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The Effect of Testosterone Used in Sportsmen on Routine Biochemical Parameters

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Abstract: The purpose of the research was to determine indicators of testosterone implication on heart, liver and kidney failure in female rats during puberty and also to determine its effect on some other chemical values. In the research, female 16 Sprague dawley rats (50 days) were used. The rats were divided into two equal groups. The first group was administrated testosterone, diluted with olive oil, 5 mg kg^{-1} (SID) subcutaneously for 10 weeks, 5 days each week. The second group was only given olive oil. Serum creatine kinase, creatine kinase-MB, alkaline phosphates, alanine aminotransferase, aspartate aminotransferase, blood urea nitrogen, creatinine, triglyceride, cholesterol, high density lipoprotein, amylase, total protein, albumin and calcium were measured with an auto-analyzer. It was determined that while testosterone application in female rats leads to decrease on the total serum protein and albumin levels ($p<0.05$), it increased aspartate aminotransferase and cholesterol levels ($p<0.05$). Consequently, it can be stated that long term testosterone implication during puberty may lead to organ defects at early ages.

Key words: Testosterone, cholesterol, aspartate aminotransferase, total protein, albumin, Turkey

INTRODUCTION

Testosterone was first defined as sexual hormone in mid 1930s (Handelsman, 2006). In men testosterone is released from adrenal cortex and testis. Spermatogenesis as male sex hormone plays role in the development of secondary sex characters and releases of gonadropin (Wu, 1997). The released testosterone is carried in blood by binding to albumin. Testosterone is found in body in three forms as free, sex hormone-binding globulin and albumin or slightly tied to cortisol binding globulin (Bukowski *et al*., 2000).

Anabolic Androgenic Steroid (AAS) is synthetic derivations similar to testosterone. When testosterone is taken orally or parenterally, it does not show any effect in the body as it metabolizes very quickly. Testosterone derivations, on the other hand are given only intramuscular or orally due to the difference of ester groups in their structure (Vardar *et al*., 2002). Testosterone and AASs are clinically used for the treatment of chronic weakness situations such as kidney failure, anemia, growing deficiency in children, late puberty, AIDS and cancer (Marshall-Grandisnik *et al*., 2009).

Though, the usage of AAS is more commonly seen in male patients, research shows that there is a rapid increase in its use with female patients (Vardar *et al*., 2002). In 2001, it has been reported that in the USA 1-2% of the young girls and 4-6% of young males used AAS at least once (Marshall-Grandisnik *et al*., 2009). The mean age to start using drugs is reported to be 16 and the cause for usage is reported as the need to change physical appearance and increase sportive performance (Vardar *et al*., 2002). It has been discovered by the international test applied by WADA that elite sportsmen have used AAS abusively. Besides, testosterone or similar steroids are used by small groups such as policemen, security guards and body guards to have bigger muscles and have a more masculine appearance. Research states that the most common of these are testosterone, nandrolone and stanazolol (Handelsman, 2006). It has been reported in a study carried out to determine the abusive usage of AASs among high school students that as the socio-economic statue increases, the usage frequency increased as well (Handelsman and Gupta, 1997).

Uncontrolled usage of testosterone or its derivations causes serious side effects such as cardiovascular system disorders, prostate, disorders in lipid metabolism or insulin sensitiveness. In addition when it is used to increase performance in sporting events, it causes serious ethical problems (Bhasin *et al*., 1996).

The most commonly reported side effects of AAS are increase in atherosclerosis, tachycardia, cardiac hypertrophy, defected cardiac function, sudden death, depression, nervousness, behavior disorder, muscles pains, nausea, vomiting, testicular atrophy and liver injury (Casavant *et al*., 2007; Marshall-Grandisnik *et al*., 2009).

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Some biochemical values measured in serum give us information on disorders of some organs or systems in living organisms. Creatine kinase MB (CK-MB) are determined as the indicator of heart injury, creatine kinase as muscle injury (Dickerman *et al*., 1999) as liver injury indicator Alkaline Phosphate (ALP), Alanine aminotransferase (ALT), Aspartate aminotransferase (AST) and Gamma Glutamyl Transferase (GGT) as kidney injury indicator urea (BUN) and creatinine, as lipid metabolism indicator triglyceride, cholesterol and High Density Lipoprotein (HDL) levels are determined (Bartley, 1989; Kramer, 1989; Finco, 1989). The enzyme that catalyzes amylase carbohydrate hydrolysis, total protein and albumin protein metabolism indicator and calcium (Ca) is an indicator that shows electrolyte balance (Turgut, 2000). In the literature research no information was found on the effects of long term used testosterone on serum biochemical values during puberty.

