

Important Information about **HEATSTROKE**

What is heatstroke? How is it caused?

Heatstroke is a life-threatening emergency characterized by a body temperature of 40° C (104° F) or higher and neurologic dysfunction that may include delirium, seizures, or coma. Heatstroke occurs in warm, humid conditions: the high ambient temperature impairs heat loss by conduction, and the high ambient humidity limits heat dissipation by the evaporation of sweat. In exertional heatstroke, exercise imposes the additional thermal burden of increased heat production. Working at maximal intensity, muscle can increase its energy consumption to levels 20 times its basal rate; because the body's efficiency is only about 25%, much of this energy is converted into heat, which is transferred from muscle to blood, raising the core temperature.

Combined with the extra heat production of exertion, athletes are put at special risk if they

- Take medication that may effect thermoregulation [diuretics, tranquilizers, antidepressants, anticholinergic medications such as OTC decongestants and antihistamines and others that typically cause dry mouth],
- Wear inappropriately heavy clothing,
- Are exposed to direct sunlight while exercising,
- Become dehydrated,
- Lack cardiovascular conditioning,
- Are not acclimated to heat,
- Have a high body mass index,
- Use performance-enhancing supplements such as Ma-huang (ephedrine) and creatine,
- Are "sprint" or strength athletes vs. an endurance athletes, and/or
- Excessively consume alcohol

Because all of these factors can be anticipated and corrected, exertional heatstroke is preventable.

The crucial pathophysiologic events causing classic heatstroke are excessive ambient heat and humidity and impaired heat dissipation caused by anhidrosis [decreased sweating]. Even slight dehydration, with decreased sweating which limits heat dissipation, is an important predisposing condition for athletes. Other factors that increase risk include neurologic and cardiovascular diseases and their medications. Alcohol consumption also contributes to some cases.

How is heatstroke prevented?

Heatstroke can be prevented by being aware of the heat index; judicious use of alcohol; maintaining adequate hydration; and working with athletes who take medication so they understand the exercise related effects of their medications. Hydration is especially important for endurance athletes who add internally generated heat to the ambient stress and have high sweating fluid loss.

Studies have long shown that hydration with carbohydrate containing electrolyte solutions is more effective than just water. Pedialyte and Gatorade-like sport drinks are examples. They have from 5% to 10% sugar in water with some salt and potassium and, possibly, calcium. [Calcium is lost in sweat and bike riders, without the weight bearing which promotes bone density, are prone to long term decrease in bone density from this loss.]

Prehydration, fluids during exercise, and post hydration are keys to avoiding heat injury in conditioned endurance athletes (See study results at the end of this article). Prehydration would be enough fluid to carry you to your first rest/drink stop [if you stop every hour, 18 oz prehydration fluid for a 180 lb. individual]. Maintaining hydration requires at least 24 oz for each hour beyond the first one. Post exercise rehydration for endurance athletes requires at least 24 - 32 oz.

How is heatstroke diagnosed?

The major challenge is to distinguish exertional heatstroke from less severe exercise-induced abnormalities, such as simple exertional hyperthermia and heat exhaustion, both of which are easily treatable. People who experience weakness or undue fatigue, lack of concentration or confusion, lightheadedness or dizziness, headaches, nausea, or muscle cramps in the heat should cease exercise, get to a cool environment, and drink cool fluids to avert more serious heat injury. They should also be sure that they medical help is available if symptoms progress.

The major manifestations of the classic and exertional heatstroke syndromes are similar. An abrupt rise in body temperature is universal; - most patients with heatstroke have core temperatures in excess of 40.5° C (105° F). Disorientation is no less common and may span a spectrum of symptoms ranging from confusion and lethargy to delirium, stupor, coma, and seizures.

Rapid heart rate is present in most patients, and low blood pressure is present in many. Shock, irregular rhythm, decreased cardiac blood flow, and swelling of lung tissue are most likely to occur early in elderly or debilitated patients with classic heatstroke but are also frequent preterminal events in patients with exertional heatstroke.

Most heatstroke victims hyperventilate. Other common clinical manifestations of heatstroke include decreased and concentrated urine output and vomiting. The skin is hot and dry in many patients with classic heatstroke but is often moist and clammy in patients with exertional heatstroke.

Early diagnosis is critical to prevent life-threatening complications.

How should heatstroke be treated?

True heatstroke necessitates prompt and aggressive therapy. Lowering body temperature is the crucial element in management. Physical cooling is essential, medications are ineffective. Field management includes removing the patient's clothing, fanning the patient, and bathing the patient's skin with cool water; and applying ice packs if they are available. The patient should be protected from sunlight and should be moved to a cool environment and evacuated to an emergency ward as soon as possible. In urgent circumstances, ice-water immersion may be employed.

Physical cooling must continue after the patient arrives in the emergency ward. The administration of room-temperature intravenous fluids is an important aspect of therapy, helping to lower core temperature and to correct dehydration. Body temperature is monitored continuously; in most cases, body temperature will decline significantly in 10 to 40 minutes, at which time cooling is reduced to avoid hypothermic overshoot with shivering and rigors that produce heat.

Even with aggressive therapy, heatstroke has an appreciable mortality but most patients who recover have normal thermoregulatory mechanisms and heat tolerance.

Footnote: An interesting recent study [Sci Med Sports Exerc. 2004;36:1239-1243;The School of Kinesiology and Recreation Studies at James Madison University] quantified how much fluid to drink.

Fifteen male cyclists rode a cycle ergometer at 75% peak oxygen consumption per unit time (VO₂peak) to voluntary exhaustion, followed by a second ride 12 to 15 hours later at 85% VO₂peak to exhaustion. Every 15 minutes of exercise, the cyclists drank 1.8mL/kg body weight of sports beverage [5 - 6 ounces for a 180 lb. man; 16 to 24 oz an hour] and they drank 10 mL/kg body weight immediately following exercise [24 - 32 oz].

[Note: Interestingly, the athletes exercised 29% to 40% longer to get to exhaustion with a carbohydrate plus protein drink - Accelerade - than with a carbohydrate-only drink (106.3 ± 45.2 vs. 82.3 ± 32.6 minute). Also, peak postexercise plasma creatine kinase (CK) levels, indicating muscle damage, were 83% lower after the carbohydrate plus protein drinks than after a carbohydrate-only drink. The protein and carbohydrate drink had an additional 5-6 grams of protein per 8 oz. This also approximates low-fat milk which has the added advantage of calcium.]