"Ethical" Embryonic Stem Cell Research?

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Despite ongoing successes with adult stem cell research, recent months have seen the debate over embryonic stem cell research continue unabated. [1] This is especially true in state legislatures across the country where dueling proposals to ban such research or to allow and fund it continue with fascinating political drama.

In an attempt to cool the debate, some researchers have offered imaginative new ways to obtain embryonic stem cells without the necessary step of destroying living human embryos. Four proposals have been floated in recent months.

The Parthenote Proposal [2]

One of the earliest of these new proposals is the idea to create a parthenote—an egg that develops into an embryo and creates embryonic stem cells. New research has shown that a chemical trigger can cause an egg to begin dividing and organizing—even eggs that have failed to be fertilized by a sperm. Reproductive clinics throw away thousands of eggs that have failed to be fertilized through multiple in vitro fertilization (IVF) attempts. Because mammalian parthenotes cannot develop very far due to the lack of paternal DNA, many researchers do not consider them embryos but ?embryo-like? entities.

Method? Since eggs have only half of the requisite DNA, they would have to be obtained from women before the final maturation process (before ovulation) when the egg still has a full DNA compliment, or the eggs would have to copy their own 23 chromosomes to produce 46 chromosomes when exposed to a chemical trigger. Such a trigger or an electrical shock tricks the egg into believing that it has been fertilized. Upon reaching the blastocyst stage, the parthenote would be broken apart and its stem cells harvested.
Technical Challenges? Because of the faulty genetic structure of parthenotes, there are questions about whether stem cells derived from them could be used for treatments. The impact of seriously genetically flawed stem cells is unknown. Incidents of cancer could be higher than the 25% typical when using other embryonic cells. In addition, the available pool of genotypes for research would be limited since only fertile females can be used.

Ethical Issues? The largest ethical issue is the question over whether a parthenote is an embryo, and there is little consensus. Some argue that it is not an embryo because it can never develop, while others hold that it should be treated like an embryo unless it can be proven otherwise.

The Morula Proposal[3]

Reproductive Genetics Institute (RGI) in Chicago is one of the world's leading experts in pre-implantation genetic diagnosis (PGD)?a procedure where a cell is removed from a developing embryo and analyzed. Some use this procedure to identify whether a developing embryo has a genetic disorder such as Tay-Saks or Huntington's disease. Only those embryos passing the genetic test are implanted. The others are destroyed.

Scientists at RGI are claiming a new distinction?a way around of the current objection to pursuing human embryonic stem cell research. Instead of destroying living human embryos, RGI scientists think they can use the same principles of obtaining cells for PGD to develop embryonic stem cell lines.

Method? Scientists would take an early-embryo that has developed to about the 8-cell stage (called a morula), and remove a single cell. They would then attempt to coax that cell to replicate into an embryonic stem cell line. The embryo (less the one cell) could then be transferred to a womb.

Technical Challenges? The largest technical challenge to this proposal is getting a single stem cell to replicate sufficiently to turn into stem cell line. Currently, scientists wait until the blastocyst stage where the embryo has developed into several hundred cells, break the embryo apart to obtain the cells, and use all the available cells to create a line. Even with hundreds of cells, scientists have a difficult time creating cell lines. Doing so requires dozens if not hundreds of embryos. Robert Lanza at Advanced Cell Technology (ACT) in Massachusetts has said that he believes this single cell process can produce stem cell lines, but procedures do not yet exist.

Ethical Issues? There are two primary ethical issues with this proposal. First, it requires a method that is potentially harmful to the embryo. While hundreds of children have been born using PGD, we do not yet know the consequence of taking a cell from the very early embryo. Second, at the morula stage, twinning is still possible; that is to say, it is possible that the obtained cell could be an embryo itself?the single cell may be able to develop if implanted into a womb.

The Organ Transplant Proposal[4]

50 years after the first successful organ transplant, Donald Landry and Howard Zucker of Columbia University in New York think that the same principles used today to harvest organs from those at the edge of death can be used to find a way out of the current embryonic stem cell morass.

Modern organ transplant rules follow the following general principle: a person?s body does not have to be totally dead for it to be ?dead enough? to ethically remove vital tissues for transplant. Because the line between life and death is not precise, this principle has been accepted and is used to allow a definition of death other than complete death of every cell in the body. This allows the transplantation of living tissue from an otherwise ?dead? person.

