the respiratory tract for the next study, focusing on bilateral dynamic laryngeal collapse (DLC). She explained that the condition's cause and origin are unclear. Researchers determined that muscle biopsies of horses with DLC were no different than those of control horses. Fortier said this showed that DLC is not neuromuscular in origin, unlike laryngeal hemiplegia (roaring).

Motorized Floating and Cheek Teeth

Fortier concluded her section with a look at dentistry. She described a study in which researchers evaluated how much heat is transferred into horses' cheek teeth pulp cavities when veterinarians use a motorized implement during floating. Her key take-homes from this study included keeping the rotational speed as low as possible; limiting grinding to 30 seconds in one location; and allowing the tooth to cool for twice as long before carrying on (so, if you spend 30 seconds grinding, allow the tooth a minute to cool) to prevent tooth damage.

She finished by noting that motorized implements can smooth teeth and create a smooth surface layer without tearing or chipping the tooth's dentin. Also, diamond disc burrs are ideal for protecting dentin and creating a smooth surface.

CONVENTIONTWEET

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The Kester News Hour is an incredible synopsis of what is important in Equine Veterinary industry.

Ophthamology Studies

Clark began her medicine synopsis by describing several papers on eye problems. The first was on treating corneal stromal abscesses with 5% voriconazole (an antifungal) solution by injecting the drug immediately adjacent to the anterior stroma rather than directly into the abscess, as veterinarians more typically do. Necessary treatment time decreased from the reported average of eight weeks down to 5.5 weeks and resulted in less scarring.

Next, Clark reviewed a retrospective (2006-2013) study of 18 cases of orbital (surrounding the eye) fractures. In more than half of the cases, the researchers noted comminuted fractures (tiny bone fragments). They also noted that epistaxis (nosebleed) likely indicates sinus involvement. In addition, they identified neurologic signs in a horse that had reared in a confined space and suffered traumatic brain injury. In general, they were fairly successful in treating all cases, with nearly 87% returning to previous function and 60% with good cosmetic appearance.

Then Clark presented a paper in which veterinarians evaluated the use of cyclosporine implants to control immune-mediated keratitis (corneal inflammation). The researchers placed two to four of these silicone implants into 20 eyes and determined that it helped effectively control superficial (near the surface) and endothelial (the inner layer of the cornea) forms of keratitis, and the horses came off all or all but one topical medication through the follow-up of 14-18 months.

When applying any topical eye medication, there is always a concern that it could stimulate bacterial growth, thereby complicating the case. Clark described a study that showed no difference in bacterial growth in the eye with or without topical anesthetic tetracaine treatment.

Respiratory Conditions

Clark reviewed a paper in which the authors evaluated the correlation between airborne particulates and tracheal mucus at a Thoroughbred racetrack. If there is sufficient mucus in the respiratory tract, a horse experiences exercise compromise due to inflammation—the higher the mucous score, the greater the number of inflammatory cells. Of 649 study horses, 23% had mucous scores high enough to affect performance. The researchers found particulate contamination within a horse's rebreathing zone (the 2-foot area directly around the muzzle and face) was higher in stalls during the evening hours. They suggested implementing management practices that reduce ambient particulates in the stall and barn, such as improved

Researchers found that all non-natural head and neck positions decrease pharyngeal diameter.

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ventilation and dust control.

Clark also summarized the effects of environmental exposure on airway inflammation in 49 Thoroughbreds during their first month of training. The researchers measured horses' exposure to particulates, endotoxin, and ammonia and compared it to what they found on airway cytology (cell study). Particulates and airway inflammation especially increased with haynet use. Increased eosinophil (a type of white blood cell) numbers on cytology suggested allergic hypersensitivity related to environmental factors, the researchers concluded. Of the horses with increased eosinophil counts, 72-81% had some form of inflammatory airway disease (IAD) during the study.

In another study, researchers examined omega-3 fatty acid supplementation coupled with a low-dust diet to manage chronic lower airway inflammation. They determined that the best way to reduce airway inflammation is to remove hay; this led to 65% reduction in abnormal airway signs. Combining environmental control strategies with omega-3 fatty acid supplementation offered more benefits.

Heart Problems in Athletic Horses

Clark reported that the American College of Veterinary Internal Medicine and European College of Veterinary Internal Medicine have prepared a consensus statement on how to diagnose and manage cardiac murmurs and arrhythmias.

96%
of horses with shivers struggle with farrier work.

"The majority of horses with cardiovascular abnormalities can have some athletic use," she said. "Periodic re-evaluations are important as many conditions are progressive." She said a horse should not engage in athletic activities if veterinarians find evidence of pulmonary hypertension (abnormally high blood pressure in the arteries of the lungs); congestive heart failure (end-stage heart damage); or complex ventricular abnormalities (which alter the heart's strength and/or rhythm).

LORI SCHMIDT

Researchers reported that sarcoids are very responsive to the chemotherapy drug mitomycin-C.

Mitomycin-C Injections for Sarcoids

Clark reviewed a study in which researchers injected mitomycin-C, a chemotherapy drug, into 59 sarcoids identified in 24 horses and two donkeys. Nine sarcoids near the eyes resolved completely after one to four injections (average 1.9); of the 50 sarcoids in other places, 96% resolved after an average of 2.4 injections. In summary, sarcoids—especially the large nodular or fibroblastic lesions— are very responsive to mitomycin-C. Study authors said horses will not respond much in the initial four weeks and recommended reassessing 10-12 weeks post-treatment. Recurrence rate is as high as 6% and usually occurs within six to 30 months. But Clark said recurrent lesions do remain responsive to reinjection. The main side effect seen with mitomycin-C was hair discoloration at the injection site.

The Epidemiology of Shivers

In another study researchers looked at 305 surveys (in 10 countries) evaluating the epidemiology of shivers, a chronic progressive neuromuscular disorder that usually begins before age 7. The first clinical sign seen in affected horses is typically excessive hind-limb flexion or extension when backing up, which can worsen after shipping or stress. Shivers seems to be most prevalent in tall (~17-hand) male Draft or Warmblood horses. Nearly 93% show clinical signs daily, and 74% worsen over time. Eighty-five percent exhibit muscle twitching, 74% elevate their tailhead when backed, and 96% struggle with farrier work. Clark mentioned that 19% of affected horses also have facial twitching when asked to back up. The male predisposition is interesting because estrogen is known to be protective of the neurologic system in humans, she added.

N-Acetylcysteine's Effect on Sperm

Blanchard described a multi-center study researchers conducted to determine what concentration of N-acetylcysteine (NAC) administered in mares just prior to insemination would not affect sperm. This drug is a mucolytic sometimes used to help treat endometritis—inflammation of the endometrium, or the inner lining of the uterus. "If you must breed a mare shortly after treatment with NAC, the authors suggested the use of 0.5-1% NAC to avoid adverse effects on sperm," he said.

CCFA as an Endometritis Treatment

In this experimental study, Colorado State University researchers evaluated ceftiofur crystalline free acid (CCFA) levels in the endometrium after intramuscular administration. They gave the antibiotic—normally used for lower respiratory infections—to three groups of mares (at a 6.6 mg/kg body weight dose) at various intervals and collected blood and endometrial biopsy samples. Upon analyzing these, the team determined that CCFA remains at endometrial levels above the minimum concentration for inhibiting the growth of *Streptococcus zooepidemicus*, the most common cause of infectious endometritis, for up to six days.

PRP's Effects on Endometritis

In an effort to provide veterinarians with another treatment option for persistent endometritis, researchers evaluated autologous (derived from the horse's own blood) platelet-rich plasma's (PRP) effects on uterine inflammatory response when infused into the uterus after artificial insemination (a common cause of inflammation that can inhibit fertility). The team found that in susceptible mares, uterine fluid, nitric oxide levels, and percentage of neutrophils (the most abundant type of white blood cell) all decreased after PRP was administered four hours post-breeding. These measurements indicate a reduced inflammatory response, leading Blanchard to conclude that PRP might provide another effective treatment option for this condition.

Comparing ACP Prep Techniques

Sticking to regenerative medicine topics, Blanchard described a study comparing five autologous platelet concentrate (APC) preparation techniques originally developed for humans and now routinely used in horses. Practitioners use APC to enhance regeneration in tissues that have poor natural healing capabilities. They found marked variation among important enrichment factors that could influence how APC works in the body. The authors concluded that veterinarians should not rely on the manufacturer's data relating to human patients when selecting an appropriate method for horses. "Many of these techniques … are not nearly as effective (in horses) as they have been reported to be in enhancing platelets and platelet factors in humans," Blanchard said. "So they may need to be tailored to the horse."

Stem Cells to Treat Endometritis

Colorado State University researchers set out to determine whether biological treatments, such as autologous conditioned serum (ACS) and MSCs, could help modulate the inciting inflammatory response in mares with persistent mating-induced endometritis. They determined that both treatments decreased inflammatory response six hours post-insemination. They also found that MSCs increased the inflammatory mediator IL-1Ra, which Blanchard said might be very important in helping to control some of the effects of interleukin-1, a common pro-inflammatory cytokine produced during post-mating endometritis. Overall, they concluded that stem cells might benefit these cases.

Monitoring Supplemental Corpora Lutea Formation in Recipient Mares

A recipient mare used for embryo transfers must be cycling in synchronization with the donor mare in order to be a match for the transfer. Veterinarians might administer the synthetic hormone progestin (Regumate) to noncycling recipient mares to synchronize estrus and maintain pregnancy.

In the next study Blanchard described, scientists monitored supplementary corpora lutea (SCL, structures that ovarian follicles develop when endometrial cups in a developing pregnancy produce a hormone called equine chorionic gonadotropin) formation in 25 noncycling embryo transfer recipient mares via ultrasound to determine when to stop progestin treatment.

PAULA DA SILVA

Researchers determined that adding cholesterol-loaded cyclodextrin to cooled semen increased pregnancy rates in poor-cooling stallions.

The team concluded that they could cease progestin administration as early as Day 70 of gestation without affecting the pregnancy and that "monitoring SCL formation by ultrasound may be adequate for determining a need for progestin supplementation," Blanchard said.

He added that this information is useful even for veterinarians not working with noncycling recipient mares. "Many of the mares we have coming back into our practices from breeding farms are on Regumate," he explained. "One of the first questions your client will ask you is, 'When can I stop the Regumate?' Instead of just coming up with an arbitrary opinion, you can certainly scan for (SCL) when you're evaluating the pregnancy."

Frozen-Thawed Epididymal Sperm vs. Ejaculated Semen

A research team in Brazil compared sperm quality and fertility rates using frozen-thawed epididymal sperm (taken directly from the testes) versus frozen-thawed ejaculated semen from eight subfertile stallions. They found that the frozen-thawed epididymal sperm quality and artificial insemination pregnancy rates were much higher than those of the ejaculate. The researchers concluded that epididymal sperm were more resistant to freezing than ejaculated sperm.

Boosting Cooled Semen's Resistance

Some practitioners add cholesterol-loaded cyclodextrin (CLC) to the membranes of collected sperm to increase their resistance to freezing. However, cholesterol might also delay or inhibit sperm capacitation (activation) and the acrosome reaction required for fertilization. In another study out of Brazil, researchers evaluated CLC's effects on cooled semen from both a "good" and "bad" cooling stallion (which, said Blanchard, had not been studied previously) and found that it increased pregnancy rates for the poor-cooling stallion. This simple treatment might provide another method to improve poor-cooling stallions' fertility rates in shipped-semen breeding programs.

Fertility and Oxidative Stress

In the final study Blanchard described, a group from Australia performed a series of clinical trials to try to determine a relationship between stallion fertility and the oxidative stress that occurs when the body produces more free radicals than it can counteract, but which also provides energy for sperm motility. "They concluded that stallion sperm were highly dependent on oxidative phosphorylation for energy production," Blanchard said. Simply put, the most fertile sperm "live fast and die young," he said.

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Managing WILD HORSES

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MICHELLE N. ANDERSON

Wild Horse Health: On the Range, In Holding, and Postadoption

Feral mustangs managed by the Bureau of Land Management (BLM) require care different from your average domestic saddle horse, explained Albert Kane, DVM, MPVM, PhD, USDA Animal and Plant Health Inspection Service (APHIS) veterinary epidemiologist.

The BLM is responsible for 49,000 horses and burros on 32 million acres of publicly owned lands. The horses live on rangelands and in long- and short-term holding facilities.

Feral horses and burros are hardy animals that have survived harsh environmental conditions for several generations, Kane said. But they are still susceptible to illness and injury. The most common musculoskeletal problems veterinarians and managers see are club feet (which are often severe) and limb deformities.

The horses live in areas where food and water resources are often scarce. Kane described habitats where horses might have to use snow and puddles for hydration and eat shrubs and bushes during the winter. "Obesity is not an issue with mustangs in the wild," he said, noting the frequent lack of winter grazing resources and the constant movement of bands.

While the horses can survive on limited resources, the overall belief that free-roaming feral horses are hardy and, thus, immune to parasites and infectious disease is a myth, Kane said. "We find internal parasites—including ascarids, pinworms, and strongyles—in horses fresh off the range," he said. "We especially see heavy ascarid burdens in horses of all ages, including in adults (in which you might normally expect to see immunity)."

The BLM tests all horses removed from the range for equine infectious anemia (using a Coggin's test) and, under veterinary supervision, uses a vaccination protocol with periodic boosters to protect the horses from Eastern and Western equine encephalomyelitis, tetanus, equine influenza, equine herpesvirus, West Nile virus, strangles, and rabies.

Horses in holding facilities are especially susceptible to bacterial respiratory infections, such as those caused by *Streptococcus zooepidemicus* (upper respiratory infections or pneumonia) and *S. equi* (strangles), as well as viral infections such as influenza and herpesvirus (EHV). The cause, Kane said, is congregation of immunologically naive, stressed animals as they adapt to captivity.

> "Proper hoof care is the biggest welfare issue postadoption for mustangs."
>
> DR. ALBERT KANE

To protect horses from disease spread, the BLM follows biosecurity measures, which he said can be challenging when moving and handling large numbers of horses. Centers receiving horses from multiple management areas are emptied and cleaned to the extent possible, and handling facilities are disinfected prior to each use, but respiratory outbreaks still happen occasionally. All horses transported over state lines do so with brand inspections and health certificates.

Wild horse and burro specialists perform compliance visits to adopters' premises with assistance from APHIS veterinarians in some areas. The BLM also relies on private practitioners to certify that horses are getting adequate care on the adopter's title (ownership) application. "Poor hoof care is the biggest welfare issue postadoption for mustangs," he said, noting that feral horses haven't had their feet handled and require training for this.

While the challenges sometimes seem overwhelming, the BLM's goal is to keep the horses healthy, ensure they are treated humanely, and place them in good long-term homes, Kane said.

Managing Feral Horses on National Park Service Lands

For most people, the mention of wild horses in the United States conjures

images of BLM-administered American mustangs roaming the West. However, pockets of feral horses also live throughout the country on National Park Service (NPS) lands and are managed by the agency. Jenny Powers, DVM, PhD, an NPS wildlife veterinarian, presented the unique challenges of managing feral horses on NPS lands and described the agency's relationship with the BLM in co-managing horses.

Horses and ponies currently reside in about 20 NPS units; 10 units contain feral donkeys and burros. These herds include the Assateague Island ponies residing off the coast of Maryland and Virginia, the Shackleford ponies of Cape Lookout National Seashore in North Carolina, the Theodore Roosevelt National Park feral horses in North Dakota, and others.

The NPS formed under the Organic Act of 1916 with the mission, among other things, to preserve the "naturalness" of parklands, Powers said. Within the definition of "naturalness" lies the agency's challenge. Because NPS horses are feral domestic animals, not native wildlife, argument as to whether they're a natural part of the ecosystem exists.

Horses played a vital role in transportation, military action, and agriculture as the nation formed and settlers headed west. But, as reliance on equids dwindled with industrialization, they were released or abandoned on rangelands or remained as remnant herds from early colonial exploration, homesteading, and ranching.

Equids residing on NPS lands fall into four management categories:

1. ***Animals that reside within an NPS unit and aren't specifically managed as a cultural resource*** "Management of these animals often ranges from attempting to eradicate these animals from within the park to no management, usually because of lack of funds," Powers said, adding that many of these horses create natural resource damage, including soil erosion, damage to historic structures, and competition with native wildlife. Examples include the burro populations in the Grand Canyon National Park, in Arizona, and Mojave National Preserve, in California.
2. ***Trespass animals from herds on publicly managed neighboring lands, including BLM and U.S. National Forest*** Herds crossing between federally managed lands are often co-managed by the agencies using similar methods, Powers said. Management efforts might include roundups, adoptions, and fertility control. "Examples include the famous Pryor Mountain horse herd that neighbors Bighorn Canyon National Recreational Area in Montana," Powers explained.
3. ***Trespass animals from private lands or tribal reservation lands*** In these cases, the first priority of NPS is to confirm ownership of the animals and notify responsible parties of the trespass. If animals are deemed abandoned, NPS officials have several options, including fencing, roundup and removal, and lethal removal. "Examples where this occurs include Big Bend National Park, in Texas, and Glacier National Park, in Montana," Powers said.
4. ***Horses and ponies maintained as desirable, managed feral species as part of the cultural landscape of a park*** These herds (such as the Assateague ponies) are the most popular, celebrated, and controversial equids on NPS lands, Powers said. "They are small herds that are highly visible, and they have many interested stakeholders," she explained. "However, we have to balance the needs of native wildlife, habitat quality, and other park management priorities." Management of these equids includes fertility control, occasional veterinary care, genetic monitoring and manipulation, capture for branding/microchipping, roundup for sales, and working with non-NPS groups to facilitate adoption.

Managing all types of horses on NPS lands requires resources and a multifaceted approach. "Flexibility and a full range of tools are necessary to allow managers to balance the competing needs of many natural and cultural resources," she said.

CONVENTIONTWEET

Michelle Anderson
@TH_MNAnderson

BLM: Mustang populations in some areas grow 15-20% a year. #AAEP2014

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The Shackleford ponies of Cape Lookout National Seashore in North Carolina are one of the feral herds residing on National Park Service lands.

Caring for the Navajo Nation's Horses

Feral tribal horses walk the streets within the Navajo Nation. They're outside restaurants. In people's yards. There are just too many horses, and the Navajo government is working to change that. It started in 2013 with community roundups and a veterinary management program.

Scott Bender, DVM, works as tribal veterinarian with the Navajo Nation Veterinary Program and is a USDA APHIS consulting veterinarian. He shared the challenges faced when managing feral horses within the Navajo Nation, along with results of tribal equine population management efforts.

The Navajo Nation is located in the southwestern United States, with territory spanning Arizona, Utah, and New Mexico. The reservation comprises 18 million acres and, said Bender, an estimated 75,000 to 96,000 horses. The tribe permits 12,000 livestock owners, with the majority of permit holders having one to five privately owned horses. Under tribal law, all unbranded horses within the Navajo Nation are tribal property, Bender explained. That leaves the tribe with a lot of horses.

The Navajo traditionally view horses as sport, working, and food animals. "The horse is sacred to the Navajo, but that doesn't mean we don't eat them," Bender explained. The Navajo believe horsemeat has medicinal, healing properties and is useful as a "winter" meat, he said.

Initially, and into the early 20th century, the U.S. Bureau of Indian Affairs managed tribal livestock, but management has slowly transitioned to the sovereign nation government, Bender said. This happened partly because of U.S. government-approved reduction of livestock in the 1930s and the euthanasia and burial of more than 500 horses by federal authorities following an outbreak of the venereal disease dourine at the Canyon de Chelly National Monument, in Arizona. "This 'waste of resources' has left a negative indelible mark on the attitude of Navajo livestock owners toward the U.S. government," he said.

To the Navajo, unused horsemeat is a wasted resource that the creator gave the peoples, he clarified.

With this in mind, surplus Navajo horses historically had been sold off-reservation to slaughter as a way to manage populations and produce income. When U.S. equine slaughter plants closed in 2007, the tribal horses lost 95% of their value and the surplus feral horses were left to breed without human controls, Bender said. "The current (tribal) horse issue is a direct result of the elimination of an outlet for surplus horses," he added.

As herds grew, damage to rangelands increased, as did horse-caused human injuries. "Horses in right-of-ways caused car wrecks, human injuries, and even deaths," Bender said. These issues led tribal communities to request that the Navajo National Department of Agriculture start its equine population management program in 2013, which involved roundups and veterinary services, including free:

- Stallion and colt castrations;
- Mare fertility control via porcine zona pellucida (PZP) vaccination;
- Deworming for all castrated or fertility-control-vaccinated horses;
- Five-way vaccination against tetanus, Eastern and Western encephalomyelitis, EHV, and equine influenza; and
- Microchip placement.

