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DRUGS IN SPORT & RUGBY LITERATURE REVIEW

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A REVIEW OF DRUG USE IN SPORT

RELEVANT TO A SOUTH AFRICAN RUGBY EDUCATION PROGRAMME

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ABSTRACT

Rugby Union is a multi-faceted game requiring, amongst other attributes, strength, power and speed. In an attempt to enhance their chances of success in a professional sporting environment, rugby players may choose to use performance-enhancing substances, many of which are banned by sporting governing bodies. Of these, the anabolic androgenic steroids are the most widely abused. This paper reviews the scientific literature relevant to the performance-enhancing drugs most commonly used in rugby, categorizes them and analyses the purported ergogenic effects as well as described side-effects. In addition, the apparent emerging trend in professional sport of using illicit recreational drugs is discussed. Finally, the means of controlling drug abuse and educating players that have been instituted by the sport's regulatory bodies is assessed.

Key words: rugby union, performance-enhancing, anabolic steroids, illicit drugs, drug testing

INTRODUCTION

The use of exogenous substances to enhance performance in sport goes back centuries but has become increasingly prominent and problematic in the era of professionalism due to financial incentives and increased temptations to perform and gain prestige. Associated with the increased pressures, status and income of top sportspersons, including rugby players, there also appears to be a trend to use increasingly accessible recreational drugs. This article reviews the use of both performance-enhancing as well as illicit social drugs most prevalent in rugby within the context of the legislation of the sport's governing and anti-doping bodies in South Africa, the South African Rugby Union (SARU) and the South African Institute of Drug Free Sport (SAIDS) respectively. It also reviews international protocols as determined by the International Rugby Board (IRB) and the World Anti-Doping Agency (WADA). Although attempting to be both comprehensive and precise, such a review is limited by the lack of scientific data on performance-enhancing substances at the doses and in the combinations often used in sport, and an almost complete lack of scientific reporting on recreational drug use in a rugby context.

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DEFINITIONS

An all-encompassing, one-line definition of doping is almost impossible to achieve. In 1963, the Council of Europe Committee for Out-of-School Education defined doping as "the administration to or use by a healthy individual … of any agent or substance not normally present in the body … and/or of any physiological agent or substance … when introduced in abnormal additional quantities and/or by an abnormal route and/or in an abnormal manner … with the purpose and effect of increasing artificially and in an unfair manner the performance of that individual during the period of competition".[1]

However the ever-expanding list of performance-enhancing substances and methods has led to WADA adopting a much broader definition:

"Doping is defined as the occurrence of one or more of the anti-doping rule violations…
Athletes or other Persons shall be responsible for knowing what constitutes an anti-doping rule violation and the substances and methods which have been included on the Prohibited List."[2]

The definition and the list of prohibited substances and methods are extensively expanded upon in the WADA Code[3], a 136-page document first published in 2004 and revised in 2009.
The underlying principles of the Code and the tenets of drug regulation in sport including rugby are that:

- unfair advantage may be gained by those athletes who use banned substances or methods to enhance performance;
- substances or methods can produce harmful and significant side-effects;
- potential legal implications are recognised in that the distribution of many banned substances (e.g. anabolic steroids), if not for a medically justified reason, is illegal in many countries; encouraging or assisting athletes to use such substances or methods is unethical and, therefore, equally forbidden.

A full list of terms relevant to doping in rugby can be found on the IRB "Keep Rugby Clean" website[4] *http://www.keeprugbyclean.com/downloads/Reg21_EN.pdf.* It is the responsibility of every rugby player, especially professionals, to familiarise themselves with these codes.

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THE HISTORY OF DOPING IN SPORT

Elixirs and potions used as aids to mental and physical performance have been in existence since at least the 3rd century BC when ancient Greeks were apparently urged by the physician Galen, perhaps the first sports medicine clinician, to "consume the rear hooves of an Abyssinian ass, ground up, boiled in oil, and flavoured with rose hips and rose petals to improve performance."[5] Through the ages, Scandinavian mythology describes the use of a mixture prepared from the Amanita muscaria mushrooms to increase power, Incas chewed cocoa and ancient Olympians soaked bread in opium,[5] whilst Albert Schweitzer wrote of the people of Gabon that "…having eaten certain leaves or roots, toil vigorously all day without feeling hungry, thirsty or tired and all the time showing a happiness and gaiety."[6] During World War II the effectiveness of amphetamines as a stimulant used by RAF pilots allegedley led to its increasing use in athletics circles. Its perceived effects gave it the nickname "speed".[7]

During the 1904 Olympic marathon, an American, Fred Lorz, was twice injected with a milligram of Strychnine by his trainer to enable him to finish second.[8] The emergence of endurance cycling as a popular sport in the early 20th century appears to have led to a more intense search for ergogenic substances, with nitroglycerine and cocaine both allegedly being used.[8] It appears that the acceptance of drug-taking in the Tour de France was so complete by 1930, when the race changed to national teams that were to be paid for by the organisers, that the rule book distributed to riders by the organiser, Henri Desgrange, reminded them that drugs were not among items with which they would be provided![9]

