Clinicopathological study on the effect of boldenone undecylenate as growth promoting agent in goats

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Abstract

This study investigated the effects of boldenone undecylenate as an anabolic steroid on the performance and body weight of goats. Goats were divided into three groups in a completely randomized design. Two groups received two different doses of boldenone undecylenate for a period of 6 weeks. The 3rd group was the control. Liver enzymes, (Afp) tumor marker, electrolytes, and body weight were monitored in all goats 2 weeks of the last injection. Body weight was higher (P<0.01) in treated groups than control. Liver function enzymes (AST, ALT, GGT), Afp, sodium, potassium, urea and creatinine did not differ significantly in 0.5 mg/kg treated group, while in 1 mg treated group, activities of ALT and AST were significantly increased (P<0.01). Serum cholesterol and red cell count were significantly high in both treated groups. It was concluded that Boldenone undecylenate in a dose of 0.5 mg/kg could be used for improving the body weight and the physical conditions in goats without any adverse effect on liver or kidney.

Abbreviations: AFP, alphafetoprotein; ALT, alanine aminotransferase; AST, aspartate aminotransferase, GGT, gamma glutamyle transferase .

Introduction

Boldenone undecylenate is an injectable synthetic anabolic steroid derived from testosterone (***Blanchard, et al. 1983***). Boldenone is highly anabolic, with only low to moderate androgenic potency **(*Howe and Morello, 1985)***. Boldenone is an efficient muscle builder, though it is much less apt to produce androgenic side effects (oily skin,

acne, hair loss, body/facial hair growth) compared to an androgen such as testosterone ***(McDonnell, et al. 1986).***

In veterinary medicine, it is labeled for use as adjunctive therapy as an aid for treating debilitated horses when an improvement in weight, hair coat, or general physical condition is desired. In the presence of adequate protein and calories, anabolic steroids promote body tissue building processes and can reverse catabolism ***(Nielen, et al. 2006)***. Anabolic steroids can cause nitrogen, sodium, potassium and phosphorus retention and decrease the urinary excretion of calcium ***(Bates, et al. 1987)***. It has been recorded that they have the potential to cause hepatic toxicity ***(Tincello, et al. 1997)***. The dose and effect of boldenone in animals other than horses are unknown. Therefore the aim of this work was to give spot light on the effect of different doses of boldenone undecylenate on body weight, tumor markers, electrolytes, erythrogram, hepatic and kidney functions in goats.

Material and methods

Animals:

Twenty one male, baladi goats (12-14 months age) were used in this study. The animals were divided into 3 groups (7 animals per group). Group (A) was the control, group (B) was injected with boldenone undecylenate 0.5 mg/kg body weight. Group (C) was injected with boldenone undecylenate 1 mg/ kg body weight.

Drug:

Boldenone undecylenate is an injectable anabolic steroid derived from testosterone. Its chemical name is 17 beta-hydroxyandrosta-1,4-dien-3-one; available in a sesame oil vehicle. The drug was obtained from EM Egypt Pharmaceutical Company as 50 mg/ml in 50 ml vials. Boldenone was administered by intramuscular injection to goats 3 times with 2 weeks in between injections.

Blood tests:

Blood samples were collected 2 weeks after the last injection of boldenone on EDTA. The red blood cell count, Hb concentration, and PCV percentage were performed according to ***Duncan, et al. (1994)***. Serum samples were also prepared for performing blood chemistry tests. Kits were obtained from Diamond and Quimica Clinica Aplicada S.A. Companies. Sodium was measured according to ***Trinder (1951)***, potassium was estimated according to ***Henry (1974)***, total protein was performed according to ***Weichselbaum (1946),*** and cholesterol was measured according to ***Richmond (1973)***. Blood Urea Nitrogen was performed according to ***Patton and Crouch (1977).*** Creatinine was measured according to ***Henry (1974)***. AST and ALT activities were measured according to ***Reitman and Frankel (1957)***, GGT was estimated according to ***Merikallio, et al. (2004)***, Alpha-fetoprotein (Afp) was performed according to ***Strickland, et al. (1992***) using BN-prospec (BN-Nephelometer 100), Dade Behring , Germany, for trace plasma proteins.

