Low serum testosterone levels in male hemodialysis patients associate with reduced physical activity and impaired body composition

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Introduction

Chronic kidney disease (CKD) associates with alterations in body homeostasis and metabolic derangements including hormone secretion disorders. In male CKD patients, hypogonadism represented by testosterone deficiency is common and associates with various complications including increased mortality.

Objective

We wanted to evaluate the relation between circulating testosterone levels and body composition and physical activity in male hemodialysis (HD) patients.

Methods

Cross-sectional study including 57 male prevalent HD patients. Baseline testosterone and nutritional biochemical parameters were measured. Body composition was assessed by bioelectrical impedance analysis. Physical activity (PA) was assessed by the use of pedometers, and the number of steps per day was recorded. Patients with testosterone below the normal range established in our laboratory (reference value 241-827 ng/dl) were classified as being hypogonadal.

Conclusions

There is a high prevalence of hypogonadism in the male hemodialysis population and it is associated with impaired body composition characterized by a lower percentage of lean body mass and a higher percentage of fat body mass.

Additionally, for the first time we show that lower testosterone levels are associated with reduced levels of physical activity in male hemodialysis patients; this relation is probably through the connection between testosterone and muscle mass.

Results

The mean testosterone level was 321 ± 146 ng/dl. Twenty patients (35%) had a testosterone concentration below the normal range established in our laboratory and were classified in the group of hypogonadism. The general characteristics of all patients, and for patients placed according to testosterone levels in two groups, are summarized in **Table 1**.

Table 1. General characteristics of 57 prevalent male HD patients and stratified according to the presence of hypogonadism. (Median and range of 10th to 90th percentile)

Variable	All patients n=57	Hypogonadism Testosterone <241 ng/dL n=20	Normal Testosterone >241 ng/dL n=37	p-value
Age, years	65 (49 to 80)	72 (52 to 84)	63 (48 to 78)	0.03
BMI, kg/m^2	25 (20 to 29)	25 (21 to 30)	24 (19 to 29)	0.2
MAP, mmHg	91 (76 to 109)	87 (73 to 99)	96 (78 to 113)	0.02
Diabetes, n (%)	22 (39%)	8 (40%)	14 (38%)	0.9
CVD, n (%)	36 (63%)	15 (75%)	21 (57%)	0.2
Vintage, months	30 (7 to 183)	29 (7 to 152)	30 (4 to 199)	0.7
Creatinine, mg/dL	8.0 (5.2 to 11.5)	7.9 (5.2 to 9.8)	8.1 (5.2 to 12.2)	0.4
Albumin, g/dL	4.0 (3.6 to 4.3)	3.9 (3.3 to 4.3)	4.0 (3.7 to 4.3)	0.3
Hemoglobin, g/dL	12.4 (11.2 to 13.9)	12.2 (11.2 to 13.9)	12.4 (11.2 to 13.9)	0.4
ESA dose, *	7.1 (0 to 17.3)	10.6 (4.3 to 36.6)	4.0 (0 to 15.5)	<0.01
IL-6, pg/mL	3.6 (1.5 to 13.3)	4.7 (1.5 to 27.9)	3.3 (1.2 to 10.9)	0.05
TBW (L)	32 (28 to 44)	33 (26 to 47)	32 (28 to 44)	0.9
ECW/ICW	0.93 (0.82 to 1.15)	0.95 (0.83 to 1.18)	0.92 (0.77 to 1.07)	0.07
LBM (%)	48 (35 to 61)	45 (31 to 54)	48 (39 to 65)	0.04
FBM (%)	37 (27 to 46)	39 (31 to 48)	36 (25 to 43)	0.04
BCM (kg)	17.1 (10.7 to 27.2)	16.2 (9.5 to 27.9)	17.6 (11.2 to 27.4)	0.3

* ESA (erythropoiesis-stimulating agent) normalized by kg of body weight and Hb level(UI/kg/mg/dL/week). BMI: body mass index, MAP: mean arterial pressure, CVD: Cardiovascular disease, TBW: total body water, ECW: extracellular water, ICW: Intracellular water, LBM lean body mass, FBM: fat body mass, BCM: body cell mass

