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Medical Applications of iPS Cells

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Preface

The creation of chimeric animals and the discovery of embryonic stem cells have had a profound effect on the study and treatment of diseases. The resulting animal models have enabled extraordinary insights on the very beginnings of a disease that can only be identified in its late stages in human patients. Of course, these models have limitations, mostly being that animals and humans, while sharing a great deal of similarities, differ in significant ways that are best summarized by Judah Folkman's remark, "if you have cancer and you are mouse, we can take good care of you."

The discovery of induced pluripotent stem (iPS) cells, specifically human iPS cells, began a new generation of modeling that invited the opportunity to watch a patient's cells develop the disease phenotype in real time. Understanding how to control the pluripotency network of a somatic cell has enabled scientists to reprogram easily accessible cells into those afflicted by the pathology and observing how development differs in healthy and diseases groups and even within diseased subgroups. That these experiments can be done using human cells invites comparisons with animal models and explanation as to why patients diagnosed with the same disease respond differently to an experimental medicine.

Thus, the very first report of human iPS cells was followed by a surge not only in research that explored the reprogramming mechanism but also in research that sought to exploit the power of reprogramming technology for new medical applications. These applications include the study of the pathogenesis of diseases along with new drug discoveries and cell therapies. In more recent years, the development of complementary technologies, such as gene editing and organoids, has only added to the expectation that iPS cells will provide solutions to what are currently intractable diseases.

Accordingly, we have invited authors who view iPS cells as a tool that advances medical treatments and use them to study disease development and generate cells for transplantation or to find candidate compounds. We have also invited authors

who use iPS cells to test their new technologies in gene editing, nanomachines, and organoids. Overall, the intention of this book is to provide readers with an impression of the reach iPS cells have in medicine and how their own research can benefit by incorporating iPS cell technology.

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Contents

Part IV iPS Applications