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Are There Ethical Ways to Obtain Embryonic Stem Cells?

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New technologies for treating disease and understanding the human body are frequently discussed in the news. One of the most commonly debated issues concerns the merits and pitfalls of stem cell research. Though the debate once centered on adult versus embryonic stem cells, a recent surge of alternative stem cell sources is gaining widespread interest and criticism.

Although there are serious concerns about diverting attention away from adult stem cells – with their proven treatments and noteworthy flexibility – it is encouraging to see that many of these alternatives have been proposed *prior* to experimentation in the laboratory. This marks an important step in science and bioethics. Most often, we hear about these new breakthroughs (embryonic stem cell research, cloning, *in vitro* fertilization) after the fact. The presentation and discussion of novel research alternatives and their moral implications *before* the research is conducted is truly step in the right direction.

These alternative sources claim to obtain pluripotent stem cells without using living embryos or traditional adult stem cells. The moral implications of these options are still largely unknown. The following is a thumbnail sketch of the new possibilities with their promises and pitfalls.

Pluripotency?

Much of the current discussion in stem cell research centers on ways to derive pluripotent stem cells from sources other than a human embryo. Many people are confused by the term "pluripotent." A pluripotent stem cell is a cell that has the capacity to develop into every type of cell, tissue, and organ in the body.

A commonly held belief in the science community has been that embryonic stem cells are the only type of stem cells that are pluripotent. However, a growing body of scientific literature demonstrates that adult stem cells are also pluripotent.

For more information on the pluripotency of adult stem cells, see What the Media Won't Tell You About Stem Cell Research

Altered Nuclear Transfer (ANT)

The science: Proposed by Professor Dr. William Hurlbut, Stanford University, this is an alternative to "therapeutic" cloning (cloning embryos for stem cell research). ANT would introduce genetic mutations at the first stage of cloning so that the genes responsible for making the embryo develop properly would be turned off.

There is at least one published study that examines the feasibility of this technique. That study, done in mice, did not demonstrate whether a "disabled embryo" or "mass of cells" was created.

For more information about this alternative, see Altered Nuclear Transfer: An Ethical Cloning Alternative?

The ethics: The goal is to create an entity (a "non-embryo") that lacks an embryo's moral status as a human but is still a source of embryonic stem cells. This is ethically problematic for those who see ANT as the creation of a disabled embryo rather than the creation of a non-embryo.

Oocyte-Assisted Reprogramming (ANT-OAR)

The science: A variation on Altered Nuclear Transfer (ANT). It turns *on* genes known to be essential for the growth of pluripotent stem cells rather than simply turning *off* genes that may result in a developmentally disabled embryo. By turning these genes on, the goal is to completely bypass the creation of an embryo in favor of creating a cluster of pluripotent stem cells.

There are no published studies on this proposal.

The ethics: While some ANT-OAR supporters believe that turning specific genes "on" completely bypasses the development of an embryo, animal studies are needed to determine whether ANT-OAR creates a disabled embryo or a cluster of stem cells.

Blastomere Biopsy

The science: This technique removes ("biopsies") 1-2 cells from an already existing human embryo. The removed cell(s) can be grown into embryonic stem cells.

There is some evidence this can be done without harming the remaining embryo – mainly from the genetic testing technique, preimplantation genetic diagnosis (PGD), which removes 1-2 cells from a young embryo for testing. For more information on PGD, see Preimplantation Genetic Diagnosis.

The ethics: The process of removing cells for PGD is still a relatively new technique, and there are long-term safety concerns for an embryo who undergoes a biopsy. It is unknown how cell removal at such an early stage of development will affect the child in later years.

Additionally, the single cell removed for stem cells has the potential to form a completely new embryo. In this case, the destruction of a new life is no better than the current practice of destroying embryos to collect their stem cells.

Gathering embryonic stem cells from "dead" embryos

The science: The process of *in vitro* fertilization (IVF) often involves freezing embryos that are not immediately implanted in a woman's uterus. Although these frozen embryos can be thawed for a later implantation, the freezing and thawing process creates a greater risk of embryo death. Frozen embryos presumed to be dead could be used for their embryonic stem cells.

There is some evidence this is scientifically feasible.

The ethics: The most significant problem is the uncertainty of how to determine if the embryo is truly dead. Significant numbers of embryos would be put at risk or killed in an attempt to determine exactly when an embryo ceases to be alive.

In addition to the difficulty in determining if an embryo is dead, this technology could create incentives for excess IVF embryo production.

Dedifferentiation

The science: Adult stem cells are shifted ("dedifferentiated") back to an earlier stage of development. In essence, adult stem cells are stimulated to revert back to an embryonic stem cell-like state.

There are a few published studies indicating that this is possible.

The ethics: There are no ethical concerns as long as the cells are not altered to an early developmental stage where they have the capacity to develop into a new human embryo.

For additional information about adult stem cells that demonstrate the flexibility of embryonic stem cells, see What the Media Won't Tell You About Stem Cell Research.

Reprogramming

The science: Adult cells are fused with embryonic stem cells in order to make the adult cells behave like embryonic stem cells.

One of the most noteworthy studies using this technology was recently conducted by Harvard researcher Kevin Eggan. Eggan and his colleagues found that when the adult and embryonic cells were fused together, the genes from the embryonic stem cells "reprogrammed" the adult cell to act like a young, embryonic stem cell.

The ethics: While it is encouraging to see researchers look to other ways of creating stem cells without the destruction of more human embryos (either through IVF or cloning), this method still requires embryonic stem cells which were harvested by destroying young human lives.

Parthenogenesis

The science: A normal oocyte (unfertilized egg) is chemically tricked into dividing. It begins to develop but does not have the capacity to form a fully functional embryo. An understanding of parthenogenesis has been around for years but the fact that parthenotes (the product of parthenogenesis) contain stem cells is a recent discovery.

The ethics: Some critics say the creation of parthenotes is equivalent to the creation of a human life and so we shouldn't pursue this line of research.

Another concern is the quantity of human eggs needed for parthenogenesis. The process of collecting eggs from women through ovarian hyperstimulation is a risky procedure; researchers who perform parthenogenesis would need to subject many women to hyperstimulation to harvest the needed eggs.

Fetal Stem Cells

The science: Stem cells are extracted from an aborted baby. While there has been at least one fatal treatment involving fetal tissue therapy, there is some evidence that fetal stem cells may be more scientifically promising than either embryonic or adult stem cells.

The ethics: The source of these stem cells – an aborted baby – makes them ethically problematic, and we reject the use of fetal stem cells in research and therapy.

Disclaimer: *These summaries significantly simplify the scientific techniques described. Like any overview of a complex topic, oversimplifications are inevitable. This document attempts to provide the most accurate information in easily understandable terms.*