Nutrition

BY NANCY S. LOVING, DVM

Endocrine Disorder Feeding Tips

Nicholas Frank, DVM, PhD, Dipl. ACVIM, associate professor of large animal clinical sciences at the University of Tennessee, spoke about equine endocrine disorders that are the most manageable by dietary control: equine metabolic syndrome (EMS) and equine Cushing's disease (ECD or pituitary pars intermedia dysfunction, PPID).

An EMS horse tends to be fairly young, might have some genetic predisposition, and has pronounced fat deposits, especially on the neck, shoulders, and buttocks. These horses are considered "easy keepers." Some breeds are more likely to develop EMS than others, such as Paso Finos and Arabians. Generally, these horses have a higher-than-normal blood insulin concentration. An ECD horse is typically an older or aged horse with pituitary dysfunction that results in excess secretion of ACTH (adrenocorticotropic hormone), alpha-MSH (alpha-melanocyte stimulating hormone), and other hormones. These horses have delayed or patchy hair coat shedding, and there is noticeable muscle loss. Often there is excess drinking and urination, which might go undetected.

Frank said insulin resistance can develop in either EMS or ECD individuals. Insulin resistance results from impaired tissue responses to insulin due to problems with insulin receptors, insulin-signaling pathways, or glucose transport systems. To compensate, many horses will secrete additional insulin, thereby worsening the problem. An obese horse has lipid accumulation within adipose (fat tissue) and skeletal muscle tissue that interferes with insulin signaling, leading to insulin resistance. Frank described some basic concepts that are important for a horse owner and veterinarian to consider:

- Obesity predisposes to insulin resistance;
- Insulin resistance is a diabeteslike state;
- Sugars exacerbate insulin resistance;
- Insulin resistance makes horses more prone to laminitis;

SUSAN KORDISH

An insulin-resistant horse in good body condition should be fed to improve insulin sensitivity.

It is important to avoid laminitis triggers such as intestinal abnormalities, seasonal variations, and dietary changes.

A goal for managing an obese horse is to induce weight loss. In a horse that is in good body condition, yet has insulin resistance, you should aim to maintain its current weight with the objective of improving insulin sensitivity. A thin Cushing's horse with insulin resistance should gain weight and improve its insulin sensitivity.

Of three possible diets to manage insulin resistance, the first Frank described is a ***weight loss diet*** in which all grain is eliminated and access to pasture is eliminated or restricted to less than two hours per day or to a small area of strip grazing. A grazing muzzle is useful to control consumption of grass. Dynamic phases of grass growth (i.e., following drought conditions) should be avoided. Soaking hay for 30 minutes before feeding lowers its sugar content. Hay should be analyzed for its nonstructural carbohydrate (NSC) content, and hay should be selected that is low (less than 10-12%) in NSC. Frank notes that it is impossible to identify NSC content (simple sugars and starches) from appearance, and content varies by grass type, rainfall, soil type, season, cutting, and time of day. (As a comparison to forage, oats have a value of 50% NSC.)

Initially, the fat horse should be fed 2% of its current body weight in hay along with elimination of grain and pasture grass from the diet. Then, hay is lowered to 1.5% of current body weight, then offered at 1.5% of ideal body weight. For example, you'd give 15 pounds of forage to a 1,000-pound horse. The horse is fed at this level until an ideal body condition score is achieved. In some cases, a hay-only diet might provide insufficient protein; a diet of 8% protein is acceptable. If more protein is needed, a small amount of alfalfa hay or soybean meal can be substituted for a portion of the diet.

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DR. RAY GEOR

Exercise is important for weight loss, provided laminitis or lameness does not preclude physical activity.

The second diet Frank considered is a ***weight maintenance diet*** that is predominantly forage-based (hay) with less than 12% NSC. Hay is fed at a rate of roughly 2% of body weight to maintain weight. Vitamins, minerals, and protein are provided as needed. High-glycemic feeds should be completely avoided, such as sweet feed with molasses, as this challenges glucose and insulin metabolism and exacerbates insulin resistance. A horse experiences a higher glycemic response (blood sugar) if carbohydrates are digested in the small intestine, so it is best to feed small amounts of food more frequently, (so lesser amounts of carbs ferment in the small intestine at one time) and to feed hay before concentrates. Always avoid sudden changes in feed so the bacterial flora in the bowel can adjust gradually to various feed materials.

Frank stressed that "a safer feed is not necessarily a safe feed." General recommendations apply to most, but not all, insulin-resistant horses since insulin resistance varies in severity and there are individual variations in responses to feed. Body condition should be assessed every two to four weeks, and blood insulin should be monitored.

