CLINICAL VIGNETTE

Rhabdomyolysis After a Spinning Class: A Case Report

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Introduction

Rhabdomyolysis is a potentially lethal condition resulting from muscle necrosis and leakage of muscle contents into the circulatory system. The most common causes are traumatic muscle injury, overexertion, alcohol abuse and certain medications. Other less common causes include infection, inflammation, metabolic, endocrinologic and genetic conditions. There are two ways that medications can increase risk of Rhabdomyolysis. Statins, cyclosporin and zidovudine have direct myotoxic effects. Alcohol, cocaine, amphetamine, ecstasy, LSD, and neuromuscular blocking agents have been associated with indirect muscle damage. Other causes of Rhabdomyolysis include severe muscle trauma from crush injury, immobilization, and third degree burns. Ischemia can also result in muscle injury as well as heatstroke, and malignant hyperthermia neuroleptic malignant syndrome. There are approximately 26,000 cases of rhabdomyolysis reported in the United States annually.[1]

Case Report

A 25-year-old woman with no past medical history presented to the emergency room after 2 days of brown-colored urine and progressive bilateral thigh pain. She attended a spinning class for the first time 2 days before presentation. She did not take any medications, drugs or alcohol. In the ER, patient had a temperature of 99°F, blood pressure of 133/90 mmHg, heart rate of 112 beats per minute and respiratory rate of 12 per minute. On physical examination, the patient had warmth and tenderness to palpation on both thighs and limited range of motion to both knees because of pain. Laboratory results showed a creatine kinase (CK) of 18,200 units per liter (normal range, 38–234 units per liter), elevated levels of muscle enzymes (creatine kinase–MB, lactate dehydrogenase, alanine aminotransferase, aspartate aminotransferase and myoglobin) and serum creatinine of 0.87 mg/dL. Urine dipstick was positive for blood but showed no red blood cells, suggestive of myoglobinuria. A diagnosis of rhabdomyolysis was made, and the patient was treated aggressively with intravenous fluids during hospitalization. The patient's hospital course was uncomplicated. Her CK levels progressively declined and her kidney function remained stable. Patient was discharged home after four days of hospitalization.

Discussion

Exercise–induced rhabdomyolysis related to spinning classes has been reported in the past. The first case of spinning–induced rhabdomyolysis was reported in 2004 in the United Kingdom.[2] After reviewing cases of spinning-induced rhabdomyolysis in the literature, case reports revealed various complications ranging from benign electrolyte imbalance to severe complications such as compartment syndrome and acute kidney injury. Other examples of exercise-induced rhabdomyolysis has been reported in relation to military training, marathon running, and other forms of strenuous exercise.

Clinical Manifestations

Rhabdomyolysis is characterized by the presence of myalgias, red to brown urine due to myoglobinuria and elevated serum muscle enzymes including creatine kinase (CK). Muscle symptoms include muscle pain, weakness, stiffness and cramping. More than half of patients may not report muscular symptoms but in contrast, others may experience severe pain.[3] When muscular symptoms are present, the proximal muscles such as thighs, shoulders, calves and lower back are involved. Additional symptoms that are common in severe cases include fever, malaise, tachycardia, nausea, vomiting and abdominal pain.[4] Altered mental status may occur from the underlying etiology (e.g., electrolyte abnormalities, toxins, drugs, alcohol).

Physical Findings

Muscle swelling, weakness or tenderness maybe present depending upon the severity of muscle injury. Skin changes due to ischemic tissue injury such as discoloration, blisters or necrosis may also be seen. Patients may be in distress with fever, tachycardia or tachypnea in severe cases of rhabdomyolysis.

Laboratory Findings

The hallmark of rhabdomyolysis is an elevation of creatine kinase (CK) and other serum muscle enzymes. The other important finding is the red to brown urine from myoglobinuria. This finding is present in only half of the cases and therefore its absence does not exclude the diagnosis.[4]

Creatine kinase: At presentation, the CK levels are at least five times the upper limit of normal, but could range from approximately 1,500 to over 100,000 international units per liter. The CK is almost entirely of the skeletal muscle fraction

and only a small portion of the total CK maybe from myocardial source. The serum CK begins to rise within 12 hours following muscle injury and reaches its maximum level within 24 to 72 hours. A decline is typically seen within 3 to 5 days of cessation of muscle injury. CK has a certain half-life of about 1.5 days and declines at a relatively constant rate of about 40 to 50 percent of the previous day's value.[5-7] Other muscle enzymes in addition to CK are generally elevated (e.g., aldolase, amino-transferases, lactate dehydrogenase), but such testing is not necessary to make the diagnosis of rhabdomyolysis.

