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# THE CrossFit JOURNAL

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## Rhabdomyolysis Revisited

Dr. Will Wright explains “rhabdo” and what you can do to prevent it.

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By Dr. Will Wright

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***Rhabdo can be prevented when coaches and athletes gradually increase intensity and watch out for conditions that might increase the risk of rhabdo.***

This review article was written to remind the CrossFit community that rhabdomyolysis is a real and dangerous medical condition which creates a need for introductory workouts that are appropriate and safe for new clients.

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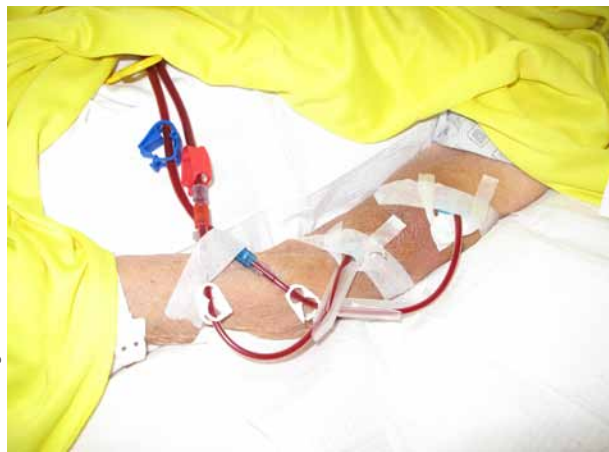
In recent months, there have been a few incidents of rhabdomyolysis in our affiliates, some of which could have clearly been avoided with more precaution and concern for our newest affiliate members.

### What Happens?

Rhabdomyolysis is the sequela of skeletal muscle-tissue injury and breakdown, which can be initiated by a variety of causes, including severe trauma, burns, heatstroke, seizures, metabolic derangements, viral infections, alcohol, medications such as statins and amphetamines, genetic defects of lipid and carbohydrate metabolism (thought to be related to an impairment in ATP production), and, of particular concern in our community, intense exertion, hence the term “exertional rhabdomyolysis.”

Although there are many causes of rhabdomyolysis, muscle-cell destruction with the release of the cell’s contents is the end result. Along with muscle injury, a lack of ATP, electrolyte imbalances and increased cellular calcium are central to the physiological cascade unleashed.

The skeletal-muscle breakdown that characterizes rhabdomyolysis impairs kidney function due to an inability of the kidneys to handle the increased myoglobin released into the bloodstream from the damaged muscle cells. This inability of the kidneys to “filter” the increased myoglobin, as well as the direct toxic effects of myoglobin metabolites, can lead to a condition called “acute tubular necrosis” and renal failure. In severe cases, dialysis (a mechanical “cleansing” of the blood) is required until kidney function improves.



**A rhabdo patient undergoes dialysis.**



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***In severe cases of rhabdo, a dialysis machine is used to cleanse the blood.***

Rhabdomyolysis induces several physiologic changes in the body that include hyperkalemia, hyponatremia, hypocalcemia and hypovolemia. When muscle cells are injured, potassium is released into the bloodstream and produces a state of elevated potassium called “hyperkalemia.” Severe hyperkalemia can induce cardiac arrhythmias and cardiac arrest. The injured muscle also promotes an influx of sodium and calcium into the cells, with water following. This is a result of ATP depletion and impairment of the Na/K ATPase at the muscle-cell membrane.

This Na/K ATPase is responsible for maintaining an electrochemical gradient across the cell membrane and is vital for cell survival. As sodium moves into the injured cells, it yields a state of decreased sodium, known as “hyponatremia.” Severe hyponatremia can produce an alteration in mental status due to brain swelling. The increased fluid accumulation in the injured muscle cells results in muscle swelling and contributes to decreased intravascular blood volume

or hypovolemia. In severe cases of muscle swelling, the intracompartmental pressure in the muscle is greater than the capillary perfusion pressure and can result in a condition called “compartment syndrome.” This is a critical condition that requires immediate medical attention.

