

## **Steroid Abuse in Athletes...A Very Bad Choice**

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An athlete, by description, is one who chooses and is able to be trained in acts of strength and agility. An athlete is also one who usually shows proficiency in a sports environment and often in more than one physical activity. And, finally, a truly competitive athlete is one who seeks various ways to help carry his physical potential as far as it will take him to meet success in his chosen effort. It is this last correlative that has become worrisome in the last two decades or so. Seeking ways to increase physical potential is a very serious business. With good guidance and correct and sufficient research, most choices for supplemental energy consumption are safe, effective, and appropriate; but there are a few that are as bad as they are seducing.

I would like to capture the thoughts from the title of an old “spaghetti-Western” (made in Italy) from the 60’s starring Clint Eastwood: The Good, the Bad, and the Ugly, to describe the effects of a class of very potent biologic chemicals and their actions on many of the basic processes of the human condition. These chemicals are steroids, and they deeply effect the most basic processes of the body’s internal environment. Mother Nature has provided for this both in appropriate amounts and times throughout the circadian cycle (daily rhythm). There are different types of steroids produced and secreted by the body to help keep its functioning on an even keel in dealing with life’s stresses: to control inflammation, to regulate the mineral content of our internal fluid environment, and to influence sexual characteristics and tissue building and repair. But when we fool with nature’s ways, we often pay the price for our folly.

Some things in life, when first implemented, present early as perfect or nearly so. They can even astound their discoverers. Often the hard science has to play catch-up with the discovery to paint a clearer picture as to cause and effect. Steroids are powerful hormones and produce very profound effects. Effects that, at times, can alter the very nature of the body’s physiologic processes and appearance and produce astounding, even frightening results. This usually ties into the realm of the medical and/or pharmaceutical world and has offered up the concept that if a little does so much good naturally, why not play adventuresome physiologist and pep up the dose of certain steroids to produce biologic “super-men and women.”

My extensive backgrounds as pharmacist, biochemist, and physiologist have prepared and grounded me over the years to help keep my biological wits. Very potent chemicals, when ingested, must be treated with the respect they command. In good conscience and practice, the three main tenets of ergogenic (a substance taken to help the body perform work) consumption must be respected and followed: (1) does the substance WORK AS DESIRED; (2) is it LEGAL TO USE under the auspices of the various sports governing bodies; and (3), most importantly, is it SAFE FOR THE ATHLETE to take, especially over time? Of the several classes of steroids found naturally in the body only one will be discussed at length because of its inherent ability for abuse to build muscle tissue along with desired ancillary characteristics found beneficial to those athletes participating in vigorous training, competitions requiring power, and body-building. This class of steroid is labeled, depending upon slight molecular differences, either androgenic or anabolic. I will also discuss the other seducing biochemical that has reared its ugly head in sports in recent years: natural growth hormone and explain a major physiologic difference between the two.

### **Androgenic and Anabolic Steroids**

When extracted and isolated from its natural state in the body and tested for its specific activity, the prime male characteristic hormone, testosterone, shows its signature overt effects for masculine maturity: deepening of voice, all-over increase in body hair, thickening of skin and bones, and maturation of genital organs. This is the androgenic response. The relatively rapid effect of thickening the body with lean skeletal muscle tissue comes about from what is biochemically called a positive nitrogen balance. This, in turn, produces the tissue-building response called anabolism. Because the building blocks of protein (amino acids), and protein itself, have the element nitrogen attached, the more protein brought to the body, the more nitrogen comes along for the ride. A positive nitrogen balance therefore is synonymous with tissue-building. On balance, the body can also experience protein breakdown in its daily functioning when enduring vigorous exercise on a regular basis. If insufficient protein replenishment ensues, tissue-breakdown (catabolism) results. This condition is also seen with wasting diseases like AIDS, the metastases of cancer, the atrophy of multiple systems in the poorly-nourished elderly, and with frank starvation. If allowed to proceed without appropriate daily protein replenishment, this negative nitrogen balance would produce severe tissue wasting to the point

of death. Combating wasting disease is the “good” of anabolic steroid ingestion.

