EDUCATIONAL SUMMARY

1.The aim of research project

The motor unit (MU) is the smallest neuromuscular structure composed of a single motoneuron and a group of muscle fibers of the same type innervated exclusively by this neuron. Therefore, MUs are the smallest functional elements participating in movements. The research concerns changes in the force regulation in three basic physiological types of motor units (FF, FR and S). Recently, the applicants of project have observed that at a sudden change of the stimulation frequency, i.e. the decrease from the higher one to the lower one, the force temporarily decrease to a level lower than that expected for the lower stimulation frequency. This decrease in the ability to force production is a new phenomenon, which have never been an object of study. The research aims to describe this surprising phenomenon and will be conducted on animals. The detailed goals of this project are: 1/ to confirm the presence and to determine a range of the studied force decrease for three types of MUs; 2/ to analyze the relationship between the studied force decrease and the fusion degree of tetanic contraction for investigated MUs of three types; 3/ to analyze the relationship between the MU force and the amplitude of the force decrease following the change in the stimulation frequency; 4/ to study the influence of the muscle stretching force (optimal for the twitch force, lower and higher) on the rate as well as amplitude of decline in the force in three types of MUs; 5/ additionally, within the project the shortest train of the high-frequency burst able to evoke the phenomenon will be determined. The main hypothesis assumes that tested phenomenon occurs with various intensity in three types of MUs and depends on all tested factors, indicated above. It can also be expected that the results of analyses will indirectly suggest possible intracellular mechanism of the phenomenon studied.

2. The project research

The research will be conducted in electrophysiological experiments *„in vivo”* on medial gastrocnemius muscle of the rat, which is composed of three types of MUs (S, FR, FF). The MUs will be isolated by splitting of the ventral roots of the spinal nerves to the thinnest possible filaments. The filaments will be electrically stimulated with trains of pulses containing three phases: low-high-low frequency, suitable to evoke the unfused tetani contractions. The stimulation frequency will be matched to the MU type, higher for fast and lower for slow MUs. For fast units (FF and FR) the following frequencies will be used: low – 10-50 Hz (500 ms), high – 75 Hz (300 ms) whereas for slow MUs the frequencies will be: low – 10-25 Hz (1000 ms) high – 50 Hz (300 ms). The transitory force decrease in the third phase of the contraction (low frequency), following the high-frequency stimulation will be measured and compared to the force generated in first phase of protocol stimulation (the same low frequency, control). The phenomenon will be determined in three types of MUs, and analyzed as a function of the fusion degree of tetanic contractions and of variable force of MU contraction, will be studied at different patterns of stimulation and at variable degree of muscle passive stretching.

3. The research reasons

The primary reason of the study is the need to improve the knowledge concerning one of two basic mechanisms regulating the muscle force i.e. changes in discharge rates of motoneurons. Moreover, most probably the studied phenomenon influence the course of muscle relaxation during voluntary activity with dynamic changes in force, e.g. writing, playing instruments, in sports. The applicants expect that the results of research will enlarge a basic knowledge for kinesiology, muscle physiology and biomechanics. The research can contribute to develop or ameliorate techniques used in rehabilitation and sport training, as well as contribute to a progress in muscle electrostimulation, e.g. in paralyzed patients.