While the initial fertility vaccination was effective, Bender described owner booster rates of horses as "dismal," despite efforts to promote boosters. The program's leadership is now investigating gonadotropin-releasing hormone vaccine use as a longer-acting and single-dose alternative to PZP.

In 2013 the Navajo Nation local communities, with the help of the Navajo Nation Departments of Agriculture and Resource Enforcement, rounded up 8,900+ horses. Permitted owners claimed about 250 horses; the tribe sold the rest with the requirement that they could not be returned to the Navajo Nation.

The veterinary program's goal was to castrate 1,000 male horses and vaccinate 1,500 mares against fertility by the end of 2014. To date, more than 700 horses have been castrated or vaccinated with PZP. Bender said members of communities where horse removals took place have reported improved forage conditions in spite of the area's continuing drought.

COURTESY DR. SCOTT BENDER

The Navajo are trying to find ways to manage their tribal equine population.

Fertility Control Study in NPS Mares

The National Park Service (NPS) is currently studying the use of fertility control vaccines to control feral horse populations on NPS lands, and Jenny Powers, DVM, PhD, an NPS wildlife veterinarian, shared their preliminary results.

In October 2009 NPS started a study using a gonadotropin-releasing hormone (GnRH) immunocontraceptive vaccine on mares in Theodore Roosevelt National Park, in North Dakota. They used 29 mares in their treatment group and 28 controls. The treatment group received 2 mL of GnRH vaccine. The control group received 2 mL of saline. Most mares were pregnant at the time of treatment.

"The GnRH vaccine we used showed promise as a multiyear vaccine after a single dose," she said, noting it is highly unusual for a vaccine to work for more than a year and that this would greatly improve the efficiency over currently available vaccines.

> A single GnRH vaccination provided a modest decrease in foaling rates for two years.

Over the next four years, they observed the mares for foaling rates; foal survival; mare body condition; mare reproductive behaviors; and mare social behavior.

In the first foaling season, 2010, researchers saw no statistical change in foaling or foal survival rates, as was expected because most mares were pregnant in 2009, Powers said. In the second foaling season, 35% fewer treated mares foaled than untreated mares. In the third, 30% fewer treated mares foaled than untreated mares. But in the fourth foaling season they saw no statistical difference in foaling rates between mares.

Overall, NPS researchers found a single GnRH vaccination provided a modest decrease in foaling rates for two years post-vaccination and had little effect on social behaviors, she said. Treated mares did have apparent inflammatory reactions at injection sites, she noted, but this did not appear to affect their well-being.

"The NPS is currently studying the efficacy of revaccination four years after the first vaccination, and researchers are interested in how long a booster vaccine might last and how effective it can be at preventing pregnancy," Powers said.—*Michelle N. Anderson*

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[1] UC Davis (Nicola Pusterla) & Merck Animal Health. Infectious Upper Respiratory Surveillance Program. Ongoing Research 2008-present.

[2] Townsend HGG. Onset of protection against live-virus equine influenza challenge following vaccination naive horses with a modified-live vaccine. Unpublished data.

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STEPHANIE L. CHURCH
REBECCA GIMENEZ, PHD

Barn Fire Prevention, Response

Traditional barn design hasn't changed much over the past 600 years. Despite improvements in fire prevention and building ventilation engineering, many barn builders and owners never consult with firefighters, veterinarians, or ventilation engineers. So Rebecca Gimenez, PhD, president of Technical Large Animal Emergency Rescue, and Coralie Mouraw, a third-year veterinary student at the University of Illinois, described their top six recommendations for designing, building, and managing a barn for optimal fire prevention and response:

1. Every house or public building has at least two exits, as dictated by the National Fire Protection Association (NFPA) Life Safety Codes and Standards. Ideally, stalls should have interior and exterior doors. If this were standardized by all barn designers, it would give any responder a chance to safely remove horses from stalls. Even better, have runout lanes or small paddocks to the outside so horses can be let out, haltered, and led away from the barn.
2. Barn and horse facility designers and builders should consult the NFPA 150 Standard on Animal Housing for best practice guidelines. The firefighting community has made great suggestions for ways facilities of all sizes can reduce fire risk and minimize fire effects.
3. Minimize the obstacles in aisleways that make it harder for firefighters to reach horses. Put access aisles through the barn at least every 50 feet. The ability to egress is important.
4. Minimize the barn's fuel load. Everything inside a barn is combustible fuel, from the shavings and hay to the rubber mats. Make sure your barn owners or managers know how dangerous practices such as storing hay in the barn above the horses are, and ask them to put it in a separate building at least 50 feet away from the facility.
5. Make sure you have increased the chances of firefighters accessing your barn. Is your barn well-marked with a big reflective sign at the road? Can firefighters get through your gate, down your driveway, then around the barn? Do you have fire extinguishers in place and hose systems hooked up at all times to put out the flames until the fire department arrives? Do you have a pond or standpipe hydrant they can use for water? Invite your local fire department officials to your property, and ask them to conduct a full preplanning tour to discuss ways you can improve fire safety and response to your property.
6. Make a plan and practice it. Start from the middle of your driveway and see how long it takes to get to the barn, halter the horses, and lead them all to a safe area. With a 3- to 5-minute window of time from ignition to a dangerous-to-life level of smoke production, this can be a sobering experience. Make improvements to the process until you can evacuate in less than 5 minutes.

> "Invite your local fire department officials to your property, and ask them to conduct a full preplanning tour."
> DR. REBECCA GIMENEZ

Fires happen in all sectors of the horse industry, knowing no socioeconomic, breed, or discipline boundaries. Follow these tips to reduce your chances of becoming a statistic. For more detail about each step, see TheHorse.com/35166.

Proper Hand Hygiene, Skin Health Prevent Equine Disease

Denis Verwilghen, DVM, MSc, PhD, DES, Dipl. ECVS, associate professor in Large Animal Surgery at Denmark's University of Copenhagen, described threats of the microbial sort. He and colleagues from Canada's Ontario Veterinary College

recently dug into scientific evidence regarding hand hygiene in both the human and equine medical communities.

"Skin health among veterinarians is important," he said. If you compare a vet clinic barn to a human hospital, "there are more potentially pathogenic bacteria on practitioners' hands in the veterinary sector than in the human health sector."

Out of a 2009 survey of veterinary surgery specialists, only 6.7% of respondents said they followed World Health Organization guidelines for pre-surgical hand asepsis. Practices had improved by 2013, but 66% still did not follow current guidelines. That got Verwilghen and co-authors wondering what's right: current guidelines or current practices? Here are some observations they made in the literature:

- The goal of surgical hand hygiene is to reduce or eliminate the burden of potentially disease-causing transient skin organisms and reduce microbiota (the natural population of organisms) long enough to avoid causing surgical site infections. It is not to sterilize the skin.
- Traditional scrubbing with alkaline medicated soaps, such as chlorhexidine gluconate (CHX), has deleterious effects on the skin's local defense mechanisms. "Medicated soaps can remove skin's protective floras, fatty acids, and make you more susceptible to pathogenic organisms and latex allergy," he said.
- 44% of respondents to another survey said they always use brushes to scrub up, even when current recommendations are to use soft sponges.
- The health community considers alcohol-based hand rubs (AHRs) superior for a variety of reasons (antibacterial efficacy, no known acquired alcohol resistance in bacteria, and reduction of methicillin-resistant *Staphylococcus aureus* cases in several hospital studies, for example) but there seems to be delayed adoption of these products by surgeons despite their time-saving advantages.
- About 17% of respondents in one study scrubbed before surgery with a medicated soap and also used an AHR, which is not recommended. Among the reasons: Dermatitis from continued use of soaps makes skin more difficult to decontaminate, and combining soaps with AHR likely increases skin damage without any demonstrable advantages. Also, prior hand-washing can alter AHR efficacy, particularly if the individual doesn't dry his or her hands completely before use.
- Overuse of CHX could be a contributing factor in antibiotic resistance.
- Gram-negative bacteria can lurk in faucets and sinks and potentially recontaminate hands after washing and prior to surgical gloving. And because gloves inevitably get punctured from time to time, hands must be well-cleaned.

Verwilghen's take-home message for veterinarians was to use AHRs (or a gentle soap followed by AHR if there's organic material to wash away) and apply moisturizer regularly. "Vets should use well-tolerated alcohol rub to optimize skin health in the midst of using hand hygiene techniques," he said.

For any approaches to be effective, the veterinary community must adopt and abide by them the way the human health community has. "We need to change our infection control culture," he said. "It needs to be inherent in ourselves, and in many ways it is all in our own hands."

CONVENTIONTWEET

Stephanie L. Church
@TH_StephLChurch

Gimenez: Are your stall door latches something a firefighter can figure out how to open quickly … and with gloves on? #AAEP2014

13 More Ways to Prevent Barn Fires

Rebecca Gimenez, PhD, president of Technical Large Animal Emergency Rescue, in Georgia, provided tips for preventing and responding to fires. Here are a few more things to think about from her talk:

1. ***When selecting stall hardware:*** Select latches that a firefighter can open with gloves on. Also, make sure stalls are both intuitive and easy to open. Some barn owners have attached reflective tape to latches to make it more obvious.
2. ***When picking your hay storage location:*** Firefighters actually use hay in training as fuel for the fire. Think about that when considering your hay storage location.
3. ***When selecting and placing your fire extinguishers:*** The average 5-pound fire extinguisher has "3.9 seconds worth of stuff in it," Gimenez said. "You will not put a barn fire out with a 5-pound fire extinguisher." Get several 10-pounders, learn to use them, and turn them upside down a few times a year to keep the chemical loose.
4. ***When considering cleaning frequency:*** Remember that all it takes is a spark of static electricity to ignite cobweb-lined rafters.
5. ***When designing your barn:*** Keep in mind that tall roofs with good ventilation allow heat to leave in a large fire.
6. ***When selecting building materials:*** Ideally, use concrete block construction, encase all electrical wires in conduit, install a metal roof over wood, and have a sand floor beneath your structure.
7. ***When putting up barn signage:*** Mark all exits for horses and people and the locations of your fire extinguishers.
8. ***When selecting smoke detection systems:*** The cheap $3.99 smoke detectors are not for barns. Call an electrical contractor who installs smoke detection systems to come to your facility and assess what type of detectors you need.
9. ***When deciding whether to install a sprinkler system:*** Sprinkler systems have been known to be more than 90% reliable in residential and public structures.
10. ***When putting up fans this spring/summer:*** Remember that cheap, old box fans are prime accidental ignition sources. Invest in an agricultural rated fan.
11. ***When parking your equipment and storing combustibles:*** Ideally, separate them from the barn. But if you must keep them in the barn, have them in an area separated by a fire door.
12. ***When choosing stalls for horses:*** Put the most valuable horses near the exits, or install exit doors on the outside walls.
13. ***When establishing a parking lot:*** Park cars and trailers at least 25 feet away from the barn, and leave keys in them.

Also, if your barn is burning and firefighters are working, remember they sometimes use a strategy called a passive defense attack—letting a large fire burn when they deem that entering the building would put human lives at stake.—*Stephanie L. Church*

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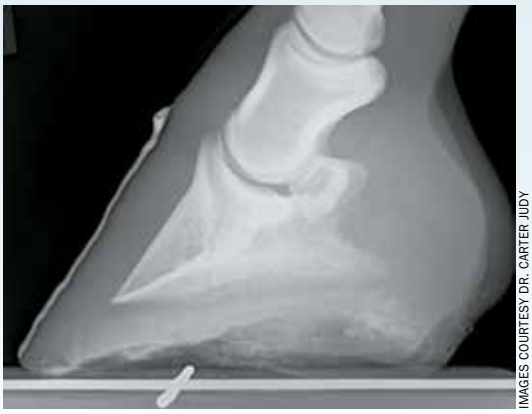
Using nuclear scintigraphy, MRI, and radiographs (shown counter-clockwise from top) together can help veterinarians better diagnose a problem, such as the resorption seen in this horse's coffin bone.



IMAGES COURTESY DR. CARTER JUDY

DIAGNOSTIC IMAGING

ALEXANDRA BECKSTETT

Radiography, Scintigraphy, and MRI: Benefits and Pitfalls

Today, veterinarians have the ability to peer inside horses' bodies and see what's causing swelling or pain. However, choosing which diagnostic imaging tool to use and interpreting its results is not always black and white. Carter Judy, DVM, Dipl. ACVS, described some benefits and pitfalls of three imaging modalities: radiography, nuclear scintigraphy (bone scan), and MRI.

"Knowing the caveats of each will help determine what modalities to use and how to interpret the findings," said Judy, who practices at Alamo Pintado Equine Medical Center, in Los Olivos, California.

Nuclear Scintigraphy Veterinarians can perform this simple, relatively noninvasive procedure with the patient standing under light sedation. It reveals areas of active bone remodeling, and Judy said practitioners typically use it to identify physiologic changes in bone and soft tissue.

"Scintigraphy is often used when the region of lameness is unknown or indeterminate using routine techniques such as nerve blocks to localize the area of pain," he said. Its downside is that you don't always know what's causing the bone remodeling, and it's less effective at identifying soft tissue lesions than MRI.

> "Negative results on one imaging modality do not preclude the absence of a problem in the patient."
>
> DR. CARTER JUDY

MRI This tool is quickly becoming more accessible to equine veterinarians, said Judy. Practitioners can use a low-field MRI system in the standing, sedated horse or a high-field system in an anesthetized one.

"Magnetic resonance imaging is used when the area of pain is known but the cause has not been well-established using other techniques," Judy explained.

One of the challenges of using MRI is that some findings identified using this technique might not be visible on other modalities, and vice versa, which can confound results, he said. Also, it can be more difficult to interpret than scintigraphy or radiographs.

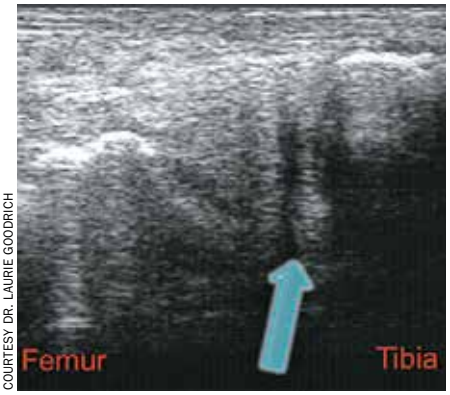
Radiographs Likely the most commonly used diagnostic modality in horses, radiography has become even more important since the advent of digital results. High-resolution images are now instantly

available and can be sent anywhere.

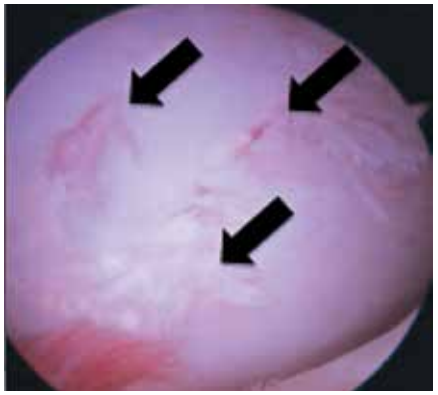
"While some soft tissue changes can be ascertained, the focus of radiographs is to provide an evaluation of the bony structures of an object," Judy said.

That is one of radiography's pitfalls: Its use is primarily limited to bone problems, he said. Also, radiography is less sensitive than, say, MRI, and it produces images that are two-dimensional representations of three-dimensional structures.

All three modalities are user- and interpreter-dependent. Also, said Judy, it's important to consider them complementary to one another: "Negative results on one modality do not preclude the absence of a problem … and an alternative imaging technique may provide more insight into the pathology of a particular patient."



COURTESY DR. LAURIE GOODRICH



As far as imaging horses' stifles, ultrasound is better for detecting meniscal tears (left), while arthroscopy is superior for detecting cartilage lesions (right).

Arthroscopy vs. Ultrasound for Diagnosing Stifle Lesions

Veterinarians can use both ultrasound and arthroscopy (inserting a slender arthroscope into a small incision to view a joint) to detect joint pathology. Laurie Goodrich, DVM, PhD, Dipl. ACVS, associate professor of surgery and lameness at Colorado State University's (CSU) College of Veterinary Medicine, in Fort Collins, recently compared these two imaging modalities' ability to diagnose stifle lesions. She first described each tool's imaging capabilities within the stifle:

"Arthroscopy is considered the gold standard to view stifle soft tissues," she said, but veterinarians can only "observe limited aspects of the meniscus (cartilaginous tissue within the joint) due to the narrow joint space."

Ultrasound, she said, is a "valuable tool for intra-articular soft tissue evaluation and has high specificity/sensitivity (identifies unaffected/affected joints correctly) in diagnosing meniscal injury."

In her retrospective study, Goodrich and colleagues used ultrasound and arthroscopy to evaluate 47 stifles in 37 horses admitted to CSU's clinic with injuries of that joint. They found that "ultrasound detected far more lesions of the meniscus due to arthroscopy's inability to observe the entire meniscus," Goodrich said. "Arthroscopy detected far more lesions of the cranial meniscotibial ligament and cartilage than ultrasound," supporting her hypothesis about the extent of each modality's diagnostic potential.

Combining the modalities, therefore, can help veterinarians better assess stifle disease and increase their diagnostic and prognostic capabilities, she said.

MRI to Predict Catastrophic Fetlock Fractures in Racehorses

These fractures are the leading cause of euthanasia in Thoroughbred racehorses worldwide. During training and racing the fetlock joint is under extreme tension.

"Flexing the fetlock while racing places the suspensory ligament and sesamoid bones under tremendous tensile forces, which then acts like a sling shot so the sesamoid bones compress the back of the condyle (the end of the cannon bone that fits into the fetlock joint)," explained John Peloso, DVM, MS, Dipl. ACVS, a surgeon at the Equine Medical Center of Ocala, in Florida.

When pre-existing disease or bone changes are present, condyles are more likely to fracture. So if veterinarians could detect these changes pre-race, they could intervene to prevent fetlock fracture.

"Is MRI the tool that will help us do better?" Peloso asked.

To answer this question, he evaluated 71 Thoroughbred racehorses euthanized at Florida tracks from September 2011 to March 2013. Eighteen suffered catastrophic fetlock fractures, and 53 were euthanized for other reasons (the control horses). Peloso took MRIs of all horses' limbs 48 to 72 hours post-euthanasia to see if he could identify any significant pathology in the fetlock.

He found that 67% of the fracture horses' condyle bone density had increased by 50%, which indicates the bones bore significant loads. This compared to 13% of control horses. He also noticed an increased STIR signal (which indicates bone edema, or early damage and fluid accumulation in the bone) in 78% of fetlock fracture cases but none of controls.

"These changes might be useful as a screening test to identify horses at increased risk of fetlock fracture during racing," Peloso said.

This means racehorse owners and their veterinarians should pay close attention to these structures when evaluating signs of lameness. Because the changes are happening inside the bone itself, a horse with a stress fracture in his fetlock is not going to exhibit the conventional indicators of fetlock lameness. "Horses whose fetlocks are cool to the touch, have no joint distension, and are negative to flexion tests may still have an unrecognized fracture and may need an MRI," Peloso said.

He suggested veterinarians use diagnostic blocks to localize lameness to the fetlock joint and then perform a standing MRI. If MRI images reveal greater than 50% bone densification and/or STIR signal increase, "our research suggests that the horse should not be subjected to the high forces of racing," Peloso said. "Temporarily suspending training, or training at slower speeds until the bone edema resolves, is the current recommendation in elite athletes in human medicine," and this approach might help reduce the occurrence of catastrophic fetlock fractures in Thoroughbred racehorses.

