Mini-Review

Neuronal Polarity

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The remarkable diversity of neuronal morphologies and synaptic connections in the CNS provide striking examples of cell polarity. Over the past decade, genetic studies in *Caenorhabditis elegans* identified a series of PAR (for partitioning-defective) proteins required to generate cell polarity and asymmetric cell divisions. The discovery of related proteins in *Drosophila* and vertebrates suggests an evolutionarily conserved mechanism for cell polarity divisions (Hutterer et al., 2004; Macara, 2004; Wiggin et al., 2005). In mammals, Par3, Par6, and aPKC/PKC ζ form a protein complex (mPar6 α) that binds the Rho GTPase Cdc42. Although the molecular mechanism by which conserved polarity proteins influence cell polarity in different species and/or different cell processes are not likely to be identical, they provide an exciting new experimental approach to neuronal polarity in the developing brain. This Mini-Review summarizes some of the work presented as a Symposium at the Annual Meeting of the Society for Neuroscience on recent progress in neuronal polarity related to CNS development.

Using the mouse cerebellar granule cell as a model system, Dr. Hatten will discuss live imaging experiments, which illustrate the key role of mPar6 α signaling in glial-guided neuronal migration (www.jneurosci.org/cgi/content/full/26/42/10624). Cultures of hippocampal neurons have long provided a key assay system for defining signaling cascades leading to axon and dendrite development. Studies by Dr. Kaibuchi and others have revealed the important role of the phosphatidylinositol 3-kinase (PI3-kinase)/

Akt/glycogen synthase kinase-3 β /collapsin response mediator protein-2 signaling for axon specification and elongation. Dr. Kaibuchi will discuss recent findings on the Rho family small GTPases and the mPar6 α signaling complex in the initial events of neuronal polarization (www.jneurosci.org/cgi/content/full/26/42/10626).

Dr. Jan and colleagues used genetic screens in *Drosophila* to identify mutations that perturb dendritic patterning (www.jneurosci.org/cgi/content/full/26/42/10631). The mutants have defects in the secretory pathway of dendrites, but not axons, suggesting a key role for the secretory pathways in the growth and differentiation of dendrites. The final article in this Mini-Review series, by Dr. Van Aelst, discusses polarity mechanisms in the establishment of functional connectivity (www.jneurosci.org/cgi/content/full/26/42/10633). Previous experiments by Dr. Van Aelst and colleagues showed that the Rho GTPases are key integrators of environmental cues, which regulate axo-dendritic plasticity in developing hippocampus. Van Aelst reviews mechanisms, by which Rac regulators remodel both the actin and microtubule cytoskeletons, in hippocampal axon development. Thus, the research presented in the symposium, on both invertebrate and vertebrate systems, reviews and integrates the rapid advances in this exciting interface between cell biology, genetics, and neuroscience, to provide novel insights into the development of neuronal polarity.

References

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