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REVIEW ARTICLE

Diagnosis and management of equine metabolic syndrome

F. R. Bertin

Department of Comparative Biomedical Sciences, Nancy Fair Link Laminitis Research Centre, College of Veterinary Medicine, Mississippi State University, Mississippi State, Mississippi, USA

Correspondence: F. R. Bertin
Email: fr.bertin@msstate.edu

Summary

Equine metabolic syndrome (EMS) is a prevalent endocrine disorder that increases the risk of hyperinsulinaemia-associated laminitis (HAL), the most common and clinically significant form of laminitis. The central pathological feature of EMS is insulin dysregulation (ID), which encompasses basal or postprandial hyperinsulinaemia and tissue insulin resistance. Although obesity is a frequent finding, EMS can occur in lean animals, and not all obese horses are affected, necessitating objective diagnostic testing rather than reliance on body condition alone. Excessive dietary nonstructural carbohydrates (NSC), reduced hepatic insulin clearance, and impaired insulin signalling contribute to sustained hyperinsulinaemia which induces laminitis. Environmental and management factors, particularly high-NSC diets, unrestricted pasture access and physical inactivity, are the primary drivers of EMS development. Obesity exacerbates metabolic dysfunction through suspected adipose-derived inflammation. Age and genetic predisposition further influence risk, with ponies and certain breeds being disproportionately affected. Diagnosis focuses on identifying ID. Basal insulin measurement is specific but insensitive, while dynamic tests, particularly the oral sugar test, are more reliable for detecting exaggerated postprandial insulin responses and assessing laminitis risk. Tests of insulin resistance, such as the insulin tolerance test, provide complementary information. Management is centred on strict dietary NSC restriction, controlled forage intake and elimination or careful management of pasture access. Regular exercise improves insulin sensitivity but must be adapted to laminitic status. Appropriate hoof care is essential given the high prevalence of chronic and recurrent laminitis. Pharmacological therapy, including sodium-glucose cotransporter-2 inhibitors, may be indicated when nonpharmaceutical measures fail but should be considered adjunctive and individualised. Prognosis is favourable when EMS is recognised early and managed rigorously. Outcomes worsen with recurrent or chronic HAL, underscoring the importance of early detection, sustained management and close collaboration between veterinarians, farriers and owners.

KEYWORDS

glucose, horse, insulin, laminitis, obesity, sodium-glucose cotransporter-2 inhibitors

INTRODUCTION

Equine metabolic dyndrome (EMS) is characterised by a constellation of clinical and clinicopathological signs that increases the risk of hyperinsulinaemia-associated laminitis (HAL) (Durham et al., 2019; Frank, Geor, et al., 2010). The core feature of EMS is insulin dysregulation (ID) (Frank & Tadros, 2014). Additional, but not consistent, findings include hypertriglyceridaemia, altered adipokine concentrations, hypertension, and systemic markers of inflammation (Durham et al., 2019; Frank, Geor, et al., 2010). Although EMS often presents with obesity (generalised or localised), lean phenotypes are recognised meaning that not all EMS horses are obese and not all obese horses have EMS. Because of this incomplete overlap, a careful diagnostic approach is required to detect horses at risk of developing HAL, ideally before the first episode of laminitis.

After summarising the physiology of equine glucose metabolism, this review will detail the diagnostic workflow and the available management strategies for EMS, encompassing both nonpharmaceutical and pharmaceutical measures.

GLUCOSE AND INSULIN REGULATION IN HEALTHY HORSES

In horses, resting blood glucose concentration is maintained within a narrow range between 4 and 6.5 mmol/L (Ralston, 2002). This range is only mildly affected by fasting, moderate exercise or feeding patterns, and glycaemic control is restored rapidly after transient perturbations such as acute stress, systemic disease or ingestion of high-sugar feeds (Bamford et al., 2015; Bertin et al., 2018). This reflects the coordinated actions of endocrine regulations, with insulin and glucagon as the primary factors (Bamford et al., 2015; Fields, 1998; Lawrence et al., 1995; Nadal et al., 1997; Williams et al., 2001).

