Recurrent Exertional Rhabdomyolysis in Thoroughbred Racehorses: Effect of Diet and Exercise Intensity

Jennifer M. MacLeay, DVM, PhD; Stephanie J. Valberg, DVM, PhD, Flavio De La Corte, DVM; and Joseph Pagan, PhD

Diets high in soluble carbohydrate and exercise below racing speeds are associated with rhabdomyolysis in Thoroughbred racehorses, but rhabdomyolysis is not related to lactic acidosis. Energy sources containing fat or adequate but not excessive amounts of carbohydrate as well as exercise programs tailored for each horse that would minimize stress and excitability should be effective in reducing the frequency of episodes of rhabdomyolysis. Authors’ addresses: Dept. of Clinical Sciences, Colorado State University, 300 W. Drake Rd., Fort Collins, CO 80523 (MacLeay); Department of Clinical and Population Sciences, College of Veterinary Medicine, University of Minnesota, 1365 Gortner Ave., St. Paul, MN 55108 (Valberg and De La Corte); and Kentucky Equine Research, Inc., 3910 Delaney Ferry Rd., Versailles, KY 40383 (Pagan).

1. Introduction
Exertional rhabdomyolysis, also known as tying up, is a syndrome of muscle cramping and necrosis in response to exercise. Clinical findings include anxiety, sweating, contracture of major muscle groups, elevated serum creatine kinase (CK) and aspartate transaminase (AST) activities and myoglobinuria.

Recurrent exertional rhabdomyolysis (RER) in Thoroughbred horses has been described as a defect in muscle contractility that is similar but not identical to malignant hyperthermia in swine.1 RER affects approximately 5% of Thoroughbred racehorses, represents a major cause of economic wastage and occurs more commonly in young, female Thoroughbred racehorses with a nervous temperament.2

A high-carbohydrate (CHO) diet and periods of stall rest with subsequent glycogen loading of the muscle have been proposed in the pathogenesis of exertional rhabdomyolysis. Therefore, a common recommendation for horses with chronic rhabdomyolysis is to decrease total dietary soluble CHO. The purpose of this study was to examine the effect of diet and exercise intensity on rhabdomyolysis in Thoroughbred horses with RER.

2. Materials and Methods
Each of eight Thoroughbred horses (three with RER and five healthy controls) was fed three different diets (low-CHO, high-CHO, and fat) for 3 weeks on each diet. The fat and low-CHO diets were formulated to meet the caloric needs of the horses, and the high-CHO diet provided 35% more digestible energy. Horses performed identical treadmill exercise pro-
tocols 5 days per week consisting of 2 nonconsecutive days of exercise performed at a gallop, 2 nonconsecutive days performed at a canter, and 1 day performed at a trot. On the last day of each 3-week period, horses performed a standardized exercise test (SET). Blood was collected daily before, at the conclusion of, and 4 hours after exercise and was analyzed for plasma lactate concentration and CK activity.

Heart rates (HR) were recorded and venous blood samples were taken before the SET, during the last 30 seconds of each stepwise incremental increase in speed and 5 minutes after and 4 hours after completion of the SET. Samples were analyzed for packed cell volume (PCV), plasma total solids, and plasma lactate concentration. Blood samples obtained before and 4 hours after the SET were analyzed for CK activity. Biopsy samples from the middle gluteal muscle were obtained before and immediately after completion of the SET and used to determine muscle lactate and glycogen concentrations.

3. Results
There was no effect of diet or daily exercise intensity (trot, canter, gallop, SET) on CK activity before or after exercise within the control group or on CK activity before exercise between RER and control horses. Irrespective of exercise intensity, RER horses fed the high-CHO diet had higher CK activity before exercise than RER horses fed the fat diet. RER horses fed the high-CHO diet had CK activity after exercise twice as high (p = 0.03) as the value in RER horses fed the low-CHO diet and 1.4 times as high as (p = 0.09) that in RER horses fed the fat diet. RER horses exercised at a trot had CK activity after exercise 1.8 times as high (p = 0.04) as that of horses exercised at a gallop. RER horses exercised at a canter had CK activity after exercise 1.7 times as high (p = 0.06) as that of RER horses that galloped. RER horses fed the high-CHO diet and exercised at a canter had the highest CK activity after exercise, whereas the second highest values were in RER horses fed the high-CHO diet and exercised at a trot.

Plasma lactate concentration was higher for RER horses before exercise but did not differ after exercise between RER and control horses. CK activity 4 hours after exercise and serum lactate concentration immediately after exercise were not correlated in RER horses.

Metabolic responses to the SET, including muscle glycogen concentration before and after the SET, were not different between RER and control horses. Mean packed cell volume and HR before the SET for horses fed the high-CHO diet tended to be higher than for horses fed the low-CHO and fat diets. There was no significant effect of group on CK activity before or after the SET. However, CK activity after the SET was greater than 400 U/l more frequently in RER horses than in control horses.

4. Discussion
The results of this study show no difference in metabolic response to exercise in RER and healthy control horses. Results indicate that a high-CHO diet designed to exceed daily caloric requirements increases serum CK activity in Thoroughbred horses susceptible to RER. However, increased CK activity and rhabdomyolysis caused by glycogen loading and subsequent lactic acidosis was unsubstantiated. In the Thoroughbred horses performing the SET, there was no evidence of glycogen loading and no correlation between plasma or muscle lactate concentrations and serum CK activity.

Subjectively, the horses in this study were more excitable when consuming the high-CHO diet and calmer when consuming the fat diet, as has been observed in other studies. The higher plasma lactate concentration, packed cell volume and HR seen in the RER horses before daily exercise and the SET may have reflected anticipation of exercise or anxiety.

Management of horses with RER should include exercise protocols that involve short bouts of high-intensity exercise and the use of diets low in CHO or high in fat that are formulated to meet but not exceed daily caloric requirements.

References