EFFECT OF WEIGHT TRAINING WITH AND WITHOUT USING 'POWER ENHANCING DRUGS' ON NORMAL MALE SUBJECTS: A STUDY ON HEMATOLOGICAL PARAMATERS

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Abstract

Exercising in a gym, largely aimed at getting a better-shaped body, is a long and tiring process. In order to boost athletic performance, many people opt for power enhancing drugs, like steroids, erythropoietin, creatine, protein and zinc supplements. Together with an increase in the muscle bulk, they exert highly undesirable effects on normal physiology as well. In the present study the effects of these drugs were evaluated on the changes observed in the counts of RBC and Reticulocytes, together with the percentages of Hb and Hct. Peripheral blood samples were collected and quantitatively analyzed. All the parameters were compared against a control group. The results showed that depending on the type of PED used, it exerted a profound effect on all hematological parameters and significant differences were found among these groups. The changes suggested that these drugs have predisposed the users to various cardiovascular disorders.

Introduction

A regular and strenuous training in a gym results in a better-shaped body. To get noteworthy physical changes in least possible time, youngsters opt for Power Enhancing Drugs (PED). These drugs aid both athletes and non-athletes to improve performance and appearance (Koch, 2002). PEDs include various synthetic compounds such as synthetic derivatives of testosterone, known as anabolic androgenic steroids (AAS) and are misused in supraphysiological doses by an increasing number of athletes and adolescents (Bahrke *et al*., 1998; Hartgens and Kuipers, 2004). It has been argued that motivation for AAS misuse includes improvement of physical appearance, muscular strength, and/or peer approval. The finding that muscle hypertrophy associated with exercise is blocked by androgen antagonists (Inoue *et al*., 1994) supports a primary role for androgen receptors in exercise-induced muscle hypertrophy. Androgen receptors are present in skeletal muscle of every mammalian species (Sar *et al*., 1990 and Takeda *et al.*, 1990). However the numbers of these receptors differ from muscle bed to muscle bed. Human muscle beds differ from each other, with expression higher in the muscles of the neck and chest girdle, in comparison to the limbs (Kadi *et al*., 2000). Recent studies in multiple species showed that androgen receptor can be up-regulated by exposure to AAS (Bricout *et al*., 1994; Doumit *et al*., 1996; Kadi *et al*., 2000). The increased size is due to more muscle fibers in a given set of muscles.Body weight reliably increases after AAS use and part of the increase is in lean body mass, although part also reflects retention of water (Friedl, 2000). Inspite of majority of these harmful effects being well known, people continue to use these probably because the effects of steroids can boost confidence and strength, motivating abusers to overlook the potential serious and long-term damage that these substances could cause. Creatine (Cr) is a naturally occurring compound derived from the amino acids glycine, arginine, and methionine (Williams *et al*., 1999). Almost all the Cr in the body is located in skeletal muscle in either the free (Cr: approximately 40%) or phosphorylated (PCr: approximately 60%) form and represents an average Cr pool of about 120-140 g for an average 70 kg person. Creatine does not increase strength; rather, it increases an athlete's ability to train (Koch, 2002).Until the safety of creatine would be established in adolescents, the use of this product is discouraged.

Erythropoietin (EPO) is a hematopoietic hormone, an ergogenic substance released from the kidney. The number of RBC in blood determines the efficacy of oxygen supply to the actively respiring cells, the hematocrit as blood viscosity. Average hematocrit for males is 46%.EPO is abused by the administration of Recombinant human erythropoietin (rHuEPO), its effects last several days after its last intake. Theoretically more RBC means more efficient oxygen delivery to tissues. Thus endurance athletes who put some extra strain in exercise use EPO. Protein supplements including arginine, histidine, lysine, methionine, ornithine, and phenylalanine may stimulate the release of growth hormone, insulin, and/or glucocorticoids, thereby promoting anabolic processes (Kreider *et al*, 1998). Intravenous arginine and ornithine infusion have been used clinically for stimulating growth hormone release (Carlson *et al*., 1989).Ingestion of protein with carbohydrate has been reported to increase insulin and/or growth hormone levels to a greater degree than ingestion of carbohydrate alone (Chandler *et al*., 1994; Zawadzki *et al*., 1992). Consequently, ingesting protein and carbohydrate prior to

exercise may serve as an anti-catabolic nutritional strategy (Carli *et al*., 1992). Zinc is involved in numerous aspects of cellular metabolism, playing a role in; immune function, protein synthesis, wound healing, DNA synthesis, cell division, normal growth and development during pregnancy, childhood, and adolescence, also required for proper sense of taste and smell. A daily intake of zinc is required to maintain a steady state because the body has no specialized zinc storage system (Dietary Supplements, 2009).

