

Axonal hyperpolarization associated with acute hypokalemia: multiple excitability measurements as indicators of the membrane potential of human axons

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摘要

Abstract

Multiple nerve excitability measurements have been proposed for clinical testing of nerve function, and an important determinant of excitability is membrane potential. We report a patient with acquired hypokalemic paralysis in whom multiple excitability indices (stimulus-response curve, strength-duration properties, threshold electrotonus, recovery cycle) were measured during and after an acute hypokalemic attack (serum K⁺ level, 2.1 mEq/L and 4.5 mEq/L, respectively). During hypokalemia, there was a shift of the stimulus-response curve to the right, a decrease in strength-duration time constant, a fanning-out of responses during threshold electrotonus, a reduction in relative refractory period, and an increase in superexcitability; all of these indicate axonal hyperpolarization, presumably due to the K⁺ equilibrium potential being more negative. These indices returned to normal 20 h later, associated with normalization of the serum K⁺ level. These results demonstrate that the changes associated with hypokalemic paralysis are not confined to muscle and that axons undergo hyperpolarization in vivo. Multiple excitability measurements can be used as a tool to identify changes in membrane potential of human axons.