An Echinoderm Model to Understand the Biological Functions of the Golgi Ribbon

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Project Summary

The Golgi apparatus is central to the physiology of eukaryotic cells. In mammalian cells, the subunits of the Golgi apparatus, the mini-stacks, are centralized into a superstructure called “ribbon”. Structural alterations of the ribbon, collectively known as Golgi “fragmentation”, are linked to pathologies such as neurodegenerative diseases, inherited neurological disorders and cancer. To date, ribbon’s biological roles remain unclear, precluding insight into how Golgi structural changes may lead to pathological outcomes. Investigation into ribbon functions has been hindered by the complexity of the mammalian molecular machinery involved in its formation.

In the sea urchin embryo, the Golgi switches from the typical invertebrate architecture with separated mini-stacks to a mammalian-like ribbon: an indication that this structural change plays fundamental roles in development. As sea urchins are Echinoderms, a sister phylum of Chordates, this observation has an important evolutionary implication: the Golgi ribbon is not exclusive to Vertebrates, but rather a feature of the phyla with which they share common ancestry (Deuterostomes). Most importantly, since sea urchins, in contrast to Vertebrates, have non-duplicated genomes, the molecular machinery involved in the formation of their Golgi ribbon is likely to be conserved but “simpler” (i.e., less redundant) than that found in Mammals.

The PhD project aims at understanding the functions of the Golgi ribbon during sea urchin development. The sudden switch in Golgi arrangement makes of the sea urchin an experimental system uniquely suited for identifying the molecular factors involved in ribbon formation. By using differential transcriptomics and proteomics to characterize the Golgi-associated factors at pre- and post-ribbon stages, the molecular determinants of the sea urchin ribbon will be identified. The non-redundant among these structural factors will then be experimentally disrupted in functional studies to uncover the Golgi ribbon’s biological role(s) during development.

Implementation of this PhD project will make a substantial contribution to the understanding of the biology of the Golgi ribbon in the development of an organism related to Vertebrates and will provide a biological framework in which the pathogenic consequences of its disruption in human diseases can be deciphered.