Equine obesity: the most common risk factor for laminitis in the UK?

**OBESITY** is often cited as the greatest threat to equine welfare in the UK. Rates may be as high as 70 per cent in some populations and the condition can be associated with morbidities, most notably laminitis, that may ultimately result in mortality. The rise of obesity in horses mirrors the situation in companion animals that was reported by Veterinary Times in July (VT47 28).

Equine metabolic syndrome (EMS) describes a constellation of metabolic disturbances that has insulin dysregulation as its foundation and is typically associated with generalised or localised obesity (although can be found in the lean animal) and may ultimately lead to laminitis. Although other mechanistic mechanisms by which laminitis may develop have been reported, EMS is by far the most common cause of pasture-associated laminitis. Additionally to EMS and laminitis, adverse consequences of obesity include orthopaedic disease, hypolipaemia, hyperthermia/heat intolerance, increased respiratory effort, infertility and poor performance.

Many factors are likely to have contributed to the apparent increase in prevalence of obesity, including a change in perception of what constitutes a healthy body condition, increasingly sedentary lifestyles, excess energy intake (including from grass), provision of inappropriate feedstuffs/forages, and over-rugging.

**Defining obesity and EMS**

Horses with a body condition score (BCS) of seven or higher – using a nine-point scale – are considered to be obese as at least 10 per cent of bodyweight (BW) is fat. In very obese horses, fat mass may even exceed 40 per cent of BW. When a definition of obesity as a BCS of seven or higher is used, it is widely used. Using a five-point scale, horses with a BCS higher than three are considered obese.

Leisure horses should, ideally, have a BCS of five tending to six towards the end of summer, and five tending to four at the end of winter, owners should aim for corrective weight loss over winter.

**Consequences of obesity**

Obesity and recent weight gain have been demonstrated to have a number of negative consequences on health, including:

- Increased risk of laminitis.
- Poorer prognosis for recovery from laminitis.
- Increased risk of hyperlipaemia.
- Impairment of normal thermoregulation.
- Altered oestrous cycles and decreased fertility.
- Increased prolactin/ghrelin production characteristic of “satiety-signalling.”

Greater risk of osteochondrosis dissecans in foals born to obese mares.

Undesirable behavioural traits.

Increased blood pressure.

It may also be associated with:

- Increased risk of orthopaedic disease through increased loading.
- Preputial and mammary oedema and dermatitis.

- Ventral oedema, possibly as a consequence of compromised lymphatic drainage.
- Strangulating small intestinal lesions caused by pedunculated mesenteric lipomas.
- Disturbances of cortisol – as well as lipid – metabolism, and vascular dysfunction.
- EMS describes the presence of insulin dysregulation (ID) with or without other metabolic alterations and is associated with an increased risk of laminitis. Obesity is typically present, but is not a defined pathological hallmark. Strictly, diagnosis of EMS necessitates demonstrating that ID is present, either by identifying hyperinsulinaemia or abnormal insulin responses to an oral or IV glucose load. A presumptive diagnosis of EMS is often made if obesity and laminitis are concurrent, and the laminitis has no other apparent cause. Some animals, particularly mares, will always be at an increased risk of laminitis if they are fed inappropriately.

Obesity and ID are often overlooked in older, leaner equids, which have a tendency towards intra-abdominal fat deposition. In these cases, laminitis may erroneously be attributed to phylary paras intermedia dysplasia (PPID) if appropriate investigations are not performed.

**Identifying obesity**

BMI is often used as a proxy for obesity. Portable weight scales are extremely useful, but should be calibrated regularly.

- Weigh tapes may be helpful, but have not been validated for obese horses and take no account of body condition. Changes in girth will tend to lag behind changes in BW.
- Different body condition scoring schemes have been proposed, with the nine-point scale – modified in 1992 – from the original in 1983 – being the most widely accepted and studied. At the top of the body condition scoring scale, less discrimination of body fat content exists; however, horses of a BCS of seven or higher are considered obese. BCS is less precise when used to assess UK native breeds. Which are mostly overweight, and can be very slow to change in response to reductions in BW. Different body condition scoring scales typically change before BCS in such cases.

- Crest neck score (30) and crest depth (20) provide estimates of nuchal fat deposition, and insulin resistance has been associated with nuchal crest adiposity in some studies. However, the neck crest fat (20) is functionality discrete, heavily influenced by breed, and develops and decreases more slowly than other fat deposits. Furthermore, changes in nuchal crest adiposity reflect longer-term management trends, may be affected by season and may not correlate with generalised obesity. Once a nuchal crest develops, it is unlikely to disappear as connective tissue will remain.

