

DRUGS AND ATHLETE PERFORMANCE

Dr. Rajkumar Sharma*

ABSTRACT

Sports Medicine physicians should take care the orthopedic needs of whole athletes along with the medical problems, mental disorders, as well as an understanding of how medications affect training and exercise. To protect the athlete, physicians who take care of athletes need to be able to educate coaches, parents, and athletes about the benefits and risks of performance enhancing drugs from a scientific perspective. First, physicians must educate themselves regarding performance-enhancing drugs i.e. stimulants (Amphetamines and related drugs, Epinephrine and related drugs, Ephedrine & Cocaine). because this is not a subject taught in medical school or residency. Performance-enhancing drugs have been a part of sports since sporting competition began and likely always will be. Considered cheating by purists and necessary by some athletes, we must accept the fact that they are used, understand why they are used, and study how to prevent their use to institute change. This article summarizes current scientific information regarding the use of performance- enhancing drugs in young athletes so that physicians can take the information and knowledgably educate others.

Keywords: Drugs, Performance enhancing, Stimulants, and Athlete

* S.A.I. Grade-I Gymnastic Coach, State Gymnastic Coaching Centre, Department of Sports and Youth welfare, District Sports Complex, Bilaspur (CG)

INTRODUCTION

Much of the earliest performance drug use in athletics involved stimulants. In the late nineteenth century European cyclists reportedly consumed a number of concoctions to reduce fatigue. Prior to competition athletes would take caffeine-based sugar cubes that had been dipped in nitroglycerin or a drink called Vin Mariani, that was a combination of wine and coca leaves.

In the modern era of sports, these crude preparations had been replaced with more powerful stimulants, most notably amphetamine. Stimulant use was suspected initially during the Summer and Winter Olympic Games in 1952. Amphetamine use was blamed for the deaths of two elite cyclists, one during the 1960 Summer Olympics in Rome and the other during the 1967 Tour de France. Shortly thereafter, the use of amphetamines, or "pep pills" by professional athletes was exposed.

Epidemiology

As with most performance drug use, few epidemiological studies have been conducted that define the magnitude of the problem. The most comprehensive work to date has been from a team of researchers at Michigan State University College of Human Medicine at National Collegiate Athletic Association institutions. The survey, which was conducted initially in 1985 and repeated in 1989, shows that during that time period amphetamine drug by athletes dropped from 8% to 2%. The use of weight loss products, many of which are stimulants, was not studied in 1985 but in 1989 five percent of respondents indicated that they used these substances. Caffeine use was virtually unchanged (68% in 1985 down to 64% in 1989) and cocaine/crack use fell dramatically from 17% to 4% over the same period. An important and potentially troubling result from the same study was that 22% of respondents indicated that the source of amphetamines was a representative of the athletic department (coach, trainer or team physician). In 1985 only 4% of respondents identified this group of individuals as their source for amphetamines. This finding was a notable exception to the trend of obtaining ergogenic drugs outside of the athletic department.

Mandell and colleagues studied the usage rates of amphetamines by National Football League teams. Purchase records from 1968 and 1969 revealed that approximately 65 amphetamine tablets per player per game were used by NFL teams. Subsequent interviews with 87 players from eleven different teams suggested that two-thirds of professional football players use these drugs occasionally and more than half were regular users. Dosages used varied by position and ranged from 5 to 150 mg per game.

Certain sports, such as gymnastics and wrestling as well as ballet dance require weight control. Participants in these activities may be at an increased risk for eating disorders and therefore amphetamine abuse.

Amphetamine

Amphetamine is a potent central nervous system stimulant. The main effects of the drug include alertness, decreased fatigue, mood elevation, increased self-confidence, increased motor activity and decreased appetite. The clinical use of amphetamine has decreased as concern over addiction and other adverse reactions has increased. Today, the drug is used sparingly for a small number of medical indications including: minimal brain dysfunction, attention-deficit disorder and narcolepsy.

