Preface

The continuing enthusiasm for and controversy around stem cell research has been spurred by the establishment of human embryonic stem cell lines in 1998. This technology has opened up novel avenues for tissue engineering in organ transplantation. Never in the history of biomedical research have scientific discoveries stirred up such tremendous repercussions on a global scale. Stem cells have been compared to the "fountain of youth", that mankind has searched for since time immemorial. It has been speculated that out of stem cells, we might be able to produce all sorts of replacement parts for regenerative medicine.

Despite this world-wide enthusiasm and efforts, major fundamental issues have remained unresolved. For embryonic stem cells, the challenges are tumorogenesis, rejection by the host immune system, transmission of pathogeneic agents during cultivation, in addition to the continuing ethical debate. For adult stem cells, initial results intended to demonstrate the plasticity potentials have been severely challenged. Some of the initial experiments were not reproducible and others have demonstrated that nuclear or cell fusions might account for most of results interpreted to be due to transdifferentiation. In addition adult stem cells, if identifiable, are of such miniscule amount to be of no clinical relevance.

Nevertheless, stem cells derived from the adult bone marrow, i.e. hempatopoietic stem cells, have been used in the clinic already for almost 40 years for patients with leukaemia and hereditary immuno-deficient diseases. Within this time, blood stem cell transplant has evolved from an experimental therapy into standard of care for specific types of myelo- and lymphoproliferative disorders. Progress was, however, gradual and incremental and many groups have contributed. This development has shown that stem cell research requires resources, commitment and team work.

To bring stem cell technology into clinical practice for regenerative medicine, a thorough understanding of the basic principles underlying stem cell regeneration and regulation of self-renewal versus differentiation is absolutely essential. Research efforts in the next years should focus on the cellular and molecular mechanisms regulating "stemness" and the decision process involved in differentiation. Only through a fundamental understanding of these principles can we be able to acquire the power to manipulate a stem cell's destiny. This volume, Frontiers in Stem Cell Transplantation, deals with all the above mentioned challenges.

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Part 1 focuses on basic stem cell biology with an introductory chapter on clinical potentials of stem cells. This is followed by a chapter each on the epigenetic control of hematopoietic stem cell fate and the impact of micro-RNAs on stem cell biology and medicine.

Part 2 focuses on standardization and quality assurance of stem cell preparations with chapters on novel mobilization based on a precise understanding of the SDF-1α/CXCR4 pathway in stem cell lines derived from umbilical cord blood and bone marrow and the challenges associated with genetic manipulation of hematopoietic stem cells.

Part 3 focuses on the strategies which are on the threshold to clinical applications: large animal models testing the plasticity of human marrow-derived stem cells, a unique murine blastocyst model for studying transdifferentiation, animal models testing the potentials of MAPC, and mesenchymal stem cells as vehicles for genetic targeting. The last and fourth is on novel strategies using adult stem cells within clinical trials. Mesenchymal stem cells might serve as a unique immunomodulator, and this is dealt with in chapter 15. The clinical practice and the evidence for adoptive immunotherapy in hematologic malignancies are summarized in chapters 14 and 16.

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