

BASICS OF STEM CELLS

***Dr. Niranjana Bhattacharya, D.Sc.,
M.D., M.S., FACS (USA)***

***Advisor and Consultant, B.P. Poddar
Hospital & AMRI (Gol Park)***

Characteristics of Stem Cells

- Stem cells have the potential to develop into many cell types during early life and growth.
- When a stem cell divides, it produces one stem cell and a specialized cell.

Stem cells differ from ordinary cells

- A. Stem cells are unspecialized cells, which is capable of renewing themselves after a long period of inactivity
- B. Under experimental or physiological conditions, they can be induced to become tissue or organ specific cells with special functions
- C. In case of gut and bone marrow, stem cells regularly divide and repair damaged cells; however, in case of the pancreas and heart, they divide under special conditions

Stem cells

- (a) Embryonic – mouse (1981), human (1998)
- (b) Non-embryonic, somatic or adult stem cells
- (c) In 2006, scientists could prepare induced pluripotent stem cells from adult cell reprogramming

In a 3 or 5 day old embryo, known as a blastocyst, the inner cell mass gives rise to an entire body of organisms.

Characteristics:

- Stem cells are capable of dividing and renewing for a long period
- Though unspecialized, they can produce specialized cell types
- Specialized cells like muscle cells, blood cells and nerve cells, do not normally replicate

Scientists are keen to understand why

- (a) Embryonic stem cells proliferate for one year without differentiating
- (b) What are the factors in living organisms that regulate stem cell proliferation

Characteristics

Stem cells are unspecialized cells; hence they cannot carry oxygen like RBC or pump blood like heart muscle

However, stem cells, through differentiation, can be converted into RBC, heart cells or neurons

Characteristics

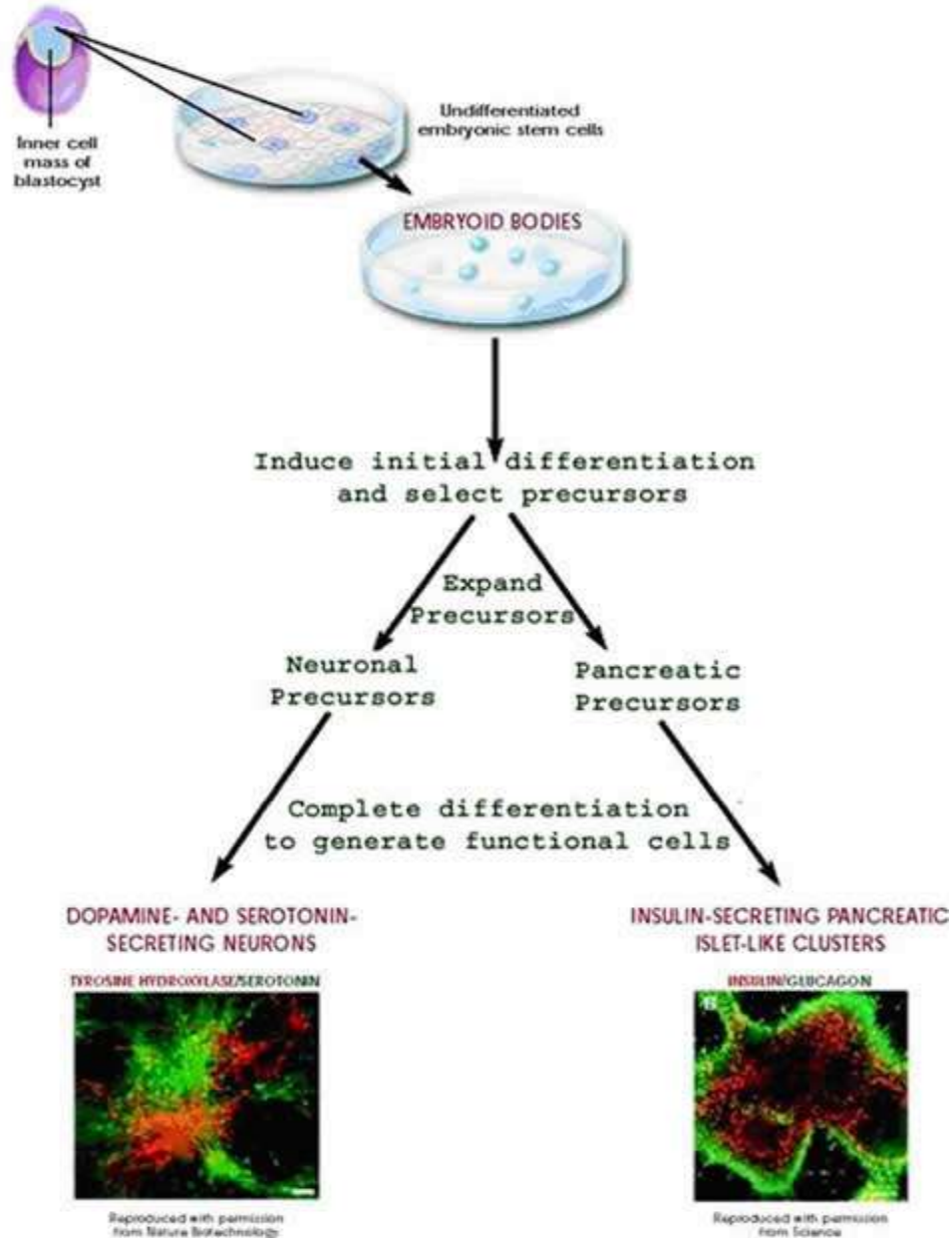
Embryonic stem cells can grow in a laboratory after putting the inner cell mass in a petri-dish, and adding a feeder layer (treated mouse embryonic skin cells that cannot grow), then culturing and sub-culturing to form embryonic stem cell lines