The use of pharmacologically-active substances to enhance performance in sport may have been prevalent for centuries but appears to have increased significantly over the last 40 years since the introduction of androgenic anabolic steroids (AAS).[10]

The extent of the abuse of this drug was perhaps first revealed in post-unification Germany when it was shown how prevalent doping was amongst East German athletes.[11] Indeed, in many sports relying on speed and power, rugby union included, AAS remain the most commonly used form of performance enhancement. The introduction of anabolic agents to Western athletes is attributed to John Ziegler, a doctor who treated American athletes and went to Vienna with the American weightlifting team.[12] There he allegedly met a Russian physicist who said that his own athletes were being given testosterone. Returning to America, Ziegler tried weak doses of testosterone on himself, on the American trainer Bob Hoffman and on two lifters, Jim Park and Yaz Kuzahara. All gained more weight and strength than any training programme would produce but there were side-effects. Ziegler sought a drug with fewer after-effects and experimented with an anabolic steroid, methandrostenolone (Dianabol, DBOL), made in the US in 1958 by Ciba. The International Amateur Athletic Federation, now the International Association of Athletics Federations (IAAF), was the first international governing body of sport to ban doping in 1928 but had little means of testing. In 1967, following the death of a cyclist in the Tour de France, allegedly

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from amphetamine use, Union Cycliste Internationale (UCI) and Fédération Internationale de Football Association (FIFA) joined the IAAF in the fight against drugs, closely followed by the International Olympic Committee (IOC) the following year.[13]

Since then it appears that advancements in pharmacology have always outstripped the ability of sports federations to implement rigorous testing procedures. However, since the creation of WADA in 1999, to whose policies SARU and the IRB strictly adhere, more and more athletes are being exposed.

PERFORMANCE-ENHANCING DRUGS RELEVANT TO RUGBY UNION

When attempting to approach this topic from a scientific and analytical point of view, the literature serves as a guide but is by no means all-encompassing and may actually be misleading. This is due to athletes often using more than one ergogenic aid, both permitted and banned – the combined performance-enhancing and side-effects of which are most often not known. Studies tend to focus on single agents. Athletes rely more on anecdote and hearsay, hence doses and combinations of agents vary and are most often not documented. This applies particularly to AAS where the process of "stacking" (using a number of anabolics in the same cycle) is common. A review of positive doping tests in South African rugby (unpublished data, SAIDS), reveals half to be for anabolic agents. As rugby is a multiple-sprint sport requiring physical strength and plyometric ability, this review focuses primarily on those drugs which increase or claim to increase strength, power and speed.

ANABOLIC ANDROGENIC STEROIDS (AAS)

AAS – Performance-enhancing effects

Testosterone is a steroid hormone, synthesised in the human body from cholesterol. It serves distinct functions at different stages of life. During embryonic life, androgen action is central to the development of the male phenotype. At puberty, the hormone is responsible for the secondary sexual characteristics that transform boys into men. Testosterone regulates many physiological processes in the adult male including muscle protein metabolism, sexual and cognitive functions, erythropoiesis, plasma lipid levels, and bone metabolism. The AAS are chemical, synthetic derivatives of testosterone modified to enhance the anabolic rather than the androgenic actions of the hormone. Since the emergence of AAS (commonly referred to as "anabolic steroids" or "steroids") as mainstream ergogenic agents, the opinion of the scientific and medical communities has shifted from one of cynicism regarding their efficacy[14-17] to an acknowledgement that the supra-physiological doses that athletes use have significant strength and power benefits especially when combined with appropriate strength training.[18-26] This paradigm shift is best encapsulated by the change in position statements of the American College of Sports Medicine (ACSM) who, prior to 1984, regarded AAS as being ineffective until revising their position more recently.[27]

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Some early studies that have shown limited effects were plagued by poor scientific design (i.e. non-randomised, not double-blinded, no-placebo trials used) and issues that contrasted with how athletes were using androgens in real-world settings. In these studies, researchers often administered too low a dose of androgens (e.g. a clinical dose or lower typically prescribed for androgen deficiency, which is far exceeded by athletes), or did not have subjects train in conjunction with androgen use (whereas athletes were training at a high level), did not examine "stacking" of androgens or the compounding effects of multiple-drug use (many androgen users use multiple drugs), used untrained subjects, and failed to examine dietary interventions such as increased protein intake coinciding with androgen use (many androgen users increase protein and kilocalorie consumption greatly).

