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## Preface

Human embryonic stem (hES) cells, especially the newly developed human induced pluripotent stem (hiPS) cells, have become one of the most promising renewable cell sources for regenerative medicine and tissue engineering. Both hES and iPS cells are capable of self-renewal and differentiation. They can be cultured *in vitro* for extended periods of time. Such unique properties make these cells very promising for cell replacement therapy. Because of their huge potential in disease treatment and life quality improvement, enormous efforts have been made to develop new methodologies to translate lab discoveries in stem cell research into bedside clinical technologies.

While many new ideas and new approaches in embryonic stem cell research emerge every day, they are widely scattered among laboratories around the world. Thus, the systematic collection of these ideas and approaches will be helpful for researchers and students who want to explore these areas and transform their discoveries into the next generation of regenerative medicine and tissue engineering technologies. This book presents a comprehensive collection of protocols developed by leading scientists in the field. The topics covered include techniques used for maintenance of hES and hiPS cells in either small or large scale; techniques for directing hES and hiPS cell lineage specification; techniques for enhancing maturity of differentiated hES and hiPS cells within three-dimensional scaffolds; techniques for reprogramming adult cells into hiPS cells; techniques for generating patient-specific hiPS cells; and techniques for translating hES and hiPS cell research into new therapies. The book consists of 5 sections and 34 chapters. Chapter 1: Feeder-free growth of undifferentiated human embryonic stem cells, Chap. 2: Growth of human embryonic stem cells in long-term hypoxia, Chap. 3: Laboratory-scale purification of a recombinant E-cadherin-IgG Fc fusion protein that provides a cell surface matrix for extended culture and efficient subculture of human pluripotent stem cells, Chap. 4: Scale-up of single cell-inoculated suspension cultures of human embryonic stem cells, Chap. 5: Three-dimensional culture for expansion and differentiation of embryonic stem cells, Chap. 6: Expansion of pluripotent stem cells in defined xeno-free culture system, Chap. 7: Pluripotent stem cells *in vitro* from human primordial germ cells, Chap. 8: Cryopreservation of human embryonic stem cells and induced pluripotent stem cells, Chap. 9: Induced pluripotent stem cells from cord blood CD133<sup>+</sup> cells using Oct4 and Sox2, Chap. 10: Generation, maintenance, and differentiation of hiPS cells from cord blood cells, Chap. 11: Generation of iPS cells from human umbilical vein endothelial cells by lentiviral transduction, and their differentiation to neuron lineage, Chap. 12: Generation of human induced pluripotent stem cells from endoderm origin cells, Chap. 13: Derivation of human induced pluripotent stem cells on autologous feeders, Chap. 14: Human mesenchymal stem cells and iPS cells (preparation methods), Chap. 15: Retroviral-vector-based approaches for the generation of human induced pluripotent stem cells from fibroblasts and keratinocytes, Chap. 16: Generation of nonviral integration-free induced pluripotent stem cells from plucked human hair follicles, Chap. 17: Generation of iPS cells from human skin biopsy, Chap. 18: Generation of human iPS cells from human primary amnion cells, Chap. 19: *In Vitro* two-dimensional endothelial differentiation of human embryonic stem cells, Chap. 20: A feeder-free culture method for the

high efficient production of subcultural vascular endothelial cells from human embryonic stem cells, Chap. 21: hES cell feeder-free culture and feeder-independent maintenance of human embryonic stem cells and directed differentiation into endothelial cells under hypoxic condition, Chap. 22: Differentiation of endothelial cells from human embryonic stem cells and induced pluripotent stem cells, Chap. 23: Differentiation of human embryonic and induced pluripotent stem cells into blood cells in coculture with murine stromal cells, Chap. 24: Generation of multipotent CD34<sup>+</sup> CD45<sup>+</sup> hematopoietic progenitors from human induced pluripotent stem cells, Chap. 25: Adipogenic differentiation of human induced pluripotent stem cells, Chap. 26: Chondrogenic differentiation of hESC in micro-mass culture, Chap. 27: Deriving hepatic endoderm from pluripotent stem cells, Chap. 28: Multistage hepatic differentiation from human induced pluripotent stem cells, Chap. 29: Hepatic maturation of hES cells by using a murine MSC line derived from fetal livers, Chap. 30: Generation of lung epithelial-like tissue from hESC by air-liquid interface culture, Chap. 31: Directed differentiation of human embryonic stem cells into selective neurons on nanoscale ridge/groove pattern arrays, Chap. 32: Neural differentiation of human ES and iPS cells in three-dimensional collagen and Matrigel<sup>TM</sup> gels, Chap. 33: Single-cell transcript profiling of differentiating human embryonic stem cells: Lineage-specific differentiation protocols, and Chap. 34: Using endogenous mRNA expression patterns to visualize neural differentiation of human pluripotent stem Cells.

Finally, we would like to take this opportunity to acknowledge all of the contributors for their dedicated works and their kindness to share their wisdom and their expertise in the field. We are also grateful to Mr. Patrick J. Marton at Humana Press for his support and encouragement. Without his encouragement, the publishing of this book would not have been possible. In addition, we would like to thank Mr. David C. Casey for his editing and support on publishing this book. We hope this book will further stimulate the development of new technology for lineage-specific differentiation of hES and hiPS cells for generating a full spectrum of clinically relevant cell lineages for cell replacement therapies. We anticipate that this book will contribute to the development of new technologies for tissue engineering and regenerative medicine.

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