Advantages, Disadvantages And Risks Of Stem Cell Research

Introduction

The progress of science is notoriously capricious; one can never be certain when it will advance, or what the advancement maybe, but change often comes in drastic leaps, skipping many steps along the way. One such change occurred quite recently in the field of medicine when a cell was discovered with the potential to renew, regenerate, and regrow human tissue. However, as with most real-world miracles, this cell, the human embryonic stem cell (hESCs), has the potential for both good and evil. With embryonic stem cell research forcing humanity to address the deepest and most controversial roots of bioethics, the future is coming, and society is far from prepared.

The study of embryonic stem cells is a recent one; it was not until 1981 that scientists knew of such cells, and not until 1998 that a method was developed to derive them from human embryos (Bethesda, 2016b). These cells, usually extracted at the cost of the embryo, are the basic template of all cells in the body and capable of unlimited differentiation and self-renewal (Deb & Totey, 2010, pp. 4, 121-122). However, while it is evident that a cell that can become any cell could have revolutionary abilities, it is also evident that producing such a cell at the cost of an embryo could be crossing a line. The embryo that is terminated to produce an hESC line could have if left to grow, become a human being. Furthermore, hESC research could open the door to an unprecedented ability to manipulate the human genome, raising questions of to what extent it is acceptable to play God in such a fashion (Furcht & Hoffman, 2008). Because the limits of modern human embryonic stem cell research are defined by its bioethical controversies, and because lives, whether of patients or of embryos, are at stake on either side, both the benefits and the risks of the treatment are worthy of careful consideration before any conclusions are to be drawn.

Advantages and Benefits of Embryonic Stem Cell Research

It is undeniable that embryonic stem cell research raises some serious ethical dilemmas. It may well be worth the pain of controversy, however. In their book Stem Cell Technologies, Kaushik Deb and Satish Totey described embryonic stem cells as “diploid pluripotent, self-renewing cells that propagate indefinitely and have the potential to give rise to any tissue in the human body” (Deb & Totey, 2010, p. 121). Human embryonic stem cells have a plethora of applications due to their unique abilities and maybe the pioneers of future regenerative medicine. From failing organs to brain trauma to aging, embryonic stem cells could provide promising and versatile therapies and treatments in the future (Deb & Totey, 2010). So before considering the ethical quandaries the technology poses, it may be worth considering the many advantages it could offer.

In particular, there are two major advantages hESCs have over adult stem cells and other treatment options. One of these advantages lies in their unique ability for variation (Deb & Totey, 2010, p. 4). Adult stem cells are multipotent; that is, they may form a limited number of

cell types. Embryonic stem cells, in contrast, are pluripotent, meaning they have the potential to differentiate into any of the cells in the human body. This invaluable ability stems from the hESC's origination. hESCS are "derived from the inner cell mass of blastocysts" (Deb & Totey, 2010, pp. 120-121), which are preimplantation embryos consisting of a trophoblast, an inner cell mass, and a fluid-filled cavity called a blastocoel (Hill, 2019). This mass is extremely primitive in the development stage, and many would argue that such a being does not count as living, or at least not as a human. This means that this mass must be able to form every type of cell the human body will ever have. Thus, stem cell lines created in a laboratory may be engineered to produce virtually any cell desired, including nerve cells and insulin-producing beta-islet cells, giving them the potential to treat many common and chronic or terminal disorders such as Alzheimer's and diabetes (Deb & Totey, 2010).

The other key ability of stem cells is their capacity for self-renewal. As long as grown in the correct medium, usually on a plated layer of human or mouse embryonic fibroblasts, the cells will remain undifferentiated and continue to replicate (Deb & Totey, 2010, p. 294). The mass of hESCs may then be separated into different masses and propagated further. This is a sensitive procedure, and it has yet to be an efficient one, but in theory, a single mass of embryonic stem cells may be cultured and produce countless stem cell lines (Deb & Totey, 2010, pp. 294-297). Then, when ready for use, they may be treated with a cocktail of chemicals and growth factors to encourage differentiation (Deb & Totey, 2010, p. 186). Once again, the success with this has been varied; however, if research into hESCs continues, it may one day be possible to differentiate any cell in the body from the mass. This, combined with the self-renewing ability, suggests that a single embryo may potentially save many lives and bring great leaps in medical technology. Even if one were to consider embryos to be living, this could arguably be considered a reasonable tradeoff, particularly from a Classical Utilitarian perspective (Bethseda, 2016a; Veatch et al., 2015).