In this proposal, scientists argue that embryos exist that are, in essence, dead just like those who are brain dead.
with functioning organs. The term "arrested development" is often used to denote embryos that are believed will never develop further. Landry and Zucker estimate that 60% of human embryos in cryopreservation are in a state of "arrested development."

Method? Scientists hope to identify arrested development embryos whose stem cells are functional, obtain the stem cells (using the standard method of breaking embryos apart), and develop stem cell lines for research and possible future treatment.

Technical Challenges? No test currently exists to determine whether an embryo that is not developing is truly dead. Landry and Zucker are working to develop tools to measure the chemical and genetic signatures of embryos after 24 hours of non-development.

There is a question about whether the embryonic stem cells obtained from such embryos would be useful. It is possible that failure to create stem cell lines from "surplus" IVF embryos is due to the failure of the cell from "dead" embryos to replicate.

Ethical Issues? Is it possible to identify a "brain death" criterion for embryos? This is uncertain. There simply is no test similar to that which determines brain death. Chemical and genetic signatures would measure seemingly arbitrary criterion, particularly since we know so little about embryology (and especially compared to current understandings of a fully-developed nervous system that governs the brain death criterion).

The Alternate Nuclear Transfer (ANT) Proposal[5]

Suggested by Stanford physician and ethicist William Hurlbut, alternate nuclear transfer (ANT) is similar to cloning. Using the cloning method, scientists would create an embryo or "embryo-like entity" that lacks a developmental gene. The entity would be similar to those that generally develop into a cancerous tumor—an entity that most scientists and ethicists consider never to have been an embryo.

Method? A developmental gene is turned off in the nucleus about to be transferred. Using the normal cloning process, the changed nucleus is then inserted into an enucleated egg, stimulated to divide, and stem cells are harvested when the resulting embryo or entity reaches the blastocyst stage.

Technical Challenges? Currently, the proposed method would be both difficult and expensive; the difficulties of cloning are compounded by the difficulties of genetic alteration. It likely would be a number of years before this method was successful, and, due to the technical hurdles of genetic manipulation, cloning technology, and stem cell cultivation, even longer before reasonable.

Ethical Issues? The core question for most ethicists is whether the entity created is a non-embryo or a disabled embryo. Hurlbut suggests that because the entity lacks a developmental/organizational gene and could never develop, it is never an embryo, thus no embryo is destroyed. Others, such as Richard Doerflinger of the US Conference of Catholic Bishops, argue that if the knocked out gene offers several days of development, the entity is an embryo for that period of time, and only later ceases to be such.

The answer to the question of whether an embryo-like entity that cannot develop is an embryo or not is likely the same for both parthenotes and ANT.

Conclusion

Currently, Christians oppose embryonic stem cell research for several interconnected reasons. Most importantly, it requires the destruction of human embryos. But also, using embryonic stem cells on human beings likely constitutes a violation of proper ethical considerations regarding experimentation on human subjects. This is in
part due to the lack of proper animal modeling and experimentation. This is particularly important in light of current alternative methods of disease treatment for many of the ailments considered possible targets for future embryonic stem cell therapies.

Currently, too many unanswered questions remain about these proposals to be able to move ahead with determining whether any of them are ethical methods for obtaining embryonic stem cells. We must take the cautious route by not pursuing them in human research until it is clear from animal studies that the entity in question is in fact not an embryo.

The Morula Proposal is unique in that it does not require breaking apart an entity that might or might not be an embryo; the question is whether the early embryonic cell is itself totipotent?capable of further developing in the same way that you and I developed from a single cell. Even if we assume that this is not the case, given the possibility of possible unknown danger for the developing embryo (no treatment option currently provides an overriding ethical justification for exposing an embryo to such unknown risk) this method still cannot be justified at this time.

As a final note, all other objections aside, we do not yet have sufficient knowledge from animal models to justify the pursuit of any embryonic stem cell research in humans. While pursuing in animal studies the knowledgebase that might justify human trials, these methods of obtaining such cells should be used so that we might have as much knowledge as possible for determining potential ethical means of obtaining embryonic stem cells if or when it becomes necessary to do so.

References


[5] Ibid.

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