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Process of Regenerating Cells to Establish Normal Function

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Abstract

Research on stem cells is advancing knowledge about how an organism develops from a single cell and how healthy cells replace damaged cells in adult organisms. This promising area of science is also leading scientists to investigate the possibility of cell-based therapies to treat disease.

Keywords: Pain status; Campaigns; Equipment; Heterogeneity; Lesions; Interventions

Introduction

In our present review we tried to provide the information about stem cells and their significant role in regenerative medicine for treatment of various diseases. In the early 1900's European researchers realized that the various type of blood cells, white blood cells, red blood cells and platelets all came from a particular 'stem cell'. Stem cells were first studied by Becker et al. (1963), who injected bone marrow cells into irradiated mice and noticed that nodules developed in the spleens of the mice in proportion to the number of bone marrow cells injected. They concluded that each nodule arose from a single marrow cell. Later on, they found by evidence that these cells were capable of infinite self-renewal, a central characteristic of stem cells. Thus, stem cells by definition have two essential properties, i.e. the capacity of self-renewal, and the capacity to differentiate into different cell lineages [1]. Under the right conditions, or given the right signals, stem cells can give rise to the many different cell types that make up the organism. Stem cell lineage determination is explained by several ideas, one among is focused on the stem cells microenvironment or 'niche'. A niche consists of signalling molecules, intercellular communication and the interaction between stem cells and their neighbouring extracellular matrix. This three-dimensional microenvironment is thought to influence and control genes and properties that define stem of the stem cells, i.e. self-renewal or development to committed cells. An interesting theory put forward is that stem cells might be terminal differentiation cells with the potential to display diverse cell types, depending on the host niche. Adult stem cells that are implanted into a totally different niche can potentially differentiate into cell types similar to those found in the new environment [2]. The potential of stem cells and its plasticity are having invaluable properties for regenerative medicine. Beneficiaries of regenerative medicine include the increasingly ageing population, people with sports injuries and war casualties. The tremendous technological progress achieved during the last decade in gene transfer methods and imaging techniques, as well as recent increases in our knowledge of cell biology, have opened new horizons in the field of regenerative medicine. Genetically engineered cells are a tool for tissue engineering and regenerative medicine, albeit a tool whose development is fraught with difficulties. This review summarizes current knowledge of stem cells in regenerative medicine particularly in the treatment of various diseases. Although the term stem cells are often used in reference to repair cells within an adult organism, a more fundamental variety of stem cells is found in the early stage embryo. Similarly, there is now emerging evidence of benefit following transplantation of human embryonic stem cell derived neural progenitors and cardio-myocytes into animal models of Parkinson's disease and myocardial injury respectively. In the mouse, there is now proof of concept for the use of ES cell-derived tissues to treat models of diabetes, myocardial infarction, spinal injury, and a severe genetic immune disorder. In as much as this type of experimentation with mouse ES cells has gotten under way in only the past years, the progress is Encouraging, For most cell types of interest, this is not yet really feasible, though in some areas pure populations of precursor cells may routinely be obtained from ES cultures, expanded in numbers, and differentiated into mature cells [3]. For neurodegenerative diseases, it is better to transplant neural progenitor cells or fully mature neurons. Conversely, recent evidence suggests that even in their undifferentiated state, human embryonic express discrete levels of HLA class I antigens that increase as the cells mature. An interesting viewpoint has recently been proposed that irreversible arrest of cell division rather than the death of each and every cell correspond to the organism death of the embryo. Embryonic stem cells are pluripotent cells that can give rise to derivatives of all three embryonic germ layers. Due to its characteristics, the patient-specific ES cells are of great potential for transplantation therapies [4]. Considering future clinical use, the differentiation from ES to neurons, cardio-myocytes and many other types of cells provide basic cognition and experience to regenerative medicine. Adult stem cell populations have been most thoroughly characterized in mouse and human bone marrow, where they continuously replenish the differentiated cells of the peripheral blood lost through attrition [5]. From studies of the haematopoietic system it has been possible to define a stem cell as a cell with the capacity to self-renew and to generate cells of multiple diverse lineage within the tissue in which the stem cell resides. The ability of the haematopoietic stem cells within bone marrow to give rise to all blood elements has been extensively exploited in the clinic for transplantation of bone marrow and stem cells. Recent reports suggest that some of these stem cells can differentiate outside of their tissue of origin. Both muscle and neural tissue appear to be a source of hematopoietic stem cells, whereas bone marrow may house muscle precursor cells. Moreover, bone marrow stroma, which contains mesenchymal stem cells, may also give rise to neurons and glia. Indeed, the breadth of lineage capabilities for both the mesenchymal stem cells and hematopoietic stem cells of bone marrow

