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MYOSITIS UPDATE
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INTRODUCTION
Although the terminology can be somewhat confusing, it important to recognize the various manifestations of muscle disease in horses that have been defined in the past several decades.

Exertional rhabdomyolysis (ER) is a condition of horses with post-exercise elevations in serum AST and CK. Elevation in CK indicates acute muscle necrosis, persisting for a few days following muscle damage. Elevation in AST indicates muscle or liver damage and elevated values persist for 1 to 2 weeks due to the prolonged half-life of this enzyme. Exertional rhabdomyolysis has been described for a variety of breeds under different conditions; this is a brief review of these manifestations of muscle pathology.

RECURRENT EXERTIONAL RHABDOMYOLYSIS (RER)
Arabian, Standardbreds and Thoroughbreds are predisposed with young, nervous fillies being overrepresented. This form of RER has been reported to have a familial basis that is carries an autosomal dominant mode of inheritance. Clinical manifestations of disease occur most commonly with stress and/or following periods of stall rest prior to exercise. Muscle biopsy reveals various stages of muscle necrosis and regeneration with centrally located myonuclei. Affected horses demonstrate prolonged relaxation of muscle after a contractile twitch, suggesting abnormal intracellular calcium regulation is the cause of this form of ER. Myoplasmic calcium concentrations are elevated in horses with RER.

RECOMMENDATIONS FOR PREVENTION OF RECURRENT EPISODES OF RER INCLUDE THE FOLLOWING:

1) Minimize stress, standardized daily routine, vitamin-mineral supplement, quality feed; avoid excess carbohydrate in the diet.
2) Maintain a diet of high fat (20%) with minimal starch (<7%) in the concentrate.
3) Try to avoid strict box-stall rest for extended periods of time - small paddock turn-out when horse can walk freely - return to exercise program when CK returns to normal.
4) Dantrolene (4 mg/kg PO) 1 hr prior to exercise, inhibits release of calcium from the calcium release channel, used to treat malignant hyperthermia and appears to have some benefit in horses.

POLYSACCHARIDE STORAGE MYOPATHY (PSSM)
Quarter Horses and related breeds have been most commonly identified to suffer from PSSM. Horses with PSSM often have a calm, sedate demeanor. A familial basis for this disorder has been identified in Quarter Horse-related breeds and is reported to be an autosomal recessive disorder. Females are overrepresented and constitute 70% of affected horses.

Polysaccharide storage myopathy is a glycogen storage disorder characterized by the accumulation of polysaccharide in the myoplasm. Affected horses demonstrate an increased sensitivity to the effects of insulin, evidenced by increased rates of glucose clearance resulting in excessive glycogen accumulation within myosites. Abnormal glycogen and complex polysaccharide is found in type-2 (fast twitch) glycolytic fibers, which are the fibers most often found undergoing necrosis in horses with ER. Muscle cramping and damage with exercise has been attributed to the inability of glycogenolysis to generate ATP for mechanical work and maintenance of chemical gradients.

A 15 minute exercise test (trotting on a lunge line) is useful for screening horses for PSSM. An increase in CK of 1000 U/L is observed 4 to 6 hours after exercise in affected horses. Muscle enzymes remain elevated for long periods of time, even if the horse is rested. Foals of affected individuals may demonstrate an increased CK activity after turn-out; histopathologic evidence is generally not present in young horses, necessitating glucose tolerance testing in offspring of affected individuals.

Muscle biopsy reveals subsarcolemmal vacuoles, glycogen storage, and abnormal periodic acid-Schiff (PAS) positive, amylase-resistant inclusions in fast-twitch fibers (5% of muscle fibers). Muscle glycogen concentrations are often more than 1.5 times normal, which classifies this disease as a glyogenosis (glycogen storage disorder).

Treatment is based on increasing the oxidative capacity of skeletal muscle through gradual training and providing a high-fat diet, consisting of good-quality grass hay, no grain or sweet feed, and a fat supplement (0.5 to 3.0 kg/day). The recommended diet provides 25% of total daily calories as fat, which is 2.5 to 3 times the approximately 200 gm of fat proved in typical equine diets. A by-product of rice processing (rice bran, Wollcott Farms, Willows, CA) consisting of 20% fat, corn oil, or spray dried fat supplements can be used. Corn oil can be fed at 1 to 4 cups/day mixed with alfalfa pellets. A high-protein diet (12 to 17%) is also recommended to combat protein use as energy and help build muscle. Due to the increased oxidative potential with a high-fat diet, vitamin E and selenium supplementation is recommended. Daily lunging or riding as well as pasture access are essential. Box stall rest for more than 12 hours per day appears to increase the incidence of rhabdomyolysis.

Dietary change without changes in training are not enough to prevent rhabdomyolysis. A 15 minute exercise test should be used to determine the amount of exercise necessary in the initial training stages. If the horse does not pass, 2 weeks of pasture turn-out with dietary change should be recommended. If horses successfully pass the exercise test, 15 minutes of lunging per day is recommended. Gradual increase of exercise should be implemented by a few minutes every few days. Once horses are capable of trotting for 30 minutes on the lunge without difficulty, work under saddle can begin. Control of clinical signs of ER have been demonstrated after 2 to 6 months of dietary modification and incorporation of a regular exercise routine.

EQUINE POLYSACCHARIDE STORAGE MYOPATHY (EPSM)
This is a condition that has been specifically described in Draft-type breeds. Although the condition has similarities to PSSM, the conditions do not appear identical. Based on abnormal periodic acid-Schiff positive polysaccharide staining on muscle biopsies the overall incidence of disease has been estimated to be 45-66% in Draft-related breeds. Two clinical manifestations of EPSM have been described and include post-exercise rhabdomyolysis and a second condition that
appears to be progressive in nature with a shivers-like gait, progressive muscle wasting, muscle weakness, recumbency and potentially death. Muscle enzymes are variably elevated in association with these conditions and may be mildly to significantly elevated depending on severity of rhabdomyolysis.

Diagnosis of EPSM is based on clinical signs, abnormal muscle enzymes, and glycogen accumulation identified on muscle biopsy specimens. Clinical management involves dietary changes with increased fat intake, similar to levels that have been mentioned for previously described myopathies. Optimal electrolyte, vitamin E and selenium levels should be maintained in all Draft breed horses. It has been suggested that due to the frequency of disease in Draft-type breeds that low carbohydrate/ high fat diets be implemented in all Draft patients.

GLYCOCEN BRANCHING ENZYME DEFICIENCY IN QUARTER HORSE FOALS

Seven related Quarter Horse foals that died by 7 weeks of age have been described to suffer from glycogen branching enzyme (GBE) deficiency. Various clinical signs included stillbirth, transient flexural limb deformities, seizures, respiratory or cardiac failure to persistent recumbency. Glycogen branching enzyme activity was markedly reduced or absent in affected foals and approximately 50% activity was observed in leukocytes obtained from the foals’ dams. Pedigree analysis supported an autosomal recessive mode of inheritance. In the first publication describing this abnormality in QH foals, it was estimated that the affected foals could have as many as 2,600 half-siblings, suggesting that GBE deficiency may be a cause of neonatal foal morbidity and mortality that is obscured by clinical signs that resemble other conditions in neonatal foals. Quarter Horse neonatal foals presenting for sepsis with persistent hypoglycemia, elevated liver enzymes, and elevated CK should be considered to have this emerging disorder.

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