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STEM CELLS & TISSUE ENGINEERING

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TABLE OF CONTENTS

Amnion-Derived Stem Cells *(Dale Woodbury, RWJMS 06-22)* *Therapeutic*

Background
Recently, stem cells have been identified in a number of extra-embryonic tissues, including the placenta and chorion. The present invention revolves around identification and characterization of new fetal stem cell population isolated from the amniotic membrane. Unlike the previously described amniotic epithelial and mesenchymal cells, these amnion-derived stem cells (ADSCs) exhibit the prototypical stem cell traits of long-term self renewal, multi-differentiation and clonogenicity.

Description of the Technology
The present invention discloses the methods for isolation of a novel stem cell population from the amnion, an extra-embryonic structure. Additionally, novel methodology for cryopreserving the amnion is disclosed, allowing for long-term storage in standard laboratory freezers. The isolated ADSCs express neuro-ectodermal (MAP-2, neurofilament-M, GAP-43), mesenchymal (vimentin, fibronectin, osteonectin) and endodermal (BDNF, NT-4/5) and growth factors (FGF2, BMP2). Also the isolated ADSCs differentiate into neural, fat, bone and liver cells. These ADSCs were found to survive for at least two months (the longest time investigated) after *in utero* transplantation into the embryonic brain and liver.

Applications
- As an alternative stem cell population to embryonic stem cells.
- Potential to be utilized in any clinical application involving cell replacement including, but not limited to, Alzheimer's disease, Parkinson's disease, spinal cord injury, ischemic events (heart attack, stroke), heart failure, diabetes, osteoporosis, liver failure and kidney disease.

Patent Status
United States Provisional Application – June 2006.

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Method for Producing a Functional Neuron *(Rameshwar, NJMS 04-50) CNS/Stem Cells*

Background

Experimental evidence shows that stem cells could have future benefits in the area of regenerative medicine. Mesenchymal stem cells (MSCs) are major adult bone marrow stem cells with multilineage potential. They are easily obtained from adult bone marrow, and can be expanded by *in vitro* procedures. MSCs have been shown to transdifferentiate into cells of other germ layers and the generation of MSCs into neurons as characterized by morphology and action potential has been studied. However synaptic transmission has not been reported for neurons derived from MSCs. **The present invention describes a method for generating functional neurons from adult human MSCs.**

Description of the Technology

The present invention is a method for producing a functional neuron. The transdifferentiation of MSCs into neurons is determined by phenotypic and electrophysiological analysis. In particular embodiments, the functional neurons are subsequently polarized by contacting the functional neuron with at least one selected growth factor. Isolated functional neurons and polarized functional neurons are also provided. The neurons provided by the method of the present invention are capable of synaptic transmission, as evident by immunofluorescence for synaptophysin, and can be used in neuronal repair.

Applications

- For treatment or amelioration of a variety of diseases or conditions including, but not limited to, neurodegenerative diseases such as Parkinson's disease, Alzheimer's disease, Down's syndrome, prion disease, polyglutamine disease, and amyotrophic lateral sclerosis; cerebral ischemia; demyelination; head injury; spinal damage; cerebral infarct and the like.

Patent Status

United States patent application filed in November, 2005

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Miniature Tissue Culture System *(Samuel Lieber & Stephen Vatner, NJMS 06-09)*
Research Tool

Background
Currently there is great interest in using Tissue Engineering techniques and Gene Therapy towards the treatment of disease and dysfunction. The development of these concepts, however, requires a better understanding of the mechanical and biochemical mechanisms that regulate normal and diseased tissue growth and development. The present invention discloses an engineered system that allows the culture and mechanical/biochemical testing of small-scale rodent tissues. This miniature tissue culture system can be used to develop new tissue engineering methods and novel gene therapy solutions towards potential clinical treatments.

