Ergogenic Aids in Sports

Introduction to Ergogenic Aids

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Ergogenic is defined as, “tending to increase work”

An ergogenic aid is defined as ..... “A physical, mechanical, nutritional, psychological, or pharmacological substance or treatment that either directly improves physiological variables associated with exercise performance or removes subjective restraints which may limit physiological capacity”

Sports Supplement = Ergogenic Aid

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Examples of Ergogenic Aids?

Swim suits
Equipment – golf, cycling, ....
Shoes
Steroids
EPO
Diuretics
Blood doping
Caffeine
Others???????
What Are The Issues?
Media Coverage & Corporate Sponsorships
President’s Council on Physical Fitness
More Than Just Sports & Athletics!

Types of Ergogenic Aids

I. Mechanical
Running shoes, nasal breathing strips, equipment innovations, artificial turf, etc.

II. Pharmacological
Erythropoietin, β-blockers, antihistamines, growth hormone, anabolic-androgenic steroids, caffeine, amphetamines, ephedrine, β-hydroxy-β-methylbutarate (HMB), Androstenedione, Dehydroepiandrosterone, etc.

III. Physiological
Blood doping, saline infusion, warm-up, clothing, etc.
IV. Psychological
Hypnosis, psychotherapy, imagery, etc.

V. Nutritional
A. Metabolic fuels
   carbohydrate, protein, pyruvate, lactate, fat, caffeine,
   branched chain amino acids, etc.
B. Limiting cellular components
   creatine, carnitine, vitamins, phosphate, NaHCO₃, etc.
C. Anabolic or stimulatory substances
   protein, chromium, vanadium, dichloroacetate, ephedrine,
   β-hydroxy-β-methylbutarate (HMB), Androstenedione,
   Dehydroepiandrosterone, caffeine, etc.
D. Anti-Catabolic
   anti-oxidants, β-hydroxy-β-methylbutarate (HMB), etc.
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Caffeine

- The most highly consumed drug in North America and Europe.
- IOC initially banned caffeine in 1962, then removed from list in 1972.
- Today, urinary caffeine > 12 µg/L is an IOC infringement. \((NCAA > 15 \mu g/L)\)
- This urinary level requires > 13.5 mg/kg caffeine, where 1 cup coffee provides 80 mg.

**IOC banned dosage**
1012 mg/80 = 12.7 cups
330 mg/80 = 4.1 cups

Assumes 75 kg body mass

Ephedrine

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University of Western Sydney
CAFFEINE

Improved exercise endurance

Stimulant to CNS

Diuresis

Lipolysis

Incidence of cardiac arrhythmias

Muscle glycogenolysis

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Androstenedione

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E. Substances that may enhance thermoregulation and/or prevent dehydration

*fluid, electrolytes, glycerol, sports drinks, etc.*

**Glycerol**

Ingestion of ~1.2 g glycerol/kg body mass with sufficient volumes of water (26 mL/kg) can induce an increase in hydration, termed *hyperhydration*.

Increased hydration can improve cardiovascular function and thermoregulation during conditions where dehydration is inevitable.
Carnitine
Molecule that transports fatty acids into mitochondria. Research indicates that carnitine provides no ergogenic benefit.

Phosphate
Some evidence for increased VO$_2$max and VT.

Sodium Bicarbonate
Increases blood bicarbonate and buffering potential. Increases performance during intense intermittent exercise.

Creatine
• Most popular nutritional supplement on market @ $300 million sales in U.S. in 2000.
• First reported supplementation – Barcelona Olympics 1992.
• Creatine is the main component of creatine phosphate. Creatine is found in meat and fish (mixed diet provides about 1 g/day), but is also synthesized in the liver, pancreas, & kidneys (1 g/day, which is suppressed with supplementation).
Creatine

- Dietary supplementation of creatine of at least 15 - 25 g/day for 2-7 days can increase muscle creatine by 20 - 30%. (~ 20% is in CrP form)
- Physiological benefits inconsistently reported in research and changes are not large.
- Some detriment – increased body water (weight), muscle cramping, possible renal damage from long term high intake.
- Not banned, but in the U.S. the NCAA prevents college teams from providing it to players.

Branched Chain Amino Acids

The main BCAA’s are leucine, isoleucine and valine. These amino acids decrease the ability for tryptophan to cross the blood brain barrier, impeding the formation of serotonin and the perception of fatigue (central fatigue).
**Erythropoietin (EPO)**

- A hormone that is mainly produced in the kidney in response to hypoxia, anemia, and blood loss.
- EPO stimulates increased red blood cell production (erythropoiesis).
- EPO also provides central nervous system stimulation.
- EPO is widely used by elite endurance athletes, but has caused deaths due to organ damage resulting from excessive increases in blood viscosity.

**Blood Doping**

- The removal of 1-4 units of blood, storage of the blood for 4-8 weeks, and the reinfusion of the red blood cells.
- Reinfusion usually occurs ~1 week prior to competition.
- Blood doping can double the [Hb], but typically this causes too much of an increase in blood viscosity.

\[
\begin{align*}
140 \text{ g/L} \times 1.34 \text{ mL/g} \times 0.98 &= 148 \text{ mL/L} \\
200 \text{ g/L} \times 1.34 \text{ mL/L} \times 0.98 &= 263 \text{ mL/L} \\
262 - 148 &= 79 \text{ mL/L}
\end{align*}
\]
Conclusions

• Many forces are at work to promote supplement use and abuse.
• Most nutritional ergogenic aids are unjustifiable.
• Only positive choices are fluid, CHO and HMB.
• Is steroid, or any ergogenic, abuse a symptom of a larger problem (*e.g.: win at all costs*)?
Thank You