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Exploring the role of the mitochondria/endoplasmic reticulum (ER) interface in axonal development

Yusuke Hirabayashi and Franck Polleux

Columbia University- Department of Neuroscience- Mortimer B. Zuckerman Mind Brain Behavior Institute- Kavli Institute for Brain Science, New York, NY 10032, yh2674@cumc.columbia.edu (Y.H.)

Axon arborization and assembly of presynaptic terminals are critical for the formation of functional neural circuits. Our group studies the role of the serine/threonine kinase LKB1 (also called STK11 or Par4) in axon morphogenesis (Barnes et al. Cell 2007) and we recently discovered that LKB1 and one of its 14 downstream kinase, NUAK1, controls axon branching by promoting mitochondria immobilization at nascent presynaptic sites (Courchet, Lewis et al. Cell 2013). Importantly, the LKB1-NUAK1 pathway immobilized mitochondria specifically at nascent presynaptic sites. These results suggest that presynaptic mitochondria capture plays an important role in axonal/presynaptic development. However, what anchors mitochondria at specific presynaptic sites is currently unknown.
The physical coupling of mitochondria with ER represents one of the best-characterized organelle interface at least in simple eukaryotic cells such as yeast. We are currently testing the potential role of mitochondria/ER coupling in the control of axon and presynaptic development. In the current study, we developed novel ways to visualize this organelle interface in developing neurons and we examined the dynamics of ER/mitochondria interaction in developing axons. Our results suggest that the mitochondria-ER interface might play a role in mitochondria localization presynaptically and thereby might play a role during axon morphogenesis.

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