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EVMS Journal Club

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Clinical Scenario: You are working in the ED when a 20 y/o male comes in complaining of generalized muscle aches and a change in the color of his urine. He states that he has no medical conditions and takes no medications at home. He states that he ran a marathon 3 days earlier. His CK was found to be 123,000, UA showed 3+ blood, but no RBC's were seen on microscopic evaluation, and BMP is WNL. Physical exam is WNL. How would you manage this patient?

P: In otherwise healthy individuals with exercise related elevations in serum CPK

I: Are withholding acute interventions such as NaCl boluses and urine alkalinization

C: Compared to oral rehydration and expectant care

O: Associated with poor outcomes such as acute renal failure

Article	Study Group/Design	Study Type	Outcomes	Key Results	Limitations
Clarkson *et al.* Medicine & Science in Sports & Exercise. 2006. 623-627	203 Volunteers. 18-40 y/o. 2 sets of 25 maximal eccentric contractions of elbow flexor muscles. CK, Mb, LDH, AST, ALT, Cr, BUN, Phos, K, Osm, Uric Acid measured before, 4, 7, 10 days after exercise. Excusion: Resistance exercise training w/in 6 months, occupation that required heavy lifting, abnormal	Observational Cohort	111/203 CK > 2,000, 51/203 CK > 10,000. CK ranged from 55 – 80,440 on day 4 with an average of 7,713. Myoglobin averaged 394 with a range of 27-2,300. LDH, AST, ALT also increased significantly. No increase in renal function markers, no visible myoglobinuria	CK values > rhabo threshold were not associated with renal impairment No relationship between CK and renal function tests. No patient was hospitalized or required IV fluids/bicarb.	Small amount of patients. No UA or microscopic analysis to determine myoglobinuria.

	baseline blood values, known muscle disease, DM, or hyperthyroidism. Subjects refrained from analgesic use, muscle treatments, physical exercise, and alcohol during the study				
Sinert *et al*. Ann Emerg Med. 1994. 23. 1301-6	35 patients who met inclusion criteria for exercise-induced rhabdo: hx strenuous exercise, CPK>500, UA +blood, -RBC's. Excluded: hx of trauma, MI, stroke, sepsis	Retrospective chart analysis	Average admission CPK: 40,471 +/- 34,295. No patient with hyperK, acidosis, hypoCa, or hyperPhos. All patients except 1 treated with forced bicarbonate diuresis. 2 patients treated with mannitol. 31/35 patient's treatment delayed > 48 hrs after exercise. No patient developed ARF.	No renal failure in 35 patients despite markedly elevated CPK and myoglobinuria. Incidence of ARF in rhabdomyolysis 17-40%. Treatment given to 34/35, but well after the 6 hour cut off. Authors do not believe treatment had any effect. "Absence of nephrotoxic cofactors (significant hyopvolemia and/or aciduria) in the setting of exercise-induced rhabdomyolysis explains lack of acute renal failure."	Retrospective study. Patients presented average of 2.7 +/- 0.3 days after exertion. 34/35 patients treated with bicarb.
Smith *et al.* Br J Sports	34 marathon runners. 7 female, 27	Observational Cohort	Significant rise in CK-MB (3.6-13.4),	CK values can be elevated above rhabdo	Patients were not followed after marathon.

Med 2004; 38: 292-294.	male. Blood taken before the start and immediately after completion of marathon. Samples analyzed for urea and electrolytes, LFT's, CK, CK-MB, myoglobin, troponin I, CBC, Clotting screen, D-dimer. Excluded: Participants with hx of muscle disorder, clotting abnormality, or cardiac disease, and those taking drugs that may have altered the measured variables.		myoglobin (74.8- >500), CK (195-707.8), Creatinine 98.1-118.9. P <0.001. % change in CK positively correlated with lower training status and slower race time (p<0.05).	cutoff points after exercise.	Did not examine renal effects.
Skenderi *et al*. Med. Sci. Sports Exerc., 38, 6, 1054-1057. 2006.	39 runners of the Spartathalon 246 km race who completed the race within 36 hours. Blood samples, taken a day before and immediately after the race were assessed for CK, LDH, AST, ALT, GGT.	Observational Cohort	No adverse medical events requiring medical attention during or after the race. CK 29,384 +/- 4,327%. No significant difference between time of finish and CK values.	Very prolonged moderate-intensity exercise induces exertional rhabdomyolysis, which remains asymptomatic. CK values reached > 160,000 without symptoms of rhabdomyolysis and did not require hospital treatment.	States that no patient required hospital treatment after race, but did not specify how they performed follow up or for how long after race. No measurement of kidney function. No urine samples.
Alpers *et al*. Muscle	177 Military rhabdomyolysis	Retrospective cohort	The exertional rhabdomyolysis	Acute renal failure was less	Retrospective study.

Nerve 2010.	patients at military hospital between May 2002 and September 2007 based on acute normothermic neruomuscular illness with CK > 5 times normal limit. 63/177 deemed exertional based on onset of clinically symptomatic rhabdomyolysis during or immediately following strenuous exertion in the absence of other cause. All exertional rhabdomyolysis patients who had no preceding history of rhabdo, had follow-up in the military electronic medical record > 2 months after initial presentation, and were not subsequently restricted in physical activity were included in a retrospective cohort to assess for recurrence of rhabdomyolysis (22/63).		patients had a 19.1% occurrence of ARF compared to 34.2% in the rhabdo from other causes (P 0.04). CK ranged from 21,697-43,325.	common in patient with ER compared with rhabdo from other causes.	Historical information such as level of physical activity prior to training was not available. ARF was defined as Cr > 1.3. No measurement of baseline Cr of patients. No mention of treatment given.

Case Reports

Carson *et al.* Clin J Sport Med. 16, 5, 9/2006. Galves *et al*. Clin J Sport Med. 18. 4. 7/2008. Gagliano *et al.* Cases Journal 2009, 2:7. Sprinker *et al*. Medicine & Science in Sports & Exercise. 2003. 1499-1502. George *et al*. Pediatr Emer Care 2010; 25: 864-866. Braseth *et al*. Euro Journal of Emerg Med, 2001, 8, 155-157.	14 patients. Ages 16-37 12 male, 2 female Patients with uncomplicated PMH presenting a few hours to 4 days after intense exercise complaining of muscle soreness and 12/14 with dark urine. CK levels ranged from 9,056-234,000 (average 87,633). 12/14 were found to have +blood with no RBC's in urine.	Case Series	4/14 outpatient treatment. All inpatients received IV fluids. 4/14 patients received bicarb. All patients experienced a gradual decrease in CK and urinary symptoms. No patient experienced renal failure.	No difference in the results of different treatments of previously healthy patients presenting with exertional rhabdomyolysis.	Case studies. Small amount of patients.

Clinical Bottom Line: Previously healthy patients with a high CK that appear clinically stable, and are able to drink water and produce copious amounts of urine, should be able to be treated as outpatients with PO hydration and close follow up. It does not appear that treatment of this patient population with IV hydration and Bicarb has any proven effect on forestalling renal impairment. More studies are needed to quantify exact CK values for diagnosis of exertional rhabdomyolysis, to find what values and patient characteristics are associated with a predisposition to poor outcomes such as sustained renal impairment.