**BMIPlus** (3) provides the most sensitive indicators of generalised fat loss in response to management change and is arguably the single most useful measure for monitoring, heart girth (4) and rumen width may also be useful (Figure 3).

**Ultrasonography** is a useful means of demonstrating the presence of fat, although it is a poor means of determining total body fat composition. Fat depth can be measured most easily on the ventral midline immediately caudal to the xiphisternum and about 10cm either side of the linea alba.

**Standing adipose tissue concentration decreases with increasing adiposity, although this is breed and diet-dependent.** A low total adiponectin concentration is associated with increased markers of insulin resistance, and is a potentially useful marker of pathological adiposity. Of the tests offered in the UK, only an immunodot/biometrical assay for total adiponectin has been shown to be reliable and correlate with laminitis risk, other methods generate inconsistent results.

**Measures of insulin dynamics do not give an indication of obesity per se, but are a useful means of assessing the risk of laminitis, which may be associated with obesity and metabolic dysfunction. Basal insulin concentrations provide an indication of insulin dysregulation if they are increased; however, the test has low sensitivity, so a normal result does not rule out ID. Tests of insulin responses to oral sugars provide a more sensitive means of identifying ID and are, therefore, recommended. The high-dose oral sugar test is simple to perform and can overcome issues of palatability, which can occur when glucose or dextrose powder are used as the sugar challenge. Horses should ideally be fasted for 3 to 12 hours (although this is not imperative), administered 45ml of corn sugar per 100kg BW by mouth using a dosing syringe, then have two blood samples collected at 10 to 15-minute intervals between 60 and 90 minutes after the sugar was administered.

**PPID** is a risk factor for laminitis and may occur concurrently with obesity. Obesity and EMS can be overlooked when PPID is diagnosed, and it...
is important ID is identified and managed additionally, providing therapy for pituitary dysfunction. Effective management of ID will have a more direct effect on reducing laminitis risk than alterations in pituitary function. Obesity will increase the activity of the hypothalamic-pituitary-adrenal axis and increase adrenocorticotropic hormone (ACTH) concentration in horses that do not have PPID – so a danger exists that obesity-related laminitis is mistaken for PPID. More conservative guidelines for the diagnosis of PPID have been recommended and advised for obese horses with mild increases in ACTH concentration should be appraised critically before they are treated with pergolide. Application of the thyrotropin-releasing hormone stimulation test and titration of the dose of pergolide, in response to diagnostic testing, aids in differentiating horses with PPID from those with obesity and EMS.

Feeding obese equids

A reduction in BWT of between 0.5 per cent and 1 per cent per week is a realistic target, but programmes of weight loss should be tailored to the patient and consider what is achievable for the owner. Greater weight loss is likely to occur for the first week after dietary restriction as a result of reduced gut fill. Current BWT is generally used, rather than target weight, and this should be remeasured or recalculated regularly (preferably weekly) and diet adjusted accordingly. Discontinuation of overfeeding and provision of more appropriate feed sources may be sufficient to induce weight loss in some animals. In patients with obesity and laminitis, weight loss programmes ought to be more aggressive, as an increased risk exists of future laminitis and a need to limit hyperinsulinaemia. Furthermore, exercise cannot be included as part of the management programme in horses with laminitis. Access to pasture is always desirable as it allows expression of normal behaviour; however, when pasture access is maintained it is very difficult to estimate intake and a tendency exists to underestimate overall feed intake. Restricting access to pasture can result in greater intake of grass over a shorter period; therefore, even short periods of turnout can severely undermine programmes of weight loss. When conditions are favourable, non-structural carbohydrate levels in grass can exceed 30 per cent, comparable to levels in many cereal-based proprietary feeds. Sand or woodchip areas of turnout would be preferred as complete control over the diet is retained (Figure 6). Hungry horses need to be monitored to ensure they do not ingest large quantities of bedding or other material, such as straw, hemp or wood shavings. Grazing muzzles can be an effective means of reducing pasture intake, although their effectiveness varies with design and between horses19,20, reductions in dry matter intake from 30 per cent to 83 per cent have been reported19,21. Grazing muzzles must be used with care – an owner’s guide and video are available from the National Equine Welfare Council39. The authors recommend they should not be used 24/7 and, if used, should ideally be in place whenever turned out as part of the overall weight management programme, or rates of ingestion will increase at other times to compensate. Hay should comprise the bulk of the ration in any obese horse or pony. Quality varies, and while forage analysis is cheap when performed through feed companies (approximately £30) and widely available, it is rarely performed in practice. The dry matter and nutrient content of hay varies, and will depend on the grass species present, time of cut and how the hay is cured. In the absence of forage analysis, grass-based hay should be assumed to be 90 per cent dry matter and low in protein. Soaking hay markedly decreases its dry matter and mineral content, and has a variable impact on water-soluble carbohydrate (WSC) intake and protein content41-42. When forage is fed at the levels required for weight loss, protein levels may already be insufficient41. Therefore, a low-calorie protein, vitamin and mineral balancer should always be included in the diet of animals offered restricted forage, and especially when feeding soaked hays. A typical practical starting recommendation for a horse undertaking little or no exercise that requires more aggressive weight loss restriction would be to feed a mature grass-based hay at 1.5 per cent BWT unsoaked (assuming 90 per cent dry matter) or 1.8 per cent if it is to be soaked (assuming 20 per cent loss of dry matter with soaking) to promote weight loss (Figure 7). Soaking is preferable as it allows a greater volume to be fed. It should be remembered the effects of soaking are variable, and any estimate is simply a starting point and will have to be adjusted according to the patient’s response. Within any population managed in the same manner, large variation in body condition will exist between individuals and similar variation will occur in responses to dietary restriction. Some animals exhibit ‘weight loss resistance’, and may require repeated re-evaluation and further reduction in their feed intake41.

