The Importance of Potassium in Strenuous Exercise Programs

By D.B. Young

The minutes immediately after cessation of strenuous exercise are termed the "vulnerable period" or the period of "post-exercise peril" regarding the occurrence of lethal cardiac arrhythmias. During the first minutes after strenuous exercise, the blood serum concentrations of catecholamines increase, while whole serum potassium (K) concentrations rapidly decline, possibly contributing to "post-exercise peril."

THE TERM "post-exercise peril" or "vulnerable period" is used to describe the period of the first few minutes immediately following strenuous exercise, when the risk of cardiac arrhythmias is greatest. During this time, blood plasma concentrations of catecholamines (a group of sympathomimetic amines including epinephrine, also called adrenaline, and norepinephrine) rise to seven to nine times their normal levels while blood serum K falls precipitously. Epinephrine is a powerful vasopressor that can accelerate the heart rate.

Our research used healthy men volunteers in a standard exercise regimen that required approximately 15 minutes of treadmill work at increasing levels of intensity until exhaustion was reached. Blood samples were taken at a resting stage prior to the exercise period and at 1, 2, 3, 5 and 10 minutes following the exercise. The samples were analyzed for K, sodium (Na), pH, epinephrine and norepinephrine.

At the initiation of post-exercise sampling, the test subjects had levels of catecholamines that were seven to nine times above resting values (**Figure 1**). Their plasma K concentrations are shown in **Figure 2**. Plasma K concentration rose slightly during exercise to about 1 meq/L above the pre-exercise level. The concentration then fell rapidly over the next 5 minutes to near the resting concentration.

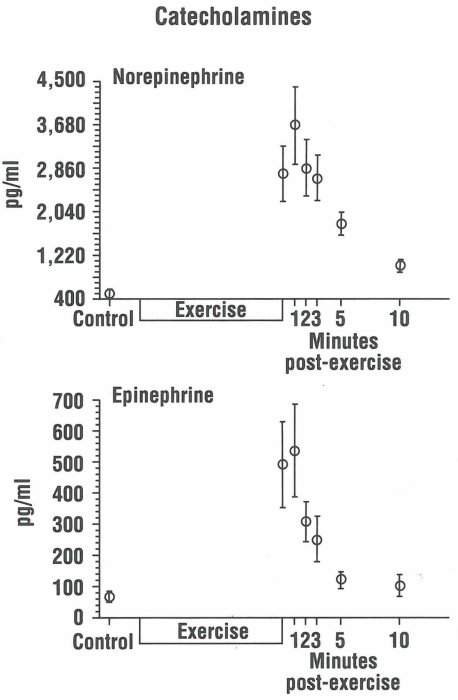


Figure 1. Plasma concentrations of epinephrine (top) and norepinephrine (bottom) during the course of the exercise and recovery periods. Means and standard errors of the mean are shown.

A continuing rise in catecholamine concentrations accompanied by a precipitous fall in plasma K has not been reported before. The plasma K levels in the test subjects fell at a mean rate of 0.54

Dr. Young is Professor of Physiology, Dept. of Physiology and Biophysics, University of Mississippi Medical Center, Jackson, MS 39216-4505.

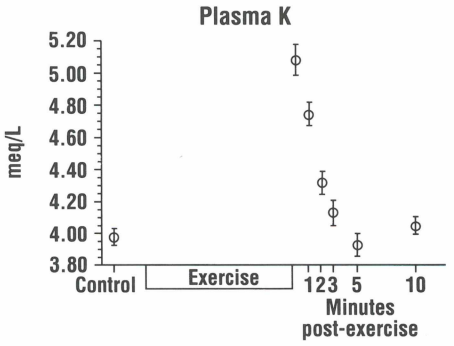
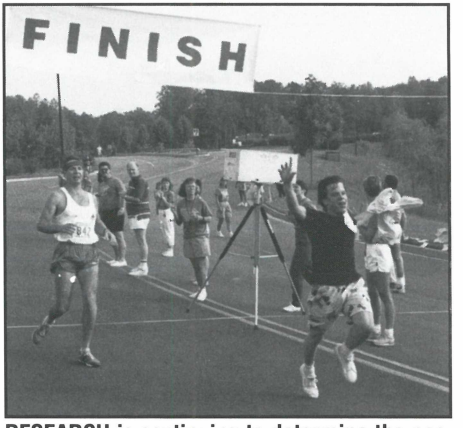


Figure 2. Plasma K concentration during the exercise and recovery period. Means and standard errors are shown.

meq/L/minute. In some individuals the fall was as great as 1.50 meq/L in 2 minutes. During the period of rapidly falling K concentrations, concentrations of the catecholamines continued to rise. These biochemical abnormalities, although present only transiently during the post-exercise period, may contribute to the vulnerability of the metabolically stressed myocardium (the middle and thickest layer of the heart wall) to other arrhythmogenic factors such as coronary insufficiency or ischemia (blood deficiency due to blood vessel obstruction).

If the coronary arteries constricted in response to the sharp fall in K after exercise, the risk of arrhythmia would be elevated in subjects whose coronary blood distribution was already limited by pre-existing disease.



RESEARCH is continuing to determine the possible role of K in reducing risk of "post-exercise peril."

Summary

This combination of biochemical and hormonal factors may contribute to the arrhythmogenic risks imposed by other factors such as myocardial ischemia. It would suggest the consumption of K-rich foods and beverages prior to strenuous exercise, because the body is unable to store K to use during periods of great demand. However, one should use caution when ingesting large amounts of K and do so only under directions of a physician. ■

Mississippi

Effects of Potassium Deficiency on Heart Functions in Animals

THE EFFECTS of moderate, chronic (five days) potassium (K) depletion on cardiac function were assessed in 14 dogs with sufficient K (normokalemic) and 13 with K deficiency (hypokalemic). Plasma K concentrations were significantly lower in the hypokalemic animals. Potassium deficiency produced major negative effects on several indices of mechanical cardiac function during both contraction and relaxation.

The authors suggest that results of the study indicate moderate hypokalemia may not affect the unstressed function of the normal heart, but may severely limit the ability of the heart to respond to stress and exercise. Deleterious effects of hypokalemia would be expected to be most severe in individuals with serious levels of heart disease. Results of this study should help determine whether to correct moderate K depletion and hypokalemia in the large number of human patients with this condition. ■

Source: D. E. Fitzovich, M. Hamaguchi, W. B. Tull and D. B. Young. J. Am. Coll. Cardiol. 18:1,105-1,111. 1991.