MECHANISMS OF EXHAUSTION DURING INTERMITTENT LEG EXTENSION EXERCISE

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INTRODUCTION

The most popular theory of fatigue during exercise, known as the "catastrophe" model, holds that exercise terminates when physiological limits of the body are exceeded, causing a catastrophic failure of homeostasis [1]. This model predicts that there must always be complete recruitment of all motor units in the active limbs at fatigue [2].

Recently, Noakes and colleagues [3,4,5] proposed a novel global approach of fatigue, called as the Central Governor Model (CGM), suggesting that central nervous system down-regulate the recruitment of motors units before catastrophic failure. Hence, the aim of this study was to observe the evolution of EMG during repeated leg extensions until exhaustion at a submaximal charge.

METHODS

Twelve trained subjects were asked to perform the more set of 15 ballistic movement of leg extensions at a charge of 50% of maximal isometric voluntary contraction (MVCiso) until exhaustion. During each recovery period (90s), subjects performed a 10s MVCiso test.

Force developed, electromyography and muscular perceived exertion (mRPE) were determined.

RESULTS AND DISCUSSION

Subjects performed 21.03±13.03 sets of 15 ballistic movements. Force developed decreased significantly between the first repetition (ISOfat1st) and the end of exercise (ISOfatend) (93.1±10.7 vs 67.2±8.66 %; $p<0.05$) (Figure 1). The loss of force was 27.58±13.87 %. Integrated EMG of Vast Lateralis (iEMGVL) and Vast Medialis (iEMGVM) remained stable between ISOfat1st and ISOfatend ($p>0.05$) and remained lower than maximal values.

mRPE increased significantly between ISOfat1st and ISOfatend (2.6±1.7 vs 9.9±0.3; $p<0.001$) (Figure 1).

Likewise, whereas iEMGVL and iEMGVM did not evolve significantly, force developed decreased significantly between the first and the last 5s of each ISOfat excepted for ISOfatend in wich it remained stable.

The decrease in force production could be explained by peripheral mechanisms of fatigue. Nevertheless, centrally controlled neural mechanism is proposed to explain the down-recruitment of motor units [6]. Moreover, central regulation is needed to explain why a reserve of force still existed. Hence, results highlight that not only physiological but also psychological responses have to be studied in a more global approach in order to understand the complex mechanism of fatigue as suggested by the CGM.

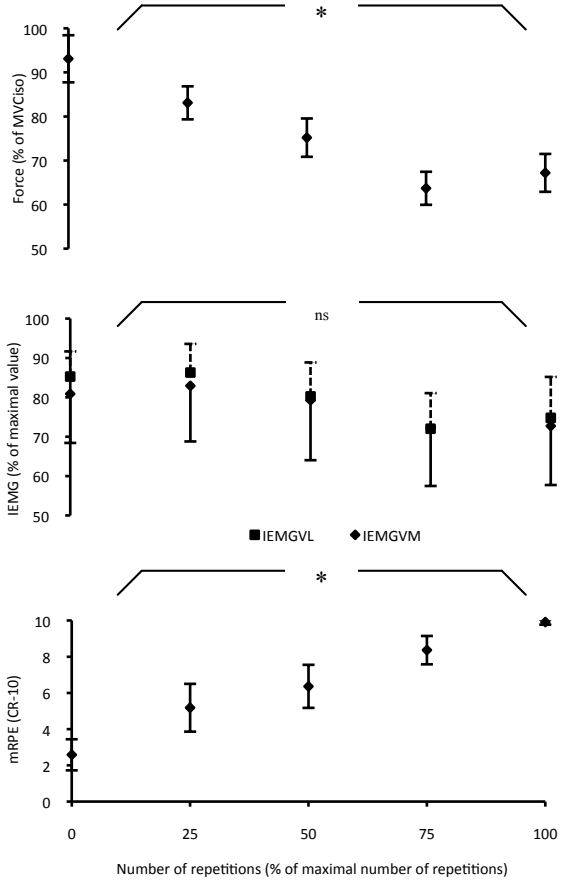

Figure 1: Evolution of force, iEMGVL, iEMGVM, and mRPE during the test of leg extensions until exhaustion.
*: significant evolution ($p<0.05$); ns: no significant evolution ($p>0.05$).

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