Stimulant amphetamine use in high intensity exercise.
Stimulant amphetamine use in high intensity exercise.

Pharmacology in Sport

By

Word Count: 1432 words
Stimulant amphetamine use in high intensity exercise athletes.

In the context of sport, stimulants are defined as, ‘a stimulating agent of the central nervous system (CNS), affecting mood, alertness, locomotion and appetite, or targeting the sympathetic nervous system causing particularly cardiovascular actions’ (Docherty, 2008). A total of 62 stimulants are noted in the World Anti-Doping List, banned only in competition, with amphetamines belong to this class of drugs (Docherty, 2008). Stimulants do have medical pharmacological benefits, producing both peripheral and central actions, but in the sporting arena an unfair advantage can be attained through their use. Amphetamine action has both physiological and perceived psychological effects on the athlete, and is identified as an indirect acting sympathomimetic CNS stimulant (Docherty, 2008).

From the articles examined, amphetamine research varied from the effect on striated dopamine outflow, to the prevalence and associated factors of use within the weightlifting community. Docherty (2008) examined the psychological versus physiological advantage to athletes, with a highlight on the mode of action of stimulants. Data provided also illustrated an increased incidence of combined amphetamine with illicit drug use, such as steroids. Implications for extended drug action in the exercised individual, and a marked difference in the effect of amphetamine dosage levels, emphasizing that less is more, was provided by Marques et al. (2008). Angoorani et al. (2012) interviewed weight lifters regarding amphetamine use, and found no link between socio-demographic characteristics or level of education amongst users.

Amphetamines Highlighted

Amphetamines are identified as indirect acting sympathomimetic CNS stimulants of monoaminergic systems, and are noted for its transient nature (Docherty, 2008). This means the action involves inducing the release of noradrenaline (NA) from nerve terminals, which
then acts on adrenoceptors (Docherty, 2008). NA is from the class catecholamine, which is secreted by the adrenal medulla in response to short term stresses, mimicking the ‘fight or flight response’ (Campbell et. al., 2009). Catecholamines are a class of neurotransmitters and hormones synthesized from the amino acid tyrosine (Campbell et. al., 2009). The physiological response to NA release include increased blood flow to skeletal muscles, dilation of pupils, reduced salivary gland secretion, relaxation of lung bronchi, increased heart rate, suppression of digestive system, inhibited pancreas activity, conversion of glycogen to glucose by the liver, and stimulation of the adrenal medulla (Campbell et. al., 2009).

Amphetamines are also identified as a psychostimulant (Marques et al., 2008), and may be taken by athletes to increase alertness or motivational advantage over other competitors, through the release of NA and Dopamine (DA) (Docherty, 2008). Dopamine is a neurotransmitter from the class catecholamine (Campbell et. al., 2009). Marques et al. (2008) identified that neurologically, amphetamine is toxic, and acts on the striatum and nucleus accumbens of the brain.

The study conducted by Marques et al. (2008), hypothesized that the neuroprotective properties of exercise, with a focus on chronic exercise, in conjunction with the relationship between DA synthesis and metabolism, could alter the striatal DA outflow through the varying doses of amphetamine. The amphetamine used was d-amphetamine sulphate. The study population consisted of male rats, randomly allocated to one of 6 groups (5-8 individuals per group): with chronic exercise saline (0.9% NaCl solution), 5mg\(^{-1}\) amphetamine, and 30mg\(^{-1}\) amphetamine, and without chronic exercise saline (0.9% NaCl solution), 5mg\(^{-1}\) amphetamine, and 30mg\(^{-1}\) amphetamine. The subjects allocated to the exercise group were placed on an eight week training program with increasing intensity. An intercerebral guide cannula was implanted in the caudate-putamen, under an anaesthetic, in
all subjects 4 days pre-solution administration. Dialysate samples were collected at 30 minute (0.5h) intervals for 6 hours before and after the intraperitoneal solution administration.