Androgenic and anabolic effects of AAS originate from activation of the androgenic receptors. The distinction between these biological effects depends on the organs and target tissues. Anabolic effects are seen in muscles, bones, the heart and kidneys. These organs possess little 5a-reductase activity (an enzyme responsible for converting testosterone to the more androgenic dihydrotestosterone) and thus AAS, particularly testosterone, induce protein synthesis, muscle fibre development, erythropoiesis, and stimulation of bone growth. In addition, anabolic steroids displace glucocorticoids from glucocorticoid receptors and inhibit muscle protein catabolism, leading overall to an anabolic or muscle-building effect.[19] AAS might cause hypertrophy in human skeletal muscle even in the absence of strength training.[20,21] Recent studies of muscular biopsies from athletes involved in doping showed that AAS further increased the muscle-fibre hypertrophy induced by strength training.[22-26] The number of nuclei per muscle fibre was higher in powerlifters using AAS than in controls. Unexpectedly, the number of myonuclei remained high in people who had stopped taking AAS several years previously.[22,23]

Although it is unlikely that rugby players are familiar with the published evidence on AAS, these documented physiological changes explain the widespread use of these agents in athletes involved in speed, strength and power-based sports as well as the associated enhanced performances especially where measurable, such as in track and field. The temptation for athletes involved in rugby and other multiple-sprint sports to derive benefit from taking these agents becomes evident. In addition, other effects such as enhanced lipolysis and aggression are perceived as beneficial in competitive as well as social circles. In short, science has confirmed what athletes were telling us from the 1950s – AAS have significant performance-enhancing effects.

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AAS - Adverse Effects

As AAS have effects in several organ systems, multiple side-effects can be observed. Androgen receptors are located not only in the male reproductive and accessory sex tissues but also in other tissues, such as skeletal muscle, skin, and parts of the brain.[28] The steroids bind to androgen receptors in the cytoplasm. In the nucleus, the binding of receptors to target genes triggers DNA transcription and the synthesis of specific proteins that mediate hormonal function.[29,30] All androgenic hormones therefore exert both the desired anabolic effects but also a range of additional influences on other tissues and systems. These effects are summarised in Table 1.[28-35]

TABLE 1. GENERAL EFFECTS OF ANDROGENS IN NON-SEX-LINKED TISSUES

PERCEIVED PERFORMANCE-ENHANCING EFFECTS	ADVERSE EFFECTS
Increases lean body mass	Increases cardiac tissue mass
Increases isometric and dynamic muscle strength and power	Increases low-density lipoproteins (LDL) and decreases high-density lipoproteins (HDL)[31,36-38]
Increases protein synthesis, accretion, and nitrogen retention (and possible anti-catabolism)	Hypertension
Increases muscle cross-sectional area	Hepatic dysfunction
Increases glycogen and creatine phosphate storage	Insulin resistance & glucose intolerance
Enhances recovery ability between workouts	Suppression of the hypothalamic-pituitary- gonadal axis
Decreases body-fat percentage	Acne
Increases bone mineral content, density, and markers of bone growth	Impaired tissue remodelling in tendons[34]
Regulation of osteoblasts, bone matrix production, and organisation	In pre- and peripubertal children, androgen use may lead to virilization, premature epiphyseal closure, and resultant adult short stature
Increases neural transmission, neurotransmitter release, myelinization, and re-growth of damaged peripheral nerves	Unknown: the combined effects of multiple AAS with other performance-enhancing agents and supplements.

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Adapted from: Hoffman JR, Kraemer WJ, Basin S, Storer T, Ratamess N, Haff GG, Willoughby DS, Rogal AD. Position Stand on Androgen and Human Growth Hormone Use. Journal of Strength and Conditioning Research. 2009 August; 23(5).

In males, the endocrine effects are dominated by testicular atrophy, sterility and disfiguring gynaecomastia. The significance of these side-effects leads to many athletes taking anti-oestrogens to counter the aromatizing effects of anabolic steroids. The association of this group of drugs with anabolic abuse and their potential side-effects has led to them also being prohibited for use in competitive sport. In females, in the main side effect is virilization - including hirsutism, amenorrhoea, clitoral hypertrophy, and a hoarse voice.[25,36,37.] Long-term effects such as amenorrhoea and ovarian cysts have been described in former East German athletes.[29,30]

The unfavourable changes in blood lipid profiles caused by AAS include an increase in the concentration of LDL, a decrease in the concentration of HDL by 30–50%, and a reduction in the concentration of apoprotein A1.[37,38] These metabolic changes explain the many reports of cardiovascular disease and hypertension in people who misuse AAS. There are case studies describing the death of 2 young American footballers who sustained fatal cardiac arrests during training associated with hypertrophic cardiomyopathy as well as published cases of myocardial infarction, of which three were fatal, associated with the use of anabolic steroids.[31-34]

Cases of hepatic complications have also been reported, such as cholestasis, peliosis, adenomas, and raised concentrations of liver transaminases.[37,38]