Insulin is a peptide hormone synthesised by the β cells of the pancreas (Steiner & Oyer, 1967). It is produced through sequential cleavage of preproinsulin to proinsulin and then to insulin and connecting peptide (c-peptide) by endopeptidases (Steiner & Oyer, 1967). Secretion is mainly triggered by hyperglycaemia, which is detected through insulin-independent glucose transporters (GLUT) 1 and 2 on β-cells. In horses, blood glucose is responsible for stimulating about 75% of the insulin secreted (de Laat, McGree, & Sillence, 2016). Amino acids and incretins such as glucagon-like peptide-1 (GLP-1) and glucose-dependent insulinotropic peptide (GIP) also stimulate insulin secretion (Bamford et al., 2015; de Laat, McGree, & Sillence, 2016; Kemp, Skinner, & Bertin, 2025). Incretins, secreted by enterocytes after ingestion of carbohydrates and amino acids, amplify glucose-stimulated insulin secretion in a species-dependent fashion. In horses, GLP-1 would account for 23% of insulin secretion, whereas GIP would account for 2% of insulin secretion (de Laat, McGree, & Sillence, 2016). In addition to stimulating insulin secretion, GLP-1 delays gastric emptying and might influence hepatic insulin clearance. Insulin release is biphasic with an early peak about 10 min after hyperglycaemia, driven by blood glucose, followed by a more prolonged peak about 2 h later, partly driven by incretins (Lorenzo et al., 2010).

After secretion, insulin enters the portal circulation and about 70% is removed during first-pass metabolism by the liver and about 30% is cleared by the kidneys (Duckworth et al., 1998). Insulin has a short half-life, estimated at about 5 min. By contrast, C-peptide, secreted in equimolar amounts, has a longer half-life of about 30 min and has been used as a marker of β-cell function; however, this is only seldom used in horses due to inadequate assays (Yosten & Kolar, 2015).

After insulin binds to its receptor, GLUT4 is translocated to the plasma membrane of insulin-sensitive cells with hepatocytes, adipocytes and especially myocytes being the major effectors of insulin action (McManus et al., 2005). Adipose tissue responds by storing triglycerides and secreting adipokines that modulate insulin sensitivity. In hepatocytes, insulin suppresses gluconeogenesis and glycogenolysis while promoting glycogen storage and lipogenesis.

Glucagon is a peptide secreted by the α-cells of the pancreas (Zhang et al., 2016). Secretion increases during hypoglycaemia or when insulin concentrations are low. Glucagon has opposite effects of insulin and promotes glycogenolysis and gluconeogenesis in hepatocytes, increasing the release of glucose into circulation. It also promotes lipolysis, increasing fatty acid availability as an alternative energy substrate. The glucagon-to-insulin ratio is a critical determinant of energy substrate utilisation (Habegger et al., 2010; Yu et al., 2019).

Additional modulators of glucose metabolism demonstrated in other species and partially confirmed in horses include somatostatin that suppresses both insulin and glucagon secretion and slows gastric emptying, cortisol that suppresses insulin secretion and antagonises its action, catecholamines that act through adrenergic receptors with opposite effects: β_2-receptors enhance insulin secretion, whereas α_1- and α_2-receptors suppress insulin release and enhance glucagon secretion, and growth hormone that antagonises insulin action in glucose and lipid metabolism but can promote β-cell function and insulin secretion at the local level (Bertin et al., 2018; Fields, 1998; Hallman et al., 2025; Kritchevsky et al., 2020; Skoglund et al., 1987; Takano et al., 2001; Toth et al., 2010; van der Meulen et al., 2015).

