Stem Cell Research, Toward the Ultimate Cure

Won Shik Choi | Science 100 | wonshik@ualberta.ca | University of Alberta, Edmonton, AB

SCIENCE 100
University of Alberta

1. Introduction

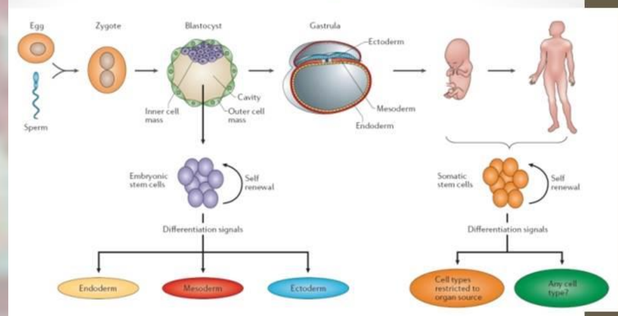
Death is human destiny, which all human beings must go through. There are many reasons for death, however, the most common factors are the following: aging, accidents, and disease.

A human is a package of cells that are programmed to die after around 50 cycles of replication. If the aged or damaged cells cannot be replaced due to some infections, the person dies.

In order to treat some of the diseases, doctors commonly use surgery, chemotherapy, etc.

Using a mechanism that humans naturally have, using stem cells, researchers proposed a transplant therapy to successively replace the damaged cells.

2. Somatic vs. Embryonic Stem Cells



Embryonic stem cells can be derived from a blastocyst of a mammalian embryo.

Human bodies have their own mechanism to replace damaged cells by using somatic stem cells (adult stem cells). They both exhibit characteristic of pluripotency and self-renewability.

Somatic stem cells can be differentiated into only certain types of cells (restricted to organ source), whereas, embryonic can be differentiated into all 3 types of germ layers.

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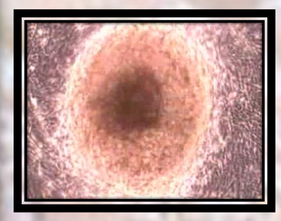
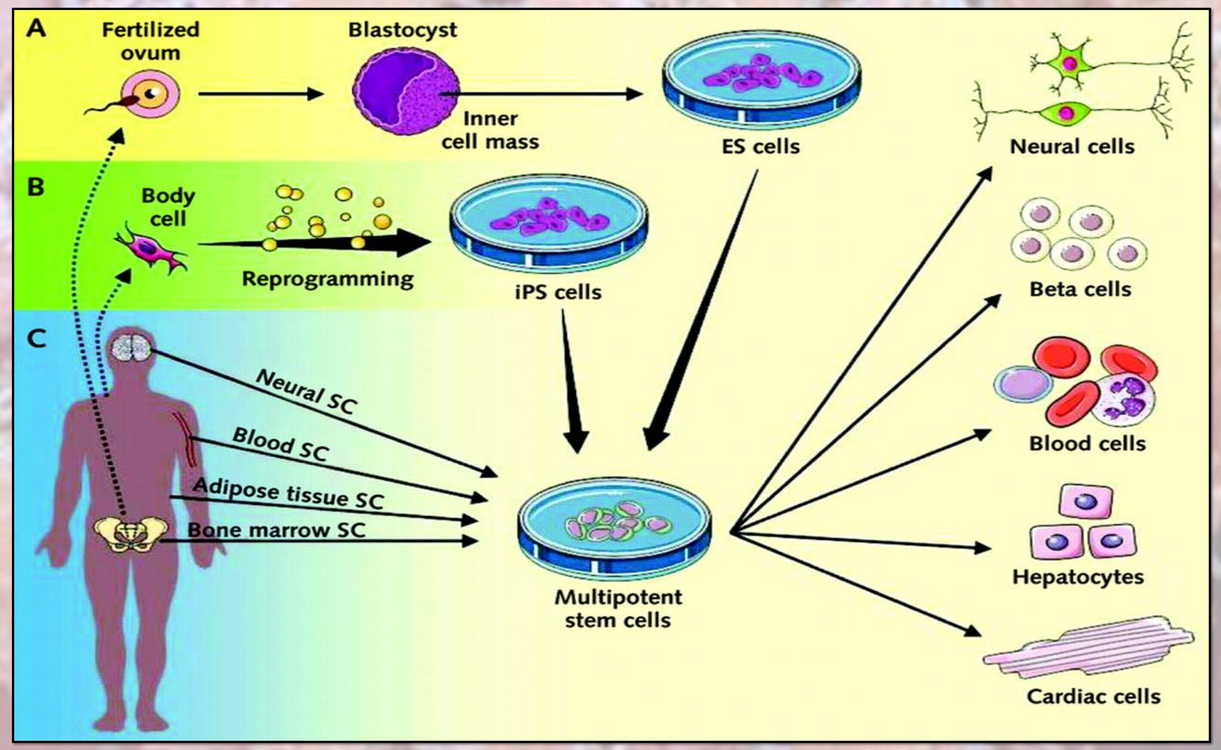
3. Embryonic Stem Cells(ESC)

Embryonic stem cell research enhanced medicine in many different ways. It allowed better transplant therapy. ESCs provide donor sources for diseases such as juvenile diabetes, Parkinson's disease, and heart failure.