It is suspected that there is an increasing use of AAS in adolescents. Premature closure of the epiphyseal growth plates is a concern among adolescents taking AAS.[39]

Several articles have confirmed the psychological and behavioural side-effects of endogenous testosterone and AAS and documented increased aggressive behaviour in volunteers.[40-42] Aggression is an often quoted (and perceived desirable) side-effect of AAS but the literature describes effects on both positive (euphoria, energy, and sexual arousal) and negative mood (irritability, mood swings, violent feelings, and hostility) and in cognitive impairment (distractibility, forgetfulness, and confusion).[43-46] These changes appear to be dose-dependent but also demonstrate considerable individual variability.[47-48] Finally, having observed an increase use of recreational drugs in professional sportsmen, the question has been posed as to whether the misuse of AAS is a gateway to substance abuse in general. In a case-control study, many users of AAS misused several other substances – either recreational or prescription drugs.[49,50]

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Recreational use of AAS

The use of doping agents is no longer restricted to competing athletes; young sportspeople in schools and non-competing amateurs also use them. Accessibility in gyms is easier.[51] The increase in use is partly reflected in a corresponding rise in citations in the sports medicine literature.[52] Terms cited in the literature may also reflect the increasing use of anabolic agents not only as performance-enhancers in professional sportspersons, but also in amateurs including students and adolescents as well as "social" users who are non-competitive bodybuilders or who suffer from forms of body dysmorphia (the so-called "Adonis complex"). But perhaps more instructive and reflective of the status quo are the large number of internet sites dedicated to the use and trade in anabolic steroids. Albeit anecdotal, much of the information gleaned from these sites may be quite insightful to clinicians working with adolescents and athletes. In the context of adolescent use, studies also observe a trend towards polyconsumption of anabolics with other substances of abuse including cannabis, cocaine and crack as well as alcohol binge-drinking.[53]

Misuse of AAS is increasing among gym customers for whom bodily appearance is a priority. Estimates of misuse have to be interpreted with great caution due to the difficulties of reliable studies of illicit drug use. In the USA, between 1 million and 3 million people are thought to have misused AAS,[54-56] the estimate for Sweden is 50 000–100 000, among a population of 9 million. These estimates roughly equate to 1% of the respective populations.[55]

An investigation of 6 000 Swedish people age 16–17 years with an anonymous, multiple-choice questionnaire revealed that 3.2% of males had used AAS, but that none of the females had.[56,57] There was an association between the misuse of AAS and the use of substances such as alcohol, growth hormone, and narcotic drugs. In males, visible results of physical training were thought important for self-confidence, respect from girls, and security in nightlife and beach culture.[58] An informational intervention programme led to a decrease of almost 50% in misuse in males.

BokSmart is the South African Rugby Union's national safety programme which aims to provide rugby coaches, referees, players, and administrators with the correct knowledge, skills, and leadership abilities to ensure that safety and best practice principles are incorporated into all aspects of contact rugby in South Africa. It is by using BokSmart as an information forum and educational tool that interventions similar to the Swedish study are hoped for in South African rugby.

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Testosterone precursors

Testosterone precursors are taken with the aim of increasing testosterone levels without the need for testosterone injections, and also in the hope of foiling current drug detection methods. The most popular agents in this group of drugs are dehydroepiandrosterone and androstenedione.

Dehydroepiandrosterone (DHEA is a weak androgen that circulates in two interconvertible forms - unconjugated DHEA and DHEA sulfate, the latter in higher concentration).[59] The physiological role of DHEA remains unclear. Concentrations fall with age and it has been trialed as therapy in a wide variety of conditions with little evidence of a positive effect, apart from increasing well-being in women with adrenal insufficiency.[60] While one study showed an increase in lean body mass, this was not confirmed in another.[61] There is one study of the effects of DHEA on strength and aerobic performance; a comparison of DHEA, androstenedione and placebo in 40 healthy middle-aged men did not show any advantage of the steroid precursors over placebo.[62] The effects of long-term, high-dose administration are unknown.[63,64]

Androstenedione and related compounds, such as 5-androstenedione, 4-androstenediol, 5-androstenediol, 19-norandrost-4-enedione, 19-norandrost-5-enediol and 19-norandrost-4-enediol, have become extremely popular in the United States since baseball home run record holder Mark McGwire admitted using androstenedione. As with DHEA, androstenedione is used in an attempt to increase testosterone concentrations.

A well-conducted, double-blind controlled trial evaluating the effects of androstenediones on endocrine function, body composition and strength showed that, compared with placebo, androstenedione did not increase concentrations of free or total testosterone and did not increase strength or alter lean body mass, but it did increase serum concentrations of oestradiol.[63] Levels of (HDL) became depressed in the treatment group compared with pretreatment levels. While this study used lower doses than are often used by athletes, these results suggest it is unlikely that androstenedione increases sporting performance.