Objective: To evaluate and compare the changes in hematological parameters of normal individuals with the athletes not using PEDs and the athletes using PEDs.

Materials and Methods

The study was conducted on total 135 healthy male subjects belong to the age group of 19-31 years, bearing weight in the range of 61 to 138kg and height in the range of 5ft 6inches to 6ft 3inches. They were divided in following groups

i. Standard (Std): 30 subjects, as a control who did not exercise
ii. Athletes Exercising Without Using Peds (W/O): 28 subjects who have been doing regular exercise in a gym for more than three years, without using PEDs
iii. Athletes Who Are Peds Users: 75 subjects who have been doing regular exercise in a gym for last four to nine consecutive years and have been using PEDs for at least three years. These include:
S: steroid users (n=10)
SE :steroids + EPO users (n=6)
SC : steroids+creatine users (n=?)
C : creatine users (n=7)
CZ : creatine+zinc users (n=13)
P: protein users (n=19)
PZ : protein+zinc users (n=12)
Blood was collected for analyzing RBC count, Hemoglobin (Hb) concentration, Hematocrit (Hct) and Reticulocytes count (RC) by using Coulter Counter. Statistical analysis of present data was done by Microsoft Excel, 2007.

Results

Table 1. Showing effect of ped on hematological parameters

UPS	RBC	Hb	Hct	RC
STD	5.497 ± 0.32	15.76±0.71	53.41±3.72*	0.73±0.34
W/O	4.95±0.28	14.84±0.56	50.12±2.87*	1.28±0.34*
S	5.95±0.32*	17.58±0.33	46.5±3.17*	1.59+0.31*
SE	6.66±0.21*	18.43±0.41	49.83±2.27*	2.21±0.20**
SC	6.05±0.31*	17.91±0.66	45±3*	1.47±0.57*
C	5.28±0.39	15.91±1	38.57±3.2*	1.46±0.3*
CZ	5.19±0.47	16.09±1.07	41.53±5.20*	1.3±0.33*
P	5.36±0.43	16.35±1.12	42.68±3.74*	0.4±0.28*
PZ	5.37±0.35	16.9±0.90*	41.83±3.48*	0.84±0.50*

± =SE, *=P-value<0.05, **p<0.005

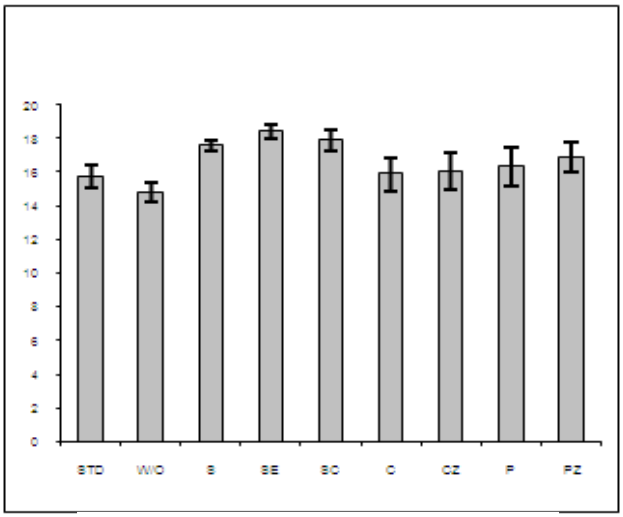

Fig. 1. Red Blood Cells Count (millions/cubic millimeters)

