Induced Pluripotent Stem Cells: An Alternative to Embryonic Stem Cells

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Stem cells are specialized cells that are able to self-renew and differentiate into many different cells. The two main types of stem cells are adult stem cells (ASCs) and embryonic stem cells (ESCs). ASCs are able to generate specific types of cells depending on their surroundings, while embryonic stem cells can give rise to all cell types. ESCs are considered to be pluripotent, meaning they can generate cells in all three germ layers, including the mesoderm, ectoderm, and endoderm.[1] Studies have been conducted showing how ESCs can be used to help treat Type 1 diabetes, aid in cardiac repair, and replace neural cells lost due to neurodegenerative diseases.[2] While ESCs prove to be a promising therapeutic avenue for many, there is a major ethical concern centered around how and where the cells are obtained. These cells are harvested from preimplantation human embryos, meaning the embryo must be destroyed in order for a successful harvest, making them a controversial, debatable topic among the scientific research community.[3] ESCs also carry immunocompatibility concerns and teratoma formation concerns.

Today's research involves the production and utilization of induced pluripotent stem cells (iPSCs) to try to eliminate these ethical and legal concerns surrounding ESCs. IPSCs are designed in a lab to specifically mimic the pluripotency and differentiation capabilities of ESCs through the use of somatic cells. In 2006, iPSCs were first discovered by expressing four transcription factors, Pou5f1, Sox2, Kif4, and c-Myc. These factors were applied to adult mouse cells, thus reprogramming the cells to behave in similar ways to that of ESCs. One year following this discovery, a similar method was used to develop human iPSCs (hiPSCs).[1] This greatly curbed the ethical dilemma associated with ESCs as it did not require the destruction of a human embryo. Additionally, iPSCs originate from autologous cells coming directly from the patient, making them more compatible and minimizing the risk of teratoma formation.[1]

Studies have been conducted proving similarity of iPSCs to ESCs through staining, imaging, and fluorescence activated cell sorting. Overall, stem cell research is important for both the medical and science community's continued understanding of human diseases. iPSCs' continued creation and refinement in the lab will provide new treatment and therapeutic methods for many patients.

References:

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