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A Practical Guide to Preventing & Managing Thrush, White Line Disease & Laminitis

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Caring for Horses with Acute Endocrinopathic Laminitis

Better understanding leads to better management & longer lives, ECIR Group says

By Eleanor Kellon, VMD

It wasn't that long ago that a diagnosis of Cushing's disease — Pituitary Pars Intermedia Dysfunction (PPID) — was felt to mean the horse had less than 5 years to live. The cause of laminitis in these horses was poorly understood and, therefore, poorly managed. We know better now.

The Equine Cushing's and Insulin Resistance Group (ECIR) was founded in 1999 by an owner with an atypical Cushing's mare who wanted to promote the dissemination of correct scientific information. We have followed the research closely, as well as thousands of cases. I can't think of any situation where it's more critical for owner, veterinarian and hoof-care professional to be fully informed and working together than in laminitis care.

Defining Acute

We often describe the newly diagnosed laminitic horse as "acute." What does acute laminitis mean?

With the possible exception of laminitis of pregnancy, few endocrinopathic laminitis (EL) cases are truly acute, where acute means the day before they were normal and the next they were in obvious laminitis. With endocrinopathy, laminitis can be the culmination of a long road.

It has been 20 years since P.J. Johnson first described occult changes to the laminae of horses with insulin resistance (IR), meaning no obvious clinical symptoms or none reported. Ascribed initially to cortisol excess (pre-Cushing's; peripheral Cushing's), this form of laminitis is now understood to be an insulin effect.

"We believe that conditions associated with glucocorticoid (GC) excess (exogenous or endogenous) and IR lead to structural changes in the connective tissues of the hoof-lamellar junctional zone that might be viewed simplistically as a 'weakening' effect on the attachment interface. Over time, these changes result in lengthening and attenuation of the primary and secondary dermal lamellae, not necessarily associated with pain, inflammation or lameness per se" (Johnson et al. 2004).

When we look under a microscope, whether 24-48 hours after insulin infusion or 3 years into a painful history, the changes in the feet are identical. Variations may apply, with changes once a laminar wedge is apparent, but the basic underlying histopathology of the laminae is the same, whether acute or chronic and whether the horse is in pain.

These changes are seen in both symptomatic and asymptomatic horses, in chronic cases, as well as within 48 hours of insulin infusion. Sudden onset is not so sudden after all. It is not an acute problem, and it

did not just happen. If you are going to successfully attack it, you have to look for the cause via a detailed history.

Signs of Occult Laminitis in the Foot

Early signs can be seen in horses that are not recognized as lame.

- Stretching in the white line.
- Hemorrhage in the white line.
- Dropped/flat soles; thin soles.
- Possibly “rings” in the hoof wall.

The above changes are even more obvious in overgrown feet with long toes. They do not happen overnight.

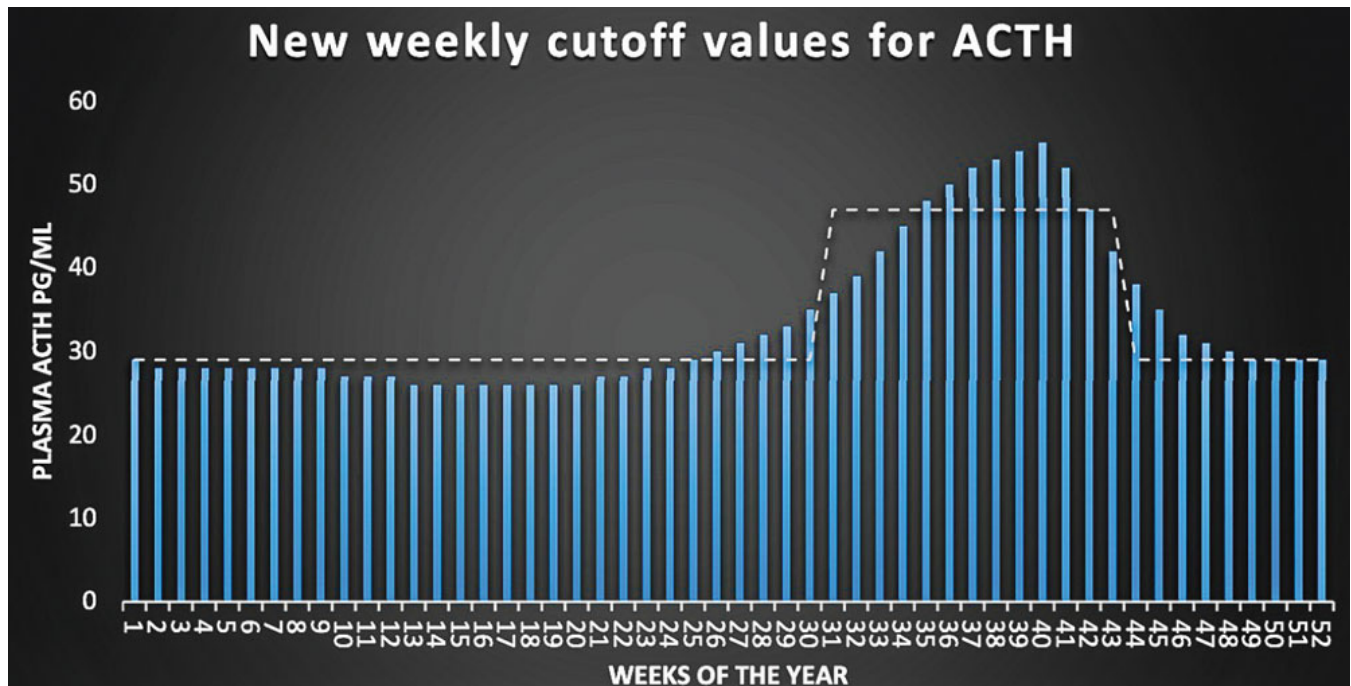
Signs of Occult or Sub-Acute Laminitis in the Horse

