

Cloning Stem Cells: Ethics Behind Stem Cell Research

Every year many die of illnesses such as leukemia and diabetes, for which cures have not yet been developed. Around only 59% of those diagnosed with leukemia survive. The incidence rate of leukemia is 12.8 cases per 100,000 people. Stem cell therapy is known to have a cure for acute and chronic Leukemia, high-risk solid tumors, and myelodysplastic syndrome. Additionally, blood disorders like anemia causes the death of 4,852 people every year, but stem cell therapy can treat aplastic anemia. Sickle cell disease affects 90,000 to 100,000 Americans every year and it can be treated with stem cell therapy as well. Similarly, many immune disorders as well as metabolic disorders can be cured by stem cell therapy. Spinal chord injury, diabetes, heart disease, Parkinson's disease, Alzheimer's disease, Lou Gehrig's disease, lung diseases, and arthritis are just some of the major diseases affecting many around the world that are being targeted with embryonic stem cell research. Many people die around the world each year because of diseases that can be cured through embryonic stem cell therapies and research. My own grandmother passed away from aplastic anemia and my family faces a genetic threat of diabetes, and stem cells can offer a solution to both illnesses. Therefore, the debate surrounding stem cell research needs to be analyzed in order to provide support for its use in research as well as medical practice, in order to ultimately treat patients.

Embryonic Stem Cells

Although there are currently no "cures" for these diseases, the solution to such illnesses is the scientific breakthrough of stem cell research, and specifically the use of

embryonic stem cells. Embryonic stem cells are a special type of stem cells, in that they are primitive cells that have the capacity to differentiate into more identical stem cells or to specialize into cells with specific functions. There are two major types of stem cells within our body: 1) embryonic stem (ES) cells and 2) 'adult' stem cells. Adult stem cells are found in many different types of tissues both in the fetus and after birth and are specialized, multipotent, as they function in tissue replacement and repair. On the other hand, embryonic stem cells can only be derived from pre-implantation embryos, but they have the ability to form cells of all tissues of the adult organism and so are known as pluripotent. vi. Because they are the only cell type that can differentiate into many different cell types, they have major clinical potential in tissue repair. Embryonic stem cells are derived from the fertilized egg during the earliest stages of gestation. This cell type is located in the cell mass known as a blastocyst. xviii. However, the blastocysts that are currently used for embryonic stem cell research do not come from a fertilized egg within a mother's body. Instead, they are created in a laboratory setting. Therefore, due to their special characteristic, embryonic stem cells are used for scientific research to develop solutions to the "incurable" disease.

Benefits of Embryonic Stem Cells

There are many benefits of human embryonic stem cell research that have been found through the small amount of legalized scientific research performed on them. Human embryonic stem cells, hES cells, are derived from the so-called 'inner cell mass' of blastocyst stage embryos that develop in culture within 5 days of fertilization of the oocyte. Due to their ability to differentiate into any cell type, they represent the future relief or cure for a wide range of common diseases. The replacement of defective cells in

a patient by transplantation of hES cell - derived equivalents would seem to restore the normal function. Throughout the past 10 years, substantial progress has been made in basic and translational research using human embryonic stem cells (hESCs). Neural stem cells, with their ability to self-renew and differentiate into cells of all glial and neuronal lineages throughout the neuro-axis, provide the ability to 'engineer' the damaged CNS towards reconstitution, and in turn treat hypoxic-ischemic encephalopathy. 3. It has also been seen that hESCs allow for modeling human-specific strategies in order to study the earliest events that lead to normal hematopoietic specification versus leukemic transformation and therefore are useful to treat leukemia. xvi. Human embryonic stem cell research can also be used to study and treat Fanconi anemia, which is an autosomal recessive disorder that leads to pediatric bone marrow failure and congenital anomalies. viii. Currently, human pluripotent stem cells are being researched for disease modeling and drug screening because of their potential to allow production of a virtually limitless supply of normal human cells that can be differentiated into any specific cell type. Additionally, through the use of induced pluripotent stem cell technology, in which specific stem cells are developed, they can also be generated from patients with specific disease traits, which allows for more relevant modeling and drug screens. Therefore, as can be seen there are many benefits to the advancement of embryonic stem cell research.