While it did not evaluate sporting performance, another study found that 300 mg of oral androstenedione given to 14 volunteers caused a significant rise in testosterone levels.[63] There was also considerable individual variation in the levels, which suggests variations in metabolism of the drug.

Although there do not appear to be any immediate clinically detectable adverse effects, long-term administration of testosterone precursors will reduce HDL, and so predispose some athletes to coronary disease. Elevated levels of oestrone and oestradiol could have effects on malignant processes and also cause gynaecomastia.[64]

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The testosterone/epitestosterone (T/E) ratio in urine is used to detect exogenous testosterone. A ratio greater than 6:1 is usually taken as an indication of misuse. DHEA has been reported to increase the T/E ratio in some, but not all, studies. Doses as low as 50 mg for three days can alter the ratio to more than 6:1 in some, but not all, individuals, suggesting there may be individual differences in the metabolism of this drug.[65]

5 Alpha-dihydrotestosterone (DHT) is the principal active metabolite of testosterone and has a greater binding affinity to the androgen receptor than testosterone. It transforms more readily to the steroid receptor complex and dissociates from this complex more slowly than does testosterone. It is used to enhance performance in a variety of sports.[66]

DHT has been a licensed pharmaceutical in some countries and gained notoriety when 11 Chinese swimmers were found to have taken the drug in the 1994 Asian Games in Tokyo. There are no published data showing there is any effect on sporting performance.

While there are few data regarding adverse reactions, typical androgenic adverse effects such as baldness in males, hirsutism in females, and acne may occur.

Despite their potential to improve athletic performance being unproven, the possible confusion of the metabolites of testosterone precursors with those of anabolic agents and the possible adverse health effects of high doses over prolonged periods class these substances as being prohibited by WADA. Users of sports supplements should also be wary of supplements potentially containing testosterone precursors, the inclusion of which may be intentional, masked or as a result of contamination.

Growth Hormone (GH)

Growth hormone, also called somatotropin in the older literature, is a pleiotropic peptide hormone synthesized, stored, and released from the anterior pituitary gland. Its physiological role is linear growth in childhood, to promote anabolic (tissue building) metabolism, and to alter body composition as part of this anabolic role. Growth hormone is administered to promote linear growth in short children.

There is convincing evidence that GH replacement in GH-deficient adults increases exercise capacity. Measures of exercise performance including maximal oxygen uptake (VO2max) and ventilatory threshold (VeT) are impaired in GH deficiency and improved by GH replacement, probably through some combination of increased oxygen delivery to exercising muscle, increased fatty acid availability with glycogen sparing, increased muscle strength, improved body composition and improved thermoregulation.[67]

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The most recent literature review[68] suggests that, contrary to improvements in exercise capacity by GH replacement in GH-deficient adults, the evidence suggests that in healthy adults, muscle strength, power, and aerobic exercise capacity are not enhanced by GH administration. Recent data indicate that GH may improve a selective aspect of performance, that of anaerobic exercise capacity.[69-74]

The possibility that GH may be beneficial in accelerating recovery from soft tissue injury has been proposed. This is based on the effects of GH on connective tissue formation, as indicated by an increase in collagen turnover markers.[75,76] Animal studies show that Achilles tendons heal faster after treatment with IGF-I.[77] Thus, the increase in IGF-I, which parallels GH treatment, may have potential beneficial effects on recovery from injury in athletes, although evidence from human studies are lacking.[68]

The long-term abuse of GH may have adverse effects including fluid retention, carpal tunnel syndrome, arthralgias, myalgias, insulin resistance, and increased risk of diabetes, cardiomyopathy, and malignancy.[78] A potential risk is that of abusers acquiring fatal Creutzfeldt-Jakob disease from the use of cadaveric pituitary-derived GH that is still available on the black market because of the high cost of recombinant human GH (rhGH). In summary, the health risks of using GH appear to outweigh any perceived anabolic role but there may be some benefit in promoting injury recovery.

Human Chorionic Gonadotropin (hCG)

Human chorionic gonadotropin is a dimeric glycoprotein hormone found in the placenta of women, is produced in large amounts during pregnancy and also by certain types of tumour.[79] Athletes use hCG because it has been shown to stimulate the Leydig cells to produce testosterone naturally. In men, hCG has a similar action to LH on the cyclic adenosine monophosphate secondary messenger system stimulating steroidogenesis .[80] It has been shown that 3,000 IU of hCG resulted in significant elevations in testosterone in athletes.[81] Before the advent of a definitive test for hCG, the hormone proved popular because hCG administration stimulates the endogenous production of both testosterone and epitestosterone without increasing the urinary T/E ratio above normal values. Scientific evidence for a direct performance-enhancing effect of hCG is scant but athletes have been reported to use it togther with testosterone-derivates, to reduce body fat, to restimulate endogenous androgen production after a steroid cycle and as a masking agent. It is banned by WADA.