Adipose tissue functions as an endocrine organ in energy metabolism with leptin and adiponectin secretion gathering increasing interest. Leptin is secreted in proportion to adipose mass and reduces appetite and increases energy expenditure but also promotes endothelial activation and inflammation (Caltabilota et al., 2010; Carter et al., 2009; Gordon & McKeever, 2005). Adiponectin, on the other hand, improves insulin sensitivity, enhances fatty acid oxidation and protects the vascular endothelium. Its concentration is inversely correlated with body mass index in horses (Gordon & McKeever, 2005; Kearns et al., 2006; Teoh et al., 2008).

DEVELOPMENT OF EMS

Insulin dysregulation, as the key element of EMS, refers to any combination of abnormal insulin dynamics, including basal (fasting or fed)

hyperinsulinaemia, excessive postprandial insulin responses to an oral carbohydrate challenge and tissue insulin resistance (IR) (Frank & Tadros, 2014). Although ID is always present in EMS, it can also be observed, permanently or transiently, in other conditions (pituitary pars intermedia dysfunction, systemic inflammatory states, pregnancy and stress) (Bertin et al., 2018; Fowden et al., 1984; McGowan et al., 2004; Mills et al., 1997; Toth et al., 2008). Hyperinsulinaemia is defined as abnormally high circulating insulin concentrations, either in the basal state or in response to a carbohydrate challenge. It can develop independently or as compensation for IR through two main mechanisms: excessive pancreatic insulin secretion caused by dietary nonstructural carbohydrates (NSC) (Treiber et al., 2005) and amplified by GLP-1 and GIP (Bamford et al., 2015; de Laat, McGree, & Sillence, 2016), and reduced hepatic clearance resulting in high systemic insulin concentrations (Dosi et al., 2025; Toth et al., 2010). On the other hand, IR is characterised by a reduced ability of insulin-sensitive tissues to increase glucose uptake and use in response to normal circulating insulin concentrations (Treiber et al., 2005). Rather than a loss of insulin receptors, IR is more likely to arise from defects in several steps of the insulin signalling pathway (Kim et al., 2006). Unlike what is observed in human type-2 diabetes mellitus, equine IR does not usually result in hyperglycaemia (de Laat et al., 2012; Frank et al., 2006; Treiber et al., 2005). Regardless of the mechanism, the consequence is an increased insulin concentration and promotion of a pro-inflammatory environment further decreasing insulin sensitivity.

Environmental and management factors are the most important contributors to the development of EMS (Geor & Harris, 2009). A diet high in NSC, whether from concentrates or pastures, increases glycaemic and insulinaemic responses and strongly promotes the development of ID (Bamford et al., 2016; Dugdale et al., 2011). Pasture NSC content is highly variable, influenced by grass species, season, climate, soil quality and time of day, with concentrations highest during cool seasons and after bright sunny days (Barnabé et al., 2025; Frank, Elliott, et al., 2010; Longland et al., 2023; Longland & Byrd, 2006). Horses and ponies with free access to such pastures are at increased risk, and it can be considered that any horse and pony receiving a diet high in NSC can develop EMS over time and is at risk of developing HAL.

Obesity once considered a central clinical feature of EMS is rather an exacerbating factor than a cause of EMS (Bamford et al., 2016). Regional fat deposition, particularly around the neck crest, tail head and peri-preputial or mammary regions, is strongly associated with metabolic dysfunction (Carter et al., 2009; Fitzgerald, Anderson, et al., 2019). Expansion of adipose tissue can cause tissue hypoxia, which would promote macrophage infiltration and secretion of pro-inflammatory cytokines such as interleukin (IL)-1, IL-6 and tumour necrosis factor (TNF)-α. (Martin-Gimenez et al., 2016; Pleasant et al., 2013; Vick et al., 2007). This low-grade chronic inflammation disrupts insulin signalling pathways and contributes to systemic metabolic imbalance creating a vicious circle (Vick et al., 2007, 2008). That being said, low-grade systemic inflammation is not a consistent finding in all horses with EMS (McGuire et al., 2025).

