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Microtubule appendages mediating T-cell motility and polarity

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Abstract

© 2015 The Royal Society of Chemistry. Polarization of the centrosome and the Golgi apparatus in the T cell (TC) toward the antigen-presenting cell (APC) is essential for the specificity of the immune response on the cellular level. Previously we reported the existence of thin, long processes on the TC surface, which emanated predominantly from the area next to the Golgi apparatus. They appeared to be involved in the orientation of the TC during the initial phases of its attachment, which preceded the formation of the immunological synapse mediated by lamellipodia. Here we improve the visualization of the long, thin protrusions in the cultured TC and demonstrate using cytoskeleton inhibitors and immunofluorescence that microtubules form their cytoskeletal basis. The protrusions are seen prior to the attachment and the development of the broad lamellipodia (within a few minutes). We propose the term "tubulopodia" for this distinct type of cell appendage. Using an established experimental model that replaces the APC surface with a biomimetic substrate coated with antibodies against the TC receptor (TCR), we demonstrate that abrogation of the lamellipodium-mediated synapse formation does not impede the orientation of the TC Golgi apparatus and the centrosome to the contact area. Video microscopy reveals the spreading of the tubulopodia on the TCR-binding substrate, which results in the area of their emanation, and consequently the Golgi apparatus and the centrosome, being closely apposed (polarized) to the TCR-binding surface. Treatment with paclitaxel made the tubulopodia rigid, preventing their attachment to the TCR-binding surface and the reorientation of the cell body with the intracellular structures. We speculate that the motility and polarity of the TC in vivo may be mediated on a large scale by differential adhesion through the long, flexible tubulopodia.

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