Urine findings and myoglobinuria: Evidence of myoglobinuria should be sought by routine urine dipstick evaluation combined with microscopic examination. Myoglobin, a heme-containing respiratory protein, is released from damaged muscles along with creatine kinase. Myoglobin is a monomer that is not significantly protein-bound and is therefore rapidly excreted in the urine, often resulting in the production of red to brown urine. It starts to appear in the urine when the plasma concentration exceeds 1.5 mg/dL. Visible changes in the urine color occur once urine levels exceed 100 to 300 mg/ dL. Myoglobin has a half-life of only 2 to 3 hours. Myoglobin is rapidly excreted and metabolized to bilirubin therefore serum levels return to normal within 6 to 8 hours. Because myoglobin has a half-life that is much shorter than CK, it is not unusual for CK levels to remain elevated in the absence of myoglo-binuria. As previously mentioned routine urine testing for myoglobin with the urine dipstick evaluation may be negative in up to 50 percent of patients with rhabdomyolysis.[4]

Both hemoglobin and myoglobin can be detected on the urine dipstick as "blood" Hemoglobin, the other heme pigment capable of producing pigmented urine is a tetramer and is protein-bound. It is a much larger protein than myoglobin, which requires a much higher plasma concentration to produce a red to brown urine.

Proteinuria may also be seen due to the release of myoglobin and other proteins from the damaged muscle cells. In 1 study, proteinuria was detected by dipstick in up to 45% of patients.[3]

Other Manifestations

Other manifestations of rhabdomyolysis include fluid and electrolyte abnormalities, acute kidney failure, hepatic injury, cardiac dysrhythmia, compartment syndrome, and rarely, disseminated intravascular coagulation (DIC). Hypovolemia results from influx of extracellular fluid into injured muscles which increases the risk of acute kidney injury. In rhabdomyolysis damaged muscle cells release potassium and phosphorus into the circulation leading to hyperkalemia and hyperphosphatemia. Hypocalcemia may occur in the first few days because of calcium entry into the damaged myocytes, deposition of calcium salt in damaged muscle and decreased bone responsiveness to parathyroid hormone. Severe hyperuricemia may develop because of the release of purine from damaged myocytes and, when acute kidney injury occurs, there is reduced urinary excretion of purines.

Acute kidney injury (AKI) is a common complication of rhabdomyolysis. The reported frequency of AKI ranges from 15 to over 50% (3). The risk of AKI is lower in patients with CK levels at less than 15 to 20,000 units per liter. Renal dysfunction in rhabdomyolysis results from volume depletion, renal ischemia, tubular obstruction due to heme pigment casts and tubular injury from free chelatable iron.

Compartment syndrome is a potential complication of severe rhabdomyolysis that may develop due to the edema subsequent to muscle injury and tissue damage.[8] The fascia that delineates the compartments prevents expansion and causes the intra-compartmental pressures to rise. Patients often present with severe pain to palpation in the extremity involved. Most commonly, compartment syndromes develop in the leg or the forearm. Compartment pressures greater than 30 to 45 mmHg typically necessitate surgical intervention.[9] Fasciotomy is the definitive treatment for compartment syndrome of any etiology. The decision to perform fasciotomy is not always simple. In general it is prudent to err on the side of release when the clinical picture is unclear since the morbidity of a missed compartment syndrome is far worse than the morbidity of fascial release. A delay could lead to muscle necrosis, persistent nerve damage or permanent disability.[10]

Diagnosis

The diagnosis of rhabdomyolysis can be made when there is an acute neuromuscular illness or myoglobinuria with a marked elevation in serum creatine kinase (CK). The CK is typically at least five times the upper limit of normal and is usually greater than 5000 international unit/L. The level of CK elevation is considered within the clinical context of the history and examination findings.

Differential diagnosis

The differential diagnosis of myalgia, elevated creatine kinase and dark urine are fairly extensive. The following conditions may be considered such as myocardial infarction, hematuria and hemoglobinuria, inflammatory myopathy, immune-mediated necrotizing myopathy and nephrolithiasis.

Management

Early diagnosis of rhabdomyolysis is important to avoid potential complications. Aggressive intravenous fluid hydration and treatment of electrolyte abnormality should be initiated in order to prevent severe metabolic disturbances and acute kidney injury. It is also important to identify the specific cause of rhabdomyolysis (e.g., exertional, crush injury, toxins, drugs, alcohol) and apply the appropriate supportive measures.

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