The purpose of the present study was to determine the effects of testosterone implication in female rats during puberty on heart, liver, kidney failure indicators and some other routine biochemical values.

MATERIALS AND METHODS

In the research, 16 female Sprague dawley rats (50 days old, SUDAM, Konya, Turkey) were used. The research was approved by Selcuk University, Veterinary Faculty of the Ethical Committee. Only 16 female rats were divided into two groups. The first groups was administrated testosterone (Sustanon® 250 amp, Organon, Istanbul, Turkey) diluted with olive oil, 5 mg kg^{-1} subcutaneously for 10 weeks 5 days each week (Saturday and Sunday resting).

The second group was only given olive oil. The animals were fed *ad libitum* during the research and kept at 25°C in a place with 5200 Rh% humidity. At the end of the 10th week, blood samples were taken from under pentobarbital anesthesia and then they were euthanized. CK, CK-MB, ALP, ALT, AST, BUN, creatinine, triglyceride, cholesterol, HDL, amylase, total protein, albumin and calcium levels were measured with an auto-analyzer (IL-300 Instrumentation Laboratory Milano, Italy). The results of the research were evaluated with paired t-test (SPSS 10.0). $p<0.05$ was accepted statistically significant.

RESULTS AND DISCUSSION

The effects of testosterone implication in female rats on serum biochemical values were shown in Table 1. It was determined that while testosterone application in female rats leads to decrease ($p<0.05$) on the total serum protein and albumin levels, it increased ($p<0.05$) AST and cholesterol levels. AAS, due to their anabolic features have been used for the treatment of trauma, burns, large surgical attempts, radiation therapy and chronic weakness since 1940s. It has been reported that AASs had been widely used for the treatment of various types of anemia before bone marrow transplantation and synthetic erythropoietin were discovered (Kerr and Congeni, 2007).

Table 1: Biochemical values of testosterone applied female rats (mean±SEM)

Parameters	Olive oil	Testosterone
CK (U L^{-1})	333±64.3^{A}	378±77.1^{A}
CK-MB (U L^{-1})	464±108^{A}	533±124^{A}
ALP (U L^{-1})	238±25.8^{A}	275±23.5^{A}
ALT (U L^{-1})	26.7±3.21^{A}	30.7±2.94^{A}
AST (U L^{-1})	76.5±4.16^{B}	89.7±3.70^{A}
BUN (mg dL^{-1})	37.4±1.36^{A}	40.2±2.74^{A}
Cretinine (mg dL^{-1})	0.52±0.01^{A}	0.46±0.01^{A}
Triglyceride (mg dL^{-1})	83.5±13.8^{A}	81.7±6.25^{A}
Cholesterol (mg dL^{-1})	41.7±1.64^{B}	47.8±1.12^{A}
HDL (mg dL^{-1})	32.5±1.88^{A}	27.7±1.44^{A}
Amilase (U L^{-1})	814±49.3^{A}	945±49.2^{A}
Total protein (g dL^{-1})	6.55±0.19^{A}	5.54±0.14^{B}
Albumin (g dL^{-1})	3.68±0.12^{A}	3.21±0.07^{B}
Calcium (mg dL^{-1})	8.80±0.75^{A}	8.85±0.09^{A}

$^{A, B}$Different letters at the same line are statistically significant ($p<0.05$, Paired t test)

AST is accepted as one of the indicators of liver injury and it has been stated that there has been increases when necrosis was observed in hepatocytes (Turgut, 2000). In the present study, it was determined that testosterone had increased serum AST level ($p<0.05$) (Table 1). While in some researches where the effect of ASS on liver was carried out, it was reported that AST and ALT levels did not change. In other studies, it was reported that there were increases on the values of AAS for a few weeks (Hartgens and Kuipers, 2004; Vieira *et al*., 2008). It has been reported that there was increase on the AST levels of the body builders that take anabolic steroid (Dickerman *et al*., 1999). This leads to the result that long term AAS intake in females during puberty may cause liver damages.

Cholesterol is the biggest lipid in the body and it is the procursor of steroid hormones and bile acids (Bartley, 1989). In the present study, it has been determined that testosterone implication has increased ($p<0.05$) serum cholesterol level (Table 1). The effect mechanisms of AASs on cholesterol metabolisms have not been defined precisely (Hartgens and Kuipers, 2004; Kuipers *et al*., 1991). However, it has been reported that the increase on the cholesterol levels is resulted from common side effects of AAS (Hartgens and Kuipers, 2004; Hurley *et al*., 1984; Marshall-Grandisnik *et al*., 2009). The disorder in the cholesterol mechanism can cause to atherosclerosis (Nizamlioglu, 2006). Heart and liver injury related to cholesterol can be expected especially for long term AAS usage in puberty.

