

# Preface

The term “stem cell” appeared in the scientific literature as early as 1868 in the work of the eminent German biologist Ernst Haeckel. In this work, Haeckel used the term Stammzelle (“stem cell”) to describe the ancestor unicellular organism from which he presumed all multicellular organisms evolved. Particularly, he also suggested fertilized oocytes as the source giving rise to all cells of the whole body. In 1892, Valentin Hacker described stem cells as the cells that later produce oocytes in the gonads. Then, this term becomes more popular with some experimental results in developmental biology. Some studies about nuclear programming in the 1900s showed that adult cells can become pluripotent stem cells, and pluripotent stem cells can differentiate into all specialized cells from three germ layers. The first successful study about epigenetic reprogramming was performed by John Gurdon in 1962 in the African clawed toad, *Xenopus laevis*. He could produce healthy and sexually mature fertile frogs by nuclei transplantation from differentiated cells. Therefore, he and Shinya Yamanaka shared a Nobel Prize in Medicine or Physiology in 2012. Besides pluripotent stem cells, the multipotent stem cells also were detected and isolated in the adult, so-called adult stem cells. Adult stem cells such as hematopoietic stem cells and mesenchymal stem cells are the essential source of stem cells in an adult that play the important roles in tissue homeostasis, wound healing, and tissue regeneration after injuries. These discoveries suggested that stem cell transplantation can help to regenerate the injured tissues. And stem cell therapy, as well as regenerative medicine, was formed from these observations.

The first autologous stem cell transplant was undergone by Dr. E. Donnall Thomas in 1957; he later received the Nobel Prize in Medicine in 1990 for this achievement. The clinical application of hematopoietic stem cells rapidly grew from the 1990s to date. From the 2000s, some other adult stem cells including mesenchymal stem cells, limbal stem cells, epidermal stem cells, and neural stem cells were used in the clinic. In recent years, embryonic stem cells, as well as pluripotent stem cells (induced pluripotent stem cells), also were permitted for use in some clinical trials.

The clinical application of stem cells broke out since the 2000s when some countries approved some stem cell-based therapies and stem cell-based products. To date, stem cells including both adult stem cells and pluripotent stem cells were clinically used in more than 50 different diseases and medical conditions. More than ten stem cell-based therapies, as well as stem cell-based products, were approved as routine treatments in some countries.

Therefore, the *Stem Cells in Clinical Applications* series brings some of the field's most renowned scientists and clinicians together with emerging talents and disseminates their cutting-edge clinical research to help shape future therapies. While each book tends to focus on regenerative medicine for an individual organ or system (e.g., the liver, lung, and heart, the brain and spinal cord, etc.), each volume also deals with topics like the safety of stem cell transplantation, evidence for clinical applications including effects and side effects, guidelines for clinical stem cell manipulation, and much more. Volumes also discuss mesenchymal stem cell transplantation in autoimmune disease treatment, stem cell gene therapy in preclinical and clinical contexts, clinical use of stem cells in degenerative neurological disease, and best practices for manufacturers in stem cell production. Later volumes will be devoted to safety, ethics and regulations, stem cell banking, and treatment of cancer and genetic disease.

This volume, *Stem Cell Processing*, presents some significant sources of stem cells for clinical applications. Mainly, this volume also introduces some new techniques to collect and expand stem cells with GMP guidelines so that these obtained cells can be used in the clinic.

In the first edition of this volume, ten chapters will focus on the recent hot topic about some accepted and approved clinical applications of stem cells (Chapter [One](#)) and some clinical trials and approved products from mesenchymal stem cells (Chapter [Two](#)). The techniques for isolation and expansion of mesenchymal stem cells are also provided in Chapters [Six](#), [Seven](#) and [Ten](#). In this volume, some effects of aging and senescence on mesenchymal stem cell properties are also suggested in Chapters [Three](#) and [Four](#). Some recent efforts in clinical usages of pluripotent stem cells are discussed in Chapter [Four](#), with some concerns covered in Chapter [Nine](#).

Many people have contributed to making our involvement in this project possible. We are extremely thankful to all of the contributors to this book. Many people have had a hand in the preparation of this book. We thank our readers, who have made our hours putting together this volume worthwhile. We are indebted to the staff of Springer Science+Business Media that published this book.

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