The interplay between endoplasmic structure, dynamics and functions

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Our overall research focus is structure-function relationship of organelles, and we mainly study endoplasmic reticulum (ER), which forms an elaborate 3D -network of nuclear envelope and peripheral sheets and tubules. ER has a key role in coordinating several critical homeostatic mechanisms for lipid and protein biosynthesis and constitutes a reservoir of Ca^{2+} ions that act as signalling molecules to regulate many essential cellular processes. Importantly, the ER forms vital membrane contacts with nearly every organelle of the cell, including mitochondria, endo/lysosomes, lipid droplets, the Golgi apparatus and the plasma membrane. To accommodate the vast range of functions, ER network spreads throughout the cell, and its functions are distributed into structural subdomains according to their specific needs.

The relationship between the elaborate structure of the ER and the numerous functions it hosts has remained largely mysterious. In general, it is believed that ER sheets and tubules host different functions. The dynamic nature of the ER also suggests that the transitions between ER sheets and tubules can occur quite rapidly in response to changing cellular environment. The main aims of my research team is to understand how different ER structures are formed and maintained; and how these structural subdomains contribute to various ER functions. Employment of wide selection of imaging techniques is my group's signature. We have established several advanced imaging techniques including CLEM and two 3D-EM techniques as well as customized image processing tools for quantitative image analysis of LM and EM images.

Our working hypothesis is that the relative ratio of different ER structural domains in cells varies as ER architecture is modified to meet the cellular demands, *i.e.* changing the cellular protein expression profile will induce morphological changes on the ER, and manipulation of ER morphology will have direct consequences on ER - associated functions. Better understanding between the structure-function connections will be the first step in unravelling molecular mechanisms behind various ER - associated diseases.