ENDOCRINOPATHIC LAMINITIS

Introduction:
Laminitis has been a difficult and mysterious malady affecting horses. Historically, farmers knew that horses put out on lush pasture in the spring could founder. They also knew that if the horses were bedded in black walnut shavings from the lumber mill, this, too, could cause a horse to founder. Another instance leading to laminitis was if the horse broke into the feed room. The causative factors of laminitis were poorly understood for many years. Even today, whilst evidence is mounting as to causation, there is still much controversy as to the exact mechanisms.

Theories of Laminitis:
There are several theories of the causative agents in laminitis that are currently discussed in research circles.

The first theory is the feed room break-in theory. In this scenario, the horse gets loose; gets into the feed room; and eats far more grain than it should. The discussions of the feed room break-in usually center around the fact that more sugar and starch is ingested than the stomach and small intestines can handle, with the additional sugars spilling over into the hind gut, which is a big fermentation vat. When the large amount of sugar and starch hit the hind gut, the bacteria multiply. After the bacteria have consumed all the sugars and starches, they die off from starvation. This die off causes the hind gut disturbances which allow amines to enter into the blood stream. The capillary beds of the hooves are very sensitive to these destructive amines and laminitis results. This is frequently referred to as carbohydrate overload laminitis.

A second theory of laminitis is that high insulin levels cause deterioration of the lamina of the foot. These high insulin levels are caused by the horse becoming insulin resistant. Insulin is necessary for glucose to enter into the cells. When something goes wrong with the mechanism, more insulin is necessary to try to keep the glucose levels stable. Horses rarely become diabetic, which is an increase in the glucose levels. But instead, they become insulin resistant, with ever-increasing insulin numbers. This increase in the insulin number causes changes within the lamina of the hoof, resulting in laminitis.

A third theory is that with the change of seasons in the fall, ACTH, cortisol and other hormones (including insulin) are significantly elevated. This elevation results in laminitis.
The term endocrinopathic (endocrine + “pathic”) laminitis is used to describe laminitis when the endocrine system is the trigger for the laminitis. This would encompass high insulin as well as elevated ACTH and other hormones.

**Implications of the Theories:**
We all have heard of ponies on spring grass that come down with laminitis. It makes sense to remove those ponies from pasture. But the problem remains, can we identify *why* they get laminitis? And can we predict which ponies or horses would be affected, so as to avoid it before it even happens? That is where the fascinating part of these differences in theories comes into play.

**Spring Laminitis:**
For many years, it was a common thought that the reason that the ponies got laminitis from spring pasture was the same mechanism as the feed room break-in. The abundance of lush grass of the pasture contains more sugars than can be digested by the stomach and small intestines, spilling over into the hind gut. This causes hind gut upset, causing laminitis. More recently, this has come into question with continued research and with unanswered questions. The problem with this theory being the cause of spring laminitis is that you would expect diarrhea, colic, and a very sick horse with a hind gut disturbance large enough to create laminitis. But many times these ponies do not have diarrhea, colic, and do not act sick.

The argument in favor of insulin resistance causing spring laminitis goes like this: Increased sugars in the grass cause increased levels of insulin to be released. When the levels are too high for too long, then the horse will become laminitic. This theory fits in nicely with the fact that you would not expect hind gut disturbance. You also would not expect to find diarrhea, colic, or sickness prior to the onset of the laminitis. In fact, you usually do not see those signs.

**Fall Laminitis:**
The argument for fall laminitis is similar. Some people think that the causative factor is the increase in fructans, which results in fall laminitis. This is a specific sugar that is fermented in the hind gut only. It is not digested in the stomach or small intestines. Additionally, it does not significantly raise blood insulin levels, since it is not digested to glucose. It is fermented in the hind gut to create volatile fatty acids (VFAs), which do not cause an increase in insulin. It is theorized that the fructans reach the hind gut, create a microbe bloom, then when the microbes die off, it damages the hind gut, with amines released into the bloodstream. This, too, would have diarrhea, colic and sickness which precedes the laminitis.
An alternative fall theory exists. Mares rarely get pregnant in the fall or in the winter. Their reproductive system shuts down during those months. With an 11-month gestation period, becoming pregnant in the winter would mean that the foal would be born in the winter. In most climates, this would be catastrophic for the mare and foal, with a great possibility that the foal and mare would not survive. As the fall arrives, the hormonal system of the horse does a radical shift. In mares, we see the changes manifest that they are no longer cycling, as well as getting a long coat for additional warmth. Changes also occur in stallions and geldings. Whilst they do not cycle, they also get a long coat. It has been shown that ACTH levels increase in the fall. It also seems to be the trend that older horses have a fluffier coat than young horses do. In the 2008 Miller study, we find that increased levels of ACTH are associated with increased age. At some point, we call this pituitary pars intermedia dysfunction. This is important to know because most older horses get this! Again, with this hormonal change, you would not expect to see diarrhea, colic or hind gut disturbances.

A recent study showed that the incidence of laminitis increased with increased age of the horse (Wylie et al., 2011). This should not surprise us, as it has been well documented that ACTH levels are higher in older horses (Miller et al., 2008).

