Endeavours and trends in spinal cord injury repair (Syllabus)

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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 risc
- 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 breaktroughs: 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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