THE CHINESE UNIVERSITY OF HONG KONG

SCHOOL OF LIFE SCIENCES

From Pattern Generator to Sound Receptor: Synaptic Development of Cochlear Hair Cells

by

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ALL ARE WELCOME

Cochlear inner hair cells (IHCs) transduce mechanical vibration of sound into neuronal signal. Interestingly, IHCs undergo dramatic switch of electrical activity during postnatal development. Here, we characterized the Ca^{2+} signaling in mouse IHCs before and after the onset of hearing. Fast confocal Ca^{2+} imaging revealed robust synaptic Ca^{2+} microdomains in response to action potentials of prehearing IHCs. Ca^{2+} microdomains of IHCs in hearing animals followed simulated receptor potentials up to 1kHz. Biophysical properties of whole-cell calcium current remain constant before and after the onset of hearing, arguing against a gross developmental switch in channel subtype. Ca^{2+} imaging and immunohistochemistry revealed that in immature IHCs more $Ca_V1.3$ Ca^{2+} channels were distributed among the more numerous ribbon-type active zones and the extrasynaptic plasma membrane. However, the average amplitude of synaptic Ca^{2+} microdomains in prehearing IHCs was not greater. We also observed a selective appearance of synapses with higher numbers of $Ca_V1.3$ after the onset of hearing. We propose that these synapses drive high spontaneous rate neurons, which are also first observed after the onset of hearing and are very sensitive to sound. In conclusion, IHCs adjust their Ca^{2+} signaling according to the requirements of presensory pattern generation and wide dynamic range sensory encoding.

Remark: Aaron Benson Wong is a MBT alumnus graduated in 2008 and pursuing his PhD degree in International Max Planck Research School for Neurosciences in Göttingen, Germany. He is now in his third year of doctoral studies at University of Göttingen, supported by Georg-Christoph-Lichtenberg Scholarship and Croucher Scholarship. Towards the end of this seminar he will share his experiences in Germany.