The Honors Program at the University of Missouri-Kansas City

The Ethical Implications of Stem Cell Research

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May 14, 2024

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A Thesis submitted in partial fulfillment of the requirements to graduate as an Honors Scholar

from the University of Missouri-Kansas City

Introduction:

Stem cells have significant potential in both medicine and research due to their capability to replace damaged cells and their potential to regenerate damaged organs, especially within the context of genetic diseases and neurodegenerative disorders. The ethical and scientific debate revolving around the use of stem cells in research has been of great interest in recent years, as the potential uses of stem cells in research expand. Stem cells were discovered in the early 1960s, and the first treatments using hematopoietic stem cells began in the late 60s. Embryonic stem cells (ESCs) were derived from mice in 1981, and human ESCs in 1994; which were then discovered to have regenerative powers. In-vitro fertilization (IVF) began in 1998, and embryonic germ cells were discovered soon after from donated fetal tissue (Cohen, 2007).

Embryonic stem cell research requires the derivation of pluripotent stem cell lines from embryos and oocytes; which is ethically ambiguous due to the dispute concerning the moral significance of the embryo. Further, downstream research involving the use of human stem cells introduces dilemmas regarding consent and oversight of research. This paper will discuss the origins and history of stem cells, as well as the role of umbilical cord blood donations within the context of the ethical implications of this research, applying a variety of ethical theories to these topics. I will also discuss ethical dilemmas in the context of research using somatic stem cells, embryonic stem cells, the use of stem cells in gamete creation, and somatic cell nuclear transfer. Then, taking these arguments, I will argue in favor of the pursuit of research using stem cells, applying a principlistic model of ethics to support the claim that the nuanced topic of stem cell research is ethical in some, but not all scenarios.

What are stem cells, and how do they function?

Within the body, each type of tissue contains specialized cells, capable of performing various functions throughout the body- these cells are terminally differentiated, and cannot become another type of cell. Stem cells are special in that they can renew via cell division, and differentiate into various cell types when given the correct signals, either within the body or via differentiation chemicals in the lab. These cells are also capable of self-renewal and can divide as needed to produce new stem cells- a stem cell is capable of both symmetric and asymmetric division, which is key to their capability to self-renew. Symmetric division occurs in most tissue types and is the quintessential cell division- a cell of one type divides into two cells of that same type. On the other hand, asymmetric cell division is typical of stem cells- a stem cell divides into two cells- one is a copy of the stem cell, and is capable of further division into more stem cells, and the other cell from this division is differentiated, meaning it is no longer capable of dividing into any cell type. They are essential to life due to their ability to replenish the body with cells and are important in tissue maintenance. These cells could be used in therapies due to their ability to differentiate into different cell types, with the potential for gene transfer from the patient, there is the potential for personalized medicine, and curing “incurable” genetic diseases.

There is significant interest in personalized medicine and the idea that we can develop an infinite and permanent source of tissue that could regenerate our organs after damage. Stem cell research also opens the door to a better understanding of human development, and how abnormal cell divisions lead to genetic disorders. Finally, stem cells could offer a new method of testing drug toxicity. Specialized cells could be

derived, and used to test the effects of drugs before human trials, which could both speed up the drug testing process and avoid harmful long-term side effects of drugs after they reach the market (Zakrzewski et al., 2019).

There are three primary sources of stem cells used in research- embryonic stem cells, adult somatic stem cells, and induced pluripotent stem cells; each with its own set of advantages and disadvantages. Pluripotent cells can differentiate into any type of cell within the body, except eggs or sperm; and have the capacity to divide indefinitely. These cells are found within embryos, and embryonic stem cells are a primary source of these cells. Induced pluripotent stem cells are another option for pluripotent cells, and are derived by dedifferentiating adult somatic (body) cells to a pluripotent state. Adult stem cells are multipotent, meaning they are not able to differentiate into every cell type, but are capable of differentiation into cell types corresponding to the type of tissue they are found in. The pluripotent cell gives rise to the multipotent; which then differentiates further until the desired cell type is made (Zakrzewski et al., 2018).

