

BME449 Tissue Engineering



Lecture #6
Cell Sources in Tissue Engineering

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DIFFERENTIATION

Niche

Cellular microenvironment providing support and stimuli to control stem cell properties.

- Once a stem cell leaves its niche and is no longer under control of intrinsic and extrinsic factors that maintain the undifferentiated phenotype, they will start to differentiate.
- This cell will become a progenitor or precursor cell, or a transit amplifying cell

STEM CELL PLASTICITY

Plasticity; the ability of adult stem cells of one tissue to generate the specialized cell type of another tissue.

For example; hematopoietic stem cells might contribute not only to the formation of blood cells, but also to the formation of for example skin, liver, brain and heart.

EMBRYONIC STEM CELLS

- When cells are isolated from the inner cell mass of the blastocyst, they can be massively expanded in the laboratory, while maintaining their pluripotency (self-renewal). These in vitro propagated cells are called embryonic stem cells.
- Mouse ES cells were the first to be isolated (Evans and Kaufman, 1981 ; Martin, 1981).
- The next major breakthrough was in 1998, when Thomson et al (1998) isolated ES cells from human embryos.

EMBRYONIC STEM CELLS

- ESCs are derived from the inner cell mass (ICM) of a 5-6 day-old blastocyst

Adult vs. Embryonic Stem Cells

Embryonic

- Pluripotent (+)
- Highly proliferative (+)

- Non-autologous
- Ethical concerns
- Tumorigenic

Adult

- Multipotent
 - Limited proliferative capacity
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- Autologous (+)
 - Less controversial (+)
 - Non-tumorigenic (+)

Stem and Progenitor Cells

- Isolation/Identification
 - Signature of cell surface markers
 - Surface adherence
 - Transcription factors
- Classifications
 - Embryonic Stem Cells
 - Adult Stem Cells
 - Induced Pluripotent Stem Cells

Embryonic Stem Cells

Strengths

- Highest level of pluripotency
 - All somatic cell types
- Unlimited self-renewal
 - Enhanced telomerase activity
- Markers
 - Oct-4, Nanog, SSEA-3/4

Limitations

- Teratoma Formation
- Animal pathogens
- Immune Response
- Ethics