Clenbuterol

Clenbuterol is a 2-agonist with a half-life of 35 hours which came to prominence during the Barcelona Olympics.[82] It is marketed in some countries, but not in South Africa, as a bronchodilator.[83]

In animals, large doses of clenbuterol have been shown to increase lean body mass. Athletes usually take clenbuterol to increase muscle mass, and it is taken orally in doses of 60-120mg per day in cycles

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of 6-12 weeks frequently in conjunction with anabolic steroids. There are no data showing clenbuterol alters athletic performance or strength in healthy people.[84, 85]

As a side-effect, Clenbuterol may produce a predictable tremor and tachycardia, and there are anecdotal reports of sudden death in two bodybuilders. It can be easily detected in urine by mass spectroscopy and is prohibited by WADA.

Insulin

Insulin is an anabolic hormone used by power athletes often in conjunction with anabolic agents although it has never been shown to enhance sports performance.[86] 2-15 units are injected 20-40 minutes after exercise with a carbohydrate load (oral or IV). The major side-effect is hypoglycaemia of which there have been reports in the literature.[87] Therapeutic use exemption may be granted by WADA for athletes with insulin-dependent diabetes mellitus for which medical evidence is required. In all other scenarios, insulin is prohibited.

Central Nervous System Stimulants

WADA has banned drugs that affect or mimic the sympathetic nervous system (sympathomimetics), such as ephedrine (EPH), phenylpropanolamine and pseudoephedrine (PSE). This is mainly due to their chemical similarity to amphetamines and the assumption that these drugs may be ergogenic in nature. Aerobic enhancements include improved skeletal muscle oxygen delivery, bronchodilation and increased FEV1 and FVC. In an anaerobic context, the administration of a dose higher than the usual prescribed therapeutic regimen (180 mg vs 120mg) PSE increased maximum torque, produced in an isometric knee extension and produced an improvement in peak power during maximal cycle performance, as well as improving lung function.[88] A dose of 2.5mg/kg was also shown to improve performance over 1 500m.[89] However, the side-effect risks, including the thermogenic effects and increases in systolic and diastolic blood pressure as well as heart rate, appear to far outweigh the relatively small ergogenic gains. Pseudoephedrine, commonly found in cold and 'flu medications, was removed from the banned list and then reinstated in 2010.[90] It is permitted in doses that result in concentrations of less than 150 micrograms per ml in urine to allow for the dispensing and consumption of 'flu medication that is unlikely to have an ergogenic effect, but this may be difficult to predict due to individual variances in metabolism.

Ephedrine, a central nervous system stimulant, is often found in fat-burning supplements, so players are advised to be extremely cautious about using such products. The ephedrine may also not be labelled as such and may come from another ingredient in the supplement some marked as "natural" or "herbal".

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A Samoa international took a fat-burning supplement called Inferno, which contained a natural source of ephedrine called Ma-Huang. Inferno listed Ma-Huang on the front of the product label; however it did not specifically state that it contained the substance ephedrine.[91]

IMPORTANT PRINCIPLES OF DOPING CONTROL

The World Anti-Doping Agency (WADA)

WADA was established in 1999 as an international independent agency composed and funded equally by the sport movement and governments of the world. WADA evolved from the World Conference on Doping convened in 1998 which led to the Lausanne Declaration on Doping in Sport. Its key activities include scientific research, education, development of anti-doping capacities, and monitoring of the World Anti Doping Code – the document harmonising anti-doping policies in all sports and all countries. WADA is a Swiss private law Foundation. Its seat is in Lausanne, Switzerland, and its headquarters are in Montreal, Canada. The main goal of WADA is to promote a drug-free sporting environment.

The South African Institute for Drug Free Sport (SAIDS)

SAIDS is a public entity established by an Act of Parliament, Act No. 14 of 1997, "to promote participation in sport free from the use of prohibited substances or methods intended to artificially enhance performance, thereby rendering impermissible doping practices which are contrary to the principles of fair play and medical ethics, in the interest of the health and well-being of sportspersons; and to provide for matters connected therewith".[90]

The Drug-Free Sport Act grants the Institute statutory drug testing powers and the authority to conduct and enforce a national anti-doping programme. By virtue of the Institute's legislative ambit, national sports federations are obligated to co-operate with the Institute. The South African Rugby Union and all senior rugby players and those competing in tournaments overseen by SARU fall within this realm and are required to comply with the policies of SAIDS and WADA.

