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Dynamic and elastic membrane remodeling by ESCRT-III

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Cells and organelles are delimited by lipid bilayers. Since these membranes are impermeable to most solutes, in order to exchange material with their environment, organelles and cells have developed a large protein family involved in budding membranes to form membrane carriers. These carriers transport material between organelles. Proteins involved in intracellular membrane traffic can remodel the membrane by several ways. Clathrin, for example, polymerizes into a spherical cage onto the membrane, forcing it to curve. Here we describe a recently discovered protein complex called ESCRT-III, which has the property of forming spirals at the surface of the lipid bilayer. This unique structural feature did not suggest any known mechanism by which it could deform the membrane. It was theoretically proposed that, while growing into a spiral, it accumulates stress energy which can be released by buckling of the central part of the spiral (1). By using high-speed AFM and biophysical tools to measure membrane elasticity we show how the elastic and polymerization properties of the ESCRT-III filament are compatible with such model (2). We further investigated the dynamics of the complex when the Vps4 - an ATPase that causes the ESCRT complexes to disassemble - is present. We found that Vps4 promotes a dynamic instability within the ESCRT polymers in a similar way than for actin or microtubules. We propose that this instability is necessary for assembly in presence of growth inhibiting subunits Vps2 and Vps24, and to allow constriction by relaxation of elastic stress within large ESCRT assemblies (3).

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