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Full Length Research Paper

A study of short term administration of testosterone on serum development hormone and body mass index in mature male albino rats

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Testosterone is a steroid hormone from the androgen groups, secreted primarily in the testicles of males. Studies have shown that testosterone production will also boost growth. The present study was carried out to study the effect of short-term administration of testosterone on serum growth hormone concentration, body mass index (BMI) and body weight in adult male rats. Twenty-one male rats were divided into three (3) groups of seven (7) rats each; a control group, a low-dose and a high-dose testosterone group. Normal saline was administered intramuscularly to the control group, while 2.5 and 6.25 mg/d of testosterone propionate were administered intramuscularly to the low-dose and high-dose groups, respectively, for fourteen (14) days. The body weight and the length of the rats were recorded for calculation of the body mass index. Blood samples for serum growth hormone assay were collected via cardiac puncture. Results showed a significant (P<0.05) increase in the serum growth hormone concentration in the high dose testosterone group when compared to the control while changes recorded in the BMI and body weight were not significant. It was concluded that testosterone can exert its anabolic effects by acting synergistically with the anabolic effects of growth hormone.

Key words: Testosterone, growth hormone, high-dose, body mass index.

INTRODUCTION

Testosterone is a steroid hormone from androgen groups and is found in mammals, reptiles (Cox and John-Alder, 2005), birds (Read et al., 2006) and other vertebrates. In animal, it is secreted primarily in the testicles of males and in the ovaries of females, although small amounts are also secreted by the adrenal glands. It is the principal male sex hormone and an anabolic steroid.

In men, testosterone plays a key role in the development of male reproductive tissues, such as testis and prostate, as well as promoting sexual characteristics (Mooradian et al., 1987). In addition, testosterone is essential for health and well-being, as well as prevention of osteoporosis (Seidman, 2007).

The original and primary use of synthetic testosterone is for the treatment of males with too little or no natural

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endogenous testosterone production (males with hypogonadism). Appropriate use for this purpose is legitimate hormone replacement therapy, which maintains serum testosterone levels in the normal range (Handelsman, 2005).

Human growth hormone is a hormone produced by the anterior pituitary gland that has wide-reaching effects on the body. Once it is released into the bloodstream, it stimulates the production of more testosterone by the testes. It stimulates the production of insulin-like growth factor 1 (which is an anabolic hormone) and directly impacts cell growth, regeneration and DNA synthesis.

Though previous studies have shown that testosterone production will also boost growth hormone (Handelsman, 2005). Ultimately, the balance of risk and benefits for testosterone treatments can only be determined reliably, by suitably powered prospective placebo controlled trials (Handelsman and Zajoc, 2004). A recent Institute of Medicine also voted recently that the existing efficacy evidence was equivocal that it could not even recommend large-scale clinical trials without better short-term evidence of efficacy (Handelsman and Zajoc, 2004).

Therefore, our report is a short-term study, aimed at investigating the mechanisms of action of testosterone by studying its effect on the serum growth hormone and body mass index (BMI) in adult male rats.

MATERIALS AND METHODS

Experimental protocols

Twenty-one (21) male albino rats (mean weight 100-120 g) were maintained under standard laboratory conditions and were allowed free access to food and water. Animals were divided randomly into three (3) groups of seven (7) rats each and were treated with testosterone of low and high doses during the experimental period. Group A served as the Control (drug vehicle), Group B - low dose testosterone (0.5 mg/day) and Group C - high dose testosterone (6.25 mg/day).

Drug route and duration of treatment

Testosterone propionate is a fixed ester. It is commercially available as 25 mg/dl in one ampoule of 2 mls. Doses selected were 2.5 and 6.25 mg/day, for low dose and high dose administration, respectively. The duration of treatment was for fourteen (14) days before sacrifice.

Procedure

Normal saline was administered intramuscularly to animals in the control group (Group A). Animals in Group B were treated with 2.5 mg/day of testosterone propionate intramuscularly for two (2) weeks. Rats in Group C were treated with 6.25 mg/day of testosterone propionate intramuscularly for two (2) weeks. On three (3) different occasions (days 0, 7 and 14), the following parameters were measured and calculated accordingly for each rat:

- Body weight
- Body length
- Body mass index (BMI)

Their body weight was measured with an electronic /digital weighing scale. Similarly, the body lengths were measured with a meter rule using the tip of the mouth and anus as landmarks. The BMI was calculated by dividing the body weight in grams by the body length in centimeters squared.

BMI = Body weight (g) / length in (cm2)

The rats were then sacrificed on day fourteen (14) and the blood samples were collected through cardiac-puncture for growth hormone assay.

Growth hormone estimation

The growth hormone (GH) Human Elisa (enzyme-linked immunosorbent Assay) kit (Cambridge U.K.) was used. It is an in-vitro enzyme –linked assay for the quantitative measurement of Human GH in serum, plasma and cell culture supernatant. This assay employs an antibody specific for human GH coated on a 96- well plate. Standards and samples were pipetted into the wells and GH present in the samples was bound to the wells by immobilized antibody.

