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Editorial

The Complexities of Engineering Human Stem Cell-Derived Therapeutics

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The aim of this special issue is to provide the scientific audience with an up-to-date review of pluripotent and tissue-specific stem cells and their differentiation in combination with cellular engineering in the quest to develop novel regenerative therapies.

The field of regenerative medicine is focused on the creation of functional tissue units to either repair or replace compromised tissue or organs in vivo. The field therefore offers the promise that, in the future, scientists will be able to grow tissues in the laboratory and use them safely as extracorporeal devices to stimulate endogenous repair [1] or implant them when the body cannot heal itself, but only when cell-based therapies are deemed safe and effective [2, 3]. If successful, such an approach would have a significant impact on the problem of the shortage of donor organs available for transplantation.

The collections of papers that make up this special issue provide broad-ranging coverage of the field and provide comprehensive and up-to-date reviews of human development and the relationships that exist between development, regeneration, carcinogenesis, and the role of stem cells in these processes (Kung et al., 2010). There is a focus on application of this knowledge using human embryonic stem cells which have the potential to provide novel biological models and medical devices (Sharma et al., 2010). Additionally, we discuss adult stem cell populations exploring their in vitro expansion (Wells, 2010) and plasticity (Lui et al., 2010), essential to regenerative medicine and tissue engineering. This is supported by the review article on generating the correct cell-cell and cell-environment interactions in these processes (Titushkin et al., 2010).

The ability to prepare homogeneous preparations of somatic cells for regenerative medicine will necessitate the development of methods which are simple and do not expose derivative cell populations to greater stress. A highly attractive procedure, dielectrophoresis, shows great potential in population enrichment and in stem cell sorting and is discussed in this special issue (Pethig et al., 2010). It is likely that technologies which do not require cell surface labels will play an increasing role in regenerative medicine.

Stem cell-based therapies have been used successfully in the past, and many more are predicted for the future, therefore, it is critical that we produce cell types which are stable and contribute to tissue homeostasis in vivo. A crucial element of tissue homeostasis and organ stability is DNA repair. This process protects stem cells in both embryonic and adult tissues from genetic damage thereby maintaining a stable genome. DNA repair is a fast and efficient process, but it can prove problematic when stem cells undergo malignant transformation (Frosina et al., 2010). In order to gain a better understanding of this process noninvasive cellular techniques have been developed to accurately determine differences in normal and transformed cell lines. Raman spectroscopy is one such example and has provided insight into changes in DNA and RNA concentrations during the lifecycle of a cell, and, as such, we have highlighted this technique as a promising approach in this issue (Downes et al., 2010).

We hope that this collection of papers stimulates interest within the academic community and provides a basic and up-to-date overview of key areas in regenerative medicine, cell biology, and tissue engineering.

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