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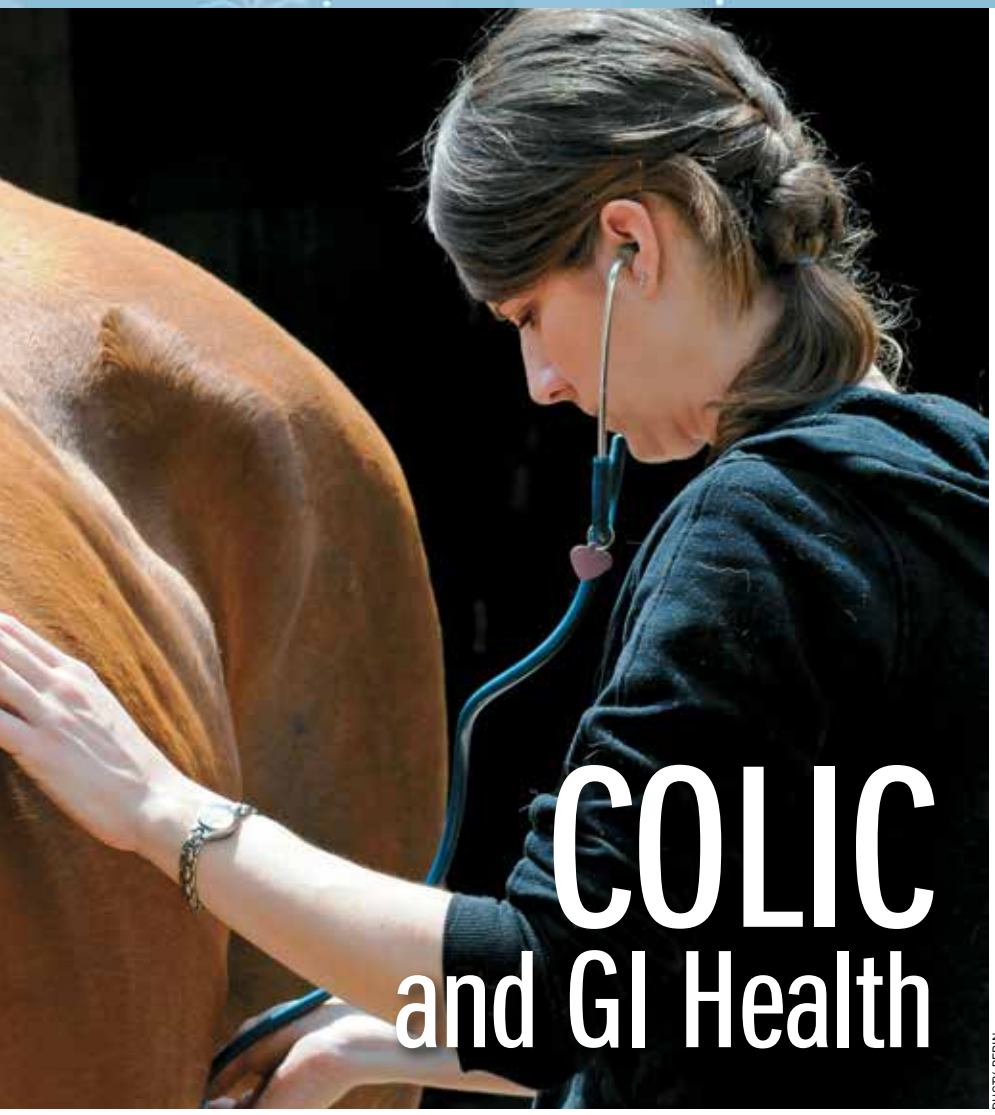

COLIC and GI Health

DUSTY PERIN

ERICA LARSON

Keys to Managing Colic Medically

Colic might rank as one of the most common equine ailments veterinarians manage, but fewer than 5% of those cases require surgery to correct. So how do they handle the other 95%? Medically, of course.

Sarah Reuss, VMD, Dipl. ACVIM, clinical assistant professor and large animal internal medicine service chief at the University of Florida College of Veterinary Medicine, reviewed the mainstays of medical colic management. She said that while there's no new "silver bullet" medical treatment for colic, there's merit to reviewing the three main approaches: fluid therapy, laxative administration, and pain management.

Fluid therapy Reuss said veterinarians use fluids for a variety of reasons, but their main goals typically include replacing fluid losses, supporting the cardiovascular system, and maintaining hydration in the face of ongoing fluid losses. Veterinarians can administer fluids either intravenously (IV) or enterally (via the GI tract).

She began with a discussion of enteral fluids: "Given the supply shortage of large volumes of commercially available intravenous fluids currently, it is especially important to remember that enteral fluids are effective in most cases of medically managed colic," Reuss stressed. "Rapid transit of fluids through the small intestine makes enteral fluids a logical option in treating large colon impactions."

> **"Despite its routine use, there's little literature to support the use of mineral oil in horses."**
>
> DR. SARAH REUSS

Reuss said enteral fluids have been proven effective in managing cases with nonstrangulating large colon lesions and can also be used to correct mild electrolyte imbalances. Other benefits include easier preparation than IV fluids and no need to be sterile, she said. But they do present a few issues.

"There is evidence that leaving an indwelling nasogastric tube in place for 72 hours does delay gastric emptying, so repeat intubation may be better despite its inconvenience," Reuss said.

Further, large volumes of plain water or hypotonic solutions (those with more water and fewer electrolytes than blood plasma) can cause electrolyte imbalances; isotonic fluids (which have an electrolyte concentration similar to blood plasma), however, appear well-tolerated and have no significant effects on electrolyte levels.

"Abdominal distension can also be seen with high-volume enteral fluids," said Reuss, but most horses tend to tolerate the distension well. Further, many horses treated with enteral fluids for an impaction will develop diarrhea as the impaction resolves (because of the abundance of fluids).

Despite the supply shortage, veterinarians still use IV fluids to treat some colic cases, including horses with diarrhea, signs of hypovolemic shock, or nasogastric reflux (the fluid removed with a tube during a colic workup) measuring more than 2 to 3 liters. Veterinarians often use IV fluids more commonly in hospitalized horses than those treated at home.

Reuss said veterinarians sometimes use high-volume IV fluids to soften impacted materials. She cautioned, however, that there's conflicting evidence regarding whether this practice is effective.

"In one study of normal horses, 5 liters per hour of IV fluids for 12 hours—approximately twice the amount of fluid a normal horse should consume in a day—did not show any effect on hydration of right dorsal colon contents or feces, while the same fluid rate delivered (via nasogastric tube) did," Reuss relayed. In another study comparing fluid rates and administration routes in dehydrated horses, however, veterinarians restored fecal and systemic hydration with the twice maintenance IV dose.

Intravenous fluids don't come without drawbacks either. Reuss said IV fluids are more expensive than enteral fluids, require an indwelling IV catheter (which has a risk of causing thrombophlebitis, or inflammation of the jugular vein), and are often impractical when horses aren't hospitalized.

Laxative administration "Despite its routine use, there is little literature to support the use of mineral oil in horses," Reuss said. "It is most useful as a marker of (gastrointestinal) transit time, as it should be seen in the feces of a normal horse 12 to 24 hours after administration."

If they do use mineral oil, veterinarians must place the nasogastric tube carefully, "as deposition of mineral oil in the lungs can cause a fatal lipoid pneumonia."

Psyllium is an option for treating and preventing sand colic, Reuss said, though there's conflicting evidence on its efficacy. Further, there's some belief that horses' colonic flora could degrade psyllium after continuous administration, which would eliminate its laxative properties.

Another laxative is magnesium sulfate, which veterinarians commonly use to treat impactions. They sometimes administer enteral magnesium sulfate in concert with IV fluids, she said, which is thought to promote fluid secretion into the intestine. Researchers on one study, however, showed that enteral fluids alone were still more effective at hydrating ingesta than the combined approach described.

Dioctyl sodium sulfosuccinate (DSS) is a detergent product that can help break up impactions and stimulate gut motility, but Reuss said it's less effective than a magnesium sulfate/water combination. She also said toxicity has been reported at high concentrations, so using DSS is questionable when there are safer alternatives.

LINDA SHERRILL

Veterinarians frequently use fluid therapy to manage colic cases.

Additionally, Reuss said veterinarians often successfully use activated charcoal and/or di-tri-octahedral smectite (DTOS, marketed as BioSponge) to treat colics thought to be caused by an ingested toxin.

Pain management Pain itself can inhibit motility, but so can the analgesics used to manage it. "While many of the drugs used to treat colic may cause transient (short-lived) decreased motility, the beneficial effects typically outweigh those consequences," she said. Options include:

- Nonselective non-steroidal anti-inflammatory drugs, or NSAIDs (flunixin meglumine, phenylbutazone, and ketoprofen);
- COX-2 preferential NSAIDs (meloxicam, firocoxib, carprofen, etodolac);
- α-2 adrenergic agonists (xylazine, detomidine);
- Opiods (butorphanol); and
- Others (N-butylscopolammonium bromide and lidocaine).

Overall, a major potential benefit of medical management is that the vet bills typically wind up being lower than for surgical cases, Reuss said.

"The caveat to that would be horses with diarrhea or large amounts of nasogastric reflux can get very expensive due to the amount of fluids and supportive care they require," she relayed.

"Medical therapy continues to be an appropriate and effective treatment for most cases of colic," Reuss said. "It is important to remember, however, that any horse that remains painful despite appropriate medical therapy and analgesia should be referred for possible surgical intervention."

Ophthalmic vs. Orthopedic Case Colics

Surgery, hospitalization, and other issues can cause colic. So when a research team from the University of Pennsylvania School of Veterinary Medicine (Penn Vet) read a previously published study indicating ophthalmic patients appear to be at a higher risk of colic due to chronic pain, long-term hospitalization, atropine use (a common therapeutic agent for equine eye problems), and frequent sedation, they decided to evaluate colic incidence in ophthalmic patients versus orthopedic patients in their own hospital. Nicole Scherrer, DVM, an ophthalmology resident at Penn Vet, presented their findings.

In their retrospective study, the team reviewed records of 105 ocular patients and 197 orthopedic patients admitted during the 2011-2012 academic year that stayed at least overnight and were treated by one of two clinicians. While they did find significant differences between the two groups, there was no significant difference in colic incidence (8% in ophthalmic patients vs. 5% in orthopedic patients).

"Horses hospitalized with ocular disease were not at an increased risk of colic relative to orthopedic cases," she said, "and episodes of colic in both groups were resolved with medical management in all but one case."

She believes the lower incidence of colic among their ophthalmic patients could be due to preventive measures the staff at her clinic takes, including:

- Administering atropine no more than twice daily;
- Using a low dose (0.25 mg/kg) of the NSAID flunixin meglumine rather than a standard 1 mg/kg dose;
- Hand-walking and/or grazing patients at least twice daily; and
- Examining patients as infrequently as possible (to reduce stress levels and sedation frequency) without compromising the horse's treatment.

"The incidence of colic in both groups was comparable to other (published) reports of horses in the general population and hospitalized cases," Scherrer said. "The dose of non-steroidal anti-inflammatory used was associated with an increased risk of colic in these patients," highlighting the importance of using a low dose whenever possible.

CONVENTIONTWEET

Betsy Charles
@betsycharles71

Dr. Whitcomb doing an awesome presentation on the history of ultrasound!!! Great to learn about this imaging legacy! #AAEP2014

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Supplement's Effects on Ulcers Studied

Nicola Kerbyson, BVMS, Cert. AVP (EM), MRCVS, a PhD student at the University of Glasgow, in Scotland, presented the results of a study in which she and colleagues compared a digestive health supplement's effects on gastric ulcer severity to those of the current gold-standard treatment: omeprazole.

Kerbyson said omeprazole has been well-studied up to 56 days of administration (where its reported efficacy is very good, she said), but many horses are treated for much longer periods. She also noted consumers are interested in supplements for managing gastric ulcers.

Her team compared the effects of a commercially available dietary supplement containing polar lipids (oat oil), soluble fiber, and amino acids (SUCCEED), marketed as a digestive supplement to help heal gastric ulcers, and omeprazole (GastroGard) on the development and treatment of squamous gastric ulcers (in the stomach's nonglandular area) in Thoroughbred racehorses.

They began with 67 horses either in training or actively racing diagnosed with squamous ulcers rated Grade 1 or higher on a 0 to 4 severity scale. The horses had not received ulcer treatment for at least 28 days and were not consuming supplements marketed to manage or treat ulcers, Kerbyson said.

The researchers divided the horses into two treatment groups: Group 1 received omeprazole at a dose of 4 mg/kg daily, while Group 2 received 27 g of the dietary supplement daily (both according to label dose). At Days 30, 60, and 90 of treatment, blinded observers evaluated each horse via gastroscopy.

Kerbyson stressed that because the supplement's manufacturer funded the study, the research team analyzed the results with particular scrutiny. But they ultimately determined the dietary supplement was not inferior to omeprazole in terms of the proportion of horses whose squamous ulceration completely resolved and those whose ulcer score was less than or equal to 1 at Day 90.

Kerbyson noted that because it's not legal to race on omeprazole in the U.K., about half the omeprazole group came off the medication prior to racing and restarted after; it's unclear what effect that might have had on the results, she said. Other factors, such as rebound gastric acidosis (abnormally high acidity levels due to the sudden stop in omeprazole), might have impacted their findings. Thus, Kerbyson said it's too early to draw firm conclusions, as more research is needed.

"But this research does point to the fact that we need to study long-term omeprazole use better, and that supplements may have a place in long-term management of gastric ulceration," she noted. "We need to look beyond omeprazole use in the management of gastric ulceration and consider management factors as equally, if not more, important in managing this condition."—*Erica Larson*

Ultrasound or Rectal Palpation?

Practitioners use palpation *per rectum* and percutaneous (through the skin) ultrasound to narrow the source of a colic and decide on hospital referral. Tracy E. Norman, VMD, Dipl. ACVIM, of Blue Ridge Equine Clinic, in Staunton, Virginia, reviewed how veterinarians use these techniques.

Rectal palpation of the horse's abdomen has long been considered a colic exam mainstay, but improvements in ultrasound protocols and availability of portable equipment "have made percutaneous ultrasound an increasingly utilized modality in the diagnosis of acute colic."

And, like many other diagnostic modalities, each has its own strengths and weaknesses: "Each one is a powerful diagnostic tool, but together they could provide information that neither could alone," Norman said.

Palpation *per rectum* is most useful for evaluating structures located in the caudal (closest to the rear) abdominal cavity, she said. A veterinarian might use rectal palpation on horses with acute or chronic colic, as well as with fevers of unknown origin, urogenital problems, weight loss, and inappetence, among other issues. She cautioned that a late-term fetus, bladder distension, and colonic or cecal gas distension can all obstruct a practitioner's ability to palpate other structures in the abdomen.

Norman advised against using palpation *per rectum* in very small or fractious horses and noted that veterinarians who are small in stature might have difficulty palpating very large horses. While rectal palpation allows access to examine about a third of the abdomen, this percentage can drop to about a quarter when a veterinarian with short arms is working with a large patient.

> "The most dreaded complication of rectal palpation is a rectal tear."
>
> DR. TRACY E. NORMAN

"The most dreaded complication of rectal palpation is a rectal tear," Norman said. Horses of some specific breeds (including Arabians and Miniature Horses), those older than 9 years, and mares have all been shown to be at increased risk of rectal tear following palpation, she added.

Additionally, she said, palpating a horse's abdomen from behind places the veterinarian in a precarious position: subject to kick or crush injury.

Percutaneous ultrasound generally allows veterinarians to visualize the superficial (less deep) two-thirds of a horse's abdomen. This can augment information collected on rectal exam, or it can be especially helpful in evaluating colicky horses when rectal palpation is impossible or unacceptably risky.

But the ultrasound technique also has its limitations. First, Norman said, a horse's hydration status, perfusion (blood supply), skin thickness, fat coverage, and hair coat thickness, along with ambient temperatures, can all negatively affect ultrasound image quality.

To that end, most patients must be groomed and clipped, and the target area must be coated in either ultrasound gel or isopropyl alcohol.

Another potential drawback, she said, is that ultrasound units require power, and some farms don't have safe electric wiring (or electricity at all).

"In addition, although more affordable units and probe options are becoming increasingly available, there is cost involved in obtaining optimum equipment," Norman said.

"Performed together, palpation *per rectum* and sonographic examination provide complementary information about lesion location, etiology (cause), and severity," she said.

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[1] Comparison of innate immune responses in equine respiratory epithelial cells to modified-live equine influenza vaccine and related wild-type influenza virus. HL Pecoraro, D. Koch, G Soboll Hussey, L Bentsen, GA Landolt; Proceedings ACVIM Annual Forum 2014.

[2] UC Davis (Nicola Pusterla) & Merck Animal Health. Infectious Upper Respiratory Surveillance Program. Ongoing Research 2008 – present.

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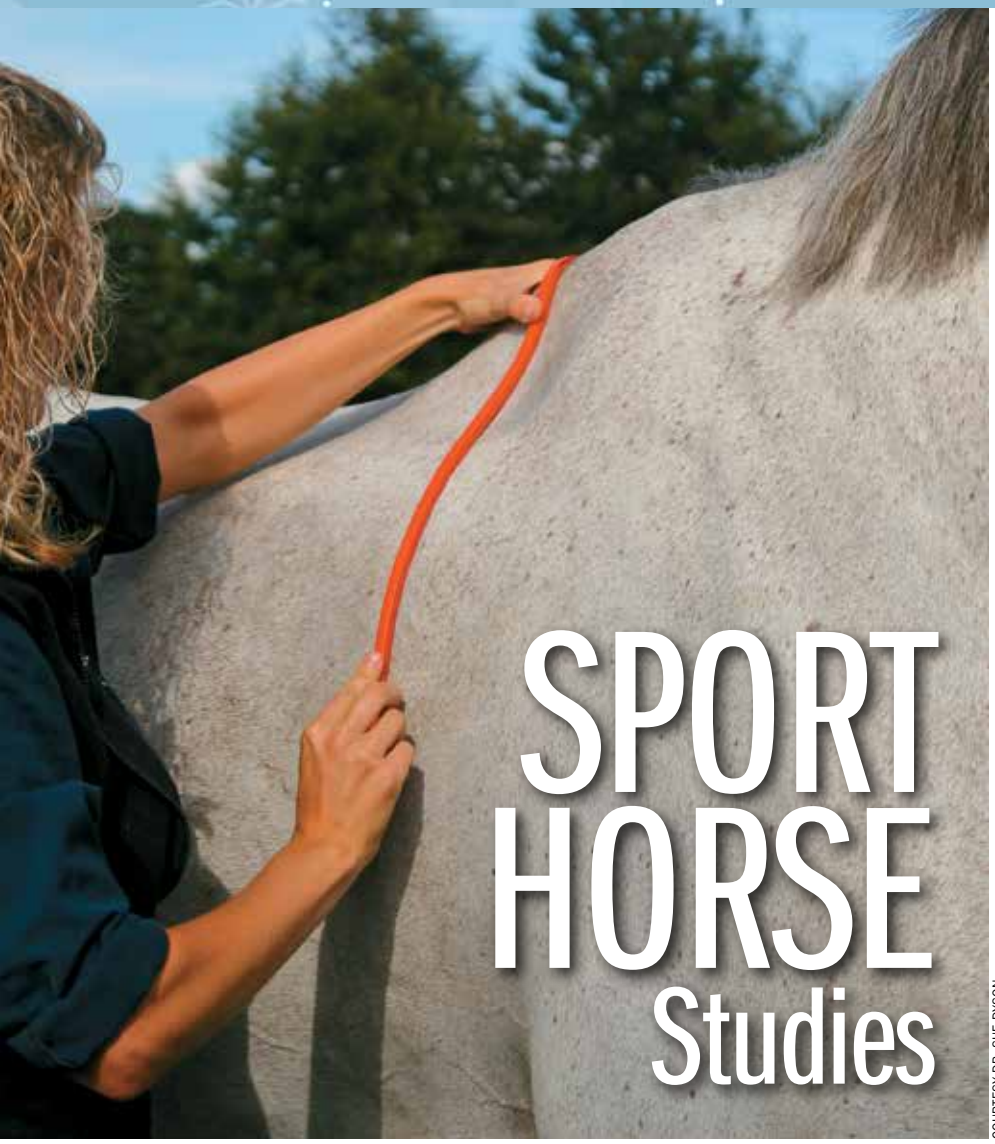

SPORT HORSE Studies

COURTESY DR. SUE DYSON

ALEXANDRA BECKSTETT

Exercise's Effects on Horses' Back Dimensions and Saddle Fit

If you're a runner, you've probably noticed that after a 45-minute jog your calf muscles are swollen. They are responding to post-training fluid shifts, fiber hypertrophy (thickening), and the general strain of exercise. Horses' muscles, particularly along the back, respond to exercise the same way, which could affect saddle fit as your horse works.

Sue Dyson, MA, VetMB, PhD, DEO, FRCVS, and a team at the Animal Health Trust, in Newmarket, U.K., recently studied exercise-induced changes in horses' back dimensions because they knew if a saddle doesn't fit properly, it can cause a horse pain and impair his performance.

"There has been no investigation of whether the thoracolumbar region (lower back, in front of the pelvis) changes in shape in association with exercise or how improper saddle fit may influence potential changes," Dyson began.

Factors she said influence horses' back muscle dimensions include conformation, type of exercise, age, head and neck position, lameness, tack fit, and rider skill and weight. In this study the team aimed also to determine the influence of work quality, saddle fit, and rider skill on these muscles.