In fact, even with the limited progress that has been made in Embryonic Stem Cell Therapy thus far, many promising treatments have been developed. Already, great leaps have been made in hESC treatment for many debilitating illnesses. For instance, according to an article by Geeta Shroff published in Stem Cells and Cloning (2018), research into stem cell therapy may provide new and better treatments for Multiple Sclerosis. Currently, there are no FDA-approved treatments that can completely stop and reverse the progression of this debilitating autoimmune disease, which occurs when the immune system attacks the myelin sheath of neural cells. In recent years, however, promising steps have been made with stem cell therapy, and stem cell transplants have been performed and shown to be effective. However, human trials using hESCS have been extremely limited, with most stem cell therapies using adult stem cells. The problem with this is that adult stem cells are often less potent and more unstable than their embryonic counterparts, decreasing their curative abilities. In her article, Shroff argued that there is a strong case to be made for the inclusion of embryonic stem cells in this research, asserting that "The remarkable properties of hESCs have shown their clinical usefulness over the other stem cells studied" (Shroff, 2018). Indeed, the limited studies that have been conducted using hESCs have demonstrated they are both more efficient and safer than adult stem cell treatment. Furthermore, because hESC therapy is usually a one-time treatment and the cells may be produced in great quantities from a single fertilized egg, they are also more cost-effective, so they may benefit a wider range of patients. This example makes a strong case for embryonic stem cell research, as Multiple Sclerosis, like many other neurodegenerative diseases hESCs may remedy, is a chronic, progressive illness that results in permanent disablement. Moreover, this is only the preliminary stage of stem cell therapy. With further

experimentation, embryonic stem cells could produce groundbreaking therapies (Shroff, 2018).

Additionally, embryonic stem cells do not have to be implanted directly into a human to create great benefits for society and for medicine. Consider, for instance, the development of a prenatal human. Past a certain level of maturity, all but diseased and dead fetuses are not available for research of prenatal human development (Deb & Totey, 2010, 244). With the rise of embryonic stem cell research, however, a researcher may now be able to culture-specific types of cells and even organs to observe their development and maturation. This has the potential to provide valuable insights into how a healthy child is formed, and what can make this growth go awry. This method produces more accurate results than generalizing from mice, as HESCs, in the right conditions, follow the same dynamic transitions in vitro as an embryo might in vivo. Furthermore, hESCs allow researchers to manipulate the DNA of the cells and observe the effects on the development of the cell line. This may allow researchers to isolate the effects of a specific gene on the development of an embryo, and consequently, a human being. Furthermore, because embryonic stem cells may be mass-produced, pathological cells may be produced in large quantities for investigation, which could provide crucial information on the origin and cause of rare disorders. This may be accomplished either by artificially inducing the disorder or selecting an embryo that already has the disorder (Deb & Totey, 2010, pp. 251-252). The hESC line may then be used to screen drugs to correct the pathology or observe its effects and progression. They may also allow us to consider the effects of embryonic lethal genes, genes whose absence generally results in the termination of the embryo. The information collected from these studies could be used to identify and repair genetic defects by replacing the mutant gene, thus sparing many embryos at the price of one (Deb & Totey, 2010, p. 256).

Although the field of embryonic stem cell research is marred with controversy, hESCs have many essential characteristics that make them ideal for medical research and treatments. Their ability to self-renew, their versatility, and their ability to reveal insights into the nature of prenatal development and disorders all suggest that this research may save countless lives (Deb & Totey, 2010). It is no surprise, then, that embryonic stem cells appeal to many physicians and scientists. Some of these scientists may argue that the blastocyst from which the ICM is removed does not constitute life and see no moral crisis at all (Miklavcic & Flaman, 2017), and even if a physician does agree that the embryo constitutes a living being, there is still a case to be made from a Classic Utilitarian perspective for its exploitation, as its sacrifice may save thousands of lives.

Disadvantages and Risks of Stem Cell Research

As demonstrated in the previous section, there are few topics as compelling as embryonic stem cells in the field of medicine. There are also few fields that pose such direct moral dilemmas. In the study of hESCs, live embryos must be dissected to access the ICM (Deb & Totey, 2010). This process brings Embryonic Stem Cell therapy into direct confrontation with the ethical dilemmas such as avoidance of killing and nonmaleficence as well as confronting the definition and value of life, a controversy that often provokes strong reactions and heightened emotions. Although embryonic stem cells have the potential to save many lives, each cell line is the result of a deliberate termination of an entity that may have one day become a human being. Indeed, many would argue that the case against embryonic stem cell research surmounts the case for it. Depending on one’s ethical views, a whole host of moral controversies may be raised concerning this dilemma.

