Nanomechanics of membrane fission

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Abstract

Division of cellular membrane compartments, organelles and vesicles, is conducted by dedicated protein machineries. Despite substantial structural and functional diversity, all of these proteins are unified through their specific ability to produce generic lipid intermediates of membrane fission. We reconstructed creation of these highly transient and confined lipid structures *in vitro*, using highly curved membrane nanotemplates and purified Dynamin 1 (Dyn1), a large GTPase orchestrating membrane fission during endocytosis in neurons. We observed in real time how individual complexes of Dyn1 produced membrane curvature stresses at different stages of the GTPase cycle of Dyn1. We further used molecular engineering to arrest Dyn1 at different stages of the GTPase cycle and examine corresponding membrane structures. We were able to identify elementary steps of lipid rearrangements during fission and associate them with particular force fields generated by Dyn1. Based upon these analyses, a general two-step mechanism of membrane fission was proposed.