Physical inactivity further exacerbates metabolic dysfunction. Regular exercise improves insulin sensitivity in skeletal muscle, whereas sedentary lifestyles reduce glucose disposal efficiency and promote fat accumulation; however, some reports failed to demonstrate a beneficial effect of exercise on insulin dynamics (Carter et al., 2010; de Laat, Hampson, et al., 2016). The combination of high-NSC diets, abundant pasture access, and reduced physical activity common in modern management systems creates conditions highly favourable for EMS development.

Although ID is found in horses as young as 4 years of age, insulin sensitivity decreases with age (Hart et al., 2016; Jacob et al., 2018; Pleasant et al., 2013). This physiologic change likely contributes to the increased prevalence of EMS in middle-aged and older animals, and increasing age is a risk factor for ID (Clark et al., 2024; Frank, Geor, et al., 2010).

Breed differences support a genetic contribution to EMS, but evidence is less robust than initially believed. Certain horse breeds such as native British pony breeds, Andalusians, Arabians and Morgans are consistently more susceptible to ID and laminitis than Thoroughbreds or Standardbreds (Bamford et al., 2014; Clark, Bamford, et al., 2023; Norton, Avila, et al., 2019; Norton, Schultz, et al., 2019). Familial clustering within pony populations has been described, suggesting heritability, but the mode of inheritance remains undefined and likely complex (Norton, Avila, et al., 2019; Norton, Schultz, et al., 2019). Genome-wide association studies in Welsh ponies and Arabian horses have identified candidate regions, yet no causative mutations have been confirmed and results could not be confirmed in different populations (Clark, Bamford, et al., 2023; Norton, Avila, et al., 2019; Norton, Schultz, et al., 2019; Roy et al., 2020). Current understanding supports breed predisposition and complex epigenetic regulation rather than a single genetic defect.

EPIDEMIOLOGY AND CLINICAL SIGNS

The reported prevalence of ID is variable and ranges from 10% to 15% in general horse populations to over 30%–40% in pony populations, with certain at-risk breeds (Morgans, Arabians and Andalusians) (Al-Ansari et al., 2024; Clark et al., 2024; Durham et al., 2019; Heaton et al., 2024). Middle-aged animals are most frequently affected, although EMS has been reported in horses as young as 4 years of age, especially in predisposed pony breeds (Frank, Geor, et al., 2010). There is no consistent sex predilection, yet mares can be overrepresented in some studies (Clark et al., 2024).

Generalised obesity is a common but not consistent feature of EMS. Many affected horses have a high body condition score (≥7/9) (Henneke et al., 1983). Obesity can be accompanied by abnormal regional fat distribution, most notably accumulation along the nuchal crest ('cresty neck'), tail head and peri-preputial or mammary regions (Carter et al., 2009). Presence of those local adipose deposits correlates with the risk and severity of ID, even in horses that are not systemically obese. Although not always present, a CNS

>3/5 is often associated with increased odds of ID and HAL (Clark et al., 2024).

Laminitis is the most clinically relevant consequence of EMS. Recurrent and chronic laminitis is the hallmark presentation in many affected horses and ponies (de Laat et al., 2019). Sustained hyperinsulinaemia experimentally induces laminitis in healthy ponies and horses, establishing a causal relationship (Asplin et al., 2007; de Laat et al., 2010a). The prevalence of HAL is variable but consistently exceeds that of the two other forms of laminitis: sepsis-associated laminitis and supporting-limb laminitis (Karikoski et al., 2011). It is estimated that 90% of cases of laminitis are caused by hyperinsulinaemia, demonstrating the central role of ID in the epidemiology of laminitis (de Laat et al., 2019). Episodes often occur during periods of abundant pasture growth (spring and autumn), reflecting the seasonal variation in pasture NSC content (Longland & Byrd, 2006). Even in the absence of acute clinical episodes, horses with EMS often display chronic laminar pathology: divergent hoof wall growth rings, widened white lines and dropped soles (de Laat et al., 2010b). Laminitis associated with EMS tends to be insidious and recurrent rather than catastrophic in onset, but it can still cause profound acute pain and long-term disability (de Laat et al., 2010b).

