

# Insulin Resistance in Horses

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The two major hormonal problems (endocrine disorders) that affect horses are Cushing's disease and equine metabolic syndrome (EMS). Both these disorders are important because they predispose horses to laminitis, which is also called founder. Middle-aged or older (> 15 years) horses are more likely to suffer from Cushing's disease, whereas EMS first develops in younger animals. Cushing's disease predisposes horses to laminitis, particularly when accompanied by insulin resistance (IR). Older horses should therefore be tested for both Cushing's disease and IR because some affected horses are insulin resistant, whereas others have normal insulin sensitivity; those with IR are more likely to develop laminitis. Cushing's disease is diagnosed on the basis of the history and clinical signs, as well as the resting adrenocorticotropin hormone (ACTH) concentration in the blood. A high ACTH concentration indicates that a horse has the disease. Medical management of Cushing's disease involves daily administration of pergolide for the rest of the horse's life. This treatment has a high success rate.

Equine metabolic syndrome refers to a clinical syndrome of obesity, IR, and laminitis in horses, ponies, and donkeys. Horses first develop physical characteristics of EMS when they are young and then become more susceptible to laminitis over time.

## Understanding Insulin Resistance

Insulin is a hormone produced by the pancreas that stimulates movement of glucose into insulin-sensitive tissues. These tissues become less responsive when IR develops, which slows the rate of glucose uptake unless additional insulin is secreted. The pancreas responds to this problem by secreting more insulin, which means that higher insulin concentrations are detected in the blood of affected horses. Insulin resistance leads to type 2 diabetes mellitus in humans and this occasionally occurs in horses as well. Obesity and IR are related because fat accumulates within cells and interferes with insulin signaling.

## Insulin Resistance and Laminitis

Insulin resistance may increase the risk of laminitis by compromising blood flow to hoof tissues. Insulin normally dilates blood vessels, so insulin-resistant horses may have difficulty maintaining adequate blood flow to the feet, particularly when this system is challenged. Laminitis may be triggered when alterations in blood flow interfere with nutrient delivery to hoof cells or when cells of the vessel lining overreact to systemic inflammation.

Laminitis is usually triggered by changes in diet such as grain overload or grazing on pasture grass that is high in starch or sugar (pasture founder). Healthy horses can tolerate these dietary challenges, but insulin-resistant horses have a harder time coping with them.



## Insulin Resistance and Obesity

Horses that are too fat (obese) are more likely to be insulin resistant, so it is better to maintain horses in a leaner body condition. As a rule of thumb, you should always be able to feel a horse's ribs as you run your hand across its side. It is important to recognize that obesity and IR often occur together, but not all fat horses are insulin resistant and IR can occasionally develop in thinner animals. This emphasizes the importance of regularly screening for IR.

Many horses are overweight because they have a very efficient metabolism, and this may be genetically determined. These horses are sometimes referred to as "easy keepers" because they require fewer calories to maintain body weight. The physical appearance of the horse can indicate a problem with IR. Horses with IR often have a thick neck crest filled with fat ("cresty neck"), fat pads near the tail, or fat accumulation within the sheath or mammary gland regions. This is referred to as regional adiposity, and horses with these signs should always be tested for IR.

## Testing for Insulin Resistance

Collect a blood sample after the horse has spent approximately 6 hours without feed. If blood is going to be collected in the morning, the horse should be left with only one flake of hay in the stall from 10 p.m. onwards the night before. Measure blood glucose and insulin concentrations. High insulin concentrations indicate that the horse has IR. If very high glucose concentrations are detected, the horse may also have diabetes mellitus.

## Managing Obese Horses with Insulin Resistance

It is important to manage IR because this will reduce the risk of laminitis. The most effective way to improve insulin sensitivity in obese horses is to make them lose weight.

1. Eliminate grain and pellets from the diet. Give a handful of beet pulp (that does not contain molasses) or low-sugar pelleted feed as a treat if necessary, but that is all. Do not feed apples, carrots, or sugar cubes. Sugar aggravates IR in the same way that it does diabetes mellitus in people.
2. Exercise an obese horse as often as possible, as long as the lameness associated with laminitis has resolved. Increase the amount of exercise gradually with a goal of 5 days of exercise per week. Trotting and exercising on a hillside will increase calorie consumption.
3. Horses with laminitis (founder) must be taken off pasture completely until their feet have recovered and obesity and IR have been controlled. Keep the horse in a dirt paddock instead of a stall to encourage exercise and reduce stress.
4. Feed grass hay with low non-structural carbohydrate (NSC) content to horses with IR. Have a hay sample analyzed to determine the carbohydrate content or purchase bagged forages.
5. Obese horses require a weight-loss diet. Simply eliminating grain and pellets from the diet is sufficient to induce weight loss if the horse has been overfed. Suspend pasture access while weight loss is being induced because grazing represents an unregulated source of calories. Ideally, keep the horse in a dry lot to allow exercise, which increases calorie consumption. Reduce the amount of hay fed.

Feed an obese horse 1.5 % of its ideal body weight in hay, which is equivalent to 1.5 lbs. of hay per 100 lbs. of body weight. Use kitchen scales to weigh the hay or purchase a hanging scale at a feed store. Divide the daily amount of hay into 2 to 4 feedings.

6. The risk of laminitis triggered by diet (grain founder or grass founder) is high as long as the horse remains obese and IR. Eliminate grain from the diet of obese horses and hold them off pasture until their blood glucose and insulin concentrations return to normal.

Even after glucose and insulin values have improved, the horse may remain at higher risk for laminitis. Avoid turnout on pasture when the grass is turning green and growing fast. This growth occurs in the spring as the weather turns warmer and during the summer after heavy rain. Temperate pasture grasses also accumulate sugar when they are stressed by drought or the onset of winter. The IR horse is therefore at greater risk for laminitis when the pasture grass is in one of these dynamic phases. Horses with a history of IR should be held off pasture or made to wear a grazing muzzle at these high-risk times of the year. The use of fertilizers on horse pastures also increases the likelihood of problems with IR and laminitis. If a previously insulin-resistant horse is being returned to pasture after a period of time in a stall or dirt paddock, start with 1 hour twice daily and gradually increase grazing time over 2 weeks. It is better for the horse to be turned out for multiple 1-hour periods than a single longer period.

7. Proper hoof care is also important to lower the risk of laminitis in IR horses. Consult an experienced farrier.
8. Medical treatment of obesity may become necessary if the horse does not lose weight on the recommended diet and exercise program. Levothyroxine sodium can be prescribed to induce weight loss and improve insulin sensitivity. Consult a veterinarian about using this drug.
9. Give a balanced daily vitamin and mineral supplement to horses that are on hay-only diets.

## Managing Leaner Horses with Insulin Resistance

Leaner horses with IR do not need to lose weight, but careful attention must be paid to their diet. Follow the above recommendations for hay selection and pasture turnout, and exercise the horse as often as possible. Leaner horses may require additional calories to maintain body weight and this can be accomplished by feeding additional hay. If body weight is still not being maintained, feed a commercial low-sugar complete pelleted feed. Select a feed designed for insulin-resistant horses.

The diabetes drug metformin hydrochloride may be recommended by a veterinarian in severe cases of IR that do not respond to diet and exercise programs.