Description of the Technology
The design of the Miniature Tissue Culture System (MTCS) is unique in that manipulations can be conducted for positioning and cannulating small scale tissues all in a sealed culture bath environment. Currently, the MTCS has been configured to perfuse the mitral and aortic valves while they sit in their natural position in the heart, where we have successfully cultured the mitral valve of 10-day old mouse hearts for four days. However, other small-scale rodent tissues could also be cultured under perfusion in the MTCS; including: the whole heart, arteries, veins, kidneys, stomach, and intestines. The MTCS can also be used to study Gene Therapy techniques where it has already been successfully used to induce adenovirus-mediated gene transfer into the cultured valve.

Applications
- To culture rodent tissues under perfusion allowing mechanical and biochemical testing of tissues
- To study Gene Therapy methods by inducing adenovirus-mediated gene transfer into the cultured tissues
- To study the genetic (signaling pathways) and epigenetic (shear flow) factors involved in developing rodent tissues.
- To culture rodent heart valves, i.e. the mitral and the aortic valves, while sitting in their natural position in the heart.

Patent Status
United States Provisional Application filed 2006.

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Extracellular matrix for transplant survival and differentiation *(Marco Zarbin, NJMS 06-59) Tissue Engineering*

Background

Age-related macular degeneration (AMD) is the most important cause of new cases of blindness in patients older than 55 years of age in the industrialized world. Retinal pigment epithelium (RPE) cells are thought to be targets of the pathological processes that cause AMD. In diseases such as AMD, RPE and photoreceptor cell death constitutes a component of "irreversible" visual loss in many patients. Among AMD patients with evolving atrophy, RPE transplantation could be curative. However, disease-related changes may mask extracellular matrix ligand availability to transplanted cells, impairing post-attachment events and leading, in turn, to cell death or inability of the cells to differentiate. The present invention relates to the production of an extracellular matrix and methods of use for clinical treatment for disease in the central nervous system, including the eye.

Description of the Technology

The present invention is a b*iologically* synthesized complex extracellular matrix featuring a complex 3D structure that is difficult to reproduce artificially and, depending upon cell source of extracellular matrix, can incorporate cell stimulating and cell supporting molecules (e.g., growth factors and glycosaminoglycans). The matrix of the present invention will raise the transplanted cells above the damaged or age-modified surface thereby removing the cells from toxic interactions with the underlying surface and providing an environment for growth and differentiation of the transplanted cells.

Applications

- Transplantation of extracellular matrix as adjunctive treatment combined with cell transplants for geographic atrophy in AMD, choroidal neovascular membrane excision in AMD, glaucoma, Parkinson's, Alzheimer's, diabetes mellitus, and potentially other diseases.

Patent Status

United States Provisional Application –2006.

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Methods and Compositions for the Regulation of Proliferation of Stem Cells
(Pranela Rameshwar, NJMS 02-20) *Oncology/Stem Cells*

Background

Chemotherapeutic agents do not distinguish between the aberrant cancerous cells and the rapid growing, but normal stem and immune cells. Hence, both tumor and healthy stem and immune are killed off by the administration of chemo- and radio-therapeutic toxic agents. This leads to a drop in blood count, suppression of the immune response, and to an increased risk of bacterial and/or fungal infection, which can lead to death. Thus, there has been and continues to be, a long felt need for a away to protect the healthy stem and progenitor cells of the body from the toxic effects of chemo- and radio-therapy. The present invention includes novel compositions and methods for showing, and or turning off, stem and progenitor cell growth in a subject, specifically, in a subject about to undergo toxic cancer treatment, thus protecting these cells from the highly toxic effects associated with chemo- and radio-therapy.

Description of the Technology

UMDNJ researchers have discovered that neutral endopeptidase (NEP) utilizes Substance P (SP) to produce a tetrapeptide, SP(1-4), that inhibits proliferation of lymphoid-myeloid stem and progenitor cells, It has been determined, through its interactions with TGF-beta and TNF-alpha, that SP(1-4) can be used as an effective treatment to shield both stem and progenitor cells from the toxic effects of chemo- and radio-therapy thereby protecting a subject's immune system from being compromised and reducing the risk of bacterial or fungal infection, allowing for a greater dosage of chemo- and/or radio-therapy to be administered and/or over a longer administration period, as well as, shortening the recovery period required for new stem cell growth and terminal blood cell replenishment.

Patent Status

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