INVESTIGATION OF ENGINEERING HUMAN EMBRYONIC STEM CELL DIFFERENTIATION

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Stem cell research is one of the promising areas of biotechnology, which offers the prospect of developing new methods to repair or replace tissues or cells damaged by injuries or diseases. The therapeutic potential of stem cells includes chronic heart disease, end-stage kidney disease, liver failure, diabetes, cancer and many other are diseases. Recent advances in human embryonic stem cell (hESC) biology now offer an alternative cell source for tissue engineers, as these cells are capable of proliferating indefinitely and differentiating to many clinically relevant cell types. The indefinite proliferative capacity and ability to differentiate into all somatic cell types can make human embryonic stem cells (hESCs) useful in experimental and applied studies in embryonic development, tissue engineering, genetic engineering, pharmacokinetics, and the like.

Novel culture methods capable of exerting spatial and temporal control over the stem cell microenvironment allow for more efficient expansion of hESCs, and significant advances have been made toward improving our understanding of the biophysical and biochemical cues that direct stem cell fate choices. Urrent sources of stem cells for tissue engineering include embryos and adult donors. The range of cell types to which they can differentiate varies, with embryonic stem cells the most pluripotent. For tissue engineering, stem cells can provide a virtually inexhaustible cell source. Current research is focused on promoting stem cell differentiation to required lineages, purification of consequent cells, confirmation that there is no residual carcinogenic potential in the cell population and implantation in a form that will replace or augment the function of diseased or injured tissues. Both types of stem cell, embryonic and adult, have drawbacks. With embryonic stem cells there are ethical considerations, together with the possibility of tumorigenicity; also, not many cell lines are available. Adult stem cells are more limited in potential and are often difficult to harvest in sufficient numbers. Thus, the search continues for an ethically non-controversial, easily accessible and abundant source of stem cells. The discussion here focuses on embryonic stem cells.

Effective production of lineage specific progenitors or terminally differentiated cells enables researchers to incorporate hESC derivatives into engineered tissue constructs. Therefore Novel engineering approaches will play a key role in studying ESC differentiation and developing ESC tissue engineering therapies. Here, we describe current efforts using hESCs as a cell source for tissue engineering applications, highlighting potential advantages of hESCs over current practices as well as challenges which must be overcome.

Keywords: *Human embryonic stem cells, Tissue engineering, differentiation*