But science and human curiosity being what they are, organic chemists began manipulating the basic testosterone molecule to magnify and specify its biochemical actions. Just a few slights-of-hand, and we had products that exhibited as much as 1000 times the muscle-building (anabolic) potential of the original natural parent hormone yet with less androgenic (masculinizing) effects. How quickly and how emphatically a positive nitrogen balance could be developed became more a matter of the chemists’ skills in the lab with an agenda to produce chemical “super-beings” than a philosophical reckoning as to where all this would lead. Lean-body tissue-building (mostly muscle) amazed researchers and seduced them into thinking that many dysfunctions of the human process could be corrected quickly and dramatically and with little or no untoward effects. Those engrossed in athletics felt first-hand the steroid’s ability to accelerate power output, enhance the ability to recover more quickly from strenuous training, and produce both an extended emotional state of euphoria and an exaggerated aggressiveness to beat the competition. But life was found to be not so kind nor so simple. Add to this a mix of ignorant, gullible youth and highly competitive adults with self-serving agendas, and we move through the “bad” with the Eastern-European Block drug-doping scandals of their female swimmers of the 1970’s into the Chinese duplication of abuse of the 1980’s and early 1990’s to arrive at the present-day environment surrounding professional and highly desirous amateur athletes and others who choose to gamble on their long-term health to deal with pressures to excel beyond their potential by consuming potent androgenic steroidal medications.

### **The Dosing and Extent of Illegal Steroid Abuse**

It has only taken about two decades for steroid abuse to grow into the national scandal it is today. The problem is such that the federal government had one of its agencies, the National Institute on Drug Abuse, develop a web site that deals in great depth trying to dispense impartial, hard-nosed facts on the dangers of this practice.

The full extent of abuse is understandably unknown. Few want to admit illegal usage in competition, and none want to suffer the consequences of illicit possession. But experts in epidemiology estimate upwards of three million current or former abusers in the U.S. alone. With high-schoolers

alone, next to creatine (the most highly-abused supplement) anabolic steroids place a strong second and are strongly associated with various sports. It is also known that much more than the admitted 15% of high school boys have taken “roids,” but as mentioned, dealing with probable reprisals for this troublesome behavior has kept the experts guessing.

The majority of abuse comes from participants in football (almost 30%), track and field events (21%), wrestling (15%), weight training and power lifting (10%-15%).

Abusers have developed numerous dosage schemes to minimize adverse effects, avoid detection, enhance efficacy, and prevent the development of tolerance. Stacking refers to the practice of taking more than one steroid concurrently hoping that 1 + 1 will equal 3. In cycling abusers set a standard period of time for their cycle, such as anywhere from six to 16 weeks. They can sometimes take high doses for one cycle, moderate down for a cycle, then stop for a cycle. Repeating of this periodic usage over time presumably allows the body to acclimate to the hormone’s benefit but not succumb to its dangers. In the method called pyramiding (also known as “stacking the pyramid”), abusers use a cycle to try and escalate the doses and/or the number of steroids used to reach a self-set peak at mid-cycle. Then, the abuser tapers the dosage and/or the steroids until the end of the cycle. This can get quite complicated and usually requires help and the wrong kind of “guidance.” When the abuser stops using the steroids altogether during the cycle, it is called a “drug holiday.”

As mentioned above, the swimming world was deeply tarnished for several years as records have shown once the former Communist Block countries had their secret files on such things brought to light. Thousands of elite female athletes from all areas of sport were dosed repeatedly with anabolic steroids, many not knowing what they were given. The most obvious recipients of anabolics were the female field-event participants. They presented as anything but female, many with vastly more bulk than contour. The hulking Russian, Tamara Press, world record holder and Olympic gold medalist in the shot putt, seemed Bunyonesque compared to her competition who, in their own right, were the best representatives of their respective countries.

The 1976 Montreal Olympics proved to be the most blatant example of

illegal drug abuse during high-level world competition. Several of the USA female swim team complained repeatedly that the East Germans and other Communist-run teams had women that seemed more like men. Deep voices, inordinate musculature, square jaws, “Adams Apples” and other androgenic physical features predicated extremely powerful performances throughout the competition. While the USA men had their best swimming Olympics in history, the USA women, also with a very talented team, were only able to win one gold medal in all of the swimming competition... the last event: the 4 x 100 free relay. And they (the USA girls) were not treated kindly by the U.S. press. The team and their coach, Jack Nelson, were unfairly blamed for “embarrassingly” leaving the USA without gold medals. This negativity hung over this team for years.

Once the cheating coaches, managers, and administrators of the Eastern Block teams were forced to resign in disgrace, all thought this insult to sportsmanship would never be of concern again. Not so. It took several years for the same type of subterfuge to rear its ugly head again. The cheaters simply went where they were welcome: Communist China. And they brought what they knew about pharmacologic cheating with them.

