

Equine Metabolic Syndrome: “big” is *not* beautiful!

Dr. Christine King

Metabolic syndrome is a relatively newly recognized medical condition in horses, although the problem (the overweight horse or pony) has been with us forever. We simply didn't see it as a distinct medical entity or give it a name until a few years ago.

In 25 words or less, metabolic syndrome is the state of hormonal and metabolic derangement a body gets in when it stores an excessive amount of body fat. Far from being an inert lump of blubber, fat (or adipose tissue) is metabolically and hormonally active tissue. In fact, fat deposits act like an endocrine gland, producing a wide range of hormones and other biochemicals which alter the metabolism of the entire body.

This function of fat is a normal and appropriate survival strategy, as it ensures that the body has sufficient energy stores during lean times, such as the cold winter months when food is scarce. However, when the horse never gets to experience lean times and fat stores accumulate because of how we feed and otherwise manage our horses, the persistence of this metabolic state begins to adversely affect the horse's health and well-being. Accumulation of fat is supposed to be just a short-term survival strategy, not a way of life.

What's in a name?

During its short evolution as a recognized clinical syndrome in horses, it has gone through several name changes, including the initial “peripheral Cushing's disease,” the current “equine metabolic syndrome” (or EMS), and the most recently proposed “prelaminitic metabolic syndrome” (or PLMS). That last one is my favorite so far, and I half hope it catches on, because it reminds us that horses with this condition are at increased risk for developing laminitis, which really is the crux of the matter with metabolic syndrome.

The first name on the list, peripheral Cushing's disease, did little more than confuse everyone, because metabolic syndrome is a distinctly separate condition from equine Cushing's disease. (Although there is an intriguing theory, and one I agree with, that the presence of metabolic syndrome increases the potential for a horse to develop equine Cushing's disease later in life.)

Other names I'd vote for would include "fat horse syndrome" and hyper-calorie-osis. These names would not satisfy the scientific crowd, but at least they'd make it clear that this condition is one of overfeeding and excessive body fat.

One of the many biochemical consequences of accumulating too much fat is a decreased sensitivity or "resistance" to the effects of insulin. (More on that in a minute.) So, you'll often see metabolic syndrome referred to as insulin resistance (or IR). That's OK, I suppose; but just as every poodle is a dog, yet not every dog is a poodle, not every horse with insulin resistance is overweight and has metabolic syndrome. Pain or some other cause of physical or psychological stress causes insulin resistance for as long as the source of stress persists. That's because stress from any cause stimulates an increase in the concentration of cortisol in the bloodstream. Cortisol and insulin have antagonistic actions on blood glucose regulation, so an elevation in blood cortisol causes insulin resistance for a time.

Glucose: a simple sugar (a monosaccharide) that is the major source of energy for the body's cells; it is used as fuel for many different cellular functions. Glucose is supplied in various foods and it can be made by the liver from the breakdown of proteins. Surplus glucose is reversibly stored in the liver and muscle cells as glycogen; when glycogen stores are full, excess glucose is irreversibly converted to fat and stored around the body as fat deposits. The concentration of glucose in the bloodstream is closely regulated by the production of insulin and glucagon.

And while we're at it, I do not think it is appropriate to call this condition diabetes. Diabetes is a disease that is caused by inadequate production of insulin, either from destruction of the insulin-producing cells in the pancreas (type I diabetes) or from exhaustion of insulin production by the pancreas because of persistent insulin resistance (type II diabetes). Neither scenario occurs in horses with metabolic syndrome; in fact, equine metabolic syndrome is confirmed by documenting an abnormal *increase* in blood insulin. (Unlike humans with type II diabetes, the horse's pancreas seems particularly resistant to "pooping out" under the strain of chronic insulin resistance.)

Insulin: one of several hormones produced by the pancreas. It has many different functions in many different tissues, but it is essentially a hormone of *storage*. One of its primary functions is to promote the storage of glucose; it does this by facilitating the movement of glucose from the bloodstream into cells, enhancing glycogen production within liver and muscle cells, and inhibiting

the breakdown of glycogen. It also promotes the production and inhibits the breakdown of proteins and fats throughout the body.

What's the "big" deal?

