Cardiovascular Gap Junctions
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Volume Editor

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... all the things do depend upon the motional pulsation of the heart:
To the heart is the beginning of life.

William Harvey, 1653

With this sentence and his investigations, William Harvey started modern cardiovascular research and medicine. While he was fascinated by mechanical motion and discovered a basic principle of the cardiovascular system, recent research focuses on motion itself and its regulation. The expression ‘motional pulsation’ somehow includes rhythm. The basis for this rhythmical motion is an electrical activation wave leading to contraction, which has to propagate from its origin at the sinus node to the whole heart. Thus ‘motional pulsation’ encompasses another form of motion, a propagating electrical wave. This is made possible by a network of communicating cells interconnected by gap junction channels. However, these channels not only allow the transfer of electrical signals, they also enable the transfer of small molecules which may serve as signals for cell growth, death or differentiation. In addition, it has become clear that these gap junction channels also importantly contribute to vascular motion. It was the classic paper by N.B. Gilula (1944–2000), published in Nature [Gilula et al., Nature, 1972;235:262–265], that provided the first clear evidence that gap junctions are involved in exchange of metabolites and ions between neighboring cells. Thereafter, our knowledge about these channels and their functions has been enlarged by many elegant studies, and gap junction research has become a focus in cell biology, since intercellular gap junction communication provides the basis of the organization of many organs as a cellular network.
With these studies, it became increasingly evident that gap junctions significantly contribute to the regulation of the cardiovascular system and that failure or alterations of these channels lead to dysfunction.

Since the publication of Cardiac Gap Junctions in 1998 [Dhein S, Cardiac Gap Junctions. Physiology, Regulation, Pathophysiology and Pharmacology. Basel, Karger] gap junction research in the cardiovascular system has considerably grown and has largely improved our understanding of the regulation of the heart and vasculature in health and disease. Several well-known gap junction researchers in the cardiovascular field have contributed to the present edition of this book, which is intended to give insight into this fascinating field. I wish to thank them all for their help and support, as well as all the other gap junction researchers who made these and my own studies possible with their basic findings and seminal papers.

The first part of this book is focused on the major aspects of these intercellular channels, allowing the readers who are not familiar with the field to get a deeper understanding of gap junction physiology, pharmacology and regulation, while the second part elucidates their role in the pathophysiology of a number of important cardiovascular diseases, such as arrhythmia, heart failure, ischemia, atrial fibrillation, diabetes and arteriosclerosis. Hopefully, this book will help stimulate researchers to extend their investigations in this fascinating field, and exchange their views and findings in an open communicating scientific network, as the cells they are investigating do.

Stefan Dhein
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