Risk Factors and Causes of Laminitis in Horses
Nicholas Frank, DVM, PhD, Diplomate ACVIM
Associate Professor, Large Animal Medicine
University of Tennessee College of Veterinary Medicine
Knoxville, Tennessee

Introduction
Risk factors are conditions that increase the likelihood of a disease occurring. The disease in this case is laminitis, which is commonly referred to as founder. Results of recent studies reveal that hormonal and metabolic problems are important risk factors for laminitis in horses. Direct causes of laminitis have not been definitively established, but researchers are gathering evidence to support the theories that laminitis is caused by 1) an insulin resistance crisis or 2) an intestinal disturbance.

Risk factors: Hormonal disorders
There are two hormonal disorders that increase the risk of laminitis in horses. The first disorder occurs in young or middle-aged horses and is related to obesity. This condition is referred to as equine metabolic syndrome (EMS) and is comprised of: 1) obesity, 2) insulin resistance (IR), and 3) laminitis. Horses with EMS can be recognized by the presence of excess fat in the neck, tail-head, and sheath/mammary gland regions. Insulin resistance refers to a state in which insulin fails to exert its normal effects on tissues. Glucose uptake is impaired; so, IR can be viewed as an early form of diabetes mellitus. Insulin resistant horses secrete more insulin to compensate for the reduction in tissue action; so, elevated blood insulin concentrations (hyperinsulinemia) are usually detected. Insulin resistance is important to diagnose and manage because this disorder has been associated with an increased risk of laminitis. Horses of certain breeds and bloodlines are genetically predisposed to EMS. In our practice, Morgan horses, Paso Finos, Arabians, Tennessee Walking Horses, Warmbloods, and pony breeds are at higher risk of developing EMS. A more efficient energy metabolism predisposes horses to obesity and modern management practices contribute to this problem.

The second hormonal problem is equine Cushing’s disease (ECD), which is also called pituitary pars intermedia dysfunction (PPID). Older horses are more likely to develop ECD and they can be recognized by their long curly haircoat, muscle loss along the topline, and excessive drinking and urination. Delayed shedding of the winter haircoat is an early sign of ECD. Equine Cushing’s disease also increases the risk of laminitis developing.

It is interesting to consider the idea of converging hormonal problems. Horses with EMS often transition into ECD as they get older and this usually occurs during middle age (10 to 20 years). It is likely that the risk of IR, and therefore laminitis, markedly increases when horses enter this transition state.
Risk factors: Obesity

Obese horses are more likely to develop laminitis because obesity leads to the development of IR. As fat accumulates, tissues become more resistant to insulin in an attempt to slow the uptake of glucose, which is being converted into fat. Obesity and IR occur together in horses\(^3\) and this increases the risk of laminitis. Individual horses vary in their response to obesity, so some horses develop IR as soon as they become obese, whereas others remain tolerant of the condition. However, it can be concluded that obesity increases the risk of laminitis and should therefore be avoided. Obese horses also carry more weight on their hooves, which is likely to increase the damage caused by laminitis.

Relating insulin resistance to laminitis

The primary action of insulin is to increase glucose uptake by tissues, but this hormone has other functions within the body. One important function is to stimulate the opening of blood vessels (vasodilation) to increase blood flow. Since IR is a state of reduced insulin effectiveness, blood vessels are more likely to remain closed (vasoconstriction) in horses with this condition. Insulin resistant horses may therefore have a harder time maintaining blood flow to the feet when challenged.

Causes of laminitis

The two theories relating hormonal disturbances to laminitis are 1) the occurrence of an insulin resistance crisis or 2) horses undergoing intestinal disturbances.

1. Insulin resistance crisis

In a recent study, researchers in Australia experimentally induced laminitis in healthy ponies by injecting large amounts of insulin into the blood.\(^4\) Ponies developed very high blood insulin concentrations and it was concluded that laminitis developed as a result. These findings relate to horses with IR because higher insulin concentrations are detected in affected animals as the pancreas secretes more insulin to compensate for the decrease in tissue action. Insulin resistance gets worse and blood insulin concentrations rise as horses consume starches and sugars on pasture. This often occurs in the spring when horses are grazing on pasture grass that is turning green and growing rapidly. Sugars and starches are synthesized via photosynthesis when conditions are warm, and rainfall and sunlight are plentiful. Horses consume large amounts of grass in the spring and IR is exacerbated by starches and sugars in the grass. It is therefore conceivable that laminitis develops after IR suddenly gets worse in response to this change in diet. The same theory would explain the occurrence of laminitis after a horse suddenly consumes large amounts of grain (grain overload) because this feed contains sugars and starches. As IR suddenly gets worse, blood vessels to the feet would be expected to constrict and deprive hoof cells of nutrients. Hoof cells may become stressed by this sudden reduction in nutrient delivery, which then leads to laminitis.

