

Endeavours and trends in spinal cord injury repair (Syllabus)

G. Onose, Monica Haras

“Carol Davila” University of Medicine and Pharmacy, Bucharest

Background

- SCI current data and statistics
 - Prevalence and incidence worldwide
 - Prevalence and incidence in Romania
 - Average age at injury, male: female ratio
- Medical and social consequences of SCIs
 - Clinical classifications of SCIs
 - Medical complications/ co-morbidities
- Current therapeutic means and their limitations in SCIs
 - Current context of Regenerative Medicine

Integrative emphases regarding limits, detrimental pathways and related targets for neuroprotection/ recovery, in SCI

- Morpho-functional, inner restrictions of the CNS/ spinal cord's post injury self-repair
- Primary injuries in SCI
- Secondary injuries - patho-physiological events' cascade - targets for neuroprotection
- Final (irreversible) consequences of SCIs
- Current trends in SCI (experimental) therapies

Integrative emphases – clinical/ therapeutic connections

- “Classical” drugs, with a long history of clinical use
- New/ experimental drugs/ procedures

Stem cells & tissue engineering - background

- Medical and social potential
- Brief history of stem cell research
- Spontaneous regeneration phenomena in lower vertebrates
 - Definition of Regenerative Medicine
 - Definition and clinical use of tissue engineering
 - Stem cells:
 - Definition
 - Classifications
 - Main characteristics & properties
 - Embryonic stem cells
 - Adult stem cells

Regenerative Medicine in SCI repair

- Main issues/ problems
 - Ethical concerns
 - The availability of suitable stem cells
 - The inhibitory environment of the lesioned SC, especially in chronic SCI (glial scar, cyst formation) → grafts fail to survive
 - Immune reactions to allografts/ xenografts
 - Regeneration with aberrant reconnections → neuropathic pain, spasticity
 - Contamination of the stem cell lines with feeder cells, bacteria and/or transfection with feeder cells genic material
 - High proliferative capacity of ESC → cancer risk
 - The role of glial scar prevention therapy (Regeneration Promoting Therapy)
 - Cordaneurin

- CordaChron
- Chondroitinase ABC
 - Current status of preclinical and clinical research of stem cells in SCI repair
 - clinical studies currently underway
 - Human embryonic stem cells (hESCs)
 - Fetal stem cells:
 - Fetal OEG (olfactory ensheathing glia)
 - Fetal Schwann cells
 - Umbilical cord blood cells
 - Adult stem cells:
 - Mesenchymal stem cells/ Marrow Stromal Cells (MSC)
 - Olfactory ensheathing glia (OEG) - including of differentiated ones transplants
 - Schwann cells - - including of differentiated ones transplants
 - Adult-derived neural progenitor cells NPCs
 - Stem cell research at the Teaching Emergency Hospital “Bagdasar-Arseni”, Bucharest, Romania
 - Tissue engineering in SCI repair
 - Polymeric scaffolds used for spinal cord regeneration - properties
 - “Smart” biomaterials - characterized by stereospecificity and self-assembling - nano-scale self-assembling bio-scaffolds
 - Recent conceptual & technological breakthroughs: implants built by 3D-printing
 - RP (rapid printing) machine (for replacement organs and whole bodies)
 - “Direct writing” - printing implants by MAPLE-DW

Conclusions

Considering the complexity of SCI pathobiology, it is important to adopt multifactorial (combinatory) strategies, that may include:

- (Stem) cell replacement

- Long distance guidance of neural re-growth and re-connection
 - Advanced scaffolding/ encapsulation (for cells replacement)/ tissue re-construction
 - Local delivery of neuroprotective/ neurotrophic substances (e.g. scar formation inhibitors, growth factors, neurotrophins)
 - Surgical removal of glial scars, posttraumatic cysts
 - Integrated Physical therapy

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*The University of Medicine and Pharmacy “Carol Davila”, Bucharest, Romania

**The Emergency Hospital “Bagdasar-Arseni”, Bucharest, Romania

***Metrorex Medical Service, Bucharest, Romania

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