One of the strong advantages that ESCs have is that they can self-replicate easily. It can be replicated on the cell culture; thus, researchers can derive particular cells or organs in order to test their drugs.

Despite their strong advantages, there are limitations of this therapy, such as limited resources of ESCs and the ethical issue following with it. Most of the embryos used in the research are mostly donated, but due to the ethical issues, it is really hard to get a sufficient enough number for the research.



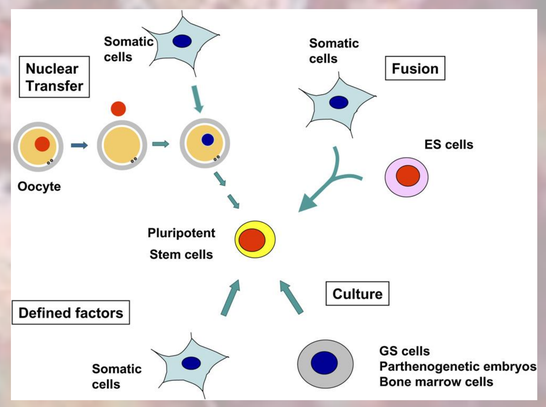


4. Induced Pluripotent Stem Cells (iPS cells)

The successful reprogramming of human somatic cells into a pluripotent state makes induced pluripotent stem cells. The reprogramming is the reverse steps of cell differentiation. The somatic cells of the patient can be reprogrammed, with some modification, to become iPS cells. Because it's using the patient's somatic cell, it has a higher chance of generation of successful patient- and disease- specific stem cells.

There are four commonly known currently available techniques to generate iPS cells. It can be generated by nuclear transfer from somatic cells to Oocyte, nuclear fusion between somatic cells and embryonic stem cells, culturing germline stem cells and parthenogenetic embryos bone marrow cells, and putting some defined factors into somatic cells.

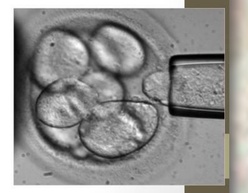
There are ethical issues involving some of the induced pluripotent stem cells.



5. Ethical Controversy

The fresh human embryos involved in stem cell research are produced by in vitro fertilization with consent of their parent.

The usage of human embryos faces ethical controversy that inhibits the embryonic stem cell research. That's because the criteria of defining life is not clear. Because some people consider the embryo as a living thing, killing embryos during the process of stem cell therapy involves ethical controversy.



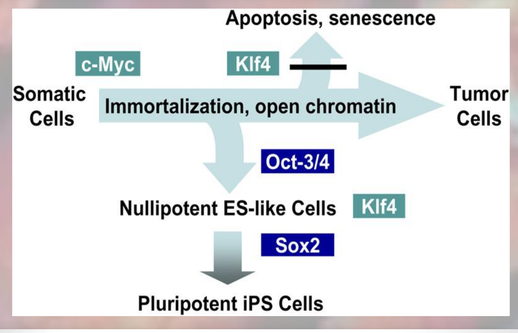
6. iPS cells generated by defined factors

Researchers have found the pluripotency of the embryonic stem cells are induced by the four factors, Oct-3/4, Sox2, c-Myc, and Klf4. Turns out, simply introducing the factors into the patient's somatic cells can induce the pluripotency of the somatic cells.

Researchers could eliminate the requirement of human embryos by using the defined factors, which indicates they are free from the ethical controversy.

Tumorigenicity

However, using this method, less than 1% of the cells that put genes transcribing four defined factors can be reprogrammed into iPS cells. This is because, out of 4 defined factors, c-Myc and Klf 4 are cancer-associated transcription factors.



Conclusion

Future of stem cell therapy

Stem cell therapy is a relatively recently developed technique. A lot of researchers around the world are working on some of the limitations and trying to come up with a better method and technique for stem cell therapy. There is no such better technique over others. However researchers believe that stem cell therapy, overall, is an ultimate cure and can possibly treat the full range of untreatable diseases in our future.