Laminitis is a dynamic molecular process superimposed on normal biology. Many of its features are normal processes appearing at the wrong time and place. - Dr. Christopher Pollitt

Laminitis is the second most-common killer of our horses (colic is first). “Fifteen percent of horses in the United States are estimated to be affected with laminitis over the course of their lifetimes, and seventy-five percent of these horses develop severe or chronic lameness and debilitation that necessitates euthanasia.”

It is imperative we understand that laminitis is not a disease of the hoof. Until that is clear we will just continue to prolong the misery of our horses and misuse potential treatment time with ineffective protocols. By definition, laminitis is the breakdown between the laminae connection of the inner hoof wall and the coffin bone. This definition, though quite accurate, gives us nowhere to go to find help for our horses. The true complication about laminae separation is that, although it occurs in the hoof, it is actually the end result of a number of metabolic processes. Laminitis enters the developmental stage as soon as these processes have been set in motion by a triggering event, and that happens long before any lameness or hoof pain is evident.

In large part, the confusion about the cause of this disease comes from the vast array and apparent disparity of the triggering events. In a recent study, gastrointestinal tract diseases, such as colic, inflammatory bowel disease, enteritis, and colitis were found to be the primary issue in 54% of the horses that developed acute laminitis. Grain overload, grass founder, mechanical overload due to trauma in a contralateral limb, Cushing’s Disease (Equine Metabolic Syndrome), retained placenta, pleuropneumonia and other illnesses accompanied by the release of endotoxins (a toxin produced by certain bacteria and released upon destruction of the bacterial cell) can also result in laminitis. In addition, laminitis can be induced by the use of a number of medications including corticosteroids, such as dexamethasone and prednisone. Finally, it is also clear that a laminitic episode can occur with no apparent cause. What we do know is that once a triggering event has occurred, before there is any indication of foot pain, the process leading to laminae separation has begun. The actual time between the onset of the developmental stage and the acute stage, where pain and lameness are evident, varies by cause. In the case of grass founder, it may be forty to forty-eight hours between the laminitic trigger and the acute stage, whereas a horse that has ingested a toxic plant could be lame in twelve to twenty-four hours, depending on the plant. This means that given a triggering event, we cannot wait for a “clear” diagnosis for our horse’s lameness to prevent or limit laminae damage.

Effective intervention requires knowledge, and several researchers have committed their talents over many years to develop the body of information we now have available to combat laminitis. Dr. Christopher Pollitt, BVSc, PhD, Director of the Australian Equine Laminitis Research Unit at Queensland University is associated with the most advanced research and understanding of laminitis. As he states, the focus of his work has been “primarily on the cause, pathophysiology and developmental stages of laminitis.” The following is a summary of the results of the many years of devoted research, conducted by Dr. Pollitt, into understanding the hoof’s anatomy and growth as well as the molecular processes that eventually result in laminae breakdown.
Hoof Wall Growth and Matrix Metalloproteinase (MMPs)

The direction of hoof wall growth is from the coronary band down to the ground. One of the most amazing features of the laminae that attach the hoof wall to the coffin bone is that they are able to adjust in such a way as to allow this growth and yet keep the coffin bone suspended perfectly in place. This is due to MMPs, which are enzymes that maintain and control the necessary ‘remodeling’ of these laminae by precise quantitative release. MMPs influence the inner hoof wall laminae's ‘timed’ separation from the coffin bone to allow this 'growing down' process, therefore it is essential for healthy hoof wall growth that MMPs are meticulously regulated. The MMP release must stop at the correct moment, shutting off the laminae separation progression, so that the laminae rejoin and the coffin bone remains suspended correctly. This miraculous moment in time occurs by the release of another enzyme called “tissue inhibitor”.

Common Causes of Laminitis

Whatever the triggering event, the unregulated release of MMPs is the central mechanism of any laminitic episode. When this “floodgate” release occurs, it overrides the intervention of the “tissue inhibitor” enzyme. As a result, some laminae permanently detach and other laminae stretch. This loosens their hold on the coffin bone and allows it to rotate.

The development of laminitis through grain overload and grass founder demonstrates this process clearly as they both stem from the ingestion of a high concentration of sugars, and that results in the uncontrolled release of MMPs. It is not the grain per se that is the problem but the overload of grain. In the same sense, it is not the grass but the concentration of fructans (complex sugars) in the grass that overload the horse's system.

Certain environmental conditions increase the concentration of sugars in pasture grass. The most familiar are seasonal, such as spring and fall. This is the reason that “easy keepers” and horses with a propensity or history of laminitis are put in a dirt lot and given hay for the duration of these seasons. This method has been used by generations of horse-people, long before anyone knew of the relationship of founder and fructan ingestion. Other conditions that may not be so familiar are cold nights that approach freezing, followed by sunny mornings. These conditions dramatically increase the manufacture of high concentrations of sugar in the grass stems. Stressed pasture grass rather than lush pastures are much higher in fructan content. These are just a few environmental conditions that generate fructan levels that can achieve a laminae separation trigger episode. And horses do love fructans – they are beasts with an “incredible sweet-tooth”.

