Bassoon, Piccolo and their role in orchestrating the active zone of neurotransmitter release

Eckart D. Gundelfinger
Leibniz Institute for Neurobiology, Magdeburg, Germany
(http://www.ifn-magdeburg.de)

Chemical synapses are asymmetric cell junctions that serve as key structures for neuronal communication and information processing in the brain. Communication is mediated via chemical messenger molecules – neurotransmitters –, which are released from the presynaptic neuron at restricted sites of the presynaptic cell membrane – the active zones. These release sites are positioned exactly opposite to the postsynaptic neurotransmitter reception apparatus. At active zones, transmitter-filled synaptic vesicles dock, fuse with the plasma membrane in response to depolarization-triggered calcium influx and then are rapidly retrieved and refilled. This cycle of membrane trafficking events is organized by a complex electron-dense meshwork of proteins assembled at the active zones, which we call the cytomatrix of the active zone or CAZ (for review see Dresbach et al., 2003; Schoch & Gundelfinger, 2006). Our laboratory is interested in how the CAZ is assembled during brain development, how it is organized at the molecular level and how it functions.

With Bassoon and Piccolo we have identified two related giant proteins that are exquisitely localized at neurotransmitter release sites of both excitatory and inhibitory synapses and are thought to serve as major scaffolding elements of the CAZ. During the talk I will report on comparative studies on conventional brain synapses and ribbon synapses in retinal photoreceptors and inner ear hair cells, which have provided novel insights into the molecular organization of neurotransmitter release sites.
Moreover,I will discuss how we have used Bassoon and Piccolo to monitor assembly mechanisms of the active zone during the major period of synaptogenesis. In contrast to our original assumptions, the CAZ and major elements of the active zone like voltage-gated calcium channels and cell adhesion molecules seem to be partly assembled inside the cell – at Golgi apparatus – and then transported as prefabricated elements to sites of synapse formation (Fertighausprinzip).

Literature:

Dresbach T, Altrock WD, Gundelfigner ED (2003) Neurotransmitterfreisetzung an chemischen Synapsen: Zusammenbau und molekulare Organisation der aktiven Zone. Neuro*forum* 3/03, pp. 79–86

Schoch S, Gundelfinger ED (2006) Molecular organization of the presynaptic active zone. Cell Tiss Res 326:379-391