Original Article

Testosterone with Hb

Relationship of Testosterone with Hemoglobin in Healthy Fertile Males

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ABSTRACT

Objectives: To establish a probable relationship of serum total testosterone with hemoglobin under normal physiological conditions in Pakistani population.

Study Design: Cross sectional study.

Place and Duration of Study: This study was carried out at the Institute of Basic Medical Sciences, Department of Physiology, Dow University of Health Sciences, Karachi from September 2010 to September 2011.

Material and Methods: 200 apparently healthy, non-smoker and adult males of age group 30 – 50 years were selected by convenient sampling. Early morning samples of serum total testosterone and hemoglobin were obtained by venipuncture after detailed medical history and thorough physical examination. All the tests were done on the same day and results were calculated.

Results: The mean (± SD) total testosterone was 15.92 (± 6.32) nmol/L. The frequency of low serum total testosterone was 13.5%. The frequency of anemia was 4.0%. Hemoglobin and MCHC directly correlated with total testosterone ($p < 0.05$) while PCV, RBC count and MCH did not show significant correlation ($p > 0.05$).

Conclusions: Low testosterone is prevalent in Pakistani apparently healthy males in the age group 30-50 years. Significant direct relationship of testosterone with hemoglobin showed that physiological variations in testosterone can modulate hemoglobin status in middle age apparently healthy sedentary Pakistani men.

Key Words: Serum total testosterone, hemoglobin, middle age.

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INTRODUCTION

Testosterone is the main androgen secreted in males causing genital growth and development and is essential for reproducibility. In addition, testosterone not only affects body musculature[1] and bone mass[2] but also erythropoiesis.[3] Testosterone affects erythropoiesis by multiple mechanisms including both erythropoietin dependent[4] and independent mechanisms[5]. Anemia has been observed as the frequent feature of hypogonadism in men.[6,7] On the contrary, men receiving testosterone replacement therapy may experience polycythemia.[8,9,10] The relationship of testosterone with hemoglobin in middle age apparently healthy men is not well defined.

MATERIALS AND METHODS

200 males aged 30-50 years were selected for the study by purposive sampling. The study was carried out at Institute of Basic Medical Sciences (IBMS), Dow University of Health Sciences (DUHS) from 2010 to 2011. The following were excluded from the study:

Smokers; Variable levels of testosterone in smokers have been reported.[11,12,13]

Individuals indulged in regular heavy exercise; Higher physical activity has been associated with increased testosterone,[14] individuals suffering from diseases like asthma, TB, diabetes mellitus, hypertension, ischemic heart disease; testosterone level tends to decline with acute/chronic illness by 10 to 15%,[15] individuals with total leucocyte count more than 11×10^9 cells, with recent history of malaria and/or jaundice, acute or chronic blood loss and/or anemia on clinical examination. Individuals having reticulocyte count more than 2.5%,and/or serum creatinine level more than 1.5mg/dl.Individuals with history of testosterone supplementation; it leads to the suppression of endogenous testosterone, and/or with history of hypogonadism and signs and symptoms including decreased libido and erectile dysfunction with evidence of low testosterone from medical records.

A total of 245 individuals were interviewed from 2010 to 2011**.** Out of these 245 individuals, 26 were smokers, 17 had systemic disease (3 having diabetes with hypertension, 2 with ischemic heart disease, 8 with diabetes mellitus, 2 with bronchial asthma,1 with obstructive uropathy,1 with glomerulonephritis) and were excluded on the basis of history, clinical examination and laboratory investigations where available. In addition, 2 participants consented but did not come up for sampling. So they were also excluded from the study. This eventually led to the final sample size of 200.

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Informed written consent, approved by Institutional Review Board (IRB) of DUHS, was taken by the subjects willing to participate in the study. Detailed medical history with general and systemic examination was carried out and findings were recorded on prescribed proforma approved by IRB of DUHS.

Weight and height of participants were recorded on proforma and blood samples were collected from one of the peripheral veins of arm in the morning as testosterone shows diurnal variation and low levels in the evening. All tests were done in Dow Diagnostic Reference Research Laboratory (DDRRL) on the same day. The results were computed on SPSS version 16.0.

RESULTS

The mean age of the respondents was 38.72±6.56. The mean weight and height were recorded as 73.17±12.66 kg and 1.71±0.06 m respectively. Mean serum total testosterone, hemoglobin, red cell count, packed cell volume (PCV), mean corpuscular volume (MCV),mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCHC) of the sample is shown in table 1. 13.5% of participants had testosterone lower than normal. The comparison of mean values between two groups of testosterone showed significant differences for hemoglobin and MCV ($p < 0.05$), whereas insignificant difference in mean values for RBC count, PCV, MCH and MCHC (p value> 0.05).Pearson correlation showed that serum testosterone directly correlated with hemoglobin and MCHC. (p value < 0.05) as shown in table 2.

