Equine obesity is a problem, too

Proper diet and exercise mandatory to avoid long-term negative and debilitating health effects

by Amy Gill, Ph.D.

HORSES affected by equine metabolic syndrome, insulin resistance, and Cushing's disease require modification in several areas of management to regain their health. Diligent adherence to dietary, exercise, and therapeutic changes are mandatory to avoid long-term negative and debilitating health effects.

We now know that horses with equine metabolic syndrome, insulin resistance, and Cushing's disease do not metabolize starch and sugar like normal horses, and this negatively affects endocrine function. Other major health problems are also associated with the disorders, such as obesity, although not all horses affected by these disorders become grossly overweight.

Excessive fat deposits adversely predispose horses to exercise-related disorders; increased risk of laminitis, colic, and hyperlipidemia (abnormally high blood lipid concentrations); and growth and reproductive problems. Also, abdominal fat cells in horses with equine metabolic syndrome cause the conversion of inactive cortisone into active cortisol, so strict weight control is mandatory.

Exercising horses use some body fat as a substrate for energy production during prolonged exercise, but excessive amounts of fat also reduce the horse's stamina, due to the weight handicap. Also, layers of fat serve to insulate, reducing the horse's ability to dissipate heat generated during strenuous and/or prolonged exercise.

Heat stress can be fatal in all horses but is more likely to occur in overweight horses asked to perform strenuous work. Obesity also increases respiratory dysfunction because excess body mass increases oxygen requirements but decreases the ability of the horse to take up oxygen. Additional body fat against the chest wall requires increased respiratory effort, reduces respiratory efficiency, and may lead to alveolar hypoventilation. The extra effort to remain well ventilated could have further negative impact on horses that are bleeders.

Obesity in horses is associated with an increased risk of laminitis or founder, which results in separation of the laminae and downward rotation of the coffin bone in the hoof. This is a common problem in overweight broodmares and stallions. Excess weight carried by obese horses dramatically increases the risk of rotation of the pedal bone following a bout of laminitis. This damage is irreversible and difficult to manage, plus these horses are more inclined to suffer subsequent episodes of laminitis.

Lipomas and colic

Another problem in fat horses is lipomas, solid balls of fat encased in the mesenteric tissues with a long tether that can become entwined with the intestines. Horses that accumulate large amounts of fat in their abdominal cavity are more susceptible to the formation of lipomas than horses at normal weight. Lipomas are often the cause of strangulation colic that requires surgery to correct. Obese horses also take longer to recover following surgery, due to the larger surface area and more pressure on the area that must heal.

Horses have an extreme sensitivity to a life-threatening metabolic disorder called hyperlipidemia when deprived of feed. When a horse is deprived of feed for more than a day, the animal mobilizes body fat to meet its energy requirements. This survival mechanism is perfectly normal and effective in non-overweight or even slightly thin horses. Obese horses, on the other hand, have very large fat deposits that are rapidly mobilized, and once released from tissue into the bloodstream, fill arteries and veins so the blood has a milky color to it. Rapid mobilization of fat and its subsequent clearance from the bloodstream put an abnormal amount of stress on the liver, where the lipids must be metabolized. Extreme cases of hyperlipidemia may cause irreparable liver damage or be fatal.

As noted in a previous article, growing horses may be affected by insulin resistance, which can lead to developmental problems when these animals are fed feeds high in starch and sugars. They are also negatively impacted by carrying too much body mass on an immature skeletal system.

Rapidly growing, large youngsters tend to be most often affected by developmental problems such as physitis, contracted tendons and OCD lesions, and insulin-resistant individuals are particularly susceptible.

Obesity in broodmares can lead to laminitis, and insulin-resistant mares might have difficulty becoming and staying pregnant due to changes in normal endocrine function or from pain associated with laminitis. Very obese mares also might have difficulty delivering a foal. Fetal growth can also be negatively impacted by obesity in the mare. Overconditioned mares have an increased chance of producing a foal exhibiting developmental orthopedic diseases after birth.

Another area of concern, especially in cases of Cushing's disease, is lowered immune response. Horses with Cushing's disease often become immunosuppressed and susceptible to a variety of parasitic or infectious agents. Many cases show muscle loss and become polydipsic (increased water intake) and polyphagic (excessive feed intake), which can lead to obesity.

The longevity and productivity of the overconditioned or obese horse are much less than that of a normal horse, especially in horses affected by equine metabolic syndrome, insulin resistance, or Cushing's disease. Management techniques must be altered to encourage weight reduction by increasing exercise, making necessary dietary modifications, and administering therapeutics to correct the problem.

Tests for Cushing's disease

Initially, and of tremendous importance, is a definitive diagnosis of a specific disorder. Farm managers, owners, and trainers who recognize a horse that has become obese, lethargic, and an extremely easy keeper and may have a disorder should work closely with their veterinarian to obtain the necessary blood analysis that will show what is occurring.

