Stem cell based therapies for Parkinson’s Disease

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Stem cells in life

Stem cells creates the cells in our body during development

Stem cells also replenish many of our organs throughout life

- Stem cells in the blood makes 1 trillion ($10^{12}$) new blood cells every day
Stem cells in regenerative medicine

Stem cells can serve as reservoirs for cells and tissues needed to repair the human body

Hope vs Hype
What is a stem cell?

1. Make more stem cells  
   = self renewal

2. Make more mature cells  
   = differentiation
Different types of stem cells

**In vitro**

- **Fertilization**
  - **Zygote**
  - **Blastocyst**
  - **Gastrula**
    - Ectoderm
    - Mesoderm
    - Endoderm

- **ES cells**
  - Self-renewal

- **Organ-specific stem cells**
  - Self-renewal

- **Types of cells**
  - Endoderm
  - Mesoderm
  - Ectoderm
Which diseases can be treated with stem cells?

- Leukemia and other diseases in the blood
- Routine treatments
Stem Cell Treatments for Neurodegenerative Disease

Parkinson’s Disease
Huntington’s Disease
Alzheimer
Stroke
ALS

Charles and John Sabine
Parkinson’s Disease

- Tremor
- Muscle rigidity
- Difficulties initiating movements
- Posture and balance
- Non-motor symptoms

Image from: This is Parkinson’s
http://parkinsonslife.eu
Parkinson’s disease

Loss of midbrain dopamine neurons

Supply dopamine via medication
Transplantation of human fetal DA neuroblasts

Fetal DA neurons → Cell suspension → Stereotaxic injection
An instrument guides cells to their correct location
Before transplantation

12 months post-op

The method results in significant clinical benefit

Courtesy of Dr. Ivar Mendez, Halifax transplantation program
Difficulties using fetal cells

- Large variation in outcome
- Lack of material
- Ethical and societal considerations that vary with national regulations
- Logistical and practical issues
Stem cells!  

Stem cells are an unlimited source from which transplantable cells can be derived
Not all tissue specific (adult) stem cells are the same:

95% av kroppens celler
10 000 000 000 000 000 new cells/day
This is not the case for the brain:

- Hard to get to
- Low division (if any)
- New neurons formed in only very limited regions of the brain
- Do not self repair
This is not the case for the brain:
**Embryonic stem cells** are isolated from preimplantation blastocysts – an early developmental stage

Established embryonic stem cell cultures

- **Cleavage stage embryo**
- Cultured blastocyst
- Isolated inner cell mass
- Cells dissociated and replated
- Irradiated mouse fibroblast feeder cells
- New feeder cells
Embryonic stem cells are pluripotent and can make all mature cell types of the body.
Dopamine neurons derived from stem cells
Pre-clinical assessment in animal models of PD

Rotationstest:

Cylindertest:
Analyze the cells after transplantation
Form mature DA neurons

Release dopamine

Repair Circuitry

Restore motor deficits

stem cell derived DA neurons survive and function *en par* with fetal DA neurons
A Global Effort

**NeuroStemcellRepair**
European Stem Cell Consortium for Neural Cell Replacement Reprogramming and Functional Brain Repair

**Gforce-PD**

**G-force PD:** A Global Effort to Bring Cell Based Therapies to PD Patients
Conclusions and future directions

Stem cells in adult brain

Blastocyst → ES cells ✔

Fetal mesencephalon → Dopaminergic neurons

Patient

Hematopoietic and/or mesenchymal stem cells

Bone marrow

Skin biopsy → iPS cells
THANKS FOR LISTENING
AND THANKS TO MY
FANTASTIC
COLLEAGUES!