Biologists prove critical step in membrane fusion

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Cells constantly swap cargo bound in vesicles, miniscule membrane-enclosed packages of proteins and other chemicals. Before the swap can take place, the vesicle membrane must fuse with another membrane, creating channels packages can pass through.

This process, known as membrane fusion, is fundamental to health and disease. It occurs at fertilization and is particularly critical to keep hormones circulating and brain cells firing. Membrane fusion is also how HIV and other viruses infect cells.

But membrane fusion occurs in less than a millisecond, making it difficult to see precisely how it unfolds. Now Brown University biologist Gary Wessel and his laboratory team have seen and recorded a critical step in the process in a live cell.

Researchers in the Wessel lab are experts in fertilization; they used sea urchin eggs to study membrane fusion. In urchin eggs, thousands of membrane-bound vesicles are attached to the plasma membrane. Within seconds after fertilization, the contents of these vesicles are rapidly released. Previous research has shown that special proteins kept these vesicles tethered to the egg's membrane. What about the membranes? What do they look like before vesicle cargo is released?

Wessel and his collaborators discovered that the membranes of the egg and the vesicles are hemifused – a state where the membranes are shared but the contents remain separate. Using fluorescent dyes and a high-

resolution microscope, the researchers show that hemifusion is surprisingly stable in live cells.

"The novelty of these results is that a live cell can maintain a hemifused state for hours, days, even months," said Julian Wong, a postdoctoral research associate in the Wessel lab and the first author of the journal article in Developmental Cell. "When using the right cell – the sea urchin egg – the phenomenon is observable."

"What we've found here with membrane fusion is that everything is set and ready for it to occur, to the point of sharing membranes," Wessel said. "So all that is needed is a puff of calcium from within the cell and fusion is complete. The process is quick because of hemifusion – the vesicles are right there and ready to go."

Wong and Wessel said that their findings might help scientists find new ways to deliver drugs to cells. If membrane-bound drugs can be induced to hemifuse with target cells – rather than fully fuse – there is the potential to control the timing of drug delivery.

Source: Brown University

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