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Researchers decipher the mecanism of membrane fission

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A cell is composed of a nucleus which encloses its genetic information and the cytoplasm which is itself confined by an external membrane separating the cell from the outside world. The impermeability of the membrane and its ability to repair itself protect the cell from its environment. Although this membrane resistance is fundamental to the survival of the cell, the cell also needs to let in particles necessary for its proper functioning. The mechanism by which a small region of the cytoplasmic membrane invaginates to form a bud that will then be sectioned off to let molecules and other particles into the cell is known as endocytosis.

However, this natural process remains elusive due to the remarkable resistance of the cell membrane. Aurélien Roux, a professor of biochemistry and member of the National Centres of Competence in Research (NCCR) Chemical Biology, heads a team that focused on dynamin, a protein involved in endocytosis, to try to understand how an ultra-resistant membrane can nevertheless let external elements enter into the cell.

The power of dynamin

Scientists conducted in vitro experiments using artificial membrane tubules with a radius of 10 to 100 nanometres. They discovered that once dynamin is injected into the tube, it polymerises. In other words, it forms a helix around the tube and compresses it until it breaks. Dynamin produces the energy necessary for this constriction by "consuming" GTP molecules, much like a car consumes gasoline.

Based on these experiments, Professor Roux's team observed that the location of the fission is very specific and appears at the boundary between the helix and the membrane. "A change in radius that curves the membrane, caused by the polymerisation of dynamin, induces a stress that promotes the fracture," states Sandrine Morlot, researcher at the Department of Biochemistry. "This is new data allowing us to explain the process of fission."

The researchers were also able to measure the time it took to fission the membrane. Its duration depends on the mechanical properties of the membrane, which vary from one cell to another.

"We found that the ability of dynamin to break an ultra-resistant membrane is due to its torque, that is to say, its rotational force, which is vastly superior to that of other proteins," explains Professor Roux. "By decrypting the effect of dynamin on the membrane, we have come to understand the workings of membrane fission, a phenomenon which is certainly natural but remains extremely complex."

Provided by University of Geneva

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