Additional clinical signs include reduced exercise tolerance and lethargy, often attributed to excess weight or subclinical laminitis, altered reproductive performance, although this association is not as established as in other species, hypertriglyceridaemia, altered adipokine concentrations and systemic markers of low-grade inflammation, which are usually subclinical (Donnelly et al., 2025; Durham et al., 2019; Frank, Geor, et al., 2010; Zemek et al., 2024).

TESTING OF EMS

With an increasingly variable phenotype of EMS, objective diagnostic testing rather than reliance on body condition is required to properly diagnose ID (Bamford et al., 2016). Many tests are available but only a few are relevant in practice. Diagnostic tests can be broadly divided into those that assess insulin secretion (hyperinsulinaemia) and those that assess tissue IR (Bertin & de Laat, 2017).

Diagnosis of hyperinsulinaemia

A single insulin concentration, measured after a 6–12-h fast, is the simplest test. Values > 20 μIU/mL are considered abnormal, but thresholds vary between assays and concentrations > 45 μIU/mL are consistent with a high risk of laminitis (Hart et al., 2016; Knowles et al., 2023; Morgan et al., 2014). Basal hyperinsulinaemia is highly specific but has limited sensitivity, meaning that a normal basal insulin concentration cannot rule out ID (Clark, Stewart, et al., 2023).

Given the low sensitivity of basal insulin, the oral sugar test (OST) is recommended to detect exaggerated postprandial insulin responses. Corn syrup (0.15–0.45 mL/kg) is administered orally after a 3–6-h fast, with blood samples collected at 60 or 90 min (Bertin et al., 2016). Insulin concentrations > 45 μIU/mL are considered abnormal (Jocelyn et al., 2018; Schuver et al., 2014). The OST is practical and more sensitive than basal insulin and is the best predictor of the risk of developing laminitis (Clark, Stewart, et al., 2023; Knowles et al., 2023). If corn syrup is not available, the oral glucose test using dextrose powder (0.75 g/kg) delivered by nasogastric tube or mixed in chaff or standardised pellets can be used as an alternative challenge (de Laat & Sillence, 2017; Warnken et al., 2023).

Diagnosis of insulin resistance

The insulin tolerance test evaluates tissue responsiveness to exogenous insulin. Following intravenous administration of 0.1 IU/kg regular insulin in a nonfasted horse, blood glucose is measured at 0 and 30 min (Bertin et al., 2016). A < 50% reduction in glucose concentration indicates peripheral tissue IR and has the best prediction of a diagnosis of ID (Bertin & Sojka-Kritchevsky, 2013; Clark, Stewart, et al., 2023). The test is simple and informative but carries a small risk of hypoglycaemia, requiring careful monitoring (Durham, 2017). For a complete assessment of a given case, both tests should ideally be performed.

Other tests including the combined glucose-insulin test, the euglycaemic-hyperinsulinaemic clamp or the frequently sampled intravenous glucose tolerance test, all based on intravenous administration of dextrose and insulin followed by serial measurement of glucose and insulin concentrations, provide detailed information but are less practical in field settings due to time and sampling requirements (Eiler et al., 2005; Geor et al., 2010; Kemp, Yuen, et al., 2025; Pratt et al., 2005; Pratt-Phillips et al., 2015; Stokes, Bertin, Stefanovski, Belknap, et al., 2020; Stokes, Bertin, Stefanovski, Poulsen, et al., 2020; Toth et al., 2009). Indices calculated from paired insulin and glucose values lack sufficient reliability for individual diagnosis in horses and are not recommended (Bertin et al., 2016; Bertin & de Laat, 2017).