Feed intakes of 1.1 per cent BWT of uns soaked hay – or 1.3 per cent BWT of soaked hay – are considered the minimum desirable level43. In one study – in which hay produced commercially in the UK was soaked for 16 hours at 1°C – the reduction in WSC ranged from 6 per cent to 54 per cent, with a mean of 27 per cent44. By contrast, in another study, soaking for 14.5 hours (±2.1 hours) resulted in a mean reduction of 50.1 per cent non-structural carbohydrate, with little variation between samples44. Water temperature can have a marked effect – soaking in water of 16°C for 1 hour has a similar effect on sugar content as soaking at 8°C for 16 hours, in colder weather, the use of warm water should be encouraged47.

Figure 3. Belly girth often provides a sensitive means of monitoring generalised obesity and is measured around the widest part of the trunk. Figure 4. Heart girth may be used with belly girth, and is measured on expiration passing the type immediately behind the points of the elbows and the caudal end of the withers in the same manner as a weigh tape. Figure 5. Rump width is measured from the point of one hip to the point of the other.
Levothyroxine administration has been reported as an adjunct to dietary management in horses that cannot be exercised\textsuperscript{24,25}, and has been combined with “weight loss resistance”\textsuperscript{26} and in severe cases of laminitis associated with insulin dysregulation that were not responding despite conventional management. The use of levothyroxine for laminitis is not evidence-based, but derived from extensive clinical experience in the US where a three-month to six-month duration of treatment with levothyroxine (0.1 mg/kg for 3 days per week) is recommended. Treatment is continued until target BW has been reached – at which point the dose is decreased by 50% per 0.05 mg/kg per day being increased by 50% per 0.025 mg/kg for a further two weeks prior to discontinuing treatment\textsuperscript{27,28}. Metformin is used in EMS, but its efficacy in reducing insulin resistance is very little, partly because the circulation in horses\textsuperscript{49}, and its use does not appear to be associated with detectable improvements in insulin sensitivity\textsuperscript{49,50}. Metformin would not be indicated for the management of obesity in the absence of laminitis and ID.

In non-obese horses, metformin has been demonstrated to impair glucose absorption and reduce insulin secretion by interrupting the endogenous ingestion of glucose\textsuperscript{51}, which may be of benefit in reducing glucose absorption and in limiting postprandial hyperglycaemia, which is a key factor in the development of obesity. However, exercise is not effective to be limited to a few hours post-administration and no robust evidence exists of improved outcomes in treated animals.

**Conclusion**

Obesity represents a significant threat to equine welfare as a factor in multiple health problems, most commonly laminitis. Education is required to alter perceptions of what constitutes a healthy BCS and what should be fed to maintain a healthy body condition. Exercise is not a substitute for an appropriate diet and moderate exercise in the absence of dietary restriction has no effect on weight loss\textsuperscript{52}. Efficacy of the exercise, on insulin sensitivity is short-lived\textsuperscript{53}, exercise – whenever clinically appropriate – should be regular in horses where insulin dysregulation and should be continued after the desired level of weight loss has been achieved.

**Medical treatments for obesity**

Pharmaceuticals

Pharmaceuticals should not be an excuse for poor compliance with weight loss protocols. Levothyroxine has been demonstrated to be an effective means of inducing weight loss and increasing insulin sensitivity in small numbers of normal horses\textsuperscript{45,54}. The induction of a hypothyroid state has been demonstrated to be safe in small number of horses\textsuperscript{55}, but larger, further studies are required.

**Further reading**