One major roadblock in embryonic stem cell research is the ethical dilemma of the avoidance of killing, a principle which states that killing is generally an immoral action (Veatch et al., 2015). This is a difficult problem to solve, partly because it is not a single issue; rather, it is many smaller dilemmas wrapped up neatly under the title of an ethical principle but still often in conflict with one another. One major aspect of this moral conundrum depends upon what one considers to be the moral status of the embryo. To a great extent, this is determined by religious and philosophical beliefs (Furcht & Hoffman, 2008, pp. 101-103). It is universally agreed upon that at one point or another, whether at conception or birth, a developing fetus or child passes the threshold from inanimate to alive. As with many moral dilemmas, the source of the debate is where to draw the line. In Roman Catholicism, for example, an egg is considered living as soon as it is fertilized, and thus generally unsuitable for experimentation. At the other extreme, Confucianism pushes the moment of life out to the birth of the child.

The atheist and scientific community has also failed to reach a consensus, with some focusing on physical stages, others on mental landmarks, and neither of these groups in full agreement amongst themselves (Furcht & Hoffman, 2008, pp. 101-103). Some define it as beginning at fertilization, believing that it is the only definitive transition that could be identified as the start of life and that this definition would eliminate the risk of killing a human being. Other perspectives might define life by which organ sets are fully developed or functional, often pushing the moment of life to the third trimester. Some scientists may also define life by the level of intelligence and the capacity for certain feelings and sensations (Miklavcic & Flaman, 2017). There is a whole list of ways to define life, and another for the reasons for each definition.

The ethical debate does not end with a consensus on the definition of life, however. To those who classify an embryo as non-living, there are usually few qualms about using it for medical research. Those who do not, however, are faced with serious moral dilemmas. To many, the issue is whether it is ethical to end a life for the sake of others, a problem that rests in the health care provider’s ethical and moral beliefs. For those who focus on nonmaleficence, the risk that the embryo may be a living organism is more important than the benefits that may be reaped. A staunch believer in nonmaleficence, believing that a physician should “first do no harm,” may be opposed to hESC research, believing that it will harm the embryo (Veatch et al., 2015 pp. 201, 66, 73). In contrast, a Classic Utilitarian, who calculates the net benefits and harms of action, may see no moral dilemma at all. One potential death for the potential benefit of thousands is no choice at all when considered arithmetically, although many would argue such a cynical perspective is not appropriate when the matter concerns human life (Veatch et al., 2015).

There is, however, another side to the story, as Ropert P. George described rather eloquently in the introduction to his article “Embryo Ethics” (2008), by comparing the status of a fetus to that of a mentally impaired child. The dilemma, he argues, has nothing to do with the lives that could be saved, but to the doors that might be opened by declaring a human – albeit an incomplete one – as inferior to the rest of society. “[I]s it right,” he asks, “relegate a certain class of human beings - the handicapped - to the status of objects that can be killed and dissected to benefit others?” (George, 2008). Once humanity begins down that path, it is impossible to tell for certain how far they will go and where they will draw the line. Indeed, George is not alone in his concerns regarding the road that hESC research- and stem cell research in general – could take. As well as potentially devaluing human life, the same treatments developing from hESC research that promise to correct dangerous genetic mutations at birth could also lead to “designer babies,” a prospect that many are less than enthusiastic about (Furcht & Hoffman,

2008, p. 88).

Finally, there are medical disadvantages to stem cell treatments. As mentioned above, embryonic stem cells require extensive work to maintain and differentiate controllably. In addition, there is the risk of teratoma formation in transplanted tissue, or the formation of tumors formed from multiple types of cells (Deb & Totey, 2010, p. 4) Additionally, there is the question of whether the differentiated embryonic stem cells will behave identically to their naturally grown counterparts. Furthermore, there is always the risk of rejection, as a healthy immune system is inclined to reject all foreign material, although some methods exist that could potentially bypass this dilemma (Deb & Totey, 2010, p. 191).

Conclusion

Ethics and its implications are not an exact science; there is no known way to quantitatively and scientifically measure the value of human life, much less that of human life in the making. Many believe that hESC research involves murder and is inherently an evil act (Furch & Hoffman, 2008; Veatch et al., 2015), while those with a more Utilitarian ethic, including myself, do not think hESC research has crossed any lines that abortion has not already thoroughly stampeded, and that even if it had, there is little cause for worry. I see the problem as a bioethical version of the Trolley Problem, only instead of pushing one person in front of the train to save three, it is one not-quite person to potentially save thousands. The chance that that one embryo could provide the world with the knowledge and contribution on par with the thousands its sacrifice could save is relatively slim, especially considering many of the embryos used for this research are often leftovers from IVF treatment that might otherwise simply be thrown away (Furcht & Hoffman, 2008, p. 94). While this basis for decision making does not consider the questions of human life and its worth, the answers to those moral dilemmas often come from gut feelings, and I do not trust my gut with decisions greater than what and when to eat, so I will remain ambivalent to that note.

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