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Modification of the Hodgkin-Huxley wave behavior by electroporation

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The Hodgkin-Huxley equations [1] have long been used to assess membrane current and its impact on conduction and excitation in nerves for action potential initiation and propagation by modeling the ion channels as parallel combinations of voltage and voltage-dependent conductance that yield a set of nonlinear differential equations. Applying sufficiently intense electric pulses (EPs) create membrane pores that form an additional, parallel, cell membrane potential-dependent shunt conductance that can arrest the action potential [2]. While a self-consistent theory provides the most thorough means of relating the applied EP conditions, cell membrane potential, and resulting cell membrane pore formation [2], it is not readily amenable to assessing the EP induced changes in the wave behavior. This study provides an initial assessment of a simpler approach to specifically examine the EP-induced wave behavior by using a semi-empirical approach to assess EP-induced cell membrane conductivity due to pore formation [3]. We report the impact of various EP conditions on the wave and chaos behavior of the Hodgkin-Huxley equations and potential implications on therapy and nonlethal defense.

1. A. L. Hodgkin and A. F. Huxley, "A quantitative description of membrane current and its application to conduction and excitation in nerve,"J. Physiol. vol. 117, pp. 500-544, 1952.
2. R. P. Joshi, A. Mishra, Q. Hu, K. H. Schoenbach, and A. Pakhomov, "Self-consistent analyses for potential conduction block in nerves by an ultrashort high-intensity electric pulse,"Phys. Rev. E, vol. 75, 2017, Art. no. 061906.
3. B. Mercadal, P. T. Vernier, and A. Ivorra, "Dependence of electroporation detection threshold on call radius: an explanation to observations non compatible with Schwan's equation model,"J. Membr. Biol., vol. 249, pp. 663-676, 2016.

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