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MetroHealth Medical Center

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Abstract Submission Form

Poster Title: **Application of direct current to the rat sciatic nerve can augment the sensory signal generated by plantar stimulation.**

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Category: **Physical Medicine and Rehabilitation**

Direct current (DC) nerve block has many potential therapeutic applications; providing block of action potential conduction in a gradable and reversible manner. The Separated Interface Nerve Electrode (SINE) system allows DC to be applied safely for up to four hours continuously. This study investigates DC block of sensory fibers in the rat sciatic, a mixed sensory and motor nerve. Electromyographical (EMG) signals were recorded in the biceps femoris muscle, resulting from activation of the nociceptive flexion reflex (NFR) by electrical stimulation of the plantar surface of the foot. Activity related to activation of nociceptive C-fibers occurs with a latency of 150-600 ms. In humans, the amplitude of the NFR-related-EMG signal in the C-fiber window correlates strongly with perceived pain.
Block threshold (BT) is the current required to instantaneously arrest all sensory neural activity. At amplitudes lower than BT it is possible to instantaneously partially block nerve conduction, which is represented by a reduction in area under the EMG signal in the C-fiber response window. If a sub-BT amplitude is left for sufficient time the partial block can progress to become complete block. At DC amplitudes lower than those required to achieve instantaneous partial block, augmentation can occur. Augmentation is an increase of the EMG amplitude, either within or outside of the C-fiber time window. If augmentation-level DC is sustained for sufficient time then the complete nerve conduction block can still be achieved, wherein the augmented signal and the baseline EMG signal are both eliminated. Augmentation only can only occur when cathodic DC is applied to the sciatic. Ephaptic interactions may be the cause of the augmentation effect. This describes the propagation of action potentials between nerve fibers without the involvement of either chemical or electrical synapses. In the current study it is likely that a low level depolarizing DC field was able to facilitate ephaptic transmission between both myelinated and unmyelinated fibers, thus resulting in an increased EMG response. Under certain circumstances, the augmentation effect can increase the amplitude and duration of the sensory signal. We hypothesize that the low level cathodic DC field facilitates the de novo generation of action potentials in adjacent axons. In non-anesthetized subjects this could cause a more intense and/or longer duration pain sensation. Therefore, it would be prudent to minimize DC augmentation in future DC block clinical applications.