

## CLINICAL VIGNETTE

# The Danger of High Intensity Exercise: A Case of CrossFit® Related Rhabdomyolysis

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### Case Presentation

A 31-year-old male with familial hyperlipidemia on a statin presented to his primary care physician for routine follow-up for elevated blood pressure without the diagnosis of hypertension. At baseline, he was very active and fit and had completed an Ironman® half triathlon just 3 weeks prior to seeing his PCP. After completing the half triathlon, he decreased his exercise activity, but two days prior to his PCP appointment, he performed the CrossFit® workout named 'Murph'. This consists of wearing a 20-pound weighted vest and performing the following in the least amount of time as possible: 1 mile run, then 100 pull-ups/200 push-ups/300 squats (partitioned as needed), followed by another 1 mile run.<sup>1</sup> He complained of bilateral arm/upper back pain as well as stiffness and mild swelling for the few days prior to his appointment especially in the biceps and latissimus dorsi. Labs were checked with normal renal function, but CK, AST, and ALT were found to be 6794 U/L, 513 U/L, and 205 U/L, respectively. He was advised to aggressively hydrate by mouth and to stop the statin. Even with drinking 4+ liters of water per day, he remained quite sore, and CK was 19,940 U/L when rechecked two days later. The patient was directly admitted to the hospital and started on IV hydration at 250cc/hr with subsequent decrease in CK to 9453 U/L the following morning and 8267 U/L by early afternoon. Patient felt well and was discharged with instruction to continue aggressive oral hydration. He did well and on repeat labs drawn as outpatient 10 days later, CK had normalized at 185 U/L.

### Discussion

Rhabdomyolysis is the breakdown of skeletal muscle cells. Exertional rhabdomyolysis (ER) is well described in athletes, military personnel, and incarcerated individuals who are exposed to unaccustomed physical activity with an incidence of 29.9/100,000 patient years.<sup>2</sup> In particular, eccentric muscle contractions where the muscle lengthens while resisting a load (such as the lowering phase in squats, presses, push-ups, etc.) increase the risk of ER, and athletes from strenuous sports without repetitive eccentric motions such as marathon runners have a much lower reported incidence of ER.<sup>3</sup> Some degree of muscle microtrauma is expected with exercise and acts as the stimulus for muscle growth and strength gains with repetitive training. Normally found within muscle cells, elevated creatine kinase (CK) levels can be detected in the blood after exercise

induced microtrauma. When CK elevation is accompanied by associated symptoms, it is termed exertional or exercise induced rhabdomyolysis (ER).<sup>3</sup> All cases present with myalgia, muscle swelling, and/or muscle weakness. On the cellular level, as exercise depletes ATP within the muscle cell, the ATP-dependent pumps and channels which closely regulate the intracellular calcium level stop functioning correctly leading to highly elevated sarcoplasmic calcium concentrations. This cascade ultimately leads to enzymatic breakdown of the myofibrillar network and myocyte necrosis releasing intracellular myoglobin and CK into the blood stream.<sup>4</sup>

Severe cases of exertional rhabdomyolysis can present with oliguria and renal failure as the released myoglobin aggregates within and blocks renal tubules. If requiring hospital admission, aggressive IVF administration with close monitoring of urine output and electrolytes is the general treatment with a goal urine output of several hundred cc's per hour; some cases, however, may require hemodialysis if inadequate urine output is noted.

The official CrossFit® Journal published an article about the danger of exercise induced rhabdomyolysis in 2005.<sup>5</sup> In the intervening decade, high intensity exercise programs such as CrossFit®, Insanity®, P90X®, etc., have become immensely more popular. There are now more than 13,000 CrossFit® affiliated gyms and an estimated 4 million participants worldwide.<sup>6</sup> Exercise has even become sport itself with the Reebok CrossFit® Games crowning the "fittest man and woman on earth" and broadcast on ESPN.<sup>7</sup> With the increasing popularity of high intensity exercise programs such as CrossFit®, Insanity®, P90X®, etc., more cases of exercise induced rhabdomyolysis are being reported - most prominently when the University of Iowa men's football team had 13 members admitted to the hospital for ER after off-season workouts.<sup>8,9</sup> Multiple factors of this style exercise program contribute to the elevated risk of ER including the high intensity level and eccentric exercises as noted above, as well as the group dynamic of competition and peer coaching which encourage participants to perform beyond their usual activity threshold leading to injury.<sup>10,11</sup>