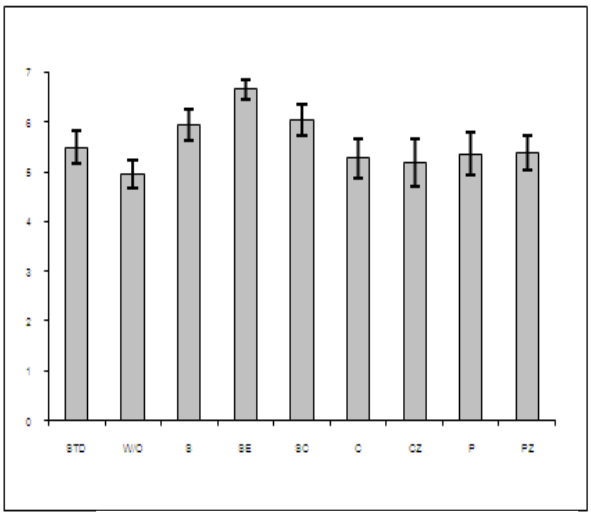

Fig. 2. Hemoglobin (gram/deciliter)

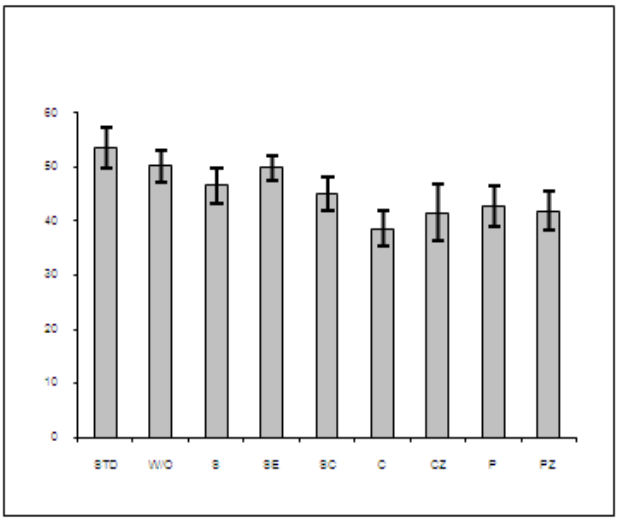

Fig. 3. Hematocrit (%)

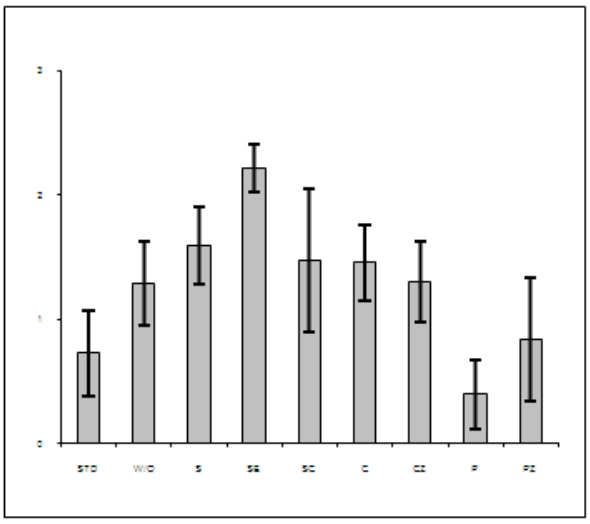

Fig. 4. Reticulocytes Count (%)

Results and Discussion

Intensive exercise is related to increased generation of reactive oxygen species (ROS), which results in oxidative stress (Oztasan *et al*., 2004). ROS mainly results from damaged mitochondria of the muscles, and it is also produced by red blood cells (Clemens and Waller, 1987; Turrens, 2003). In order to prevent oxidative stress, there is an elaborate antioxidant defence system consisting of enzymatic antioxidants, such as catalase, superoxide dismutase, glutathione peroxidase, glutathione reductase and numerous non-enzymatic antioxidants, including glutathione, vitamin C, E, Q, carotenoids, and uric acid (Tauler *et al*., 2003; Urso and Clarkson, 2003). Thus, it is important that the antioxidant defensee system in blood, especially in RBCs, is effective and recovers properly after exhaustive physical load. RBC count was lowered in group W/O ($p<0.05$), while it was seen significantly increased in groups S, SE and SC ($p<0.05$). However, no significant differnce was observed in groups C, CZ, P and PZ. The most common finding in athletes is a dilutional pseudoanaemia that is caused by a plasma volume expansion, rather than an actual blood loss (Shaskey and Green, 2000). The degree of dilutional anemia correlates with the intensity of exercise (Kimberly, 2004). This increases the blood volume, resulting in an increase in cardiac stroke, decreases the blood viscosity, which is an essential variable in microcirculation. It suggested that RBCs of endurance athletes are more prone to wear and tear and a minor fraction of maybe removed from circulation before the completion of the normal 120 day life-cycle. Iron deficiency can also be responsible for a decreased RBC count. Athletes who exercise strenuously on a daily basis can also lose iron through sweat and decreased absorption of iron in their intestines by taking aspirin or anti-inflammatory drugs to get rid of soreness as these drugs reduce the body's ability to absorb iron (NAAC,