- A stilted, wooden gait: the horse is stiff.
- Rigid head carriage at the walk.
- Less spontaneous movement.
- Reluctance to trot.
- Reluctance to make sharp turns.
- Hesitant on hard ground.
- Tension through shoulders, back and hind quarters.
- Social status will drop when in pain.
- Pain and signs will disappear with blocking of the feet.

Owners are often unaware of an issue because pain is symmetrical — the horse does not limp and there is no head bob. A horse may be more stoic about pain that builds insidiously, and the animal is often valued as unusually quiet or gentle.

What Drives Endocrinopathic Laminitis?

It all boils down to insulin. Approximately 90% of horses being seen for lameness caused by laminitis have an endocrinopathy as the cause — either Equine Metabolic Syndrome (EMS) or PPID (Karikoski et al. 2011). More specifically, studies such as Coleman, et al. 2018 and Menzies-Gow et al. 2017 have identified hyperinsulinemia as the risk factor for pasture laminitis.



Bars represent adrenocorticotrophic hormone (ACTH) cutoff values for every week of the year (Durham 2016, unpublished data) with the dashed line indicating previously used monthly cutoff values (Copas and Durham, 2012).

Hays with hydrolyzable carbohydrates (HC) — ethanol soluble carbohydrates (ESC) plus starch — over 10% can also precipitate laminitis in susceptible horses. Laminitis has been induced in both clinically normal horses and ponies by hyperinsulinemic, normoglycemic conditions under insulin infusion. In PPID, the excessive levels of adrenocorticotrophic hormone (ACTH) and other pituitary hormones create IR or worsen it if already there.

The key to success is to get and keep insulin and ACTH controlled, with normal levels being the goal for ACTH and as close to normal as possible for insulin.

Triggers of Acute Worsening

Diagnosis often is made when lameness worsens because of increasing hyperinsulinemia from some precipitating event such as the following.

PPID seasonal rise. Uncontrolled PPID or exaggerated seasonal rise can drive insulin higher. Liphook Equine Hospital in the United Kingdom tested more than 30,000 horses, both PPID and normal, to establish weekly normal cutoffs of ACTH values throughout the year. Because the chart consists of unpublished data, age distribution is unknown. Lee et al. 2010, also in the U.K., found that older, non-PPID horses might have a higher seasonal rise than young horses. An older horse may go as high as 80 or 90 in the fall and still not be PPID.

Dietary indiscretion. Hay, pasture, feeds or even treats with HC (simple sugar plus starch) levels high enough to cause a significant insulin spike, generally ESC and starch over 10%.

Cold. EL has a strong vascular component, regardless of what else might be occurring histologically. In other species, sudden cold snaps can cause hormonal changes, with higher insulin as a common response. Acute pain response can occur either after a sudden dramatic drop in temperature or persist all season long, when temps go below a critical level, e.g., 40 degrees Fahrenheit.

