Understanding the Role of Mitochondrial Cristae Structure on Energy Metabolism through Simulation

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Abstract:

The structure of mitochondria cristae are hypothesized to play a dynamic and possibly controlling role in mitochondrial energy metabolism. An integrated modeling and experimental study is being pursued by us to develop fundamental understanding of the interplay of mitochondrial organization with its metabolic function. To this end, our previously published model (Nguyen et al., 2007) for mitochondrial energy metabolism will be integrated and be upgraded to take account of our new data on both activity-dependent regulation of ATP production and cristae structure. To ensure model sharing, enable broader participation by NIH-supported investigators, and catalyze the participation of additional investigators, the model for mitochondrial energy metabolism has been ported to the NIH-supported Virtual Cell (V-Cell) Computational Platform. Serial electron micrographs that we have prepared have been analyzed to delineate mitochondrial cristae shape and structure. V-Cell is being trained to properly import the segmented images acquired by us. The success of each of these steps should enable us to run two-dimensional and three-dimensional simulations with the mitochondrial cristae structure. By this means the measured structure will inform the computed metabolic function and the current and future metabolic measurements will be used to constrain the model.

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