So to recap, there are two major theories of the origin of laminitis:

- Carbohydrate overload/Hind gut disturbance laminitis
- Endocrinopathic laminitis

**Research Article by Karikoski:**

A research article by Karikoski, et al., is ground breaking in that it has taken simple measurements of laminitic horses in a first opinion/referral equine hospital in Helsinki and reported the findings (Karikoski et al., 2011). During a 16-month period, ponies and horses that were admitted for laminitis were tested for hyperinsulinemia or for PPID. They found that 89% of the ponies and horses that were admitted with laminitis had either hyperinsulinemia or PPID. Of the horses that had endocrinopathic laminitis, virtually all of them had elevated insulin levels. Most of them were also overweight.

There were other interesting findings by this team. Of the horses with laminitis and hyperinsulinemia:

- 95% were overweight or obese
- Only 76% had a cresty neck score >= 3 (on a scale of 1-5)
- Only 62% had bulging supraorbital fat pads
Laminitic rings were present in 86% of these horses
There was a breed association, with more ponies presenting with laminitis and hyperinsulinemia than any other breed

Discussion:
The implications of this study are far-reaching. Most significantly, it addresses the incidence of hind-gut disturbance. Veterinarians, horse trainers and horse owners should take note. Because it has been found that most cases of laminitis are NOT hind-gut disturbance, this also means that some currently utilized treatments would not be effective. For instance, using a compound like BioSponge most likely is not effective. Some vets advise to use Polymyxin B to prevent damage by the endotoxins. Since this is not the mechanism involved in most cases of laminitis, it is doubtful that the treatment would be effective. With the new information, it is debatable whether icing is effective or not. We know that icing the hooves for carbohydrate overload is helpful, but a different mechanism is involved in endocrinopathic laminitis. It has been shown that laminitis from elevated insulin does not have an initial inflammatory component (Asplin et al., 2010).

The other implication of this research is that elevated insulin is a causative factor. For a laminitic horse, removing the grains and pasture, plus feeding hay that is low in sugar and starch is imperative. Dr. Eleanor Kellon created an Emergency Diet, which is a low sugar and starch diet to nutritionally support the laminitic horse. This is the treatment of choice for elevated insulin levels. The other item that is protective against elevated insulin levels is exercise. Of course, you shouldn’t exercise a laminitic horse, but if your horse has elevated insulin levels, exercise is helpful to reduce the insulin levels.

From a scientific standpoint, this research is also important that it implicates that elevated fructans are not a significant factor in most cases of laminitis. Fructans are fermented to volatile fatty acids in the hindgut, which do not significantly raise insulin levels. Also, since hindgut disturbance is not a significant cause in most cases of laminitis, the fructan level of hay is not likely to be a significant concern. The focus should be on the ethanol soluble carbohydrates and starch level of the hay, which do not include most fructan fractions.
Take Home Message:

- If you have a compromised horse, it is important to test to see if your horse has insulin resistance or high ACTH. Testing is the only way that you can determine if your horse is insulin resistant or has elevated ACTH. If your horse is older, or has a long wavy coat, or one that is fluffier than others, you may consider getting an ACTH level done. Other signs that your horse may have insulin resistance may include:
  - Overweight or obese
  - Cresty neck
  - Bulging supraorbital fat pads
  - Laminitic rings on the hooves

- Although these signs are associated with elevated insulin levels, they are not accurate enough to be diagnostic. If you see these signs, you might consider testing your horse. However, if these signs are absent, your horse may still have elevated insulin levels (indicative of insulin resistance), or elevated ACTH levels. Of course, if your horse is overweight or obese, it is advisable to slowly reduce their weight.

- If the foot sore issues are in the spring, there is a good possibility that your horse is insulin resistant. Insulin resistance is managed by diet and exercise. Breeds that are frequently insulin resistant include Morgans, Arabians, and ponies.

- If the hoof issues are in the fall, the ACTH may be too high, which could indicate PPID. PPID is managed most effectively through pergolide. Whilst PPID has not been shown to be breed related, it is strongly correlated with age. If you have an older horse, it is advisable to test the ACTH levels prior to the seasonal rise, and again during the seasonal rise to verify that you are at the correct pergolide dosage. Pergolide is the gold standard for treatment of PPID. Whilst chastetree berry can cause observational changes in the horse, it is rare for the blood work to normalize while on chastetree berry.

- A horse may also be both, in which case, both should be treated.

- Testing is important because it is easier to treat the underlying disease of PPID or insulin resistance than it is to treat a case of laminitis. Laminitis – avoid it at all costs.
Photo Credits:
Fig. 1: http://borderlandrescue.blogspot.com/2009/11/oh-for-lush-pastures.html
Fig. 2: http://equinescienceupdate.com/articles/cushing2.html
Fig. 3: http://share.ehs.uen.org/node/1588

References:

Credits: This article originally appeared in Dr. Eleanor Kellon's ezine, The Horse's Mouth. For subscription information, please go to www.drkellon.com.