Embryonic stem cells (ESCs) are retrieved at day 5 of embryonic development from the blastocyst, the 8-cell embryo. These cells are found in the inner cell mass and disappear after the 7th day of development as the embryo forms three tissue layers. If ESCs are extracted at the right stage, they can be cultured in the lab and will proliferate indefinitely, retaining the potential to differentiate into any cell type, given the right circumstances. The benefits of using embryonic cells over adult cells or induced pluripotent cells in research include their ability to differentiate endlessly in culture- adult stem cells and induced cells are significantly more difficult to maintain in culture, and are more likely to be rejected from the patient than ESCs. They are also less likely to cause

teratomas, a type of tumor associated with undifferentiated cells, upon injection into a patient. Further, embryonic cells are more likely to differentiate into some cell types, like neurons, than their counterpart iPSCs. However, as with any stem cell, there is always the risk of immune rejection, which causes further harm to the patient, as well as the risk of teratomas. Within ESCs, there is also the risk of abnormal genetic mutations as a result of long-term storage (as cells divide, there is always a risk for spontaneous mutation) (Puri & Naly, 2012). There are several factors to consider when choosing a stem cell line, which will be further discussed in the cases of induced pluripotent stem cells and adult somatic stem cells.

Induced pluripotent stem cells are generated through a complicated process of dedifferentiation, starting with an adult somatic cell, and taking the cell back through stages of development until it reaches a point similar to the ESC. This is accomplished by introducing genes associated with pluripotency into the cell and reprogramming the cells to form colonies of cells similar to embryonic stem cells (Ghaedi & Niklason, 2018). These cells are pluripotent and capable of differentiating into any type of body cell, like the ESC. However, the process of dedifferentiating these cells introduces the potential for other mutations and furthers the risk for teratomas within the host. This, along with the other detrimental aspects of using stem cells overall, is something to consider when choosing the best type of stem cell to use in treatment (Puri & Naly, 2012).

Somatic stem cells, also known as tissue-specific, or adult stem cells, are derived from varying tissues throughout the body. Unlike ESCs, these cells are lineage-restricted, and cannot differentiate into cell types outside their origin- i.e., hematopoietic stem cells

can only produce blood cells, not neurons. It is unknown whether each organ contains stem cells, and there are fewer avenues of research to pursue using adult stem cells due to their lack of ability to differentiate into different cell types. However, this does not mean these cells are without advantages. For one, they are readily available and abundant within the blood and other mesenchymal tissues (i.e. connective and lymphatic tissues), as well as cord blood from the placenta after birth. They will also not cause immune rejection if they are procured from the patient and differentiated into another cell type outside the body, which is a possibility not available using other stem cell types; as they must come from a donor. However, these stem cells are not able to be grown in culture for extended periods, and in non-mesenchymal tissues, there are not high numbers of these cells (Leventhal et al., 2012).

Stem cells play a critical role in human development and disease, and the potential they hold for the future of research and therapies is astounding, and something to consider when discussing the ethical aspects of the stem cell dilemma.

Ethical Dilemmas in Cord Blood Donation

Somatic stem cells are significantly easier to derive from the patient than embryonic stem cells and are much easier to collect than induced pluripotent stem cells. However, this does not mean they are without ethical considerations. To begin, the aspect of informed consent and the role of consent in the formation of a stem cell bank is important to consider within the ethics of care as a whole. In the case of cord blood donation for the collection of pluripotent stem cells and hematopoietic stem cells, the parent is responsible for the consent of the child. This introduces the problem posed by the idea of “the savior sibling.” If a parent has a child with some form of leukemia or

another blood-related cancer or disease, these children require the donation of stem cells to rebuild their immune system in an attempt to cure the disease and save the child. This may lead to the parent attempting to create a suitable sibling donor using preimplantation genetic diagnosis, alongside immunogenic testing to choose an embryo for implantation, and subsequent donation of their stem cells for their sibling. While embryo selection for any reason other than genetic disability or serious medical conditions is considered unethical, the conception of savior siblings is legal, and acceptable within most countries.

Instrumentialisation of the future child is apparent in many of these cases- the parents conceive a child, not because they want another child, but because they want a donor for their existing child. This violates the ethical principles of nonmaleficence and beneficence- there is no benefit for the donor child, and there is a potential risk in any medical procedure (Boyle & Savulescu, 2001). Applying Immanuel Kant's second formulation of the categorical imperative- the principle of ends, which argues that we should not use another person as an end in ourselves, and never merely as a means to an end; this is unethical. To take a child before they are born, and choose them based on their ability to save another is to take their worth as a person, and a part of humanity, and use it as a means to an end, disrespecting their value as a person, and ignoring the good will imperative (Lindner & Bentzen, 2018). Those in favor of the use of the savior child argue that Kant does not state that a person cannot be used partially as a means to an end, just that exploiting a person as a mere tool to achieve an end goal is prohibited. So long as the child is treated as an end in themself, the creation of the child as a donor for their sibling is not inherently unethical. The creation of the child for the sake of their sibling

indicates the parents care deeply for their children, and are likely to love the donor child (Devolder, 2005).