> "Back dimensions do increase with work. This is particularly important to recognize in young horses that have not yet developed topline muscles."
>
> DR. SUE DYSON

Dyson and her colleagues assessed 63 sound sport horses (mostly dressage horses) ridden by their usual riders in their normal tack. Using a flexible curve ruler, the team measured each horse's back dimensions at four sites before and immediately after 30 minutes of exercise. They also assessed saddle fit, rider skill (good, moderate, or poor), gait abnormalities or lameness, and trot and canter grades on the 1-10 Fédération Equestre Internationale (FEI) dressage scoring system (e.g., if the horse is working on the bit, swinging through his back, etc.). They divided the horses into two groups based on total work quality score for the trot and canter: Group 1 scored a cumulative 11 or higher, and Group 2 scored 10 or lower. They observed that:

- Average back dimension changes (1-1.5 cm) were greater in Group 1 than 2;
- 41 horses were sound, and 22 had gait abnormalities;
- Average work quality was higher in sound horses;
- Sound horses had greater average back changes;
- In regard to rider skill level, the researchers determined that, of the 28 riders, four were poor, six were moderate, and 18 were good;
- Horses with good riders had the greatest back changes, and horses with poorly skilled riders had the least;
- Saddles were balanced in 39 horses, had even contact in 35, were unbalanced in 24, slipped in four, oscillated in five, and slid forward in two; and
- Back changes were greater with well-fit saddles.

Based on these results, Dyson said horses that don't work correctly due to either work quality or rider skill, or have a poorly fitting saddle, will suffer from a lack of long-term muscle development. To remedy this, the easiest thing to correct is often the saddle.

Dyson said, "Back dimensions do increase with work. This is particularly important to recognize in young horses that have not yet developed topline muscles."

Six Signs of Sacroiliac Disease

One veterinarian recently devised a "checklist" of six clinical indicators of sacroiliac (SI) disease to help practitioners diagnose this challenging condition.

"In general, complaints about sacroiliac disease in horses are diverse," said Rob van Wessum, DVM, MS, Cert Pract KNMvD (Equine), of Equine All-Sports Medicine Center, in Mason, Michigan. "Coming to a diagnosis can be a daunting task and often involves several diagnostic tools to exclude other sources of reduced performance."

All affected horses have one thing in common, however: compromised movement of the SI region, where the spine meets the pelvis.

Since 2005, van Wessum has evaluated 2,467 lameness cases with and without SI disease. He noted whether each horse showed any of 26 indicators of gait abnormality that he looked for. He then performed statistical analysis on these data to see which indicators had a significant correlation with a specific diagnosis.

He diagnosed 327 of those horses with SI disease based on clinical exam, imaging (ultrasound and scintigraphy), and improvement post-treatment. Six of the indicators were significant enough to indicate SI disease (322, or 98%, of horses had a positive score for at least three):

- ***Tracking narrow behind*** Van Wessum said affected horses often look like they are "walking on a cord" at the walk and trot, placing their hind feet on the same line in front of each other to help stabilize the pelvic region.
- ***Lateral walk*** Upon walking an affected horse in a serpentine pattern, the front and hind limbs on the same side move forward at the same time, similar to a pacing gait, perhaps due to increased tension and decreased spinal motility.
- ***Haunches in/out*** "One hip is often kept slightly lower, resulting in a slight bending to one side," van Wessum said. "This is easily observed when the horse is longed on a circle." The observer will notice that the hind limbs don't follow the same circle as the front limbs, with the haunches making a smaller circle than the rest of the body.
- ***Asymmetric tail position*** When an affected horse walks in a serpentine, he locks his tail to one side due to SI ligament involvement, van Wessum said.
- ***"Bunny hop" canter*** When affected horses canter, van Wessum said they lose their normal three-beat pattern and, instead, the hind feet land together in a "bunny hop" motion to avoid pain from the rotational forces on the pelvis.
- ***Reduced flexibility of the lumbrosacral region*** For this last observation, the veterinarian manipulates the SI region manually to gauge its flexibility. He or she does this by placing one hand on the point of the hip and pulling the tail toward one side, then repeating this on the other side. The veterinarian should also make the horse "tuck under" by scratching each hamstring with a pointed object. "Lateral (side-to-side) and ventral flexibility (vertically beneath the SI region) should be symmetrical," van Wessum said. If they're not, this is a good indicator for sacroiliac dysfunction.

In summary, van Wessum said these six tests require nearly no extra effort to perform during a lameness exam.

"Statistical analysis showed that when horses do not show at least three of the indicators, it is very unlikely they have sacroiliac disease," he said.

CONVENTIONTWEET

Tanya Thomas, DVM
@TBTDVM

At a talk where Sue Dyson is speaking! You know, the vet that wrote the book on lameness :)

Aquatic Exercise's Effect on OA

Although subtle in its onset, osteoarthritis (OA) is one of the most common career-ending musculoskeletal injuries in horses. Recently, Melissa King, DVM, PhD, Dipl. ACVSMR, assistant professor in Equine Sports Medicine and Rehabilitation at Colorado State University's Veterinary Teaching Hospital, in Fort Collins, conducted a study to determine whether aquatic exercise could help reduce OA's detrimental effects.

As OA progresses, affected horses often adapt to discomfort by changing their gaits and/or stance. But this frequently does more harm than good. "What are protective actions become maladaptive," she said.

While there's limited data on how aquatic exercise affects horses, in humans this therapy helps increase limb strength, joint mobility, muscle activation, and neuromotor control. King explained that water's buoyancy helps reduce loading on joints or injured limbs, its hydrostatic pressure reduces edema (fluid swelling), and its high viscosity (which is 12 times that of air) means horses must exert increased effort to move.

To determine whether aquatic exercise could help improve OA-affected horses' balance and postural control—and, thus, help slow the disease's progression—King induced OA in 16 horses' middle carpal

KEVIN THOMPSON/THE HORSE

When longeing a horse with SI disease, you might notice his hind limbs don't follow the same circle as the front limbs, with the haunches making a smaller circle than the rest of the body.

COURTESY DR. MELISSA KING

Underwater treadmill therapy significantly improves balance control in horses with osteoarthritis.

(knee) joints. Half of the horses exercised five days a week on an underwater treadmill (with water at shoulder height, which reduces 50-60% of body weight borne by the limbs) for 70 days, and the other half served as controls, exercising on a normal high-speed treadmill at the same speed and duration as the underwater treadmill group. The researchers collected force plate data (e.g., movements and center of pressure) from each horse while it stood in three different stance conditions (normal/square, base narrow, and blindfolded to remove its visual cues) at Days 0, 14, 42, and 70.

"Among horses exercised on the underwater treadmill, postural stability in both the base-narrow and blindfolded stance conditions significantly improved in comparison to the overground treadmill-exercised horses," King explained.

In other words, underwater treadmill therapy does, in fact, significantly improve balance control in OA horses, which King said provides important evidence-based support for equine aquatic therapy.

Overall, said King, "exercising in water provides an effective medium for increasing joint mobility, increasing muscle activation, promoting normal motor patterns, and reducing the incidence of secondary musculoskeletal injuries" in horses.

Pelvic Fractures in Horses: Not Always Career-Ending

Sarah Peters, VMD, intern at the University of Pennsylvania School of Veterinary Medicine's New Bolton Center, recently studied the short- and long-term outcomes of pelvic fractures in Thoroughbreds and determined that many of these horses can recover and race.

Peters said 0.5-4.4% of all lamenesses occur in the pelvis, and 28% of those are fractures. "These cases are out there, and you're going to see them eventually," she said. They've also recently become easier to diagnose thanks to improved imaging technology.

In her epidemiologic study of pelvic fractures, Peters reviewed the records of 136 Thoroughbreds diagnosed (via imaging in the live horse or necropsy) with pelvic fractures at Rood & Riddle Equine Hospital, in Lexington, Kentucky, from 2000 to 2010. She looked at each horse's race record or offspring race record (if the horse was retired to breed) and considered discharge from the clinic to be a successful short-term outcome and return to racing or breeding to be a successful long-term outcome.

She found that:

- 84 horses were female, 50 were male, and the sex of two were unrecorded;
- Horses' ages ranged from 3 days to 11 years;
- Most were racehorses (49%) or horses younger than 2 (40%), "which is consistent with the population seen at Rood & Riddle and not necessarily those horses that are predisposed to getting pelvic fractures," Peters noted;
- Fractures were evenly distributed between the left and right sides;
- 117 horses were discharged, 17 euthanized, and two suffered fatal hemorrhages associated with the injury;
- Of the discharged horses, 72 (62%) raced and 42 (36%) produced at least one foal following fracture;
- Acetabular involvement (that of the pelvis' cup-shaped "socket" that meets the femur to form the hip joint), articular involvement (that of the joint itself), and comminuted fractures (characterized by multiple small fragments) meant significantly more negative short-term outcomes, but affected horses discharged from the hospital could still go on to be successful;
- Young horses, racehorses, and horses with fractures only involving the ilium (the largest, uppermost pelvic bone) had better outcomes; and
- 86% of horses had good short-term prognoses, 77% of which had good long-term prognoses (keep in mind there was overlap in the groups of horses that raced and those that became breeding animals).

> "If horses (with pelvic fractures) leave the hospital they have a good chance of a good long-term outcome and performance."
>
> DR. SARAH PETERS

Peters then took a closer look at the groups of horses most likely to have successful outcomes: young horses and racehorses. "Fracture location on young horses did not affect future race performance," she said, adding that fracture location did affect racehorse outcome.

"If these horses leave the hospital they do have a good chance of a good long-term outcome and performance," Peters concluded.

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LAMENESS and HOOF CARE

KEVIN THOMPSON/THE HORSE

ALEXANDRA BECKSTETT
NANCY LOVING, DVM

Superficial Digital Flexor Tendon Rupture in Older Horses

Older horses are at risk of sustaining an uncommon injury: acute rupture of the proximal (upper) superficial digital flexor tendon (SDFT) where the metacarpus (cannon bone) meets the carpus (knee). This is because as horses age, the SDFT stiffens and becomes less elastic and resistant to cyclic loading to the point that it can tear.

Betsy Vaughan, DVM, associate professor at the University of California, Davis, School of Veterinary Medicine, described characteristics of this condition based on records from the school's Large Animal Ultrasound Service from 2003 to 2013.

First, she said, know what to look for: Clinical signs of SDFT rupture include visible swelling over the back of the knee (palmar carpus) or cannon bone and a reluctance to straighten the knee. Sometimes the veterinarian can see or palpate a notch on the back of the limb, just below the carpus. Pain on palpation varies, and veterinarians rely primarily on ultrasound for diagnosis.

In Vaughan's retrospective study of 1,317 metacarpal ultrasound exams, she determined that 171 horses (13%) had a primary SDFT injury; however, only 13 horses and one mule, ranging in age from 15 to 30 years, had completely ruptured the SDFT. About half sustained the injury during turnout, three following jumping competition, and one during transport.

The mule was affected bilaterally (on both sides). Four horses had a previous history of superficial flexor tendinitis (inflammation of the structure).

Horses can be in a lot of pain initially, said Vaughan, with 36% of affected study horses demonstrating limb tremors at rest. Upon examination at the hospital, all but two horses were either lame at a walk or non-weight-bearing. The mule with the bilateral rupture was euthanized.

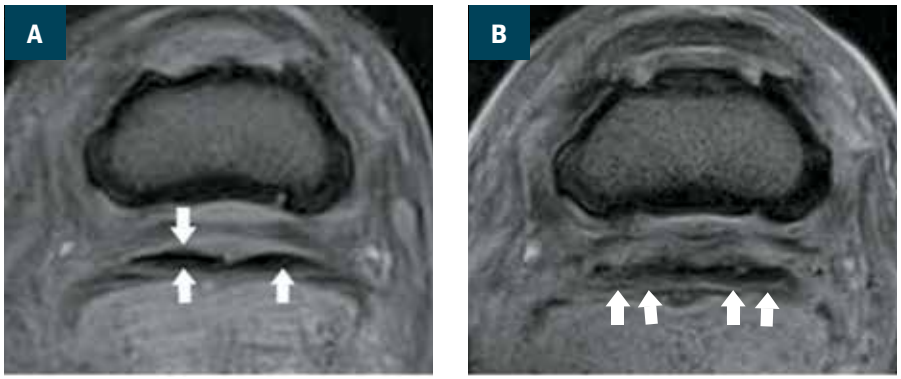
Ultrasound findings included localization of the rupture (pinpointing its exact location), severe enlargement of the tendon below the rupture site, and relaxation of damaged tendon fibers. In five horses ultrasound revealed increased fluid or hemorrhage in the carpal sheath, which surrounds the SDFT and deep digital flexor tendon (DDFT) behind the knee.

Regarding treatment, said Vaughan, success depended on a 14- to 90-day period of strict stall rest, followed by incremental increases in hand-walking. Caretakers administered phenylbutazone for five to 14 days and applied support bandages for seven to 60 days. Clinicians performed intralesional therapy with stem cells (in one horse) or platelet-rich plasma (in one), or intralesional hyaluronic acid (in five). Follow-up information was available for 11 of the 13 survivors, seven of which attained pasture soundness. Four horses remained lame, two of which developed persistent flexural contracture (an abnormal shortening of the muscle and/or tendon that results in constant joint flexion). Two of the horses went on to rupture the opposite front SDFT six months and three years after the first injury.

"In general, horses seem to be at greater risk for rupture of the proximal SDFT as age increases," said Vaughan. "The mean age for occurrence in this group was 21.4 years. Rupture of the SDFT should be considered in older horses showing signs of acute severe pain and lameness with swelling of the palmar carpus and/or metacarpus. Prognosis is good for return to pasture soundness, provided the horse is given prolonged rest and rehabilitation."

Digital Neurectomy Outcome in Horses With Chronic Foot Pain

Sometimes conservative therapies just aren't enough for managing chronic foot pain, such as what navicular disease or coffin bone fractures cause. In these cases practioners might perform a palmar or plantar digital neurectomy (PDN)—surgically cutting the nerve in the low pastern area. But some horses that undergo this procedure develop complications such as painful neuromas (fibrous scar and nerve tissue accumulation at the incision site) or residual lameness.



COURTESY DR. GUTIERREZ-NIBEYRO

Prior to PDN surgery, this jumper with deep digital flexor tendinopathy had increased signal intensity and fraying of the dorsal border of the affected tendon (A). On recheck 28 months later, the horse was lame and showed signs on MRI that the previously detected tendon injury had progressed (B).

With this in mind, Santiago Gutierrez-Nibeyro, DVM, MS, Dipl. ACVS, an equine surgeon at the University of Illinois Veterinary Teaching Hospital, in Urbana, took a closer look at what might cause poor outcomes following PDN.

> "In general, horses seem to be at greater risk for rupture of the proximal SDFT as age increases."
>
> DR. BETSY VAUGHAN

He looked at the records of 50 horses treated at four equine clinics from 2005 to 2011 that had chronic foot lesions diagnosed via low-field MRI and subsequently underwent a PDN. He noted their age, breed, sex, athletic use, lameness history and severity, response to analgesia of the digital nerves, and radiograph and MRI findings. He also noted any postoperative complications and determined whether the horse was currently sound and being used at its previously athletic level.

Gutierrez-Nibeyro found that:

- 32 (64%) horses had concurrent lesions of the DDFT, navicular bursa, or navicular bone on MRI;
- Post-surgery, 46 (92%) horses were sound, 40 (80%) returned to their previous level of work, four (8%) returned to a lower level, and two (4%) retired;
- The average time until lameness returned was 20 months;
- 18 (36%) horses suffered complications such as neuromas, residual lameness, or early lameness recurrence; and
- Other parameters were not significant.

Gutierrez-Nibeyro determined that horses with concurrent DDFT lesions were four times more likely to become lame again post-PDN. They had "a significantly shorter period of lameness resolution than horses with other foot lesions," he explained. "These are poor surgical candidates for a PDN."

Based on results, he encouraged veterinarians to use MRI to screen horses before suggesting owners pursue PDN.

Subjective vs. Objective Lameness Identification Methods

Lameness evaluations are quite subjective. When examining a horse with a mild lameness, in particular, practitioners often don't agree on a diagnosis. To overcome such disparities, they've turned to objective methods such as force plates and inertial sensor systems (ISS, the Lameness Locator). But which is superior: a subjective exam or one of these devices?

Josh R. Donnell, DVM, equine sports medicine and rehabilitation resident at Colorado State University's Orthopaedic Research Center, in Fort Collins, compared the force plate to the inertial sensor system and to two different forms

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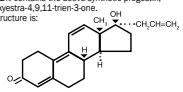
Regu-Mate® (altrenogest)

Solution 0.22% (2.2 mg/mL)

CAUTION: Federal law restricts this drug to use by or on the order of a licensed veterinarian.

DESCRIPTION: Regu-Mate® (altrenogest) Solution 0.22% contains the active synthetic progestin, altrenogest. The chemical name is 17α -allyl-17ß-hydroxyestra-4,9,11-trien-3-one. The CAS Registry Number is 850-52-2. The chemical structure is:



Each mL of Regu-Mate® (altrenogest) Solution 0.22% contains 2.2 mg of altrenogest in an oil solution.

ACTIONS: Regu-Mate® (altrenogest) Solution 0.22% produces a progestational effect in mares.

INDICATIONS: Regu-Mate® (altrenogest) Solution 0.22% is indicated to suppress estrus in mares. Suppression of estrus allows for a predictable occurrence of estrus following drug withdrawal. This facilitates the attainment of regular cyclicity during the transition from winter anestrus to the physiological breeding season. Suppression of estrus will also facilitate management of prolonged estrus conditions. Suppression of estrus may be used to facilitate scheduled breeding during the physiological breeding season.

CONTRAINDICATIONS: Regu-Mate® (altrenogest) Solution 0.22% is contraindicated for use in mares having a previous or current history of uterine inflammation (i.e., acute, subacute, or chronic endometritis). Natural or synthetic gestagen therapy may exacerbate existing low-grade or "smoldering" uterine inflammation into a fulminating uterine infection in some instances.

PRECAUTIONS: Various synthetic progestins, including altrenogest, when administered to rats during the embryogenic stage of pregnancy at doses manyfold greater than the recommended equine dose caused fetal anomalies, specifically masculinization of the female genitalia.

DOSAGE AND ADMINISTRATION: While wearing protective gloves, remove shipping cap and seal; replace with enclosed plastic dispensing cap. Remove cover from bottle dispensing tip and connect luer lock syringe (without needle). Draw out appropriate volume of Regu-Mate solution. (Note: Do not remove syringe while bottle is inverted as spillage may result.) Detach syringe and administer solution orally at the rate of 1 mL per 110 pounds body weight (0.044 mg/kg) once daily for 15 consecutive days. Administer solution directly on the base of the mare's tongue or on the mare's usual grain ration. Replace cover on bottle dispensing tip to prevent leakage. Excessive use of a syringe may cause the syringe to stick; therefore, replace syringe as necessary.

WHICH MARES WILL RESPOND TO REGU-MATE® (altrenogest) SOLUTION 0.22%: Extensive clinical trials have demonstrated that estrus will be suppressed in approximately 95% of the mares within three days; however, the post-treatment response depended on the level of ovarian activity when treatment was initiated. Estrus in mares exhibiting regular estrus cycles during the breeding season will be suppressed during treatment; these mares return to estrus four to five days following treatment and continue to cycle normally. Mares in winter anestrus with small follicles continued in anestrus and failed to exhibit normal estrus following withdrawal.

Response in mares in the transition phase between winter anestrus and the summer breeding season depended on the degree of follicular activity. Mares with inactive ovaries and small follicles failed to respond with normal cycles post-treatment, whereas a higher proportion of mares with ovarian follicles 20 mm or greater in diameter exhibited normal estrus cycles post-treatment. Regu-Mate® (altrenogest) Solution 0.22% was very effective for suppressing the prolonged estrus behavior frequently observed in mares during the transition period (February, March and April). In addition, a high proportion of these mares responded with regular estrus cycles post-treatment.