2008). It is also reported that the damage of RBCs by ROS may become evident due to limited antioxidant defene systems mainly during the early post-exercise period (Marzatico *et al*., 1997). While there is little evidence to support a beneficial role of anabolic steroids in other types of exercise performance such as muscular or aerobic endurance, but it has been reported that anabolic steroids increase the number of red blood cells. With the anti-catabolic effect and an increase in RBCs count, endurance athletes may be able to train more frequently, for longer periods of time, and with greater intensity. This was also found to be the case with steroid users in the present study. Group SE showed greatest increase in RBC count, which can be accounted due to the stimulation of erythropoiesis upon intravenous administration of EPO. SC group also showed an increase in RBC count because of the use of AAS and creatine supplements in combination. The increased RBC content, however, increases blood viscosity, thereby, predisposing these people to a great variety of blood-related disorders (do you any reference here or it is your own line). The effects of zinc supplement on hematological parameters of mice at rest as well as mice exercising were reported, where after exercise, RBC, Hb, and Hct increased significantly in exercising mice as well as zinc supplemented mice, as compared with mice at rest with and without zinc supplement (Cordova and Nawaz, 1993). A study described the effects of exercise on Hb on nine young male soldiers and concluded that Hb level was lowered as compared to control group (Satoshi *et al*., 2005). While studying diurnal and exercise-related variability of haemoglobin and reticulocytes in athletes it was concluded that Hb was similar for all groups, however 2 hours after exercise Hb decreased over the day (Schumacher et. al., 2010). In the present study Hb level was found to be significantly lower in groups W/O and PZ ($p<0.05$). This is also because of dilution effect of increased serum content in blood. Hb level was found to be significantly increased in group S, SC and SE ($p<0.05$). This increased level can be attributed due to the use of AAS that induced EPO stimulation. Group SE showed greatest increase in Hb level because of the use of AAS together with EPO whereas in C, CZ and P the increment was insignificant. The effects of exercise mode on hematologic adaptations to endurance training in adult females was studied and concluded hemodilution that reflected by decreases ($p < 0.05$) in hematocrit (Hct), hemoglobin (Hb) and RC count. The present study being conducted on males also showed similar trends. Hct of group W/O, S, SC, SE, C, CZ, P, PZ were significantly lower than the standard group, ($p<0.05$). Of all, use of creatine in group C showed the most drastic lowering effect on Hct.

The role of measurement of reticulocytes and other parameters is growing in sports medicine. The reticulocyte count in protocols used for evaluating and screening the suspected abuse of hormones that stimulate the bone marrow is an example (Banfi *et al*., 2006). RC count was found to be significantly higher in all the groups as compared to standard ($p<0.05$), being highest in group SE because of the combined use of AAS and EPO. However, group P showed a decrease in RC as compared to standard group ($p<0.05$). The results suggest that regular exercise have increased the number of reticulocytes in blood, which is possibly a response to the constant stimulus of increased oxygen demand put on by actively growing muscles.

Conclusion

The results showed that although PED practice has increased the oxygen-carrying capability, depending on the type of PED used, it has exerted profound effects on all hematological parameters, making the blood more viscous. This suggests that these drugs have predisposed the users to various cardiovascular disorders. The results of W/O group suggested that exercise has not only improved the microcirculation by pseudo-dilution of plasma, it also has increased the oxygen carrying capability.

Hence, the use of PED should be discouraged at all fronts, which are making the youth physically strong at the cost of compromised physiology.

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