Regardless of the parent's love for the child, there is always the risk of harm to the donor child as a result of their existence. For one, the use of IVF for the generation of an embryo and preimplantation genetic diagnosis for the creation of the savior sibling is inherently risky, and the long-term effects of the removal of one cell at the blastocyst stage for the genetic diagnosis are still unknown. Further, the child may be expected or asked to donate to the sick sibling every time they relapse- the constant donations of stem cells, and the anesthesia required for the retrieval of such, are inherently risky. This further implicates the role of the child as a means to an end, not an end in themself. This ignores the psychological risks of donation- the child may blame themself if their sibling dies, or if the treatment does not work (Rubeis & Steger, 2019). At the end of the day, this violates the principles of beneficence and nonmaleficence- the child is inherently a means to an end, regardless of the parent's love for the child. The existence of the child is a product of exploitation, and applying the deontological argument of a "means-end" imperative, the creation of savior children is inherently unethical.

It is also important to consider the role of cord blood donation as it relates to informed consent and the issue of autonomy in cord blood storage and donation. Cord blood can either be stored in a private bank for later use by the family, or donated to a public bank for distribution to those in need of a bone marrow transplant or some other use. These aliquots of cord blood contain hematopoietic stem cells, which can be transplanted into patients with blood disorders or cancer in an attempt to aid in their recovery. Further, many parents bank cord blood as a method of biological insurance for

their child, should a new treatment come about in the future or if the child should ever need a transplant of stem cells.

Marketing to new parents is ethically ambiguous at best, especially when the chances of a family member or child benefiting from the cord blood are extremely low. It is important to note that, while there are known uses for cord blood, a major tactic in the marketing of cord blood banks is the potential for treatments to be discovered in the future. Private blood banks have been known to oversell the potential in cord blood donation, and are not regulated by the same guidelines as public banks- they can therefore have a lower standard of quality in the blood they store, meaning that if a child or family member did need the blood, there is no guarantee that it would be good enough quality to be used in treatment (Stewart et al., 2013). These practices disregard the ethical principles of non-maleficence and beneficence presented by Beauchamp and Childress in their 4 principles of bioethics.

By marketing cord blood banking to new parents, private banks disregard a moral obligation to prevent harm- there is no guarantee that the cord blood will be viable, and they incapacitate the parents by placing an unnecessary financial strain on them (Jahn, 2013). Ethically speaking, cord blood should be easily accessible to every family, and the financial constraint of private blood banks makes this impossible. Further, the use of public banks restricts those without the resources to pay for storage to a long waiting list, one they may never get off of, further indicating the unethical nature of private banks as they disregard the ethical principle of justice, and the role of justice in healthcare.

Ethical Dilemmas in Somatic Stem Cell Use

As previously discussed, it is important to consider the virtues of varying stem cell types as they relate to research potential and future treatments. Somatic stem cells derived from adult tissues are less ethically ambiguous than their cord blood counterparts- adults are capable of informed consent when donating somatic stem cells in a way that children are not. However, we must consider the risk that comes with the use of somatic stem cells in research and treatment and the ethical considerations that come with this use. To begin, it is imperative to consider both the protection of donor privacy, as well as the efficacy and safety of treatments in progress using somatic stem cells.

Donor privacy is a highly debated bioethical topic outside of the stem cell debate, as well as within the context of stem cell donation. There are two primary considerations in this argument- the rights of the donor, as well as the rights of the recipient. It has been established in several legal cases that there are no property rights to the human body, although there are some exceptions to this rule; which are largely dependent on geographic location. For this paper, we will focus on donor privacy ethics in the United States. Generally, within the US it has been held that donors retain a right to any profits from their samples, and donors maintain the rights to their samples while they are in storage (Davies & Sethe, 2014).

