

## Steroids a boon or bane in sports

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### ABSTRACT

Steroid is a drug which is one of blessing and banes. Next to dope, it is almost the most misused drug. In sports, it is being used so much to take away the spirit of sports. This article investigates in depth of steroids. Steroids are used for medicinal purposes only, but its use has been misunderstood by the teenagers and athletes leading to use them for illegal purposes. Athletes take these drugs to gain body bulk and muscular strength. Several countries banned steroid use and the sportsmen are checked before athletic games such as Olympic to know whether they take steroids, if so, they are disqualified to play. Teenagers of these days use these drugs to attract opposite sex, thereby decreasing their self-confidence. However, these people are unaware about the side effects that these drugs cause. Most of them lost their life due to drug overdose. Steroids are also used in dentistry to treat infection and pain, but the only thing is that it only reduces the symptoms but does not treat the cause of disease. Steroids using people are more aggressive than normal individuals, and on long run, it leads to infertility. It causes premature puberty in men when has taken in small age and the primary and secondary sexual characters start to develop earlier than the ideal age in such persons. These effects are due to the factor that anabolic steroids are derived from testosterone which, in turn, is a male hormone responsible for the development of sexual hormones in men.

**KEY WORDS:** Adverse effects, Anabolic steroids, Mechanism of action, Stacking and doping, Steroid ban

### INTRODUCTION

Steroids, which are known to be a synthetic derivative of testosterone, were used for therapeutic purposes in beginning, but nowadays its use is misunderstood by athletes and teenagers leading them to overdose it which, in turn, causes serious adverse effects. Athletes use steroids to give them muscle bulk and strength, while teenagers use it to develop the so-called biceps, broad shoulders, and narrow hip to make them look handsome, while women use steroids to enhance female features in every way, making them look attractive and voluptuous. All in all, men and women use banned steroid drugs in illegal manner and it is more common among athletes.

#### WHAT IS STEROID?

The core of steroids is made of 20 carbon atoms bonded, which are four fused rings, three cyclohexane rings, and one cyclopentane ring.

The steroids are distinguished by the functional groups bonded to this four-ring core and by the oxidation of the rings. Sterols are special forms of steroids, with a hydroxyl group and a skeleton derived from cholestanone. Hundreds of distinct steroids are found in plants, animals, and fungi.<sup>[1]</sup> All steroids are made either from sterols lanosterol (animals and fungi) or cycloartenol (plants).

#### STEROID AND ITS CLASSIFICATION

According to Scott, steroids are classified into seven types based on their function: Sterols and sterol alcohols with double bonds, sex hormones - steroid produced in testis (androgens) or ovary (estrogens), adrenocortical hormones, bile acids - steroids bonded to taurine or glycine and function as emulsion-stabilizing agents in intestine, sapogenins - a plant product with steroid bonded to carbohydrates,<sup>[2]</sup> cardiac glycosides - these are steroids which act as heart stimulants, and Vitamin D.

#### ANABOLIC STEROIDS AND ITS ACTION

Anabolic steroids, technically known as anabolic-androgenic steroids (AASs), are drugs that increase

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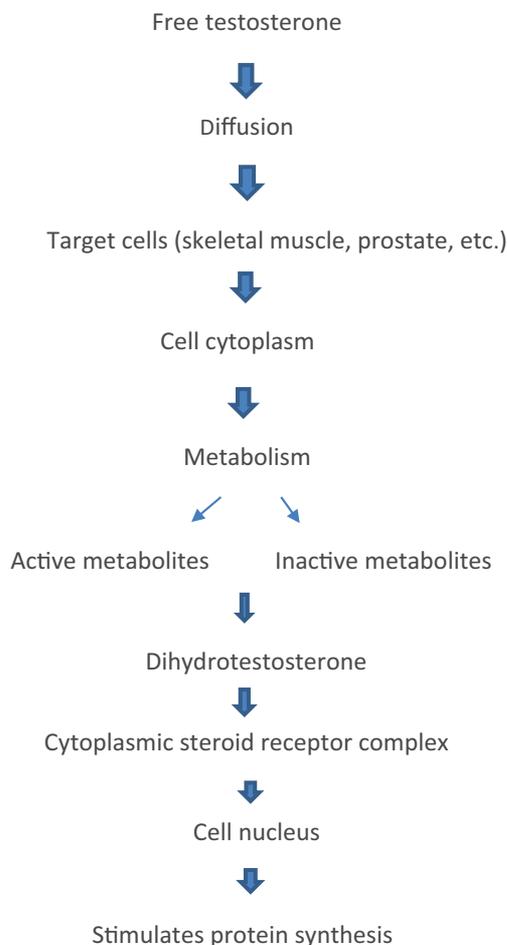
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protein within cells, especially in skeletal muscles. Anabolic steroids also have androgenic and virializing properties, including the development and maintenance of masculine characteristics. Anabolic steroids were first manufactured in the 1930s and are now used therapeutically in medicine to promote bone calcification, male puberty, and treat muscle wasting conditions. Health risks can be found in long-term use of the excessive doses of anabolic steroids.<sup>[3]</sup>

