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Marshalin, a new microtubule minus-end binding protein, regulates cytoskeletal structure in the organ of corti

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Abstract

Development of the sense organ for hearing, the organ of Corti, requires dramatic structural changes in microtubules (MT) and the assembly of complicated intercellular connections. Marshalin, a minus-end binding protein, appears to be involved in establishing these patterns. By examining marshalin expression at different developmental stages, we discovered that marshalin is dominant in both sensory hair cells and supporting cells. In the adult, marshalin expression is observed in the cuticular plates of hair cells and in the non-centrosomal MT organization centers (MTOCs) of Deiters' and pillar cells. Based upon differences in marshalin expression patterns observed in the organ of Cori, we identified eight isoforms ranging from 863 to 1280 amino acids. mRNAs/proteins associated with marshalin's isoforms are detected at different cochlear developmental stages. These isoforms carry various protein-protein interacting domains including coiled-coil (CC), calponin homology (CH), proline-rich (PR), and MT-binding domains, referred to as CKK. We, therefore, examined membranous organelles and structural changes in the cytoskeleton induced by expressing two of these marshalin isoforms in in vitro cells. Long forms containing CC and PR domains induce thick, spindle-shaped bundles, whereas short isoforms lacking CC and PR induce more slender variants that develop into densely woven networks. Together, these data suggest that marshalin is important for establishing non-centrosomal MTOCs, and is involved in MT bundle formation in supporting cells. As a scaffolding protein with multiple isoforms, marshalin is capable of modifying cytoskeletal networks, and consequently organelle positioning, through their interactions with various protein partners present in different cells.

Biography

Dr. Zheng is an Associate Professor in the Department of Otolaryngology-Head and Neck Surgery, Feinberg School of Medicine of Northwestern University. She also holds joint appointments in the Interdepartmental Neurosciences Program and Department of Communication Sciences and Disorders. Dr. Zheng is a Fellow of the Hugh Knowles Center for Hearing Research. She received her Ph.D degree from Michigan State University, USA. She has published more than 40 papers in peer-reviewed research journals and serving as editorial board members for several journals.