Strict Liability

All athletes fall under the strict liability principle, which means that they are solely responsible for any prohibited substance found in their system. Strict Liability applies irrespective of whether a player unintentionally used a banned substance or was negligent, careless or otherwise at fault. Rugby players are therefore advised to exercise great caution and care with the substances they ingest, particularly medications and supplements.[91]

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Failure to Comply

A 'Failure to Comply' is an Anti-Doping Rule Violation defined as refusing or failing to submit to sample collection or otherwise evading sample collection. The sanction for a 'Failure to Comply' is a mandatory two (2) years for a first offence and a life ban for a second offence. All rugby players are advised to fully comply with any request by an authorised testing body to provide a urine sample.[91]

THERAPEUTIC USE EXEMPTIONS

Athletes, like any other person, may have illnesses or conditions that require them to take particular medications. Should the medication an athlete is required to take to treat an illness or condition happens to fall under the Prohibited List, a Therapeutic Use Exemption (TUE) may give that athlete the authorisation to take the needed medicine.

The purpose of the International Standard for Therapeutic Use Exemptions (ISTUE) is to ensure that the process of granting TUEs is harmonised across sports and countries. Forms may be downloaded from the WADA or SAIDS websites and should be completed by the treating physician as well as the athlete. The completed TUE is then emailed or faxed to SAIDS who will consider the information and make a decision as to whether the TUE will be granted and for what period. It is the athlete's responsibility to then forward the TUE to the sport's governing body, his/her union or club and to keep a copy him/herself.

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THE PROCESS OF CONDUCTING DOPING TESTS[91]

Dope testing in South African rugby is intensive and thorough. Squad testing is conducted at Super Rugby level, random tests are performed at every international and Super Rugby match and random and target testing at Currie Cup level. At age-group level, random and target testing is conducted at the Craven Week and SAIDS is currently in the process of devising a schools testing programme. The following process is followed worldwide by any WADA-affiliated drug testing agency (in South Africa this is SAIDS).

1. Athlete Selection

The selection of athletes is based on the requirements of the responsible Anti-Doping Organisation (ADO). The selection may occur in three ways: random, based on established criteria (e.g. finishing position), or targeted (i.e. based on suspicion).

2. Notification

A Doping Control Officer (DCO) or Chaperone will notify the athlete of his or her selection for doping control. In general, this notification is done in person. The official identification and the authority under which the sample collection is to be conducted are shown to the athlete.

The DCO or Chaperone will inform the athlete of his or her rights and responsibilities, including the right to have a representative present throughout the entire process. The athlete will be asked to sign the form confirming that he or she has been notified for doping control.

For a minor or an athlete with a disability, a third party may be notified as well.

3. Reporting to the Doping Control Station

The athlete should report to the doping control station immediately following notification. The DCO may allow the athlete to delay reporting to the doping control station for activities such as a press conference or the completion of a training session; however the athlete will be accompanied by a DCO or a Chaperone from the time of notification until the completion of the sample collection process.

The athlete will be asked to provide photo identification and be given the opportunity to hydrate. Athletes are responsible for what they decide to drink. They may drink their own beverage or choose from a selection of sealed, caffeine-free, non-alcoholic beverages.

4. Selection of Collection Vessel

The athlete is given a choice of individually sealed collection vessels and selects one. The athlete verifies that the equipment is intact and has not been tampered with. The athlete should maintain control of the collection vessel at all times.

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5. Provision of Sample

Only the athlete and a doping control official of the same gender are permitted in the washroom during the provision of the sample. Minors or athletes with a disability may also have their representative present in the washroom. However this representative is not permitted to view the provision of the sample. The objective here is to ensure that the doping control official is observing the sample provision correctly.

Athletes are required to remove any clothing from the knees to mid-chest and from the hands to the elbows. This provides the doping control official with a direct observation of the urine leaving the athlete's body. These provisions are meant to ensure that it is the athlete's own urine and help prevent possible manipulation of the urine sample.
The Athletes maintain control of their samples at all times during the process, unless assistance is required due to an athlete's disability.

6. Volume of Urine

The DCO shall ensure that an athlete in full view shall provide no less than 90ml of urine. If the amount of urine does not meet the minimum requirements, the athlete will proceed with what is referred to as the Partial Sample Process.

7. Selection of the Sample Collection Kit

If the athlete has provided the required volume of urine, the athlete will be given a choice of individually sealed sample collection kits, from which to choose one. The athlete verifies that the equipment is intact and has not been tampered with. The athlete will open the kit and confirm that the sample code numbers on the bottles, the lids and the container all match.

8. Splitting the Sample

The athlete splits the sample, pouring the urine him or herself, unless assistance is required due to an athlete's disability. The athlete pours the required volume of urine into the "B" bottle. Then the remaining urine is poured into the "A" bottle. The athlete will be asked to leave a small amount of urine in the collection vessel so the Doping Control Officer can measure the specific gravity of the sample according to the relevant laboratory guidelines.

9. Sealing the Samples

The athlete seals the "A" and "B" bottles. The athlete representative and the doping control officer should verify that the bottles are sealed properly.