Statistical analysis

Data are expressed as the mean ± SE. Differences between means were analyzed by students't test. A *P* value of less than 0.05 and 0.01 were considered significant according to ***Snedecor and Cochran (1994).***

Results

1- Effect of boldenone on body weight and erythrogram

The effects of boldenone on body weight and erythrogram are shown in (Table 1 & figure 1). There was a significant increase in body weight in both treated groups compared to control one ($p<0.01$). Erythrogram showed significant increase in red blood cell count, packed cell volume ($p<0.05$) and Hb content ($p<0.01$) in both treated groups. No statistical differences were noticed between the changes recorded in both treated groups.

2- Effect of boldenone on parameters of liver function

No significant differences were observed between AST, ALT and GGT activities in group B injected with 0.5 mg/kg boldenone compared to that of the control group (table 2). In 1 mg/kg treated group, there was a significant increase ($p<0.01$) in AST and ALT activities. The tumor marker Afp showed no statistically significant differences between values of treated groups and the control one as shown in table (2).

3- Effect of boldenone on electrolytes, parameters of kidney function and cholesterol level

There was no significant effect of boldenone on blood urea nitrogen, creatinine, total protein, sodium, and potassium levels in both treated groups compared to the control as shown in table (2). On the contrary, cholesterol level showed significant increase ($p<0.01$) in treated groups.

Table. 1. Effect of boldenone undecylenate treatment on body weight, red blood cell count, PCV% and Hb content in control and treated groups

	Body weight	**RBC**	**PCV**	**Hb**
Group A (Control)	41.87 ± 1.20	8.10 ± 0.19	35.25 ± 0.36	11.4 ± 0.13
Group B (0.5 mg)	54.75 ± 3.15**	9.41 ± 0.42*	37.87 ± 0.83*	12.78 ± 0.30 **
Group C (1 mg)	57.00 ± 3.62**	9.26 ± 0.46*	38.5 ± 0.86*	13.06 ± 0.29**

Values are the mean ± S.E., n = 7. *P<0.05 **P<0.01 vs. control group.

Table. 2. Effect of boldenone undecylenate treatment on liver and kidney function tests, electrolytes, cholesterol and total protein values,

		Group A (Control)	Group B (0.5mg)	Group C (1mg)
AFP	*ng/ml*	< 0.60	< 0.60	< 0.60
ALT	*U/L*	40.75 ± 0.79	42.37 ± 1.08	60.62 ± 4.37**
AST	*U/L*	61.62 ± 0.84	64.75 ± 1.90	87.75 ± 5.04**
GGT	*U/L*	25.25 ± 0.77	26.25 ± 0.88	25.62 ± 0.88
Urea	*mg/dl*	21.75 ± 0.88	22.37 ± 1.33	23.87 ± 1.28
Creatinine	*mg/dl*	0.65 ± 0.04	0.77 ± 0.03	0.71 ± 0.04
Sodium	*mEq/L*	137.87 ± 1.95	139.12 ± 3.11	137.25 ± 2.14
Potassium	*mEq/L*	5.51 ± 0.16	5.60 ± 0.17	6.00 ± 0.22
Cholesterol	*mg/dl*	93.25 ± 1.90	115.50 ± 4.24**	115.25 ± 4.22**
Total protein	*g/dl*	6.41 ± 0.50	7.36 ± 0.25	7.41 ± 0.23

Values are the mean ± S.E., n = 7. **P<0.01 vs. control group

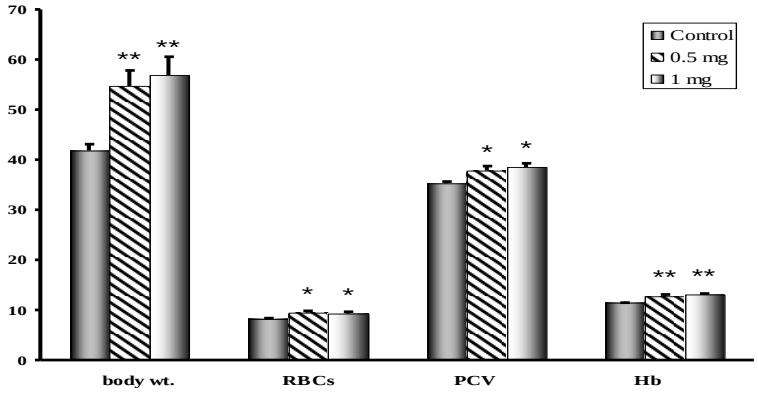

Fig. 1. Effect of boldenone undecylenate treatment on body weight, red blood cell count, PCV % and Hb content in control and treated groups.

