Màster Biomedicina

Programa de l'assignatura:

Nom de l'assignatura: Cèl·lules mare i medicina regenerativa Crèdits: 3 Coordinador: Josep M. Canals

Professorat: Josep M. Canals Francesc Cebrià M. Carme Auladell Ana M. Gomez Raquel Martín-Ibañez Michael Edel

Departaments implicats:

Departament de Biologia Cel·lular, Immunologia i Neurociències, Facultat de Medicina, Universitat de Barcelona.

Departament de Genètica, Facultat de Biologia, Universitat de Barcelona.

Departament de Biologia Cel·lular, Facultat de Biologia, Universitat de Barcelona.

Departament de Bioquímica i Biologia Molecular, Facultat de Biologia, Universitat de Barcelona. Departament de Ciències Fisiològiques I, Facultat de Medicina, Universitat de Barcelona.

Blocs temàtics:

1.- Introduction

2.- Regeneration in nature

- What is regeneration? Types of regenerative/repair responses after tissue damage or loss. Classical models of regeneration. The appearance of regeneration as a scientific discipline at the 18th century. Regeneration in the post-genomic era. Key questions in regeneration research. Regeneration and asexual reproduction. Phylogenetic distribution of regeneration.
- Wound healing: scarring vs scarless wound healing. Epidermis and epithelial/mesenchyme interactions to trigger a regenerative response. How is axial polarity re-established? The role of the Wnt/B-catenin pathway in AP polarity in Hydra and planarians. The role of the BMP pathway on DV polarity in planarians.
- Growth and pattern formation during regeneration: epimorphosis vs morphallaxis. The origin of the regenerative cells: stem cells (planarians) vs dedifferentiation (amphibians and zebrafish).
- The role of the nervous system in regeneration ("nerve-dependency" of amphibian limb regeneration). A conserved neural role required for planarian regeneration? Early events during regeneration: ROS (reactive oxygen species) and apoptosis as triggers for regeneration in vertebrates and Hydra.

3.- Stem cells in mammals

- Basis of cell therapy. Possible applications of cell therapy. Concept and definition of stem cells. The embryonic layers. Types of stem cells. Possible sources of cells.
- > Cultures of stem cells. Concepts of self-renewal and expansion.

4.- Pluripotent stem cells

- Embryonic stem cells. Obtaining stem cells. Techniques for obtaining and growth. Formation of teratomas and possible solutions.
- Cellular reprogramming. Induced pluripotent stem cells. Therapeutic cloning. Problems and advantages. Applications of IPSC in drug validation. Direct reprogramming.

5.- Hematopoietic stem cells

Hematopoietic stem cells. History of the treatment of hematologic diseases. Use of hematopoietic stem cells. Problems and benefits of treatment with HSC. Concept of autologous and heterologous transplantation.

6.- Mesenchymal stem cells

- Mesenchymal stem cells: bone marrow and fat derived MSCs. Concept of transdifferentiation. Autoimmune diseases. The immuno-modulator role of mesenchymal stem cells. Example of Crohn's disease.
- Cell vaccine; concept and potential disease target. Obtaining immune cells. Antigen presentation.

7.- Neural stem cells

- Location of stem cells in the adult brain. Stem cells located in specific niches: subventricular zone (ZSV) and dentate gyrus (DG) of the hippocampus. Analysis of the nature, dynamics and regulation of ZSV and GD stem cells.
- Changes in proliferation, differentiation and migration of stem cells against insult or injury to the brain. Changes observed in various neurological and psychiatric diseases, considered endogenous responses.

8.- In vitro expansion of stem cells

Techniques of stem cell growth, proliferation, and differentiation for pluripotent and somatic stem cells.

9.- Stem cell differentiation

Intrinsic and extrinsic factors. Genetic modifications. Candidate genes for differentiation. The differentiation of pancreatic cells. Differentiation of cardiac cells. Neuronal differentiation.

10.- Genetic modification of stem cells

- DNA/RNA transfer strategies: transgene addition and inhibition of endogenous gene expression. Non viral and viral vectors.
- Transient and stable gene transfer. Targeted and non-targeted insertion of the transgene into cell chromosomes.
- Markers and selector genes.

11.- Selection of stem cells

- > Surface markers. Cell selection techniques.
- > Introduction of genetic markers. Introduction the BACs, YACs, Zing-fingers.

12.- Transplantation and tracking of stem cells

- > Cell transplants. Differentiation vs. survival.
- > Non-invasive monitoring techniques *in vivo*. Magnetic resonance and luminescence.

13.- Carcer stem cells

Evidence of CSC. Origin of CSC. Cancers stem cells isolation. Heterogeneity (CSC markers). Metastatic cancer stem cells.

14.- Scaffolds

- Scafolds natural vs. artificial.
- Organs and tissues decellularization. Enzymatic and chemical treatments of organic material. Obtaining material from postmortem tissues. Recellularizing organs.
- > Artificial scaffolds. Natural biomaterials. Synthetic biomaterials

15.- Consolidated therapies and clinical applications

- Problems in cell therapy for hematologic diseases. Graft versus host disease (GvHD). Possible solutions.
- Cell therapy for musculoskeletal system. Applications of condrocytes for cartilage regeneration. The use of scaffolds in musculoskeletal damage.
- Cell therapy for eye diseases. Expansion of limbal cells. The use of amniotic membrane. Artificial scaffolds.

> Regeneration of skin. The use of bioreactors.

16.- Legislation

- Definition of advanced therapies. European legislation. Adaptation to Spanish law.
 The Spanish Drug Agency. The National Transplant Organization.
 GMP manipulation measures. Design of cell cultures facilities. Protocols and clinical trials.

Bibliografia:

Degut a l'actualitat de la temàtica no s recomanen llibres per a aquesta assignatura. S'aniran recomenant articles científics durant el curs de la mateixa.