Dynamic Chiropractic – March 1, 1991, Vol. 09, Issue 05

Caffeine and Sports

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For years, athletes in many sports have used caffeine as an aid to performance. Although I do not personally recommend caffeine as an ergogenic aid to my patient athletes, many of them use it for this purpose. The goal of this article is to review the biochemical effects of caffeine, summarize the recent literature, and inform the DC how to work with and not against their patient athletes who use caffeine.

Caffeine is in the methylxanthine family of compounds. It is a xanthine molecule with three methyl groups attached to it. Xanthine is formed from hypoxanthine, which is oxypurine.

Biochemical Review

1. Caffeine stimulates the central nervous system by binding in areas that are reserved for substances that inhibit neuronal firing. This results in a decrease in reaction time and perception of fatigue, and an increase in alertness.

2. Caffeine blocks an enzyme that breaks down cyclic adenosine monophosphate (C-AMP). High levels of C-AMP increase lipolysis, which results in the release of free fatty acids into the blood stream. Muscle cells then absorb the free fatty acids and use them for energy production. This process decreases the demand for glycogen, and thus is glycogen sparing.

3. Caffeine relocates intracellular calcium to a position where membrane permeability is enhanced. This yields increased motor unit involvement, which in turn results in stronger muscular contractions.

4. Caffeine absorption is greater in tissues with a high water content; thus, muscles receive high concentrations of caffeine after ingestion.

5. Caffeine inhibits kidney reabsorption of sodium and water; therefore, it has a diuretic effect on the body.

6. Caffeine increases calcium and magnesium excretion. It also blocks iron absorption when taken with or after a meal. When consumed one hour before eating, iron absorption is not affected.

My review of the current research and literature yielded conflicting data on just about all aspects of caffeine as an ergogenic aid. The majority opinion is that caffeine will enhance the performance of endurance athletes, such as distance runners or cyclists. The best results came from those studies that used doses that exceeded the International Olympic Committee limits (urinary levels greater than 12 mcg/ml). In anaerobic sports, such as weightlifting or football, proponents state that caffeine's ability to decrease reaction time and sharpen perception make it a valuable aid. However, unlike endurance studies where a clear majority of the tests resulted in athletic benefit, less than onehalf of the human and animal anaerobic studies displayed ergogenic enhancements.

A review of the signs and symptoms of caffeine toxicity include nervousness, palpitation, anxiety, muscle tightness, muscle twitching, insomnia, headaches, arrhythmias, and gastrointestinal disturbances. Many doctors state that the signs and symptoms of caffeine toxicity clinically mirror those of anxiety neurosis.

Studies reveal that peak plasma levels of caffeine occur from 15 to 60 minutes after ingestion. Studies on the optimal time of pre-event "loading" for ergogenesis also ranged from 15 to 60 minutes. Blood half-life of caffeine was as low as two and as high as seven hours in the literature I reviewed. The doses needed for an ergogenic effect ranged from 3 mg of caffeine per kilogram of body weight to 15 mg of caffeine per kilogram of body weight.

The caffeine content of 6 oz of coffee ranges from 60 mg for instant to as high as 180 mg per cup for filter drip. Twelve ounces of cola soft drinks ranged from 17 to 55 mg. There are new, high caffeine colas on the market that may contain 100 mg or more of caffeine per 12 oz serving.

There was a general agreement in the literature that when regular, heavy consumers (over three cups of coffee a day) wanted to use caffeine as an ergogenic aid, they should abstain from using caffeine for 48 hours prior to event loading. When the abstinence period was not observed, lipolysis and reaction times did not change due to the fact that in heavy, regular users the body builds up a tolerance.

Recent literature states that pre-competition high carbohydrate meals or ingestion of caffeine with niacin will block the rise in blood levels of free fatty acids.

In conclusion, if you have patient athletes who do not use caffeine as an erogogenic aid, make sure that they are adequately hydrated and consume a multimineral supplement that yields at least 1,000 mg of calcium, 500 mg of magnesium, and 20 mg of iron per day. Advise them to try moderate doses (two cups of coffee) before an event, and to use low doses (one cup) on days between competitions. Biochemical individuality will dictate levels of optimal ergogenesis. Finally, monitor your patient athletes very closely for toxicity signs and symptoms.

If you have any questions, please feel free to write me at my office.

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