CrossFit-induced rhabdomyolysis: a case report

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CrossFit is a fitness regimen that has recently gained popularity in Korea. Although this training program has been shown to increase stamina and body fitness, it has also been associated with risk of exertional rhabdomyolysis. The severity of exertional rhabdomyolysis ranges from mild to life threatening situations, including acute renal failure, compartment syndrome, hepatic dysfunction, disseminated intravascular coagulation, cardiac arrhythmia, and even death. In this report, we describe a case of exertional rhabdomyolysis after CrossFit training. We have reviewed the current literature and suggested possible preventative measures during training to minimize injuries associated with CrossFit workouts.

Keywords: CrossFit; Rhabdomyolysis

INTRODUCTION

CrossFit is a high-intensity fitness regimen, popular in western countries, that has recently gained popularity among Koreans. The number of CrossFit gyms has increased in Korea. Although it has been shown to improve stamina and body fitness, the training program has been associated with risk of injury, such as exercise-induced rhabdomyolysis. Exertional rhabdomyolysis is often underdiagnosed and underreported, and very few studies concerning CrossFit-induced rhabdomyolysis have been published [1,2]. Exertional rhabdomyolysis is a serious medical condition caused by muscle damage [1,3–5]. The condition is characterized by muscle weakness, restricted active and passive movements, severe myalgia, and dark urine. It has a wide clinical spectrum, ranging from mild to life threatening clinical manifestations, including acute renal failure, compartment syndrome, hepatic dysfunction, disseminated intravascular coagulation, cardiac arrhythmia, and even death [6,7].

With the increasing popularity of CrossFit gyms, healthcare professionals and CrossFit coaches should become wearier of the potential health risks, such as exertional rhabdomyolysis, of CrossFit workouts. CrossFit-induced exertional rhabdomyolysis should be diagnosed earlier and appropriately managed, and preventative strategies against this condition should be implemented in the near future. Here, we report a case of exertional rhabdomyolysis induced by CrossFit.

CASE REPORT

A 33-year-old male patient presented with severe myalgia on his shoulder and upper arm and with dark colored urine. The patient reported of having recently begun an intensive training program at a CrossFit gym. The training program involved several intensive workout exercises. Workout exercises would typically be three sets of 100 pushups or 3 sets of shoulder exercises, which comprise 20 alternated biceps curls, 20 shoulder presses, 20 triceps kickbacks, 20 lateral raises, and 20 lying flies, with a 20-kg dumbbell. Each set is usually completed within few minutes with a 1-minute rest interval between sets. The workout sessions are held in groups, and participants are encouraged to compete with each other. The patient...
stated that although he had exercised regularly he had never performed such intense training before. The patient was not a smoker, did not take drugs, or have any allergies or a notable medical history. The patient was 175 cm in height and weighed 86 kg.

On physical examination of the patient, we noted that he had severe muscle tenderness in the shoulder and the upper arm. Manual muscle grading test could not be performed because the patient had severe myalgia. Findings of other physical examinations, electrocardiography, and chest radiography were normal. We found that the patient had a serum creatine kinase (CK) level of 85,868 units/L (normal range, 30–300 units/L) and a muscle and brain fraction of 0.3% (reference value, < 6%). We found that the levels of lactate dehydrogenase, aspartate aminotransferase, and alanine aminotransferase were elevated to 4,750 units/L, 632 units/L, and 485 units/L, respectively. A urine analysis revealed dark brown urine, 2+ occult blood, 2+ protein, and a myoglobin level of 150,000 ng/mL (reference value, ≤ 10 ng/mL). Creatine levels and the estimated glomerular filtration rate were within the normal range.

