Case study: Exercise-induced rhabdomyolysis

By Cathie Miller

A healthy 28-year-old firefighter presented to the emergency department with complaints of abdominal muscle pain after an intense cross-training workout. He usually worked out three to five times a week and had an intense workout wherein he did 150 repetitions on a sit-up machine. Twenty-four hours later he could not stand upright and complained of discoloured urine. A dip of his urine indicated large blood and trace of protein. He did not sustain a kidney contusion and did not have CVA tenderness on examination. His physical exam elicited significant abdominal muscle tenderness. Urine was sent for a myoglobin, which returned positive and blood was drawn, which indicated a serum creatine kinase (CK) of 69,400U/L (reference 38-174U/L).

Rhabdomyolysis is the destruction of muscle resulting in leakage of the muscle protein myoglobin into the urine. Myoglobin, a heme-containing protein component of the muscle cells, is excreted into the urine when muscle is broken down. It results in the production of red to brown urine. Because of rapid excretion, myoglobin does not produce a change in plasma colour unless renal failure limits myoglobin excretion. CK is an enzyme that is in the muscle cells and elevation in this serum level is a hallmark of rhabdomyolysis. CK is a protein that facilitates chemical reactions in the body. It is also present in cardiac muscle and brain. The levels of both of these proteins can be measured in the blood to monitor the degree of muscle injury from rhabdomyolysis. Myoglobin is cleared more rapidly from the plasma than CK and the CK levels can remain elevated in the absence of myoglobinuria.

Rhabdomyolysis can be caused by muscle trauma, crush injury, severe burns, physical torture, child abuse, prolonged lying on the ground, i.e., in people who fall or are unconscious and unable to get up for prolonged periods, prolonged coma, severe muscle contractions from prolonged seizures, cocaine use with related hyperthermia related to increased body temperatures, extreme physical activity such as running a marathon, drug or alcohol intoxication, low circulating serum phosphate, potassium, or magnesium levels, genetic muscle diseases, prolonged drowning or hypothermia, medications such as statins used to treat high cholesterol, viruses and some bacterial infections, severe hypothyroidism, lack of blood perfusion to a limb, inflammatory disorders of the muscle such as myopathies, myositis, dermatiomyositis, polmyositis and venom from snake bites in Africa, Asia and South America.

Rhabdomyolysis is not normally associated with exercise. It can be brought on by severe exertion such as marathon running or an unusual amount of high-impact callisthenics. When exercise continues long enough for the body to become depleted of oxygen and fat that are needed to continue producing energy, the body may begin to break down muscle fibres. It uses this in place of fat. This causes the release of myoglobin protein, which further breaks down to compounds that can harm the body. Early symptoms from exercise-induced rhabdomyolysis include red or brown urine, weakness and extreme muscle aches and tenderness. Exercise-induced rhabdomyolysis generally occurs in poorly conditioned individuals, but can also develop in fit people. Factors such as poor hydration, humid conditions, high outdoor temperatures and a genetic predisposition are risk factors. The incidence of exercise-induced rhabdomyolysis is not really known. One study tested 337 military recruits during their first six days of conditioning and found 40% of the recruits to have some degree of rhabdomyolysis. The syndrome has also been commonly reported in professional athletes during marathon races and ice-skating competitions.

Some of the complications of rhabdomyolysis are kidney failure that occurs due to the direct injury to the kidney and plugging of the filtering tubes by the muscle proteins impairing the kidney function. Compartment syndrome from the swelling and increased pressure in a confined area of the muscle injury can compromise circulation and endanger the affected tissue. This is most common in lower leg or abdominal wall injuries. As well, serum electrolyte abnormalities can be present causing hyperkalemia and hyperphosphatemia.

This 28 year-old-male was admitted to hospital for treatment of exercise-induced rhabdomyolysis with IV rehydration of normal saline and monitoring of his renal functions, electrolytes and muscle enzyme levels. Management includes plasma volume expansion with IV isotonic saline as soon as possible, monitoring the serum potassium, calcium, phosphate and CK levels and treatment of the underlying causes of rhabdomyolysis. He also received a sodium bicarbonate to alkalinize his urine. Twelve hours after initiating IV rehydration his CK was 56,380U/L. His CK continued to fall and 24 hours post-admission the level was 50,720U/L and 48-hour level was 37,120U/L prior to his discharge from hospital.

As this case illustrates, exercise-induced rhabdomyolysis may be associated with forms of excessive physical exertion, as well as cross training and weightlifting. The increased prevalence of such "extreme" training regimens requires an awareness of this syndrome, as proper treatment is mandatory in order to prevent several serious complications, in particular, the development of acute renal failure.

References

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