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Mechanical Model of Sheet-Like Membrane and Climp-63 in ER Lumen Lipid Bilayer

Ghazizadeh. E[1], Stroberg. W.[2*]
[1]Mechanical Engineering, University of Alberta, Edmonton, Canada
[2]Mechanical Engineering, University of Alberta, Edmonton, Canada

ABSTRACT

The endoplasmic reticulum (ER) is a multifaceted organelle responsible for protein and lipid synthesis. It consists of a complex network of membrane tubules and sheet-like cisternae that constantly rearrange in response to environmental cues. Within the ER membrane, there are a variety of proteins that change the ER morphology. One such protein is Climp-63, which promotes sheet-like membrane structures by forming dimeric struts across the ER lumen. Inside of the ER lumen, increased numbers of unfolded proteins increase the pressure due causing the lumen to expand. Climp-63 dimers bind to each other across the lumen to counteract this expansion. Therefore, ER membrane shape results from a balance of Climp-63 concentration and ER protein folding load, both of which vary dynamically in response to environmental queues. This study aims to mechanically model the binding Climp-63 across the lumen to characterize the dynamic structure of the ER membrane, on the way to understanding the correlation of ER shape and ER dysregulation in diseases such as diabetes, inflammation, cancer, and ageing.

Keywords: Endoplasmic Reticulum (ER), Lipid Bilayer, Climp-63, Mechanical Model.