We diagnosed exertional rhabdomyolysis, and the patient was admitted and transferred to an internal department for aggressive fluid therapy. We administered intravenous isotonic fluid to the patient at a rate of approximately 400 mL/h initially and then titrated it to maintain a urine output of at least 200 mL/h [8]. The patient’s renal function, electrolyte levels, and urine were monitored daily. Using Tc-99m pyrophosphate, we performed scintigraphy, which revealed an increased uptake of the agent in the affected areas (Fig. 1). The patient’s CK level peaked (92,184 units/L) on the 2nd day and subsequently fell to < 20,000 units/L 4 days later. Pain and myoglobinuria resolved on the 5th day. The patient was discharged on the 7th day after having received fluid management to prevent acute kidney injury. At the 3-week follow-up, we found that the patient’s CK level decreased further to 327 units/L. By the 1-month follow-up, the patient had returned to light work and well tolerated exercise on a stationary bike.

**DISCUSSION**

CrossFit involves high-intensity exercises such as power lifting, running, and strength movements performed in rapid succession, with minimal recovery time [1]. Although the benefits of CrossFit are appealing, considerable flexibility, balance, and strength are required to achieve the many of the workout exercises. High training volumes and short rest intervals lend participants to perform imprecise CrossFit movements, which may lead to acute muscle injuries [2]. A few case reports have raised concerns about CrossFit exercises, such as that they can lead to rhabdomyolysis and, therefore, a clinical triad of myalgia, muscle weakness, and dark urine [1,2].

The incidence of exertional rhabdomyolysis is known to be relatively rare, occurring in 29.9 cases per 100,000 people [9,10]. The low incidence rate may be because the condition is often underreported and underdiagnosed. Rhabdomyolysis is the result of both physical and non-physical factors such as strenuous exercises, including marathon running [11], military training [12], and high intensity resistance training, medication, crushing injuries, and metabolic disorders [6,10]. The overarching goal of rhabdomyolysis treatment is to preserve kidney function. Fluid therapy, and in some cases dialysis, should be implemented to augment and restore kidney function [10].

Another characteristic feature of rhabdomyolysis is an elevated CK level, ranging anywhere from 1,500 to over 100,000 units/L (an approximately five-fold increase of the normal value). Therefore, an elevated CK level is used for...
as a diagnostic marker of rhabdomyolysis.
Some complications associated with rhabdomyolysis, including acute renal failure, compartment syndrome, and disseminated intravascular coagulation, can be life threatening [6,7]. Acute renal injury occurs in approximately a third of patients with rhabdomyolysis [13]; the acute injury is attributable to a direct renal injury resulting from an accumulation of myoglobin. Aggressive fluid replacement and dialysis should be immediately performed if the patient with rhabdomyolysis is suspected of an acute renal failure. Here, we did not observe any serious complications besides a marked elevation in serum CK levels and myoglobin level in urine.

One of the ways to minimize the prevalence of rhabdomyolysis may be to give advice such as “to start low and go slow” to CrossFit trainees [14,15]. For example, the session duration, the number of repetitions or sets, and the intensity of the training are all factors that may be controlled at the beginning and gradually increased. The following guidelines are currently recommended for beginners: 1) initially carry load weighing 60% to 70% of the person’s one-repetition maximum, until sufficient muscle strength is built; 2) incorporate around 8 to 10 exercises into the program, covering the major muscle groups (the upper body, the lower body and the trunk), per training program; 3) perform 1 to 3 sets per exercise; 4) do 8 to 12 repetitions per set; 5) take at least 2-minute breaks between sets; 6) work out 2 to 3 days per week and on non-consecutive days; and 7) increase the duration, the intensity, and the number of sets, repetition, and days of the workout and decrease break time gradually.

In conclusion, intensive resistance training during CrossFit may cause injuries such as exertional rhabdomyolysis not only in the trainers involved but also the trainees. Therefore, they should be aware of the risks of excessive CrossFit training and medical professionals should attempt to diagnose and treat the condition in a timely manner.

CONFLICT OF INTEREST
No potential conflict of interest relevant to this article was reported.

REFERENCES