



Mitochondria and the Heart (Developments in Cardiovascular Medicine)

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Mitochondria have been pivotal in the development of some of the most important ideas in modern biology. Since the discovery that the organelle has its own DNA and specific mutations were found in association with neuromuscular and cardiovascular diseases and with aging, an extraordinary number of publications have followed, and the term mitochondrial medicine was coined. Furthermore, our understanding of the multiple roles that mitochondria play in cardiac cell homeostasis opened the door for intensive experimentation to understand the pathogenesis and to find new treatments for cardiovascular diseases. Besides its role in adenosine triphosphate generation, mitochondria regulate a complex network of cellular interactions, involving (1) generation and detoxification of reactive oxygen species, including superoxide anion, hydrogen peroxide, and hydroxyl radical; (2) maintenance of the antioxidant glutathione in a reduced state and adequate level of mitochondrial matrix superoxide dismutase; (3) cytoplasmic calcium homeostasis, particularly under conditions of cellular calcium loading; (4) transport of metabolites between cytoplasm and matrix; (5) both programmed (apoptosis) and necrotic cell death; and (6) cell growth and development. It is therefore not surprising that this organelle has come to be the center stage in many current investigations of cardiovascular diseases, aging, and age-related disease. Concomitant with these advances, an impressive effort is underway for the development of new tools and methodologies to study mitochondrial structure and function, including powerful ways to visualize, monitor, and alter the organelle function to assess the genetic consequences of these perturbations.

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