Methods for Estimating Synaptic Potentials in Human Muscular System

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Since it is not possible to record directly from human neurons, indirect methods have been developed to study the synaptic potentials. An indirect estimate of a synaptic potential can be obtained by recording the activity developed in muscles in response to stimulating a set of afferent fibres. Classically, these indirect methods use surface or intramuscular electromyography (EMG) to represent the responses of motoneurons to stimuli. The most common classical techniques are rectification and averaging of the EMG around the time of stimulation and compiling peristimulus time histograms (PSTH) from the single motor unit records. The limitations of these classical techniques in estimating synaptic potentials were recognized and reports have claimed that they contain significant errors in estimating the underlying potentials [1]. We have studied this problem in regularly discharging motoneurons in rat brain slice preparations [2]. In these studies, we have illustrated that the classical methods for estimating pathways in the central nervous system do in fact contain significant errors and that these errors are minimized when the same discharge information is used in a peristimulus frequencygram (PSF). This workshop aims to highlight the differences between the classical and the novel methods via a formal talk followed by a demonstration to illustrate the errors for estimating the synaptic potentials when classical methods are used for estimation. For demonstration, we will: Use a simple reflex circuitry; Apply electrical stimuli on index finger and record surface EMG and single motor unit potentials from the APB muscle of the thumb; Analyse the stimulus evoked reflex responses in surface EMG using rectification and averaging around the time of the stimulus; Analyse the same single motor unit discharges using the PSTH and PSF methods to indicate the differences between them. By the end of the workshop the participants will appreciate that there are many ways of estimating synaptic potentials in human neuromuscular system and also recognize the pros and cons of each of the analyses methods. Since profile of the synaptic potentials indicate the functional wiring diagram between the stimulated afferent system and the motor neuron pool, it is extremely important that it is estimated correctly since neurologists use this information to diagnose and treat their patients. [1] TÜRKER, K.S. and CHENG, H.B. (1994) Motor-unit firing frequency can be used for the estimation of synaptic potentials in human motoneurones. Journal of Neuroscience Methods, 53:225-234.[2] TÜRKER, K.S. and POWERS, R.K. (2005) Black box revisited: A technique for estimating postsynaptic potentials in neurones. Trends in Neuroscience, 28:379-386.