### MECHANISM OF ACTION

Free testosterone diffuses into target cell-like skeletal muscle and prostate and then metabolized into active and inactive metabolites within cell cytoplasm.<sup>[4]</sup> Among which, dihydrotestosterone binds to specific cytoplasmic steroid receptors, entering cell nucleus as a complex which eventually stimulates protein synthesis. This anabolic tendency is used by athletes to enhance muscle bulk and strength.



### PHARMACOLOGICALEFFECTSOFSTEROIDS

All androgens possess cyclopentanophenanthrene nucleus and are synthetic derivatives of testosterone, a male hormone which are modified to enhance anabolic rather than androgenic effects.<sup>[5]</sup>

### Androgenic Effects Include

- Development of primary sexual characteristics in males.
- Development of secondary sexual characteristics such as genital size, prostate growth, induction of sperm production, hair distribution, and deep voice during puberty.
- Responsible for muscular skeletal configuration.<sup>[6]</sup>
- Regulates psychic changes.

### Anabolic Effects Include

- Promotes protein synthesis, positive nitrogen balance, and muscle growth.
- Enhancing calcium uptake and stimulation of skeletal growth.
- Erythropoiesis.<sup>[7]</sup>
- Percentual reduction of body fat, thereby enhancing physical features in man making them v-shaped muscled man.
- Receptacle of electrolytes.

### Anabolic Steroids in Sports

Anabolic steroids are used in sports, racing, and bodybuilding as performance-enhancing drugs and are controversial because of their adverse side effects, and the potential to gain of unfair advantage is considered as cheating.

Their use is mainly a doping agent and is banned by all the major sporting bodies. For many years, AASs have been the most detected doping substances in the International Olympic Committee-recognized laboratories. In countries where AAS is controlled substances, there is often a black market in which these drugs are smuggled and clandestinely manufactured, or even counterfeit drugs are sold to users for illegal purposes.<sup>[8]</sup>

Anabolic steroids have been used by men and women in different kinds of sports to attain a competitive edge and to assist in recovery from injury. Sports in which steroids mainly used include bodybuilding, weightlifting, shot put and other track and field, cycling, baseball, wrestling, mixed martial arts, boxing, football, and cricket. Such use is banned by the rules of governing bodies of most sports.<sup>[9]</sup> The use of anabolic steroids is commonly used among adolescents, especially by those participating in competitive sports. Male students used anabolic steroids more frequently than female students, and on average, those who participated in sports used steroids more often than those that did not. Recreational users take these drugs to enhance sex drive, aggression, stamina, and a sense of well-being.<sup>[10]</sup>

### Stacking and Doping

The athletes use drugs in cycles of gradually increasing doses and numbers of agents combined with duration

between 6 and 12 weeks. At the beginning of a cycle, one starts with a low dose of the drugs, being stacked and then slowly increases the doses; in the second half of the cycle the doses are slowly decreased to zero. Athletes tend to use both oral and parenteral (long-acting injectable) compounds. This process is called stacking. This process is called stacking.<sup>[11]</sup>

The use of endogenous or exogenous substances in abnormal amounts intending to promote the performance of athletes in competition is called doping. Amongst, the sports which presents the greatest numbers of positive tests for doping, cycling occupies the first place with 482 cases, baseball occupies the second place with 390 cases, football occupies the third place with 343 cases and finally, athleticism shows 342 positive tests, and athleticism shows 342 positive tests.<sup>[12]</sup>

### Doping Agents

Besides AAS and growth hormones, other doping agents include:

- a. Insulin-like growth factor (IGF-1) which enhances protein anabolism, glucose uptake, and glycogen storage in muscle.
- b. Erythropoietin which promotes oxygen carrying capacity of blood which, in turn, enhances aerobic exercise capacity. It causes side effects such as thrombosis, autoimmune reaction, and possibly cancer.
- c. Beta-adrenergic agents involve beta2-adrenoceptor agonists which are bronchodilator with anabolic and anti-inflammatory actions. It causes side effects such as tachycardia, arrhythmias, and myocardial ischemia. It is used in archery and shooting to relieve anxiety and muscle tremor, by athletes.<sup>[13]</sup>
- d. Gene doping - In this, genetic material is injected directly into a muscle. It stimulates endurance, muscle strength and power, recovery after injury, pain tolerance, and motivation. The potential targets are Epo, IG-1, myostatin, vascular endothelial growth factor, endorphin, and enkephalin.<sup>[14]</sup>

### Steroid Ban!!

Anabolic steroids are banned by major sports bodies including Association of Tennis Professionals, Basketball Association, Football Association, the Olympics, Major League Base Ball, National Hockey League, and National Football League. The World Anti-Doping Agency (WADA) maintains list of performance-enhancing substances used by major sports bodies and includes anabolic agents, anabolic steroids and precursors, and all hormones and related substances. Italy passed a law in 2000 where penalties range up to 3 years in prison if an athlete has been tested positive for banned substances.<sup>[15]</sup> In 2006, Russian President Vladimir Putin signed a law ratification for eradicating Doping in Sport which would encourage cooperation with WADA.

### Mode of Administration

There are four common forms in which anabolic steroids are administered: Oral pills, injectable steroids, creams/gels for topical application, and skin patches. Oral administration is the most convenient.<sup>[16]</sup>

#### Oral

- Ethylestranol
- Fluoxymesterone
- Methyltestosterone
- Danazol
- Furazabol
- Oxymetholone
- Oxandrolone
- Methandienone
- Stanozolol.

#### Injectable

- Testosterone salts: Cypionate, decanoate, propionate, and phenpropionate
- Nadrolone salts: Decanoate and phenpropionate
- Boldenone undecylenate, clostebol caproate, propionate
- Methenolone enanthate, trenbolone acetate, oxabolone cipationate.

#### Steroid in Medical Field

- Steroid injections are used in non-sports
- Tennis elbow (lateral epicondylitis)
- Golfer's elbow (medial epicondylitis)
- Joint pain of varying nature (osteoarthritis)
- Bursitis of the shoulder, hip, or knee
- Frozen shoulder
- Plantar fasciitis
- Carpal tunnel syndrome
- Herniated disc and other back pain.

Steroid injections cannot cure any of these conditions.<sup>[17]</sup> Corticosteroid injections are generally used as a last resort after anti-inflammatories and physical therapy have been tried without success. Steroid injections may help with chronic and painful inflammation, but unless the underlying cause is determined and treated, injections will provide only temporary relief.

Other indications for taking steroids are hypogonadism, catabolic disorders such as muscle wasting, growth retardation, tissue healing, cachexia, osteoporosis, aplastic anemia, virile climatic period, and mamma carcinoma.<sup>[18]</sup>

Corticoids use can result in serious side effects. Some of them are as follows:

- Weight gain
- High blood pressure
- Cataracts
- Diabetes

- Puffiness of the face
- Osteoporosis (thinning of the bones)
- Reduced immunity and increased risk of infection
- Long-term joint and tendon damage
- Ulcers.<sup>[19]</sup>

Side effects are found in those who consume steroid pills rather than injections, but as few as six injections per year can permanently damage a joint or cause risk of tendon rupture.<sup>[20]</sup>

### Steroids in Dentistry

Corticosteroids are commonly used in dentistry both topically and systemically.

- Topical use for ulcerative diseases in oral cavity inhibits inflammatory reaction, redness, and edema.<sup>[21]</sup>
- Systemically used for third molar extraction, pre-prosthetic surgery, reconstructive oral surgery, and orthognathic surgery.<sup>[22]</sup>
- Steroids are also used in root canal endodontic treatment in the form of leader mix which is a combination of steroid and an antibiotic.<sup>[23]</sup>

### HOW TO DETECT USERS?

The primary method for detecting illicit anabolic steroids (AS) use has been the analyses of urinary steroids, although both blood and hair have been investigated for these purposes, although both blood and hair have been investigated for this purpose. The anabolic steroids are of endogenous or exogenous origin and are subjected to extensive hepatic biotransformation by various enzymatic pathways. The primary urinary metabolites may be detectable up to 30 days after the last use, depending on specific agent, dose, and route of administration. Several drugs have common metabolic pathways, and their excretion profiles may overlap with those of endogenous steroids profile, making interpretation of testing results, a very significant challenge to the analytical chemist. However, the professionals encounter with cortisone and not its use, but its frequency and the short- and long-term damage possibly created from too many shots.