NONPHARMACEUTICAL MANAGEMENT OF EMS

Diet

Nutrition is the cornerstone of EMS management. The primary goal is to reduce NSC intake as it is the main driver of insulin response while still meeting energy and nutrient requirements (Geor & Harris, 2009; Macon et al., 2022). Hay should form the basis of the diet of horses with or at risk of EMS. Total forage intake should be 2% of bodyweight/day (dry matter basis), going down to 1.25% in overweight horses and in rare refractory cases and under close veterinary supervision, to promote gradual weight loss (Argo et al., 2012, 2015; Dugdale et al., 2010). Beyond the quantity of hay fed, the quality is more important. Ideally, hay with NSC content <10%–12% is recommended to be fed in small meals that

do not exceed 0.1 g of NSC/kg/meal (Macon et al., 2023). Given the variability in hay composition, frequent hay analysis is advised. If the NSC concentration of hay is unknown, soaking hay in cold water for 60 min before feeding can reduce soluble sugar content by up to 30% (Longland et al., 2011). Straw or low-NSC hay alternatives can be incorporated if necessary, but diets must remain balanced for protein, vitamins and minerals with a low-NSC ration balancer (Dosi et al., 2020; Macon et al., 2023). It should also be noted that high-protein meals can lead to a greater insulinaemic response, especially in horses with ID (Loos et al., 2019; Macon et al., 2022).

Since grazing is a major risk factor for HAL in EMS horses, it is recommended to initially eliminate pasture access and keep the horse on a dry lot to control dietary intake with hay. Once ID is managed, careful return to pasture is possible with strategies such as strip grazing, restricting grazing to early morning hours when NSC concentrations are typically lower, or using grazing muzzles to reduce intake by approximately 30%–80% (Fitzgerald, Pollitt, et al., 2019; Frank, Geor, et al., 2010; Longland et al., 2023). Restricting grazing to a few hours a day has been recommended; however, owners tend to underestimate the amount of grass consumed by horses, and especially ponies, in a few hours (Bordin et al., 2024). This results in peaks in glucose and insulin which present a risk for the hooves. Pasture management should be adapted to seasonality, since NSC concentrations peak in spring and autumn (Frank, Elliott, et al., 2010; Longland & Byrd, 2006).

Grain and commercial concentrates rich in starch or sugar should be eliminated. If additional calories are required, in underweight EMS horses for example, fat sources such as vegetable oil or rice bran may be used (Bamford et al., 2016). A low-NSC vitamin–mineral balancer is often necessary to ensure nutritional adequacy when diets are forage-based (Macon et al., 2022).

The insulin response to a diet should be monitored closely, especially when new hay is used or a new pasture is available. For this, insulin should be measured 2 h after the horse or pony has been fed that new diet. An insulin concentration < 50 μIU/mL would indicate a limited risk of HAL under current management while an insulin concentration > 100 μIU/mL would indicate a high risk of HAL. Between 50 and 100 μIU/mL, the risk of HAL cannot be determined.

Foot care

Laminitis being the most serious consequence of EMS, appropriate hoof management is essential to both acute and long-term care. Frequent farriery, every 4 weeks, is required, and close collaboration between veterinarians and farriers is critical for success (O'Grady, 2010). Radiographs should be obtained to assess hoof balance, distal phalanx position and sole thickness, guiding farriery decisions. Regular reassessment is necessary, since chronic HAL will evolve over months. It is this author's experience that a simpler approach with more frequent trimming is more successful than complex and expensive shoeing.

Exercise

Physical activity improves insulin sensitivity and supports weight loss (de Laat, Hampson, et al., 2016). In addition to a proper diet, exercise enhances glucose uptake in skeletal muscle independently of weight loss. Exercise programs should be tailored to the horse's laminitic status. Horses without active laminitis can be placed on a structured program consisting of 5 min of walking, 15 min of brisk trotting and 5 min of walking 5 days/week while carefully monitoring for signs of lameness (Bamford et al., 2019). Obese animals will initially require gradual increases in duration and intensity. In contrast, horses with active laminitis should not be exercised until they are comfortable and hoof stability has improved. Once hoof integrity is restored, exercise can be cautiously introduced, with close monitoring for recurrence of lameness (Meier, de Laat, Pollitt, et al., 2019).