The MMP problem with fructans is that they are not metabolized in the small intestine due to the lack of necessary digestive enzymes. Rather the fructans become quickly fermented in the hindgut (colon) resulting in a bacterial population change with a considerable increase in the acidity of the contents of the colon. The bacteria are known as Streptococcus bovis and grow in excess at the expense of the healthy colon bacteria (Enterobacter species). This bacterial exchange along with the rise in acidity damages the hindgut lining, releasing toxins into the bloodstream. When these toxins reach the laminae attached to the inner hoof wall, they trigger an uncontrolled release of MMPs, initiating a laminitic episode that separates the laminae suspending the coffin bone.

The Involvement of Circulation in Laminitis

Dr. Pollitt and his colleagues needed to explain how trigger factors reach the laminae and to clearly define the “floodgate” that brings about an uncontrolled release of MMP’s. Vasodilation (blood vessel expansion, which thereby increases circulation) of the hoof is present during the developmental stage of laminitis
giving the toxins released from the colon an accelerated entrance to the laminae of the hoof. In the same research study, *hoof vasoconstriction* (blood vessel contraction, which decreases circulation) was shown not to produce any laminitic triggers.[5] In fact, vasoconstriction was found to be a feasible protective situation in later studies.

Dr. Pollitt used cryotherapy (the use of cold temperatures as medical therapy) to constrict blood vessels, as a procedure to prevent the uncontrolled release of MMPs during a laminitic triggering, such as fructan ingestion and grain overload. Cryotherapy was applied in the developmental stage prior to any display of lameness or pain. The results of this study are exciting for the development of an effective course of treatment. The limbs that were cooled displayed no lameness, while lameness was evident in the uncooled limbs. The MMP concentration was dramatically less in the hooves that received cryotherapy treatment and were actually close to normal levels. In this study, the temperature of the cold limb was kept at approximately 41°F. For practical application a solution of half water and half ice will work to get the results.

The use of cold is a recognized method of slowing metabolism and constricting blood vessels, which slows down the flow of blood to the areas of the body that are affected by the decrease in temperature. **Slowing down the blood to a hoof during the developmental stage** will reduce the trigger factor of the toxic invasion from the damaged lining of the hindgut and reduce the concentration of the trigger factors in general.

**The Glucose Connection**

Glucose is the principle circulating sugar in the blood and the major energy source of the body. The “uptake of glucose” refers to the cellular utilization of this sugar source by the literal entry of glucose into cells. This is necessary for the function of the body’s cellular existence. Laminae basal cells deprived of glucose are unable to “hold up” under the tremendous weight of the horse, which is likely to bring about laminae separation and coffin bone rotation. Not all horses that experience a laminitic episode have a glucose uptake problem, but horses with a metabolic dysfunction between the pituitary gland and the adrenal glands DO have compromised glucose uptake. The feedback loop between these organs is functioning improperly and as a result there is an overabundance in the bloodstream of the adrenal glands’ hormone, cortisol. This hormonal excess causes many health issues for the horse, but most importantly here it is directly responsible for breaking down insulin’s most important function of “pushing” glucose into cells.[6]

Some of the health issues that have this dysfunction are Cushing’s disease, obesity where there is an inability to satisfy metabolic energy and hormonal balance, issues that directly affect the liver such as high triglycerides or fatty infiltrations of the liver, infections, and toxins in the blood.

Gastrointestinal overload of fructans is a situation where glucose uptake is compromised and the uncontrolled release of MMPs is activated concurrently. Many of the other metabolic disorders mentioned and not presented in this article are also likely to be MMP activators. There is a lot to be learned.

What is clear, however is that treatments designed to assist peripheral (to the extremities) glucose uptake, and also inhibit laminae MMP activation, may both prevent and help with recovery from a laminitic occurrence.

**Conclusion**

During the developmental stage of laminitis, there is an increased flow of blood to the hoof carrying toxins that have developed from a variety of causes, including gastrointestinal diseases, fructan abundance,
retained placenta, and medications, all examples of laminitic triggers. This vasodilator process leads to an uncontrolled release of MMPs that causes laminae separation. The metabolic dysfunction causing glucose deprivation in the hoof produces the same end result. Both in the majority of laminitic cases conditions must be dealt with as early as possible after a laminitic trigger to limit the damage to the horse. For immediate intervention, the application of cold (half ice and half water) to the affected limbs is an effective possibility.

Over the last ten years I have been steadfastly absorbing the laminitis and hoof wall growth information as it became available for purposes of creating effective herbal solutions for the different stages of laminitis. Visit www.forloveofthehorse.com to review the therapeutic intervention possibilities of sophisticated Chinese herbalism and the practical potentials to treat and prevent the metabolic, MMP overload, pain and chronic issues associated with this dreaded disease.

- In a follow-up article I will provide strategies for naturally preventing, managing, and possibly reversing some of these conditions. The process of formulating a sophisticated herbal blend based on Chinese medical theory integrated with western pathology will be presented in line with this issue.

About the author:

Joseph Thomas, PhD has been a practitioner, teacher and consultant in Chinese medicine for more than twenty years. Prior to that Dr. Thomas was a researcher at MIT’s Department of Psychology and Brain Science investigating the development of single cells during congenital eye diseases. He put both these skills together with his love and knowledge of horses and developed www.forloveofthehorse.com, along with his wife and their daughter. For Love of the Horse is a Chinese Herbal Solution company where precision and sophistication of proprietary formulations provide you with effective choices, results, and integrity of service.

1. Equine Internal Medicine; 2004, Reed SM, Bayly WM, Sellon DC