Exertional Rhabdomyolysis: Overview and Prevention Strategies

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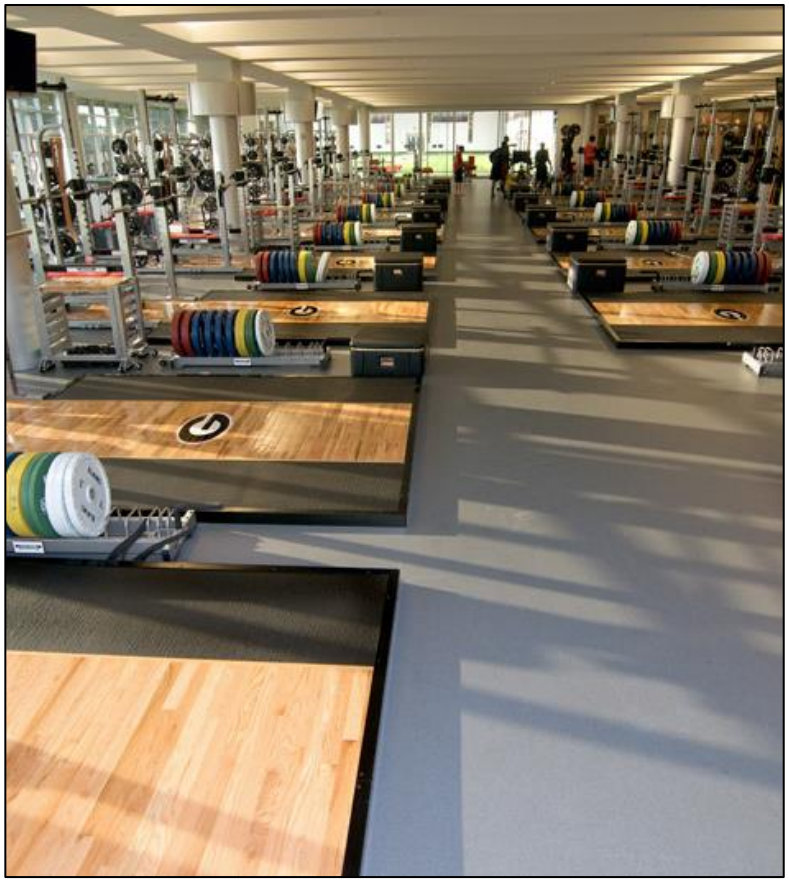
Conflict of Interest

In compliance with continuing education requirements, I, Ron Courson, have NO financial or other associations with companies to which have a direct link and/or financial relationship that is related to the topic/content of this presentation.



Objectives

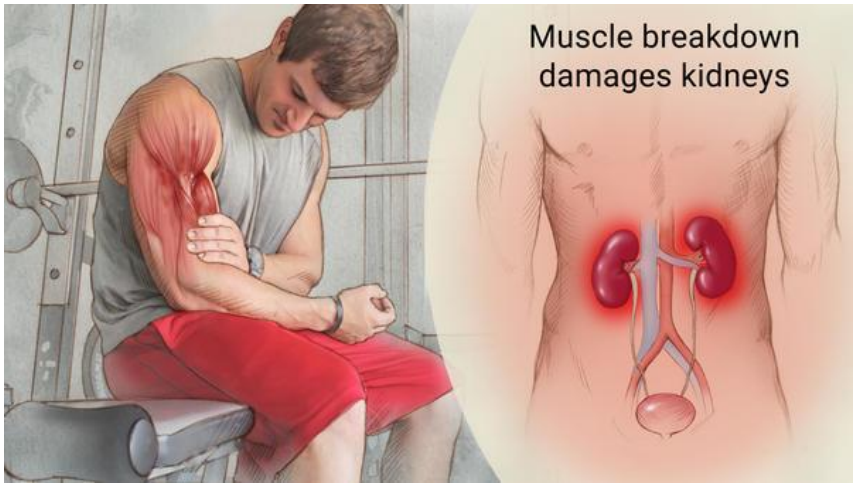
- provide an overview of exertional rhabdomyolysis (ER)
- discuss how ER may occur with intense exercise
- review common signs and symptoms of ER
- discuss prevention strategies