Discussion

Anabolic steroids are an important class of performance enhancing drugs. Boldenone undecylenate is an anabolic steroid currently used in treating debilitated horses when an improvement in weight or general physical conditions is desired.

Anabolic steroids promote muscular hypertrophy by stimulation of ribosomal enzymes necessary for amino acid utilization for protein synthesis. They also cause retention of nitrogen, potassium, calcium, sulfur, chloride and phosphorus associated with a gain in weight. Water retention occurs associated with retention of salts and protein (***Sheffield-Moore. et al., 1999; Hart, et al., 2001).***

In the present study, body weight showed significant increase ($p< 0.01$) in both treated groups of goats (0.5, 1 mg/kg boldenone). Sodium, potassium and total protein levels showed no significant increase in both treated groups while cholesterol level showed significant increase ($p<0.01$). These results agree with ***Taggart et al. (1982)*** and ***Haffner et al. (1983)*** who found that administration of anabolic-androgenic steroids increase cholesterol levels. Significant increase was found in red blood cell count, packed cell volume and hemoglobin concentration in both treated group. These results agree with ***Berozoa (1981) and Sullivan, et al. (1998***) who recorded that anabolic steroids activate the undifferentiated bone marrow stem cells and stimulate production or release of erythropoietin from the kidneys.

No significant changes were found in the activities of liver enzymes Alanine aminotransferase (ALT), aspertate aminotransferase(AST), and gamma glutamyle transferase (GGT) in 0.5 mg/kg boldenone treated group; while the 1 mg/kg treated group showed significant increase in AST and ALT activities. These results agree with ***Tahmindjis (1976)*** and ***Shephard et al. (1977)*** who found an abnormal liver function in some cases treated with high dose of anabolic steroids. Abnormal liver function was determined by the retention of bromsulphalein which competes with bile salts for excretion. Also, there were elevated blood levels of serum enzymes alanine and aspartate aminotransferases, lactate dehydrogenase and alkaline phosphatase.

Tumor marker (alphafetoprotein) showed no significant changes in both treated groups. These results disagree with ***Cocks (1981)*** and ***Carrasco et al. (1985)*** who found hepatic tumors in individuals after long term treatment with anabolic steroids, diagnosed as hepatocellular carcinomas or unspecified hepatomas, angiosarcomas, and intrahepatic cholangio-carcinomas. No significant changes were found in the levels of blood urea nitrogen and creatinine in both treated groups of goats in the present study.

In summary, the anabolic steroid Boldenone undecylenate administrated in goats at 0.5 mg/kg for 3 successive times with 2 weeks intervals between treatments increased significantly the body weight and erythrogram parameters with no adverse effect on liver and kidney functions. Administration of 1 mg/kg causes increase in the activities of liver enzymes (ALT and AST). Therefore 0.5 mg/kg boldenone is suitable for improving the body weight and the physical conditions in goats.

References

Bates, P.C.; Chew, L.F; Millward, D.J. (1987): Effects of the anabolic steroid stanozol on growth and protein metabolism in the rat. *J Endocrinol **114**:373–381*

Berozoa, G.A. (1981): anabolic steroids in horse. *J.Am. Vet. Med. Assoc. 178:278-280*

Blanchard, T.L.; Elmore, R.G.; Youngquist, R.S.; Loch, W.E.; Hardin, D.K.; Bierschwal, C.J.; Ganjam,V.K.; Balke, J.M.; Ellersieck, M.R.; Dawson, L.J. and Miner, W.S. (1983): The effects of stanozolol and boldenone undecylenate on scrotal width, testes weight, and sperm production in pony stallions. *Theriogenology, **20** (1):121-131*

Carrasco D, Prieto M, Pallardo L, Moll JL, Cruz JM,(1985): Multiple hepatic adenomas after long-term therapy with testosterone enanthate. *Journal of Hepatology 1: 573-578, 1985*

Cocks, JR. (1981): Methyltestosterone-induced liver-cell tumors. *Medical Journal of Australia **2**: 617-618, 1981*

Duncan, J.R.; Prasse, K.W. and Mahaffey, E.D. (1994): Veterinary laboratory medicine (Clinical Pathology). *3rd ed. Iowa State University press.*

