Special issue

Stem Cells

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Stem cells

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Since the first successful isolation and culture of human embryonic stem cells in 1998, stem cells have made headlines in high-impact scientific journals as well as in the news media. The almost unlimited biomedical potential of human embryonic stem cells as well as the ethical concern regarding their origin has been discussed worldwide by scientists, politicians, ethicists and the general public. As always when controversial issues are introduced there are different opinions and also many misconceptions resulting in heated discussions. There are great expectations for the application of human embryonic stem cells in regenerative medicine. It is, however, important to bear in mind that these cells have not yet entered clinical trials and they may not do so for some years to come. In the meantime human embryonic stem cells are emerging as important screening tools in drug development and as models for understanding normal organogenesis and disease processes. The controversies associated with human embryonic stem cells have reawakened interest in somatic or tissue-specific stem cells. This is evidenced by the fact that during the past five years we have witnessed a dramatic increase in our understanding of how stem cells in different compartments are regulated and it is becoming clear that stem cell fate is controlled by conserved signalling pathways and transcription factors that are shared by different stem cell types. Knowledge from one system can thus – at least to some extent – be extrapolated to other systems, emphasizing the importance of continued research on both embryonic and somatic stem cells.

The increased interest in stem cells is reflected by a quick scan of PubMed revealing almost 125,000 publications on stem cells in the biomedical literature in the last 25 years, 33,000 of these after the year 2000. During the first 10 years of this period the majority of the papers focused on haematopoietic stem cells or non-human embryonic stem cells and many of them did, in fact, not describe any experimental work on stem cells as they would be defined today. In recent years there have been some major advances in stem cell research. There is no doubt that the future is bright for stem cell research but at the same time it is important to capture the big picture to be able to translate information from one stem cell system to another.

With such an overwhelming wealth of new information there is a great need for high quality review articles aimed at a wide range of professionals who have to be well and reliably informed and up-to-date before they can start educating the general public and advising politicians. Scientists in basic as well as applied biomedical research have to keep up with a very rapidly developing field. Stem cell research will have a fundamental effect on our thinking in the biomedical sciences, as new and often unexpected light is being shed on the processes governing generation and maintenance of tissues and organs as well as on the origin and development of many diseases.

Stem cells have been heralded as offering great hope for patients suffering from chronic degenerative diseases or tissue destructive autoimmune diseases such as Parkinson’s disease, diabetes, or consequences of spinal injury. This type of repair, replacing and regenerating new healthy tissue from implanted stem cells, is unfortunately far more complicated than the general public realizes and will require years of re-
search before entering clinical practice. Nevertheless there is already one success story. The use of haematopoietic stem cells to reconstitute a new immune system following ablative treatment for leukaemia is general clinical practice and has dramatically changed the outcome for patients with haematological malignancies.

In this APMIS special issue we have collected reviews from renowned experts on a variety of topics within the stem cell field, creating a comprehensive collection of papers dealing with embryonic stem cells, organ-specific stem cells, carcinogenesis and therapeutic prospects. Germ cells are the topic of the first review by Aponte et al. describing the successful isolation and long-term culture of the stem cells that give rise to spermatozoa. The following four reviews are on embryonic stem cells. The first two provide a general description of the origin and characteristics of human embryonic stem cells (Semb) and problems relating to the chromosomal instability of these cells in long-term cultures (Hanson & Caisander). The review by Kristensen et al. gives a detailed overview of cytokine signalling in mouse and human embryonic stem cells, and this is followed by Valdimarsdóttir & Mummery focusing on the role of TGFβ in the control of self-renewal and differentiation of mouse and human embryonic stem cells. Haematopoietic stem cells are the subject of three reviews describing their origin and development during embryogenesis in human, mouse and avian models (Bollerot et al. and Pietilä & Vainio) and the history and current status of allogeneic haematogenic stem cell transplantation (Ringdén & Le Blanc). The intriguing and much debated question of transdifferentiation of tissue-specific stem cells, sometimes called stem cell plasticity, is addressed by Krabbe et al. The concept of organ-specific stem cells raises important issues concerning origin and cell renewal with implications for therapeutic applications as well as carcinogenesis. These aspects are discussed by Young for the mammalian eye, Madsen for pancreatic beta cells, Santoni-Rugio for liver cells and Villadsen for the human breast. The increasing evidence for cancer as a stem cell disease is the subject of the final review in this issue by Gudjonsson & Magnusson.
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