Among the first reported uses of amphetamine to enhance performance came from the battle field rather than the athletic field. During World War II, studies in German soldiers demonstrated that amphetamine delayed fatigue. The first in-depth research involving athletes was not conducted until the late 1950s. The American Medical Association's Committee on Amphetamine Drugs and Athletics commissioned two studies.

Smith and Beecher performed a study of swimming, running and weigh-throwing performance in the presence of amphetamine. The subjects, who included highly trained athletes, were given amphetamine doses of 14 mg/70 kg of body weight two to three hours before measuring athletic performance. Secobarbital was given at the same time in an attempt to mask the euphoric effects of amphetamine. Improvements were noted in a majority of athletes in each of the three athletic events. The magnitude of improvement was highest in the weight throwers who on average improved 3-4%. Runners showed an improvement of approximately 1.5%, and swimmers improved from 0.5 to 1.16%. The study did not address other factors that have an impact on athletic performance such as judgment, timing and eye-hand coordination.

Karpovich gave athletes amphetamine 10-20 mg or placebo before testing for performance in a variety of swimming and running events. In all but four subjects, amphetamine produced either neutral or negative results. One of the four subjects with improved performance was receiving placebo at the time.

Nearly twenty years after these first studies, Chandler and Blair looked at how amphetamine effected physiological components related to athletic performance. Study subjects were six male college students who were not varsity athletes. Each was given either amphetamine 15 mg·kg⁻¹ of body weight or placebo. The performance measurements taken were strength, muscular power, sprinting speed, acceleration, aerobic power and anaerobic capacity. Improvements were seen in all variables except sprinting speed following administration of amphetamine. Significant improvements were reported in strength, acceleration and aerobic power and increases in time to exhaustion and maximal heart rate. This suggests that amphetamine does not prevent exhaustion but instead may mask fatigue by interfering with the body's regulatory systems, effects that could result in serious medical consequences. Amphetamine is listed as a banned substance by both the International Olympic Committee.

Amphetamine can produce a variety of adverse effects, most of which are related to the CNS stimulation. Restlessness, insomnia, instability and agitation are commonly reported. Serious behavioral effects have also been reported including confusion, paranoia and vivid hallucinations. Excessive amphetamine doses may result in convulsions, coma and death.

Chronic amphetamine exposure can lead to dyskinesia, mainly of the muscles involving the face and jaw. Non-CNS side effects include hypertension, angina, cardiac dysrhythmias, nausea, vomiting, gastrointestinal discomfort, weight loss, necrotizing vasculitis and subarachnoid hemorrhage. Discontinuing amphetamine abruptly may result in chronic fatigue, lethargy and depression.

Tolerance to the mood altering effects of amphetamine occurs after prolonged exposure. This raises the question of whether tolerance can develop to the effects of amphetamine on

performance leading the athlete to escalate doses over time. The studies examining the ergogenic effects of amphetamine were all single dose or short term studies.

Caffeine

Caffeine is a methylxanthine derivative found in coffee, soft drinks and many non prescription drug products. Athletes have been reported to consume the drug in hopes of achieving ergogenic benefits.

However, caffeine does exhibit properties that are of potential benefit to endurance athletes. Most notably is the drug's lipolytic effect, which increases levels of circulating free fatty acids to be used as an alternate fuel during aerobic work. This in turn spares muscle glycogen leading to improved endurance. A number of studies have demonstrated this effect at doses of 250 mg taken one hour before exercise, with an additional 250 mg dose taken immediately before exercise and continuing every 15 minutes during exercise. Several similar studies have, however, failed to show that caffeine improves endurance. Perkins and Williams concluded that caffeine in doses as high as $10 \text{ mg}\cdot\text{kg}^{-1}$ of body weight produced no significant improvements in time to exhaustion. Additional studies have challenged the theory that higher levels of free fatty acids result in glycogen sparing.

Increased alertness, improved ability for prolonged concentration and other anecdotal claims have led to the widespread use of caffeine. Studies have been equivocal in linking caffeine to these performance variables. Caffeine appears to have no affect or an adverse effect on standing steadiness, hand-arm steadiness and reaction time.