There's a show on cable TV this summer, hosted by the flamboyant and larger-than-life actress Mo'Nique, which is essentially a celebration of "plus-size" women. Now, I'm all for self-acceptance and loving ourselves just as we are, but let's not kid ourselves: *being overweight is not healthy*. Diabetes, heart disease, high blood pressure (and all its harmful effects on various organs and tissues), and osteoarthritis are just some of the consequences of obesity and the resulting metabolic syndrome in humans.

The same is true for horses and other animals: being overweight is not healthy. Of the constellation of medical problems that are associated with excessive body condition in horses, the worst has got to be laminitis (also called founder). Being overweight does not directly *cause* laminitis, but it does greatly increase the horse's risk for developing laminitis from a number of different causes. (More on laminitis and its various causes and contributing factors another time.)

The risk for laminitis is increased in overweight horses for at least three reasons:

1. greater load on the feet, which strains the living, dynamic bond that suspends the coffin bone within the hoof capsule
2. overweight horses tend to be fairly inactive, which on its own is a risk factor for laminitis
3. merely being overweight creates a bodywide metabolic state (insulin resistance) in which the cells are less sensitive to insulin; this state renders the cellular bond between hoof wall and coffin bone more vulnerable to breakdown

It's still not entirely clear why or how insulin resistance increases the risk for breakdown of the hoof wall–coffin bone bond. One theory involves interference with the entry of glucose into cells. For many different types of cells, insulin must attach to its specific receptor in the cell's outer membrane in order for glucose to efficiently enter the cell and be used for energy production. The bond between the hoof wall and the coffin bone comprises living cells, and the integrity of those cells and that bond relies on a steady supply of glucose. Interference with glucose supply, and at least in theory insulin resistance, can lead to breakdown of the hoof wall–coffin bone bond, and thus laminitis.

Another theory involves the toxic effects of high concentrations of glucose on cells, particularly the cells lining blood vessel walls. While glucose is essential for proper cell function, high concentrations of glucose can actually be harmful to cells. Even so, in most horses with metabolic syndrome, while the blood insulin concentration may be quite high, the blood glucose concentration is only mildly or moderately elevated, if at all. Still, persistent mild elevations in blood glucose or large spikes after a high-carbohydrate meal may be sufficient to compromise the integrity of the blood vessels within the horse's feet. Metabolic syndrome in humans certainly has well documented vascular consequences, so it's reasonable to assume that the same is true for horses.

Yet another theory, which involves the upregulation of various inflammatory substances and consequent oxidative damage, explains both the increased risk for laminitis and the other visible consequences of chronic fat accumulation and insulin resistance. Even in overweight horses who are not (yet) laminitic, this chronic metabolic derangement causes the horse to feel really crappy. Typically, these horses are sluggish and a bit grumpy, uncooperative, or touchy; and they are stiff or even mildly and nebulously lame. Chronic itchiness or hives that does not respond to the usual treatment also is quite common, as is reproductive dysfunction (e.g. infertility, abnormal heat cycles).

That's because the metabolic consequences of excessive body fat involve many more hormones and biochemicals than just insulin and glucose, and they involve pretty much every part of the body, not just the feet. *Horses with this condition are in a chronic inflammatory state*, with widespread oxidative stress/damage, which affects their skin, joints, muscles, connective tissues, internal organs, immune system, and even brain function.

Too much of a good thing

Whatever you want to call it and however you want to define it, this problem fundamentally is one of too many calories and too much body fat. Many of us (vets and owners alike) have gotten all caught up in the hormonal and metabolic consequences and how to measure and monitor them with the greatest precision. But in the process we all too often overlook the root cause: too many calories in, not enough calories out.

Typically this problem is seen in mature horses, although it usually starts much earlier in life. In fact, weanlings and yearlings can become overweight and insulin resistant if they're overfed

for sales or shows. (By the way, weanlings with insulin resistance also are more likely to develop osteochondrosis and other developmental orthopedic disorders.) But even pleasure horse owners can be guilty of overfeeding young horses. Such a practice sets the young horse up for a lifetime of weight-related problems.

Much attention is currently being paid to laboratory tests (blood insulin, glucose, and triglycerides) and sophisticated calculations of insulin and glucose ratios and biomathematical proxies as a means of identifying affected individuals. But it's really as simple as looking at the horse. The hallmark of this condition is excessive body fat.