The ***weight gain diet*** relies on low-NSC (less than 12%) hay fed free-choice along with molasses-free beet pulp and rice bran or corn oil. Soaked molasses-free beet pulp is mostly digested in the large intestine.

Presoaked, one cup is equivalent to one-quarter pound. Start with one-quarter to one-half pound of pre-soaked beet pulp and feed this twice a day, increasing gradually to 1 pound daily. Beet pulp should be rinsed twice in warm water to remove simple sugars, then soaked for 10 to 30 minutes in warm water before feeding.

Commercial low-NSC pelleted feeds are also recommended for weight maintenance or gain. Advantages of these products include the ease of feeding, regular testing of ingredients to ensure a lower sugar content, and addition of ingredients that affect absorption and palatability.

Pelleted mashes and slurries combined with high-fat supplements can be offered to geriatric horses with poor dentition or missing teeth

DR. DAVID PUGH

Feeding After Colic

Nutritional support of horses following a bout of colic is important, especially for hospitalized horses following colic surgery, noted Ray Geor, BVSc, MVSc, PhD, Dipl. ACVIM, professor, Paul Mellon Distinguished Chair, and director of Virginia Tech's Middleburg Agricultural Research and Extension Center in Middleburg, Va.

There are arguments as to how much to feed following a colic attack or colic surgery. A horse needs nutrients for healing and immune function, but loading the bowels with feed (and the weight of the feed) might increase the chance for intestinal shutdown and colic relapse or for breakdown of the abdominal incision. It has been common practice to withhold feed initially and provide only water and possibly intravenous fluids and electrolytes to a horse that suffered from colic or colic surgery, then slowly re-introduce feed at a rate that allows the GI system to accommodate forage.

Geor advocated feeding a stall-maintenance ration (approximately 70% of maintenance needs; a maintenance diet accommodates basic physiologic functions without the added demands of exercise, etc.) for two to four days after horses have colic surgery, increasing the ration continually until reaching a maintenance intake of digestible energy.

Three avenues of nutritional support are available: 1) voluntary feeding, 2) assisted feeding, and 3) parenteral nutrition. Geor stressed that how a horse should be fed depends on the underlying cause of the colic incident, as well as the horse's appetite and extenuating complications that might arise in the recuperative phase. A horse with a simple colic might have feed and water withheld during the episode, but as soon as the colic has resolved, the horse can return to a normal diet. Many practitioners advocate elimination of the grain portion of the diet for a few days to allow restoration of hindgut microbial function.

In contrast, following intestinal surgery feed should not be introduced until there is evidence that intestinal motility has been restored, and, even then, only small amounts (1 pound) of forage are offered at frequent intervals (four to six times a day). Increase the amount gradually and steadily based on the horse's response.

Another tactic is to offer pasture grazing for 20-40 minutes intermittently throughout the day or to offer pelleted senior feed, which is digestible and low-bulk. For the two weeks following surgery, it is best not to offer grain so as not to further disrupt hindgut (large intestine) microbial activity. Reinstitution of grain begins with small amounts (2 pounds or less per day) and is increased gradually.

By the second or third day following surgery a horse should voluntarily consume at least 75% of stall-maintenance

requirements in forage, i.e., 8 pounds of hay for a 1,000-pound horse. A horse that won't eat this amount of hay will need appetite stimulation with grass or other palatable, but highly digestible, feed, particularly if the horse is in poor body condition. If this fails to induce an appetite, then assisted feeding is necessary. This relies on administration by stomach tube of energy-dense pelleted feed, slurried and supplemented with fats. The volume given by stomach tube four to six times per day is slowly increased over several days to a target amount. Careful clinical monitoring is important to avoid stomach distention, intestinal shutdown, or laminitis.

The third strategy for nutritional support is that of parenteral nutrition that is given intravenously through a catheter dedicated only to this purpose. This form of nutrition is particularly valuable for horses recovering from enteritis (intestinal inflammation) or from small intestinal surgery, particularly if a portion of small intestine has been removed.

Once intestinal motility is restored with no gastric reflux, it is recommended to feed a highly digestible diet using fresh green grass or soft first-cutting hay and/or pelleted feed mashes, offering only very small meals every three to four hours.

Regarding large intestinal disorders, such as an impaction, feed should be withheld until the impaction has cleared. Grain should not be fed until it is evident that manure is passing regularly and in appropriate quantity and consistency. If large intestinal surgery was performed, it is important to monitor for diarrhea, as Geor reported the risk of diarrhea is increased twofold in horses with large intestinal disorders as compared to other intestinal problems. This risk increases if the large colon has undergone direct surgical invasion. There appears to be some mitigating effect on diarrhea when grass hay is fed. Hay can be offered starting 12 hours post-surgery, with small amounts of soft first-cutting grass hay given every two to three hours. Grain should be withheld for 10-14 days, but pelleted feed can be fed due to its low bulk.