Table No.1: Mean values of Testosterone, Hemoglobin, RBC count, PCV, MCV, MCHand MCHC

Variable	Mean ± SD
Testosterone	15.92±6.32 nmol/L
Hemoglobin	14.95±1.25 g/dl
RBC count	$5.23\pm0.49 \times 10^{12}$ / L
PCV	44.56±3.62 %
MCV	83.86±5.25 fl
MCH	28.24±1.91pg
MCHC	33.02±1.35g/dl

Table No.2: Correlation between Testosterone and Hematological Variables

	Correlation Coefficient(r)	p value†
Hemoglobin	.162	0.022
RBC count	.043	0.544
PCV	.092	0.197
MCV	.046	0.515
MCH	.135	0.057
MCHC	.217	0.002

† Significant < 0.05

DISCUSSION

Testosterone levels have been investigated in many parts of the world including Pakistan with main stay of focus being infertility. Aging males experience decreased levels of testosterone after the age of 30 to 40 years[16] showing a longitudinal decline of about 1.6% per year.[15] In our study, the frequency of testosterone deficiency in Pakistani healthy, non-smoking males aged 30 to 50 years was found to be 13.5%. Harman, et al reported prevalence of serum total testosterone deficiency as 20% above 60 years.[17] In Indian healthy population aged 40 to 60 years, 24.2% frequency of low total testosterone has been reported.[18] The differences observed between the present study and other studies may be related to the differences in populations studied and/or criteria used to define the end point. Moreover, present study was conducted on Pakistani healthy males living in Pakistan, 20% higher levels were observed by Orwollet al in Asians who were living in Japan and Hong Kong as compared to Asians living in USA, suggesting some geographical impact on testosterone levels.[19] The mean total testosterone in this study was 15.92 nmol/L which was consistent with mean testosterone of 14.6 nmol/L reported by Heald et al for Pakistani men residing in England suggesting the role of ethnicity in testosterone.[20]

In the present study, it was observed that the mean hemoglobin level was 14.95 g/dl which was lower as compared to 15.91g/dl in the study by Tahir, et al[21] However, Usman, et al[22] observed mean hemoglobin as 13.04 g/dl which is low as compared to the present study. Beutler reported mean hemoglobin of 15.23g/dl from National Health and nutrition examination survey (NHANES III) and Scripps Kaiser database[23] which is in accordance with the present study.

The frequency of anemia in the present study was 3.0%. Yeap, et al reported 3.7% prevalence of anemia in males 30-94 years old.[24] Tahiret al reported 1.5% frequency of anemia in male students of Peshawar University.[21]

In present study, mean RBC count was 5.2×10^{12} /L, mean PCV was 44.5%, MCV was 83.86 fl, MCH was 28.24pg and MCHC was 33.02 g/dl which all were higher than Usmanet al, who reported mean RBC count (5.3×10^{12} /L), PCV (39%), MCV (76.30 fl), MCH (25.54 pg) and MCHC (32.27 g/dl).[22]Tahiret al reported higher PCV (46.49 %), RBC count (5.41×10^{12} /L) and MCV (84.09 fl) while lower MCH (27.74 pg) and MCHC (32.12g/dl) than present study.[21]

It has been well established that the anemia due to testosterone deficiency is mild and normocytic normochromic.[25] Willoughby and colleagues found no statistical difference in MCV, MCH, MCHC, PCV, RBC count and hemoglobin in young eugonadal men with 400% average increase in total testosterone after 8 weeks of aromatase inhibitor therapy.[26] Contrary to

this, it was observed in the present study that MCHC directly correlated with testosterone (p value < 0.05). Covielloet al[5]found insignificant relationship of testosterone with soluble transferrin receptors which are regarded as an indicator of bone marrow iron stores and bone marrow activity. Testosterone is one of the determinants of hemoglobin, and its deficiency alone, may not be able to create clinically significant anemia. None of the participants of present study had anemia on clinical examination and all had normocytic normochromic peripheral film.

In present study, no statistical significant difference was observed between two testosterone groups and PCV or RBC count. In contrast, Rochiraet al[27] and Covielloet al[5] observed significant rise in PCV and red cell count with exogenous testosterone treatment. This may be the effect of supraphysiological dose of testosterone administered as compared to normal physiological variation of testosterone producing different dose related effect on RBC count and PCV.

In this study, significant direct relationship of age adjusted total testosterone was found with hemoglobin in males aged 30-50 years. This finding is consistent with Ferruciet al[28] who also found significant age adjusted correlation of testosterone with hemoglobin in males and females aged more than 65 years but insignificant correlation with males alone. Yeapet al also found significant correlation of both total and bioavailable testosterone in males spanning middle to old age.[24]

The strengths of the study were; the study provided estimates of testosterone levels in middle age sedentary non-smoker men and its physiological relationship with hemoglobin in Pakistani population. This study was done on apparently healthy population so that confounding factors like acute and chronic diseases were minimized both for the estimation of testosterone and hemoglobin. Sampling of blood was not associated with storage of samples for any length of time (tests were done within 4 hours of sampling) as storage of serum total testosterone may lead to the degradation of SHBG thus giving high levels of testosterone.[17]

The limitations of the study were; sampling was convenient and was done in one point of time and Sex Hormone Binding Globulin (SHBG) could not be measured.

It is recommended that males with mild anemia should be looked for testosterone level when no other cause is found.

CONCLUSION

Low testosterone is prevalent in Pakistani apparently healthy males in the age group 30-50 years. Significant direct relationship of testosterone with hemoglobin showed that physiological variations in testosterone can modulate hemoglobin status in middle age apparently healthy sedentary Pakistani men.

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