Review of: "[Review] Structural and Functional Roles of Non-bilayer Lipid Phase in Mitochondria"

Chenchang Jiang[1]

1 STEM Research Center, Chaoyang KaiWen Academy

Potential competing interests: No potential competing interests to declare.

The review article “Structural and Functional Roles of Non-bilayer Lipid Phase in Mitochondria” is another novel article by the group of Dr. Gasanoff co-authored with his student Yuxuan Tao. This article focuses on the important concepts which illuminate the crucial role of lipid molecular shape in the lipid phase polymorphic transitions and functioning of the inner mitochondrial respiratory chain, an area of studies where this research group has been working for some time. It is becoming increasingly clear that participation of lipids/phospholipids in regulation of activities of membrane proteins is not simply limited to the lipid attraction to the binding sites on the proteins molecular surface. Phospholipids play much bigger role in membrane functioning modulated by reshaping and remodeling of lipid phase of mitochondrial membranes. This revolutionary concept is clearly conveyed in this review article.

Overall, this review article is an attempt to elucidate the contemporary understanding on the role of non-bilayer lipid phases in mitochondrial bioenergetics. Critical analysis of experimental and theoretical studies published over the course of 60 years conducted in this review article presents the non-bilayer lipid phases as indispensable elements of structural dynamics and remodeling of mitochondrial membranes. Particular attention is given to the studies on kinetic coupling of the electron transport chain with the ATP synthase. Authors suggest that the kinetic coupling resolves the issues of chemiosmotic theory driven by the H^+ gradient in bulk solutions across the cristae membrane. Authors emphasize that the H^+ movement in the kinetic coupling does not induce fluctuations in pH in bulk solutions in the matrix and intermembrane space, thus averting unphysiological conditions on both sides of the cristae membrane. Authors propose new and interesting details in the mechanism of mitochondrial ATP synthesis, and they hypothesize that the increase in proton density on the crista inner membrane surface next to F_o subunit of ATP synthase breaks the ionic bond between the phosphate groups of cardiolipin and conserved lysine residues in the rotor of ATP synthase. This event triggers the formation of cardiolipin inverted micelles, which not only transport protons into the matrix, but also induce the rotation of ATP synthase rotor, which is a brand-new hypothesis in regulation of ATP synthase activity.

Overall, I believe this review article will attract attention of the broad range of experts in biochemistry and biophysics of mitochondrial membrane structure and function, polymorphism of lipid phase in crista membrane, membranotropic compounds, lipid-protein interactions and bioengineering of pharmaceuticals boosting mitochondrial energetics. I strongly recommend this review article for publication in the peer review journal.