SPECIFIC USES FOR REGU-MATE® (altrenogest) SOLUTION 0.22%:
SUPPRESSION OF ESTRUS TO:

1. Facilitate attainment of regular cycles during the transition period from winter anestrus to the physiological breeding season. To facilitate attainment of regular cycles during the transition phase, mares should be examined to determine the degree of ovarian activity. Estrus in mares with inactive ovaries (no follicles greater than 20 mm in diameter) will be suppressed but these mares may not begin regular cycles following treatment. However, mares with active ovaries (follicles greater than 20 mm in diameter) frequently respond with regular post-treatment estrus cycles.
2. Facilitate management of the mare exhibiting prolonged estrus during the transition period. Estrus will be suppressed in mares exhibiting prolonged behavioral estrus either early or late during the transition period. Again, the posttreatment response depends on the level of ovarian activity. The mares with greater ovarian activity initiate regular cycles and conceive sooner than the inactive mares. Regu-Mate® (altrenogest) Solution 0.22% may be administered early in the transition period to suppress estrus in mares with inactive ovaries to aid in the management of these mares or to mares later in the transition period with active ovaries to prepare and schedule the mare for breeding.
3. Permit scheduled breeding of mares during the physiological breeding season. To permit scheduled breeding, mares which are regularly cycling or which have active ovarian function should be given Regu-Mate® (altrenogest) Solution 0.22% daily for 15 consecutive days beginning 20 days before the date of the planned estrus. Ovulation will occur 5 to 7 days following the onset of estrus as expected for nontreated mares. Breeding should follow usual procedures for mares in estrus. Mares may be regulated and scheduled either individually or in groups.

DOSAGE CHART:

Approximate Weight in Pounds	Dose in mL
770	7
880	8
990	9
1100	10
1210	11
1320	12

ADDITIONAL INFORMATION: A 3-year well controlled reproductive safety study was conducted in 27 pregnant mares, and compared with 24 untreated control mares. Treated mares received 2 mL Regu-Mate® (altrenogest) Solution 0.22% /110 lb body weight (2x dosage recommended for estrus suppression) from day 20 to day 325 of gestation. This study provided the following data:

1. In filly offspring (all ages) of treated mares, clitoral size was increased.
2. Filly offspring from treated mares had shorter interval from Feb. 1 to first ovulation than fillies from their untreated mare counterparts.
3. There were no significant differences in reproductive performance between treated and untreated animals (mares & their respective offspring) measuring the following parameters:
   - interval from Feb. 1 to first ovulation, in mares only.
   - mean interovulatory interval from first to second cycle and second to third cycle, mares only.
   - follicle size, mares only.
   - at 50 days gestation, pregnancy rate in treated mares was 81.8% (9/11) and untreated mares was 100% (4/4).
   - after 3 cycles, 11/12 treated mares were pregnant (91.7%) and 4/4 untreated mares were pregnant (100%).
   - colt offspring of treated and control mares reached puberty at approximately the same age (82 & 84 weeks respectively).
   - stallion offspring from treated and control mares showed no differences in seminal volume, spermatozoal concentration, spermatozoal motility, and total sperm per ejaculate.
   - stallion offspring from treated and control mares showed no difference in sexual behavior.
   - testicular characteristics (scrotal width, testis weight, parenchymal weight, epididymal weight and height, testicular height, width & length) were the same between stallion offspring of treated and control mares.

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Shoemaker, C.F., E.L. Squires, and R.K. Shideler. 1989.Safety of Altrenogest in Pregnant Mares and on Health and Development of Offspring. Eq. Vet. Sci. (9); No. 2: 69-72.
Squires, E.L., R.K. Shideler, and A.O. McKinnon. 1989.Reproductive Performance of Offspring from Mares Administered Altrenogest During Gestation. Eq. Vet. Sci. (9); No. 2: 73-76.

WARNING: Do not use in horses intended for food.

HUMAN WARNINGS: Skin contact must be avoided as Regu-Mate® (altrenogest) Solution 0.22% is readily absorbed through unbroken skin. Protective gloves must be worn by all persons handling this product. Pregnant women or women who suspect they are pregnant should not handle Regu-Mate® (altrenogest) Solution 0.22%. Women of child bearing age should exercise extreme caution when handling this product. Accidental absorption could lead to a disruption of the menstrual cycle or prolongation of pregnancy. Direct contact with the skin should therefore be avoided. Accidental spillage on the skin should be washed off immediately with soap and water.

INFORMATION FOR HANDLERS:
WARNING: Regu-Mate® (altrenogest) Solution 0.22% is readily absorbed by the skin. Skin contact must be avoided; protective gloves must be worn when handling this product.

Effects of Overexposure: There has been no human use of this specific product. The information contained in this section is extrapolated from data available on other products of the same pharmacological class that have been used in humans. Effects anticipated are due to the progestational activity of altrenogest. Acute effects after a single exposure are possible; however, continued daily exposure has the potential for more untoward effects such as disruption of the menstrual cycle, uterine or abdominal cramping, increased or decreased uterine bleeding, prolongation of pregnancy and headaches. The oil base may also cause complications if swallowed. In addition, the list of people who should not handle this product (see below) is based upon the known effects of progestins used in humans on a chronic basis.

PEOPLE WHO SHOULD NOT HANDLE THIS PRODUCT.

1. Women who are or suspect they are pregnant.
2. Anyone with thrombophlebitis or thromboembolic disorders or with a history of these events.
3. Anyone with cerebral-vascular or coronary artery disease.
4. Women with known or suspected carcinoma of the breast.
5. People with known or suspected estrogen-dependent neoplasia.
6. Women with undiagnosed vaginal bleeding.
7. People with benign or malignant tumors which developed during the use of oral contraceptives or other estrogen-containing products.
8. Anyone with liver dysfunction or disease.

ACCIDENTAL EXPOSURE: Altrenogest is readily absorbed from contact with the skin. In addition, this oil based product can penetrate porous gloves. Altrenogest should not penetrate intact rubber or impervious gloves; however, if there is leakage (i.e., pinhole, spillage, etc.), the contaminated area covered by such occlusive materials may have increased absorption. The following measures are recommended in case of accidental exposure.
Skin Exposure: Wash immediately with soap and water.
Eye Exposure: Immediately flush with plenty of water for 15 minutes. Get medical attention.
If Swallowed: Do not induce vomiting. Regu-Mate® (altrenogest) Solution 0.22% contains an oil. Call a physician. Vomiting should be supervised by a physician because of possible pulmonary damage via aspiration of the oil base. If possible, bring the container and labeling to the physician.

CAUTION: For oral use in horses only. Keep this and all medication out of the reach of children.

Store at or below 25°C (77°F).

NADA# 131-310, Approved by FDA.

HOW SUPPLIED:
Regu-Mate® (altrenogest) Solution 0.22% (2.2 mg/mL).
Each mL contains 2.2 mg altrenogest in an oil solution.
Available in 1000 mL plastic bottles.

* US Patents 3,453,267; 3,478,067; 3,484,462

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Fore, Hind, or Both? Compensatory Lameness Studied

Sometimes when a horse is lame in one leg, he'll compensate by overloading another leg. The horse then can become lame in both limbs—known as compensatory lameness—which can trip up veterinarians when they're trying to determine the source of a lameness.

"Compensatory lameness is likely under-recognized and should be considered before deciding on which limb is the primary lameness source in the horse, especially in conjunction with diagnostic anesthesia (nerve blocks)," said Sylvia Maliye, BSc, BVM&S, MRCVS, an associate at the University of Glasgow's Weipers Centre Equine Hospital, in Scotland. She recently looked at how to identify compensatory forelimb lameness related to hind-limb lameness.

> It's not uncommon to see forelimb lameness on the same side as the lame hind leg.

In her study Maliye used an inertial sensor system (ISS, the Lameness Locator) to objectively assess horses' vertical head height and pelvic height at limb push-off and impact, as well as limb asymmetry. She evaluated 27 horses with clinical hind-limb lameness only (16), hind-limb lameness and ipsilateral (occurring on the same side) forelimb lameness (9), or hind-limb and contralateral (occurring on opposite sides) forelimb lameness (2). After blocking the suspected source of lameness in the hind limb, she used the ISS to repeat the measurements.

Maliye said at this point she observed a marked change in head movement and asymmetry in the ipsilateral group."In 78% of cases there was significant change to the asymmetry of the ipsilateral forelimb," she said. In other words, the ipsilateral forelimb improved noticeably with diagnostic anesthesia of the hind limb.

"These included horses with evidence of hind-limb lameness only and those with evidence of hind-limb lameness concurrently with ipsilateral forelimb lameness," as determined by the ISS, she said. Maliye and her colleagues showed that a veterinarian can expect to see a change in vertical head movement or gait asymmetry in the ipsilateral forelimb of a hind-limb-lame horse, whether there's an actual lameness in the forelimb or not.

In the contralateral group, she saw no significant changes after nerve blocking the hind limb, "which implies that likely represents true forelimb lameness rather than being compensatory," she said.

In summary, Maliye said that in more than a quarter of hind-limb lameness cases, it's not uncommon to see forelimb lameness on the same side as the lame hind leg, which might well be compensatory only, without any forelimb pathology.—*Nancy Loving, DVM*

of subjective evaluation: unblinded and blinded.

A force plate measures ground reaction forces that reveal how well a horse is loading the limb as he trots over the stationary plate. A horse loads a painful (lame) leg less than a sound leg. The force plate is limited, however, in that it only measures a single stride, said Donnell.

The ISS detects asymmetry of the head, pelvis, and limbs while a horse trots. The device's benefit is that it can be used on any surface in any environment and can record continuous strides, he said.

In the study Donnell and colleagues evaluated 16 horses for baseline soundness before surgically creating a cartilage defect in the middle carpal joint to induce lameness. They scored the horses—both blinded and unblinded—for lameness on Days 15, 42, and 72 after surgery.

In the unblinded subjective evaluation, a single clinician tried to identify lameness with a hands-on musculoskeletal exam. In the blinded subjective evaluation, four experienced clinicians watched videos and formed a consensus as to which limb was lame without performing a clinical exam:

- On Day 15, unblinded subjective evaluators identified the lame leg in 87% of horses, whereas the blinded subjective evaluators identified it in 38% of horses.
- Also on Day 15, the force plate identified the lameness in 63% of horses, and ISS in 50% of horses.
- On Day 71, 50% of subjective evaluators identified lameness in the horses.

- On Day 71, 80% of ISS exams, and 30% of force plate exams identified lameness.

The results revealed some important points, said Donnell. First, all methods detected lameness on Day 15, and the blinded and unblinded studies "agreed" more often with the ISS. All systems detected the lame limb more easily as lameness worsened. There was, however, a big difference between the unblinded and blinded Day 15 evaluations, thereby demonstrating the importance of a clinical exam for mild forelimb lameness, he said.

The ISS correctly identified lameness more frequently than the force plate, which shows that the objective methods of evaluation are improving, Donnell said. However, "practitioners are doing a good job with subjective clinical evaluation, which detects mild lameness as well or better than objective methods."

COURTESY DR. KEVIN KEEGAN

Researchers determined that an inertial sensor system, seen here, correctly identified lameness more frequently than force plates did.

How to Manage the Club Foot: From Birth to Maturity

Club feet are caused by flexural deformities of the distal (lower) interphalangeal joint (DIP joint, also known as the coffin joint). The condition occurs when the musculotendinous unit shortens, causing the DIP joint to hyperflex.

Steve O'Grady, DVM, MRCVS, of Northern Virginia Equine, in Marshall, described how to manage the club-footed horse. "Left untreated, a flexural deformity represents a significant risk for chronic lameness," he said. "If recognized early and given proper intervention, especially in the young horse, then correction is possible."

When present at birth, this conformation is called a congenital flexural deformity. The foal cannot extend the distal limb joints, causing the limb to knuckle over to varying degrees. Owners should restrict affected foals to small paddocks and hand-massage the large muscle bellies above the carpus. Applying full-limb bandages can also help the muscle bellies associated with the tendon to relax. If you don't see improvement within three days of foaling, O'Grady recommends a veterinarian administer a dose of intravenous oxytetracycline (which binds calcium to encourage flexor muscles to relax) and a second dose if needed in the next couple of days. "If the foal is able to walk around, then these generally resolve," he said.

In contrast, an acquired flexural deformity develops in foals from 2 to 6 months of age due to nutritional imbalances, rapid growth, overexertion, genetic predisposition, and other causes. Generally, these involve the coffin joint. O'Grady recommended restricting exercise to decrease structural trauma and administering non-steroidal anti-inflammatory drugs (NSAIDs) judiciously. Veterinarians might administer oxytetracycline as well. The farrier can apply an acrylic composite material to the toe area— called a toe cap—to protect the front of the hoof.

O'Grady said a mild acquired flexural deformity might only need heel trimming and beveling of the breakover closer to the frog to decrease tendon tension. But with marked flexural deformity of the DIP joint, a veterinarian should radiograph the foot to define the deformity's extent before attempting correction. Heel elevation alone, as practiced by some farriers, he said, is not generally successful.

Severe cases might require surgery to cut the inferior check ligament. Following surgery, the cut ligament heals longer to reduce tension on the DDFT. Most horses that undergo this surgery can still have an athletic career. Before the veterinarian conducts the surgery, O'Grady suggested having a farrier use a rasp to remove the concavity in the front of the hoof to reduce the internal hoof stresses and to also trim from the apex of the frog to the heels so the frog and hoof wall are on the same plane. He or she can then fit the foal with an acrylic composite with fiberglass strands to form a reverse wedge without a toe extension; this composite promotes weight-bearing in the heel area.

Adult horses with flexural deformities might have been affected since birth or could have placed excessive or insufficient weight on one limb due to lameness. Often you will notice diverging hoof growth rings in these horses as the heels grow longer, due to shortening of the musculotendinous unit. When the heels grow long, the frog recedes. The hoof wall's front face is usually concave, and hoof wall consistency is poor because of reduced sole depth and increased load.

In adult horses a club foot often leads to lameness because of increased pressure on the dorsal (front) rim of the DIP joint, along with increased tension on the DDFT. The change in foot angle and use can also lead to sole bruising. To remedy this, the farrier must redistribute the load to the back portion of the foot by easing breakover and using a heel wedge when necessary to relieve DDFT tension.

O'Grady stressed that rapid recognition and intervention are important for managing horses of any age that develop flexural deformities.

CONVENTIONTWEET

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ALEXANDRA BECKSTETT

13 Ways to Predict Ovulation

Breeding a mare—even with high-quality, fertile semen—will only be as effective as your ability to predict her ovulation. Fortunately, veterinarians have tools for this at their disposal. Patrick McCue, DVM, PhD, Dipl. ACT, Iron Rose Ranch professor of theriogenology at Colorado State University, in Fort Collins, reviewed them:

1. ***Reproductive history*** Many broodmares develop a similarly sized follicle each cycle, which is important because a particular follicle size indicates impending ovulation. For these mares, he said, veterinarians can use data from previous cycles to estimate ovulation.
2. ***Follicle growth pattern*** McCue explained that a mare's dominant follicle typically increases in diameter by 2.7-3 mm a day during estrus. Ultimately, this growth peaks and holds steady for about a day or two prior to ovulation and might even decrease by 2-3 mm within the 12 hours before ovulation.
3. ***Follicle diameter*** McCue said veterinarians can predict preovulatory follicle diameter based on mare size and breed. The smaller the breed, for instance, the smaller the follicle.
4. ***Follicle shape*** Developing follicles are spherical during most of estrus, and most lose their shape around 12-24 hours prior to ovulation. At this time the follicle might form a "stigma" (cone or point) before becoming even more irregular preceding ovulation.
5. ***Follicle wall changes*** Wall thickness increases as the interval to ovulation decreases. Other changes also occur as ovulation nears, such as rents or tears in the wall, said McCue.
6. ***Follicle tone*** Early in the growth phase follicles feel firm on manual palpation. In the 12-24 hours before ovulation, they often become noticeably softer.
7. ***Endocrine markers*** McCue said endocrine markers, such as estrogens and luteinizing hormone (LH), fluctuate during estrus but are not always reliable for predicting ovulation. "Estrogen levels increase in relation to the increase in follicle diameter during estrus, peak approximately two days prior to ovulation, and decline near the day of ovulation," he explained. "Luteinizing hormone concentrations increase gradually during estrus and reach peak levels near the day of ovulation."
8. ***Uterine edema*** Fluid swelling within the uterine lining develops with the presence of estrogen and the absence of progesterone (the hormone that prepares the mare's uterus for pregnancy) and peaks about two days prior to ovulation, he said. Ovulation occurs as edema declines or disappears.
9. ***Cervical relaxation*** Also in response to increased estrogen levels and an absence of progesterone, the mare's cervix relaxes, as detectable via rectal palpation or vaginal exam.
10. ***Ovarian pain*** Some mares experience this as follicles develop.
11. ***Number of days in estrus*** A mare's average estrous cycle is 20.6 days and average duration of estrus is 5.7 days.
12. ***Interval from prostaglandin administration*** Veterinarians use this compound to manipulate mares' estrous cycles. Duration from administration to the next ovulation is typically seven to 12 days. Mares with smaller follicles take longer to ovulate post-prostaglandin administration than mares with larger follicles, McCue said.

> "There's no one predictive criterion, but a combination of parameters is useful (to predict ovulation)."
>
> DR. PATRICK McCUE

13. ***Interval from ovulation-inducing agent administration*** After administering an ovulation-inducing agent such as human chorionic gonadotropin (hCG) or deslorelin, 85-95% of mares typically ovulate within 24 to 48 hours if they've been in heat for two to three days.

"There's no one predictive criterion, but a combination of parameters is useful," to predict ovulation he said. Administering hCG or deslorelin acetate when the mare comes into heat can further enhance predictability, he noted.

Ceftiofur Sodium for Placentitis?

Placental inflammation caused by bacteria such as *Streptococcus equi* subspecies *zooepidemicus* is one of the leading causes of fetal death. Called placentitis, it is a challenging condition to treat. Currently, many practitioners administer the antibiotic ceftiofur crystalline free acid (CCFA, trade name Excede), but it does not penetrate the placenta well. Theorizing that CCFA's oil-based vehicle might be to blame, a research team tested the efficacy of a different form of the drug: ceftiofur sodium.

"We hypothesized that ceftiofur sodium would pass the fetal placental barrier," said Margo Macpherson, DVM, MS, Dipl. ACT, professor of large animal reproduction at the University of Florida College of Veterinary Medicine. Her team administered intramuscular ceftiofur sodium at commonly used low (2.2 mg/kg body weight) or high (4.4 mg/kg) doses to six and five healthy pregnant pony mares, respectively. The mares ranged from Day 270 to Day 326 of gestation (full gestation is generally 331-346 days). They took eight plasma samples at certain time points up to 24 hours after ceftiofur administration to determine its pharmacokinetics (how it's processed and maintained in the body).

The team then used eight of the mares in the second part of the study. Each received 4.4 mg/kg ceftiofur sodium daily for three days, at which time the researchers induced foaling. They collected allantoic ("first fluids" from inside the placenta) and amniotic fluid (that surrounding the foal in the uterus), plasma from mare and foal, colostrum, and placental samples at foaling and again 24 hours later.

Macpherson said ceftiofur concentrations in allantoic and amniotic fluid, placental tissues, and foal plasma were nearly undetectable. The oil-based vehicle she theorized was to blame for CCFA's lack of placental penetration, therefore, is not the root of the problem, she said.

Macpherson suggested that the drug's molecule size might be too large to cross the fetal membrane, its lipid solubility might be too low (resulting in slow diffusion), and/or its protein binding (which prevents drugs from reaching target areas) might be too high. Regardless of the reason, she said ceftiofur sodium is not a good choice for treating mares with placentitis.

CONVENTIONTWEET

Alexandra Beckstett
@TH_ABeckstett

Dr. Love: Number of times a mare is bred on one heat cycle does not appear to affect fertility. #AAEP2014

Compounded Enrofloxacin Assessed

For mares with endometritis, practitioners have wondered if a compounded form of the antibiotic enrofloxacin might cause fewer side effects than the commercial product. Scientists from Washington State University (WSU) teamed up with clinicians at Rood & Riddle Equine Hospital, in Lexington, Kentucky, to find out.

"Endometritis—an inflammation of

COURTESY DR. MARGO MACPHERSON

Based on plasma and other samples taken from both mare and foal, Dr. Margo Macpherson (second from right) and her team determined that ceftiofur sodium is not an effective placentitis treatment.

the endometrium that lines the mare's uterus—is a common cause of low pregnancy and foaling rates," said presenting author Lisa Pearson, DVM, MS, Dipl. ACT, a theriogenologist at WSU's College of Veterinary Medicine.

Enrofloxacin is an effective treatment against almost all of the bacteria isolated from endometritis cases. Pearson and her colleagues observed in a previous study, however, that severe hemorrhagic endometrial inflammation and fibrosis (scarring) developed in response to intrauterine commercial enrofloxacin (Baytril-100) administration. She said the product's high pH is to blame.

"We decided to collaborate with Rood & Riddle to determine the effects of a three-day intrauterine infusion of an alcohol-free, water-based enrofloxacin suspension on the endometrium," Pearson said, which they theorized would not have the same caustic effects as the commercial product.