Haffner, S.M.; Hushwaha, R.S. and Foster, D.M.(1983): Studies on the metabolic mechanism of reduced high-density lipoproteins during anabolic-steroid therapy. *Metabolism **32**: 413.420,*

Hart, D.W.; Wolf, S.E., Ramzy, P.I., Chinkes, D.L.; Beauford, R.B.; Ferrando, A.A.; Wolfe, R.R., and Herndon. D.N. (2001): Anabolic effects of oxandrolone after severe burn. *Ann Surg **233**:556–564*

Henry, R.J**. (1974):** Clinical Chemistry, Principles and Techniques, *2nd Ed. Harper and Row, P. 525.*

Howe, G.R. and Morello, C.J. (1985): Effects of an anabolic steroid on reproduction in female rats. *Steroids, **45** (6):497-501*

McDonnell, S.M.; Garcia,M.C.; Blanchard, T.L. and Kenney, R.M. (1986): Evaluation of androgenized mares as an estrus detection aid**.** *Theriogenology, **26** (2): 261-266*

Merikallio. A.P.; Strid,N.; Suokas, A.; Podlketnova, I. and Alho, H. (2004): Comparison of new alcohol use test, the Helsinki Alcohol Use Test questionnaire, and Alcohol Use Disorders Identification Test and laboratory markers serum γ-glutamyl transferase and carbohydrate-deficient transferring. *Addictive Behaviors, **29 (**4): 717*

Nielen, M.W.; Lasaroms, J.J.; Mulder, P. P.; Hende J.; Rhijn, A.V. and Groot, M.J. (2006): Multi residue screening of intact testosterone esters and boldenone undecylenate in bovine hair using liquid chromatography electrospray tandem. *Journal of Chromatography B, **830** (1): 126-134*

Patton, C.J. and Crouch, S.R. (1977): enzymatic determination of Urea. *Anal. chem. 49:464-469.*

Reitman, S. and Frankel, S. (1957): Transaminases in serum. *Am. J. Clin. Path. **28**:56.*

Richmond, W. (1973): Preparation and properties of a cholesterol oxidase from Nocardia sp. and its application to the enzymatic assay of total cholesterol in serum. *Clin Chem. **19**(12):1350-1356.*

Sheffield-Moore, M.; Urban, R.J.; Wolf, S.E.; Jiang, J.; Catlin, D.H.; Herndon, D.N.; Wolfe, R.R., and Ferrando, A.A. (1999) Short-term oxandrolone administration stimulates net muscle protein synthesis in young men. *J Clin Endocrinol Metab **84**:2705–2711*

Shephard, R.J.; Killinger, D.; and Fried, T. (1977): Responses to sustained use of anabolic steroids. *British Journal of Sports Medicine* ***I I:****170-173*

Snedecor, G.W. and Cochran, W.C. (1994): Statistical methods. Iowa State University Press, Ames Iowa, USA.

Strickland, D.M.; Butzin, C.A. and Wians, F.H. (1992): Maternal serum α-fetoprotein screening: Further consideration of low-volume testing. *International Journal of Gynecology & Obstetrics,* ***37****(2):153*

Sullivan, M.L.; Martinez, C.M.; Gennis. P., and Gallagher. E.J. (1998): The cardiac toxicity of anabolic steroids. *Progr Cardiovasc Dis* ***41****:1–15*

Taggart, H.M.; Applebaum-Bowden, D., Hafker, S.; Warnick, G.R., and Cheung, M.C. (1982): Reduction in high density lipoproteins by anabolic steroid (stanozolol) therapy for postmenopausal osteoporosis. *Metabolism* ***31:*** *1147-1152*

Tahmindjis, A.J. (1976): The use of anabolic steroids by athletes to increase body weight and strength. *Medical Journal of Australia.* ***1****: 991-993,*

Tincello, D.G.; Saunders, P.T.; Hodgins, M.B; Simpson, N.B; Edwards, C.R. and Hargreave, T.B (1997): Correlation of clinical, endocrine and molecular abnormalities with *in vivo* responses to high-dose testosterone in patients with partial androgen insensitivity syndrome. *Clin Endocrinol* ***46****:497–506*

Trinder, P. (1951): A rapid method for the determination of sodium in serum *Analyst,* ***76****:596*

Weichselbaum, P.E. (1946): Colourimetric determination of total protein. *Am. J. Clin. Path. 16:40*