In the present study, it has been determined that testosterone implication has decreased ($p<0.05$) serum total protein and albumin levels (Table 1). Similarly, low level serum total protein was determined in rats underwent nandrolone implication (Vieira *et al*., 2008). It has been reported that liver protein synthesis has decreased in patients with chronic liver disease. When high level of AST is accepted as liver injury in the present study (Turgut, 2000), it can be stated that the decrease on the protein synthesis can improve due to liver injury.

CONCLUSION

Consequently, it can be stated that long term anabolic androgenic steroid usage during puberty may lead to liver injury and cardiovascular diseases at early ages.

REFERENCES

Bartley, J.C., 1989. Lipid Metabolism and Its Diseases. In: Cilinical Biochemistery of Domestic animals. Kaneko, J.J. (Ed.). 4th Edn., Academic Press, London, UK., pp: 106-135.

Bhasin, S., T. Storer and N. Berman, 1996. The effects of supraphysiologic doses of testosterone on muscle size and strength in normal men. New Engl. J. Med., 335: 1-7.

Bukowski, C., M.A. Grigg and C. Longcope, 2000. Sex hormone-binding globulin concentration: Differences among commercially available methods. Clin. Chem., 46: 1415-1416.

Casavant, M.J., K. Blake, J. Griffith, A. Yates and L.M. Copley, 2007. Consequences of use on anabolic androgenic steroids. Pediatric Clin. North Am., 54: 677-690.

Dickerman, R.D., R.M. Petrusi, N.Y. Zachariah, D.R. Dufour and W.J. McConathy, 1999. Anabolic steroid-induced hepatotoxicity: Is it overstad?. Clin. J. Sport Med., 9: 34-39.

Finco, D.R., 1989. Kidney Function. In: Cilinical Biochemistery of Domestic animals, Kaneko, J.J. (Ed.). 4th Edn., Academic Press, London, UK., pp: 524-537.

Handelsman, D.J. and L. Gupta, 1997. Prevalence and risk factors for anabolic-androgenic steroid abuse in Australian high school students. Int. J. Androl., 20: 159-164.

Handelsman, D.J., 2006. Testosterone: Use, misuse and abuse. MJA, 185: 436-439.

Hartgens, F. and H. Kuipers, 2004. Effects of Androgenic-anabolic steroids in athletes. J. Sport Med., 34: 513-522.

Hurley, B.F., D.R. Seals, J.M. Hagberg, A.C. Goldberg and S.M. Ostrove *et al*., 1984. High-density-Lipoprotein cholesterol in bodybuilders v powerlifters. JAMA, 252: 507-513.

Kerr, J.M. and J.A. Congeni, 2007. Anabolic-androgenic steroids: Use and abuse in pediatric patients. Pediatr. Clin. North Am., 54: 771-785.

Kramer, J.W., 1989. Clinical Enzymology. In: Cilinical Biochemistery of Domestic Animals, Kaneko, J.J. (Ed.). 4th Edn., Academic Press, London, UK., pp: 352-360.

Kuipers, H., J.A.G. Wijnen, F. Hartgens and S.M.M. Willems, 1991. Influence of anabolic steroids on body composition, blood pressure, lipid profile and liver functions in body builders. Int. J. Sports Med., 12: 413-418.

Marshall-Grandisnik, S., R. Green, E.W. Brenu and R.P. Weatherby, 2009. Anabolic androgenic steroids effects on the immune system: A review. Central Eur. J. Biol., 4: 19-33.

Nizamlioglu, M., 2006. Lipid Metabolizmasi. In: Biyokimya, Kalaycioglu, L., B. Serpek, M. Nizamlioglu, N. Baspinar and A.L. Tiftik (Eds.). Nobel Yayin Dagitim, Ankara.

Turgut, K., 2000. Veteriner Klinik Laboratuar Teshis. Bahcivanlar Basim Sanayi AS., Konya.

Vardar, E., S.A. Vardar and T. Cengiz, 2002. Anabolik-androjenik steroidlerin kotuye kullanimi. Anadolu Psikiyatri Dergisi, 3: 104-107.

Vieira, R.P., R.F. Franca, N.R. Damaceno-Rodrigues, M. Dolhnikoff, E.G. Caldini, C.R.F. Carvalho and W. Ribeiro, 2008. Dose-dependent hepatic response to subchronic administration of nandrolone decanoate. Med. Sci. Sport Exercise, 40: 842-847.

Wu, F.C.W., 1997. Endocrine aspects of anabolic steroids. Clin. Chem., 43: 1289-1292.