## Conclusion

We as providers should certainly continue to encourage our patients to exercise more given the multiple health benefits of increased physical activity and exercise tolerance.<sup>12</sup> However, high intensity exercise - specifically unaccustomed exercise - is not without risk even in a well-conditioned athlete as this case illustrates. When discussing exercise, we should stress the risk of doing too much, too soon, too different from what a patient is accustomed to, and encourage a gradual increase in exercise activity as tolerated whatever the patient's baseline physical fitness level.

## REFERENCES

1. **CrossFit.** "Workout of the Day: Thursday 050818." *CrossFit*, 18 May 2018, [www.crossfit.com/workout/2005/08/18#/comments](http://www.crossfit.com/workout/2005/08/18#/comments).
2. **Tietze DC, Borchers J.** Exertional rhabdomyolysis in the athlete: a clinical review. *Sports Health*. 2014 Jul;6(4):336-9. doi: 10.1177/1941738114523544. PubMed PMID: 24982707; PubMed Central PMCID: PMC4065559.
3. **Scalco RS, Snoeck M, Quinlivan R, Treves S, Laforét P, Jungbluth H, Voermans NC.** Exertional rhabdomyolysis: physiological response or manifestation of an underlying myopathy? *BMJ Open Sport Exerc Med*. 2016 Sep 7;2(1):e000151. eCollection 2016. PubMed PMID: 27900193; PubMed Central PMCID: PMC5117086.
4. **Bosch X, Poch E, Grau JM.** Rhabdomyolysis and acute kidney injury. *N Engl J Med*. 2009 Jul 2;361(1):62-72. doi: 10.1056/NEJMra0801327. Review. Erratum in: *N Engl J Med*. 2011 May 19;364(20):1982. PubMed PMID: 19571284.
5. **Glassman G.** CrossFit Induced Rhabdo. *CrossFit Journal*. 2005 Oct; 38.
6. **Wang, C.** "A Chain Fad Becoming as Ubiquitous as Starbucks." *CNBC*, CNBC, 22 Apr. 2016, [www.cnbc.com/2016/04/05/how-crossfit-rode-a-single-issue-to-world-fitness-domination.html](http://www.cnbc.com/2016/04/05/how-crossfit-rode-a-single-issue-to-world-fitness-domination.html).
7. "CrossFit Games to Air on ESPN." *CrossFit Games*, [games.crossfit.com/article/crossfit-games-air-espn/open/2017](http://games.crossfit.com/article/crossfit-games-air-espn/open/2017)
8. "Iowa Players Battling Muscle Disorder." *ESPN*, ESPN Internet Ventures, 26 Jan. 2011, [www.espn.com/college-football/news/story?id=6061650](http://www.espn.com/college-football/news/story?id=6061650).
9. **Smoot MK, Amendola A, Cramer E, Doyle C, Kregel KC, Chiang HY, Cavanaugh JE, Herwaldt LA.** A cluster of exertional rhabdomyolysis affecting a Division I Football team. *Clin J Sport Med*. 2013 Sep;23(5):365-72. doi: 10.1097/JSM.0b013e3182914fe2. PubMed PMID: 23657120.
10. **Ramme AJ, Vira S, Alaia MJ, VAN DE Leuv J, Rothberg RC.** Exertional rhabdomyolysis after spinning: case series and review of the literature. *J Sports Med Phys Fitness*. 2016 Jun;56(6):789-93. Epub 2015 Feb 10. Review. PubMed PMID:25665750.
11. **Springer BL, Clarkson PM.** Two cases of exertional rhabdomyolysis precipitated by personal trainers. *Med Sci Sports Exerc*. 2003 Sep;35(9):1499-502. PubMed PMID: 12972868.

12. **Kokkinos P, Myers J.** Exercise and physical activity: clinical outcomes and applications. *Circulation*. 2010 Oct 19;122(16):1637-48. doi:10.1161/CIRCULATIONAHA.110.948349. Review. PubMed PMID: 20956238.

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