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## Preface

Over the past two decades, due to dramatic advances in molecular and cell biology, biochemistry, and genetics our view on mitochondria as a relatively static cellular powerhouse has changed radically. We now know that these organelles play a critical role in the normal and in the damaged heart as a highly dynamic integrator of energy production, in diverse signaling pathways, intracellular  $\text{Ca}^{2+}$  homeostasis, cell survival, and cell death. Although all of these functions are essential for virtually all human organs, they are particularly important for the heart, in order to maintain its permanent rhythmic contraction and ensure oxygenation of all the body tissues. Also, mitochondrial non-bioenergetic, biogenetic, and degradation pathways are very important since understanding of these pathways and the effects that mitochondrial changes have in cardiac pathology are critical for diagnosis and treatment of mitochondrial-based cardiac diseases.

This book begins with a general introduction to mitochondria, followed by laboratory methods to study the structure and function of the organelle, regulation of replication and biogenesis, and the mechanisms and functional consequences of mitophagia and mitochondrial dynamics. Subsequent chapters deal with mitochondrial oxidative stress and the role that the organelle plays in cell signaling and cell death. Readers will learn that mitochondria have their own DNA and that mitochondrial gene mutations occur at a much faster rate than those in the nucleus. This high mutation rate of the mitochondrial DNA is behind the heart ageing processes as well as on the changes in other degenerative diseases.

Discussions will be undertaken on the biochemistry of mitochondrial cell signaling, including the nature of the proteins engaged in these processes, many of them only recently discovered. Besides their implication in cardiovascular pathology, mitochondria are also involved in degenerative diseases such as Parkinson's, Huntington's disease, cancer, and ageing. Mitochondrial mutations and their consequences in ageing and other phenotypic manifestations are discussed in the following sections, and how mitochondrial proteins might constitute important targets in an attempt to develop therapeutic compounds that can regulate their function. In later chapters we examine the role of mitochondria and mitochondrial abnormalities in cardiovascular diseases—their diagnosis, therapeutic options currently available, animal models of mitochondrial disease, and new frontiers in mitochondria cardiovascular medicine, including areas of research that are relatively new or developing, such as proteomics, next-generation sequencing, and systems biology.

It is our hope that the information provided in this book will be useful to the clinician and student interested in clinical and basic cardiovascular research; new advances in our understanding of cardiovascular pathophysiology will open new ways to slow the progression of failure of the injured heart and allow a better and longer active life to us all.

Virtually, from the beginning of life...  
Mitochondria and eukaryotes have been joined together.....  
Together they may continue forever and ever

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