

Max Schaldach

Electrotherapy of the Heart

Technical Aspects in Cardiac Pacing

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FOREWORD

Biomedical engineering has significantly contributed to the success of medicine in diagnosis and therapy during the last thirty years. One of the most successful contributions has been the development of pacemaker technology. Since the first implant in 1958, the concept has evolved from a simple pulse generator to a powerful system capable of not only stimulating, but sensing, programmability and computer-based, decision-making technology. Today's implantable pacemakers demonstrate one of the most successful examples of the interdisciplinary task of applying modern technology in the fields of materials and electronics to medicine. The clinical treatment of all types of arrhythmias has reached a standard that renders possible not only emergency treatment but also increases the quality of life. Despite these impressive advances, the artificial pacemaker is still inferior to the physiological pacing system, especially regarding the capability to adjust the stimulation rate to the hemodynamic requirements.

Electrotherapy of the Heart is a unique representation of this fascinating development. The author, Max Schaldach, is one of the founders of pacemaker technology and is internationally known as a researcher and professor in the fields of applied physics and biomedical engineering. He continues to contribute extensively to the field of cardiac pacing in development, design and manufacture, and has strongly influenced the technology to its present advanced state.

There is no doubt that this book will further promote research and development in pacemaker technology with the aim of a more physiological approach for the greatest benefit to the patient.

Graz, January 1992

Helmut Hutten

PREFACE

In 1958, the first implantable cardiac pacing system was developed by Elmquist and implanted by Senning. Since then, the exemplary collaboration between medicine and engineering has developed into an extremely successful therapy.

The multidisciplinary nature of the technical task of pacemaker development is based upon the diverse components of physiology, electronics, physics, electrochemistry and the material sciences. Progress in basic technologies such as microelectronics has made it possible to design pacemakers which, in practice, has led to broad clinical applications of treating a wide spectrum of arrhythmias. The information presented here is not generally found in conventional journals and textbooks and, therefore, may contribute to the interdisciplinary collaboration between biomedical engineering and the medical profession.

This book, as its title suggests, highlights many of the recent and most important technological advances and concepts in cardiac electrotherapy to implement different approaches of adapting the stimulation rate from a systems engineering standpoint to meet the cardiovascular requirements. Innovations to solve the rate-adaptation problem include *physiological* rate adaptation which operates as a closed-loop control system. The artificial pacemaker and the Autonomic Nervous system, in concert, reestablish chronotropy by utilizing its physiological control elements. This approach is an important milestone toward development of an "intelligent" pacemaker capable of implementing a much broader concept of electrotherapy for the heart.

As progress in neurocardiology suggests, monitoring of the autonomic balance should result in a preventive pacing technique which can be superior to pharmacological approaches and which will finally replace the defibrillator.

May the multidisciplinary task of pacemaker development become evident to the reader.

Erlangen, January 1992

M. Schaldach

Dedicated to

*my colleagues and my friends
who have accompanied me
during the past thirty years.*

Max Schaldach

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