In uni- and multivariate analysis, testosterone positively correlated with the percentage of lean body mass. **Table 2**. Additional adjustment for dialysis vintage and OH did not alter the results (data are not shown).
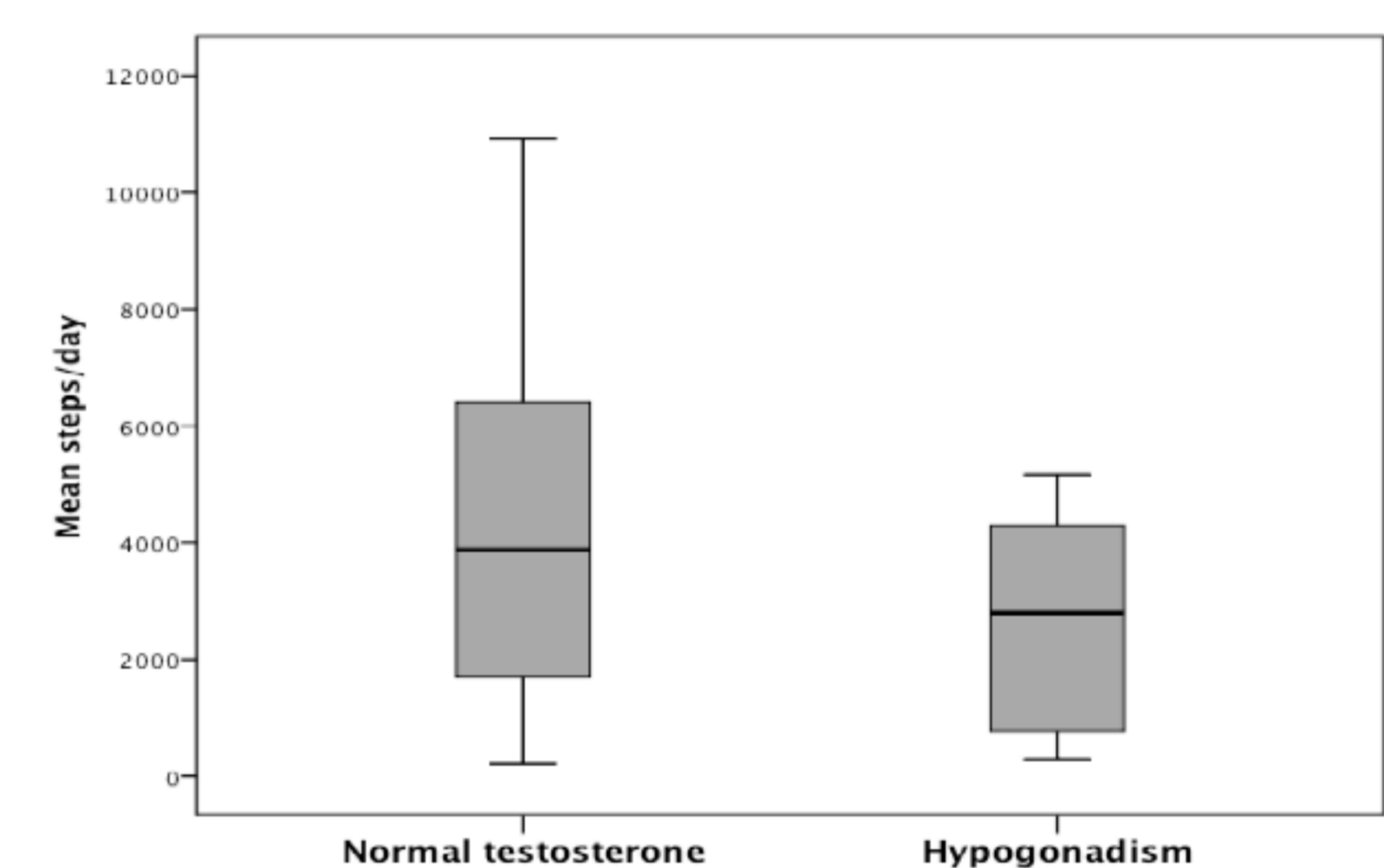
The average PA registered in the group with normal testosterone levels was 4291 ± 3225 steps/day compared to an average of 2753 ± 1784 (p=0.039) in the group of patients with hypogonadism. **Figure 1**

Figure 1. Physical activity (determined by number of steps per day) according to testosterone levels. Box plot showing median and 10th-90th percentiles. Difference was statistically significant (p=0.039).

In multivariate regression models considering confounders, testosterone levels remained positively associated to physical activity (**Table 2. Physical activity adjusted model 1**). However, when the percentage of lean body mass - presumed to be within the causal pathway - was included in the model, the association between testosterone and physical activity ceased to be statistically significant, reducing the regression coefficient of the association (β) by approximately 30% (from 0.33 to 0.22) (**Table 2. Physical activity adjusted model 2**). No changes in the model were found when we additionally adjusted for dialysis vintage or OH (data not shown).

Table 2. Linear regression model predicting for lean body mass (percentage) or physical activity (number of steps/day).

Variable	Lean Body Mass (%) Univariate Rho (P value)	Lean Body Mass (%) Multivariate analysis Adjusted Model 1 (R^2 0.26, p=0.02) B (SE)	Lean Body Mass (%) Multivariate analysis Adjusted Model 1 (R^2 0.26, p=0.02) P value	Physical Activity (Steps/day) Univariate Rho (P value)	Physical Activity (Steps/day) Multivariate analysis Adjusted Model 1 (R^2 0.48, p<0.001) B (SE)	Physical Activity (Steps/day) Multivariate analysis Adjusted Model 1 (R^2 0.48, p<0.001) P value	Physical Activity (Steps/day) Multivariate analysis Adjusted Model 2 (R^2 0.57, p<0.001) B (SE)	Physical Activity (Steps/day) Multivariate analysis Adjusted Model 2 (R^2 0.57, p<0.001) P value
Testosterone, ng/dl	0.29 (0.03)	0.33 (0.01)	0.03	0.26 (0.07)	0.33 (2.89)	0.03	0.22 (2.90)	0.1
Age, years	-0.33 (0.02)	-0.32 (0.14)	0.04	-0.44 (0.002)	-0.30 (34.2)	0.04	-0.19 (33.80)	0.2
CVD (presence)	-0.23 (0.09)	0.04 (3.24)	0.8	-0.49(<0.001)	-0.23 (796.14)	0.09	-0.26 (756.41)	0.04
Diabetes (presence)	0.01 (0.9)	-0.15 (3.04)	0.3	-0.22 (0.14)	-0.32 (784.62)	0.02	-0.27 (775.96)	0.04
IL-6, pg/mL	-0.38 (0.01)	0.13 (0.08)	0.4	-0.32 (0.03)	0.17 (18.72)	0.2	0.13 (17.94)	0.3
LBM, %	---	---	---	0.59 (<0.001)	---	---	0.34 (34.34)	0.01

Dashes indicate not included.
CVD: cardiovascular disease, LBM: lean body mass.

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