
Preface

Our understanding of embryonic cells has increased exponentially over the last 3 decades. It was only 30 years ago when embryonic stem cells were first cultured from mouse embryos. Fifteen years later, human embryonic stem cells were derived from human embryos that were donated from early blastocysts not needed for in vitro fertilization. In the 9 years since the publication of the first edition of *Stem Cells Handbook*, much has changed, yet much remains the same. Obviously, this second edition of *Stem Cells Handbook* concentrates on what has changed and provides a source for experts' critical reviews of their results in various aspects of stem cell research during the last 10 years. The chapters cover what stem cells are, how they contribute to diseases, such as cancer, how bad stem cells can be converted to good stem cells, and how good stem cells can be manipulated and used for therapy. What has not changed is the limited ability to use embryonic cells to treat disease. We hope that this book will help in reaching the goal of many FDA-approved uses of stem cells, both embryonic and adult.

This edition starts with an overview of stem cells in general and ethical problems that need to be addressed in any clinical use. Part I covers the properties of embryonic and fetal stem totipotent cells and how they may be manipulated. This includes how to get them, what signals maintain them as stem cells, how to differentiate them to selected tissue stem cells, and what immunological questions need to be answered if they are to be used for transplantation.

The area of greatest advance since the first edition is the development of methods to produce and apply iPSCs to generate cells that could be used to replace essentially any lost or diseased tissue in the body. The contribution of pluripotent stem cells in adult tissues to repair injury and replace amputated limbs in an experimental model opens Part II. Then we move on to a thorough look of the four critical steps in the use of iPSCs: obtaining them, expanding them, getting them to differentiate into functional tissue stem cells, and then successfully transplanting them. Finally, the vast commercial opportunities of iPSCs are presented.

Part III covers tissue-specific stem cells which are the cells in adult organs responsible for maintaining normal tissue renewal. Understanding how to manipulate normal tissue stem cells could lead to many approaches to preventing or curing various human diseases. The properties and characteristics of tissue stem cells is presented for individual organs or types of tissue and includes a discussion of the role of stem cells in aging.

Part IV deals with transplantation and translating therapeutic approaches, a critical stage of application of stem cell therapy. This includes transplantation of mesenchymal stem cells, use of stem cells in treatment of burns and wounds, as well as treatment of diseases of the eye and diabetes.

Part V examines the stem cell origin of cancer and cancer stem cells. The role of tissue stem cells as the cells of origin of cancer and how to target the signals that maintain cancer stem cells are discussed in general. Then approaches for targeting the stem cells of leukemia, liver and breast cancer, as well as a particular type of kidney cancer, nephroblastoma, for which cancer stem cells are readily identified, are adumbrated.

In closing, we have put together representative, timely, and substantive chapters covering critical aspects of current stem cell research, both basic and clinical. This is done with the full understanding that, given the rate of data accumulation, it is impossible to be all inclusive. Thus, there are many exciting and important aspects of stem cell research that are not covered in this book. What is in this book is a sampling of some of the most critical ongoing studies in stem cell research.

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