Donor consent is an important issue to consider in that there is no universal consent form, and consent varies from institution to institution. Some stem cell banks do not obtain consent at all, while others obtain consent for a specific area of research. The existence (or lack thereof) of consent is important when considering donor privacy and the duty of a stem cell bank to contact the donor with concerns. Somatic stem cell lines arise from an individual's donation and are considered an aspect of their privacy as it

relates to health and genetic data. For research and publication purposes, the dilemma presented by patient privacy is avoided by ensuring any published data is not identifiable, and the patient remains anonymous (Davies & Sethe, 2014). However, privacy becomes an issue when considering the potential of duty of care; or the idea that stem cell banks are morally obligated to protect their donors from harm that may be discovered in research using their cell line.

For example, a stem cell bank may be performing research on a specific type of cancer that patients are genetically predisposed to. To complete this research, the bank must perform a complete genetic analysis of each donor's cell line. During this analysis, they discover the donor is predisposed to a completely different disease- a disease that will significantly shorten their lifespan without proper treatment. Is the stem cell bank obligated to inform the donor of this disease, even if it has nothing to do with the research their cells are used for? While most professional cell banks acknowledge this duty to care, there is no legal precedent for this scenario (Davies & Sethe, 2014). Further, we must consider the duty of the stem cell bank to disclose this information to future recipients of treatments made using a cell line containing other relevant diseases.

Stem cell treatments are generally marketed with stem cells listed as an "ingredient,' or "new material," within a medication or therapy. The presence of stem cells in a treatment is regulated by both the use of biological material, as well as good manufacturing practices. This implies that any stem cells used in the manufacturing of therapies are tested extensively based on the type of treatment they will be used for. However, outside of the regulated testing for the use of stem cells in treatments, recipients are generally not informed of any potential issues that may be implicated in the

use of these stem cells in treatments. This is irreverent of the potential for future illness or disease as a result of the use of these stem cells in treatment, disregarding the donor's right to informed consent with treatment.

Under the scope of somatic stem cell research lies the use of induced pluripotent stem cells, or iPSCs. As previously discussed, these cells are adult somatic cells reverted to a pluripotent status by the use of various transcription factors. This process in itself raises ethical concerns about the potential for harm as a result of altering donor cells, as transforming somatic cells into iPSCs leads to epigenetic changes- that is, the genetic code of the cell is no longer the same as the somatic cell from which it originates. This is important to consider when thinking about the use of iPSCs in clinical research. IPSCs have shown an association with aberrant DNA methylation, which changes the way DNA is transcribed. The reprogramming process has also been linked to the deletion of tumor suppressor genes, which are essential in the body's natural defense against cancer; and has been linked to alterations in the ability of these stem cells to differentiate and proliferate. All of these problems should be considered when creating new stem cell treatments, and are important to account for before introducing this cell population into therapeutic applications (Harris et al., 2022). The primary ethical concern introduced by iPSCs is the potential to do more harm than good, which is in violation of the principle of non-maleficence.

Regardless of the potential for somatic stem cells (including iPSCs) to replace human embryonic stem cells in research, it is imperative we consider the potential to cause more harm than good when using these cell sources. There are simply too many questions left unanswered by the use of somatic stem cells in therapies, and the potential

for harm to patients as a result of these cells outweighs the beneficial attributes of these stem cell sources. Finally, a lack of transparency in the research pipeline from donor to recipient is in violation of the bioethical principles of non-maleficence and beneficence; and is something we must consider when determining which source of stem cells is the most ethical.

Embryonic Stem Cell Research

At the crux of the stem cell debate lies the use of embryonic stem cells in both research and prospective treatments. As mentioned before, embryonic stem cells are derived from the morula or blastula stage of development as the cells from the inner cell mass are extracted and grown in culture to promote proliferation. Understanding the source of embryos allows us to gain a better perspective on the ethical dilemmas imposed by embryonic stem cell (ESC) retrieval and research. Many arguments against the use of ESCs rely on the moral status of the embryo; specifically, the reality that we are not aware of what the moral status of the embryo should be. To begin this discussion, it is important to define some of the common arguments surrounding moral status. Moral status ascribes certain obligations and considerations to members of a protected group- in this case, embryos at any stage in development. If we are to argue that embryos have equal moral status to humans, it becomes inherently unethical to use embryos as a means to an end that is, to use embryonic tissue in the pursuit of research and therapeutics (King & Perrin, 2014). The action of removing cells from the blastocyst effectively halts development and ends the potential life of that embryo.

