Hot Weather Rowing

By David F. Thomashow, M.D., P.A.

Water, water, everywhere,
And all the boards did shrink;
Water, water, everywhere–
Nor any drop to drink.
The Rime of the Ancient Mariner
Samuel Taylor Coleridge

Few rowers have the luxury of being able to imbibe of the water on which they float. Where I rowed in college, one couldn't touch, much less drink, the water. Although ambient temperatures may be several degrees cooler on the water than inland, heat-stress syndromes can occur both in competitive and recreational rowers. The intent of this article is to acquaint the reader with the varied clinical disorders associated with excessive heat exposure.

The medical syndromes resulting from heat stress are varied. They range from "heat cramps" and "heat syncope" (fainting) at the more mild end of the spectrum to "heat exhaustion" and "heat stroke" at the more severe extreme. Although I will try to provide some practical advice, it is of the utmost importance to remember that heat exhaustion and stroke are potentially catastrophic events which are difficult for even well-trained physicians to diagnose and manage.

The development of these disorders need not be abrupt and dramatic. Indeed, in healthy young athletes with strong cardiovascular systems, the process may insidiously progress over several days to a week. The presenting symptoms need not be muscular. One group of military recruits with heat stroke initially presented with psychotic behavior and were hospitalized on psychiatric wards before the correct diagnosis was made. Many did not survive the error.

With the increasing popularity of recreational rowing, it is equally important to remember that the excessive heat generated by working muscles must be transferred from the body's core to the skin surface where it can be dissipated to the environment, and this transfer requires an intact cardiovascular system. Atherosclerosis (hardening of the arteries) interferes with this process. Those at greatest risk are individuals with diabetes, hypertension, a history of cigarette smoking (even those who have quit), a genetic tendency (i.e., a strong family history) and more elderly rowers. These conditions do not preclude exercise, but it is only common sense that if any of these criteria are met, an evaluation by an internist or family practitioner is in order before embarking on an exercise program, and increased caution is indicated during times of high environmental temperature and humidity.

Heat Cramps

Cramps tend to occur in healthy, acclimatized subjects who can tolerate work in the heat for extended periods of time. Those muscles most heavily used in the exercise are most likely to cramp, and the cramps tend to develop while cooling down or an hour or so later in the day. It is believed, although the precise mechanism is unclear, that they are caused by an insufficient replacement of sodium salt despite adequate volume (water) intake. Usually the patient is "hyponatremic" (i.e., has a low blood sodium level). None of the systemic symptoms of heat exhaustion are present. The appropriate treatment is, specifically, sodium salt replacement in addition to water to replenish the volume lost with excessive sweating.

Heat Syncope

Even a perfectly healthy person can feel "a bit faint" if he stands up too quickly after being seated for a prolonged period of time. In the heat, blood vessels dilate and blood can be trapped in the veins of the lower extremities. While actively rowing, the vigorous contraction of the leg muscles will prevent this "pooling" of blood, but it could easily occur even during a few moments of rest in the boat before docking. Compounded by fluid losses from sweating, a decrease in adequate return of blood to the heart

Preventing Heat Disorders

- *Try to drink as much water as you feel comfortable with before, during, and after practice. If rowing in more than one race in hot weather, rest in the shade and drink water as you can between races. (The colder the water, the quicker the rate of absorption from the digestive tract.)*
- *Sugar hinders water replenishment. In hot weather, water is the most effective replacement fluid. If you do use a commercial "sports beverage" or juice, it should be diluted with water to decrease the concentration of sugar.*
- *Never take salt tablets. Salt tablets are irritating to the stomach, can increase the danger of dehydration and potassium loss, and can cause diarrhea (and further dehydration).*
- *Wear light, loose-fitting clothing while exercising. Remove clothing when it gets wet (wet clothing reduces the skin's ability to cool).*

would cause a fall in blood pressure and result in severe dizziness or even a brief loss of consciousness (syncope). In addition, low body potassium stores resulting from excessive losses in sweat and urine not only directly lowers blood pressure, but also impairs the response of the arteries to hormones released during exercise that normally serve to help maintain blood pressure. All of the above problems are exacerbated in persons with cardiovascular diseases, and, thus, can be a greater hazard among recreational rowers. In general, the dizziness or fainting is momentary. Rest and fluid replenishment is usually adequate treatment; however, heat syncope may be a warning that serious potassium depletion is occuring. In the older rower it would be prudent to take several days off, vigorously replenish potassium and let a physician know what occurred. In the younger rower, who really should not faint under any circumstances, syncope should be taken as an even *more* serious event, and should prompt a medical evaluation with the determination of a set of blood electrolytes (salts including sodium and potassium). Under no circumstances should "salt tablets" be administered, and the athlete should be closely observed for evidence of heart rhythm abnormalities.