The status of caffeine as a banned ergogenic substance has changed over the years. Originally considered a banned substance by the IOC, caffeine was later dropped from the banned substance list. The drug returned to the IOC list of banned substances based on the aforementioned endurance studies involving higher caffeine doses. Evidence of doping with caffeine is defined as presence of the drug in the urine at or above a cutoff level of $12 \text{ mcg}\cdot\text{ml}^{-1}$. A positive urine drug test for the National Collegiate Athletic Association is set at $15 \text{ mcg}\cdot\text{ml}^{-1}$.

A legitimate concern of athletes is whether social consumption of caffeine containing beverages could result in a positive urine drug test. A recent study demonstrated that caffeine doses, given as coffee, tea or soft drink, would need to exceed $12 \text{ mg}\cdot\text{kg}^{-1}$ of body weight to produce a urine caffeine concentration of $15 \text{ mcg}\cdot\text{ml}^{-1}$. This would equate to nearly 1000 mg of caffeine in a 175 lb athlete. Approximately eight servings (5 oz.) of strongly brewed coffee or 16 cans (12 oz.) of a soft drink would have to be consumed to provide this amount of caffeine.

Cocaine

The 1986 deaths of two elite athletes, Len Bias and Don Rogers focused the attention of the public and athletic organizations on the use of cocaine by athletes. Large scale epidemiologic data is lacking. Most reports are anecdotal and suggest that the drug is used more for social reasons than to enhance performance, however, a survey of world class athletes indicated use of cocaine as a performance drug.

Cocaine does have legitimate medical uses, primarily as a topical anesthetic for nasal surgical procedures. Studies on the ergogenic properties are lacking. The most comprehensive study on the topic was conducted over 100 years ago, which showed

improvements in muscle strength and reaction time. These effects were noted minutes after the drug was administered nasally and lasted for over three hours. These ergogenic effects have not been confirmed by any subsequent studies. Most athletes who have used cocaine report that their performance worsened, despite at times having a sense of improved performance. Cocaine is banned by both the IOC.

The toxicity of cocaine is well known. Sudden death secondary to cocaine exposure has been reported, including among highly conditioned athletes. The drug produces significant effects on the heart resulting in heart attack, dysrhythmias and constriction of the coronary arteries. The central nervous system is also adversely effected by cocaine. Seizures, visual scotoma, blindness and optical neuropathy all have been reported. Serious behavioral changes are associated with cocaine use such as insomnia, euphoria, dysphoria, confusion, paranoia and hallucinations.

For the elite, highly trained athlete cocaine may hold an increased risk according to a recent hypothesis. Sprint-type athletes, because of their compact muscle composition, may be more prone to death following a cocaine-induced seizure. A lethal amount of heat and lactic acid could result in cardiac shut down.

Other stimulants

A number of drugs exist that have a chemical structure that is similar to amphetamine. Drugs, such as phenyl-propanolamine and ephedrine are widely used in non prescription products for treating the common cold. Phenyl-propanolamine is also found in many diet pills. Ephedrine is a common treatment of asthma, hay fever, sinusitis and other allergic conditions. These drugs, along with caffeine, are found in amphetamine "look-alike" products with names such as black beauties, white crosses, Christmas trees, greens and clears. Many who use these drugs are fooled into thinking that they are actually purchasing and using amphetamines. Phenyl-propanolamine has been estimated to be the fifth most abused drug in the United States. The extent to which these stimulants are used by athletes is not well known. In 1972 at the Summer Olympic Games in Munich, U.S. swimmer Rick De Mont, an asthmatic, was disqualified for taking a medication containing ephedrine.

The only performance studies involving these stimulants involved ephedrine. Twenty one male subjects were given either 24 mg of ephedrine or placebo. On three separate occasions over a three week period assessments were made of: strength, endurance and power, VO_2 max, reaction time, hand-eye coordination, anaerobic capacity and speed, cardio-respiratory endurance, response to maximal and sub-maximal effort, perceived exertion and speed of recovery following effort. Ephedrine had no effect on any of the performance variables measured, nor did any subject report any perception of improved performance.

