Preface

This book focuses on the identification of basic mechanisms that are associated with aging, e.g. in the bone and the skin, as well as tools and techniques applied in regenerative medicine. Aging is a process guided by a large number of signaling molecules and gene regulatory factors acting to establish specific gene expression patterns. The mechanisms that lead to impaired healing with increasing age remain largely unknown. Therefore, manipulation of key factors of regenerative processes within regulatory networks should help to improve regeneration in a therapeutic setting.

Accordingly, an understanding of molecular and signaling mechanisms underlying the aging process is likely to lead to novel approaches of preventing and treating age-related diseases. A combination of high throughput approaches and advanced computational techniques to dissect the molecular mechanisms of stem cell fate and cellular reprogramming are applied in regenerative medicine.

The aim of this publication is focused on the translation of basic science discoveries into regenerative therapies, as well as the application of clinical tools in aging and tissue regeneration.

OBJECTIVE OF THE BOOK

This book provides current applications of health sciences in aging as well as the latest research in this area. The book covers basic concepts, best practices, common techniques, and investigative challenges in research. Most importantly, it examines the major limitations of current tools and discusses approaches that may help investigators to deal with aging. These approaches cover a wide spectrum, from imaged-based authentication to high-throughput technologies for regeneration.

The target audience of this book is composed of professionals and researchers working in the field of clinical medicine as well as in basic science.

ORGANIZATION OF THE BOOK

The book consists of three sections, the first of which is related to “Aging and Regeneration: Basic Concepts in Medicine.” From the Berlin-Brandenburg Center for Regenerative Therapies comes a discussion of approaches to BMP signaling in regenerative medicine in Chapter 1. The authors in this chapter outline how some of these approaches have become part of the practice of bone growth induction and connective tissue regeneration in cancer diagnosis, cancer treatment, as well as cardiovascular disease prevention. Methodologies in cancer treatment and post-treatment tissue reconstruction are the focus of
the work in Chapter 2 coming from the Pediatric Department of the University of Athens in cooperation with the Laboratory of Virology of the University of Crete. In a work coming from the Department of Systems Biology and Bioinformatics, University of Rostock, in Germany, in cooperation with the Institute of Mechanics and Biomechanics, Bulgaria, the authors in Chapter 3 discuss colorectal cancer approaches for diagnosing and modeling. The gene expression regulation underlying osteo-, adipo-, and chondro-genic lineage commitment of human mesenchymal stem cells is discussed in a contribution from the Department of Cell and Applied Biology, The Netherlands, and the Research Group of Systems Biology from the Hans Knöll Institute, Jena, Germany, in Chapter 4.

In the second section, “Basic Research: A Bridge between Aging and Regeneration,” Chapter 5 begins with a discussion of Immunogenicity of stem cells authored from the Transplant and Stem Cell Immunobiology (TSI) Lab, University Heart Center Hamburg. Chapter 6, from the Center for Regenerative Therapies Dresden, serves as a comprehensive introduction to regulatory T Cell-Based Immunotherapy. Chapter 7, authored from the University of Nottingham, in England, provides a general overview on challenges, opportunities, and perspectives related to regeneration of articular cartilage. Chapter 8, from the Department of Cell Biology and Tissue Engineering, Lausitz University of Applied Sciences, Germany, describes methods used for the generation of scaffold-free 3-D cartilage-like microtissues from human chondrocytes. Chapter 9, from Research Center for Advanced Information Science and Technology, The University of Aizu, Aizu-Wakamatsu, Fukushima, Japan, gives an extended analytical consideration of Hidden Markov Models (HMM) of the brain on Magnetic Resonance Imaging (MRI) to study the bidirectional vascular depression hypothesis in the elderly and neurodegenerative diseases, respectively.

Section three is focused on “Regeneration and Aging: Applications in Medicine and Dentistry.” Section three includes 4 chapters. The emphasis of Chapter 10, from the Department of Biomedical Engineering, Faculty of Medicine, McGill University, Montreal, Quebec, Canada, is on stent technologies for efficient vascular tissue therapy and the potential of these technologies to design the next generation of therapeutic stent. Chapter 11, from the Faculty of Engineering and Industrial Sciences, Swinburne University of Technology, in Australia, in cooperation with the Research Centre for Nano-Biomaterials and the Tongji University, in China, presents an overview of current treatments for heart valve disease in the elderly. Chapter 12 describes tactile resonance sensors for detection and diagnosis of age related diseases as implemented and applied in Sweden based on the cooperation between the Department of Computer Science, Luleå University of Technology, Luleå, the Department of Radiation Sciences, and the Sweden Centre for Biomedical Engineering and Physics, of the Umeå University, in Umeå, Sweden. Chapter 13, from the School of Dentistry of the Aristotle University of Thessaloniki, Greece, and the Center of Oral and Maxillofacial Sciences, Germany, focuses on dental tissue engineering research and translational approaches towards clinical application. In Chapter 14, the authors describe a mechanism of applying activated Platelet Rich Plasma (PRP) and adipose derived stem cells to treat skin wrinkles.

The book, Medical Advancements in Aging and Regenerative Technologies: Clinical Tools and Applications, contains text information, but also a glossary of terms and definitions, contributions from international experts, in-depth analysis of issues, concepts, new trends, and advanced technologies in aging and regeneration. This edition focuses more directly and extensively than ever on applications of medicine in aging and regeneration.

Because of the diverse and comprehensive coverage of multiple disciplines in the field of aging and regeneration in this book, this book will contribute to a better understanding for current applications, research, and discoveries in this evolving, significant field.
In shaping this book, I committed myself to making the textbook as useful as possible to specialists, clinicians, as well as advanced researchers coping with the demands of modern medical research.

I hope this will make this book a helpful tool not only for the medical doctor who needs an expert source of basic knowledge in aging and regenerative technologies, but also for the computer scientist and the biologist who needs clear, concise, and balanced information on which to conduct his research.

Thanks to a very hard-working editorial advisory board of scientists, excellent authors who fulfilled our invitations, and a very efficient publisher providing clear procedures and practices for a quality production, readers may now enjoy chapters on some of the major ideas concerning aging research and its applications in health sciences.

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