Introduction

The Endocrine Society defines a clinical syndrome that results from failure of the testis to produce physiological levels of testosterone (androgen deficiency) as male hypogonadism (1). Besides the total serum testosterone levels below a physiological range (total testosterone levels < 6.9 nmol/l), symptoms include decline in lean mass, muscle strength, increased adiposity, decreased libido and erectile dysfunction, depressed mood, decreased energy or vitality, increased fatigue, and osteoporotic fractures. The symptoms mentioned above may affect males already in their late thirties. Some studies of hypogonadal men showed that low testosterone level is also highly related to insulin resistance, visceral obesity and metabolic syndrome (2). Normalization of testosterone level should be the primary treatment in men, along with caloric restriction and physical exercise. Muscle strength determines mobility and physical functioning and thus, also does affect the quality of life. Some studies suggest that aged men could benefit from testosterone replacement regarding muscle mass preservation. The direct correlation of the therapy, however, and its direct impact on strength and functional status is unproven. Testosterone treatment may provide modest improvements in lean mass among both frail and non-frail older men, but current evidence on the testosterone effect on muscle strength is conflicting and the effect on physical function is weak (3). However, other authors (4) found, that in older men, low circulating testosterone is correlated with low muscle strength, with high adiposity, with insulin resistance and with poor cognitive performance. Data from Massachusetts Male Aging Study (MMAS) found that testosterone concentration up to a critical level were positively correlated with muscle strength.

Chronic lower levels of testosterone dramatically increase the risk of many other diseases as cardiovascular disease, sexual dysfunction, aortic atherosclerosis, Alzheimer's disease and others (5). The relationship between total testosterone levels (TT) and high density lipoproteins (HDL) is confounded by the fact that both HDL and TT are inversely related to body mass index (BMI). In fact, epidemiological analyses have found that HDL levels are positively linked to testosterone levels in middle-aged men. Data from the Massachusetts Male Aging Study (MMAS) have demonstrated that there is a strong, positive relationship between HDL and testosterone in men with cardiovascular disease (low total or free testosterone correlates with low HDL-cholesterol) (6).

On a metabolic level, in obese men, hypogonadism can further worsen the metabolic profile and increase abdominal fat (7). Chronic effects of testosterone deficiency have effects on leg adipose tissue acyl-CoA synthetase activity which may relate to greater lower body fatty acid storage (8). These morphological features are linked to metabolic dysfunction, and testosterone deficiency is associated with energy imbalance, impaired glucose control, reduced insulin sensitivity and dyslipidaemia (9). Data suggest that abdominal circumference alone could be used as an anthropometric parameter to help simplify the identification of men with low serum total testosterone levels. The main goal of the study based on previous studies was to examine the relationship between the values of selected parameters of physical function, body composition, body mass index (BMI) and biochemical markers of metabolic health with the total testosterone (TT) levels in adult males. We aimed to analyse the correlation between these values and variations in the TT levels.

Methods

Subjects

Subjects were recruited from urological units at the Department of Urology, University Hospital-Petrzalka, Bratislava, Slovakia and the Department of Urology, Faculty of Medicine, Comenius University, Bratislava, Slovakia. The inclusion criteria for participation in the study of the patient population included age 40–60 years old, diagnosed with hypogonadism on testosterone replacement therapy or newly diagnosed patients. There was also a group of healthy aged matched males serving as a control group. For a purpose of this manuscript, all the groups were merged together and are presented as a one group in order of higher number of subjects for correlation analyses, which are the main focus of the present study. The exclusion criteria included regular strength training, conditions which are medical contraindications prostate cancer or abnormal serum PSA levels without adverse histological examination. In addition to written information, eligible subjects are verbally informed about the study by their responsible urologist and the study officials before start of the tests.

Seventeen adult males (50.19 ± 8.07 years old, 92.4 ± 12.83 kg) participated in the study. Complete demographic and hormonal data of the group are presented (tab. 1).

The study was approved by Ethics Committee of the Derer's Memorial Hospital in Bratislava, Slovakia and all subjects provided and signed written informed consent.

Design

To secure validity of the physical tests, all subjects underwent a familiarization session 5–7 days prior to the actual assessments. During the time between familiarization and actual testing, morning blood samples were collected and body composition measurements took place also in the morning hours.

Body composition

Body composition was measured by Dual-energy X-ray Absorptiometry (DXA) using Hologic fan-beam bone densitometer Discovery QDR series. Lean mass (LM), fat mass (FM) and total body mass (BM) were measured and are presented. The height was measured in meters by stadiometer and abdominal circumference in centimetres (cm) by stretch-resistant tape that provides a constant 100 g tension. The landmark of the average point between the 10th rib and the iliac crest at the axillary line. The body mass index (BMI) was afterwards calculated from the DXA scan data.