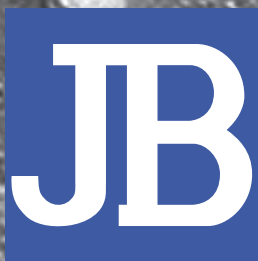


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COVER:

Discovery in Japan

Freeze-fracture electron micrograph showing a network of tight junction strands (courtesy of Dr. Hiroki Sasaki, Jikei University, Japan).

Dr. Shoichiro Tsukita (University of Kyoto; 1953–2005) and his colleagues identified tight junction membrane proteins, claudins (1, 2), in their junction preparation (3). Evidence has been accumulated that the claudin family consists of at least 24 members in mammals, as the four-transmembrane-domain proteins of ~23kDa (2), and that claudins are polymerized into tight junction strands in the presence of claudin-binding scaffold proteins, ZO-1/2, in epithelial cells (4). Thus, claudin-family members are required for the formation of the belt-like tight junction (zonula occludens) which has a paracellular barrier function with permselectivity in epithelial cells.

References

1. Furuse, M., Sasaki, H., Fujimoto, K., and Tsukita, Sh. (1998) A single gene product, claudin-1 or -2, reconstitutes tight junction strands and recruits occludin in fibroblasts. *J. Cell Biol.* **143**, 391–401.
2. Tsukita, Sh., Furuse, M., and Itoh, M. (2001) Multifunctional strands in tight junctions. *Nat. Rev. Mol. Cell Biol.* **2**, 285–293.
3. Tsukita, Sh. and Tsukita, Sa. (1989) Isolation of cell-cell adherens junctions from rat liver. *J. Cell Biol.* **108**, 31–41.
4. Umeda, K., Ikenouchi, J., Katahira-Tayama, S., Furuse, K., Sasaki, H., Nakayama, M., Matsui, T., Tsukita, Sa., Furuse, M., and Tsukita, Sh. (2006) ZO-1 and ZO-2 independently determine where claudins are polymerized in tight-junction strand formation. *Cell* **126**, 741–754.