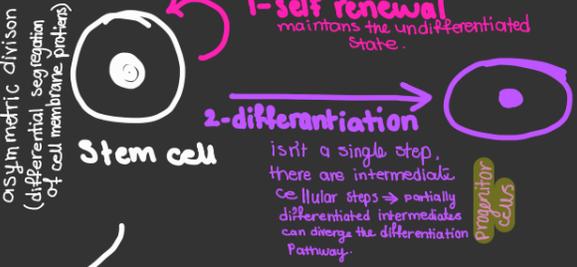


Stem cells

undifferentiated
primal cells common to all multicellular organisms



Stem cell niche
Specialized cellular environment that provides stem cells with the support needed for self-renewal and differentiation.

1. cells only
2. cells + ECM
3. secreted or cell surface soluble factors

from outside the niche

Importance:
Special support due to the demands, nutritive function, feedback control of stem cell pool size, coordination among tissue compartments, inter-lineage coordination

- Totipotent** → able to differentiate into all cells of the body + extraembryonic tissues
- Pluripotent** → all cells of the body
- Multipotent** → several cell types of the body
- Unipotent** → single cell type

embryonic stem cells (ESC)

- able to differentiate into all the specialized embryonic tissues
- from inner mass of mammalian blastocysts before implantation in the uterus
- pluripotent (Oct 4, Nanog, Wnt-β-catenin signaling)

Induced pluripotent stem cells (iPSC)

endogenous cells \ by reversing the differentiation of fully differentiated cells.

no ethical problems, safer, patient-specific \ autologous

comparison of iPS and ES cells:

morphology, surface antigens, gene expression, telomerase activities, epigenetic status of pluripotent cell specific genes, promoter activities, teratoma formation, proliferation, in-vitro differentiation.

Adult stem cells

- act as a repair system replacing specialized damaged tissues
- found throughout the body
- ability to differentiate is limited
- multipotent \ unipotent
- NOT pluripotent \ totipotent**

1 bone marrow stem cells

- hematopoietic stem cells → all cells of the blood
- Somatic stem cells (mammary stem cells, mesenchymal stem cells) → osteoblasts, chondrocytes, myocytes, adipocytes, neuronal cells

2 neural stem cells

Some types of neurons

Neurospheres: floating heterogeneous aggregates of cells containing a large proportion of stem cells responsible for adult neurogenesis. found in the subventricular zone + the dentate gyrus

3 adipose stem cells (ASCs)

(mesenchymal stem cells) → fibroblasts, endothelial cells, pericytes can be obtained after liposuction operation

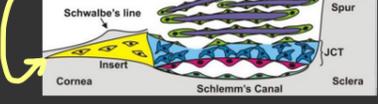
4 umbilical cord stem cells

hematopoietic stem cells + mesenchymal stem cells

5 olfactory adult stem cells

regenerating the olfactory sensory cells.

6 tissue stem cell of the cornea



Uses of stem cells

- to study differentiation signals + process
- genetic therapy
- Drug testing
- cell based therapies (personalized medicine)
- Cancer treatment

Stem cell therapy limitations

- Carcinogenicity** → mainly when they are transplanted as stem cells.
- Immune rejection** → when transplanting stem cells from one individual to another.
- Infection** → when transplanting stem cells from one individual to another.

Limitations of using adult stem cells

- lack of information about the stem cell markers results in difficulties to separate and identify cells
- in vitro-system for manipulating adult stem cell populations are not well defined
- we need to transplant cells in their proper in-vivo niche
- ability to differentiate is limited [multipotent]

Stem cell therapy & Parkinson's Disease

degeneration of nigrostriatal DA neurons

treatment available → L-DOPA, DA agonist, enzyme inhibitors, deep brain stimulation to replace loss of DA

NO treatment for dementia

- iPSCs for modelling the genetically complex PD
- **intra-striatal transplantation of cells derived from human embryonic mesencephalic tissue**

Stem cell therapy & Alzheimer's Disease

neuronal and synaptic loss, neurofibrillary tangles, deposits of β amyloid.

acetylcholinesterase inhibitors
anti β amyloid antibodies

- **neurogenesis or maturation of hippocampal neurons**
- **NGF releasing stem cells**

Stem cell therapy & Stroke

- local death of multiple neuron types, oligodendrocytes, astrocytes, endothelial cells.
- transplanted ESCs, iPSCs, NSCs to replace the missing/damaged brain cells
- MSCs were used to provide trophic support to enhance self-repair systems

Stem cell therapy & Spinal cord injury

- Formation of neurons, oligodendrocytes, astrocytes
- Formation of Synapses and axons
- remyelination: high purity oligodendrocyte progenitor cells (OPCs)

- * Clinical trials using stem cells have been performed \ initiated.
- * No stem cell-based therapy has yet been proved beneficial.
- * unproven treatments are offered at clinics with poor scientific and clinical basis
- * ethical, regulatory, societal, and economic issues need to be addressed.