Heat Exhaustion

This is a potentially life-threatening condition not at all uncommon among otherwise healthy young athletes subject to vigorous, prolonged exercise in hot environments. The symptoms are usually extreme weakness, headache, nausea, vomiting and muscle cramps. The victim may appear pale and have clammy skin; low blood pressure and a rapid heart rate may be present. The presenting picture, however, can be more subtle with only decreased performance, muscular incoordination or emotional changes ranging from impaired judgement to frank psychosis as harbingers of more severe cardiovascular events.

Low body potassium plays a critical role in many aspects of this syndrome. With continued exposure to heat, the body begins to "acclimatize." This involves very specific hormonal changes culminating in very high, sustained levels of a hormone called aldosterone that is secreted by the adrenal glands. Aldosterone acts both on the sweat glands and on the kidneys and causes retention of sodium salt and water in an effort to prevent excessive dehydration and maintain blood pressure. However, any changes in the body's steady-state results in "trade-offs." In effect, you cannot rob Peter to pay Paul. In this instance the increased absorption of sodium salt is compensated for by an increased loss of potassium salt in both sweat and urine as was previously alluded to under "heat syncope." Both the sweat glands and the kidneys are *forced* to make this exchange by the presence of high levels of aldosterone. In this regard, sodium "salt tablets" are miniature time bombs. Consumption of sodium salt actually increases the already

Potassium content of foods useful for oral replacment therapy

Food	Unit	Potassium content (mg)	(mEq)
Milk	cup	350-355	8.75
Meat, fish, poultry	3 oz	300-540 (avg 390)	9.75 (avg)
Fruits			
Apricots, dried	8 halves		
Banana	1 small		
Cantaloupe	¾ cup		
Figs, dried	3		
Orange	1 medium	300-490 (avg 380)	9.5 (avg)
Prune juice	5 oz		
Grapefruit juice	8 oz		
Orange juice	8 oz		
Raisins	½ cup		
Vegetables			
Artichoke	1		
Beans			
White, cooked	½ cup		
Lima, cooked	½ cup		
Canned, no pork	½ cup	300-500 (avg 360)	9 (avg)
Vegetable juice cocktail	8 oz		
Tomato juice	8 oz		

large potassium losses. Mild to moderate potassium depletion will cause weakness and fatigue. Severe depletion can result in fatal heart irregularities which are probably the cause of most military training camp sudden deaths.

Remember, heat exhaustion is a serious medical condition. The affected rower should be examined in an emergency room setting. To return home or to a dormitory room alone is to invite disaster.

Heat Stroke

Heat stroke is a fulminant condition (developed suddenly and severely) with higher than 75% mortality. It is characterized by abnormalities of multiple organ systems including seizures, coma, bleeding, liver failure, pancreatic failure, heart failure and renal failure. Kidney failure requiring dialysis is particularly common even among young, previously healthy individuals. Potassium depletion, once again, is the rule and increases the risk of heart and kidney dysfunction. Practical advice is relevant only in terms of prevention. The restriction of water on the belief that deprivation while training enhances an athlete's toughness is criminal. The use of pure sodium salt substitutes rather than balanced electrolyte supplements is archaic. Among lightweight oarsmen constrained to make weight, the unmonitored use of a sweat room and failure to replenish potassium is most dangerous. The use of diuretics is unethical and indefensible.

Even in skilled medical hands with hospitalization in an intensive care unit, *most* patients with heat stroke *die*.

Summary

I would emphasize two common rules of thumb in the approach to exercise in the heat. *First*, in the recreational rower, the presence of atherosclerosis, diabetes, or high blood pressure does not preclude exercise any more than does advancing age, but does necessitate close periodic medical evaluations; restriction of exercise to the coolest parts of the day (usually early morning); cessation of exercise during particularly severe heat spells (put your ergometer in an air conditioned room and pretend it's February), and careful attention to fluid and electrolyte replenishment. *Second*, in younger athletes *any* symptoms of heat stress, regardless of how slight, *cannot be ignored*. Peer and coach-imposed pressure, as well as the self-imposed pursuit of excellence, can lead to continued exertion in the face of deteriorating performance and progressive metabolic deterioration. Under severe heat-humidity conditions, he who turns and rows away may well live to row another day.

For a more detailed discussion, an article detailing the energy systems used in competitive rowing and a more comprehensive review of the physiology of exercise in the heat are available on request from *AMERICAN ROWING*.

Dr. David Thomashow is a board certified internist and nephrologist. He is a member of Sports Medicine Consultations, a multidisciplinary practice specializing in injury treatment and prevention, located in Englewood, New Jersey, and is the medical advisor to Adidas running, track and field.