Exertional Rhabdomyolysis

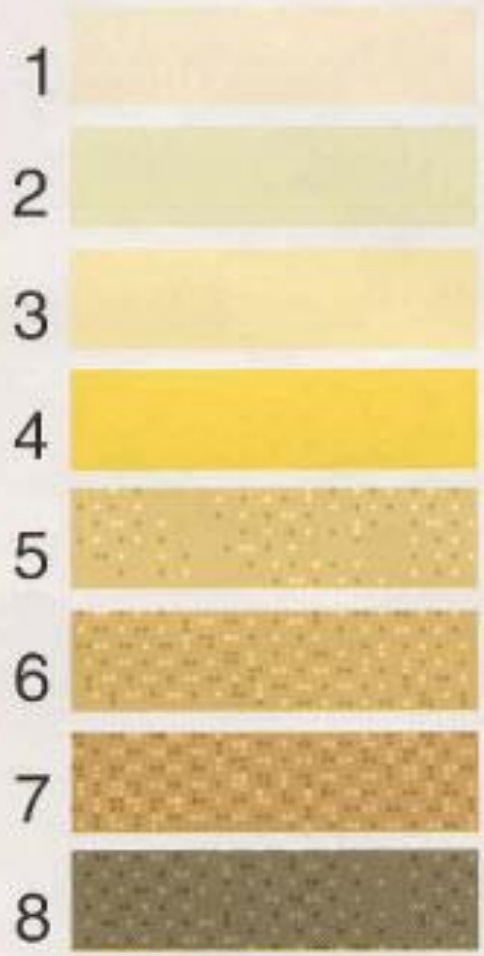
- ER is a relatively uncommon condition
- Very serious consequences:
  - muscle ischemia
  - cardiac arrhythmia
  - death

Tietze DC and Borchers J. Exertional Rhabdomyolysis in the Athlete: A Clinical Review. Sports Health.Vol. 6. No. 4. 2014

Exertional Rhabdomyolysis



- Athlete will have:
  - pain, weakness, and swelling in the muscles affected
  - significantly elevated levels of creatine kinase (CK)



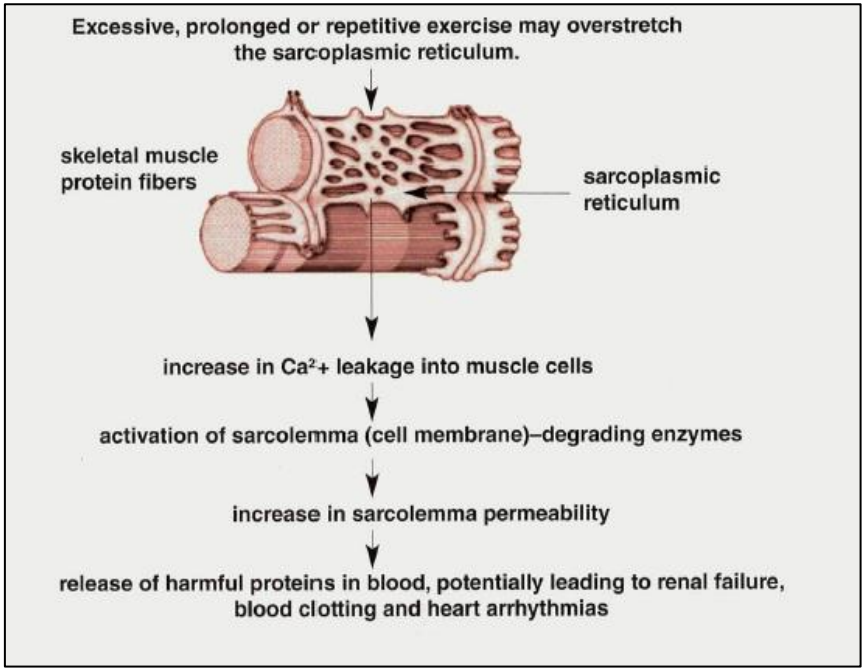
The Urine Color Chart shown here will assess your hydration status (level of dehydration) in extreme environments. To use this chart, match the color of your urine sample to a color on the chart. If the urine sample matches #1, #2, or #3 on the chart, you are well hydrated. If your urine color is #7 or darker, you are dehydrated and should consume fluids.