The classical presentation is a mature horse with characteristic fat deposits along the top of the neck ("cresty" neck), over the rump ("apple" rump), and less obviously over the shoulders and in the sheath (geldings and stallions) or in front of the udder (mares). However, with some breeds or individuals and in immature animals, the distribution of fat stores around the body may be more uniform. These individuals look more like a boiled Bratwurst sausage than a war horse from classical art.

Another common feature with these horses is that the fat deposits remain or decrease only slightly with dietary restrictions. So, while blood tests can be used to confirm the diagnosis and establish a baseline for future monitoring, these visual clues and poor response to dietary changes are usually enough.

It has to be said that the propensity for insulin resistance in horses is, in part, genetically determined. Some breeds, for example many of the pony breeds, are particularly predisposed because of where the breed originated. Breeds that developed in very harsh environments, where food was scarce for much of the year, tend to carry extra "thrifty genes" which makes them very fuel efficient and prone to obesity when food is plentiful.

However, metabolic syndrome can develop in any horse of any breed if the horse is overfed relative to her energy requirements for growth, work, pregnancy, lactation, recovery, warmth, etc. That's because *simply being overweight causes insulin resistance*. That's because fat is metabolically and hormonally active, and the more fat there is, the greater the metabolic derangement. (It's like the fat is saying, "we're full up in here; don't send us any more.")

So, whether or not a horse has a genetic propensity for insulin resistance, overfeeding—i.e. providing more calories than the horse needs to maintain her ideal body condition—is enough to

cause excess fat accumulation and insulin resistance, and its plethora of effects on health and well-being.

Body Condition Score

What constitutes “overweight” must take into account more than just the horse’s actual weight. As is the case in people, body weight alone can be misleading, as it does not factor in the height, build, heritage (race or breed), and fitness level (i.e. muscle mass) of the individual. The critical factor in determining whether an individual is overweight is the amount of fat stored on the body.

In horses, body condition score (BCS) is used to evaluate this very thing by assessing fat deposits in visible areas of the horse’s body (see the table at the end of this article). Body condition is graded on a scale from 1 (emaciated) to 9 (obese). Regardless of the horse’s age, breed, gender, height, and body weight, a BCS between 4 and 6 is ideal. Horses with a BCS of more than 6 are overweight.

Obesity (BCS of 8 or 9) is obvious to all but those horse owners who are in denial. Even so, what most people don’t realize is that *obesity is a very unhealthy state*. Not only is the obese horse teetering on the brink of laminitis, requiring the barest nudge to push him over the edge, but if that horse does develop laminitis, then the prognosis for recovery is far worse than if the horse was in ideal body condition.

Although it can be a long and frustrating process, *weight reduction must be a medical imperative* in obese horses if laminitis is to be avoided. It’s a matter of “not if, but when” with these horses. In fact, one could make a case that owners of horses with a BCS of 8 or 9 are just as guilty of neglect as are the owners of horses with a BCS of 1 or 2. Harsh words, I know; but laminitis is a terrible disease. It is also a largely preventable one, with just a bit of knowledge and effort.

More common, but almost as problematic because the risk is less obvious, are horses with a BCS in the 6–8 range. These overweight horses are unhealthy and at increased risk for laminitis, yet many owners simply consider these horses well cared for, pleasantly plump, or “easy keepers.” I think it’s time we all adjust our perceptions of what a well-cared-for horse looks like. A horse with a BCS of over 6 is not well cared for; he is overfed and overweight, and unhealthy.

Strategies for Weight Reduction

As equine metabolic syndrome is fundamentally a problem of too much body fat, correcting it is fundamentally an issue of reducing body fat. Just as in the human weight loss industry, dietary products promising rapid weight loss, better glucose and insulin regulation, and even miraculous cures for laminitis abound in the equine supplement industry.

However, there are no safe shortcuts and no miracle cures. The approach to weight reduction in an overweight horse is essentially the same as it is in overweight people. It is simple, but admittedly not always quick or easy. The horse didn't become overweight overnight, so he's not going to lose all that extra fat in just a few weeks (at least, not in any healthy way). The good news is that the horse's metabolic status (particularly insulin sensitivity) and health will be substantially improved with a drop in weight of as little as 5–10%.

The key is this: *calories in must be less than calories out*. In other words, the body must consume fewer calories than it is using. And, as in people, the twin foundations for healthy weight loss are diet and exercise.

