Stem Cells and CNS Development

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Many tissues contain a few undifferentiated cells – stem cells – which can divide and self-renew, and which also form several other more mature cell types. Stem cells in the hematopoietic system have been known for a long time and have successfully been used in the clinic to generate new blood cells in patients. The discovery of stem cells within the adult brain flipped the dogma, that mature nervous tissue is incapable of renewal and structural remodelling, on its head. This exposed the potential to harness neural stem cells for therapeutic benefits in neurodegenerative disease, ranging from Parkinson's and Alzheimer's diseases through to stroke, and perhaps even depression and learning. The potential has not gone unnoticed by venture capitalists who have poured millions into a flock of biotech companies looking to reap riches through treatments using stem cell technology.

Expert knowledge

The editor of *Stem Cells and CNS Development*, Mahendra S. Rao, has invited internationally renowned experts to contribute first-hand knowledge and their perspectives on various aspects of stem cell biology. The reader is introduced to the role of neural stem cells in the embryonic and developing nervous system, coupled to their unearthing in the adult brain and the contentious issue of which cell type is the 'true' neural stem cell. The principal focus of the book, however, concerns the proliferative capacity and multi-potency of stem cells and the degree to which they retain this inherent ability to generate all nervous system cell types. Indeed, individual chapters are dedicated to these defining features of both embryonic neural stem cells and those that are evident in the mature CNS. One intriguing question that is addressed is whether there is a basic stem cell type in the CNS, or if we are dealing with multiple kinds of age- and region-specific stem cell types. As the mammalian CNS develops, distinct regional populations of progenitor cells (proliferating, undifferentiated cells that arise from stem cell division) become restricted in their potential and are confined to either a neuronal or a glial fate. This could reflect stem cell limitations with maturity, a topic discussed in consecutive chapters.

Unfortunately the question of how closely related neural stem cells are to stem cells from other tissues, such as those found in bone marrow or skin, is not addressed. Recent reports show that blood cells might be able to give rise to brain cells, however, whether this is caused by a phenomenon known as transdifferentiation, or the presence of a 'universal stem cell', remains to be determined. The identity of the most stem-like cell in the CNS is also not yet clarified and the book would have benefited from a more objective review of this topic.

Therapeutics

The final section of the book surveys how neural stem cells are beginning to be used for therapeutic purposes, both through the stimulation of endogenous neurogenesis and transplant therapy. The multi-potency combined with the possibility to vastly expand stem cell-derived cultures underpins the enormous potential for their use in transplant therapy for the treatment of neurodegenerative disorders. This attribute has not been lost on some of the contributing authors who have recently become affiliated to biotech companies that exploit neural stem cell technology. From a drug discovery point of view, the stem cell field is still largely unexploited. This book has the ambition to address this issue but, unfortunately, never goes beyond stating the obvious and discussing standard technical approaches.

One of the strong features of the publication lies in the comprehensive documentation of the experimental approaches that the authors and other leaders in the field have followed. This takes into account both *in vivo* and *in vitro* studies that are determining the crucial factors and mechanisms governing stem cell fate. It authoritatively and comprehensively covers the current field of neural stem cell research, but the visionary context is weak – unexpected for a book in a field that is moving forward so rapidly.

For the reasons discussed above it is an impossible task for a book to present up-to-date information on areas such as patents, US federal guidelines and companies, which are appended, and this book is no exception. For keeping abreast with news in this area, the readers should rather be advised to visit some of the relevant sources of information on the internet, such as http://www.nih.gov.

This book is not a passive read; the reader is left to assimilate the information from the chapters, which each have a distinct focus, to gain an overall picture of the status and potential of this field. Into this rapidly expanding area of research, scientists are drawn from a wide range of backgrounds. *Stem Cells and CNS Development* provides a valuable tool for neurobiologists to unravel this complex field, a field that is rewriting textbooks as it progresses.

Lilian Wikström and Alex Mercer
NeuroNova AB,
Fiskartorpsvägen 15 A-D
SE-114 33 Stockholm, Sweden
e-mail: lilian.wikstrom@neuronova.com

  PII: S1359-6446(01)02041-4