Exertional Rhabdomyolysis in 8 Division I Female Lacrosse Athletes: A Case Series

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Exertional Rhabdomyolysis (ER) is a complication of exercise that can be fatal if not recognized and treated appropriately. It is defined as the dissolution of skeletal muscle that produces a nonspecific clinical syndrome that causes leakage of toxic intracellular contents into the circulatory system. This dissolution is manifested by increased extracellular myoglobin, potassium, phosphate, creatine kinase (CK), or urate that is released by the damaged myocytes. Release of these products into the bloodstream can result in decreased cellular function, renal failure, and even death in severe cases. Most cases of ER are a result of muscle overexertion, alcohol abuse, muscle compression, or the use of certain medications. Initially, ER presents with symptoms similar to those observed with cases of delayed-onset muscle soreness (DOMS). Both DOMS and ER can occur after moderately strenuous physical exertion. Because of the similar manifestations of DOMS and ER, it is essential to obtain a proper history of an athlete's activity levels, hydration levels, and medical history to ensure a proper course of treatment.

The pathophysiology of ER is a direct result of the energy requirements exceeding the athlete’s ability to produce adenosine triphosphate (ATP). As these requirements exceed production, the ATP-dependent sodium-potassium pump begins to fail, which results in an electrochemical disruption across the cell membrane and increased intracellular calcium levels. This increase initiates normally dormant enzymes that destroy the cell membrane, resulting in leakage of intracellular contents into the local circulation. ER is typically characterized by the release of intracellular contents into the local circulatory system that are signaled by an elevation in CK levels. There are no toxic properties in CK, but elevated CK levels serve as a marker for increased permeability of muscle membranes. Although slightly elevated levels of CK might be observed in cases of DOMS, ER alone results in gross elevations of serum CK. Serious complications of ER include renal failure, cardiac dysrhythmias, compartment syndrome, disseminated intravascular coagulation, lactic acidosis, and possibly death. These can all be avoided with early recognition and treatment.

Case Series

Athletes

Eight Division I female lacrosse athletes ranging in age from 18 to 22 years (M = 19.38) reported to the athletic therapy and training staff with complaints of myalgia, muscle stiffness, decreased flexion and extension range of motion at the elbow joint, and minor swelling over the distal biceps brachii muscle. The preceding day, all 8 athletes had participated in the first official weight-training session of the year. During this workout, each athlete performed three sets of 20 biceps curls with a 15-lb load in each hand, with the exception of 1 athlete who completed the task with a 10-lb load. All 8 athletes displayed symptoms consistent with DOMS and possibly ER when reporting to the clinical staff. Each was subsequently referred to the team physician. We note that 2 of the 8 athletes had a previous history of ER.
Diagnostic Testing and Initial Treatment

The team physician ordered diagnostic blood testing on all 8 athletes, which revealed gross elevations in CK levels ranging from 4,287 to 28,247 U/L (units/liter). Normal values range from 22–200 U/L. As a result of elevated CK levels, the athletes were diagnosed with localized ER. At this time there were no signs of compartment syndrome, renal failure, or electrolyte abnormalities. Intravenous saline infusions were started immediately, and the athletes were instructed to refrain from all forms of physical activity, hydrate properly, and rest. Until the condition resolved, daily follow-up visits with the team physician were scheduled.

Extended Treatment and Management

Three days after the initial workout, all 8 of the athletes continued to show average CK levels of 13,244 U/L (see Figure 1); subsequently, over the next 5 days all were restricted from any athletic physical activity. CK levels were monitored closely along with electrolytes, kidney function, and compartment status. Approximately 1 week after the onset of ER, normal CK levels, decreased swelling over the involved area, and normal range of motion were observed in 6 of the 8 athletes. These 6 were released and began participating in physical activity; however, they were not permitted to perform any upper body weight lifting for another 7 days. The athletes were instructed to approach their upper body lifts with caution and were instructed to follow a slow progression in intensity. This was essential to ensure that a relapse of the condition did not occur as a result of the weakened state of the muscles. After 2 weeks had passed, the other 2 athletes were allowed to return to physical activity with restrictions on upper body weight training. Their CK levels took an extended period of time to return to normal levels. At 3 weeks postinjury, all 8 athletes had returned to full participation and unrestricted weight training. In order to prevent future occurrences of this condition, the team physician met with the strength-and-conditioning staff, as well as the coaches, to discuss modifications in weight-lifting routines. There were no long-term complications as a result of ER in any of the athletes, and all successfully completed the competitive season.

Discussion

Treatment goals for rhabdomyolysis include resolving the condition by saline infusions, maintaining proper hydration, and rest. Hospitalization might also need to be considered. CK levels, blood tests, and urinalysis eventually return to normal. Restoring the muscles' normal function becomes a priority, but this must be

![Serum Creatine Kinase Levels Following Exertional Rhabdomyolysis](image)

Figure 1  Serum creatine kinase levels in the affected athletes on Days 2, 3, and 7 postinjury. U/L = units/liter.
accomplished slowly and progressively while closely monitoring the athlete.

The case presented here is unique given that 8 athletes on the same team developed ER concurrently. ER is often overlooked or underreported unless it has progressed to a dangerous state. Certified athletic trainers must be able to recognize the signs and symptoms associated with ER and refer these athletes immediately for prompt medical treatment and follow-up care.

Although uncommon, ER occurs in the athletic population because of the amount and level of exercise performed by this population. Athletic trainers should be aware of conditions that predispose individuals to ER and screen incoming athletes for such conditions as sickle cell anemia/sickle cell trait, infections, electrolyte abnormalities, and endocrinologic disorders. Dehydration might also predispose athletes to ER because of the increased burden it imposes on the kidneys to counter the ill effects. Individuals with these predisposing conditions should be monitored closely. Sudden changes and increases in weight-training loads or excessive physical exertion have been documented as common causes of ER. In the case in this report, the athletes participated in the first official weight-training session of the year after a 3-month hiatus. This sudden and drastic change in muscle activity, after a summer in which many of the athletes did not weight train, could have contributed to the development of ER.

Differential diagnosis with ER might include genetic rhabdomyolysis, DOMS, and chronic muscle strain. The history and mechanism of injury will aid in differential diagnosis. Athletes, athletic trainers, coaches, and strength-and-conditioning staff should be properly educated and informed on causes, as well as the signs and symptoms, of ER.

References


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