PHARMACEUTICAL MANAGEMENT OF EMS

Dietary modification and foot care remain first-line interventions and are enough in most cases (Durham et al., 2019). Medication is appropriate when nonpharmaceutical measures alone fail to control ID, when laminitis risk remains high, or in the acute phase of HAL. In any case, pharmacologic therapy is only an adjunct tool, not a replacement. Because response to treatment varies between individuals, therapy should be tailored to the specific needs of each horse.

Sodium-glucose cotransporter-2 inhibitors (SGLT2i)

Sodium-glucose cotransporter 2 inhibitors represent a growing therapeutic class for managing ID in horses. These drugs inhibit the SGLT2 in the renal tubules resulting in increased urinary glucose excretion. This mechanism reduces glucose concentrations without leading to hypoglycaemia and decreases pancreatic stimulation and insulin secretion. The SGLT2i velagliflozin is approved for managing diabetes mellitus in cats; however, in horses, there is currently no SGLT2i approved for the treatment of ID. Some studies have explored the use of SGLT2i in horses offering promising results, though limited pharmacokinetic studies have been completed in this species (Thane et al., 2025). The dosages used are extrapolated from human data and should be applied cautiously. Velagliflozin, administered at 0.3 mg/kg bwt orally once daily, has shown potential in reducing insulin secretion and risk of clinical HAL (Meier et al., 2018). Clinical trials up to 40 weeks have demonstrated no adverse effects beyond hypertriglyceridaemia not associated with clinical signs, suggesting both effectiveness and safety of this treatment (Meier, de Laat, Reiche, et al., 2019; Thane et al., 2025). Canagliflozin, another SGLT2i, has been evaluated at doses ranging from 0.3 to 0.6 mg/kg bwt orally once daily and is commonly used in continental Europe (Michanek, Bröjer, Lilliehöök, Fjordbakk, Erkas, et al., 2025; Michanek, Bröjer, Lilliehöök, Fjordbakk, Löwgren, et al., 2025). A

3-week course led to a 66.5% reduction in insulin secretion following a carbohydrate challenge without inducing hypoglycaemia (Lindase et al., 2023). This reduction in postprandial insulin concentrations is attributed to decreased postprandial glucose responses as well as improved β-cell responsiveness (Lindase et al., 2023). However, some horses also experienced hypertriglyceridaemia, though no clinical signs of hyperlipidaemia were observed. Ertugliflozin, administered at a dose of 0.05 mg/kg bwt orally once daily, has been widely used in Australia and the United Kingdom of Great Britain and Northern Ireland (Sundra et al., 2023). This treatment is effective in lowering post-OST insulin concentrations and improving HAL management (Sundra et al., 2024). While severe hypertriglyceridaemia is reported, only a few cases are reported to exhibit clinical signs of hyperlipidaemia (Sundra et al., 2023). In those cases, discontinuation of treatment has resulted in a rapid improvement of triglyceride concentrations. It is this author's experience that doses of 0.02–0.03 mg/kg bwt are associated with clinical improvement and mitigate signs of hyperlipidaemia; however, no recommendation regarding an acceptable concentration of triglycerides or increase in liver enzyme activity can be made.

The use of SGLT2i in horses represents a significant advancement in the management of ID and HAL. Despite the promising outcomes associated with these drugs, potential adverse effects have been reported and further research is necessary to understand their pharmacokinetics, optimal dosing strategies, and long-term effects before firm recommendations can be made (McGorum et al., 2024; Michanek, Bröjer, Lilliehöök, Fjordbakk, Erkas, et al., 2025; Michanek, Bröjer, Lilliehöök, Fjordbakk, Löwgren, et al., 2025).

