Microtubule bridges organize the cytoskeletons of cells in the early embryo

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Scientists at A*STAR have discovered how cells in the nascent embryo organize the 'bones' that make up the skeleton, known as microtubules. While this discovery has resolved one mystery, it also raises a range of new questions.

"This was a chance discovery. It's not something we or others could have hypothesized based on previous work," says Nicolas Plachta of A*STAR's Institute of Molecular and Cell Biology, who led the study. A structure known as the centrosome serves as a microtubule-organizing center (MTOC) in most animal cells, including older embryos. Plachta's team was examining the microtubules during the first few cell divisions in mouse embryos, which lack centrosomes, when they noticed that neighboring cells were connected by microtubule bridges. Microtubule bridges usually form between dividing cells during mitosis, but they are normally broken down afterwards. "But these were retained, so that got us interested," says Plachta. "Is there something special about these bridges and these cells in the early embryo?"

To find out, Plachta's team disrupted the bridges with a laser pulse. This led to the breakdown of microtubules in the cells and a change in cell shape. Destroying the MTOC in other cells has similar consequences, suggesting to the team that the bridges may substitute for the MTOC in the early embryo.

Further observation revealed that the bridges grew outwards from the center of the cell during division and then back into the cells afterward.

A network of microtubules grew out of each bridge, and the bridge and network proved to be crucial for the transport of adhesive proteins to the cell membrane.

The team is also investigating why the bridges persist rather than breaking down as they do in other cells. "We think that the mechanisms that normally cut the bridges—the proteins and molecular machinery—are all there in the early embryo, but just aren't active. Something represses them in the early embryo," explains Plachta.

In addition to organizing microtubule growth and providing a scaffold for transport, these bridges may also mechanically connect embryonic cells to coordinate the dynamics of their growth and division during development. "We don't know much about that at the moment, but we're studying how it might work," says Plachta. "Each cell is connected to its sister through this shared skeleton. When a cell changes shape or gets squeezed, how does the microtubule skeleton change in that cell and in the sister cell connected to it?"

More information: J. Zenker et al. A microtubule-organizing center directing intracellular transport in the early mouse embryo, *Science* (2017). DOI: 10.1126/science.aam9335

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