CLINICAL VIGNETTE

Positive CrossFit® Sign – Exertional Rhabdomyolysis

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Introduction

Rhabdomyolysis is a condition characterized by muscle breakdown leading to cellular necrosis and elevated creatine kinase (CK) levels. Symptoms typically include muscle pain, muscle weakness and myoglobinuria. This syndrome ranges from asymptomatic elevation in CK levels to profound CK elevation, electrolyte imbalances and acute renal failure. The incidence is approximately 29.9 per 100,000 patient years.[1] The percentage of patients who develop acute kidney injury varies from 13% to over 50%.[2]

The pathophysiology of this condition may be described in three main categories including: traumatic, non-traumatic exertional, and non-traumatic non-exertional. Traumatic rhabdomyolysis typically occurs with crush injuries, prolonged immobilization or ischemia. Nontraumatic exertional rhabdomyolysis occurs with intense exercise, hyperthermia, or metabolic myopathies. Nontraumatic non-exertional rhabdomyolysis occurs with medications (statins, colchicine, antibiotics, stimulants), infections (viral and bacterial), toxins (carbon monoxide, insect venom), or electrolyte disorders (hypokalemia, hypophosphatemia).[3]

This case reports non-traumatic exertional rhabdomyolysis after intense exercise in a CrossFit® program. CrossFit® is a brand of fitness regimen comprised of high-intensity interval training, Olympic weightlifting, and plyometrics. There has been an anecdotal association between CrossFit® workouts and exertional rhabdomyolysis, though the quantitative impact has not been validated in studies.

Case

A 29-year-old female marathon runner with a past medical history of irritable bowel syndrome presented to primary care for evaluation of severe arm pain and swelling. Two days prior to presentation, the patient had completed a CrossFit® workout after a year-long absence from the exercise program. She had performed dozens of body-weight pull-ups, bicep curls with 15-pound dumbbells and rope climbing over the course of 1 hour. She noted initial arm soreness that progressed to severe pain, stiffness and weakness over two days. Her symptoms worsened despite ice, salt baths, and ibuprofen. She also reported nausea, loose stools and generalized back pain. She denied redness or bruising of her arms, brown urine, vomiting, fevers, or chills. The patient took a multivitamin daily but denied taking any medications, alcohol, or illicit drugs. She reported drinking 60-80 ounces of water daily.

Her presenting vital signs were as follows: blood pressure 133/96, heart rate 77, afebrile. Physical examination revealed pronounced swelling and tenderness to palpation over both upper extremities. No erythema or pitting edema was present. Bilateral upper extremities were warm and well perfused with normal distal pulses. She was limited to 120 degrees of elbow extension and 90 degrees of elbow flexion. Forward flexion of the shoulders was limited to 90 degrees. The remainder of the physical exam was normal.

Initial labs showed a creatine kinase (CK) of 70,400 U/L, urinalysis with 2+ blood, zero red blood cells (RBCs) and pH of 7. Creatinine was in normal range at 0.66. A diagnosis of rhabdomyolysis was made. Due to the severity of her rhabdomyolysis, the patient was admitted to the general medicine service for prevention of pigment-induced acute kidney injury and monitoring. The patient was hydrated aggressively with lactated ringers' solution, initially at a rate of 750 mL/h, and then titrated to maintain urine output between 200 and 300 mL/h. Over the first two days of the hospitalization, the patient reported worsened swelling and tightness in both proximal upper extremities without shortness of breath or other signs of severe volume overload. However, serial labs showed a steady decrease in CK, bland urine and preserved renal function. On the day of discharge (sixth day of hospitalization), patient's CK had decreased to 5100. She had regained close to full range of motion in her left upper extremity but continued to have limited extension (135 degrees) at the right elbow. She was discharged with outpatient physical therapy and occupational therapy for both upper extremities and was set up for close follow-up with her primary care provider.

Discussion

The management of rhabdomyolysis is focused on preventing acute kidney injury (AKI), reducing further muscle damage, and monitoring for life-threatening complications. Treatment is directed towards the specific cause of the rhabdomyolysis, such as discontinuation of a statin in a patient with a statin myopathy or cooling a patient after heat stroke. In the case of exertional rhabdomyolysis, the focus is on prevention of AKI through early and aggressive volume repletion. Based on clinical observation, the risk of AKI appears to be much lower than with other

causes of rhabdomyolysis.[4] There have been no high-quality studies to determine the optimal rate of repletion or type of intravenous (IV) fluids that should be administered. In general, IV isotonic saline should be initiated as a bolus and then as a continuous infusion titrated to maintain a urine output of 200-300 mL/hour, while monitoring for signs of volume overload or compartment syndrome.[5] Electrolytes and CK levels should be serially monitored. IV fluids should be continued until the CK is less than 5000, as studies have shown a low likelihood of AKI below this threshold.[6] If AKI occurs or worsens despite aggressive IV fluid repletion, then hemodialysis may need to be initiated based on standard hemodialysis indications (acid/base or severe electrolyte derangements, volume overload, uremia).

While alkalinization of urine is frequently attempted in clinical practice, there is little evidence behind this practice. Theoretically, myoglobin precipitates in an acidic environment, therefore maintaining a urine pH > 6.5 can potentially decrease deposition in the renal tubules. However, alkaline diuresis has not borne out in studies to be superior to saline diuresis in preventing AKI.[5-7]

With regard to recovery, there are no evidence-based guidelines for athletes with regards to timing of return to play after exertional rhabdomyolysis. An athlete is considered high-risk if rhabdomyolysis occurs after a mild-to-moderate intensity workout, recovery is delayed more than 1 week, or if there is any degree of AKI. High-risk athletes may warrant evaluation for myopathic disorders.[1] If an athlete is considered low-risk, gradual return to play is probably acceptable.

The primary care physician may often be the first provider to assess patients suffering from rhabdomyolysis. It is important to recognize the triad of muscle pain, weakness and swelling, as well as to appreciate that dark urine may or may not be present. Initial evaluation with CK level, basic metabolic panel and urinalysis is indicated. Urinalysis may show the presence of hematuria without significant red blood cells, which is suggestive of myoglobinuria. The aforementioned muscular symptoms, in addition to an elevated CK level 5 times the upper limit of normal, make the diagnosis of rhabdomyolysis.[1]

There have been several case reports over the last few years of exertional rhabdomyolysis in healthy females in their twenties.[8-11] Primary care physicians should have a lower threshold to initiate rhabdomyolysis evaluation in patients who participate in CrossFit® and similar intense exercise regimens. The CrossFit® organization has published articles on the subject in their own journal. However, there has been criticism about the cavalier nature in which the condition has been depicted, including a cartoon mascot called “Uncle Rhabdo” – a clown who has exercised to exhaustion with his kidney and intestines hanging on the floor, attached to a dialysis machine. With increased participation in physically hyper-intensive workout programs, it may be prudent to counsel patients about the specific hazards and potential consequences of pushing too quickly beyond baseline fitness levels.

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