Horses suspected of having Cushing's disease are most commonly diagnosed using the dexamethasone suppression test. The procedure involves measuring baseline cortisol at about 4 p.m. or 5 p.m., then injecting dexamethasone, a corticosteroid, intravenously or intramuscularly. This is followed by a post-stimulation cortisol at about 11 a.m. to noon the next day—approximately 19 hours later.

Normal horses respond to the test by what is known as negative feedback, where dexamethasone, which acts like cortisol in the horse's body, decreases the pituitary release of adrenocorticotropic hormone, and this sends a signal to the adrenal glands to decrease production of cortisol. In horses with Cushing's disease, however, cortisol levels remain abnormally high after receiving a dose of dexamethasone.

The lack of normal regulatory control is generally caused by a tumor and enlargement in the pituitary gland. While the tumor itself is benign, the cells within the tumor continue to produce excess adrenocorticotropic hormone and, therefore, the adrenal glands are continually cued to produce cortisol.

The test is highly accurate and is simple and safe to perform, but in the past, there

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has been some concern of precipitating or worsening laminitis following the test. This is rarely the case, but some veterinarians prefer to measure plasma concentrations of adrenocorticotropic hormone to avoid the possibility of inducing laminitis.

Measurement of adrenocorticotropic hormone involves collection and analysis of a single blood sample. The pituitary gland in affected horses often secretes excessive amounts of the hormone into the bloodstream as compared to normal horses. This test is simple and is considered to be very accurate, but only if blood samples are handled carefully to avoid degradation of adrenocorticotropic hormone.

Because adrenocorticotropic hormone is absorbed by glass, blood must be taken in plastic tubes. The test must be performed immediately or the sample must be kept frozen on its way to a laboratory. If the hormone deteriorates in the blood sample before analysis is complete, false low values may be obtained. Stress and pain due to other conditions can also give falsely elevated values.

Measurement of blood glucose can be conducted to determine if a horse has Cushing's disease, but this test is not as definitive as the dexamethasone-suppression test. This test can be considered fairly reliable as a diagnosis for Cushing's disease as long as any other cause of elevated serum glucose levels can be ruled out, including acute stress and a starch-based meal fed within the past two to three hours.

Also, most horses with Cushing's disease have serum glucose concentrations within normal range, so testing should be conducted first thing in the morning before feeding and after the horse has been quiet through the night to achieve the most accuracy.

Published reports have shown that horses with Cushing's disease can have low, high, or normal resting cortisol levels. There is some speculation that Cushing's disease cases have lost the normal diurnal (fluctuation during a 24-hour period) cortisol rhythm; it is suggested that two blood samples taken eight hours apart be compared to obtain a diagnosis.

Normal horses with a normal diurnal rhythm will show a cortisol concentration that varies by about 30% between the two samples, while cases of Cushing's disease may show similar cortisol levels in both samples. This simple blood test can be useful to diagnose Cushing's disease but must be interpreted carefully due to other possible reasons for elevated cortisol levels, including stress, pain (from laminitis, for example), and high-starch diets.

Resting serum insulin (normal is less than 40 milli-interational units per milliliter) has become more popular recently but also should be interpreted judiciously. Often horses with Cushing's disease have elevated resting insulin concentrations because constant high cortisol levels affect insulin secretion, but high-starch diets and stress or pain can have the same effect.

Tests for metabolic syndrome

Horses with equine metabolic syndrome have some clinical signs that are similar to Cushing's disease, but they have no abnormalities of either their pituitary or adrenal glands, so testing for the disorder is somewhat different. The overnight dexamethasone-suppression test that is used to diagnose true Cushing's disease should produce normal results in a horse with equine metabolic syndrome.

When trying to determine which disorder a horse has, remember that Cushing's disease is rare in horses under 15 years of age. Horses exhibiting clinical symptoms that are younger than 15 years of age most likely suffer from equine metabolic syndrome. The other tests described above can also produce potentially ambiguous results, but resting insulin is probably still considered a fairly accurate way to assess equine metabolic syndrome, if performed correctly.

In obese horses with advanced equine metabolic syndrome, fasting concentrations of insulin are almost always elevated, and blood glucose concentrations are frequently elevated. For the most accurate results, the horse must have fasted for five hours and be free of stress and pain. In less obvious cases, the intravenous glucose-tolerance test may be needed to test for insulin resistance.

This test involves serial measurement of blood glucose and insulin following intravenous administration of a standard dose of glucose. In normal horses, concentrations of both insulin and glucose rise initially but return to normal within one to two hours. Insulin-resistant horses, by contrast, show greater elevations in both insulin and glucose, and these higher levels are sustained for a longer time before returning to baseline values.

Measuring insulin resistance

Horses can be insulin resistant and not have equine metabolic syndrome or Cushing's disease. Blood testing can be done to identify horses thought to be insulin-resistant; these tests commonly show horses to have normal glucose levels but with various stages of elevated insulin levels.

Insulin resistance in horses can be diagnosed through a series of tests involving orally administered glucose followed by collection of blood samples at several times over a period of several hours or by administering glucose intravenously and monitoring the response.