To determine what moral status we should grant embryos, we must first answer two questions. One- should we grant embryos moral status based on their intrinsic

properties, and do they have moral status at all? And, two- if embryos do have moral status, what degree of respect are they entitled to? Any living being (or being with potential for life) has some moral status, although the level of moral status is generally agreed to differ from being to being. For example, it would be morally wrong to kill every spider you see, just because you don't like spiders. On the other hand, if that spider came into your home and started biting you, you would arguably be entitled to kill them (King & Perrin, 2014). This exemplifies the idea that different beings have different moral statuses, and not every living thing is entitled to the same moral status as a fully developed human baby.

Embryos are unique in that their moral status is reliant on the people who brought them into existence- for the parents, the embryo carries the potential to become their child. For this reason, the embryo has some moral status as a result of the potential to be that person's child. However, this potential is dependent on the choice of the woman to gestate that embryo with the consent of the father. We must consider the reliance of the embryo on its parents as providers of moral status because embryos only have the potential to develop into a person when gestation occurs. Embryos do not have moral status just because they have the potential to become persons- the moral status of the embryo is largely dependent on the willingness of a person to provide the necessary conditions for life (King & Perrin, 2014). At the end of the day, embryos are not entitled to be created or gestated and have no claim to life simply because they have the potential to be people.

The argument that embryos have moral status based on the simple fact that they are human is not rational. A dish of cancer cells is human, and to say these cells are

persons is absurd. While it can be argued that embryos are different because they have the potential to become human, we have established that the moral status of the embryo is reliant on a woman's body. Embryos outside of the womb have no potential to become human, just like a seed in a packet does not have the same potential as a seed planted in fertile dirt (King & Perrin, 2014). Human DNA is not the same as personhood, and assuming that a group of cells is entitled to the same moral status as a living, breathing child is irreverent to humanity, and what it means to be a person.

It is equally important to consider the moral status of embryos created in vitro fertilization (IVF), as this is a common source of embryonic stem cells. These cell lines are derived from leftover embryos from IVF, a process in which eggs are taken from a prospective mother and fertilized outside of the body to ensure growth occurs. This treatment allows many couples who are having trouble conceiving to have biological children. However, this process is very time-consuming and expensive, and many couples can only afford to complete one egg retrieval cycle, which often results in 7-10 viable embryos. While not every transplant is successful, many couples end up with more embryos than they plan on using; leaving leftover embryos that can be stored or frozen indefinitely. Some couples choose to donate these embryos to other families, and some choose to donate their embryos to research (Juengst et al., 2000).

If we are to argue that every embryo has a right to life, we must account for every embryo made using IVF. This begins to encroach on the rights of women, and the idea that women (or anyone with a uterus) have a moral duty to gestate an embryo, simply for the reason it has the potential to obtain personhood. To consider a ban on creating embryos for research purposes is ignorant of the creation of embryos for IVF, especially

when we consider the reality that most embryos made using IVF will not be used (Juengst et al., 2000). This sends the message that the creation of embryos for reproduction is more acceptable than the creation of embryos for researching infertility and other medical conditions, even if the embryos in both scenarios will be destroyed.

Further, if we deem ESC research unethical because it uses stem cells from an embryo that was not going to be implanted, we must also consider IVF unethical because it creates embryos that will not be used and will likely be destroyed (Juengst et al., 2000). To sit back and allow the creation of embryos that will deteriorate within a freezer while prohibiting the use of these embryos for a beneficial cause to all of humanity is not only hypocritical but inherently ignorant of the bioethical principle of beneficence.

It is unfortunate that the production of treatments using ESCs requires the destruction of embryos to gather these stem cells. However, it is morally permissible to destroy these embryos at the early stages of development due to the established modest moral status. Further, the moral status of the embryo must be upheld throughout medicine, including the use of IVF and other assistive reproductive technologies- if embryos are created and not gestated, there is no difference in the moral status of these embryos and the embryos used in ESC research. There is good reason to believe that these treatments will be beneficial to lots of developed humans in the future, and it is ethically permissible to destroy these embryos provided there is a sense of respect for the moral value of the embryo, and provided there is consent of the parents.

