Essential Current Concepts in Stem Cell Biology
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Stem cell (SC) biology is a pervasive transdisciplinary research field encompassing any level of life organization (from molecular to morphological), combining different types of techniques (spanning from cellular to molecular). It can also be considered a unique arena where conceptual insights are evolving at an incredible speed. For example, think about how our vision and understanding of the SC niche has rapidly changed over the past decade.

As stated by the editor, the books in the Learning Materials in Biosciences series "compactly and concisely discuss a specific bio-topic based on lectures for upper-level undergraduates, master's and graduate students": this means that both beginners and well-trained students can benefit from reading this and other books in the same collection.

In particular, this book covers all of the multifaceted aspects of SC biology such as classical and paradigmatic hemopoietic and pluripotent SCs, the epigenetics behind genetic reprogramming, and the generation of organoids.

Each chapter consists of four main sections: 1. the "what you will learn" one deals with the main concepts readers will learn; 2. the second explains the topic of the chapter; 3. the third refers to the "take-home message"; 4. the final contains questions (and answers) useful to check the readers' level of acquisition of the concepts explained.

The first chapter, as expected, is dedicated to hematopoietic SCs. Their discovery, isolation, clinical use, and possible gene therapies are here discussed. The second chapter is all about multipotent mesenchymal SCs, the most flexible and adaptable SCs. Unsurprisingly, 711 clinical trials involving the use of mesenchymal stem cells worldwide (for study purpose or the treatment of several diseases, like cardiovascular, autoimmune, respiratory diseases, and spinal cord injuries) are listed on the website *www.clinicaltrials.gov.*

Several paragraphs detail the biochemical advancements aimed at understanding the molecular bases of mesenchymal SCs plasticity. Even the use of specific scaffolds can biophysically modulate SC multipotency to fulfill unmet clinical needs in regenerative medicine (think tissue repair and tissue/organ regeneration). Isolation protocols and ethical considerations on the use of these cells complete the chapter.

Today, cell-based therapies using umbilical cord blood are being used in new applications to treat certain types of pediatric cancer and to treat and study certain adult diseases, such as ischemic stroke. These cells are composed of hematopoietic and non-hematopoietic SC progenitors capable of being expanded *in vitro*.

Neural SCs are one of the most fascinating topics in biological research today. The development of the central nervous system from neural SCs along with the general characteristics of the SC niches are described in detail in another chapter. The role of the extracellular matrix in the creation of the morpho-functional architecture of the niche is also described. This represents the necessary prerequisite for developing new therapeutic strategies for central nervous system (brain and spinal cord) lesions and cancer thanks to the use of SCs. SC-based therapies for the treatment of muscular dystrophies are based on the full understanding of myogenesis in the embryo. This aspect, along with an accurate explanation of the different types of muscle SCs, is detailed in the book. The reader can thus grasp the remarkable regenerative ability of skeletal muscles so that the histological features behind the most common muscular dystrophies like Duchenne (an X-linked disease) and Limb-girdle (a heterogeneous group of autosomal inherited dystrophies) can be better understood. *Ex vivo* expansion of genome-edited skeletal muscle SCs will promote SC-based therapies to ameliorate these diseases.

The chapter dedicated to cardiac muscle tissue engineering illustrates the cellular composition, structure, and function of cardiac tissue and the platforms for generating cardiac micro-tissue (2D versus 3D cell culture models) using human pluripotent SC-derived cardiomyocytes, for both cardiac repair therapies and drug effect studies.

The feasibility of somatic genetic reprogramming to induce pluripotency is here explained in detail so that the reader can study and understand the generation and characterization of the famous induced pluripotent stem cells, iPS cells. Notably, the production of patient-derived iPS cells is important for studying diseases *in vitro* and for understanding how genetic disorders can be treated using genome editing.

Another chapter illustrates the possible epigenetic modifications that occur during somatic cell reprogramming (histone modifications, DNA, and RNA methylation/demethylation, *etc.*). Two chapters detail the present-day hype and hope behind the use of iPS cells for the treatment of currently incurable neurodegenerative diseases: just think of Parkinson's disease, the second most common affecting about 1% of the general population, as stated by Chengzhong Wang and Yu-Qiang Ding. These authoritative colleagues clearly explain how to generate dopaminergic neurons for cell-based therapies: they can be obtained either from their progenitors in the human fetal ventral mesencephalic tissue or by direct reprogramming of somatic cells.

Xiaoqing Zhang details the use of human pluripotent SC-based replacement therapy for the treatment of neurological disorders (*e.g.*, Parkinson, Huntington and Alzheimer). iPS cells are a useful cellular tool for modeling liver diseases like steatosis, hepatitis B/C, cystic fibrosis, and Wilson disease (copper accumulation). This fascinating opportunity is exemplified with drug test examples and 3D models (organoids) of these disorders. This latter opportunity is detailed by Tobias Cantz in a chapter entitled: "Organoids in developmental biology research and application" with a focus on hepatic organoids.

A conceptually dense chapter is dedicated to the fascinating world of extracellular vesicles and their role as mediators in intercellular communication. Extracellular vesicles (*i.e.*, exosomes, microvesicles, and apoptotic bodies) are heterogeneous entities produced by a variety of cells (notable from SC and tumor cells), and their immunomodulatory ability to exert pro-regenerative effects opens up unprecedented opportunities in SC-based therapies. Acute kidney injury and stroke are already disease models for studying the biology of extracellular vesicles, and the recently established (2012) *International Society of Extracellular Vesicles* (ISEV) is seeking for further researches to fully exploit the potential use of extracellular vesicles for regenerative medicine therapies.

The last chapter is devoted (as expected) to the many aspects that "ethics in stem cell applications" entails: from the moral status of embryonic SCs to the legal problems related to patenting are discussed with a special focus on Germany's regulations.

All chapters are decorated by clear and well-designed color illustrations.

I am pretty sure the book will meet the reader's expectations.

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