Abnormal ovarian activity. In the mare, abnormal ovarian activity has features similar to polycystic ovary syndrome (PCOS) in human females and may occur during spring transition (March in the northern hemisphere) or all year long. The crest increases and laminitis occurs when the mare shows estrus. Severe flank pain is common to the point where it is diagnosed as colic. Irregular cycling and a prolonged interovulatory interval also occur.

Drugs That Can Affect Laminitis

Phenothiazines. Suppresses dopamine production and increases insulin with acute exposure. It's found in acepromazine and some dewormers.

Xylazine. Reduced insulin and hyperglycemia followed by reactive compensatory insulin surge.

Sulfa antibiotics. Increased insulin secretion.

Praziquantel. Hyperglycemia is caused by reduced peripheral glucose utilization. The response to high blood sugar will be an insulin surge.

Corticosteroids. Induces insulin resistance.

Dormosedan/Tobugesic. Produces the same effects as Xylazine.

Third generation Cephalosporins (Excenel, Excede, Naxcel). Severe laminitis.

Vaccination. Owners and veterinarians swear vaccinations can cause laminitis; however, the mechanism and timing are questionable and cannot be reproduced experimentally. In any other species, an individual with a severe reaction would never be vaccinated again. Because there might be an increased risk of laminitis, use only core vaccines and consider titers, which is the highest dilution yielding a positive reading. Reactors should not be revaccinated.

Differential Diagnosis

Personally observed conditions initially misdiagnosed as laminitis include the following.

- Colic (stretched out stance).
- Tying-up (pain, refusal to move, tight muscles).
- Acute neurological disease (EPM) (distress, reluctance to move because of ataxia).
- Bilateral coffin bone fractures.
- Other causes of front foot lameness include deep digital flexor tendon pathology (heel pain syndrome), navicular disease, trim issues and hoof abscess, especially if the pain is worse in one foot.
- Low-grade laminitis pain is frequently misdiagnosed as hock lameness due to posture, weight transfer behind at rest and in motion and shortened stride in a rush to unload the front feet.

Effective Approach to Acute Care

Everyone's first instinct is to reach for phenylbutazone or another non-steroidal anti-inflammatory (NSAID) medication to control pain but these are minimally effective. The reason is that endocrinopathic laminitis is not inflammatory and these drugs do not control insulin.

McGowan and Patterson-Kane's 2017 literature review reported there is minimal neutrophil infiltration in endocrinopathic laminitis. Storms et al. 2022 described increased myeloperoxidase activity, presumably from neutrophils, in the laminae of horses subjected to a 48-hour euglycemic hyperinsulinemic clamp but didn't test tissues until the 48-hour mark, when damage is already done. They would have been looking at a clean-up response, not the cause.

Matrix metalloproteinase enzyme activation and basement membrane pathology are heavily publicized components of other forms of laminitis, like fructan or grain overload, but there is little to no evidence of this in endocrinopathic laminitis (Patterson-Kane et al. 2018).

Any inflammation in endocrinopathic laminitis is a secondary response to tissue damage, not the cause. NSAIDs shouldn't be used for longer than 5 days, but horses often are on a prolonged course because the insulin level and trim haven't been adequately addressed.

An acronym I use to describe a comprehensive approach is DDT.

D: Diagnosis.

D: Diet and drugs.

T: Trim.

Diagnosis

When seeking an accurate diagnosis, look at the whole horse not just its lameness or seeming lack thereof.

Consider attitude, posture, movement on hard vs. soft ground, external hoof changes, status in the herd and, when suspicion arises, always do nerve blocks.

Laminitis is a sign, not a disease, and has many causes. If the horse has not been tested for EMS and PPID with insulin and ACTH, this can be done after the condition has stabilized. Acute pain has been shown to induce insulin resistance in humans (Greisen et al. 2001) via cortisol release, but Gehlen et al. 2020 showed up to moderate pain does not influence ACTH, so complete pain relief isn't necessary before testing. In the meantime, starting metformin at 30 mg/kg twice a day can help control insulin. If the horse also has PPID, pergolide will be necessary to lower insulin.

