The Risk of Heat Stroke During Training and Competition

By

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The MABRA race calendar begins in March and goes through September. Cyclists must train hard during the hottest and most humid months of the year to stay competitive through the race season. Even the most "fit" and acclimated athletes can have difficulty performing under high "heat index" conditions, and need to be aware of the many heat related illnesses that can occur.

This article discusses "exertional heat stroke," the most life threatening heat illness that may affect cyclists during training or competition. One of our teammates, Carl Dolan, died of exertional heat stroke (EHS) during a race in 1999, and it is in his memory that we write this article, to raise awareness, in the hope of preventing another death from EHS. Heat exhaustion and heat cramps are also briefly discussed in the concluding paragraphs.

EXERCISE AND HEAT STRESS

Exhaustion in athletes may be affected by duration and intensity of exercise, environmental conditions, acclimatization to exercise-heat stress, an athlete's individual work capacity (VO2max), physical conditioning, hydration status, and other factors like medications, supplements, sleep deprivation and recent illness. Wide variation exists among athletes to heat tolerance and exhaustion, especially during competition. Nonetheless, the time to exhaustion and perceived exertion accelerates as relative humidity increases and total body water decreases. The combined effects of heat stress and dehydration reduce exercise capacity and performance greater than either alone. Every cyclist who trains and competes during high heat index conditions should be fully aware of their own susceptibility and tolerance for exercise heat stress, dehydration, and, any of the other training and personal factors that may be relevant on a particular race day or training session.

Exertional hyperthermia is defined when the core body temperature is above 104 degrees F., and occurs during exercise when muscle-generated heat accumulates faster than heat is dissipated through sweating and increased skin blood flow. Heat production during intense exercise can be 15-20 times greater than at rest, and can raise the athlete's body temperature by 1.8 degrees F every five minutes if no heat is removed. This prolonged hyperthermia can lead to exertional heat stroke (EHS). Even highly trained and heat-acclimatized athletes can develop EHS while exercising at high intensity. EHS is a life threatening condition with a high mortality rate if not recognized and treated.

Symptoms of Exertional Heat Stroke

EHS is defined by hyperthermia (core body temperature >104 degrees F), central nervous system disturbances and multiple organ failures. Most EHS patients are sweat-soaked with pale skin at the time of collapse, as opposed to the dry, hot and flushed skin in non-exercise-related heat stroke. The patient may be confused, irritable, may have seizures or be comatose. However, the signs and symptoms may be non-specific; therefore, any change of personality or performance should trigger an assessment for EHS, especially in hot-humid conditions.

The risk of EHS increases with multiple stressors: sudden increase in training, lengthy or cumulative exposure to heat, vapor barrier protective clothing, sleep deprivation, poor nutrition, inadequate hydration, medications, alcohol use or antidepressants, being over the age of forty, a history of heat related illness, sunburn, recent viral infection, obesity. It is strongly recommended that cyclists train with at least one other cyclist if environmental or personal factors or conditions are present that may increase the risk of EHS.

EHS is a true medical emergency: call for emergency medical assistance immediately. Regardless, do not wait for emergency assistance to arrive: begin cold water immersion to improve the patient's prognosis. If cold water immersion is not available, use ice water towels/sheets combined with ice packs on the head, trunk and extremities to provide effective, albeit slower, whole body cooling.

Preventing EHS

Physical training, cardio-respiratory fitness and heat acclimatization reduce the risk of EHS. Ten to 14 days of exercise training in the heat will improve heat acclimatization and reduce the risk of EHS. The major acclimatization to heat stress occurs during the first week of heat exposure (2 to 4 hours). Ideally, the first several sessions in a hot environment should be light in intensity and duration, followed by systematic training sessions to reach normal duration and intensity. After ten days of heat exposure, sweating capacity almost doubles, and sweat becomes dilute (less salt lost) and more evenly distributed on the skin surface. Therefore, the increased sweat loss in an acclimatized athlete creates a greater need to rehydrate during and after training or competition: optimal acclimatization requires adequate hydration.