2. Intestinal disturbance

The second theory identifies the intestine as the source of laminitis triggering factors. Laminitis has been associated with colic and diarrhea in horses and can also be experimentally induced by creating a situation of carbohydrate overload within the large intestine. This can be accomplished by administering sugar or a corn starch/wood flour mixture into the stomach using a nasogastric tube.\(^5,6\) Normal bacteria within the large intestine react to this sudden increase in sugars or starches. Different types of bacteria start to grow in the intestine and more acid is produced. As acid accumulates in the intestine, it alters the gut wall, which makes it more permeable. Bacterial by-products are normally found within the intestine, but cannot enter the body because of the intestinal barrier. However, permeability increases as a result of acid damage and bacterial by-products move into the blood. These toxins cause systemic inflammation, which results in vasoconstriction and movement of inflammatory cells into tissues. Laminitis is triggered by the reduction in nutrient delivery and arrival of inflammatory cells.
Pasture-associated laminitis can be explained by this theory if we recognize that pastured horses experience carbohydrate overload when the grass grows quickly and sugars accumulate. It is also possible to combine theories and propose that IR makes it harder for horses to respond to vasoconstriction, so the systemic inflammation that follows an intestinal disturbance is likely to have a more profound effect on blood flow in the insulin resistant animal.

**General recommendations for preventing laminitis**

Horses should be examined for evidence of hormonal disorders and a blood sample can be drawn to screen for these problems. However, blood sample collection should always be delayed until the pain and stress of laminitis have subsided. Both pain and stress raise blood hormone concentrations, which can lead to false positive results. Blood glucose and insulin concentrations are measured to screen horses for IR. Horses with IR have high insulin concentrations (hyperinsulinemia), yet their blood glucose concentrations remain within normal range. High blood glucose concentrations (hyperglycemia) indicate that diabetes mellitus has developed if the horse is free of stress and pain.

The plasma adrenocorticotropic hormone (ACTH) concentration can also be measured to screen horses for ECD. An ACTH concentration above normal range indicates that the horse suffers from ECD. Unfortunately, testing for ECD is complicated by the seasonal increase in ACTH concentrations occurring in the fall. It is therefore easier to interpret test results when the blood sample is collected between December and June. It should also be noted that delayed shedding of the winter haircoat and excessive urination/drinking are early indicators of ECD that can develop before the ACTH concentration rises above normal. Your veterinarian may therefore recommend treatment on the basis of clinical signs alone.

Horses with EMS should be managed by instituting a comprehensive diet and exercise plan. Weight loss should be induced to eliminate obesity and horses must be taken off pasture until this has been accomplished. Equine Cushing’s disease should be treated with the drug pergolide, which must be administered every day for the rest of the horse’s life. Equine metabolic syndrome and ECD should be managed to reduce the risk of further laminitis events.

Sudden changes in diet must always be avoided. This includes the introduction of new feeds, moving horses to a new pasture, and sudden increases in grazing time. It may be necessary to limit or eliminate pasture grazing for horses with EMS or ECD because of their increased sensitivity to changes in pasture grass composition.

**References**

**Product Focus:**

**ALAM®**

*Pelleted Feed for Nutritionally-Challenged Horses*

- Fully-fortified feed with minimal starches and sugars
- Feed designed to be fed with or without forage
- Feed with similar digestible calories as the highest quality oats
- Contains no molasses
- Safe for nutritionally-challenging conditions such as (but not limited to):
  - Laminitis/founder (when the body condition is poor or feed is required to maintain a healthy body condition)
  - Insulin resistance (glucose intolerance, Equine Metabolic Syndrome)
  - Cushing’s disease
  - Polysaccharide Storage Myopathy (PSSM/EPSM)
  - Severely malnourished horses needing to safely and rapidly gain weight

---

**M30®**

*Comprehensive Protein, Vitamin and Mineral Supplement*

- Specifically created to satisfy the high nutritional demands of horses at all physiological stages: maintenance, growth, pregnancy, lactation and work.
- Designed to balance the basic forage diet with or without grain.
- Contains minimal starches and sugars
- Ideal for:
  - Overweight horses, especially those on a dry lot
  - Horses on an energy-restricted diet (e.g., laminitis, EPM, etc.)
  - Horses on a forage-only diet
  - Idle or light working mature horses
  - Horses consuming an oats and forage diet
  - Horses needing a slower growth rate (due to physsitis, orthopedic problems, etc.).

---

To determine the best feeding program for a laminitic or laminitic-prone horse, ask, “Can the horse maintain a healthy to heavy body condition on forage alone?”

If the answer is **YES**, then **M30** is the product of choice.

If the answer is **NO** (horse is too thin on forage alone), then **ALAM** is the product of choice.

(Note: Some horses may require a combination of these two products. Please consult with McCauley’s nutritionists for specific recommendations.)