

# Running, Rhabdomyolysis, and Renal Failure - Who's at Risk

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Approximately 40 percent of our total body mass consists of skeletal muscle. Unaccustomed and especially eccentric (muscle lengthening while contracting) exercise can damage muscle cells, causing them to disrupt and release potentially toxic substances into the bloodstream. The term “rhabdomyolysis” literally means the dissolution of skeletal muscle and is a common and well known consequence of strenuous physical activity. Since ultramarathon running - and racing in particular - requires heavy skeletal muscle recruitment and places demands on the body that are well above and beyond what is typically encountered during daily training, rhabdomyolysis is a common post-race biochemical finding.

A diagnosis of rhabdomyolysis is generally made when creatine phosphokinase (CPK) levels rise above 10,000 U/L, well above the upper limit (200 U/L) of the normal range. CPK is an enzyme found inside muscle cells, so when muscle cells are damaged, this enzyme is released into the bloodstream in relative proportion to the degree of muscle breakdown. The CPK enzyme itself is not particularly harmful, but is commonly used as a surrogate marker of myoglobin release. Myoglobin is a big, red, protein that can potentially block and/or crystallize within the kidney tubules. Thus, rhabdomyolysis can lead to acute kidney injury – and renal failure in severe cases – when these massive myoglobin proteins get stuck within the filtering system of the kidney as the body is trying to excrete these substances into the urine. So, dark-colored urine (looks like coca cola) is a unmistakable sign that there is a large amount of myoglobin being released into the bloodstream and, therefore, kidney function must be monitored carefully.

Unlike non-exercise-induced rhabdomyolysis (crush injuries, infections, drugs and toxins, for example) where the progression from rhabdomyolysis to acute renal failure is between 17 – 40 percent of cases, exercise-induced rhabdomyolysis *only very rarely* progresses to acute renal failure. The reason for this curious but clear difference in the progression to renal failure is not known. However, in those very rare instances where rhabdomyolysis leads to renal failure in ultramarathon runners, it appears that a “perfect storm” of factors seems to be present (extremes of hydration, non-steroidal anti-inflammatory drug (NSAID) and analgesic use, heat stress, recent viral/bacterial infection, low fitness).

Because the incidence of rhabdomyolysis and renal failure seems to be increasing disproportionately in ultramarathon circles, the four basic questions and answers below are ones you should understand and share with your crew:

**1) How dangerous is rhabdomyolysis?** Exercise-associated rhabdomyolysis in and of itself is not dangerous nor is it an uncommon biochemical finding in runners competing in an ultramarathon race. In fact, it's more normal than abnormal! In the rare instances where rhabdomyolysis progresses to renal failure in athletes, the "perfect storm" of additional factors must be present.

**2) What are the warning signs that rhabdomyolysis is harming my kidneys?** When urine output becomes sparse and very dark, it is a good idea to start monitoring fluid intake and output carefully. In many cases, runners will urinate a reddish brown urine which resolves itself over the course of a race. However, if "coca cola" urine continues or gets worse, urinating becomes more difficult, you begin to feel "bloated", or you develop lower back pain in addition to severe muscular pain, then you need to seek the advice of a medical professional immediately – on or off the course.

**3) What are some factors that put me more at risk for developing renal failure associated with rhabdomyolysis?** Excessive heat, severe dehydration, NSAID and/ or analgesic usage, and prior viral or bacterial infection are well-documented risk factors for developing exercise-associated rhabdomyolysis leading to renal failure. We have found in a recent analysis that development of hyponatremia during the run, under-training (especially if an injury limited training time), and being a relatively younger and faster male runner pushing through pain to finish the race, may be additional risk factors for developing renal failure associated with rhabdomyolysis.

**4) How can I prevent developing rhabdomyolysis-induced renal failure during an ultramarathon?**

- Avoid taking NSAIDs (Advil, Motrin, Aleve, Celebrex, et al.) and/or analgesics during an ultramarathon race
- Do NOT race if you had a recent viral or bacterial infection
- Do NOT over- or under-hydrate
- Train properly for the event; if you get injured, race only when you have regained proper fitness
- Listen to your body; if you have any of the above-mentioned warning signs, seek medical attention immediately!