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Mitochondria in life and diseases

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Life is the interplay between structure and energy, and Mitochondria, recognized as the cell's powerhouse, have been probably essential for the evolution of multicellular organisms . Mitochondria are best known as those organelles where the energy required for life is produced in the form of ATP molecules with the highest effectiveness, by the process called oxidative phosphorylation (OXPHOS). According to the endosymbiont theory, it all started around two billion years ago when an anaerobic precursor of the eukaryotic cell engulfed an α-proteobacterium, capable of producing energy via the more effective oxidative phosphorylation. This initiated a mutually fruitful collaboration, where the host cell could beneficiate from a more efficient ATP production while constantly providing its guest with protection, food, and oxygen. However beside being more effective, the use OXPHOS to convert dietary calories into usable energy, also generate reactive oxygen species (ROS) as a toxic by-product. Thus, it is not surprising that the mitochondrial function is involved in a wide range of age-related disorders and in various forms of cancer.

The last decade has witnessed enormous progress and conceptual advances made in the field of mitochondrial biology. Nowadays Mitochondria are viewed as multi-functional organelles, regulating a plethora of cellular functions, spanning from physiological metabolism to stress responses and death. Mitochondria interact and communicate with other organelles, modulating complex metabolic networks involved in cell survival, apoptosis, redox control, calcium homeostasis and many metabolic and biosynthetic pathways.

Finally, but not less important, mitochondria hold their own DNA (mtDNA), present in thousands of copies per cell, encoding essential genes for energy production. Thus, the delayed-onset and progressive course of the age-related diseases might result from the accumulation of somatic mutations in the mtDNAs of post-mitotic tissues. The variation in the individual and regional predisposition to degenerative diseases and cancer may result from the interaction of modern dietary caloric intake and ancient mitochondrial genetic polymorphisms. Therefore, the mitochondria might provide a direct link between our environment and our genes and the mtDNA variants that permitted our forebears to energetically adapt to their ancestral homes are influencing our health today.

This webinar aims at providing an overview of the molecular mechanisms that enable mitochondria to sustain cell survival, coordinate stress responses, and mediate cell death.

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