Dynamic Chiropractic

VITAMINS / SUPPLEMENTS

Hydration -- Part II

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In this issue we will explore fluid-replacement drinks, also known as carbohydrate electrolyte drinks. They should not be confused with ergogenic-enhancement drinks, phosphate-buffering drinks, and carbohydrate-loading drinks, which will be discussed in future articles.

Fluid-replacement drinks are designed for three primary functions: hydration/rehydration; electrolyte/mineral replacement; and blood glucose/energy enhancements.

As we discussed last month, the athlete who is low on fluid has a distinct competitive disadvantage. Furthermore, the exercising athlete is only able to absorb one ounce of fluid every three or four minutes, while fluid losses can exceed one ounce per minute. Therefore, we must encourage our patient athletes to consume extra amounts of fluid before they become thirsty. Studies have shown that athletes will consume greater amounts of fluid if it tastes good. Fluid-replacement drinks contain various types of sugars and minerals that increase palatability.[1,2,3] A fluid-replacement drink with good balance will increase the absorption of carbohydrates, electrolytes, and water.[4] In my literature review, I came across exercise-induced hypotonic hyponatremias in athletes who are exercising vigorously and consuming only plain water or non-electrolyte solutions.[5] Consumption of a good fluid-replacement drink can avoid this unfortunate circumstance.

There are many reasons for the inclusion of minerals and electrolytes in fluid-replacement drinks:

1. Activity-induced dehydration, whether frank or marginal, can result in electrolyte imbalances coupled with fluid shortages.[6]

2. The body's ability to absorb water is enhanced by the active transport of glucose and sodium in the small intestines, and by passive absorption of potassium and other solutes which displace and/or bind with osmotically active particles in the small intestine.[7]

3. Optimal glucose absorption can only occur when sodium is present in sufficient amounts intraluminally.[8]

4. Magnesium activates over 300 enzymes in the body. Among these are reactions involving the production of energy (ATP is bound to magnesium). Recent studies have shown that vigorous exercise results in magnesium depletion. Noted sports nutritionist Dr. Brian Leibovitz states that "Some evidence exists for a redistribution of magnesium (from blood to the muscle) during exercise, which could contribute to exercise-induced reduction in blood magnesium levels."[9] Coupled with sweat losses, often times this can result in significant magnesium deficiency. Preliminary studies are showing that marginal magnesium deficiency can result in skeletal muscle mineral imbalances which, in turn, can decrease performance.

5. Chromium is a trace mineral that is currently receiving a great deal of attention. It enhances insulin's ability to deliver nutrients into the cells by increasing insulin sensitivity. Athletes require additional amounts of this vital trace mineral. Research has shown that athletes' urinary chromium levels are increased fourfold following continuous aerobic training of 45 minutes or longer.[10]

6. Chloride is an often overlooked electrolyte in exercise physiology. I came upon one study that showed that fluid-replacement drinks may slightly inhibit the body's ability to absorb chloride.[11] Thus, to maintain electrolyte hemostasis, a good fluid-replacement drink should contain chloride.

One of the most studied aspects of fluid-replacement drinks is carbohydrate source and amount. For many years, sports experts felt that plain water was the optimal sports drink, and the advent of the original sports drink, that contained sucrose and glucose only, did not change a lot of minds. Today you will find various combinations of glucose, fructose, sucrose, and maltodextrins in most sports drinks. The goals of carbohydrate inclusion in a sports drink are to contain the maximum level of carbohydrates that will:

1. Not inhibit the rate of gastric emptying.

2. Provide a maximal amount of energy without causing a rebound hypoglycemia.

3. Not retard the absorption of water, carbohydrate and electrolytes in the small intestine.

We will now briefly review carbohydrates as they pertain to hydration.

Sucrose:

It is this author's opinion that sucrose or simple sugar is not the optimal source of carbohydrates for a sports drink. As most of you know, it causes a sharp rise in the blood plasma levels of insulin, which in turn leads to a rapid decrease in blood glucose levels. When intestinal fluid uptake of a 3.6 percent glucose polymer, 1.8 percent fructose, 1.6 percent sucrose solution (7 percent total) was compared to equal amounts of plain water, net fluid absorption from the small intestine was significantly reduced in those subjects who consumed the 7 percent carbohydrate solution.[12] In another study, a 7 percent solution consisting of 5 percent glucose polymer and 2 percent fructose emptied the stomach and was absorbed in the small intestine at rates very close to that of plain water.[13] This is another example of the powerful affect even small amounts of sucrose can have on human physiology.

The obvious question is, what if sucrose is the only available source of carbohydrates for the athlete? Is sugar and water better than plain water? The answer depends on what the doctor needs to accomplish. When compared to an artificially-sweetened noncarbohydrate drink, the cycling athletes who consumed a dilute sucrose solution had increased endurance during their trial and a faster sprint performance at the end of the test.[14] Thus, a dilute sucrose drink is better than plain water for energy enhancement. However, the athlete who is dehydrated or dehydrating should choose plain water over a water-sucrose combination.

Glucose

The stimulating effect of glucose on water absorption in the small intestine is a key mechanism in the advent of fluid-replacement drinks.[15] Glucose also increases passive and active sodium transport in the small intestines.[16] This is accomplished because free glucose can be used to generate energy in the gastrointestinal mucosal cells directly.[17]

Fructose

Fructose has many interesting effects in applications for fluid-replacement drinks. Fructose solutions leave the stomach faster than equal molar glucose solutions,[18] but are absorbed more slowly than glucose from the small intestine.[19] Fructose stimulates potassium absorption in the small intestine.[20] Fructose also increases water absorption in the small intestine, but not as much as glucose.[21] It is non-insulogenic and spares glycogen.[22] Finally, fructose is sweeter than glucose, glucose polymers or sucrose, and as previously-referenced studies have noted, athletes will consume greater amounts of beverages that are pleasing to the palate.

Glucose Polymer

Glucose polymer or maltodextrin are medium chains of the monosaccharide glucose. They are larger than mono- or disaccharides, but smaller than a starch. It, therefore, has some of the best properties of simple sugars and starches. Glucose polymers clear the stomach faster than glucose.[23] They also have a lower osmotic pressure than either fructose or glucose. This results in a decreased amount of intestinal secretion needed for its uptake. Glucose polymer ingestion maintains a greater plasma volume during exercise than simple carbohydrate drinks or plain water.[24] This means that beverages with the right amount of glucose polymer are absorbed by the body better than plain water. The thinking of many people (this author included) that nothing was better for hydrating the athlete than plain water is now becoming obsolete.

Next month in Hydration, Part III, we will continue this series with a discussion of the optimal ranges of carbohydrates and electrolytes a good fluid replacement drink should contain.

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