How the rewiring of surface protein organisation facilitated multicellular life

Initiative: "Leben?" - Ein neuer Blick der Naturwissenschaften auf die grundlegenden Prinzipien des Lebens

(beendet)

Bewilligung: 06.07.2020

Laufzeit: 5 Jahre

The evolution of complex multicellular organisms 600 million years ago required sophisticated cell-cell communication systems to coordinate growth, differentiation, and tissue organization. This evolutionary leap is thought to have required a fundamental change in protein organization at the key interface for intercellular communication: the cell surface. Phylogenetic data have shown that the tetraspanin family of membrane organizing proteins co-evolved with multicellularity, but the large-scale functional contribution of tetraspanin-based membrane protein organization to intercellular communication remains poorly defined. To delineate how tetraspanin-mediated surface organization enabled the evolution of multicellularity, the research team will quantify the global contribution of tetraspanins to metazoan cell-cell communication using a multidisciplinary approach involving multiplexed super-resolution imaging, materials science, and cell biology. Cutting-edge imaging techniques, combined with machine learning algorithms, will first define the complex recurring nanoscale patterns of up to 100 surface receptor-ligand pairs and tetraspanin proteins on partner cells, and further map how environmental signals alter these patterns. The team will then fabricate precise protein arrays on DNA scaffolds to block specific motifs and probe their functional importance in intercellular communication. Finally, the effect of tetraspanin deletion on functionally important protein motifs, global surface organization, and intercellular communication will be measured. Overall, this project will provide insight into the changes in cell surface organization that enabled the diversity of cell-cell interactions required for multicellular life.

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