The scientific validation of this color chart may be found in the *International Journal of Sport Nutrition*, Volume 4, 1994, pages 265-279[194] and Volume 8, 1998, pages 345-355.[195] Adapted by permission from Larry Armstrong, 2000, *Performing in Extreme Environments*, (Champaign, IL: Human Kinetics).[196]

This is urine from a patient with Rhabdomyolysis

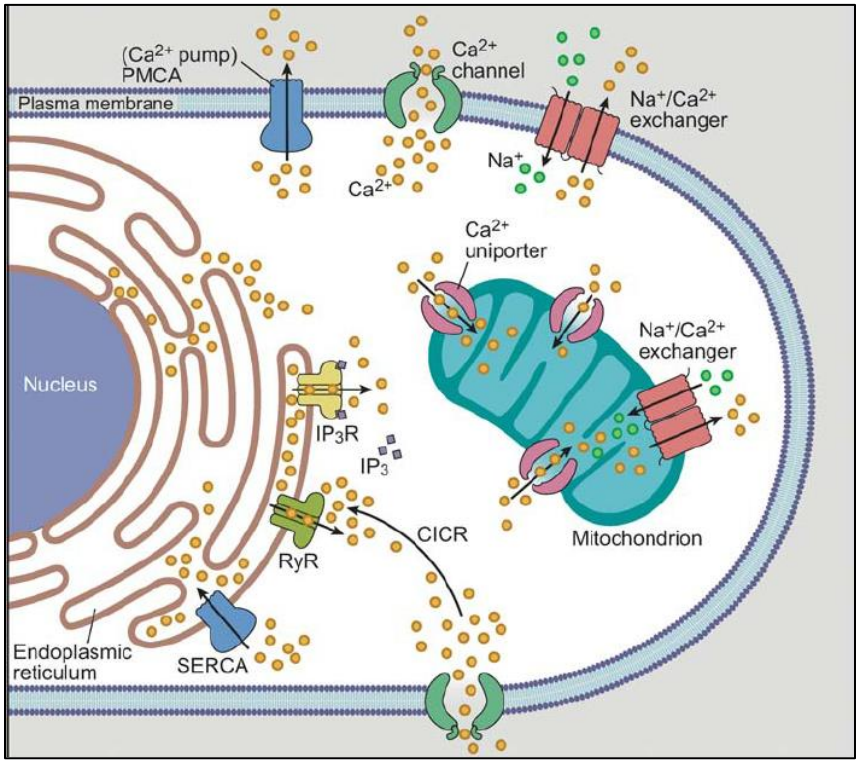
Exertional Rhabdomyolysis:
Pathophysiology

- Breakdown and necrosis of striated skeletal muscle after engaging in physical activity
- Necrosis of skeletal muscle cells releases intracellular contents causing, pain, swelling, and potential end organ damage



Exertional Rhabdomyolysis:

Pathophysiology



- Increase in intracellular free ionized calcium to a level much higher than normal in the cytoplasm and mitochondria

Exertional Rhabdomyolysis:

Epidemiology

- ER associated with exertion, sickle cell trait, hyper- and hypothermia, crush syndromes, infection, autoimmune and metabolic disorders and certain drugs
  - stimulants such as phentermine

Exertional Rhabdomyolysis:

Epidemiology

- Sports that reported ER include:
  - American football
  - swimming
  - bodybuilding
  - running

Exertional Rhabdomyolysis:

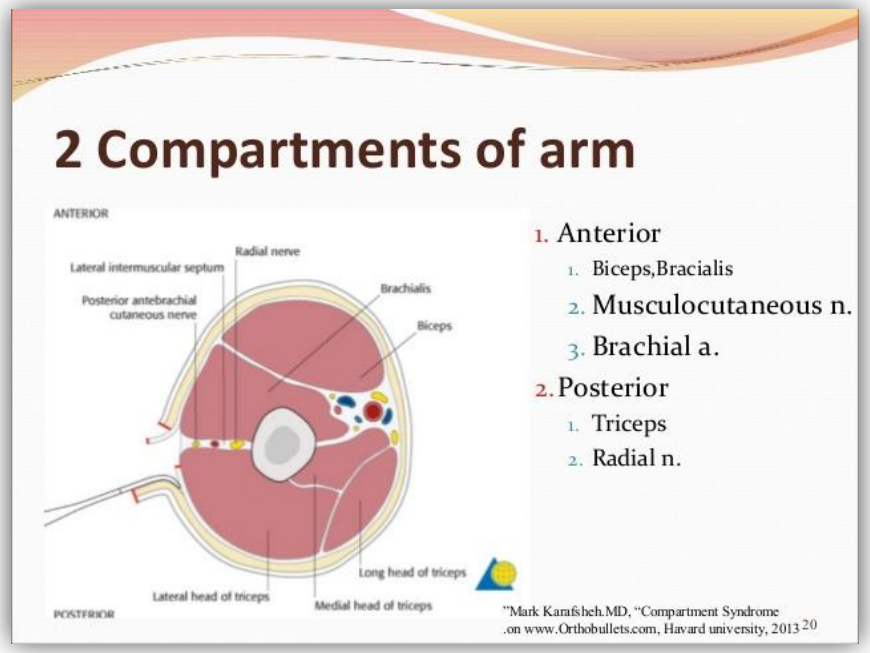
Epidemiology

- 13 members of a NCAA D-I football team hospitalized
  - diagnosed and treated for ER
  - committee convened by president of university to investigate
- Causal factors:
  - high-volume intense squat work-out
  - 3 week break between bowl game and beginning of winter work-outs
  - not associated with risky behavior, banned substances, Rx or OTC medications, supplements, or energy drinks

Report of the Special Presidential Committee to Investigate the January 2011 Hospitalization of University of Iowa Football Players

Exertional Rhabdomyolysis:

Epidemiology



- Retrospective cohort of high school football players identified 22 of 43 players at a camp with ER
  - 12 hospitalized
  - 3 also diagnosed with compartment syndrome

Oh JY et al. Acute Exertional Rhabdomyolysis and Triceps Compartment Syndrome During a High School Football Camp. Sports Health. 2012. 4:57-62.

Exertional Rhabdomyolysis:
Epidemiology

- Retrospective cohort of high school football players identified 22 of 43 players at a camp with ER
  - 12 hospitalized
  - 3 also diagnosed with compartment syndrome
- Repetitive eccentric loading, hyperthermia, and dehydration were contributing factors

Oh JY et al. Acute Exertional Rhabdomyolysis and Triceps Compartment Syndrome During a High School Football Camp. Sports Health. 2012. 4:57-62.

Exertional Rhabdomyolysis:

Epidemiology

- Case series of 7 Division I swimming athletes identified increased activity in well-conditioned athletes as a cause of ER
  - urine myoglobin present in 3 of 7 athletes
  - underwent intense push-up routine and body squats the week prior, provoking the syndrome
  - not every swimmer developed ER, suggesting additional factors unique to those affected

Galvez R, Stacy J, Howley A. Exertional Rhabdomyolysis in Seven Division I Swimming Athletes. Clin J Spts Med. 2008. 18:366-368

Exertional Rhabdomyolysis:

Epidemiology

- Division 1 collegiate swim team competed in the League Championship meet followed by a 1-week break from formalized training
- The team then began off-season weight lifting sessions combined with daily swimming.
- Ten days into off-season training, the entire team participated in a novel arm competition workout

Stafa MR et al. Risk Factors for Collegiate Swimmers Hospitalized With Exertional Rhabdomyolysis. Clin J Spts Med. 2017. 27:37-45

Exertional Rhabdomyolysis:
Epidemiology

- Overall, 13 swimmers presented to the ED with complaints of severe upper body pain, swelling, and dark-colored urine:
  - 6 (3 females and 3 males) were admitted to the hospital for treatment
  - 7 (4 females and 3 males) were treated and released on the same day
  - **novel exercise ?**
  - **water vs. land-based training ?**

Stafa MR et al. Risk Factors for Collegiate Swimmers Hospitalized With Exertional Rhabdomyolysis. Clin J Spts Med. 2017. 27:37-45

Exertional Rhabdomyolysis:

Epidemiology

- Bodybuilder diagnosed with ER and compartment syndrome of the lower extremity overused a supplement (creatine monophosphate)
- Overuse may have caused ER in this case