There are not "evidence-based" recommendations for returning to training or competition if an athlete has EHS. However, for the majority of patients with EHS who received prompt cooling therapy, the prognosis for full recovery and rapid return to activity was good. The American College of Sports Medicine, in their position stand "Exertional Heat Illness During Training and Competition, March 2007, " Medicine and Science in Sports and Exercise, lists five recommendations to determine if an athlete is ready to return to training or competition, based on being able to reestablish heat tolerance:

1. Refrain from exercise for 7 days after release from medical care;
2. Follow up in one week for physical exam, lab testing, diagnostic imaging of affected organs, as per physician evaluation;

3. Begin exercise in a cool environment and gradually increase duration, intensity and exposure to heat for two weeks;
4. If return to activity is difficult, have lab exercise-heat tolerance test one month post-incident;
5. Clear the athlete for full competition if heat tolerance exists after 2 – 4 weeks of training.

OTHER HEAT RELATED ILLNESSES

Exertional Heat Exhaustion

Other heat related illnesses, in decreasing severity—meaning they are typically not life threatening nor precursors to EHS, if corrective action to reduce the heat stress and rehydration begins, with or without immediate medical intervention-- are heat exhaustion and heat cramping. Heat exhaustion occurs more frequently on hot humid days, when the athlete experiences excess sweating, as the body tries to dissipate heat from high intensity exercise. This excess sweating is likely to deplete the volume of body fluids, increase peripheral vascular dilation which can create accelerated fatigue due to the rising core body heat. Blood can pool in the dilated peripheral vessels, drastically reducing the central blood volume required to maintain cardiac output: the athlete's choice is to either slow down or fall down. It is thought that this heat related exhaustion may protect the body against overexertion in stressful situations: a built-in safety brake, per se.

Symptoms may be profuse sweating, low blood pressure, high pulse and respiratory rates, headache, dizziness, weakness, nausea, vomiting, irritability and/or muscle cramps. Major neurologic impairment is generally absent. Heat exhaustion is the most common heat related disorder, and heat exhaustion related to dehydration is more common in hot conditions. Dehydration and high body mass index (excess body fat negatively impacts work performance in hot environments) increase the risk of an athlete experiencing exertional heat exhaustion. Like EHS, ten to 14 days of exercise training in the heat will reduce the risk and improve heat acclimatization.

Those treating someone with exertional heat exhaustion may not know if it is EHS or heat exhaustion. Therefore, call for emergency medical assistance immediately. On-site, move the athlete to a shaded or air conditioned area, remove excess clothing, place them in a supine (face up) position, and check the pulse and respiration rates, until medical assistance can arrive. Keep their legs elevated, provide oral fluids and keep the athlete rested. Cooling therapy will help the athlete's prognosis and the vast majority of athletes recover within 48 hours following medical intervention, especially if mental acuity is not altered and the athlete alerts quickly.

In any case, an athlete with heat exhaustion cannot return to training or competition that day. An evaluation by a physician should state when it is prudent for the athlete to return based on the mildness or severity of the exhaustion.

Heat Cramps/Exercise Associated Muscle Cramps

There is a difference between athletes who are profuse sweaters and suffer from dehydration/electrolyte imbalances rather than true heat exhaustion. Additionally, there are those athletes who suffer greatly from heat cramps and exercise associated muscle cramps (EAMC), but not affected by heat exhaustion. Heat cramps are painful spasms of skeletal muscles of the arms, legs and abdomen that can occur during or after prolonged strenuous exercise, often in the heat. EAMC are different from heat cramps in that they are accentuated by large sodium (salt) and water losses, and can create relentless cramping in hot, humid conditions. Some individuals are more susceptible to EAMC, and it may be related to genetic or metabolic abnormalities, versus the garden variety heat cramps that strike any and all during high heat-stress index days.

Both heat cramps and EAMC respond well to rest, prolonged, full range of motion (ROM) stretching of the cramped muscle(s), replacement of fluids and electrolytes, and, especially with EAMC, oral sodium ingestion in fluids and foods. During heat acclimatization, those athletes prone to heat cramps and EAMC should pay attention to exertional levels that trigger cramping and develop a hydration/electrolyte or sodium protocol that helps reduce the frequency and intensity of cramping.

The specifics of hydration, electrolytes and the risks of hyponatremia will be the subject of our next cycling health and safety article.

References

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