Following extensive large colon resection (removal of a section), Geor noted that transit time of nutrients is altered so low-bulk feeds, such as pelleted feed, can be offered initially, followed by legume forage or a grass-legume hay mix. Additional calories can be obtained through high-fat concentrates (oil, rice bran, or supplements especially high in fat) with avoidance of grains and sweet feed.

Feeding the Geriatric Horse

A horse kept healthy and disease-free in its younger years has the potential to live well into its 20s and 30s, stated David Pugh, DVM, MS, Dipl. ACT, ACVN, of Fort Dodge Animal Health. In the senior horse, routine medical management should be implemented, including parasite control, dentistry, and dietary modifications to accommodate existing problems.

Maintaining stability of the hindgut microbial community is of paramount importance to GI health

DR. RAY GEOR

Dental disease is a common problem in aged horses, so the teeth should be checked at least twice yearly to minimize the risk of choke and to avoid weight loss. Pelleted mashes and slurries combined with high-fat supplements can be offered to geriatric horses with poor dentition or missing teeth. If an older horse is able to maintain good body condition on a regular maintenance diet, then no extra supplementation should be necessary. Some aged horses require "safe" feeding areas to avoid herd competition, especially if afflicted with arthritis or failing eyesight.

Pugh noted that nutrition for aging horses and young, growing horses is similar in the protein and energy needed to support their metabolism. An old horse might not digest dietary fiber efficiently, and he also might need a higher (12-14%) protein intake because he can't digest protein as well. It is important to ensure adequate intake of specific amino acids, such as lysine and threonine. In many cases including alfalfa in the diet helps to limit loss of muscle mass and weight. A high-fat supplement (vegetable oil and/or rice bran) is useful to provide calories, as are beet pulp mashes or pelleted feeds. Pugh recommends that concentrates be restricted to no more than 0.5% of body weight per feeding, as, for example, a 1,000-pound horse should not receive more than 5 pounds of concentrate at a meal.

Body condition might be difficult to maintain in some older horses due to inadequate intake of feed, poor digestive capacity, dental disease, metabolic disease, endocrine disease, or infection. A complete physical exam and blood work should be performed on a geriatric horse to rule out existing problems.

Before protein is increased, it is important to examine liver and kidney function. In general, dietary calcium should be kept below 1% due to the potential for kidney stones in aged horses. Thus, the use of alfalfa must be considered carefully. In these cases increased protein needs might be provided with soybean meal.

A horse with kidney disease should receive less than 8% protein and will do best on grass hay supplemented with fat and/or corn oil if more calories are needed. Digestion of phosphorus seems to decline with age, and it is valuable to monitor the calcium to phosphorus ratios. A horse with liver disease should not be fed a high-fat or high-protein diet, and that horse might benefit from vitamin B supplementation.

Support of a geriatric horse's immune system could be helped by supplemental vitamin C and vitamin E, along with maintaining a good body condition score. Pituitary adenomas (benign tumors in glandular tissue) and/or obesity elicit glucose intolerance and insulin resistance, making feeding of such individuals a real challenge. If a horse requires additional calories and does not have a liver problem, these are best offered as high-fat supplement.

Managing Carbs in Horses

How is feeding carbohydrates related to gastrointestinal (GI) disease? Geor discussed the conflict between GI physiology and the way horse owners tend to fed modern horses, especially those with high athletic demands. The propensity to feed high-grain and high-concentrate diets instead of relying on high-fiber diets has increased the incidence of colic.

One study from 1997 indicated that on 31 farms, the risk of colic increased 4½ times when horses were fed moderate to large amounts of grain (5-10 pounds).

An increased risk of colic also is related to a change in diet; particularly in the first week after a diet change, there is a chance

of simple colonic obstruction or distention, but risk diminishes 15-28 days following dietary changes.

Geor stressed that other contributing factors should be considered, such as level of physical activity, breed, age, season, and the area's weather, but, in general, there is an increased risk of colic with high-grain concentrate diets and with recent dietary changes. So, the question is, "Why?"

Geor said there is a disturbance of the hindgut ecosystem related to delivery of undigested starch and other rapidly fermentable carbohydrates to the hindgut. A limited capacity for starch digestion in the small intestine contributes to overflow of starch to the hindgut. There is also a lag or transition time in the speed of microbial adaptation to dietary changes. He pointed out that maintaining stability of the hindgut microbial community is of paramount importance to GI health.