- “Perfect storm” consisting of bacterial/viral illness, NSAID use, and latent myopathy can cause renal failure and potentially death in runners

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Exertional Rhabdomyolysis:

Epidemiology

- In military personnel, incidence of ER was 29.9 per 100,000 person years
- 435 US service members diagnosed with ER
  - 48% hospitalized
  - black, non-Hispanic male members < 20 years of age were most affected
- Common themes involved alterations in training regimen, heat illness, poor conditioning, and dehydration

Tietze DC and Borchers J. Exertional Rhabdomyolysis in the Athlete: A Clinical Review. Sports Health.Vol. 6. No. 4. 2014

Exertional Rhabdomyolysis:

Diagnosis

- ER may be an extreme continuation of delayed-onset muscle soreness (DOMS)
- Affected individuals typically complain of:
  - proportional pain, tenderness, weakness, and swelling in muscles affected following athletic activity
  - elevated CK levels 5 times the upper limit of normal with these symptoms are required for diagnosis

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Exertional Rhabdomyolysis:

Diagnosis

- Black football players with sickle cell trait (SCT) are at a 37 times higher risk of exertional-related death than non-SCT counterparts
- **Be aware of athlete medical history !**

Tietze DC and Borchers J. Exertional Rhabdomyolysis in the Athlete: A Clinical Review. Sports Health.Vol. 6. No. 4. 2014

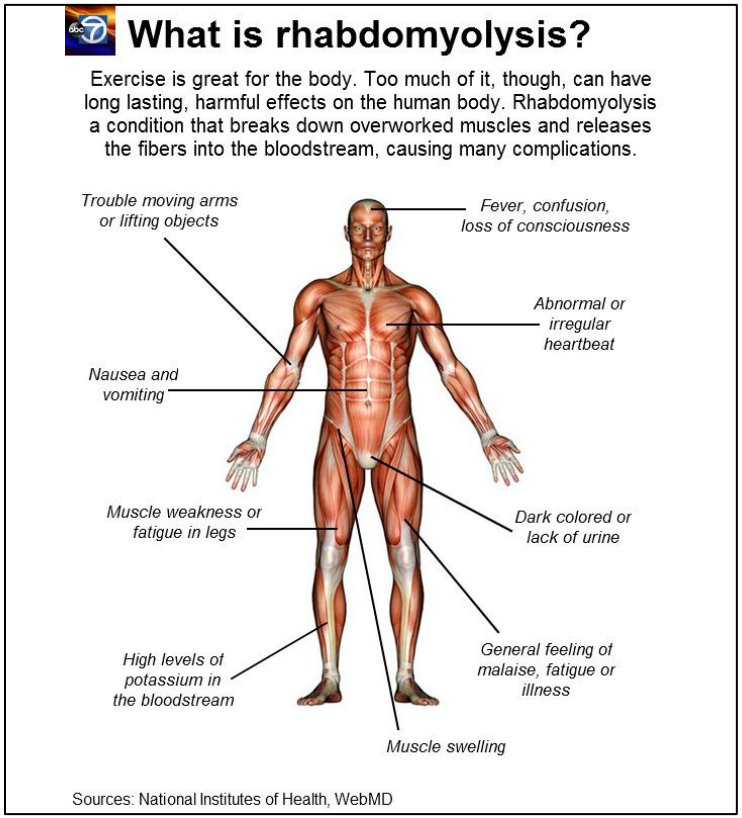
Exertional Rhabdomyolysis:

Diagnosis

- Elevated levels of CK are normal after exercise in healthy, asymptomatic individuals

Exertional Rhabdomyolysis:

Diagnosis



- Significantly elevated CK must be present for diagnosis of ER but must be made in association with presenting clinical syndrome of muscle weakness, swelling, pain, and occasionally, darkening of the urine to differentiate ER from other causes

