Causes of Laminitis

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Many cases of laminitis are caused by more than one factor and are rather due to a combination of causes.

Carbohydrate overload

If a horse is given grain in excess or eats grass that is under stress and has accumulated excess non-structural carbohydrate (NSC, i.e. sugars, starch or fructan), it may be unable to digest all of the carbohydrate in the foregut. The excess then moves on to the hindgut and ferments in the cecum. The presence of this fermenting carbohydrate in the cecum causes proliferation of lactic acid bacteria and an increase in acidity. This process kills beneficial bacteria, which ferment fiber. The endotoxins and exotoxins may then be absorbed into the bloodstream, due to 'leaky gut syndrome', caused by irritation of the gut lining by increased acidity. The endotoxaemia results in impaired circulation, particularly in the feet. This results in laminitis.

Insulin resistance

Laminitis can also be caused by insulin resistance in the horse. Insulin resistant horses tend to become obese very easily and, even when starved down, may have abnormal fat deposits in the neck, shoulders, loin, above the eyes and around the tail head, even when the rest of the body appears to be in normal condition. The mechanism by which laminitis associated with insulin resistance occurs is not understood but may be triggered by sugar and starch in the diet of susceptible individuals. Ponies and breeds that evolved in relatively harsh environments, with only sparse grass, tend to be more insulin resistant, possibly as a survival mechanism. Insulin resistant animals may become laminitic from only very small amounts of grain or 'high sugar' grass. Slow adaptation to pasture is not effective, as it is with laminitis caused by microbial population upsets. Insulin resistant horses with laminitis should be removed from all green grass and be fed only hay that is tested for Non Structural Carbohydrates (sugar, starch and fructan) and found to be below 11% NSC on a dry matter basis. Soaking hay underwater may remove excess carbohydrates and should be part of a first-aid treatment for any horse with laminitis associated with obesity or abnormal fat deposits. This can have the effect of depleting the hay of soluble minerals and vitamins, however, so care with dietary balance is important.

Nitrogen compound overload

Herbivores are equipped to deal with a normal level of potentially-toxic non-protein nitrogen (NPN) compounds in their forage. If, for any reason, there is rapid upward fluctuation in levels of these compounds, for instance in lush spring growth on artificially-fertilized lowland pasture, the natural metabolic processes can become overloaded, resulting in liver disturbance and toxic imbalance. For this reason, many avoid using artificial nitrogen fertilizer on horse pasture. If clover is allowed to dominate the pasture, this may also allow excess nitrogen to accumulate in forage, under stressful conditions such as frost or drought. Many weeds eaten by horses are nitrate accumulators. Direct ingestion of nitrate fertiliser material can also trigger laminitis, via a similar mechanism.
**Hard ground**

Whenever possible, avoid working horses on hard ground. This includes concrete or gravel roads. An indoor or outdoor arena should be periodically dragged with a rake, to loosen the soil and to prevent it from hardening. Hard surfaces increase the concussion upon the horse's feet. The greater and more prolonged the concussion, the more likely it is that the horse will contract laminitis.

**Lush pastures**

When releasing horses back into a pasture, after being kept inside (typically during the transition from winter stabling to spring outdoor keeping), it is important to re-introduce them gradually. Feed horses before turning them out and limit the amount of time outside (45 minutes to an hour at first, gradually increasing the amount of time) and decrease the amount fed to them beforehand, as the season progresses. If a horse consumes too much lush pasture, after a diet of dry hay, the excess carbohydrate of grass can be a shock to its digestive system. If the horse is fed beforehand, it will not eat as much fresh grass when turned out and will be less likely to founder. It is also true that ponies are much more susceptible to this form of laminitis than are larger horses.

**Frosted grass**

Some cases of laminitis have occurred after ingestion of frosted grass. The exact mechanism for this has not been explained but sudden imbalance of the normal bowel flora can be surmised, leading to endotoxin production.

**Freezing or overheating of the feet**

Cases of laminitis have been observed following an equine standing in extreme conditions of cold, especially if there is a depth of snow. Laminitis has also followed prolonged heating from incorrectly-applied hot-shoeing. In either case, it is possible to understand how the circulation of the feet may become adversely affected.

Cold exposure however has been shown to have a protective effect when horses are experimentally exposed to carbohydrate overload. Feet placed in ice slurries were less likely to experience laminitis than 'un-iced' feet.

**Untreated infections**

Infections, particularly where caused by bacteria, can cause release of endotoxins into the blood stream, which may trigger laminitis. A retained placenta in a mare (see below) is a notorious cause of laminitis and founder.

**Colic**

Laminitis can sometimes develop after a serious case of colic, due to the release of endotoxins into the blood stream.

**Lameness**

Lameness causes a horse to favor the injured leg, resulting in uneven weight distribution. This results in more stress on the healthy legs and can result in laminitis.
Cushings disease

Cushings disease is common in older horses and ponies (but can occur at any age) and causes an increased predisposition to laminitis.

Peripheral Cushings disease

Peripheral Cushings disease is an area of much new research and is increasingly believed to have a major role in laminitis. It involves many factors such as cortisone metabolism and insulin resistance. It has some similarities to type II diabetes in humans (see also ‘insulin resistance, described above).

Retained placenta

It is common practice, in horse-breeding establishments, to check by careful inspection that the entire placenta has been passed, after the birth of a foal. It is known that mares that retain the afterbirth can founder, whether through toxicity or bacterial fever or both.

Drug reactions

Anecdotally there have been reports of laminitis following the administration of drugs, especially in the case of corticosteroids. The reaction however may be an expression of idiosyncrasy in a particular patient as many horses receive high dose glucocorticoid into their joints without showing any evidence of clinical laminitis. No evidence exists to show the mechanism by which glucocorticoids trigger laminitis in the horse.

Exposure to agro-chemicals

Even horses not considered to be susceptible to laminitis can become laminitic when exposed to certain agro-chemicals. The most commonly experienced examples are herbicide and artificial nitrate fertilizer.