There are three types of carbohydrates:

Hydrolyzable Starches and sugars are digested in the small intestine to generate glucose, but these ferment rapidly in the stomach or the large intestine.

Rapidly fermentable Fructans and oligosaccharides (saccharides of a small number of component sugars) that rely on *Lactobacillus*, *Streptococcus*, and *Clostridium* spp, with lactate production as a byproduct.

Slowly fermentable Cellulose that relies on *Fibrobacter* and *Eubacterium* spp that consume lactate.

If a large load of rapidly fermentable carbohydrates enters the hindgut, overgrowth of lactate-producing bacteria leads to increased lactate and gas production, acidity of the hindgut, a die-off of Gram-negative bacteria, and the release of endotoxin and other substances. The result is disruption of the mucosal layer of the intestinal lining, absorption of endotoxin, more gas distention, and altered gut motility with the potential for an intestinal volvulus (twist). This sequence of events results in an acute and severe colic.

A more chronic and less severe intestinal disruption develops from a decrease in fiber-fermenting, acid-utilizing microbes. This leads to chronic acidosis, digestive inefficiency, weight loss, altered fecal consistency, and the development of stereotypic behaviors such as cribbing.

Hindgut acidosis develops subsequent to sudden introduction of grain feeding or an abrupt increase in amount of grain fed. Acidosis also results from large grain concentrate meals, lush spring pasture grazing, or from forage that is high in nonfiber carbohydrates, such as what occurs with rich legume hay.

Studies indicate there is a stepwise decrease in cecal pH relative to increasing amounts of grain and the size of a starch meal. Larger grain meals increase risk of starch bypass of the small intestine with rapid fermentation in the large intestine. The effects of this depend on the horse's adaptation to the types of starch and size of meal.

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Cecal acidity is associated with feeding grain starch of low digestibility, such as is seen with corn. The higher digestibility of oats mitigates this effect, whereas barley and corn starch are more resistant to digestion and lead to acidosis.

Oats are about 84% digested before reaching the cecum as opposed to corn at 45% or less digestion. Heat treatment or reduction in particle size (micronization or extrusion) is needed for improved pre-cecal digestibility and retention of normal cecal pH.

As for probiotics (dietary supplements containing potentially beneficial bacteria or yeasts), Geor pointed out that data is lacking due to the absence of well-designed scientific studies. In addition, there are issues regarding product quality, and some studies show adverse effects in foals receiving probiotics containing *Lactobacillus pentosus*.

Another new supplement (made by Kentucky Equine Research) that is advertised as a hindgut buffer is purported to mitigate moderate decreases in cecal pH following a grain meal or when grazing lush pasture.

Geor summarized his recommendations to reduce colic risk:

- Minimize the flow of rapidly fermentable carbs to the cecum and large colon;
- Limit amount of grain, sweet feed, or pelleted feed per meal to no more than 4½ pounds of starch for a 1,100-pound horse;
- Increase the number, not the size, of meals to at least three feedings per day and provide free-choice hay when possible;
- Feed starch sources high in pre-cecal digestibility, such as oats. If using corn or barley, these need heat treatment, such as extrusion, popping, or micronization;
- Slowly introduce changes in cereal or sweet feed to increments of less than 1 pound per day over seven to 10 days;
- Use alternative concentrated energy sources, such as oils, or rice bran, or highly digestible super fibers, i.e., beet pulp or soya hulls;
- Encourage long-stem forage intake to at least 1-1½% of body weight, i.e., 12-17 pounds per day for a 1,000-pound horse; and
- When switching hay batches, blend over seven to 10 days.

Geor also mentioned how diet affects equine gastric ulcer syndrome (EGUS), which is reported to have an incidence of 60% in pleasure and show horses, and 85-90% in racehorses.

The "trickle" feeding pattern of pastured horses (small intake of feed over a long period of time) might have a protective effect that is coupled with the high-fiber diet of pasture grass. Saliva production doubles when eating hay and is continuous when grazing; saliva has a powerful buffering effect on stomach acid.

Alfalfa has an additional buffering effect on stomach acid, whereas recent findings do not support any benefits from corn or rice oil in preventing development of EGUS. Overall, it is important to remember that a horse has a small stomach and large hindgut and a limited capacity for starch digestion in the small intestine. In general, the best strategies rely on feeding smaller and more frequent meals with less reliance on cereal or sweet feeds.

Other supplements were discussed, such as "stabilizing" products for the hindgut ecosystem. A live yeast preparation or prebiotic (a food substance intended to promote the growth of certain bacteria in the intestines; 10 grams per day of *Saccharomyces*) mitigates the decrease in pH that occurs with high-starch meals, but of greater importance is the feeding of high dietary fiber, i.e., forage.