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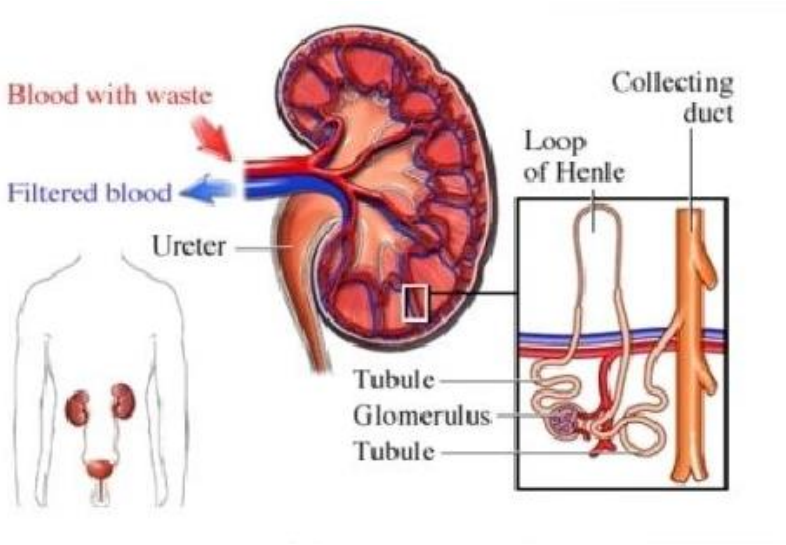
Exertional Rhabdomyolysis:
Diagnosis

- Severe consequences of ER include:
  - disseminated intravascular coagulation
  - acute kidney failure
  - hyperkalemia
  - cardiac dysrhythmias
- Elevated levels of myoglobin in the serum do not necessarily predispose athlete to renal failure



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Exertional Rhabdomyolysis:

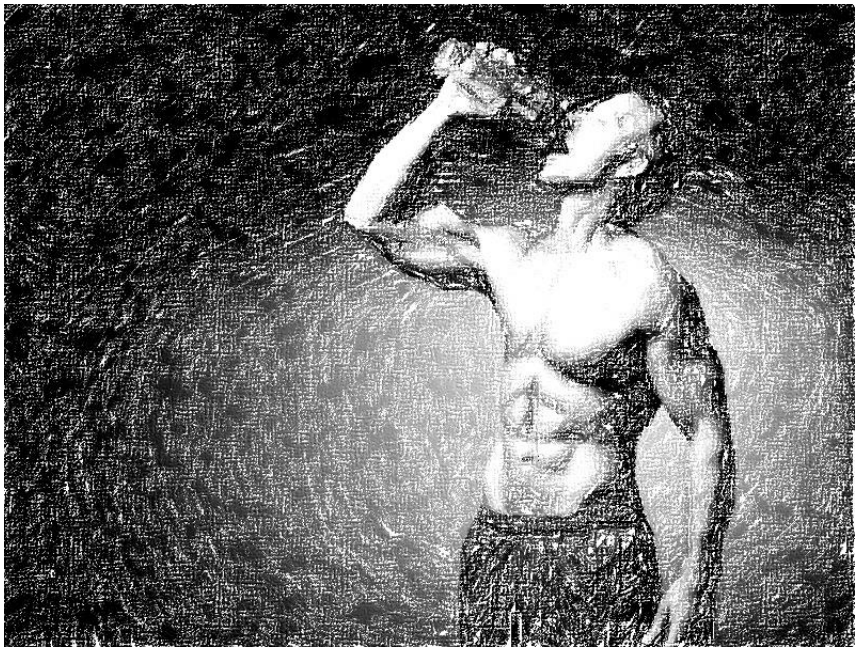
Diagnosis

- **Of the deaths that occurred in athletes due to ER, other factors, including recent illness and cardiac ischemia, were listed as potential causes as well**
- **Prompt recognition of these symptoms is paramount**

Tietze DC and Borchers J. Exertional Rhabdomyolysis in the Athlete: A Clinical Review. Sports Health.Vol. 6. No. 4. 2014