They administered the compounded version (at 2.5 mg/kg) to eight healthy embryo transfer recipient mares in estrus and evaluated the drug's effects on the mares' reproductive tracts.

Water-based enrofloxacin was associated with a short-lived, but not statistically significant, inflammatory response, as well as a significant increase in intrauterine fluid and its echogenicity (reflection of the ultrasound signal).

"Compared to the commercial product, we did not see severe, long-standing, permanent changes to the uterus," she said.

Twenty-one days post-treatment, all mares had negative bacterial cultures, indicating the drug was also effective.

"These findings suggest that a water-based enrofloxacin suspension may be useful for treatment of bacterial endometritis sensitive to enrofloxacin without the deleterious effects seen with administration of the commercial product," she said.

Further, "this drug is useful for bacteria which are resistant to other commonly used antibiotics and can potentially be used to treat drug-resistant infections in mares," Pearson said.

Cooled-Shipped Sperm Fertility

Breeding with cooled-shipped semen is one of the most common modalities in the industry. But this semen is generally less fertile than in its fresh form.

To help veterinarians evaluate a stallion's potential as a cooled-shipped semen candidate, researchers at Texas A&M University, in College Station, examined sperm quality's relationship to fertility.

"Currently, there are no guidelines available that can (help someone) discern sperm quality that is associated with good fertility from sperm quality associated with lesser fertility," said presenting author Charles Love, DVM, PhD, Dipl. ACT, associate professor in equine theriogenology. So he set out to define some.

> "A higher seminal plasma level will result in lower sperm quality after shipping."
> DR. CHARLES LOVE

His study involved 459 ejaculates collected from 130 stallions, then shipped to an embryo transfer facility for artificial insemination. The research team measured fertility using embryo recovery rate from 196 mares. They used 330 ejaculates to inseminate mares the same day as collected and 129 to inseminate 24 hours later.

"Embryo recovery rate was higher when bred on the same day as collection than when bred 24 hours later," Love said, so the sooner you breed a mare after collecting the stallion, the better your chances of establishing a pregnancy.

Love also looked at the effect of repeating breeding during one estrous cycle on fertility. Ninety-four mares were bred more than once and 365 only once, and the researchers saw little difference in fertility among the two groups.

Stallion age affected fertility, however, possibly due to decreased sperm numbers with aging. Concentrated ejaculates are an additional factor associated with lower sperm numbers, he said, that result in a higher seminal plasma level in shipped semen. "The higher seminal plasma level will result in lower sperm quality (i.e., sperm motility, or movement) after shipping."

To establish guideline values for distinguishing semen quality at collection, the team analyzed samples with high and average fertility. They assessed each sample's motility, morphology (form and structure), viability, concentration and volume, and DNA quality prior to insemination. They found that sperm motility, viability, and DNA quality tend to change from

AMH Helps Assess Aging Mares' Fertility

Equine researchers at the University of Kentucky (UK) have been studying the qualities of anti-Mullerian hormone (AMH, which is produced by cells in fetal testes as well as granulosa—or tumor—cells) for quite some time. They've determined they can use it to test for cryptorchidism in male horses as well as ovarian tumors in mares. Now, they're trying to see if the hormone can predict an aging mare's follicle count.

Barry Ball, DVM, PhD, Dipl. ACT, Albert G. Clay endowed chair in equine reproduction at UK's Gluck Equine Research Center, presented his group's results.

> Mares with lower AMH concentrations had smaller follicles.

"Mare fertility declines with age in association with reduced follicle count," Ball explained. In other species, such as cattle and mice, "AMH is highly correlated with antral follicle count (AFC, or the total number of follicles that can be counted on ultrasound)." He hypothesized that AMH concentrations might help predict an aging mare's AFC, fertility, and reproductive longevity.

In the study, Ball and his colleagues examined 10 young (3-8 years), 16 middle-aged (9-18 years), and 19 older (over 18) mares using transrectal ultrasound and enzyme-linked immunoassays (ELISA tests). In their results they found a strong relationship between AMH and AFC in older mares but not in young ones. They also discovered that mares with lower AMH concentrations had smaller follicles. Additionally, he said AMH concentrations in older mares that maintained pregnancies were significantly higher than in those that did not.

"Follicular reserve declines with age," Ball concluded. "Our goal is to be able to use AMH concentrations to examine reproductive longevity in older mares, but we need larger numbers to better understand how this can be applied clinically."—*Alexandra Beckstett*

the time of collection to 24 hours when shipped under suboptimal conditions. Morphology and sperm concentration don't change, regardless of shipping conditions.

Values that the team said separate average from high fertility groups are:

- Total sperm motility (percentage exhibiting motility of any form) ≥ 65%;
- Progressive sperm motility (the percentage of sperm moving in a rapid linear manner) ≥ 45%;
- Extended sperm concentration (that in semen with extender added) ≥ 31.8 million sperm/mL;
- Total sperm number ≥ 1.14 billion;
- Viable sperm ≥ 71%;
- Sperm with < 27% abnormal DNA; and
- Morphologically normal sperm ≥ 47%.

When veterinarians evaluate shipped semen, they can use these guidelines to help determine whether sperm quality plays a role in reduced fertility.

Overall, Love said, sperm quality is associated with fertility, and the thresholds his team identified can help veterinarians make better breeding decisions.

COURTESY DR. JENNIFER LINTON

A blinded observer evaluates a foal to determine whether misoprostol administration during pregnancy had adverse effects.

GI Drug for Use in Pregnant Mares?

Many medications, for all the good they do, also come with some potentially negative side effects. Just think of the laundry list of disclaimers you hear at the end of pharmaceutical commercials. For horses, it's no different.

Take, for instance, the gastrointestinal cytoprotectant misoprostol: This drug, which is used to prevent or treat right dorsal colitis (an ulcerative inflammatory condition of the colon) in horses causes abortions in human patients. So is it safe to administer to pregnant mares? Researchers from the University of Pennsylvania (Penn Vet) School of Veterinary Medicine's New Bolton Center have been gathering safety data that veterinarians and owners can use to weigh the risks and benefits of misoprostol treatment. Co-author and reproduction resident Jennifer Linton, VMD, presented their results.

Among other uses, misoprostol is administered in humans to purposefully terminate pregnancies, Linton said. In those pregnancies that continue to term despite treatment, babies can suffer from neurologic, musculoskeletal, and cognitive defects.

In a 2013 study (also conducted at Penn Vet, led by Candace Jacobson, DVM) administering oral misoprostol mid-gestation in 11 pregnant mares resulted in no adverse effects or disrupted pregnancies. To continue this work, Linton wanted to examine the safety of the same misoprostol regimen during early gestation and evaluate the health of surviving neonates.

She and her colleagues administered oral misoprostol to 15 healthy mares in early gestation (Day 35-85) for five days. They monitored the mares via transrectal palpation and ultrasound and measured serum progesterone daily during treatment and for five days after treatment ended. They continued to perform regular ultrasound examinations for a month.

Fourteen of the pregnancies had no disruptions through the initial study period. The one exception appeared normal through treatment, but 10 days later was no longer pregnant. Interestingly, Linton said, this mare had low progesterone levels before treatment even started.

The researchers were able to follow eight of these mares through their entire pregnancy and parturition, as well as through six months of the foals' development. All resulting foals had normal musculoskeletal, neurologic, and cognitive measures, as determined by a blinded observer who evaluated their behavior and development markers next to matched controls in a field setting.

"All in all," Linton said, "30 of 31 pregnancies (25 of 26 mares in these two studies, along with five additional mid-gestation mares studied at New Bolton Center) appeared unaffected. These results suggest a relatively low risk of disruption of early or mid-gestation pregnancy or adverse effects on foals following oral misoprostol administration."

Estrogen Concentration and Pregnancy Outcome

During pregnancy, mares experience elevated estrogen levels. Why? Well, that's largely unknown. What researchers do know is that mares that lose a pregnancy late in gestation have low estrogen levels. So researchers from the University of Kentucky recently tried to find out whether there's a relationship between estrogen concentrations and pregnancy loss. Barry Ball, DVM, PhD, Dipl. ACT, Albert G. Clay Endowed Chair in equine reproduction at the University of Kentucky's Gluck Equine Research Center, presented their results.

In their study, the team treated six mares with 500 mg of letrozole, an estrogen inhibitor, every four days from Day 240 of gestation to foaling. Six untreated mares served as controls. They evaluated the mares' estrogen and androgen (a male sex hormone) concentrations weekly, along with parameters such as fetal growth and the combined thickness of the uterus and placenta biweekly.

Ball said the treated mares' androgen levels increased and their estrogen levels dropped 90% immediately after the first treatment. All six mares gave birth to healthy foals with no abnormalities.

"Gestational length was unchanged, neonatal viability was normal, but birth weights of foals born to letrozole-treated mares were reduced by 15%," Ball said.

He concluded that reduced estrogen in late pregnancy does not affect pregnancy outcome. Supplementing mares in late gestation with estrogen, therefore, is likely unnecessary, he added.

"Reduced estrogen associated with pregnancy loss likely reflects disruption of placental function, but is not the cause of abortion," Ball said.

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CARING for Foals

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Managing Foal Rejection

Your long-awaited foal is almost here, and you can't wait to see the bond he forms with his dam. But when he arrives, your mare wants nothing to do with him. She pins her ears, tosses her head, and spins away as he wobbles on spindly legs toward her. She's rejecting him, and it's now up to you to manage the situation.

While uncommon, rejection is a documented behavioral phenomenon that can have significant adverse effects on foal, dam, and owner. Charles F. Scoggin, DVM, MS, Dipl. ACT, resident veterinarian at Claiborne Farm, a breeding and racing farm in Paris, Kentucky, described how to manage this scenario.

"Foal rejection can be seen in all breeds of horses, with the highest rates reported in Arabians (5.1%), followed by Paint Horses (1.9%) and Thoroughbreds (less than 1%)," he said.

Mares that reject foals typically get aggressive, attempt to avoid the foal, or both, he said.

Risk factors include mare:

> "Foal rejection can be seen in all breeds, with the highest rates reported in Arabians, followed by Paint Horses and Thoroughbreds."
>
> DR. CHARLES SCOGGIN

- Age and experience (young, inexperienced dams are more likely to reject foals than older, experienced ones);
- History of foal rejection;
- Underlying disease or pain;
- Poor milk production;
- Delivery of sick or abnormal foals;
- Removal from their normal environment; and
- Rough handling.

Additionally, he said, foals treated with dimethyl sulfoxide (DMSO) or other drugs with strong odors could interfere with a mare's olfactory recognition.

Your primary concern as rejection becomes apparent should be ensuring the foal's safety and welfare, said Scoggin. Remove foals immediately from mares that show signs of aggression.

Once safe, give the foal at least one pint of good-quality colostrum through

a nasogastric tube for passive transfer of immunoglobulins and nourishment, if needed, he said. Then feed the foal every two to three hours with his dam's milk, goat's milk, or a commercial milk replacer.

The veterinarian can also give intravenous fluids and administer broad spectrum antimicrobials to prevent or treat dehydration and sepsis, he said.

Once the foal has received the necessary immediate attention, there are a variety of ways to deal with the situation. (For more in-depth descriptions of all these methods, see TheHorse.com/35292.)

Physical Restraint This is one of the most commonly used ways of dealing with foal rejection, he said. Under that umbrella fall several methods of mare restraint:

- In-hand restraint;
- Lip chain or twitch application; and
- Using a padded barricade with a removable panel between mare and foal (see above), which allows safe nursing.

Scoggin stressed that all restraint methods are temporary solutions. Some mares accept their foals after a short period, while others become resentful.

Behavior Modification Often used in tandem with restraint, Scoggin recommended positive reinforcement—offering encouragement, rubbing or patting, or giving treats—as a way to reward a mare's good behavior around her foal.

Pharmaceutical Intervention If physical restraint fails, veterinarians have several drug options to help a mare bond with her foal. Sedating her can help in some scenarios, but Scoggin cautioned that some tranquilizers make horses hypersensitive and aggressive toward external stimuli.

Another option is to administer prostaglandin-F2α (PGF2α, a drug used to induce estrus). Scoggin's protocol of choice—the so-called "concaveation" method first described years ago by Peter Daels, DVM, PhD—begins by removing the foal from the mare's sight before administering a large dose of PGF2α.

"Approximately 15 to 20 minutes after receiving PGF2α, mares will show signs of intense sweating and cramping, as well as stream milk," he said. "With one person holding the mare and another leading the foal, the foal is taken back in the stall and presented at the mare's head. Often the mare will nuzzle and nicker at the foal."

After that, the handler encourages the foal to nurse. Scoggin said mares often accept their foals in 15 to 30 minutes and can be left alone loose with their foal.

"This protocol seems to effectively 'reprogram' the mare's behavior to where she becomes highly attentive to and accepting of the foal," Scoggin said. "If the mare still rejects the foal after the first attempt, this method can be repeated 24 hours later."

Surrogation Unfortunately, some mares never accept their foals. Surrogates, which are usually used when a dam becomes very ill or dies, can help.

Nurse mares, he said, are an excellent option if they're available. If not, you can induce lactation in another mare.

He added that surrogates are a better option than raising foals by hand, as the former tends to result in fewer negative effects on development and behavior.

In the past six years out of nearly 700 mares bred, Scoggin said he's managed eight cases of foal rejection in mares aged 4 to 6 years. He said he's had a 100% success rate in inducing proper maternal behavior and foal acceptance within 72 hours of birth with:

- Physical restraint alone in one case;
- Physical restraint plus a tranquilizer in five cases; and
- The concaveation method in two cases.

Building a Milking Device for Orphan Foals

When the going gets tough, they say the tough get going. So when the sister of an employee at Waller Equine Hospital, in Texas, found herself with an orphaned foal, unable to secure a nurse mare and unable to provide the frequent feedings the foal needed to thrive due to a busy schedule, the clinic staff got moving to find a solution. They created an automatic milk-feeding device, which allowed the foal access to frequently dispensed milk rations without the milk replacer spoiling in the warm Texas climate.

Waller veterinarian Jenni Schroeder, DVM, and colleagues designed the automatic milk feeder to fulfill foals' nutritional needs, while freeing up time for human caregivers. She said constructing one of these devices is as easy as acquiring a compact refrigerator, two storage containers, a dosing pump, and some tools—and it all costs less than $400.

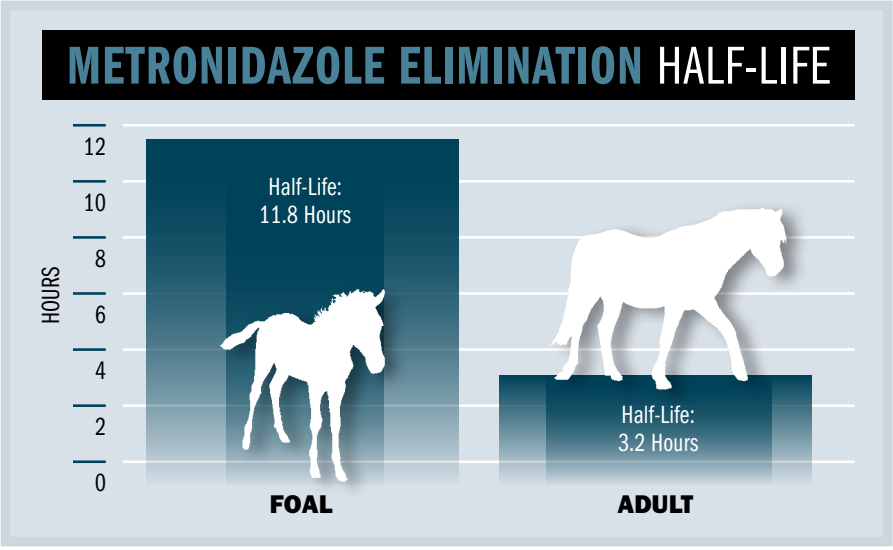
COURTESY DR. JENNI SCHROEDER

One of the items needed to build a milking device is a peristaltic pump.

Before you start building, however, it's important to ensure:

- The foal has consumed adequate antibodies normally contained in colostrum (first milk);
- The foal knows how to drink from a bucket; and
- There's a safe 110-volt electric outlet near the stall that's protected from the elements.

To read a step-by-step guide to building an automatic milking device, see TheHorse.com/35293.—*Erica Larson*



He's also used the methods to graft 24 nurse mares to 22 foals (91.7% success).

Managing foal rejection can be labor-intensive, but it doesn't generally take long. Scoggins said that with persistence and progressive steps, caretakers can reintroduce mares and foals successfully or graft foals other mares.

Metronidazole Pharmacokinetics in Foals Studied

Just as it's not the best idea to give an infant an adult-sized dose of ibuprofen, it's ill-advised to give a neonatal foal a drug dose intended for a mature horse.

Neonatal foals metabolize drugs differently than adults,"which may lead to accumulation of drugs and adverse effects when adult dosing regimens are used," said Elsbeth Swain, DVM, Dipl. ACVIM.

But veterinarians still don't know exactly how all the drugs they commonly use to treat neonates interact with their young bodies. To that end, Swain and colleagues at the University of California, Davis, evaluated the pharmacokinetics (how drugs are processed and maintained in the body) of metronidazole, an antimicrobial often used to treat neonate diarrhea.

Swain, now at Colorado State University's College of Veterinary Medicine & Biomedical Sciences, in Fort Collins, and her team evaluated the drug's effects on healthy foals, aged 1 to 2.5 days, when administered as a single intravenous (IV) or intragastric (IG, oral) dose. They separated 12 neonates into two groups; one received 15 mg/kg of metronidazole IV and the other received the same dose orally. The team monitored plasma metronidazole concentrations regularly. They repeated the test on the IV group at 10 to 12 days of age to assess maturation differences.

The team learned that:

- When administered IV in the younger foals, metronidazole's maximum plasma concentration was 18.79 µg/mL, its half-life (the time it took for the drug concentration in the blood to reduce by half) was 11.79 hours, and its clearance rate (how quickly the drug is eliminated from the body) was 0.84 mL/min/kg.
- Oral bioavailability (absorption rate) was 100%;
- The medication's half-life was significantly longer and clearance significantly lower in the 1- to 2.5-day-old foals than in the 10- to 12-day-old foals.

COURTESY DR. SARAH CZERWINSKI

It's important to have foals' eyes examined within 36 hours of birth.

"The peak plasma concentration was comparable to adults, suggesting that 15 mg/kg dose is adequate to treat the organisms we are interested in targeting in both foals and adults," Swain said. The clearance, however, varied substantially.

"The clearance was much reduced compared to metronidazole clearance reported for adult horses," she explained, which increases the drug's half-life.

This means the drug can accumulate in newborn foals if administered at the same dosing interval as adult horses, which can increase the risk of adverse effects.

Swain said 10- to 12-day-old foals exhibiting increased clearance and a decreased half-life "supports the idea they are becoming more efficient at metabolizing metronidazole as they mature, though at this age, metronidazole is still cleared much slower than in an adult horse."

Based on these results, foals should get a 10-15 mg/kg IV or oral dose every 12 hours.

Eye Problems in Neonatal Foals

Sarah L. Czerwinski, DVM, an ophthalmology resident at the University of Florida College of Veterinary Medicine, in Gainesville, said that because eye diseases can negatively impact a horse's life, value, and career, it's important to have a veterinarian examine his eyes within 36 hours of birth.

She reviewed several common eye abnormalities in neonatal foals. For more in-depth descriptions of each condition, see TheHorse.com/35294.

Cataracts This lens clouding can be congenital, inherited, or acquired, Czerwinski said, and blocks images rather than light.

Microphthalmia This is characterized by an abnormally small globe.

Persistent Hyaloid Artery The hyaloid

artery supplies the lens with blood *in utero* and remains in the eye after birth in 85% of foals. This condition does not significantly impact vision, and there is no treatment—the structure typically regresses with age, Czerwinski said.

Persistent Pupillary Membranes These tissue strands are blood vessel remnants that did not regress during late embryonic development. They have minimal impact on vision and don't require treatment.

Dermoids These pigmented plaques of epidermal (skin) tissue on the cornea, conjunctiva, or eyelid can contain hair, which can cause irritation and ulceration. Dermoids can be removed surgically.

Aniridia This rare condition is a partial or total absence of an iris.

Congenital Glaucoma This rare condition results in a rapid globe enlargement.

Congenital Retinal Detachment Also rare, congenital retinal detachment has a poor visual prognosis and isn't treatable.

Entropion This condition occurs when the eyelids roll inward, and it requires immediate treatment because the eyelashes can irritate the globe.