Diet

As I discussed in other articles, the foundation for good health is good nutrition. (See www.animavet.com/articles.html for links to other articles.) Regardless of whether the horse is BCS 4 or 9, his diet should primarily consist of good quality forage (pasture and/or mixed-grass hay). Fresh grass and even some hays can be an issue when it comes to weight reduction, however, as the sugar content of grasses can be quite high at certain times. That is a topic which requires much more space than I have here. For now, let me direct you to a web site that is dedicated to the issue of pasture grasses in relation to laminitis risk: www.safergrass.org.

When pasture turnout is not available or not advisable for an individual horse, then a good quality, late-cutting, mixed-grass hay (or mix of single-grass hays) should be fed at a rate of approximately 2% of the horse's *ideal* body weight per day. For a horse whose ideal body weight is around 1000 lbs, 2% of body weight is 20 lbs of hay per day. Some horses need less than that to achieve or maintain their ideal body weight. However, the amount of hay fed per day should not drop below 1.5% of body weight (15 lbs per day for a 1000-lb horse). Weigh out a day's worth if necessary until you get a good feel for how much hay that is.

It is unhealthy and actually counterproductive to feed the overweight horse less than 1.5% of his body weight per day or to feed a diet of very low nutritional quality (e.g. yellowed, stemmy hay). Feeding a horse “starvation rations” (a diet which provides fewer calories than the body needs to perform its basic functions) sends the body into survival mode, which makes weight loss even more difficult, as the preservation of energy stores becomes a metabolic priority. In other words, this strategy makes the body even more resistant to giving up its fat stores.

Furthermore, the poor-quality grass hay-only diet fed to many overweight horses in an effort to get them to lose weight is marginally to grossly deficient in numerous nutrients (vitamins, minerals, co-factors, antioxidants) that are essential for good health and for energy production, not to mention the repair and regeneration processes required to recover from laminitis. No wonder that few horses look well or lose weight on such a poor diet!

For horses who have no access to fresh grass and other living herbage, I recommend supplementing the hay diet with a high-quality multivitamin-mineral product and extra antioxidants (see below). Other forage options for overweight horses include the use of a grazing muzzle; limited pasture turnout or hand grazing (from 15 min to 2 hrs at a time, depending on season and pasture quality); substituting unsweetened beet pulp for part of the hay ration; and use of a certified low-NSC grass hay, supplied as a bale, chopped forage, or pellet.

(NSC stands for nonstructural carbohydrates, which include starches and sugars. A forage whose NSC content is less than 15% is fine for most horses with metabolic syndrome; in a few cases a forage that is less than 10% NSC may be needed. By the way, some improved pastures used for grazing or haymaking can be over 30% NSC at certain times of the year.)

Grain. Grain and grain-containing feeds (sweet feed, pellets, etc.) are high in starch and so should not be fed to overweight horses. For one thing, these horses do not need the extra calories. In addition, in some very insulin resistant individuals with preexisting laminitis, even a small amount of grain (as little as a cupful in some cases) can cause spikes in blood glucose and metabolic alterations that interfere with effective weight loss and laminitis management.

For the same reasons, molasses, sweet treats, and other high-starch or sugary foods should be avoided. Grass hay cubes can be a good alternative to sweet treats, provided the hay cubes do not contain molasses and treats are offered only occasionally and only in small amounts. Personally,

I prefer people to treat or reward their horses with a pat, a brush, a light massage, and/or a kind word rather than with food.

Fats. High-fat feeds also should not be fed to overweight horses, no matter how low the feed's content of starch and sugars. These feeds do not present the health risks that grain-based feeds do, but overweight horses simply do not need the extra calories. It should be obvious to all that it is counterproductive to feed fat to a horse who needs to lose fat!

Exercise

Feeding fewer calories is very important, but in most cases it is not enough on its own. It does nothing to use up the extra calories already stored as fat on the horse's body, unless the ration provides significantly fewer calories than are required to meet the horse's maintenance energy needs. (And I've already discussed why that's not a good idea.) For effective and healthy weight loss, the horse must also perform more daily activity than she has been doing. The objective is to use up the extra calories already stored on the body as fat, and thus minimize the metabolic influence of the horse's body fat reserves.

This aspect of weight management can be quite a challenge in overweight horses who already have laminitis or some other problem that causes lameness or exercise intolerance. However, it is not impossible. The exercise does not need to be high intensity or high impact. Simply walking the horse each day can be beneficial (provided the horse's medical condition allows). In fact, short hand walks can be great therapy even for laminitic horses, provided the condition is relatively stable and both veterinarian and farrier have given the "OK."