New Weapons in the War Against Insulin — SGLT2 Inhibitors

- Despite our best efforts with diet control, metformin and pergolide, some horses do not come under good insulin regulation and continue to be laminitic. This is often, but not always, horses with PPID, and in some cases they are diabetic with abnormal blood sugar. Fortunately, we have another option.
- SGLT2 is the acronym for sodium-glucose cotransporter 2. This cellular transporter is most active in the kidney where it serves to take glucose from the filtered blood and return it to the body. The two drugs blocking this that have been used in horses are canagliflozin/Invokana and ertugliflozin/Steglatro. By blocking reuptake, the glucose load on the body is greatly reduced and insulin drops (Kellon and Gustafson, Sundra).
- The degree of insulin improvement varies from normalized to barely changed, but interestingly, there is virtually 100% improvement in laminitis pain. Decreased kidney function from the resulting increased urine output and urinary tract infections are potential complications but have not been seen to date. Horses should be given generous amounts of salt in their feed or sprinkled on moistened hay to keep them drinking well.
- The major side-effect is elevated levels of triglycerides. This occurs because of the energy crisis created by the glucose loss. Increases are also seen naturally with fasting or after exercise. If uncontrolled, it can lead to liver enzyme elevations (Kellon EM and Gustafson KM). This is addressed by feeding free choice, unsoaked hay with hydrolyzable carbohydrates up to 12% and 1 lb. beet pulp per 500 lbs. of body weight daily. Beet pulp produces primarily acetate when fermented. Acetate can substitute for glucose in energy pathways.

Diet & Drugs

As above, a short course of NSAIDs during the clean-up phase, with metformin to assist in insulin control, is indicated. If PPID is strongly suspected, a trial of pergolide is reasonable. Remember that horses in their teens may have fall onset laminitis as the first sign of PPID with no other external indicators (Donaldson 2004). Suspect this if unexplained fall laminitis is the first episode of laminitis in the horse's life.

The emergency diet should be soaked grass hay only, fed at 1.5% of current body weight or 2% of ideal weight, whichever is larger. Plain beet pulp, which has been well-rinsed and then soaked, can be used to carry supplements and medications. No pasture, alfalfa or clover. No grains, including those that claim to be safe and no balancers, since their base is often not safe. Safe means a focus on hydrolyzable carbohydrates — less than 10% simple sugar (ESC) and starch combined.

It is not unusual to see pain drastically improve within 2 to 3 days when an appropriate diet is started, even if NSAIDs are discontinued.

A general vitamin and mineral supplement can be added, but it is far better to have the hay analyzed so that one can be chosen that matches what the horse needs. Also, analyze for sugar and starch to see whether soaking to lower should continue. Vitamin E, 2000 IU for the average size horse and 4 to 6 oz. of ground flax should be added, as well as 1-2 weighed oz. of salt. After the hay is analyzed, supplementation of vitamins and minerals with correct ratios to match the hay should be done (Kellon 2007).

Trim

Getting and maintaining appropriate hoof trimming is often the most difficult challenge for owners of these horses. Whether barefoot or in a device, a realigning trim is essential for good results and healing to begin, as described in the instructions for the Steward Clog, as well as Taylor et al. 2014, which can be found in the May/June 2023 issue of *American Farriers Journal*.

The feet should be radiographed as soon as possible. The ultimate goal in a healthy hoof is approximately equal distance from the coffin bone to the ground, the edge of the coffin bone to the hoof wall and the tip of the coffin bone to the tip of the toe — all on lateral radiographs. The most common trimming errors are long toes, putting significant leverage on weakened laminae during breakover, and underrun heels, reducing the shock-absorbing capacity of the hindfoot, frog and digital cushion.

To correctly realign bones and soft tissue within the hoof capsule, remove shoes and trim the horse to have a short, rounded toe and palmar angle no higher than 5 degrees to minimize stress to the laminae.

The walls should be unloaded by beveling and heels brought back to the widest part of the frog if there is sufficient foot to do this. Otherwise, the heels can be ramped.

Styrofoam blocks or boots and pads are best for comfort in the acute phase when growth is often accelerated and requires frequent trims, often as much as every 2 weeks.

If you focus on diagnosis, diet and trim — not just pain control — the outcome will be much improved. **Q**

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How to Prevent & Treat Thrush

Foot trimming basics can reduce the risk of anaerobic bacterial infections

By Jeff Cota, Editor

Proportionally, the frog is close to one of the smallest structures in the equine body. Yet, despite its size, it plays a central role in maintaining healthy, sound horses. A healthy frog shares in the load-bearing function of the hoof and absorbs concussion each time the hoof contacts the ground.

In healthy hooves, the triangular-shaped frog tissue expands and contracts within each stride, pushing dirt and debris out of the crevice known as the frog sulcus. The sulcus crevices are a self-cleaning mechanism to “pop” foreign materials out of the hoof.

When the central sulcus or the grooves on either side of the frog are compromised, the hoof structure is predisposed to developing thrush. When the sulci are deep and if the cornified frog has ragged edges or pockets, the frog has an increased risk for anaerobic bacteria to invade and deteriorate healthy tissue.

