EDITORIAL

Ion channels in somatosensory transmission: an introduction to the collection [version 1; peer review: not peer reviewed]

Nikita Gamper
School of Biomedical Sciences, Faculty of Biological Sciences, University of Leeds, Leeds, UK

Abstract

Excitation of peripheral endings of sensory nerves is a primary event in most types of somatosensation, including pain. This excitation and transmission of action potentials within somatosensory pathways is brought about by the concerted action of the wide array of plasmalemmal ion channels, some of which are specific to somatosensory nerves. Accordingly, ion channel deficiencies or ‘channelopathies’ often underlie sensory disorders and pathological pain states and many current and prospective analgesics target ion channels. This F1000Research article collection is focused on the current advances in understanding function and regulation of ion channels controlling excitability and synaptic transmission within somatosensory pathways. The focus is on the peripheral neurons but studies of central mechanisms that integrate peripheral inputs are also welcome. We also welcome discussions of emerging approaches, methods and techniques in somatosensory physiology.

This article is included in the Ion channels in somatosensory transmission collection.

Corresponding author: Nikita Gamper (N.Gamper@leeds.ac.uk)
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Peripheral somatosensory neurons underlie a variety of somatic sensations, which can be torturing or pleasant. These neurons are different from most other neurons in the mammalian nervous system in several key features. Thus, these neurons have a very specific anatomy, being pseudo-unipolar neurons with a single giant neuritis that are split in a t-way and can reach several meters in length in some mammals. The action potentials in the somatosensory neurons normally originate not at the axon initial segment (as in most CNS neurons) but at the nerve endings within the peripheral tissues (skin, muscles, joints, blood vessels, internal organs etc.); therefore, the giant neurites (or fibres) of the somatosensory neurons serve both axonic and dendritic functions. Major segments of a somatosensory neuron (that is the cell body, axonal stem, peripheral and most of the central branches of the fibre) are located outside the blood-brain barrier and, thus, are exposed to circulation at least to some extent. Yet, the central branch of the fiber enters the CNS as it synapses in the dorsal horn of the spinal cord. Thus, the peripheral somatosensory neuron in fact belongs to both peripheral and central nervous systems simultaneously. There are other important distinctions of peripheral somatosensory neurons, for instance they accumulate high intracellular chloride levels so that, in contrast to the CNS neurons, activation of chloride channels in these neurons can result in excitation instead of inhibition (Liu et al., 2010). Finally, these neurons express a specific set of ion channels, some of which are more or less unique to this type of neurons (Raouf et al., 2010), such as a voltage gated Na+ channel Nav1.7 for example.

Recent decades have seen a tremendous advance in understanding function and regulation of ion channels controlling excitability and synaptic transmission within somatosensory pathways. The focus is on the peripheral neurons but studies of central mechanisms that integrate peripheral inputs are also welcome. We also welcome discussions of emerging approaches, methods and techniques in somatosensory physiology.

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References


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