Creation of Stem Cell Gametes

Gametes, or egg and sperm cells, are essential to reproductive technologies, and the lack of viable gametes is the reason many couples have trouble conceiving a child. In

vitro, production of gametes has been accomplished and holds promise for allowing couples who were not previously capable of conceiving a biological child to do so. This could be beneficial to same-sex couples, couples with a significant risk of passing down severe genetic diseases to their children, and parents without suitable gametes. Further, this field of study could hold the key to studying infertility and gaining a better understanding of gametogenesis. Stem cells are the key to this field of study, as artificial sperm and eggs are derived from stem cells at different stages of differentiation (Moreno et al., 2015). Artificial gametes can be derived from adult stem cells, iPSCs, and embryonic stem cells.

Understanding the potential of artificial gametes is relevant to the stem cell debate as it provides an example of potential use for stem cells in research. For example, oocyte donation has long been accepted as a means of researching infertility and reproduction but comes with several risks and burdens for the woman donating her eggs. The artificial creation of oocytes bypasses the risk for women while allowing beneficial research in fertility and reproduction to occur (Moreno et al., 2015). The generation of gametes from stem cells avoids several of the ethical implications of oocyte donation while maintaining beneficial outcomes.

However, this is not to say the creation of stem cell gametes is without ethical dilemmas. One of the primary ethical dilemmas presented by this field comes in the potential for commodification of reproduction, as the ability to create gametes in a petri dish, so to say, introduces the potential for designer babies (Bredenoord & Hyun, 2017). These children would be created according to their parent's preferences, using genetic modification techniques to generate “the perfect child,” or a child with genetic traits

selected to meet parental preferences. This not only implicates the role of genetic modification as a means of removing diversity from society but also ignores the bioethical principles of autonomy and justice (Horer et al., 2023). While this is relatively far removed from the stem cell debate as it relates to research potential, it is still important to consider in the scheme of using stem cells in contemporary society.

Under a similar umbrella lies the potential of misusing genetic material from unconsenting people to make children without their knowledge or consent. Assuming we are capable of making gametes from skin cells or other tissue types, as has been done in the mouse model, we are capable of creating gametes, and eventually children, from unknowing parties. Ethical questions arise concerning the obligation of a parent to care for a child if they do not consent to having that child, and this technology introduces the potential for abusing the responsibilities of parenthood (Horer et al., 2023). Considering these dilemmas presented by the use of stem cell-derived gametes, we introduce the question of the moral obligation of a parent to a child, and the potential for misuse of this technology if the proper precautions are not accounted for.

Somatic Cell Nuclear Transfer

Also within the scope of assistive reproductive technology lies somatic cell nuclear transfer, or reproductive cloning. Somatic cell nuclear transfer is the process by which offspring is created using the same genetic material as the donor. To accomplish this, the nucleus of a somatic cell is removed and transferred to an oocyte of the same species. The two components of the cell are fused using electrofusion, and the oocyte is transplanted into a uterus for gestation. This process has been accomplished in non-human species, which is exemplified in the case of Dolly, the lamb popularized in

the late 1990s as the first viable case of cloning (Daar et al., 2016). Further research has been done in this field, and it is commercially available for cloning of animals.

SCNT introduces several ethical dilemmas, both in animal species, as well as in the potential for cloning humans. Within veterinary studies, this technology remains dangerous and is associated with high mortality and developmental disorders, although improvements in cloning technology have made SCNT a viable option for those who can afford it. Further research in this field involves the use of cloning to generate tissue samples for treatment of disease. Research involving human development is limited in the lab setting by legal boundaries, and any human clones made have been limited by the 14-day restriction- no embryos are allowed to develop past the blastocyst stage. This research derived a nucleus from human skin cells, transplanted the nucleus into oocytes; allowing them to develop until the blastula formed, and then derived ESCs from these blastulas to ensure proper development had occurred (Daar et al., 2016). While it is important to note the potential for this technology, we must consider the ethical implications of using this as a form of assisted reproductive technology.

Acknowledging the fact that human SCNT has been prohibited worldwide, it is obvious there are ethical concerns. The primary arguments for the use of this technology are based on the concept that people have a right to reproductive freedom by whatever means they choose to pursue. However, this argument is in denial of the right of a child to be unaware of how they will evolve in the future, setting a predetermined future for a child based exclusively on their genetic makeup (Blesa et al., 2016). This violates the child's right to self-determination and prevents their ability to avoid being used as a

means to an end, again in violation of the categorical imperative, as well as several bioethical principles.