The more daily exercise the horse performs, the better for weight loss. However, the horse's current fitness and comfort must be the guide as to how much exercise (how far and how fast) to perform at a time. It is best to begin with short sessions (e.g. 10–15 minutes of walk and jog) and then steadily increase in both duration and intensity. Options include riding, driving, walking in hand, longeing, free schooling in a round pen or arena, ponying (i.e. leading the horse while riding another), ground driving (i.e. long-lining), and swimming or wading. *Paddock or dry lot turnout generally is not enough*, as most overweight horses just stand around out there.

Note that I keep saying *daily* exercise. It's alright if you skip a day here and there; but in order to make significant progress, the horse really needs to do some type of structured and

gradually increasing exercise at least 5 days a week. All too often, that one day missed here and there becomes exercise only once or twice a week, and then the horse's weight loss slows down to zero. At the risk of sounding like one of those gym Nazis, it takes commitment to get these horses into a trimmer, healthier state, just as it does with your own body. Unfortunately, in this case it is your horse who pays when you lack the time or willingness to do what is required and stick with it until you achieve the desired result.

One thing I'll often recommend to folks who don't have much time to spare is to throw on your running shoes and take your horse for a brisk walk or even a hike if you have some good trails nearby. You'll be working both bodies at the same time, and it can turn out to be great quiet time for yourself, a brief respite from your busy day.

Supplements

There are many different vitamins, minerals, and co-factors which are essential for efficient energy production and healthy metabolism. The basic diet should supply these substances in a species-appropriate and bioavailable form. My preference is for horses to get what they need from living plant material: grass and other meadow or woodland herbage. However, as I've already mentioned, sometimes pasture is unsafe for these laminitis-prone horses. When fresh stuff is not available or advisable for a particular horse, I'll use a variety of dried herbs and nutritional supplements, customized to the horse's individual circumstances and health needs.

In addition, I believe that supplemental antioxidants are vital in every horse with metabolic syndrome. Antioxidant supplementation will not directly affect insulin sensitivity, but it will help to counter the increased oxidative stress and cellular damage that occurs with metabolic syndrome. Many different nutrients serve or support antioxidant functions; chief among them are vitamins A, C, and E, selenium, and omega-3 fatty acids. In addition, nature has provided an extensive variety of more complex plant substances which have antioxidant properties. Some of the more potent and widely available include green tea and grapeseed extracts, but there are many, many others.

Other supplements I'll occasionally use in the short term to aid in weight reduction or glucose regulation include supplemental thyroid hormones and adaptogenic herbs (some of which have insulin-like effects). None of these substances will cause significant weight loss

without appropriate dietary changes and regular exercise, though. There are no safe short cuts or magic bullets.

It can be a long road back to good health in horses with metabolic syndrome. However, the improvements in attitude, energy, health, and longevity are well worth it!

BCS	Description
1	emaciated; skeleton is very prominent; very little muscle mass; skin sunken over the skeleton
2	skeleton is prominent under the skin; little muscle mass on the body
3	bones of ribs, spine, pelvis, and tail head all very noticeable; bones of wither, shoulder, and neck faintly noticeable
4	ribs faintly noticeable; bones of spine form slight ridge along back; pelvic bones well covered by muscle; can feel a little fat at the tail head
5	ribs not visible but can easily be felt; bones of spine well covered; pelvic bones well covered; spongy fat at tail head; rounded withers; shoulder and neck blend into body
6	spongy fat covers ribs, but can still feel individual ribs; may have slight crease down back; pelvic bones well covered; soft fat around tail head; some fat deposits on wither, neck, and behind shoulders
7	obvious filling between ribs, but can still feel ribs; may have crease down back; rump has rounded contour; soft fat around tail head; fat deposits on wither, neck, and behind shoulders
8	hard to feel ribs; crease down back; very soft fat at tail head; fat on inner thighs; fat fills wither area and behind shoulders; thickened neck
9	dimpled fat over ribs; obvious crease down back; bulging fat at tail head and inner thighs; flanks filled with fat; bulging fat on wither, neck, and behind shoulders

Body Condition Scoring system for horses. Regardless of the horse's age, breed, gender, height, or body weight, a body condition score (BCS) between 4 and 6 is ideal.

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