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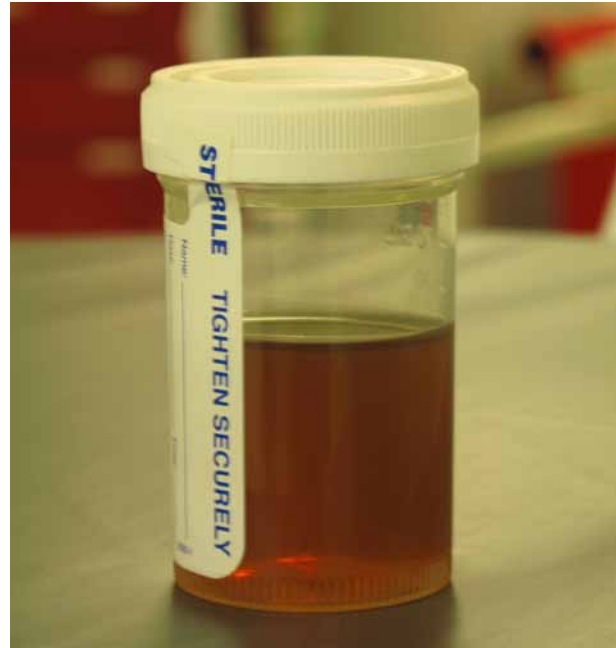
Hypovolemia and fluid shifts induced by rhabdomyolysis potentiate the kidney impairment. Other contents released by injured muscle cells include creatine kinase, phosphate, sulfate and urate. Some of these contribute to a state of metabolic acidosis. Disseminated intravascular coagulation is a rare complication of rhabdomyolysis.

It is known that eccentric or “negative” muscle contractions are more often associated with exertional rhabdomyolysis. Eccentric movements are particularly stressful for muscles because the muscle cells are lengthening while trying to contract. This “stretching” increases muscle tension and predisposes the muscle cell to injury. Eccentric contractions are a component of many movements, such as jumping pull-ups, the deceleration or lowering phase of lifts, push-ups and running downhill—to mention a few. In fact, after review of the known cases of rhabdomyolysis in the CrossFit community, these movements were often part of the workouts that preceded the condition.

Intense exercise should be of concern in hot and humid environments. Some of our classic WODs are tough enough in the California spring but quite a bit more challenging in the Texas summer. That is not to say rhabdomyolysis can be prevented in milder climates. Coach Glassman has seen a handful of cases, most of which occurred in mild and even cold climates, which he has referred to as “cold rhabdomyolysis”.

### **What Are the Symptoms—And How Do You Avoid Rhabdo?**

The symptoms of rhabdomyolysis include muscle pain, stiffness and extreme weakness. Increased myoglobin in the urine is called “myoglobinuria” and will be evident as it produces a classic darkening of the urine similar to the color of tea or Coca-Cola. Altered mental status can also occur.



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***Urine samples from a rhabdo patient have a dark color similar to cola.***

The diagnosis of rhabdomyolysis is supported with a five-times elevation of serum creatine kinase (CK) above normal values.

The treatment goal of rhabdomyolysis is preservation of kidney function. This requires intravenous fluids in an attempt to increase renal perfusion pressure and urine output, dilute toxic substances in the blood and urine, and treat metabolic derangements such as acidosis. Nephrology consultation is warranted.

In the rare case of compartment syndrome, surgical intervention is needed. The treatment of compartment syndrome is a fasciotomy, longitudinal incisions of the muscle’s covering, the fascia, in an attempt to reduce the muscle compartment pressure with the goal of preserving muscle and nerve viability.

Following the acute phase of treatment, physical therapy often includes stretching, range-of-motion and flexibility exercises, and a slow reintroduction to resistance training and CrossFit WODs, often with scaling.

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### Remember, it is easier to prevent rhabdomyolysis than to confront and treat it.

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Remember, it is easier to prevent rhabdomyolysis than to confront and treat it. It is paramount that our trainers understand the seriousness of rhabdomyolysis. Uncle Rhabdo is well known to the CrossFit community, but he is around to remind and warn us that what we do has the potential to be dangerous. Think of him as the equivalent of Smokey the Bear. Recall that Smokey is there to remind us about the potential dangers of fire and the importance of fire prevention.

Dr. Will Wright



**Uncle Rhabdo is a warning to both athletes and trainers: be smart.**

Coaches and trainers are the ambassadors of our clients' health and well-being. Given this unique position, there are predisposing conditions that trainers should be aware of; they include the types of exercises being performed, environmental conditions and the hydration status of the individual. In addition, and most importantly, the capabilities of the client and his or her known medical conditions need to be considered.

New or prospective affiliate members should be introduced to the CrossFit methodology gradually. We need to take extra time to determine the baseline and capacity of these individuals as we introduce them to the CrossFit prescription. This includes inquiring about fitness levels, medical conditions, physical limitations, recent illnesses and family history. An introductory workout should be tailored to the individual. "On-ramp classes" are often employed at many affiliates, and these too should be structured to slowly increase the work capacity of the client as the intensity and breadth of workouts is increased.

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All Web links last accessed May 31, 2011.



Courtesy of Dr. Will Wright

### About the Author

*Will Wright, M.D., is a practicing physician and lives in Pismo Beach, Calif. Will partitions his time between the hospital and CrossFit HQ.*