All of a sudden, seemingly out of no where, the Chinese girls were breaking world records without the appropriate build-up to fast times in international competitions. Bells, whistles, horns went off signaling the same problem that came from Eastern Europe years before. Expected denials, and angry countercharges ensued all to again tarnish a noble sport and deprive deserving athletes of their just rewards. Enough negative publicity was generated that once again the steroid problem and its perpetrators thinned out and seemingly just blew out to sea. But man’s brilliant though devious nature once again allowed a new chemically-enhanced approach to inspired performance. The use and abuse of the most powerful endogenous substance Nature provides, growth hormone, was explored and expounded. Since the young healthy growing body naturally relies so dearly on this physiologic wonder, why not intentionally utilize it in a planned training regimen in mature athletes that would allow recovery from vigorous training so much more quickly and provide inordinate amounts of energy and power to train at a higher level that athletic superiority would be almost a given. Well, that is just what happened.

## **Growth Hormone**

Growth hormone has now been used (and abused) in most sports requiring endurance and power since it affects muscle growth in a special way. In swimming, all efforts (and energy costs) are at least four times the requirement than for running. And the property of water is such that as the swimmer moves more quickly through it, the water holds him back by increasing its resistance by the square of the effort to move. If the swimmer doubles his speed, for example, he is expending at least four times as much energy to move through the water, which holds him back by a factor of four:  $2 \text{ squared} = 4$ . To illustrate by times: Michael Johnson set the world's record in the 200 meter dash at 19.32; Alexander Popov has the swimming record for 50 meters at 21.64. Johnson has the fastest 400 meter run at 43.18 while Pieter Van Den Hoogenband covered 100 meters freestyle in 47.84.

When swim racing 100 meters or more, even the best slow down towards the end of their events because of how the water treats them. The idea is to train to slow down less than the competition, and this utilizes the sciences of physiology, biochemistry, and biomechanics plus talent and determination. If we add growth hormone to the correct training protocol, you can imagine the results.

Physiologic flags go up when we see power swimmers actually accelerate towards the end of their races. You see, with growth hormone, we actually have more muscle fiber cells being formed... a greater "army" of muscle tissue from which to recruit power. With steroids what muscle fibers we have are simply made bigger. This also provides more power but the endurance factor is not as pronounced as with growth hormone since there are less cells to help along the way. Again, the size or bulk of muscle groups will enlarge with both hormone classes, but for obviously different reasons; one because of greater density of substance (steroids), the other because of greater numbers of cells (growth hormone). The muscle group that has more muscle fibers from which to recruit will not tire as readily, and the athlete will be able to finish his event not only with more power but with enhanced endurance over those not so "anointed." Thus, if given the choice, growth hormone has the greater effect on performance.

Up till now it has been very difficult to test for growth hormone abuse. Being a naturally-found substance, amounts could be regulated up and down as major competitions approached, and any questionable amounts found would bring about the usual individual variation response. Sports administrators had to be absolutely sure of bad intentions if positive results

were found. Litigation, or the threat of same, was almost a reflex response from the accused athlete to almost every drug-testing scenario.

But now there is a means to observe “footprints” or “markers” in the blood and urine. If growth hormone is found naturally produced by the body (endogenously), it shows as remnants with scalloped edges or irregularities under examination. If abuse has taken place and outside sources consumed (exogenously), the edges of the remnants are perfectly smooth with no irregularities. Of course, the hormone could have been utilized illegally for several months during intense training and stopped well in advance of competition. But that is why the governing bodies have instituted unannounced body-fluid testing to which all competing athletes must agree.

The human condition being what it is, it is almost a sure bet that drugs that will mask growth hormone’s presence, or some other protocol that will be geared to enhance the possibility of cheating will be sought and tried.

### **Adverse Effects**

Adverse effects could be and usually are profound since the abusers could be taking from 100 to 1000 times the amount of hormone or steroid normally found in the body. This is the “ugly” of this whole topic. Some produce mainly cosmetic effects though rather intense; others can cause permanent disfigurement and organ dysfunction, and some lead all the way to death even in healthy young vigorous athletes.

A. Cardiovascular effects: blood pressure has been seen to spike uncontrollably; lipoproteins (cholesterol and all its “cousins”) become totally unfriendly to the internal environment with the “good” cholesterol, high-density lipoproteins (HDL’s) being lowered as much as 70%, and the “bad” cholesterol, the low-density lipoproteins (LDL’s) being raise as much as 100%; the actual structure of the heart can become negatively altered with the enlargement of the left ventricle and resultant poor diastolic function (the lower number of the blood pressure reading being too high); this results in not allowing the heart to rest in between beats because of the constant back-pressure being created; this abnormality can persist for years after usage is stopped and is what probably killed the former NFL great, John Matusack, 12 years after his playing days were over while he enjoyed a budding acting career; acute myocardial infarctions (major heart attacks) are not uncommon even after short-term usage due to an exaggerated response of the left

ventricle to a hypertrophic stimulus such as vigorous exercise; steroids can also increase the risk of acute vascular thrombosis (blood clot) in peripheral, coronary, and cerebral vasculature. The athlete's degree of atherosclerosis (clogging of the artery) is directly related to elevated plasma homocysteine which is induced by steroids.

