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Effect of androgenic anabolic steroids on sperm quality and serum hormone levels in adult male bodybuilders

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Abstract

The purpose of this study was to assess the influence of the administration of high doses of androgenic anabolic steroids (AAS) on endocrine and semen parameters. Thirty volunteering bodybuilders were studied (ages ranging between 26.6 ± 4.1 years). A history of anabolic steroid administration was recorded for fifteen subjects, and results of semen analysis and endocrine parameters were compared with data from fifteen bodybuilders not using steroids. In those subjects using AAS, eight had sperm counts under the lower normal limit (20×10^6 sperm /ml), three had azoospermia, two polyzoospermia, and two had normal sperm counts. The percentage of morphologically normal sperm was significantly reduced, only 17.7% had normal spermatozoa. In the control group, only one subject had oligozoospermia. The hormonal parameters revealed reduced FSH (1.5 ± 3.2 *vs* 5.0 ± 1.6, $p < 0.001$) and PRL (5.1 ± 4.9 *vs* 9.2 ± 4.4, $p < 0.01$) levels. LH, T, E_2 and DHEA levels did not vary.

Keywords: Anabolic steroids; Bodybuilders; Oligoasthenoteratozoospermia; Use of androgenic anabolic steroids for bodybuilders

Introduction

The use of androgenic anabolic steroids (AAS) by athletes began in the early fifties [1], increasing noticeably since then [2, 3]. During this time, a group of physicians in the United States reported that certain American athletes used this type of drug. Soon, physicians started to conduct chemical tests for detecting the use of these drugs. The use of anabolic steroids became very popular among athletes.

The benefit that AAS may possibly provide athletes in increasing their ability and performance is controversial. It is not well known whether these drugs really increase a person's

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athletic ability. Athletes consuming these substances state they indeed increase their performance [4–6]. The medical and scientific community doubt any real beneficial effect is achieved from the use of steroids, since previous studies have reported inconsistencies. It seems a great number of athletes with high anabolic steroid intake have not shown changes in their athletic ability [7]. The second point of controversy is whether anabolic steroids produce damage to the athlete's health. Many of the athletes using steroids believe that the side effects are neither serious nor permanent [8], while some physicians have found changes in liver function tests [9] and the development of liver tumors [10].

The adverse effects of AAS on the male reproductive function compromise the athlete's fertility. The main changes that have been observed are: oligozoospermia, azoospermia, a decrease in testis size, concomitant to a decrease in serum gonadotropin and testosterone levels [11,12]. The mechanisms by which these functional abnormalities are produced are due to the induced suppression in the production of gonadotropins caused by the anabolic steroids used by athletes. The changes in these hormones are reversible after discontinuing their use, but the long-term effects on the hypothalamus-pituitary-testicular axis are still unknown. However, certain residual abnormalities have been reported on the testicular morphology of healthy males six months after discontinuing the use of steroids [13].

The drugs most often used are testosterone and synthetic analogues. These androgenic drugs, in addition to having an anabolic effect, have a virilizing one. In addition to these compounds, it has been reported that the use of growth hormone and human chorionic gonadotropin has similar results to anabolic steroids [14]. Athletes consuming this type of substance are not truly conscious whether they are efficacious for the end they are pursuing, and even less, on the short and long term effects on their health associated to their use [15]. The objective of this study was to assess the effect of the use of anabolic steroids on sperm quality and hormone levels in bodybuilders.

Methods

Study design

A total of 30 adult male bodybuilders were included in the study. Initial contact with the bodybuilders was established by one of the authors (JTC) who serves as a family practitioner to several of them. They approached him for having undesirable side effects due to the use of steroids. Bodybuilders were allocated in two groups. Group I, comprised by 15 bodybuilders that only exercised to increase their muscle mass and mold their bodies; while group II, also comprised by 15 bodybuilders, in addition to exercise, voluntarily took anabolic steroids. All participating subjects were given a full medical examination. Secondary sexual characteristics were assessed, while the external genitalia were studied by palpation to record consistency and testis size. A directed questionnaire was given in order to know more about their exercise routine, history of drug intake and certain aspects concerning their reproductive health.