Ethical Issues of Embryonic Stem Cells

However, the use of hES cells is also highly controversial because they are derived from human pre - implantation embryos. There are many ethical issues associated with embryonic stem cell research that hinders its use and application to the field of medicine. There are two views in the debate of embryonic stem cell research. The

'conceptionalist' view believes that the embryo is a person. vi. They believe that the embryo has full moral status from fertilization onwards: either the embryo is believed to be a person while it is still an embryo, or it is seen as a potential person. This is similar to the concept of an egg being a potential animal, which provides the reason for the dietary category of lactovegetarians. On the other side, there is the view that the embryo and even the fetus is a 'non - person' that does not necessarily have any moral status at all. Therefore, there is a debate among valuing the ability to prevent or alleviate suffering and the duty to respect the value of human life.

In the case of embryonic stem cell research, it is impossible to respect both moral principles to obtain embryonic stem cells, the early embryo has to be destroyed. This means destroying a potential human life. But embryonic stem cell research could lead to the discovery of new medical treatments that would alleviate the suffering of many people. One way that has been brought up to resolve this issue is that to limit and protect the human embryo after, around day 14 after fertilization when the primitive streak develops and three germ layers appear. vi. After 14 days the embryo can no longer split to form twins. Additionally, before day 14, the embryo has no central nervous system and therefore no ontological individuality. Federal research funds were prohibited for embryonic stem-cell research until August 2001, when ex-President Bush approved spending for research but only using only already-existing cell lines, which included less than two dozen viable cell lines. xv. However, President Obama has expanded the legal, viable lines that are available for research. This legalization of embryonic stem cell research was based on the numerous benefits that are associated with using undifferentiated cells in order to give rise to any cell type. There are currently three main

sources of human embryonic stem cell lines: 1) cell lines that already exist 2) spare embryos left over from fertility treatment and lastly 3) Custom-made embryos that are created by somatic cell nuclear transfer (SCNT), this is also the technique used to create Dolly the Sheep. The first type of cell line was legalized by the Bush administration in 2001 and Obama legalized the second type of cell line. However, the third type still faces much controversy in the scientific field.

Comparison of Somatic Nuclear Transfer and Induced Pluripotent Cell Therapies

Due to the fact that the risk of immune rejection to stem cell transplantation is high, the generation of patient-specific stem cell lines provides a better alternative to the embryonic stem cell line. It can be seen that the immune rejection of transplanted tissues presents a serious challenge for regenerative medicine, because similar to organ transplantation, if stem cell-derived tissues are not a close MHC-match to the patient, life-long immune suppression is required. i. However, when dealing with stem cell based therapies, immune rejection is an even more serious concern because the dispersed addition of transplanted lines impedes their surgical removal if immune issues occur. It has been estimated that the amount of embryonic stem cell lines needed, that are derived from embryos that are produced by fertilization, in order to provide for a good match for a specific patient population is from hundreds to several million. ii. Therefore, the extensive genetic diversity of the population causes the need for an alternative therapy in order to develop stores of embryonic stem cell lines, and patient-specific stem cell lines would offer compatibility at both major and minor antigenic sites.

The use of special embryonic stem cells has very promising results in the scientific field and one method to generate matched pluripotent cells is somatic cell

nuclear transfer to produce stem cells from cloned embryos(NT-ESCs). In other words, therapeutic cloning currently is defined as creating an embryonic stem cell line by a technique called somatic cell nuclear transfer (SCNT). In this process, an embryo is made by placing the nucleus of an adult cell from an animal into an egg cell that has had its nucleus removed. xiv. Then the embryo is allowed to grow to a very early stage of development, and then it can be used as a bank of stem cells. In the future this method could provide a source of cells for therapy. SCNT has proven to be more challenging in humans than in other mammalian species as two embryonic stem cell lines have been isolated from cloned macaque monkey blastocysts, but SCNT-derived human blastocysts have also recently been reported. iv. The most controversial aspect of this method is the transfer of a somatic cell - nucleus from a patient to an enucleated oocyte, an unfertilized egg, in order to produce hES cells that is genetically identical to that patient for 'autologous' transplantation, or 'therapeutic' cloning; this may prevent tissue rejection. Due to the fact that it produces genetically identical stem cells, cloning, this remains extremely controversial.