B. Hepatic (liver) effects: some anabolic steroid structures (methyl testosterone, fluoxymesterone) have greater adverse effects on liver tissue than others; at first there is a reversible deterioration of the active liver tissue, then it becomes non-reversible; what can arise is increased liver tissue to cause painful swelling, inflammatory reactions of this tissue (jaundice), blood-filled cysts, benign tumors, and cancerous growths;

C. Reproductive effects: since reproductive tissue had its origin from birth using testosterone as a starting point, both reversible and irreversible changes in function can arise; since this system is heavily influenced by feed-back mechanisms, if supra-therapeutic doses of testosterone or its relatives are given, the body senses that it no longer needs to produce these vital sex-related hormones (testosterone, luteinizing hormone, follicle-stimulating hormone); the sex organs are deemed not necessary and lose their capacity to function properly; hypogonadism begins to develop within 24 hours post-administration which produces these far-ranging negative responses: reduced sperm count, poorly-shaped and ill-functioning sperm, testicular atrophy (wasting away) and infertility; recovery may take as long as a year or may never happen.

D. Behavioral/psychiatric effects: often causes inappropriate aggressive behavior patterns called "roid rage;" severe changes in mood such as depression, paranoia, hypomania, schizophrenia, steroid dependence, psychotic symptoms, the risk of homicide and suicide; often seen is a condition called reversed anoxia syndrome where the victim senses his body is not as well developed as it actually is; this can lead to an inappropriate and all-consuming perception that more work must be done to build muscle, called the Adonis syndrome.

E. Miscellaneous adverse effects: with supratherapeutic doses of anabolic steroids are administered, the excess is converted to estrogens; male abusers may discover that their breasts have begun to grow resulting in a painful condition called gynecomastia. Surgery may be needed to reduce breast tissue if this doesn't resolve once abuse ends; females experience male-

pattern baldness, permanent lowering of the voice, shrinking of the breasts, enlargement of sex organs, menstrual irregularities, and increased body hair; tumors can arise almost anywhere; the famous NFL all-pro defensive lineman, Lyle Alzado, knew he was dying from a steroid-induced brain tumor and made several public health commercials warning of this; any growth, whether benign or cancerous can be induced to spread much more quickly when growth hormone is abused; an benignly-enlarged prostate gland can become quite troublesome in response to excess growth hormone.

### Penalties for Steroid Possession and Trafficking

It seems the famous have been able to dodge bullets when it comes to the long arm of the law. Some are stripped of their title and promise of wealth and stardom as the most recent Tour-de-France winner found out so unceremoniously. Some endure controversy and persevere: an elite American female sprint swimmer of the early 1990's tested positive for testosterone 1000 times greater than she claimed her birth control pills caused. She was initially banned for life by United States Swimming; but somehow found her way back to elite competition within two years.

But some actually bask in the heat of notoriety. Jose Conseco's recent book about steroid abuse running rampant in Major League Baseball brought the expected controversy especially when he named as co-chronic abusers some of the greatest home-run hitters of all time. Everyone's icons. Those who have been prosecuted for selling and distributing to these professionals and have named names and situations are doing time and paying fines, but, again, the famous, are free to roam about. And to their shame, they have never owned up to the obvious. Mark Maguire entered the league in his early 20's at 6'5", 180 pounds, and retired at 6'5", 240 pounds, not looking at all soft and fat. Bobby Bonds similarly "thickened up" to aid his ability to power the ball over the years to be presently positioned second only to the fabulous Henry Aaron who relied on natural gifts, hard work, and longevity. And there are plenty more now undergoing scrutiny.

For anabolic steroids, individual states may have harsher penalties than allowed by the Anabolic Steroid Control Acts of 1990 and 2004. However, both acts specify that the first offense of possession of anabolic steroids obtained illegally carries a maximum penalty of one year in prison and a minimal \$1,000 fine. If trafficking is found to be the game, the maximal penalties for a first offense are five years in prison and a \$250,000 fine;

these both double for a second offense.

This seems harsh enough; you would think the negative notoriety would cause the potential offenders to pause and think of the legal consequences not to mention the great risk to bodily health. But the perception of all this must not be as negative as we would hope because the allure of greatness still calls so many of the young and talented (and, oh, so foolish) to try anything that just might give them that edge up on everyone else.