Levothyroxine sodium

Although EMS is not associated with any thyroid dysfunction, levothyroxine has been used in horses with EMS to accelerate weight loss and improve insulin sensitivity (Frank et al., 2005, 2008). Levothyroxine increases metabolic rate and promotes lipolysis (Frank et al., 2005). The recommended dosage is 0.05–0.2 mg/kg bwt administered orally once a day, with treatment duration extending up to 48 weeks or until the desired weight loss is achieved. Relapse occurs if diet and exercise are not maintained. Cardiac arrhythmias have been reported with levothyroxine administration when given at supraphysiologic doses and it should be used with care in performance horses (Bertin et al., 2024; Kritchevsky et al., 2022). Compared to SGLT2i, levothyroxine has a slower and milder effect on insulin regulation in clinical practice.

Metformin

Metformin is a biguanide that reduces hepatic gluconeogenesis and might decrease intestinal glucose absorption. In horses, oral bioavailability is extremely poor, and clinical efficacy very variable (Hustace et al., 2009; Tinworth et al., 2010). Dosage recommendations range from 15 to 30 mg/kg bwt administered orally every 8 to 12 h depending on the feeding schedule of the horse. Considering its suspected local effect, metformin should be administered 30–60 min before feeding the horse for maximum efficacy (Durham, 2017). Some studies suggest transient reductions in postprandial insulin concentrations, but metformin has a strong horse-dependent effect and despite mixed results, metformin remains an option in select cases where dietary management is not successful (Colmer et al., 2024; Durham et al., 2008; Rendle et al., 2013).

Pioglitazone

Pioglitazone is an anti-type-2-diabetes drug used to improve glucose and lipid metabolism by acting on the peroxisome proliferator-activated receptor gamma (PPARγ). The use of pioglitazone in horses has shown limited efficacy, with overall disappointing results; however, it would have a beneficial effect by increasing adiponectin concentration and more data are necessary before recommendations can be made (Legere et al., 2019; Lowndes et al., 2025; Suagee et al., 2011; Wearn et al., 2012).

Summary on the use of the pharmaceutical management of EMS

The decision to initiate pharmaceutical therapy must be individualised. Some horses respond extremely well to diet and exercise alone, whereas others require pharmacologic support to achieve metabolic control. Treatment choices should consider the horse's phenotype, risk of HAL, owner compliance and cost. Continuous monitoring of insulin concentrations, body condition and hoof health is essential to adjust therapy appropriately.

FOLLOW-UP AND PROGNOSIS

Effective monitoring is essential to assess progress, adapt management and sustain owner engagement. Body condition and regional adiposity should be scored at regular intervals to track changes in weight and fat distribution. Hoof health requires ongoing evaluation by both veterinarians and farriers, supported by periodic radiographs every 4–8 weeks depending on hoof condition and growth. Metabolic testing should focus on postprandial insulin measurement, which provides the most reliable assessment of treatment response in clinical practice. Repeated OST are not recommended for follow-up, as their value is in the detection of cases and they do not reflect the horse's response to the current management. Establishing a collaborative partnership with owners, veterinarians and farriers is key for a successful management and regular communication between all three parties sustains compliance, improves outcomes and strengthens welfare.

The long-term prognosis for horses with EMS is strongly influenced by the severity of ID and the presence of HAL. Horses diagnosed and managed before the onset of clinical HAL have an excellent prognosis when dietary control, exercise and weight reduction are implemented (Coleman et al., 2018; Morgan et al., 2016). Once HAL is present, particularly if it is recurrent or chronic, the prognosis becomes more variable and can range from good to guarded depending on the degree of structural damage to the distal phalanx and lamellae (de Laat et al., 2019). Premature retirement or euthanasia most often occurs because of uncontrollable HAL rather than metabolic dysfunction itself. With sustained management, improvements in body condition, insulin responses and hoof health are achievable in most horses, though relapses remain common if dietary programs are relaxed (Morgan et al., 2016).

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