Unsanitary living conditions and excessive hoof dampness are largely to blame for thrush, so encouraging horse owners to keep horse hooves clean and give the hoof time to dry out is a fundamental horse-keeping skill.

“We see a lot of thrush here in Missouri because of the snow and mud with our often wet and climate conditions,” says Amy Rucker, an equine veterinarian from Columbia, Mo. “We have quite a bit of affordable land and so our horses are out a lot. The biggest place I see thrush develop is when horses stand around hay bale feeders because the footing is a compacted combination of rotted hay, manure and mud.”

Nearly half of farriers see a case of thrush each week during the year, according to the 2024 *American Farriers Journal* Farrier Business Practices survey. Another 18% see thrush monthly, while 15% only deal with it a few times a year. Another 22% indicated thrush is only a seasonal concern.

“Far too many farriers ignore it and say, ‘It’s not my issue,’” says Mike Wildenstein, FWCF (Hons), CJF, from Sharon, Vt. “They see it as a maintenance issue and blow it off, but I think it needs to be brought to the attention of the team caring for the horse. Poor maintenance destroys the integrity of the bottom foot and takes away the insensitive tissue that protects sensitive tissue.”

Unsanitary environmental conditions are not the only culprit. Horses living in the filthiest conditions might never develop thrush while those receiving “best practice care” develop infections over and over. The best key to preventing recurring cases is to encourage a healthy foot through basic trimming —

and shoes as necessary — to increase the odds of a hoof fighting off an infection, says Scott Fleming, DVM, CF, of Rood & Riddle Equine Hospital in Lexington, Ky.

“If a hoof is strong and able to clean itself, or allow itself to be cleaned,” he says, “the foot has a lot better chance of fending off infection.”

With thrush being among the most common hoof ailments, farriers of all levels of expertise must be able to recognize the earliest signs of infection. Responding with trimming and treatment protocols can keep infections from progressing to more serious hoof conditions.

Identifying Thrush

Traditionally, a dark discoloration and sometimes a strong odor are the most recognizable signs of thrush. Wildenstein, though, explains that thrush is a broad term that describes an infection that can present itself in various ways, including pain.

“Identifying thrush starts with recognizing any irregularity in the sole or the frog,” says the International Horseshoeing Hall of Fame member. “If the tissue does not look normal, chances are it isn’t.”

Fleming adds, “Thrush is obvious when I pick out the foot, and it is black and cruddy. I also look to see if normal tissue like the frog or sulci is starting to degrade.”

In healthy hooves, a frog is broad and well-formed. Conversely, an unhealthy frog is shrunken and shriveled. As the frog withers away, the sulci deepens. Organic material accumulating in these deep grooves creates conditions where anaerobic bacteria can thrive.

While researchers have not linked a specific organism to the cause of thrush, *Bacteroides* sp. and



DR. AMY RUCKER

Most horses have frogs with a different appearance on all four feet. They are affected by the width of the heels, the strength of the digital cushion and the angle of the coffin bone in relation to the ground. The left foot has a 14-degree positive palmar angle (palmar surface of the coffin bone in relation to the ground). The central sulcus mimics that angle. The narrow heels, as well as the high palmar angle, create deep collateral and central frog sulcus. The ragged frog tissue is susceptible to thrush. The pockets and flaps were debrided using a sharp hoof knife to help prevent thrush from developing. Feet with wide heels and zero-degree palmar angle, such as the one on the right, generally have a broad and flat frog with a shallow central sulcus. They are less prone to packing material in the sulcus, so they might resist thrush.

Fusobacterium necrophorum are suspect. These two anaerobic bacteria naturally occur in the environment and are commonly found in the bottom of the horse's foot.

Thrush can be mild, moderate or severe in the level of active infection. For example, a frog that looks "ratty" or has deep cracks or fissures is mild thrush. However, when the protective outer horn is weakened, the frog tissue becomes more susceptible to penetration by the bacteria and, consequently, the development of the disease.

"Even if it is dry and looks good at the moment, but you pick up the hoof and recognize the architecture of the frog is not normal or healthy, that's time to start addressing it," Fleming says. "Waiting even a day or two can set back the time to heal the hoof."

In many cases, farriers can successfully treat thrush. Fleming adds that if the infection is deeply seated in the central sulcus and sensitive tissue and involves the bursar tissue, it might be time to bring in a veterinarian.