Laboratory analysis

A blood sample for assessing endocrine parameters was drawn from the antecubital vein. Three 10 ml peripheral blood samples were taken every 20 minutes. Serum was separated

and mixed to form a pool and stored at -20° C until their analysis. From this pool, the following hormones were measured: luteinizing hormone (LH), follicle-stimulating hormone (FSH), prolactin (PRL), estradiol (E2), testosterone (T) and dehydroepiandrosterone (DHEA). The hormonal assessments were done in duplicate using RIA (Amerlex-M, Amersham International, Aylesbury, Buckinghamshire, UK). A semen sample was obtained through masturbation after three days of sexual abstinence. The semen was analyzed following the WHO criteria [16]. With respect to the control group, blood and semen analysis were done after eight weeks of exercise practice.

Statistical analysis

The U Mann-Whitney test was used to determine statistical differences between the groups.

Results

Details of the steroids used are shown in Table 1. A mixture of testosterone propionate and testosterone decanoate was the most frecuently used, followed by nandrolone decanoate, oxymetholone and methenolone acetate. The amounts of anabolic steroid intake were considerably higher than the therapeutically recommended doses.

Compared with the control group where only one volunteer showed to have severe oligozoospermia (sperm concentration 5×10^6 Spz/mL), sperm concentrations in bodybuilders taking AAS were severely impaired. As a result, three bodybuilders had azoospermia, three others had severe oligozoospermia (sperm concentrations $< 5 \times 10^6$ Spz/mL), five bodybuilders showed moderate oligozoospermia (sperm concentrations between 5 and 20×10^6 Spz/mL) and four others had normal sperm concentrations. The average sperm concentration of the group using AAS was smaller than that found in the control group (46.1 ± 96 vs 67.9 ± 48.3, $p < 0.005$). Upon excluding the subjects with azoospermia from the AAS group, the difference in concentration was found to be statistically greater in the control group (57.6 ± 104.9 vs 67.9 ± 48.3, $p < 0.05$).

In addition, the amont of sperm with normal morphology was statistically smaller in the AAS group (17.7 ± 13.6 vs 44.5 ± 7.6, $p < 0.001$).

The group using AAS showed a serum FSH concentration less than that of the control group (1.4 ± 3.2 vs 5.0 ± 1.6, $p < 0.001$). PRL concentrations were also found to be smaller in the AAS group (5.1 ± 4.9 vs 9.2 ± 4.4, $p < 0.001$). When comparing LH, T, E_2 and DHEA levels, no differences were found (Table 2).

Discussion

The use of high doses of androgenic anabolic steroids (AAS) for increasing muscle mass, has become a very common practice especially for persons not usually to doping tests. In the population studied, we assessed the cyclic and prolonged use of AAS. The cyclic use of these substances was characterized by a progressive increase in dosage, followed by its decrease, using both the oral as well as the parenteral route. In our study, all bodybuilders had a history of AAS usage. Personal dosages and different time periods were followed, whether suggested by their trainer or by their designing a special regimen. The repercussions of the long term

Table 1
Anabolic steroids used by bodybuilders

		AAS		AAS	
Subject	Weeks	ORAL	mg/wk	P	mg/wk
1	16	O	100	ND	500
		MA	90	TDP	500
2	8	O	25	ND	500
				TDP	500
3	11			ND	250
				TDP	250
4	5	O	50	ND	200
		M	300	TE	500
		MA	100		
5	5	O	50	PT	240
		MA	100		
6	8	O	25	ND	600
		M	300	TDP	500
7	4	O	50	TDP	200
		M	300		
		MA	200		
8	12			ND	300
				TE	500
				TDP	500
9	12			ND	100
				TE	500
				TDP	500
10	5	O	50	TDP	500
11	8			ND	300
				TDP	1500
12	8			ND	300
				TDP	500
13	8	MA	150	ND	250
14	8			ND	250
				TDP	500
15	12			ND	250
				TDP	500

SA: P, parenteral; O, oximetalone; MA, metenolone acetate; ND, nandrolone decanoate; TDP, testosterone decanoate and propionate; M, mesterolone; TE, testosterone enanthate; TP, testosterone propionate.

use of high doses of AAS, equivalent to 40 times the dosages used in the treatment of hypogonadism [17], have still not been reported. Among the undesirable collateral effects for which the bodybuilders visited their physicians are gynecomastia as the most frequent, possibly since it is the most evident. Other secondary effects aren't as apparent and therefore do not cause athletes, to worry.

