THE EFFECTS OF LONG-TERM "DRY" IMMERSION ON THE CONTRACTILE AND ELECTRICAL PROPERTIES OF THE HUMAN TRICEPS SURAE

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Various Earth-based models have been used in an effort to simulate unweighting of the neuromuscular system. "Dry" immersion (DI) has been used on occasion to simulate the unweighting effects of spaceflight on human (Shulzhenko et al. (1976) Kosm Biol Aviakosm Med **10**, 82). The results of such studied support the use of Earth-based models. It is known that inactivity results in deconditioning and physiological deconditioning induced by inactivity affects important system of the body including musculoskelatal. Skeletal muscle deconditioning is associated with adaptation to a microgravity environment. These physiological changes may result in altered muscle function and motor control (Koryak (1996) Eur J Appl Physiol **74**, 133, 496). The interesting finding that rhe reduction of the mechanical tension is not proportional to the reduction of muscle weight, fiber diameter, and concentration of contractile proteins (St.-Pierre et al. (1985) Exp Neurol **90**, 635), suggested that electrical activity might contribute to the reduction of the contraction force in disused muscle (Booth (1982) J Appl Physiol **52**, 1113). Up to now, owing to methodological difficulties, the free contractile properties of human skeletal muscles in a true weightless environment or during its simulation were beyond the field of vision of the scientists who in the main have concentrated on examining the mechanical features of the voluntary muscular contractions. This is the first study to make quantitative measurement of the functional properties of a single muscle in a man exposed to the long-term DI. The investigation was concerned with the parameters of mechanical responses of the triceps surae muscle, a postural antigravity muscle (Campbell et al. (1973) Am J Phys Med **52**, 30). The purpose of study were to analyze the effects of 7-day of DI on the mechanical and electrical changes of the triceps surae. The methods for measuring electrically evoked and voluntary forces have been described in detail elsewhere (Koryak (1995) Eur J Appl Physiol **70**, 344). Maximal voluntary contraction (MVC), maximal twitch (P_t), tetanic forces (P_o), time-to-peak tension (TPT), half-relaxation (1/2RT) were measured. The difference between P_o and MVC expressed as a percentage of P_o and referred to as force deficiency has also been calculated. The surface action potential (SAP) was recorded by bipolar surface electrodes applied over the belly of the soleus. After DI, the MVC was reduced by 34% ($p<0.01$), and the P_o was reduced by 8% ($p>0.05$). The force deficiency increased by a mean of 44.1% ($p<0.01$). The decrease in P_o was associated with increased maximal rates of tension development (7%) and of tension relaxation. The TPT was not significantly changed, and 1/2RT and TCT were decreased by 5% and 3%, respectively, but the P_t was not significantly changed and the P_t/P_o ratio was decreased by 9% after DI. The muscle SAP showed an increase in duration (19%) and decreases in amplitude and total area (15% and 3%; $p<0.05$-0.01, respectively). Comparison of the electrical and mechanical alterations recorded during voluntary contractions, and in contractions evoked by electrical stimulation of the motor nerve, suggests that DI not only modifies the peripheral processes associated with contraction, but also changes central and/or neural command of the contraction. At peripheral sites, it is proposed that the intracellular processes of contraction play a role in the contractile impairment recorded during DI.

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