"In these cases, antibiotics might be required," he says. "I'll often use an intramammary mastitis treatment in these cases."

Rucker cautions that a horse that isn't responding to treatment for thrush might have canker. When the tissue looks warty, soft and bleeds, the underlying issue is likely canker.

"I've only seen a couple of dozen cases myself and most horse owners never have a case of canker, but it is possible," says the International Equine Veterinarian Hall of Fame member. "If someone thinks they are treating thrush and it is not getting better, they need to consider canker."

Trimming Basics

While farriers can't control a horse's living conditions, they can influence the hoof capsule. Since an abnormal hoof capsule is another primary culprit, farriers can reduce or prevent thrush during scheduled visits. Upright feet or a club foot are more prone to thrush because the structure allows manure and dirt to pack in and trap bacteria, Wildenstein adds.

Extremely contracted heels and deep sulci increase the chances of a thrush infection. The key to healthier and stronger hooves starts with the caudal aspect of the frog and digital cushion while also mitigating or reducing negative plantar or palmar angles.

"I try to minimize the distortions and model the foot into its strongest self to maintain healthy architecture and function," Fleming says. "It's important to recruit load-bearing structures evenly to maintain the healthiest for that individual."

In mild cases and depending on the horse's conformation, rasping the heels might be enough to bring the structures back onto the same plane. In more advanced cases, additional trimming is necessary.

"In trimming, I'm trying to mirror the sensitive structures with external structures," he adds. "At the same time, I don't want the heels to get excessively long to the point where packing of environmental debris can happen. My goal is to improve that architecture in the back of the foot."

The healthier the foot, the better its odds of fighting off infection and external factors such as environment. If the hoof is strong and able to clean itself or allow itself to be cleaned, there is a much better chance of fending off infection.

In the 2018 literature review, "Three common equine hoof ailments: Laminitis, thrush and navicular disease," Jennifer A. Stoltz identifies a lack of exercise as another contributing factor to thrush.¹ Stalled horses move less, thus allowing dirt and debris to stay in the sole. In the worst-case scenario, Stoltz notes that thrush could develop into white line disease.

Treating the Infection

Encouraging a healthy hoof capsule is part of a long-term maintenance hoof-care plan. In the short term, topical treatments might be necessary to destroy the anaerobic bacteria. Copper sulfate has been a go-to product for many farriers.

"The cure can be worse than the disease," Fleming says. "I routinely use copper sulfate, but it is case-specific and you have to be careful. There is a line you cannot cross. If the thrush is invading sensitive tissue, deep sulci or heel bulb, then I opt for something that is less caustic."

While copper sulfate is a common option to treat thrush, it can pose safety risks to farriers, horses and the environment. Copper is naturally found in the human body with acceptable levels ranging from 50-120 mg. Levels higher than that pose health risks through absorption or ingestion. In drinking water, the Environmental Protection Agency limits copper sulfate to 1 part per million.²

The National Pesticide Information Center (NPIC) cautions users about the speed at which copper sulfate is absorbed into the body and moves throughout the bloodstream once eaten or inhaled.³

The compound subsequently binds to proteins and enters different organs, according to NPIC. While the excess copper is mostly excreted from the body, deposits can be found in the liver, stomach secretions, bone, brain, hair, heart, intestine, kidneys, muscle, skin and spleen. The Center's compilation of research also finds that it takes between 13 and 33 days for only half of a large copper dose to be eliminated from the body.²

“Be aware that in granulated form, copper sulfate is caustic to your eyes, as well as the horse’s sensitive tissue,” Fleming says. “I got it in my eyes more times than I care for. You have to be extra cautious when it is windy and take extra steps to prevent self-ingestion.”

For these safety reasons, Wildenstein advises against copper sulfate.

“Systemically in the body, copper sulfate is like the pesticides and herbicides used on crops,” he says. “It alters the animal’s biome and makes digestion more difficult because some of the biome is destroyed. The compound is used to kill all the bacteria and fungus it encounters; that’s why it’s often used to sanitize poultry and cattle barns and to control bacterial and fungal growth in water.”

The 1975 study, “Copper Sulphate Poisoning in Horses,”⁴ documented horses’ sensitivity to the compound. The research showed that even a single application of 0.125 g/kg body weight in 1% concentration contributes to stomach and gut disturbances such as ulcers and colic and other poisoning symptoms.

“The horse’s sole and frog are very absorbent, so we have to be very careful in what we use on horse’s feet,” Wildenstein says. “Just think if a horse stands on black walnut shavings, they will likely become laminitic quickly; that’s how sensitive the hoof tissue is to caustic materials.”