The effect of the use of AAS on the number of spermatozoa in the ejaculate varied greatly among subjects. Three of them had azoospermia, two had polyoospermia, eight had sperm counts below 20 million, while only two had normal sperm counts. This is reflected on the great standard deviation estimated from the data submitted to statistical tests and their

Table 2
Sperm characteristics and hormonal concentrations in subjects with (Group II) and without (Group I) AAS intake

Group II Subject	Age (years)	Count (Spz/10^6/ml)	Normal morphology (%)	E_2 (pg/ml)	LH (mU/ml)	FSH (mU/ml)	T (ng/ml)	PRL (ng/ml)	DEHA (ng/ml)
1	31	11	10	97	0.6	0.03	10.6	8.0	203
2	22	3	15	201	0.5	0.03	10.8	1.0	406
3	27	2	17	70	0.4	0.03	8.0	2.0	142
4	32	57	12	22	5.0	0.19	21.0	1.0	413
5	22	238	33	26	5.0	3.40	20.0	4.0	242
6	21	27	23	34	5.0	0.03	7.5	9.0	536
7	29	16	2	239	0.6	0.03	1.7	2.0	24
8	34	0	0	10	12.9	0.03	2.1	19.7	297
9	32	5	25	27	0.2	0.03	3.7	2.4	104
10	24	0	0	5	8.2	11.30	6.5	8.8	385
11	24	0	0	10	16.0	0.40	14.0	1.5	210
12	25	2	27	113	1.9	0.03	1.9	0.9	165
13	25	316	43	1	5.0	6.00	21.0	7.8	196
14	25	8	28	9	0.5	0.03	1.3	4.7	112
15	27	7	30	54	0.5	0.03	4.3	4.0	242
Mean±DE	26.6±4.1	46.1±96	17.7±13.6	61.2±73.4	4.1±4.9	1.4±3.2	8.9±7.1	5.1±4.9	245±138
Group I	26.0±4.1	67.9±48.3[A]	44.5±7.5[B]	18.7±9.8	5.0±1.9	5.0±1.6[C]	5.0±1.8	9.2±4.4[D]	325±86

[A]$p<0.005$, [B]$p<0.001$, [C]$p<0.001$, [D]$p<0.01$ by Mann-Whitney U test vs Group 1.

comparison to control groups. Although statistically significant, the average number of spermatozoa fall well within normal ranges.

With respect to morphology, only three of the subjects had morphologically normal spermatozoa. The most frequently found changes were the presence of amorphous spermatozoa, changes in the head and defects of the center pieces.

Concerning serum hormone concentrations, it was seen that eight subjects had oligozoospermia, with FSH concentrations under 0.1 mIU/ml and 7 had LH concentrations below 0.9 mIU/ml. These findings can be due to the effect of high doses of steroids, interfering with the negative feedback mechanisms at the level of the hypothalamus inhibiting the release of GnRh.

Serum testosterone concentrations in six of the subjects taking steroids were over 10.5 ng/ml and in 5, high estradiol concentrations were recorded. This can be explained by the aromatization of testosterone to estrogen. PRL serum concentrations were less in androgen-consuming bodybuilders in comparison to the control group. However, PRL concentrations in both groups were within normal limits.

In spite of the fact that this study was not designed to assess the effects of the use of AAS, it reflects what really happens in the evermore extensive practice of exercise and the empirical use of high doses of steroids, in addition to the unawareness of the health problems this may cause, especially on the individual's reproductive sphere.

Semen and hormone tests for the control group were within normal ranges, suggesting that exercise by itself does not change the parameters assessed.

This study is a sing of alarm for subjects that freely consume steroids in order to decrease the time required for increasing muscle mass using only exercise routines. Word should be spread in order to avoid this from becoming a public health problem.

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