Ocular Hemorrhage Common following dystocias (difficult births), bleeding in the eye resolves on its own within a few days.

Corneal Ulceration She said all foals, especially systemically ill ones, have decreased corneal sensitivity, which makes them less likely to feel scratches or damage to their eyes.

Uveitis This is often caused by sepsis (blood infection), so managing the underlying disease condition is key to correcting this problem.

"The ophthalmic examination is an essential part of the neonatal exam," Czerwinski said. "It is important for the equine practitioner to be able to recognize normal features of the foal's globe, in addition to common diseases."

Hearing Loss in Foals

Hearing loss occurs in foals, but it's rarely reported, said Monica Aleman, MVZ, PhD, Dipl. ACVIM, probably because people are rarely looking for it. But in reality, many conditions common to foals can contribute to or cause auditory dysfunction.

Aleman, of the UC Davis School of Veterinary Medicine, described foal hearing assessments. Veterinarians can utilize a brainstem auditory evoked response (BAER) test. This involves using small electrodes under the skin of the scalp to detect electrical activity from the inner ear all the way to the brain (auditory pathway) when the horse is exposed to a noise.

COURTESY DR. BABAK FARAMARZI

This foal's lateral palmar process fracture is visible on an oblique view radiograph of the hoof.

To gain a better understanding of the causes of foal hearing loss, Aleman and colleagues completed a retrospective study to evaluate BAER readings from 15 foals at the UC Davis Clinical Neuropathology Laboratory from 1982 to 2013. They found that 10 of the 15 foals had absent BAER, indicating they were completely deaf. Conditions in those foals included:

- Coat-color associated issues, such as overo lethal white or lavender foal syndrome;
- Encephalopathies, such as dummy foal syndrome or neonatal isoerythrolysis (destruction of a foal's red blood cells);
- Sepsis;
- Prematurity; and
- Intracranial abscesses.

Other causes of hearing loss in foals include meningitis, congenital malformations, trauma, brain stem disease, otitis (ear infection or inflammation), and some drugs.

"Hearing deficits occur in foals and could be associated with common neonatal diseases and certain coat and eye color patterns," Aleman said. "Therefore, evaluation of hearing should be a part of the physical and neurological examination in critically ill neonatal foals."

Detecting Coffin Bone Fractures in Young Foals

Researchers are determining that distal phalanx (coffin bone) fractures in foals are more common and have a better prognosis than previously thought.

Babak Faramarzi, DVM, MSc, PhD, assistant professor at Western University of Health Sciences' College of Veterinary Medicine, in Pomona, California, studied this fracture's prevalence in young foals and how to best diagnose it. He described the seven types of distal phalanx fractures, each involving a different part of the foot. Foals typically experience Type VII fractures of the solar margin (toward where the hoof meets the ground) that often go unnoticed due to lack of lameness. He said these have an excellent prognosis.

"In adult horses, the most common cause is trauma (e.g., kicking a hard surface)," Faramarzi explained. "The etiology is not known in foals," but the fractures could result from conformation, nutrition, genetics, excessive sole trimming, excessive force from the deep digital flexor tendon, and being turned out on muddy surfaces (i.e., slipping and stressing soft tissue and bone attachments).

Veterinarians most commonly use radiographs to diagnose these fractures, but "obtaining good-quality radiographs of foal hooves under field conditions is challenging," he said. "It's very important for the foal to stand symmetrical and still, so be patient and use sedation when necessary."

To determine the best way to detect distal phalanx fractures in foals, Faramarzi radiographed the front feet of 19 6- to 8-month-old foals in the field from various angles. He diagnosed 10 (53%) of those foals with at least one distal phalanx fracture, noting that several foals had multiple fractures (17 total from 10 foals).

Interestingly, he said, he could identify only 65% of the fractures using the common lateral (straight from the side) and dorsoplanar (straight toward the back) projections. He identified the remaining 35% using complex oblique views (which pass neither parallel nor perpendicular to the foot but, rather, diagonally).

When diagnosing these subtle injuries, Faramarzi said, "Don't be shy to take multiple radiographs, and always do oblique projections. If you're unsure, take more radiographs."

Most of the fractures healed within 10 months without medical or surgical intervention, he added.

Proper diagnostic technique and good-quality radiographs are critical for diagnosing palmar process fractures in foals, because clinical signs can be easily missed, Faramarzi said.

STIFFNESS
MUSCLE SPASMS
CAN'T MOVE
SENSITIVE TO SOUND
CAN'T EAT
EYES PROTRUDING
SWEATING
SENSITIVE TO LIGHT
ANXIOUS
RESPIRATORY FAILURE

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ANNE M. EBERHARDT

Drug EFFICACY

ERICA LARSON
NANCY LOVING, DVM

New Antimicrobial Formulation Confirmed Safe, Effective

Veterinarians commonly use a broad-spectrum antimicrobial agent called potentiated sulfonamide to manage horses' respiratory infections. While effective, its downsides are that it must be administered twice daily and, as antimicrobials do, it has the potential to disrupt levels of favorable bacteria in the colon, leading to diarrhea. With this in mind, researchers explored a new formulation of trimethoprim sulfadiazine (TMS) that the small intestine absorbs more readily—so that, theoretically, less reaches the colon—to determine its safety and efficacy when given at a reduced dose (24 mg/kg every 12 hours, as opposed to the currently recommended 30 mg/kg).

In their safety study, Scott McClure, DVM, PhD, Dipl. ACVS, associate professor of equine surgery at Iowa State University's School of Veterinary Medicine, in Ames, and colleagues treated horses with lower respiratory disease caused by *Streptococcus equi* subsp. *zooepidemicus* with the novel oral TMS suspension to determine its efficacy at the reduced dose. They looked at effects of the standard 24 mg/kg dose, along with doses three and five times that amount. They also administered these doses for 30 days rather than the normally prescribed 10-day course to check for development of diarrhea or other adverse effects.

They determined that the treatment regimen was effective at the lowered dose, dropping horses' rectal temperatures to within normal range by Day 5. Horses' coughs persisted through Days 5-10, but they disappeared by Day 17. This is in part due to the time it takes for mucus and debris to clear from the lungs, McClure said. The researchers cultured fewer *S. equi* organisms from treated horses at Day 17 than they did from controls, which had received only saline.

The TMS formulation eliminated infection in 58% of treated horses, while infection cleared in only 15% of control horses. By Day 5 of treatment, it was evident which treated horses were not going to respond—these horses' fevers failed to drop by 2°F or to less than 101°F (considered "treatment failures"). By Day 10, only about 9% of horses in the treatment group were considered failures, whereas 46% of the control horses were treatment failures. The team observed no significant differences between treated and control horses' manure—38% of treated horses had loose stool at some point during treatment, compared to 33% of control horses. Horses treated with higher doses (30 mg/kg every 12 hours) had a higher incidence of loose feces. The team said the new TMS drug is both safe and efficacious for use in horses.

> "The reduced dose (of TMS) significantly improved clinical success without seeing diarrhea or other adverse events."
>
> DR. SCOTT MCCLURE

McClure summed up the study by noting, "There is no benefit to an increased dose of this new TMS solution—a higher dose does not increase serum levels. The reduced dose significantly improved clinical success without seeing diarrhea or other adverse events."

Low-Dose Diclazuril for Preventing EPM

Drugs to treat the potentially fatal neurologic disease equine protozoal myeloencephalitis (EPM) are more effective than ever but—aside from barring opossum access to the horse's feed and forage—preventive measures still remain elusive. That could be changing, however, thanks to an alternate use for the antiprotozoal drug diclazuril (Protazil).

Horses develop EPM after ingesting forage or other matter contaminated with opossum feces containing *Sarcocystis neurona* or another one of the disease's causative agents.

Laszlo Hunyadi, DVM, PhD, shared the results of a study evaluating the drug's

pharmacokinetics (how the drug is processed and maintained in the body) when administered at a low dose. Hunyadi is a resident at the University of California, Davis, School of Veterinary Medicine.

Hunyadi and colleagues sought to determine whether administering a low dose of diclazuril—which comes in an alfalfa-based pellet—could result in adequate plasma and cerebrospinal fluid (CSF) levels to inhibit *S. neurona* growth in cell culture. If it did, it could mean diclazuril supplementation could help reduce a horse's likelihood of contracting EPM.

The team administered 0.5 mg/kg (half the label dose) of diclazuril pellets to six healthy horses before collecting plasma samples at regular intervals for 168 hours. Then the horses consumed diclazuril daily for 10 days. The team collected plasma and CSF samples after the ninth dose, and following the tenth dose the team again collected plasma samples regularly for 168 hours. After a four-week washout period, the team completed the study again, this time using the label dose.

The team determined that the mean diclazuril concentrations in both plasma and CSF were adequate for inhibiting *S. neurona* after the tenth dose.

"The results of this study show that diclazuril pellets given at both a low and label dose reach plasma and CSF levels known to inhibit *Sarcocystis neurona* in cell culture after steady-state levels have been reached," Hunyadi said.

He said his team is currently running a study to determine a metaphylactic treatment course (i.e., how often and for how long horses should be treated). So until this study is complete, it's best not to supplement diclazuril as described.

He stressed, however, that if a horse is displaying neurologic signs related to EPM, the veterinarian should administer the FDA-labeled dose to treat the animal rather than the low dose.

Tiludronate's Efficacy in Managing Navicular-Related Lameness

Navicular syndrome, a disease of the horse's foot that causes lameness and loss of performance, has re-entered the spotlight recently with the FDA's approval of a new treatment: tiludronate disodium (trade name Tildren). And with any new drug comes a slew of efficacy studies.

Kent Allen, DVM, of Virginia Equine Imaging, in The Plains, described several

COURTESY DR. LASZLO HUNYADI

A low dose of diclazuril might help inhibit one of the neurologic disease EPM's causative agents.

of these studies. As a part of the approval process, manufacturer Ceva Animal Health conducted the research on horses treated to manage navicular syndrome.

The progressive degenerative disease commonly causes bilateral lameness in the front feet, and in many cases there's evidence of abnormal bone remodeling of the distal sesamoid (navicular bone). The treatment is designed to interrupt this process and ameliorate clinical signs.

Veterinarians at 12 U.S. equine hospitals conducted the study. On clinical exam the horses were Grade 2 or 3 lame (on a scale of 5) and had no other lameness issues. Allen said they diagnosed the horses with navicular syndrome based on lameness exam, radiographs, and MRI evaluation showing primary bone lesions.

The study included 181 horses: 119 treated with intravenous (IV) tiludronate and 62 with a placebo. The horses received no other drugs during treatment. Farriers performed corrective shoeing on all the horses to standardize breakover, hoof-pastern angle, palmar angle, and medial-lateral hoof balance. Bilateral lameness was present in 78% of the cases.

Allen said two months following tiludronate treatment:

- 64% showed significant improvement of at least one grade in the most lame leg.
- 48% of the placebo-treated horses improved, likely due to standardized and corrective shoeing.

In summary, said Allen, the researchers observed a 16% overall improvement in lameness when using tiludronate treatment compared to just corrective shoeing. Nearly 50% of treatment horses were sound after six months, as compared to 12% of placebo horses. Other studies in which researchers evaluated tiludronate as a navicular treatment demonstrated a 67% improvement in treated horses' lameness, with return to normal activity within two to six months.

"Bone resorption and formation are a paired process," Allen said, "but navicular bone inflammation causes this paired process to fall out of balance. The objective in treatment with tiludronate sodium is to inhibit the osteoclasts (bone cells that promote demineralization and resorption of bone for remodeling) from stimulating excessive bone remodeling, thereby reducing inflammation, bone edema, pain, and lameness caused by navicular disease."

Allen stressed the importance of corrective shoeing to address mechanical imbalances in the foot when managing navicular syndrome. In addition, he said using tiludronate as early as possible in the course of disease would likely be more beneficial to help re-establish the normal balance of bone formation and resorption.

Nearly 50% of horses treated with tiludronate for navicular syndrome were sound after 6 months.

Tiludronate Safety Studies for Navicular Treatment

Valentine Williams, DVM, MS, Dipl. ACVS, of Tildren manufacturer Ceva Animal Health, presented the results of the safety studies involving IV infusion of tiludronate disodium.

In one exaggerated dose study, which is designed to determine what—if any—side effects an overdose would cause, researchers administered various concentrations of IV tiludronate. The most common sign they observed in both

treated horses and untreated controls was discomfort defined as "colic." The team noted, however, that horses were restrained for long periods in stocks, and inactivity on top of drug administration could have been to blame. The only significant clinical abnormality they observed was decreased ionized calcium and increased serum phosphate in the horses' blood, both of which normalized within 72 hours following treatment. Williams pointed out that bone mechanical strength and tissue in bone remodeling units (cells that remove and form bone) were all normal. From a safety standpoint, exaggerated doses had few negative effects, the team determined.

Another research team set out to see if horses' kidneys—responsible for excreting bisphosphonates (tiludronate's drug class) and other compounds the horse metabolizes—could handle processing the drugs. Following tiludronate treatment, they observed no clinical signs of kidney disease, no elevated kidney values on blood work, and no treatment-related renal effects.

Due to the electrolyte changes seen in normal bisphosphonate-treated horses' blood, researchers also examined tiludronate's effects on horses carrying the gene for the potentially fatal disease hyperkalemic periodic paralysis (HYPP). Potassium concentrations rise to dangerous levels in these horses, so it was important to examine the possibility of the drug inducing a potassium-related HYPP attack in susceptible animals. No horse showed confirmed signs of HYPP associated with treatment, but a few showed mild signs of discomfort perceived as colic that resolved.

In two field efficacy studies, researchers administered 389 IV doses of tiludronate to study horses. They noted that 41% of treated horses showed at least one colic sign—i.e., restlessness, agitation, rolling, looking at sides, or pawing—that resolved either spontaneously or when treated with an NSAID. The reason for the discomfort is unknown, but Williams noted that humans have reported gastric, visceral, bone, joint, and musculoskeletal pain during tiludronate treatment for bone disease.

An additional Ceva field safety study helped better characterize the duration and severity of observed clinical signs of discomfort associated with tiludronate administration. Forty-four percent of study horses showed at least one colic sign that was generally short-lived and intermittent and tended to occur near the end of the IV infusion of the drug. Most cases resolved with hand-walking for 10 minutes. Twelve percent required treatment with a sedative or analgesic.


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Researchers showed that owners and veterinarians can manage Cushing's horses long-term without an increase in pergolide dose.

Williams summed up the studies: Tiludronate is safe to use as directed, with transient "colic" discomfort as the primary abnormal clinical sign, which typically responds to hand-walking alone.

> **"There is evidence that pergolide does improve a horse's quality of life, but there is no evidence that it prolongs it."**
>
> DR. HAROLD SCHOTT II

Long-Term Pergolide Use for Cushing's

Owners have come to accept the fact that many horses will develop Cushing's disease (pituitary pars intermedia dysfunction, or PPID) as they age. The FDA-approved drug pergolide has been commercially available since 2011 as a treatment for this complex endocrine dysfunction. But veterinarians and researchers have questioned whether the drug's dose might need to increase as treatment progresses. They've also wondered how to monitor treated horses over time, alongwith whether pergolide improves or even prolongs a horse's quality of life.

Harold Schott II, DVM, PhD, Dipl. ACVIM, professor of large animal clinical sciences at Michigan State University's College of Veterinary Medicine, spoke to these concerns. In 2009 he and other researchers at the school began evaluating 30 horses confirmed positive for PPID before going on pergolide. The team re-examined the horses six months, 2 ½ years, 3 ½ years, 4 ½ years, and 5 ½ years later to determine dose effectiveness.

Of the 30 horses, 14 were euthanized and four died by 2013. At 5 ½ years, blood endocrine testing revealed well-controlled PPID in most of the remaining 12 horses. Veterinarians increased the pergolide dose for four of the horses due to muscle wasting, slow shedding, and failed endocrine testing.

Schott said the most common problems they observed in the horses were colic and diarrhea, as well as intermittent laminitis flare-ups. The causes of death or euthanasia were similar to those of aged horses without PPID. Although a decrease in appetite was the most common adverse effect reported at the start of treatment, it was only a minor problem during prolonged pergolide use. A cresty neck, decreased body weight, elevated blood glucose or triglyceride concentrations (indicative of PPID), or elevated ACTH levels (the PI secretes more of this hormone in affected horses) were not significant factors in assessing whether a horse would survive, said Schott.

"Approach to management and medical treatment should be performed on a case-by-case basis and should be monitored by physical examination and endocrine testing on a yearly basis (in the spring), unless the horse's condition changes for the worse," Schott stressed.

The researchers showed that owners and veterinarians can manage PPID horses for a long time on pergolide without a progressive dose increase—50% of the study horses did not need an increase above the standard 2 µg/kg dose. That said, Schott suggested there might be a need for a seasonal dose increase for some horses, because the endocrine system is more sensitive in the autumn. He also said there is evidence that pergolide does improve a horse's quality of life, but there is no evidence that it prolongs it.

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COURTESY DR. CLEET GRIFFIN

Dental CARE

ERICA LARSON

Endoscopy for Equine Dental Exams

Many veterinarians are in the habit of using an endoscope—a long, flexible tube with a light source at one end and a viewing scope at the other—when they need to look inside a horse's airway, lungs, or even stomach. One Texas A&M practitioner also uses this device for something a little less common: conducting dental exams and procedures.

Cleet Griffin, DVM, Dipl. ABVP, a clinical assistant professor in the university's College of Veterinary Medicine and Biomedical Sciences, described in detail how he employs dental endoscopy.

Structures near the back of the horse's mouth can be difficult to evaluate, said Griffin. To aide in viewing them, veterinarians have two options: an oral endoscopic system and a handheld intraoral camera. He said both are safe and effective.

The oral endoscope "consists of a rigid endoscope, light source, digital video camera, video monitor, and recording device," Griffin explained.

On the other hand, the handheld camera has a self-contained hand piece (around 22 cm long) and a USB drive, which can be linked to a computer for viewing and recording. "The device contains a built-in fixed-focus camera with an LED light source and an image capture button on the handle," he said.

Griffin said oral endoscopy should not be viewed as a replacement for more commonly used exam procedures but, rather, as a way to augment them. "With it there is improved capability of detecting subtle changes that may be more difficult to visualize with a dental mirror," he said. For a complete list of dental problems endoscopes can help diagnose, see TheHorse.com/35287.

Dental Care: Diet's Important, Too

Don't forget to consider your horse's dental status when planning his diet.

"The annual oral examination provides the equine practitioner with the opportunity to not only identify dental abnormalities but also to document the loss of cheek-teeth chewing surface area that occurs with age as a product of normal dental eruption and wear," said Caroline N. Niederman, VMD, FAVD/Equine, owner of Complete Equine Dental Maintenance, in Houston, Texas.

Dental abnormalities can have a negative impact on how horses—especially older ones—consume and utilize nutrients in food. As such, performing a complete oral exam affords the veterinarian the opportunity to educate owners on how to provide adequate nutrition as the horse ages to prevent choke, impactions, and pronounced weight loss.

The Complete Dental Exam "A complete oral examination begins with taking a dental history," Niederman said. She recommended collecting as much information as possible by asking detailed questions about the horse and his diet.

Niederman then recommended veterinarians observe their patients' body condition, eating habits (i.e., the ability to prehend food and if there's any evidence of quidding hay), and fecal consistency.

If the veterinarian suspects problems, Niederman recommended carrying out a complete blood count, chemistry, and other specific tests to identify conditions such as anemia, kidney or liver dysfunction, or equine Cushing's disease that could impact dietary recommendations.

Finally, the in-depth oral exam provides important information regarding how a horse chews his food. Niederman said that the exam, from a nutritional perspective, should focus on evaluating the cheek teeth's chewing surfaces and enamel loss.

Nutritional Recommendations Teaching owners about how horses' teeth erupt throughout their lives and common wear patterns could help them better understand how to feed their horses.

"Dietary recommendations should be a part of these conversations before the horse has lost weight" and his teeth are in poor condition, she said.

"The routine oral examination presents an opportunity to improve client awareness of the significance of age-related tooth wear and to discuss proactive dietary modifications," Niederman said.

To read this article in its entirety, see TheHorse.com/35288.

