Changes in knee extensor muscle size and neural activation during electromyostimulation training and detraining

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Introduction

Electromyostimulation (EMS) has been used as a modality of resistance training to enhance maximal voluntary strength (Maffiuletti et al. 2002, Gondin et al. 2005). We have recently demonstrated that neural adaptations mainly occurred during the first 4 weeks of EMS training, while changes in muscle mass became significant between the 4th and the 8th weeks of the training program (Gondin et al. 2005). However, data concerning the effects of EMS detraining period on neuromuscular function are scarce. The purpose of the study was to assess the effect of a short term period (i.e., 4 wk) of detraining subsequent to an 8-wk EMS training program on changes in neural and muscular properties of the knee extensor (KE) muscles.

Methods

Seventeen male were divided into 2 groups: the electrostimulated group (EG, n=9) and the control group (CG, n=8). The EG subjects were tested before (B), after 8 wk (WK8) of EMS training and after 4 wk of detraining (DE). The training program consisted of 18-min sessions of isometric EMS over a 8-wk period, with 4 sessions per week. 40 isometric contractions were delivered by a portable stimulator (Compex, Sport P, Ecublens, Switzerland) during each training session. Rectangular-wave pulsed currents (75 Hz) lasting 400 µs were delivered with a rise time of 1.5s, a steady tetanic stimulation time of 4s and a fall time of 0.75s. KE maximal voluntary isometric contraction (MVC) was recorded by using a dynamometer. Voluntary activation level (VAL) was estimated by the twitch interpolation technique. Quadriceps muscle anatomical cross-sectional area (ACSA) was assessed by ultrasonography.

Results

KE MVC increased significantly between B and WK8 (+26%, P<0.001), decreased significantly between WK8 and DE (-9%, P<0.01) but remained higher at DE than B (+14%, P<0.01) in the EG (Figure 1). VAL increased significantly in the EG between B and WK8 (+6%, P<0.05), decreased significantly between WK8 and DE (-5%, P<0.05) while no significant differences were found (P>0.05) between B and DE (Table 1). In the EG, quadriceps ACSA increased significantly between B and WK8 (+6%, P<0.001), decreased significantly between WK8 and DE (-3%, P<0.001) but was found higher at DE than B for the EG (+3%, P<0.01) (Figure 2). No significant changes in KE MVC, VAL and quadriceps ACSA occurred in the CG (Figures 1 & 2, Table1).

Discussion/Conclusion

The significant decrease in MVC observed after detraining was accompanied by a significant decrease in both neural drive and muscle size. Neural activation decreases could be ascribed to changes occurring at the supraspinal level (Maffiuletti et al. 2002). The decrease in muscle ACSA observed after detraining could be explained by changes at the muscular level (i.e., atrophy). The preservation of voluntary strength observed at the end of the detraining period could be ascribed to a larger quadriceps muscle size.

References