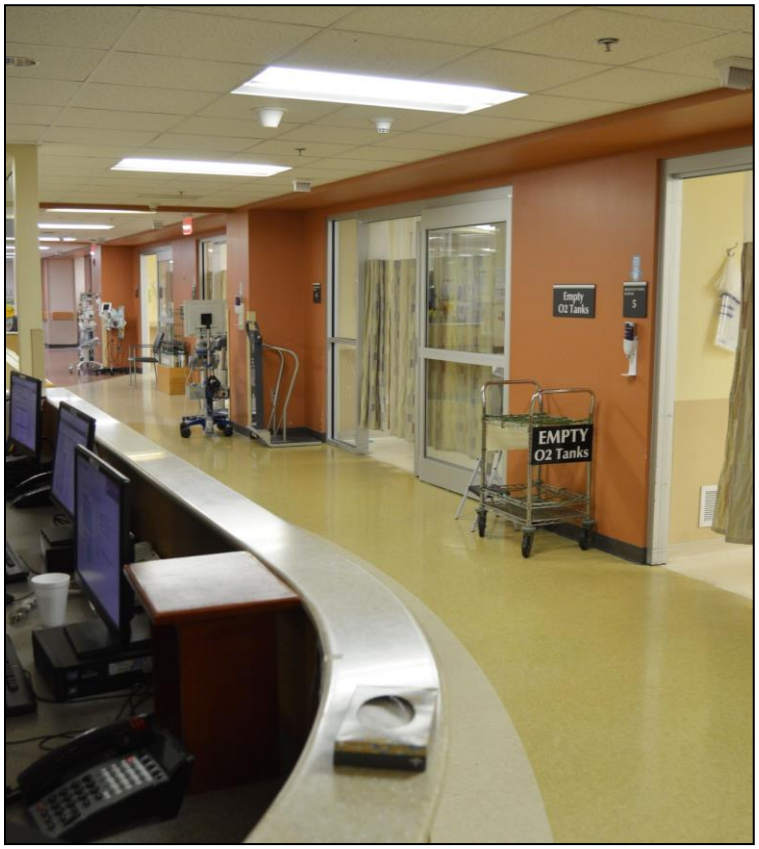
Exertional Rhabdomyolysis:
Treatment

- In mild cases, ER may go undiagnosed and could be managed on out-patient basis with oral hydration and rest



Exertional Rhabdomyolysis:

Treatment

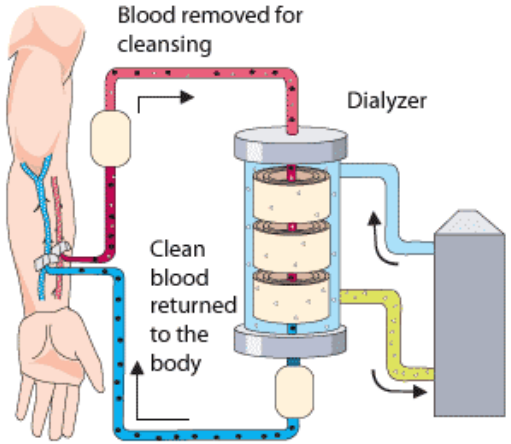


- With severe ER symptoms (CK greater than 5 times upper limit of normal or darkening of urine), hospital admission is indicated
  - IV hydration
  - tracking of CK levels, kidney function, and electrolyte values
  - continuous venovenous hemodialysis and other services readily available

Exertional Rhabdomyolysis:

Treatment

- CK levels should be monitored daily
- If levels continue to elevate past 48-72 hours from time of injury, consultation of a nephrologist or surgeon should be considered, depending on severity of kidney disease or presence of compartment syndrome
- Dialysis should be considered if athlete not able to maintain appropriate volume or electrolyte balance



Exertional Rhabdomyolysis:

Return to Sport

- No evidence based guidelines for return to play after episode of ER
  - Consortium for Health and Military Performance (CHAMP)
  - Return to Play After Exertional Rhabdomyolysis JAT 2016
  - Challenging Return to Play Decisions: Heat Stroke, Exertional Rhabdomyolysis, and Exertional Collapse Associated with Sickle Cell Trait (ECAST) Spors Health 2015

Exertional Rhabdomyolysis:

Prevention Strategies

- Proper planning, preparation, and implementation of training programs
  - scientific background
  - physiologically based
- Communication between all parties:
  - sport coaches
  - S&C staff
  - medical staff
  - student-athlete
- Familarity with S-A medical history
- **Use common sense**

Can a workout be too intense? Four key points on muscle condition rhabdomyolysis

- Detraining
- Eccentric training
- Square wave approach
  - abruptly beginning intense workouts after a period of rest
- Dehydration