On the other hand, another method to generate patient-matched embryonic stem cells is direct programming to yield induced pluripotent stem cells (iPSCs). Induced pluripotent stem cells are adult cells that have been genetically reprogrammed to an embryonic stem cell stage by being forced to express genes and factors that are important for maintaining the defining properties of embryonic stem cells. This is done through the introduction of transcription factors that are able convert skin or blood cells to be reprogrammed back into an embryonic-like pluripotent. v. When somatic cells are reprogrammed by transferring their nuclei into oocytes or by fusion with ES cells,

genome-wide transcriptional activity and DNA methylation patterns are converted from the somatic state to an embryonic state. v. More specifically, iPSC are derived from skin or blood cells that have been reprogrammed back into an embryonic-like pluripotent state and so they can be differentiated into any type of human cell needed for therapeutic purposes. For example, iPSC is seen to be able to be programmed to be beta islet cells, which is able to treat diabetes, and even to blood cells in order to create new blood that is free of cancer cells for a leukemia patient, or even neurons to treat neurological disorders and iPSC research has quickly become the foundation for a new regenerative medicine. vii. Therefore this method to generate patient-matched embryonic stem cells through direct programming to yield induced pluripotent stem cells (iPSCs) is extremely beneficial in the medical field.

Additionally, it can be seen that iPSCs are advantageous compared to both ESCs and NT-ESCs methods of stem cell therapy. This is because iPSCs are relatively easy to be obtained from a single biopsy and its eligibility of iPSC research for federal funding. Also its comparatively decreased ethical and practical burdens, which are associated with either embryo destruction or egg donation, makes it a better alternative. xii. The iPSCs are entirely patient derived, and therefore the problems of demonstrating immune compatibility and donor safety are a lot lower than for ESCs or NT-ESCs. Therefore, induced pluripotent stem cells are noted to be an important and effective alternative to the ethically controversial usage of embryonic stem cells and can provide the key to the progress of stem cell research to cure numerous illnesses.

Ethical Issues of SCNT and Induced Pluripotent Cells

Additionally, many ethical issues are associated with both methods of direct programming to yield induced pluripotent stem cells as well as somatic cell nuclear transfer. The embryonic stem cells that are produced by SCNT would be patient-specific, and so could avoid the complications of immune rejection, but because they require the use of human eggs, they would be subject to regulatory requirements that govern egg-donor selection and screening. Furthermore, NT-ESCs raise serious ethical issues compared to the generation of stem cell lines from excess IVF embryo, which will “die anyway”. Therefore, the embryos that are produced only for research has far less public support as a poll in 2008 showed 47% were in favor of using excess IVF embryos for research, while only 18–30% support the creation of embryos only for research purposes.

xi. Additionally, the medical risks for women that are associated with egg donation also raise significant ethical concerns for NT-ESCs. Ix. Lastly, because generation of human ESCs and NT-ESCs forces the damage of human embryos, many do not support this research on both ethical and religious grounds. The threat the misguided individuals could attempt to implant cloned human embryos in a woman’s uterus in order to create a cloned person, the practice of reproductive cloning, raises serious ethical concerns. Therefore, there are many ethical issues associated with both methods but the production of induced pluripotent stem cells is seen as the least controversial and therefore the most beneficial.

Deduction

Therefore, it can be seen that although there are many ethical issues associated with embryonic stem cell research as well as the generation of patient-matched embryonic stem cells, induced pluripotent stem cells can be seen to be the most

advantageous. Although there are two distinct methods used to generate stem cell lines, SCNT and direct programming to yield induced pluripotent stem cells, the iPSCs are demonstrated to be the most advantageous because of both ethical and scientific reasons. Stem cell therapy is one of the most useful scientific breakthroughs that can be used to cure many illnesses. Bone marrow and peripheral blood stem cell transplants have been used for many years, but with the introduction of embryonic stem cells as well as the generation of specific stem cell lines like induced pluripotent stem cells many illnesses can be cured. However, many ethical issues are associated with stem cell therapy with the ‘conceptionalist’ view that the embryo is a person. This view hinders the use and application of stem cell therapy to the field of medicine. To this day, not all methods of embryonic stem cell research have been legalized even though numerous benefits have been discovered. However, because of the numerous illnesses that are known to be able to be cured by the use of stem cells and due to the fact that the finding of induced pluripotent stem cells significantly reduces the amount of ethical concerns, I believe stem cell research should be encouraged. In order to prevent its malpractice, the use of stem cells should be regulated, but not so strict as to limit the amount of scientific breakthroughs possible. Many lives can be cured by this research, and although President Obama has loosened the regulation placed on stem cell usage, it should be promoted more strongly both in policy as well as in the scientific research fields.

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