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10. Measuring Specific Gravity

The DCO measures the specific gravity using the residual urine left in the collection vessel. The values are recorded on the doping control form. If the sample does not meet the specific gravity requirements, the athlete may be asked to provide additional samples as required by the Anti-Doping Organization.

11. Completion of Doping Control Form

The athlete is asked to provide information about any prescription/non-prescription medications or supplements he or she has taken recently. These medications are recorded on the doping control form. The athlete has the right to note comments and concerns regarding the conduct of the doping control session. The athlete should confirm that all of the information on the doping control form is correct, including the sample code number.

The person who witnessed the passing of the sample, the athlete representative, the Doping Control Officer and the athlete will sign the doping control form at the end of the sample collection process. The athlete is given a copy of the doping control form. The form is anonymous - it does not contain any information that could identify the athlete.

12. The Laboratory Process

Samples are packaged for shipping to ensure that the security of the sample is tracked. The samples are sent to a WADA-accredited laboratory. In South Africa this is based at the University of the Free State. The laboratory will inspect the samples upon their arrival to ensure there is no evidence of tampering. The WADA-accredited laboratory will adhere to the International Standard for Laboratories when processing a sample, ensuring the chain of custody is maintained at all times.

The "A" sample will be analysed for substances on the Prohibited List. The "B" sample is securely stored at the laboratory and may be used to confirm an Adverse Analytical Finding from the "A" sample. The laboratory will report the results of the sample analysis to the responsible Anti-Doping Organization and WADA.

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ILLICIT RECREATIONAL DRUG USE IN RUGBY

Anecdotal reports of rugby players using recreational drugs have increasingly emerged in the lay press in the last few years both in South Africa and abroad. Statistics from SAIDS reveal a preponderance of positive tests for marijuana ("dagga") but both locally and internationally there are an increasing number of test positives as well as press reports of cocaine, ecstasy and LSD use. After a number of high-profile cases involving rugby union players testing positive or admitting to using illicit drugs and after researching the policies of several other sporting codes, the English Rugby Football Union (RFU) has launched an integrated, three-fold programme of education, testing and sanction together with counselling and treatment for recreational drug users. The testing programme also provides for Guinness Premiership clubs to request a pre-employment drugs test on any prospective new signings subject to player agreement.[92]

For a first positive test (or first admission of use), the matter is kept confidential between the RFU illicit drugs staff, the player and his club's medical officer. The problem is dealt with as a confidential health-related issue with the focus firmly on how to help the player deal with and be treated for his drug use. Only if the player fails to comply, or commits a second violation, is the player liable to suspension and public disclosure of the reasons for his suspension. Importantly however, positive tests for illicit drugs following in-competition tests conducted under the anti-doping programme continue to be dealt with in accordance with the anti-doping regulations to the exclusion of the illicit drugs policy, although counselling and treatment may still be made available to the player.

As an educational initiative, the IRB has launched the "Keep Rugby Clean" campaign.[93] Keep Rugby Clean is an online anti-doping educational programme for Players, Player Support Personnel and Administrators of Rugby which covers the key areas of anti-doping in Rugby which complies with the World Anti-Doping Code and IRB Anti-Doping Regulations. Five short interactive video modules allow players, parents and coaches to learn about various aspects of anti-doping.

In South Africa, media reports of player drug use appear to be increasing perhaps indicating that both enhanced educational drives as well as better defined punitive and rehabilitation protocols are called for.

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CONCLUSION

Doping and performance-enhancement in sport has evolved over centuries to a science accessible to many participants in a variety of codes including rugby union. The emphasis on size, strength, power and speed in the game has necessarily meant that anabolic agents have been the most popular. Anabolic androgenic steroids have proven efficacy but also a range of adverse effects both physical and psychological. Of particular concern to clinicians and scientists is that the literature investigating anabolic agents seldom assesses the mega-doses used by athletes nor the combined effects of multiple drugs and supplements making the in vitro data we have available of less practical value. As a result, legislation, educational initiatives and indeed clinical advice have been largely reactive with the users rather than the clinician taking the lead and often having more "knowledge" albeit anecdotal and experimental. Other drugs including prohormones, growth hormone and stimulants have their own performance-enhancing claims, some of them unsubstantiated. These drugs appear to be most beneficial when used in conjunction with AAS. In addition, increasing anecdotal reports of recreational drug use in rugby union, on which there are few scientific data, necessitates policies which deal with this issue in the interests of preserving the athlete's health. SARU complies fully with SAIDS, WADA's South African national anti-doping agency and all South African rugby players are obliged to educate themselves on doping policy and control measures. The BokSmart programme, as part of it's educational and safety mandate, aims to proliferate this knowledge, but more definitive South African guidelines dealing with athletes using recreational drugs are called for.

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