He prefers products made from turpentine, pine tar and tea tree oil — all products derived from sap or pitch from trees. If Wildenstein knows the horse owner is hands-off in maintenance, he uses packing with pine tar under a pad.

“I find I can heal a lot of these with the application of appropriate packing and a pad,” he says. “Ichthammol is one of oldest medicines known to mankind.”

Wildenstein has also found that changing pH levels in the bedding or pastures the horses live in creates environments these infection-causing organisms need to thrive. Baking soda or vinegar are two topicals that can change the pH in the foot, he explains. Liming stalls and paddocks can also significantly influence pH levels, but it must be used with discretion as lime is caustic.

The Bottom Line

Sometimes no matter how hard the farrier and owner work to clear up a case of thrush, cases can persist until the environment changes. In Missouri, horses that develop thrush in the winter will not see a clearing until May when the ground changes.

“We have great farriers here who identify it and get the client treating it,” Rucker says. “Typically, the only time I get involved in thrush cases is when pockets in the hoof start to redevelop mid-trimming

cycle. We have a shortage of farriers here, so they aren't always available to stop in between the 6- or 8-week schedule, so I'll clean it up in between."

While some cases may linger, Fleming says focusing on the hoof structure is essential.

"If you can improve the function and architecture of the foot, thrush will work itself out a lot of times," he says. "Spring shoes or finding a way to widen the heel and enhance function and action back for the foot have a way of improving chronically thrushy feet." **Q**

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Rethinking White Line Disease

Keratinolytic disease of the zona alba is a more accurate term for this common hoof ailment

By Jessica Lash, Contributing Writer

Keratinolytic disease of the zona alba (KDZA), commonly known as white line disease, is a hoof pathology present across a wide range of breeds and disciplines. Referred to previously as hollow wall or seedy toe — as well as by various other descriptors — KDZA emerged as the most clinically correct term for the pathology when it was introduced in 2018 by fourth-generation farrier and author Simon Curtis, PhD, FWCF (Hons), HonAssocRVCS, of Newmarket, England.

White line disease has been the widely accepted term to describe a recognizable separation in the hoof wall in which keratinolytic pathogens have invaded since the 1990s, says Sarah Logie, FWCF. However, the Inverness, Scotland-based farrier cautions that terms like seedy toe and white line disease are often misleading.

“Both descriptions involve the growth of the same anaerobic bacteria and subsequent invasion by keratinophilic fungal spores, but these invasions extend beyond the most proximal aspect of the white line,” Logie explains. “This means the term ‘white line disease’ is inaccurate because when the infection is in the unpigmented horn of the stratum medium, it can spread to the coronary band. That’s not the white line — it’s just where we tend to first see it.”



Radiographs help reveal the extent of the KDZA infection of the hoof wall.



A patch, when correctly applied, mimics the healthy hoof capsule and can help the horse return to a normal workload during the treatment period.

KDZA is the first accurate term used to describe this commonly encountered hoof ailment, Logie says.

“It truly says what it is — a disease affecting the non-pigmented portion of the stratum medium, or zona alba, where the horn cells are digested by keratinolytic pathogens,” she says. “All these different terms are recognized as the same condition, but to use an inaccurate one for the sake of tradition seems pointless.”

Tell-Tale Signs: Identifying KDZA

KDZA is characterized by the damage and subsequent separation of the stratum medium from the stratum internum, Logie says.

“This separation may be recognized as a small to large separation anywhere in the white line where dirt is packed in, or in the shod foot where the cavity is filled with a foul-smelling black mush and cheesy, crumbling horn matter,” she explains. “The wall itself may bulge when viewed on the ground. In severe cases, lameness may occur as P3 becomes destabilized. In other cases, horses may have poor hoof quality with all four hooves having issues throughout the white line.”

In all cases, Logie says the pioneer organisms are anaerobic, sulfur-reducing bacteria that destroy the sulfur bonds between the keratin molecules. This destruction opens the door for opportunistic keratinophilic fungus and bacteria to infiltrate and digest the elements of the keratin, thereby leaving the hoof wall weakened or absent.

Understanding the Subtypes

KDZA is grouped into two subtypes — Type 1, known as structural; and Type 2, known as systemic.