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are subjects of active study and lively debate. The mature central nervous system has a limited capacity for self-repair therefore many different cell-engineering strategies are used to regenerate damaged neurons. Stem cells will provide an inexhaustible source of neurons and glia for therapies aimed at cell replacement or neuro protection in disorders affecting the brain and spinal cord. The most obvious and familiar application of stem cell research for nervous system disorders is through cell replacement therapy. The possibility of using stem cells as a source of neurons that can be implanted to replace cells and circuits lost in Parkinson's disease, amyotrophic lateral sclerosis, Huntington's disease, or Alzheimer's disease is an exciting prospect. Vawda review potential sources of cellular replacements, including embryonic stem cells, fetal and neonatal neural stem cells and a variety of mesenchymal stem cells. They also reviewed published studies to illustrate where stem cell therapies have been evaluated for therapeutic gain and discuss the hurdles that will need to be overcome to achieve therapeutic benefit. Overall, they concluded that children with paediatric brain injuries or inherited genetic disorders that affect the brain are worthy candidates for stem cell therapeutics. Neurodegenerative diseases are characterized by progressive and gradual irreversible loss of physiologically active neurons over a period of several years, ultimately leading to significant morbidity and mortality. The two most common age-related neurodegenerative disorders are Parkinson's and Alzheimer's diseases. Parkinson's disease is a very common neurodegenerative disorder that affects more than the population. Such disease is pathologically hallmarked by the presence of intra-neuronal Levy bodies and a progressive neuro-degeneration of dopaminergic neurons in the substantial nigra, resulting in depletion of striatal dopamine [6]. This is clinically manifested in motor dysfunctions and rigidity, sometimes combined with rest tremor and postural changes [7].

Discussion

Factors that support this notion include the knowledge of the specific cell type needed to relieve the symptoms of the disease. It is thought that PD may be the first disease to be amenable to treatment using stem cell transplantation. The hope is that research on human ES cells may reveal methods for producing an infinite supply of dopamine neurons for transplant into patients and the isolation of human embryonic stem cells has stimulated research aimed at the selective generation of specific cell types for regenerative medicine. At NIH, Lee have used a progressive expansion, selection, and differentiation strategy to convert mouse ES cells to a mixed population of mature neurons in tissue culture with having the characteristics of dopamine cells [8]. Using different approach, have generated dopamine neurons from mouse ES cells without embroid body formation. Clinical trials of the transplantation of human fetal dopaminergic neurons have shown that cell replacement can produce major, long-lasting improvement in some patients. So it is promising that cells with properties of dopaminergic neurons have been generated in vitro from stem cells of various sources, such as ES cells and stem cells isolated from bone marrow and fetal brain. To make stem-cell therapy for PD, dopaminergic neurons with the characteristics of substantial nigra neurons must be produced in large numbers. Some patients will need implants in several areas of the brain, optimum recovery will require a tailor-made grafting procedure based on preoperative imaging [9]. It will also be necessary to develop strategies that hinder disease progression. One possible approach to prevent the death of existing neurons could be to transplant human stem cells engineered to express neuro protective molecules such as glial-cell-line-derived neuro trophic factor. Regarding human stem cell therapy, scientists are developing a number of strategies for producing dopamine neurons from human stem cells in the laboratory for transplantation into humans with Parkinson's disease. To overcome the shortcomings of foetal and embryonic tissues as sources for neural grafts and invasive surgical procedures, embryonic stem cells, neural stem cells derived from foetal or adult brain and other tissue stem cells derived either from bone marrow or umbilical cord blood have been experimentally applied to generate dopaminergic neurons. Such cells will help to provide a clinically competent and effective therapeutic regime without the need for further interventions. Stem cells graft strategies are: in vitro pre-differentiation to dopaminergic neurons prior to transplantation; or in vivo differentiation of stem cells after implantation into the striatum or substantial nigra. The most important clinical issue is the ability to generate functional dopamine neurons and establish the role of other cell types, such as glial cells, present in the mesencephalic foetal grafts in the differentiation and function of these neurons. Site specific integration in to the brain parenchyma is essential to replace dopamine in a physiologically natural fashion [10]. This requires transplanting a cell population with a high percentage of live cells secreting a consistent and standard amount of dopamine that is capable of interlinking with the host cells to replace damaged neuronal circuitry without immune rejection.

Conclusion

Importantly, the loss of a single phenotype of cells, together with the uniform pathology that characterizes Parkinson's disease, suggests treatment regime based on the substitution of this single neuronal cell type. The successful generation of an unlimited supply of dopamine neurons could make Neuro-transplantation widely available for Parkinson's patients at some point in the future.

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Conflict of Interest

None

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