Testosterone Replacement and Resistance Training Improve Muscle and Physical Function in Men With COPD

T. Storer 1, L. Maglino 1, L. Cosentino 1, D. Walsh 1, S. Bhasin 1 and R. Casaburi 1
1El Camino College, Torrance, CA, 2Harbor-UCLA REI, Torrance, CA and 3Charles Drew University, Los Angeles, CA

Abstract

Skeletal muscle dysfunction contributes substantially to exercise intolerance seen in chronic obstructive pulmonary disease (COPD). In addition, testosterone (T) concentrations in men with COPD are often low, contributing to abnormal muscle size and strength. Purpose: To examine the singular and combined effects of a physiological replacement dose of T and resistance exercise training (RT) on muscle performance and physical function in men with COPD. METHODS: Fifty-two men with severe COPD (mean FEV1, % predicted <50) were randomized to receive no T and placebo (NRP), no T and RT (NRT), R and placebo (RP), or R and RT (RT). Results of five lower extremity exercises performed 3 d/wk for 10 wks. Training was progressive with loads ranging from 60-80% 1-RM performed in 3-4 sets of 8-12 repetitions. T was administered intramuscularly 100 mg/wk for 10 wks. RESULTS: Subjects receiving T doubled nadir T levels to values that were in the mid-range of normal for young men. Significant (P<0.001) improvements in leg press strength (by 1-RM) were noted for NRT, RP, and RT. The 17%, 16%, and 23% increases, respectively, were greater than the 2% change in NRP. The change in +X/T was also significantly greater than the change in -X/T. Leg press repetitions to failure (80% initial 1-RM) increased significantly (P<0.02) only in the +X/+T group (Figure 2). The 17%, 16%, and 23% increases, respectively, were greater than the 2% change in -X/T. The change in +X/X was also significantly greater than the change in -X/T. No significant improvements in leg press strength (by 1-RM) performed in 3-4 sets of 8-12 repetitions. T was administered intramuscularly 100 mg/wk for 10 wks.

Methods

STUDY DESIGN: Randomized, double-blind, placebo controlled. SUBJECTS: Fifty-two male volunteers aged 55-80 yr with moderate to severe, but stable Chronic Obstructive Pulmonary Disease (COPD) and low testosterone levels randomized to one of four groups (Figure 1). RESISTANCE EXERCISE TRAINING: Five lower extremity exercises (seated leg press, seated leg curl, seated leg extension, seated calf press, seated ankle dorsiflexion) performed 3 d/wk for 10 wks. Training was progressive with loads ranging from 60-80% of the one-repetition maximum (1-RM) performed in 3-4 sets of 8-12 repetitions. TESTOSTERONE REPLACEMENT: Testosterone enanthate administered intramuscularly 100 mg/wk for 10 wks. OUTCOME MEASURES: Changes in maximal voluntary strength assessed by 1-RM in the leg press exercise, peak leg power (watts) with the Bassey Leg Rig, leg press repetitions to failure using 80% of the baseline 1-RM leg press strength score, and time to failure (sec) by photodiode cells and timers to assess a standardized four-step stair climb. STATISTICAL ANALYSES: Analysis of variance (ANOVA) on change scores with Newman Keuls post hoc analyses for significant ANOVAs.

Introduction

Exercise intolerance invariably accompanies chronic pulmonary disease. Pulmonary rehabilitation, with resistance training considered as the most important component, has been found to improve exercise tolerance. However, exercise regimens have traditionally focused on the pulmonary system since patients are ventilatory limited. Accumulating evidence suggests that muscle dysfunction contributes significantly to the exercise intolerance seen in chronic pulmonary disease. Possible mechanisms explaining this muscle dysfunction include deconditioning resulting in muscle atrophy, a specific myopathy (especially corticosteroid-induced myopathy), malnutrition, chronic hypoxia, and low levels of anabolic hormones leading to muscle wasting. Consequently, attention has been directed to anabolic strategies that improve skeletal muscle function, reverse disuse atrophy, and improve exercise tolerance. The purpose of this study was to examine the singular and combined effects of a physiological replacement dose of testosterone and resistance exercise training on muscle performance and physical function in men with COPD and low levels of endogenous testosterone.

Results

Forty-seven of the 52 subjects randomized completed the study as depicted in Figure 1. Changes in nadir serum testosterone levels are presented in Table 1. No statistical differences were noted in body composition, muscle strength, and physical function among the experimental groups. The 17%, 16%, and 23% increases, respectively, were greater than the 2% change noted in the +X/T group (Figure 2). The 17%, 16%, and 23% increases, respectively, were greater than the 2% change noted in -X/T. The change in +X/X was also significantly greater than changes in -X/T (P<0.05). Leg press repetitions to failure (80% initial 1-RM) increased significantly (P<0.02) only in the +X/+T (15 to 23) and +X/X (13 to 24) groups (Figure 3). The 87% increase noted in the +X/X group was significantly greater than the 9% and 14% changes in -X/T and +X/T, respectively. There were no significant changes within or between groups for leg power. Stair climb performance improved significantly (P<0.01) only in +X/T (Figure 4). No changes from baseline within or between groups were noted for timed up-and-go or 10-meter walk performance.

Conclusion

Both testosterone supplementation and strength training, alone or in combination, significantly improve maximal voluntary muscle strength and fatigability, but not leg power in men with COPD. The combination of testosterone plus resistance exercise training was required to improve stair climb time.

Supported by University of California Tobacco Related Disease Research Project Grant 6LT-0362