“In Type 1 KDZA, an insult or weakness occurs in the hoof through a fundamentally isolated mechanical cause,” she says. “Cracks, a nail hole or an area of gravel pushing into the soft white line can cause a separation. Horses suffering from this may have recognizable healthy horn in all other parts of the affected hoof and may only have one affected hoof. The isolated area will be obvious and if untreated may spread as sulphur-reducing bacteria weaken the horn structure, allowing fungal species to enlarge the cavity.”

In Type 2 KDZA, Logie says the signs often point to an environmental or systemic cause.

“These horses are observed to have generally poor hoof quality with brittle outer layers of horn and signs of blackening around the nail holes or around the white line in general,” Logie explains. “They may not retain shoes well or may not withstand being without shoes. They may be lame or hoof sore, and they may also experience chronic laminitis.”

Preventing KDZA

Prevention varies depending on whether the origin is structural or systemic. Because of this, Logie says the root causes of a horse's KDZA must be identified.

"In Type 1 cases, incorrect hoof balance and over-dressing of the dorsal wall is one of the major causes of KDZA," she says. "Incorrect landing and loading of the hoof capsule create strain on the hoof wall, thereby allowing something as seemingly benign as a nail hole or crack allow bacteria the opportunity to enter the hoof. Ensuring even loading of the hoof wall and as true limb movement as possible to avoid torque in the hoof, while preserving hoof wall structure and thickness, is the best prevention in these cases."

In Type 2 cases, Logie cautions that multiple factors, including environment and nutrition, may be at play.

"Type 2 cases may improve when the environment changes," she says. "Maintaining dry and clean conditions underfoot, although difficult, is one of the best things for these horses. Although environmental factors affect all feet in an individual horse, they do not affect all horses — there must be some underlying weakness in the affected individual."

In addition to environmental conditions, nutritional deficiencies may play a key role in keeping KDZA at bay.

"Nutrition plays a major role in the occurrence of Type 2's weak feet," Logie explains. "If the horn being produced is of poor quality and strength, opportunistic organisms can rapidly invade and digest the innermost layers of horn, leaving the outside layers to collapse — particularly if they're already compromised by environmental conditions."

Logie advises farriers to identify and be aware of less-than-optimal conditions that may adversely affect the horse's hoof quality.

"Being aware of any systemic weaknesses or environmental challenges allows the farrier to trim or shoe appropriately," she says. "The owner should also tailor the management to give the hooves the best nutrition, hygiene and environment possible."

Hoof Resection & Disease Management

Much like thrush, KDZA is a common and largely treatable hoof ailment. Resection is the go-to course of treatment in both structural and systemic cases, with the foremost goal of resection being to expose the affected area to air.

"Type 1 cases are very straightforward to treat," Logie assures. "The area should be debrided back to solid, sound horn. Small areas may not require resection, but larger areas where the margins of the cavity cannot

be observed should be fully resected.”

As the initial bacteria are anaerobic, the traditional treatment was to expose the area to the air and keep it clean. However, Logie’s study about KDZA reveals that heavy reliance on management and environment often meant the area showed further infection when reexamined at the next shoeing.

“By adding a medicated patch, the farrier can ensure they can safely cover the area, knowing that any further bacteria will not survive in the environment under the patch,” she explains. “On the other hand, a patch with a non-effective treatment is just as bad as ignoring the initial infection and may worsen the condition.”

Once the area has been debrided, Logie says she prefers a copper sulfate powder under Imprint thermoplastic material but acknowledges that other adhesives also have been proven effective.

“The goal is to remove the damaged and infected horn, prevent reinfection in case of any bacteria working their way in or left behind, and return structural strength to the hoof capsule with the patch — which also keeps the area clean,” she explains.

In milder cases not requiring resection, Logie recommends the area be packed with copper sulfate and a hoof putty or clay.

“Copper sulfate must not be used on any area where sensitive tissue has been exposed,” she cautions. “Even the smallest pinprick of blood must be excluded with a hoof putty, or treatment delayed for a couple of days until it has keratinized and not sensitive because it will burn sensitive tissue.”

Although Type 1 cases are relatively straightforward in treatment protocol, Logie says Type 2 cases, which may have environmental or nutritional influencers, are more complex.

“These cases are harder to treat because it varies depending on the individual case,” Logie says. “If the underlying cause is brought under control, normally the feet improve as a side effect. Farriery alone will not solve these cases.”

The implications of untreated KDZA can be far-reaching.

“Complications can range from the inconvenience of hooves never being solid, awkward to nail to, and shoe loss to lameness and laminitis due to loss of attachment from P3 to the hoof wall,” she says. “It’s a condition that will not resolve without a proactive hoof management approach and appropriate management.” **Q**