Another issue with the use of SCNT for reproduction comes with the use of several oocytes to develop one viable embryo. The egg retrieval process is inherently dangerous and difficult for women, as well as in violation of several ethical principles, as it instrumentalizes women and disregards other, safer options for reproduction (Blesa et al., 2016). Regardless of the potential presented by the use of SCNT in reproduction, ignoring the dignity and safety of oocyte donors violates the bioethical principles of non-maleficence and beneficence.

Somatic cell nuclear transfer used in the pursuit of reproductive cloning is not ethically feasible for several reasons. Namely, the process of SCNT is ignorant of the dignity of both the human individual produced by this process, as well as the dignity of the egg donor making this process possible (Blesa et al., 2016). Further, this process disregards the value of human life by utilizing a surplus of oocytes with a low efficacy rate; and would likely lead to future developmental disorders as a result of using this technology when there are several other options available.

Conclusion

Applying the ideas presented by a utilitarian model of principalism, there are several factors to consider when discussing the ethics of stem cell use in research and treatment. Through presenting several of the ethical dilemmas introduced by stem cell research and the use of stem cells in a clinical environment, this thesis aims to provide a compelling argument for the use of embryonic stem cells in research as an alternative to other options, while supporting the continuing research using other forms of stem cells.

The four principles of autonomy, nonmaleficence, beneficence, and justice are all at risk with current cord blood donation procedures. The autonomy of the patient and parent is disregarded when private cord blood banks ignore the right of the parent to an informed choice- they exaggerate the potential for cord blood donation and storage and exploit new parents with promises of cures for their child. Further, the principles of beneficence and nonmaleficence are ignored due to the lack of regulations in the private sector of storage- there is no guarantee that the cord blood will be of good enough quality to be used in the case of illness, and there is no guarantee that the promise of potential treatments will ever be fulfilled. Finally, the principle of justice is disregarded with the financial barrier presented by private storage- many parents cannot afford the high price tag associated with these services, and public storage and distribution centers are not likely to be able to provide services necessary to a patient in critical condition in time to provide adequate aid. In conclusion, the current means of cord blood donation and storage is unethical and requires a change to meet the ethical standards put forth by utilitarian principalism- autonomy, nonmaleficence, beneficence, and justice.

Somatic stem cell use carries with it similar ethical issues, ranging from the balance between research potential and ethical considerations. While this stem cell source is less ambiguous than hematopoietic cord blood donations, it is not without considerations, such as a duty of care to both the donor and recipient, as well as concerns in the realm of donor privacy. A lack of transparency in stem cell treatments is imperative to consider, and the ethical framework of informed consent should be considered when we strive to uphold considerations of autonomy, privacy, and beneficence in stem cell research and future treatment use. Finally, we must consider the potential for harm to

patients when using induced pluripotent stem cells, as the lack of research and potential for harm when using this stem cell source outweighs the benefits.

The use of embryonic stem cells is central to the stem cell debate, and the primary argument against the use of ESCs is reliant on the moral status of the embryo. While the embryo is entitled to the potential for life, the moral status of the embryo is contingent on the willingness of a mother to carry the child, and the circumstances of their creation. IVF complicates this further with the generation of surplus embryos, which raises the question of how the use of an embryo affects moral status. Assuming the embryo is entitled to a modest moral status, using ESCs in research is acceptable when we aim for beneficence in medicine and appreciate and respect the potential for life.

The development of artificial gametes as a byproduct of stem cell research has the potential to address infertility and introduce new avenues for researching human development. This technology holds great promise for couples struggling to conceive through IVF and provides the opportunity for parents to prevent disease in their children. However, we must consider the ethical implications of this research as they relate to the commodification of reproduction or the misuse of genetic material without consent. It is imperative to consider the potential misuse of stem cells in research, just as it is important to acknowledge the massive potential for growth and new developments in science. We must understand and account for the various implications that come with stem cell research, and uphold the principles of autonomy and respect for human life.

Stem cell research is a nuanced topic, with lots of considerations to account for. On one hand, stem cells hold vast potential for curing “incurable diseases,” as well as providing several treatment options for infertility. However, when we account for the

potential harm that can be caused by using these tools when we do not know enough about the long-term side effects, it becomes clear that, while some tools using stem cells are viable sources of treatments and therapies, we must be extremely careful in determining what is ethical under the scope of stem cell research, and what we must avoid.

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