### Analysis of Steroids

Thin-layer chromatography is a commonly used qualitative analysis for steroids.

### Advantages

- Samples can be analyzed quickly and simultaneously at relatively low cost.
- Multiple separating technique and detection procedures can be applied in low nanogram range.
- Quantitative densitometric methods are accurate.<sup>[24]</sup>
- Involves two phases, namely stationary and mobile phases. Silica gel 60F254 is employed in

stationary phase and chloroform-acetone-isopropyl alcohol - glacial acetic acid (9:1:0.4:0.1) as in mobile phase for estimating estradiol.

## ADVERSE EFFECTS OF STEROIDS

### Hepatic Effects

Methyl derivatives of steroids cause jaundice, hepatic carcinoma, and peliosis hepatis which are characterized by the formation of blood cysts within the liver. Increase in aspartate and alanine transaminase, lactate dehydrogenase, and alkaline phosphatase, in bodybuilders, causes benign lesions such as diffuse hyperplasia and focal nodular hyperplasia.<sup>[25]</sup>

### Kidney

Clenbuterol and testosterone cause obstructive glomerulosclerosis and tubulointerstitial damage in bodybuilders. Anabolic steroids cause elevated levels of serum urea, serum uric acid and hyper phosphotaemia.

### Cardiovascular System

Anabolic Androgenic Steroids (AAS) leads to increased level of low-density lipoprotein and reduced level of high-density lipoprotein, resulting in arteriosclerosis, thrombus formation, coronary artery vasospasm and enhanced coagulation enzyme activity, myocardial ischemia, cardiomyopathy, atrial fibrillation dispersion, and acute heart failure. There is also an increase in systolic and diastolic blood pressure within 4 weeks of steroids ingestion due to fluid retention. There is also a decrease in triglycerides level, serum apolipoprotein A-1 level is decreased, and B level is increased.

### Endocrine and Reproductive System

In men, reduced luteinizing hormone and follicle-stimulating hormone levels cause decreased sperm density, count and motility, infertility, reduced testicular volume, prostatic carcinoma, and aromatization leading to feminization.

In women, use of anabolic steroids is not only associated with menstrual abnormalities but with, masculinizing effects as well in addition to this, development of acne vulgaris, changes in libido, voice alteration, increased hair loss, alterations of pubic hair growth, clitoral hypertrophy and reduction of breast mass can also occur.

### Musculoskeletal Effects

- Growth retardation due to premature closure of epiphysis.
- Tendon damage in weight lifters.
- Deterioration in muscular plasticity.
- Rhabdomyolysis or acute skeletal muscle destruction.

## Behavioral Effects

It includes dependence/addiction, hostility, aggression, psychosis and manic episodes, reduction of insomnia, increase in self-esteem, and paranoia.

## Dermatological Effects

Dermatological effects are acne and alopecia.

## Anabolic Androgenic Steroids and Body Composition

- Following anabolic androgenic steroids administration, body weight increases to about 2–5 kg in <10 weeks. For example, stanozolol administration increases body weight in 6 weeks by 5 kg.
- Leads to largest gain of circumference around neck, thorax, shoulders, upper arm giving men broad shoulder, and narrow waist features to enhance manliness.
- Anabolic androgenic steroids induce lean body mass (LBM) by stimulating protein synthesis and muscular hypertrophy.
- Anabolic androgenic steroids reduce unwanted fat mass by increasing LBM.
- Anabolic androgenic steroids promote muscle mass and strength. It affects type II (fast twitch) muscle fibers more than type I (slow twitch) fibers.
- Anabolic androgenic steroids enhance muscle strength in athletes.
- Long-term use of anabolic androgenic steroids leads to an increase in serum Hb concentration, white blood cell, and platelet levels in users.

## CONCLUSION

Steroids, an important and useful group of drugs, are employed in medical profession. Its one subgroup, anabolic steroids, is misused by sports personalities and comes under the heading doping. It is banned by many sports bodies. Such use can also result in dangerous side effects.

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