Normally, peak blood glucose concentrations in horses occur approximately 60 minutes after the oral glucose dose is given. After this time, blood glucose levels fall as glucose is cleared from the bloodstream. Eventually, blood glucose falls below basal concentrations so the horse is actually hypoglycemic, but then cortisol stimulates the liver to produce more glucose and blood glucose concentrations return to baseline. The entire oral glucose-tolerance test—including the initial rise, fall, hypoglycemic phase, and final return to basal concentrations—is complete in three to five hours in the horse, depending on dose and status of the animal.

Insulin-resistant horses do not respond to the test this way. Instead, their glucose levels rise higher than normal after glucose is administered and come down to normal levels much slower. The reason is they are not responding to effects of insulin.

The intravenous glucose-tolerance test provides insight as to how well a horse clears glucose relative to insulin secretion. It is more accurate than the oral test and is less complicated because it provides a direct measure of glucose clearance and is not affected by possible malabsorption in the gut.

Healthy horses show an immediate increase of plasma glucose concentration after the intravenous glucose injection, with return of values to baseline in one hour. Insulin-resistant horses show elevated resting blood glucose and insulin levels and then a delayed return of glucose and insulin values to baseline following injection of the glucose solution.

A newer, more accurate test called the euglycemic hyperinsulinemic clamp procedure uses a basic principle of maintaining a steady-state blood level of insulin and glucose via constant infusion. The total amount of glucose infused over time is a measure of insulin action on the uptake of glucose. Insulin-sensitive individuals require glucose to be infused at a high rate to maintain constant blood levels, but insulin-resistant individuals require much less glucose to maintain basal plasma glucose levels due to the lower rate of uptake of glucose into the cells.

Aids to correct disorders

Managing a horse with a metabolic disorder may involve a combination of medication to normalize the function of the pituitary gland and modification of diet and exercise. Most of these changes will have to be for the life of the horse because there is no way to reverse the disease process.

This is particularly true for horses with Cushing's disease. Medications used to treat Cushing's disease focus on reducing the amount of adrenocorticotropic hormone secreted by the pituitary and/or suppression of cortisol synthesis by the adrenal glands. The drug of choice is currently pergolide mesylate (Permax), which is administered daily by the oral route. Two classes of drugs used in human medicine for type 2 diabetes can improve sensitivity to insulin: biguanides and thiazolidinediones. These drugs function by reducing glucose production in the liver and increasing muscle glucose use. Exercise also reduces insulin resistance in this way.

Other medicines used in humans with diabetes such as alpha-glucosidase inhibitors restrict or delay the absorption of carbohydrates after eating, resulting in a slower rise of blood glucose levels. Sulfonylureas and meglitinides increase insulin production,

which is generally not the cause of insulin resistance in horses. Limited studies that are available verify the usefulness of these drugs in horses, but some preliminary evidence exists that biguanides may be effective in reducing insulin resistance.

Other management techniques that work for horses with metabolic disorders include increasing exercise, body clipping the animal to remove a long hair coat, and paying strict attention to teeth and hooves, because affected horses often are insulin-resistant, using concentrates lower in starch and higher in soluble fiber and fat.

Horses with any type of metabolic disorder must be managed closely to ensure the intake of sugars and starch are minimized, if not completely eliminated, from the diet. The use of high-fat and -fiber rations to offset the effects of blood glucose response to concentrate meals high in starch is largely becoming the standard choice of ration fed to these horses. By supplying the horse with energy or calories in the form of fat or soluble fiber, insulin resistance is curtailed because blood glucose levels remain low following a meal.

These horses also should be maintained on grass forages or forages low in soluble sugars called fructans, which also will cause a rise in blood glucose if consumed in large quantities. Because spring and fall pasture is an excellent source of fructans, horses with metabolic syndrome should have limited access to pasture during these periods.

Other specific nutrients that are useful in managing the above-mentioned disorders are chromium and magnesium, which play a role in reducing resistance to insulin. Horses affected by Cushing's disease, equine metabolic syndrome, and insulin resistance are magnesium deficient and may be chromium deficient, though no specific requirement has been defined for horses.

Chromium is an element that combines with niacin to form glucose-tolerance factor. Though the exact mechanism remains unidentified, it appears glucose-tolerance factor helps increase insulin sensitivity by increasing the number of receptor sites for insulin to bind to the cell, enabling more glucose to gain entry into the cell for storage.

Intracellular magnesium is a cofactor for numerous enzymes involved in carbohydrate metabolism, and horses that are insulin resistant are deficient in magnesium. The lower intracellular magnesium concentration may result in reduced insulin sensitivity, either by altering receptor activity after insulin binds to a cell or by influencing intracellular signaling and processing.

Increasing the dietary level of magnesium and chromium in the diets of horses affected by these disorders may be effective in alleviating some or all of the symptoms. However, the addition of these nutrients should be achieved by using a balanced supplement or the advice of a professional, because excesses of any of these nutrients can cause serious nutritional imbalances and further complications.

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