> **"The routine oral exam presents an opportunity to improve client awareness of the significance of age-related tooth wear and to discuss proactive dietary modifications."**
>
> DR. CAROLINE N. NIEDERMAN

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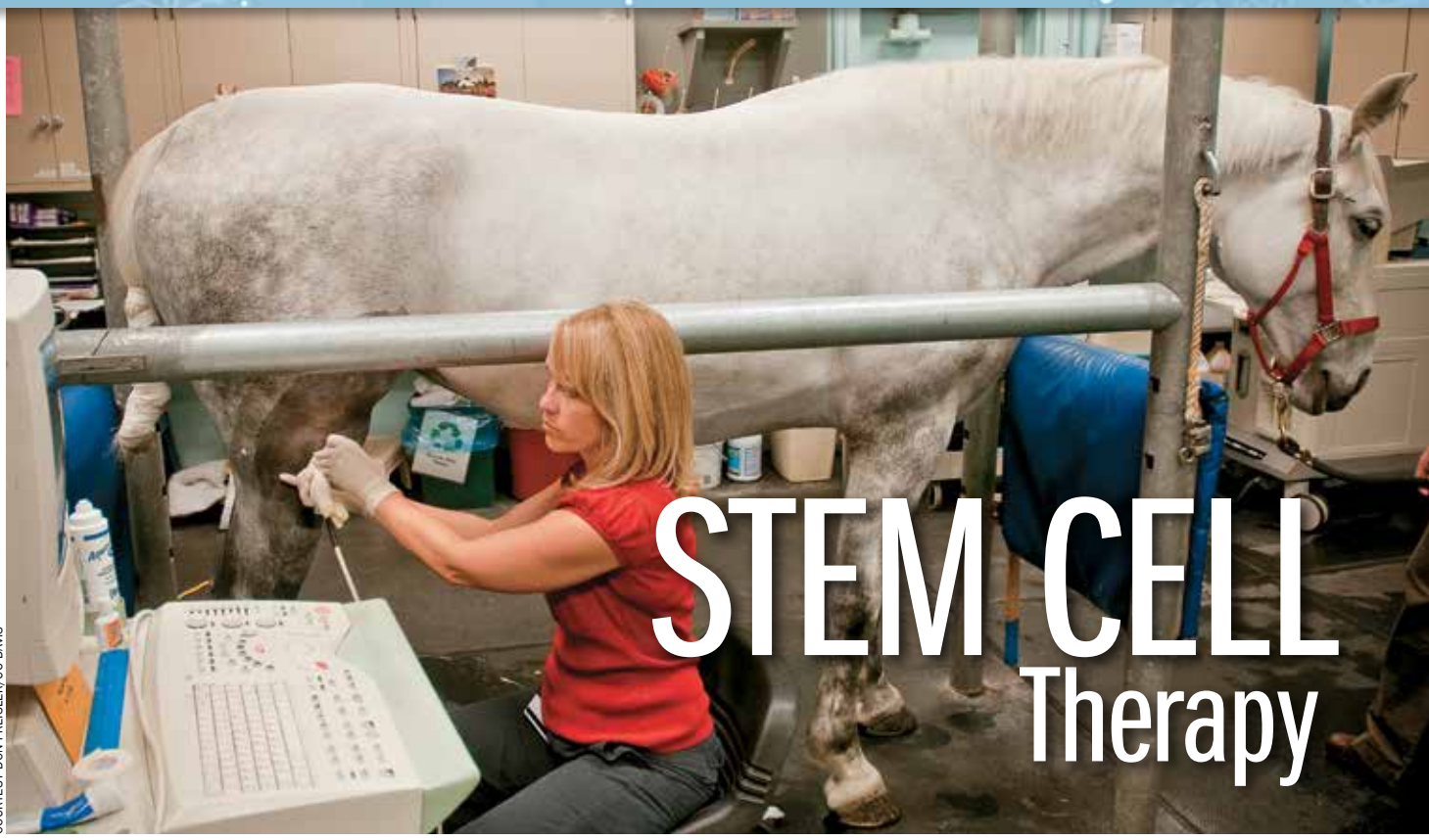

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STEM CELL Therapy

STEPHANIE L. CHURCH
ERICA LARSON

The ABCs of Stem Cells and Other Regenerative Medicine for Horses

"Regenerative medicine has been referred to by many people as a veritable alphabet soup," said Ashlee Watts, DVM, Dipl. ACVS, of Texas A&M. "There are many types and varieties of stem cells, growth factors, what have you." Equine researchers have been studying, using, and learning more about everything from MSCs to PRP and ACS to BMPs, all with a goal of harnessing natural healing processes to improve tissue repair for a more functional outcome.

Watts, who is assistant professor at the university's College of Veterinary Medicine & Biomedical Sciences, in College Station, broke regenerative medicine down to the basics. First, what is a stem cell? "It's a cell that can do two things through asymmetric division," she said. "One half of the cell division creates a cell to replace itself, or self-renew. The second half of the cell division can become different tissue types, or differentiate."

There are several types of stem cells to understand before diving into the world of regenerative medicine:

Embryonic stem cells Referred to as "the ultimate stem cell," these are present approximately one week after conception and are pluripotent, meaning they can become any type of equine cell that is present in the adult horse. After Day 8 of embryonic development they commit to one germ line (group of tissue types) and are no longer considered embryonic.

Adult-derived stem cells Little pockets of lineage-committed stem cells can be found in nearly all adult tissues throughout life. The horse's body calls on these for normal remodeling and repair, which is why veterinarians have targeted them for extraction and culture as a therapy. However, the older these cells become, the less flexible they become; they don't multiply (expand) as easily in culture, they don't differentiate into different types of cells as readily, and they aren't as powerful.

Mesenchymal stem cells (MSCs) These are basically adult-derived stem cells from almost any tissue in the body. But if your horse has been treated with MSCs, they most likely came from bone marrow or fat tissue. These cells have their roots in a certain tissue type and are isolated and expanded to many millions in the lab. Once isolated from the donor tissue's other cell types, the stem cells can be used to treat a variety of different tissues.

"Bone-marrow-derived MSCs from both the horse and human have been the most thoroughly studied and have the most evidence for the ability to undergo chondrogenesis, tenogenesis, and osteogenesis (cartilage, tendon, and bone tissue production, respectively) and might contribute to … repair (of these tissues) as well as modulate inflammation and soft tissue repair within the joint," Watts said.

Even among the MSCs are subsets:

Autologous stem cells Autologous means the cell or tissue used in a patient is from that individual, or is self-derived. Several labs isolate, expand, and freeze stem bone marrow, fat, umbilical cord, and blood cells for autologous use, meaning veterinarians will inject the stem cells back into the horse from which they extracted them. This means there's minimal risk for disease transmission, but the flip side is there's a necessary delay for treatment: The isolation and expansion process takes approximately three weeks.

Allogeneic stem cells Allogeneic means the cell or tissue used in a patient is from a different individual of the same species. Labs could prepare allogeneic MSCs from donor horses and bank them to be used in in the next injured horse(s).

Commercial allogeneic stem cells, however, aren't available just yet.

The non-stem-cell approaches include:

Platelet-Rich Plasma (PRP, aka platelet-reduced plasma) "Platelets are the body's first-responders after any injury," she said, referring to how this blood segment can release many bioactive substances that promote healing, stimulate blood vessel formation, recruit from pockets of endogenous stem cells, and control inflammation. Companies and veterinarians prepare autologous PRP by separating liquid and solid parts of blood—even patient-side for immediate use.

Autologous conditioned serum (ACS) "We use ACS to upregulate (increase cellular response to) interleukin-1 receptor antagonist protein (IL-1Ra; IRAP) to block the activity of interleukin-1," she said. Inhibiting interleukin-1, a naturally occurring potent inflammatory mediator, means pain relief and reduced inflammation for the injured or arthritic horse. Practitioners use ACS in intra-articular (IA) injections to treat joint disease, osteoarthritis (OA), or synovitis (joint lining inflammation); they've also injected it in and around tendons and ligaments.

Growth factors Watts touched on this experimental treatment area, which at its most basic level involves adding substances to the body to encourage functional tissue production. Veterinarians introduce these factors directly by injecting proteins, or indirectly by using gene therapy techniques to stimulate protein production. Researchers have been studying the latter approach because it has the potential for continued expression, whereas proteins injected directly don't last very long because the body metabolizes them. The group includes another set of acronyms:

- TGF-β (transforming growth factor-β) and IGF (insulinlike growth factor), which have been injected in horses as proteins or used as gene therapy to stimulate healing of hyaline cartilage (normal cartilage within the joint) and tendon, respectively.
- Bone morphogenic protein (BMP), which has been injected in horses as proteins or used as gene therapy in fractures and cystlike lesions to stimulate bone production.
- Growth-hormone-releasing hormone (GHRH) gene therapy, which has been used to treat laminitis.
- IL-1Ra gene therapy, which has been used to treat joint inflammation.

Basically, gene therapy involves using the shell of a virus to introduce growth factors to the horse's body in a directed way to enhance injury repair. Watts noted that gene therapy techniques are not yet available for clinical application.

She also said that practitioners have come a long way in understanding and using regenerative medicine, but they still have a lot to learn about how and when to use it; in which cases; and technique, route, dose, timing, and frequency.

For now, something all regenerative medicine camps seem to agree on is that early treatment, prior to scar tissue formation, and possibly repeated treatment are best to heal tissue and keep the horse at its pre-injury performance level.

Are Stem Cells Safe to Use in Horses' Eyes?

Veterinarians worldwide have been studying stem cells' efficacy for a variety of equine musculoskeletal skeletal conditions with some success. A research team from Texas A&M recently took a closer look at the future of stem cell use in horses' eyes.

Ashlee Watts, DVM, PhD, Dipl. ACVS, an assistant professor at the university's College of Veterinary Medicine & Biomedical Sciences, presented the results of a study in which researchers evaluated the safety of injecting allogeneic mesenchymal stem cells into healthy horses' subconjunctiva (beneath the mucous membrane lining the eyeball and inner eyelid).

COURTESY DR. ASHLEE WATTS

A horse's subconjunctiva immediately after injection with allogeneic MSCs.

The team used 14 healthy horses and randomly assigned each horse's eye to receive either 3 million MSCs in the upper-lid subconjuntival area or a control injection consisting of cell medium. Two observers unaware of the treatment group for each eye monitored the eyes regularly. The team repeated the injections three weeks following the initial injections.

They identified no adverse reactions or complications in either the MSC- or control-treated eyes during the study. Watts said MSC-treated eyes were redder and had higher chemosis (conjunctival swelling) scores on Days 1, 22, and 28, but not at other points in the study. The team observed epiphora (watery eyes) in some horses, but it was present prior to the injections. Affected horses' eyes continued to water throughout the study, and there were no significant differences in the presence of epiphora between the groups.

Watts and colleagues concluded that administering two subconjunctival allogeneic MSC injections appears safe, but further research on the topic is warranted.—*Erica Larson*

CONVENTIONTWEET

Stephanie L. Church
@TH_StephLChurch

Fortier: Keep in mind PRP is not going to cure them without all the other rehabilitation techniques, weight loss, etc. #AAEP2014

Using MSCs to Treat Joint Injuries

David D. Frisbie, DVM, PhD, Dipl. ACVSMR, professor of equine surgery at Colorado State University's Equine Orthopaedic Research Center, in Fort Collins, uses MSCs regularly. He presented general points to consider, how he selects cases, and a brief wrap-up of existing studies on MSCs for joint injury treatment.

Source and processing method He dialed down the oft-debated topic of MSC source to those he considers clinically relevant: bone marrow, which he referred to as the gold standard for joint-related treatments, and adipose tissue (fat).

As far as where the bone-marrow-derived stem cells come from, Frisbie said that low-volume (5 mL) aspirate from the ilium (the wing of the pelvis) has been shown to form better cartilage matrix production than those from the sternum.

Dose and timing Studies showing

treatment success used doses of 10-50 million cells, but a recent study in which physicians treated people with medial meniscetomy (surgery cleaning up the knee after a meniscal tear) and MSCs looked at an even larger dose: 150 million cells. "The 50-million-dose group gave better MRI volume of the medial meniscus," Frisbie said, indicating better long-term results and that more isn't always better.

Regarding when to administer stem cells, Frisbie cited a study on MSC treatment of tendon injuries. Researchers found significantly better long-term outcomes when they delayed MSC treatment until the post-inflammatory phase—four or more weeks after the injury or surgery.

Pick your cases Much can go wrong inside a joint, and that has to do with the four different types of tissues involved: the articular cartilage, the fibrous joint capsule and synovial membrane, the soft tissue structures, and the subchondral bone (which lies beneath the cartilage).

Some or all of these usually are affected in a joint injury, and the horse is generally trying to bear weight on damaged structures—hence, why treatment approach isn't always a clear-cut decision. "The severity and extent are what should dictate the treatment protocol," he said. In cases of cartilage loss, he said researchers have shown that MSCs contained in a scaffold or fibrin gel are ineffective for repairing cartilage defects. Injecting MSCs free within the joint (intra-articularly) following cartilage resurfacing, however, has benefited horses more long-term than cartilage resurfacing alone.

In soft tissue, IA injection of MSCs free into the joint lead to improved soft tissue healing and a decrease in OA progression.

Finally, Frisbie described regional perfusion of MSCs—using a tourniquet to keep stem cells in a limb segment for a period of time. He said he only uses this method as a last resort in subchondral bone disease cases because he hasn't seen published evidence of its efficacy.

Ultimately, Frisbie has experienced success using autologous bone-marrow-derived stem cells in treating joint injuries. He recommends routine rehabilitation protocols involving stall confinement and controlled exercise, and successful cases generally end up with four months away from full work and competition.

COURTESY DR. LANE EASTER

Using ACS, researchers shortened the convalescent period of horses with hind-limb PSD.

Western Performance Horses with PSD Benefit from ACS Treatment

An Oklahoma veterinarian has been examining the use of ACS to treat proximal suspensory desmitis (PSD) and has found some success with certain cases.

Lane Easter, DVM, Dipl. ACVS, of Performance Equine Associates, in Thackerville, performed the research and teamed up with Watts to write the study. He said PSD (inflammation and tissue damage of the upper part of the suspensory ligament) is the No. 1 cause of forelimb lameness of young Western performance horses in his practice that precludes them from competing in major events for which they have trained. Traditional treatment approaches generally involve extended confinement or inactivity, and horses end up missing major career-making futurities. Researchers have shown that many horses with PSD in one or both hind limbs have a guarded prognosis for returning to full athletic function at all.

Easter tried ACS to reduce inflammation and lameness and enhance healing.

He treated 271 mostly Western performance horses with PSD in one or two limbs over 10 years, injecting 352 limbs.

Easter selected cases carefully, opting to treat horses suffering from acute or chronic ligament strains rather than major tears. He used the same periligamentous (around the ligament rather than directly into the lesion) injection technique on all horses and then sent them home with strict instructions for stall rest, hand-walking, and re-examination—then, eventually controlled, gradually increasing under-saddle exercise. Treatment failures were horses that remained lame or became lame again within a month from the same problem in the same leg(s).

The horses that became sound, showed improvement on imaging, and were judged suitable for the exercise program were considered a success and went back to training after three months: That included 85% of unilateral (one leg) forelimb cases; 82% of bilateral (both legs) forelimb; 78% of the unilateral hind-limb; and 71% of the bilateral hind-limb.

Many of the cases considered statistical treatment failures continued on ACS and controlled exercise and eventually became sound and trained successfully, he said. "We were able to significantly shorten the convalescent period of horses with PSD, compared to what's been shown in literature, especially for rear limbs."

ACS is traditionally thought of as an intrasynovial treatment—used in joint structures—but this study demonstrated it could modulate inflammation in and stimulate repair of nonsynovial structures.

"As long as major disruption of (ligament) fibers is not ultrasonographically evident," he said, "even horses chronically lame because of PSD are good candidates for treatment with (periligamentous) ACS, as it may be possible to return the tissue to normal size and function and heal or treat pain from neuropathies." He and Watts do not recommend forcing ACS into ligamentous or tendinous tissue in which there is no tissue void—this forces fibers apart, disrupting healing.

The study's limitations included short follow-up times and no matched controls, but he said in his experience horses that train a month after PSD recovery without lameness generally stay in training long-term. Some horses do get lame again from PSD, but usually less severely, and many young horses mature out of this syndrome by age 6, as long as they don't sustain a tear.

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RESEARCHShorts

Owner-Reported Response to Headshaking Treatments

To gain a better understanding of the perceived success rates of headshaking treatments, Monica Aleman, MVZ, PhD, Dipl. ACVIM (University of California, Davis), and colleagues created a questionnaire for owners of affected horses. They learned that headshaking was most common in the spring, summer, and early fall; triggers included sun, wind, rain, snow, pollen, flies, eating, and loud sounds; and clinical signs included the horse tossing his head vertically, acting as if an insect flew up his nose, and rubbing his nose on objects. Aleman concluded that nose nets and fly masks produced the most successful outcomes. Dietary magnesium also produced a relatively high percentage of positive outcomes, as did antihistamine administration.

COURTESY DR. AIMEE COLBATH

Does Throat Spray Reach Horses' Upper Airway Structures?

Veterinarians routinely administer topical laryngeal and pharyngeal medications when treating upper airway disease in horses, but until recently no studies had been done to determine the distribution of this throat spray. The two administration methods practitioners use are via nasopharyngeal catheter and orally. In their study, Colorado State University researchers found that after nasopharyngeal administration, spray contrast was present in all of the regions evaluated. With oral administration the contrast reached the soft palate and esophagus but did not distribute well in the larynx. For the time being, said co-author Aimee Colbath, VMD, "when treating horses with larynx problems, it looks like the nasopharyngeal method is worth the extra effort."

Complications Related to Intrauterine Marbles

One technique veterinarians use to keep mares out of heat is to implant a glass marble in the uterus. But this method isn't without its risks. Some veterinarians have begun noticing issues when marbles remain in place for long periods of time, so Mariana Diel de Amorim, DVM, DVSc, Dipl. ACT, and colleagues from the University of Saskatchewan's Western College of Veterinary Medicine reviewed medical records from five mares that developed complications associated with long-term intrauterine marble use. They found that "the long-term use (more than one year) of intrauterine glass marbles may have severe deleterious effects on reproductive health," and is not recommended. If breeders do use these devices, Diel de Amorim suggested removing them no later than three months following insertion.

Does Uterine Edema Affect Pregnancy Outcome?

Many veterinarians report seeing uterine edema (fluid swelling) as mares approach ovulation. Because no studies have previously been performed to determine whether this affects pregnancy rates, researchers from the University of Kentucky's Gluck Equine Research Center and clinicians from Rood & Riddle Equine Hospital recently evaluated uterine edema in 920 mares. The team hypothesized that prolonged or excessive edema would lower pregnancy rates and increase incidence of early embryonic loss. They found out, however, that excessive uterine edema near the time of ovulation did not adversely affect either, meaning that, based on this study's results, owners and veterinarians have little reason for concern when it comes to this type of swelling.

Researchers Evaluate Henderson Equine Castration Instrument

David G. Levine, DVM, Dipl. ACVS (New Bolton Center), and colleagues evaluated the Henderson equine castrating instrument to determine whether it resulted in fewer castration complications. They found that the instrument did result in a low complication rate (18 out of 180 study horses, or 10%), especially among younger horses. Additionally, they said use of the tool resulted in a substantially shorter surgical time, which could explain the less-severe complications.

Using Fluorescent Markers to Look at Laminar Microanatomy

Hannah Galantino-Homer, VMD, PhD, Dipl. ACT (University of Pennsylvania School of Veterinary Medicine), has been studying lamellar microanatomy to try to improve veterinarians' ability to diagnose, treat, and prevent laminitis. She demonstrated that one particular lectin (a type of protein that can bind to cell membranes) derived from wheat germ is an excellent marker for the microanatomy of the complex interlocking epidermal and dermal laminae. She used this lectin in combination with fluorescent markers for other proteins laminitis affects in order to pinpoint precisely how laminitis alters their distribution.

Standing Medial Patellar Splitting for Delayed Patellar Release

If a horse suffers from delayed patellar release, his stifle occasionally locks into an extended position. Sarah James, DVM, Dipl. ABVP (Steinbeck Country Equine Clinic), studied the efficacy of splitting the medial patellar ligament for treating the condition. In general, 89% of horses benefitted from the procedure, James said, which shows that it can be an effective surgery for long-term success and return to performance.

Infectious Arthritis Incidence Following Joint Injections

Anna Bohlin, DVM (Evidensia Equine Hospital), reviewed veterinary records from horses treated with joint injections from 1999 to 2010 to determine whether adding prophylactic antibiotics to prevent infectious arthritis during these procedures is really necessary. "Out of 10,000 horses, 17 of those receiving only treatment developed infection," she said. Based on her findings, Bohlin still considers infectious arthritis a rare event following joint injection, but suggested using amikacin, the most commonly used prophylactic antibiotic in joint injections, when injecting polysulfated glycosaminoglycan.