The wells were washed and biotinylated anti-human growth hormone anti-body was added. After washing away unbound biotinylated anti-body, HRP-Conjugated Streptavidin was pipetted into the wells. The wells are again washed and colour developed in proportion to the amount of GH bound. The stop solution changed the colour from blue to yellow and the intensity of the colour was measured at 450 nm.

Statistical analysis

All results were expressed as mean ±SD. Data was analyzed by one-way analysis of variance (ANOVA) and Duncan New Multiple Range Test (DMRT). Differences in means were considered significant at $P \leq 0.05$. All analyses were performed using SPSS version17.

Table 1. Showing the effect of low dose and high dose testosterone on body weight (g).

Days	Control (Drug vehicle)	Low dose testosterone (2.5 mg/d)	High dose testosterone (6.25 mg/ d)
0	113.0 ± 4.01	106.2 ± 3.34	125.6 ± 9.63
7	149.0 ± 3.66	142.2 ± 4.43	130.4 ± 10.00
14	164.2 ± 8.59	159.4 ± 3.17	156.6 ± 7.71

p>0.05 for all recorded values when compared to control.

Table 2. Showing the effect of low dose and high dose testosterone on body mass index (g/cm^2).

Days	Control (Drug vehicle)	Low dose testosterone (2.5mg/d)	High dose testosterone (6.25mg/d)
0	0.405 ± 0.03	0.398 ± 0.02	0.460 ± 0.03
7	0.510 ± 0.01	0.486 ± 0.01	0.478 ± 0.03
14	0.548 ± 0.02	0.527 ± 0.01	0.519 ± 0.02

p >0.05 for all recorded values when compared to control.

Table 3. Showing the effect of low dose and high dose testosterone on growth hormone.

Group	GH Concentration (µg/L)
Control	3.68±0.26
Low dose (2.5mg/d)	4.36±0.69
High dose (6.25mg/d)	5.76±0.28*

*p-value <0.05 when compared to the control group.

RESULTS

Mean body weights of the control and the experimental groups on days 0, 7, 14 are shown in Table 1. There were no significant changes (p>0.05) noticed in the experimental groups.

The mean BMI of the control and the experimental groups on days 0, 7 and 14 are shown in Table 2. Observed changes in the experimental groups when compared to the control were insignificant (p>0.05).

The mean GH in the control group was 3.68±0.263 as against experimental groups B (4.36±0.69) and group C (5.76±0.28). Increases observed were only significant (P<0.05) for group C. This is shown in Table 3.

DISCUSSION

Testosterone and GH are two hormones that play roles in growth, aging and overall health. Both of these hormones are commonly manipulated by athletes and aging adult in order to enhance their sport performance, improve their body composition and bring back their youthful vitality. While natural testosterone and GH supplements are widely available, most people simply do not understand how these hormones work in comparison to one another, which makes it difficult to use them effectively (David, 2006).

Our research was carried out to study the effect of testosterone on GH and BMI in male albino rats. Results from our study showed a significant (P<0.05) increase a serum GH concentration, following administration of a high dose testosterone (intramuscularly) for fourteen (14) days.

Testosterone either activates androgen receptors in its unchanged form or gets converted to 5α-dihydrotestosterone by the enzyme 5α-reductase and then binds to androgen receptors. Once bound, the receptors-hormone complex moves into the cell nucleus and binds to specific genes sequences on the cellular DNA. This leads to modification of proteins, thereby giving rise to the androgenic effects exerted by testosterone. It might mediate its effects on growth through regulating GH synthesis and release (Somana et al., 1978); although it does not affect the sensitivity of the pituitary somatotrophes to Growth hormone releasing hormone (GHRH), it stimulates the secretion of GH by modulation of N-Methyl- D-aspartic acid (NMDA) drive to

GHRH neurones (Read et al., 2006; Bran, 1995).

The increase in serum GH Concentration seen in our study corresponds to studies by Deller et al. (1966) and Illing and praver (1970), who reported that androgen treatment in humans increases pituitary GH content and enhances release of GH through indirect pathways. This was also reported in rats (Jansson et al., 1982).

The body weight and the BMI were not significantly ($P>0.05$) affected by administration of testosterone (intramuscularly) for fourteen (14) days. This finding contradicts those in a presentation by Dr. Saad who described administration of testosterone for four (4) years to patients with erectile dysfunction. He noticed a significant decrease in BMI, and body weight in the treated patients. He explained that the increase in the level of activities noticed in the patients would potentially increase muscle mass and decrease fat mass, contributing to a faster metabolic rate which could contribute to weight loss (ICAO, 2012).

It can be concluded from our study that testosterone could exert its anabolic effects by acting synergistically with the anabolic effects of GH. This gives further insight to the physiologic actions of testosterone and complements on previous studies on testosterone.

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