Results from the study showed that the administration of saline solution produced no significant difference in either exercise group. With the group administered 5mg⁻¹ amphetamine, DA levels were not significantly different between the two groups. Although training did delay the peak extracellular DA effect, from 350pg.30ul⁻¹ at 0.5h in the non-exercise group to 350pg.30ul⁻¹ at 1h in the exercised group (Marques et al. 2008). DA levels were also measurable for a longer period (30 min) in the group with exercise. This data highlights the increased DA levels and extended effect amphetamines have on exercised persons. This has implications for the type and intensity levels the athlete using dopamine may partake in. Due to the time and duration of action, high intensity exercise is at increased risk of athlete doping. The data provided from the 30mg⁻¹ amphetamine groups, does show a different trend. Groups, with and without exercise, show a marked separation in DA levels at 0.5 h and1.0 h. The exercise group presented 170pg.30ul⁻¹ and 200pg.30ul⁻¹ at the respective times, with the non-exercised group showing dopamine levels of 205pg.30ul⁻¹ and 290pg.30ul⁻¹(Marques et al. 2008). This level of amphetamine actually shows an increased effect in the non-exercised study group, and promotes a use of lower doses of amphetamines in athletes.

When looking at the risk groups for amphetamine doping, is there a trend toward certain socio-demographic characteristics or level of education of users compared with non-users. In a study conducted by Angoorani et.al.(2012) on amphetamine use within the weightlifting community, the prevalence and associated factors of amphetamine use in body builders this was examined. 843 male weightlifters between the ages of 16–40years, from randomly selected gymasia, were interviewed. Participants completed 45 minute structured questionnaire examining social and demographic characteristics, sporting activity patterns,
and substance abuse history, with amphetamine use including amphetamines and derivatives. From the data collected, 13.3% (112 participants) of the sample group reported amphetamine use. There were no significant differences in the socio-demographic characteristics or level of education of users compared with non-users. Age did not appear to be a factor. Interestingly, there was a slight statistical increase, 42.7% (47 participants), in the proportion of amphetamine users that did have university qualifications (Angoorani et al., 2012). This may have an impact on intercollegiate athletes, and may indicate an increase in drug exposure and availability. Another factor that has implications for doping, is that of 19.6% of amphetamine users concurrently using steroids, this is higher than the non-user at 17.1% (Angoorani et al., 2012). This data highlights the incidence of athletes simultaneously using additional illicit drugs, and may increase the risk of athletes using multiple drugs in cases of doping.

Is it worth the risk?

Regardless for the reason of in-competition amphetamine doping, stimulant drugs allow the athlete to gain a mental and physical advantage. Docherty (2008) highlighted the mode of action of stimulants, and illustrated the physiological impacts of inducing the release of noradrenaline (NA) from nerve terminals, which acts on adrenoceptors. Docherty (2008) examined the class stimulants, an application to amphetamines would have provided increased processes on mode of action and may have explored, with an amplified focus, central and peripheral actions. From Marques et al. (2008) the doses and impact of exercise were highlighted, but the difference is of mice and men. There is a marked difference in the physiology between the two species. The study did not examine the effects of dopamine on an exercising individual. This would highlight any metabolic differences incurred, and to what degree there was an impact on peak dopamine levels and the duration of time. Angoorani et al. (2012) did not examine the reasons for amphetamine use, whether it was recreational or to gain the competitive advantage. The quantity, dosage and frequency of
amphetamine use was also neglected from this study. The data was collected in an interview style process, which in itself creates flaws due to confidentiality, and participants may have withheld information regarding their drug use.

From a society perspective, does the World Anti-Doping List placing stimulant bans only on in competition testing send an altered acceptance of their use? The study provided by Angoorani et al. (2012) illustrates that drug use and exposure to drugs occurs at all levels of society, there is no discrimination between users or the action of amphetamine. The acceptance of use increases pressure for athletes, at all levels of competition, to consume drugs to match those using. The implications for negative influence would be passed through to junior athletes, and acceptance of use and a culture of doping may develop. Once, amphetamine use occurs, the incidence of athletes simultaneously using additional illicit drugs increases (Angoorani et al., 2012). This not has an impact on the individual, but also their family and community. Incomes may be lost, addictions develop, and the health care system experiences stress on inpatients. Due to the nature of amphetamine action, high intensity exercises are at greater risk of athlete abuse, but more definitive studies and the global rate of positive doping cases need to be explored.

Comment [P12]: While the accuracies and inaccuracies of each article were identified, no judgement was made as to how these would affect the results. Implications for society were identified and covered in some depth. The article by Angoorani et al. was not appropriate considering the topic, and it had little biological relevance.
Reference List