Lisanti J. Sports Illustrated. 1/19/2017

ECAST: Strategies for Mitigating Risk

- Emphasize the importance of year-round conditioning
- Focus early season training and conditioning on the progressive establishment of an aerobic base and on heat (or altitude) acclimatization
- Gradual training progression and longer rest/recovery between repetitions or intervals
- Avoid timed runs, repeated intervals, or conditioning tests early in the training cycle
- Decrease total volume and intensity of activity during hot/humid conditions
- Stop activity immediately if muscle pain or cramping develop
- Report symptoms immediately to medical staff
- Consume fluids at regular intervals before, during, and after activity
- Educate athletes on conditions that increase risk for ECAST (heat, altitude, dehydration, illness, supplements, other medications)
- Ensure site-specific emergency action plan specific for ECAST exists

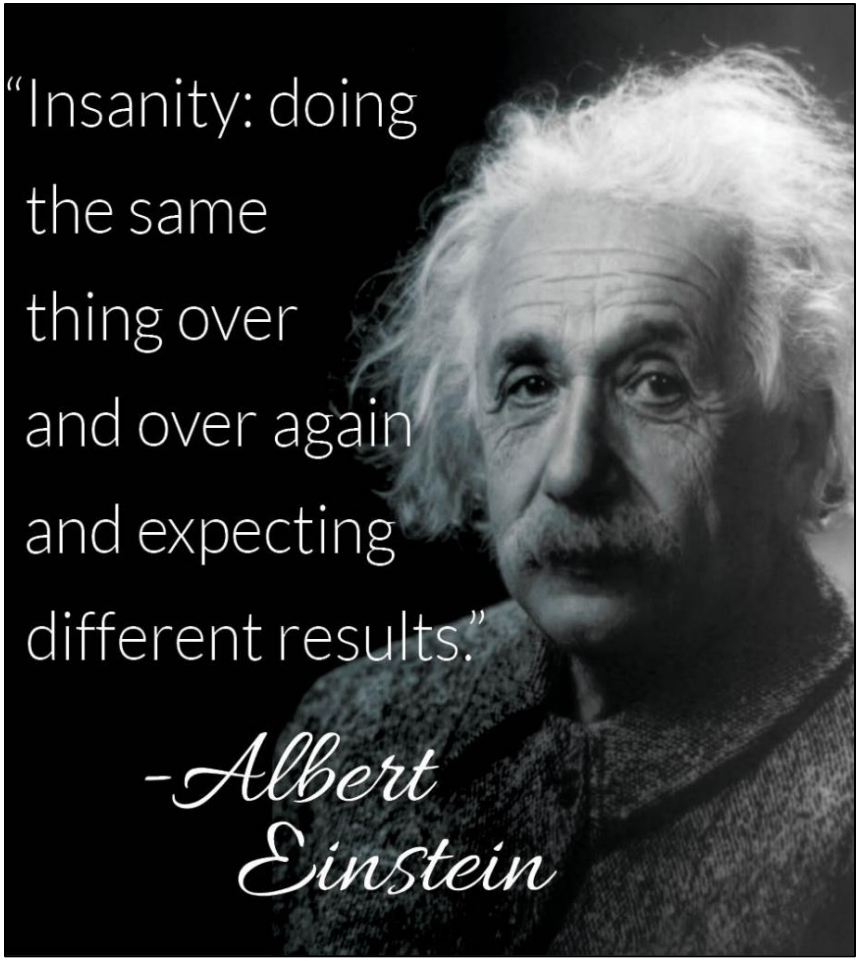
O'Connor FG et al. ACSM and CHAMP Summit on sickle cell: mitigating risks for warfighters and athletes. Med Sci Sports Exerc.2012:44:2045-2056

Athletes in active recovery to early fatigue: continue rehydration, rest intervals, cooling and controlled breathing.

Athletes who are showing signs of physical distress should be allowed to set their own pace while conditioning. Instruct athletes to rest while experiencing symptoms as they may soon feel better and be ready to continue. If symptoms reoccur or progress, the athlete should stop exercise and be assessed by a health care provider.

Athletes unable to stand on their own from a kneeling position or having trouble walking normally during recovery should raise suspicion of distress, and additional medical intervention should be considered.

Exertional Rhabdomyolysis



- **If we do not follow history we are doomed to repeat it**