Both phenyl-propanolamine and ephedrine are banned by the IOC. Many sports medicine experts feel that given the lack of conclusive ergogenic data, these drugs should be removed from the banned substance list. For athletes competing at events where drug testing is conducted, any treatment of common cough and cold ailments must avoid products containing either phenyl-propanolamine or ephedrine. This raises two points. First, athletes searching for relief of cold symptoms may not go to the team physician, but rather self-medicate using a non prescription product. Selecting a product containing a banned substance, the athlete could unwittingly risk disqualification. Secondly, for athletes who do access treatment through a team physician or trainer, drug therapy that does not include a

banned substance leaves little alternative but to use antihistamines. Non prescription antihistamines are sedating, a property that has a potential adverse effect on performance.

PROHIBITED STIMULANTS

Adrafinil, Adrenaline^{**}, Amfepramone, Amiphenazole, Amphetamine, Amphetaminil, Benzphetamine, Benzylpiperazine, Bromantan, Cathine^{***}, Clobenzorex^{****}, Cocaine, Cropropamide, Crotetamide, Cyclazodone, Dimethylamphetamine, Ephedrine^{***}, Etamivan, Etilamphetamine, Etilefrine, Famprofazone, Fenbutrazate, Fencamfamin, Fencamine, Fenetylline, Fenfluramine, Fenproporex, Furfenorex, Heptaminol, Isometheptene, Levamethamphetamine, Meclofenoxate, Mefenorex, Mephentermine, Mesocarb, Methamphetamine(d-), Methylenedioxymphetamine^{****}, Methylenedioxymethamphetamine, P-Methylamphetamine, Methylephedrine^{***}, Methylphenidate, Modafinil, Nikethamide, Norfenefrine, Norfenfluramine, Octopamine, Ortetamine, Oxilofrine, Parahydroxyamphetamine, Pemoline, Pentetrazol, Phendimetrazine, Phenmetrazine, Phenpromethamine, Phentermine, 4-Phenylpiracetam (carphedon), Prolintane, Propylhexedrine, Selegiline, Sibutramine, Strychnine, Tuaminoheptane and other substances with a similar chemical structure or similar biological effect(s).

^{*} The following substances included in the 2008 Monitoring Program (bupropion, caffeine, phenylephrine, phenylpropanolamine, pipradol, pseudoephedrine, synephrine) are not considered as Prohibited Substances.

^{**} **Adrenaline** associated with local anaesthetic agents or by local administration (e.g. nasal, ophthalmologic) is not prohibited.

^{***} **Cathine** is prohibited when its concentration in urine is greater than 5 micrograms per milliliter.

^{****} Each of **ephedrine** and **methylephedrine** is prohibited when its concentration in urine is greater than 10 micrograms per milliliter.

A stimulant not expressly mentioned as an example under this section should be considered as a Specified Substance only if the Athlete can establish that the substance is particularly susceptible to unintentional anti-doping rule violations because of its general availability in medicinal products or is less likely to be successfully abused as a doping agent.

REFERENCES

- Chandler, J.V. and Blair. S.N.** "The Effect of Amphetamines on Selected Physiological Components related to Athletic Success". Medicine Science & Sports Exercise 12 (1980) :65-69.
- Costill, D.L., Dalsky G.P. and Fink. W.J.** "Effects of Caffeine Ingestion on Metabolism and Exercise Performance". Medicine Science and Sports 10 (1978):155-158.
- Delbeke, F.T. and Debackere. M.** "Caffeine: Use and Abuse in Sports". International Journal of Sports Medicine 5 (1984):179-182.
- Giammarco, B.** "The Athlete, Cocaine and Lactic Acidosis: a Hypothesis". American Journal of Medicine Science 294 (1987) :412-414.
- Karpovich, P.V.** "Effect of Amphetamine Sulfate on Athletic Performance". Journal of American Medicine Association 170 (1959) :558-561.
- Murray, T.H.** "The Coercive Power of Drugs in Sports". Hastings Center Report 13 (1983):24-30.
- Perkins, R. and Williams. M.H.** "Effects of Caffeine upon Maximal Muscle Endurance of Females". Medicine Science and Sports 7 (1975):