Asymmetrical orthodromic and antidromic passive conduction between soma and dendrites

AUTHOR BLOCK: *P. A. FORTIER¹, C. BRAY²;
¹Univ. Ottawa, Ottawa, ON, Canada; ²Univ. of Ottawa, Ottawa, ON, Canada

Abstract: A vast body of knowledge has been gathered on the structure and function of single neurons. This has led to a greater understanding of their role in behaviors generated by neural networks. Although the action potential is the common "language" of single neurons, they have important underlying differences which affect processing of electrical signals. These include differences in neurotransmitter receptors, ion channels and neuron morphology. Even if the reason for the complex neuron morphologies might be to accommodate the input source (neocortical dendrites must span the cortical thickness to receive inputs from layers I and VI) and input number (more surface area is required to accommodate more synaptic inputs), these complex morphologies nevertheless affect passive conduction of current between the axodendritic site and the soma. This electrotonic conduction is bidirectional allowing current to flow orthodromically from dendrite to soma and antidromically from soma to dendrite. It has been shown that there is an asymmetry in the voltage along these two directions of current flow. There is a much larger orthodromic than antidromic voltage attenuation. This has been attributed to the larger conductance load (sink) for dendritic inputs (reviewed in Rabinowitch et al. 2008). Our aim was to study the consequences of this asymmetrical voltage attenuation on neuron excitability. We used the NEURON simulation package (Moore et al. 2001) to reproduce the morphology of a thalamic interneuron (Briska et al. 2003) in order to measure the passive conduction of current along the dendritic tree and to map the attenuation of voltage. In mapping attenuation for brief stimuli delivered either to the dendritic tree or to the soma, we confirmed the asymmetrical attenuation of voltage. For example, a 3.6 pA stimulus delivered to a distal dendrite produced an 8.0 mV response locally and a 0.6 mV response at the soma which corresponds to an attenuation of 92.5%. The same stimulus applied to the soma produced a 1.5 mV response locally and a 0.6 mV response in the distal dendrite which corresponds to an attenuation of 60%. Note, however, that the final voltage was the same (0.6 mV) for both directions of current flow. This was consistently observed for all other dendritic morphologies tested. Since the work of Koch et al. (1995) shows that voltage-gated ion channels responsible for neuron excitability are activated by a voltage rather than a current threshold, then this asymmetrical attenuation of voltage would nevertheless be expected to yield symmetrical activation of target channels. We are currently adding voltage-gated channels in the soma and dendrites to verify this hypothesis.

Presentation Preference (Complete): &nbspPoster Only
Linking Group (Complete): None selected
Nanosymposium Information (Complete):
Theme and Topic (Complete): G.06. Computation, Modeling, and Simulation
Keyword (Complete): ACTION POTENTIAL ; DENDRITE ; ELECTROPHYSIOLOGY
Support (Complete):
  Support: Yes
  Grant/Other Support: : NSERC of Canada

Special Requests (Complete):
  Religious Conflict?: No Religious Conflict
  Additional Conflict?: No

Status: Finalized

OASIS Helpdesk

Powered by OASIS, The Online Abstract Submission and Invitation System SM
© 1996 - 2009 Coe-Truman Technologies, Inc. All rights reserved.