Now, researchers have devised a way for growth of stem cells without the use of mouse feeder cells, to avoid AIDS like problems

Laboratory tests to identify embryonic stem cells

- Presence of transcription factors (which turn genes on or off at the right time) Oct4 and Nanog, justifies undifferentiated embryonic stem cells

How are embryonic stem cells stimulated to differentiate?

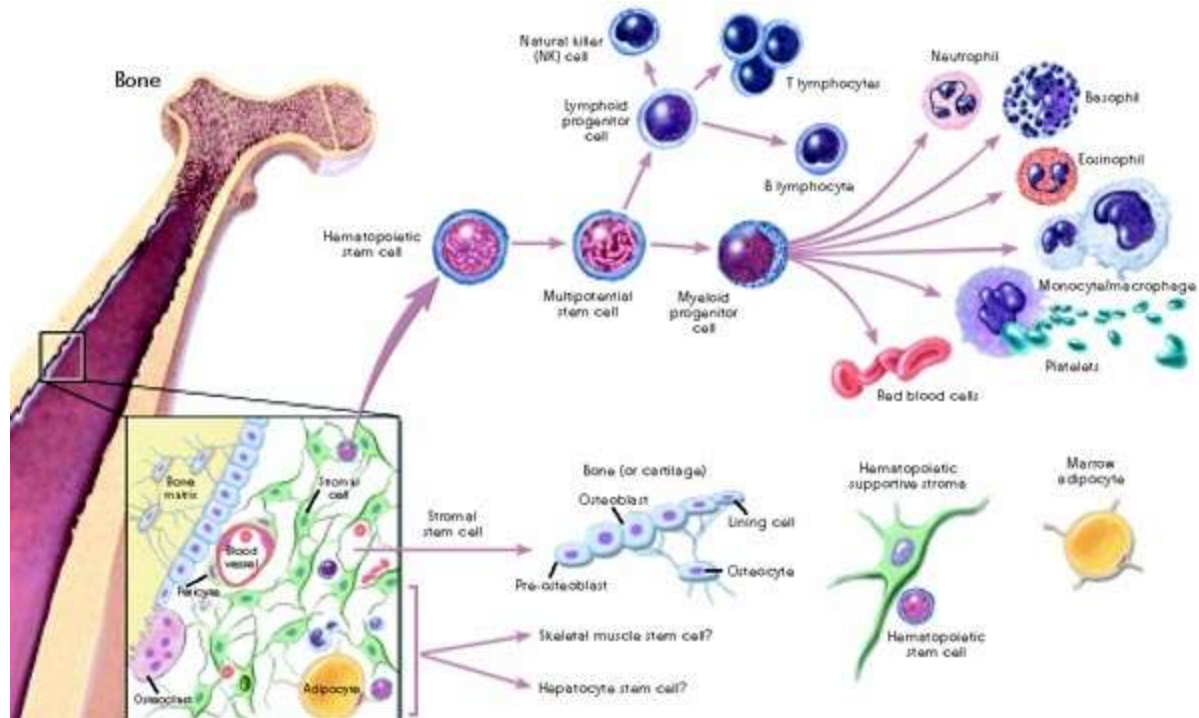


Adult stem cells

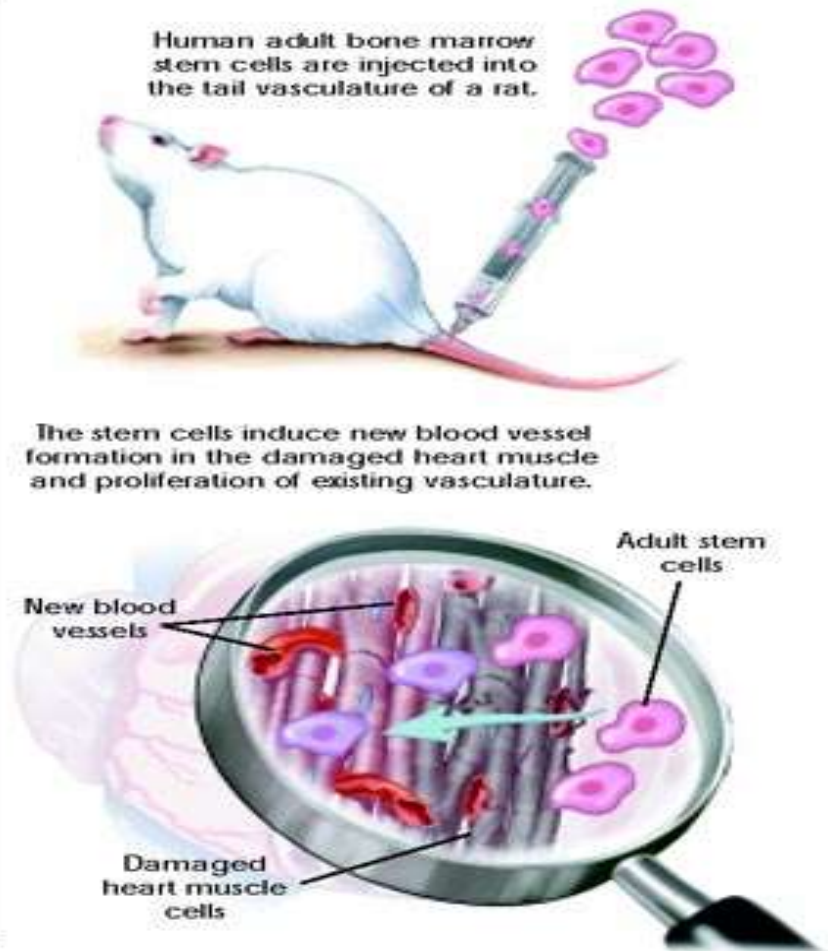
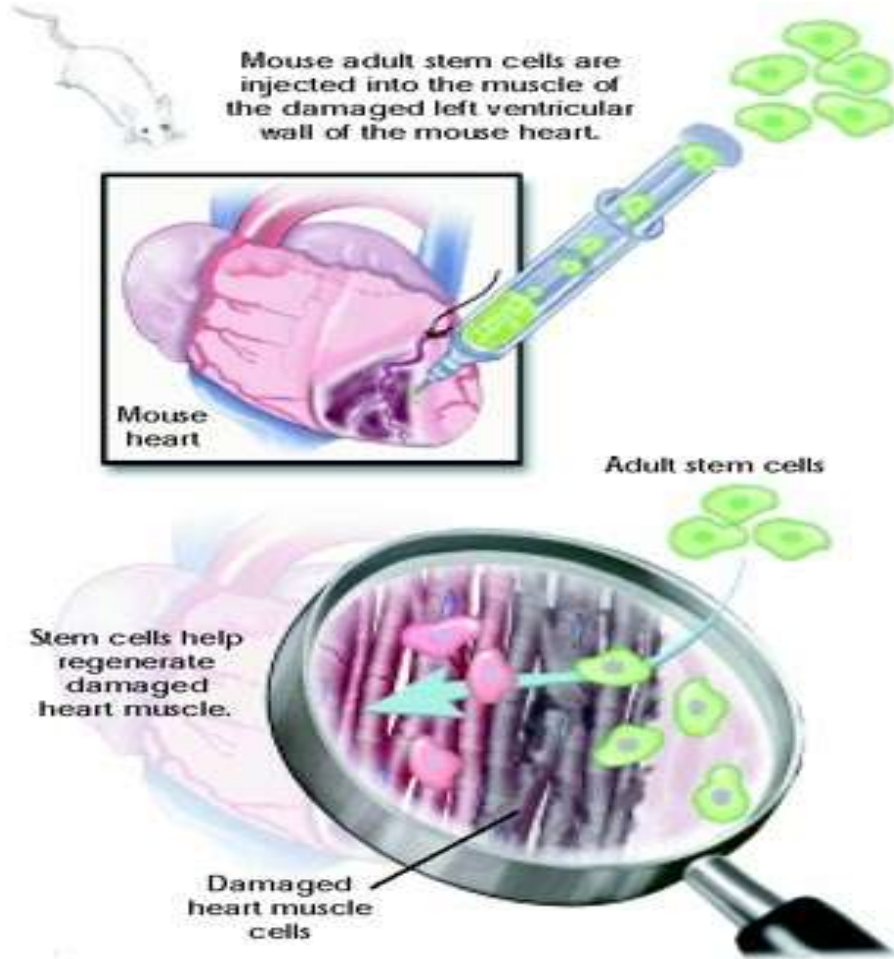
These are undifferentiated cells found in different differentiated tissues or organs.

They reside in specific areas known as stem cell niche

What is known about adult stem cell differentiation?



Strategies to repair heart muscles with adult stem cells



Embryonal stem cells

