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Review

Stem Cells and Ethics

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ABSTRACT

Several ethical challenges, particularly those relating to stem cell research, have been introduced as a result of the field of biotechnology's rapid expansion and advancement. The stem cells in our bodies have the capacity to develop into various varieties of specialized cells and tissues. The human-derived stem cells have great potential to be used as regenerative medicine and cell replacement therapies useful for the treatment of many diseases. As we go forward with stem cell research and get closer to the clinical use of these cells, a variety of ethical questions are raised. More moral dilemmas about patient accessibility may appear after solving the existing ones, yet it is the only way to progress. The purpose of this chapter is to cover the most important bioethical concerns relating to stem cell research and to consider the current ethical debate regarding them through an analysis of the scientific literature.

Keywords: Cloning, ethics, genetic engineering, human embryonic stem cell, regenerative medicine, stem cell.

Why is the world showing increasing interest in stem cells? Over the years that extended from the late twentieth century to the beginning of the twenty-first century, the local and international media, as well as scientific journals, reported news and developments of these cells, so what is their story?

Most of us do not lose sight of the importance of stem cells and the radical changes they brought about in the world of medicine, genetic engineering, and genetic surgery, given the characteristics that these cells have which do not exist in other cells, such as the ability to constantly renew themselves, in addition to their transition from an unspecialized cell to specialized.[1] Specialized cells are capable of replacing an excised part of an organ that was subjected to surgery, regenerating deformed tissue, or even producing some hormones as a result of treatment before the stage of functional specialization of the stem cell.[1,2] There is hope to manufacture and then inject insulin-producing cells into the patient's pancreas that is unable to produce it. Among the most important diseases expected to be treated are Parkinson's diseases, diabetes, and heart muscle diseases that cause angina pectoris.[3] When these stem cells are taken from human embryos, they are more effective to be used. It is crucial that early human embryos be used to harvest embryonic stem cells. It implies saving lives with minimal human losses and without prejudice to the dignity of the being.

STEM CELL AND ITS CHARACTERISTICS

Stem cells are cells of a special type that are unique in the property of multiplying and transforming from non-specialized cells into cells with specific functions, as this is in response to certain external signals.[4] Stem cells are characterized by their ability to perform two basic functions together, the first is that they constantly renew themselves, and the second is the production of specialized, differentiated cells.[1] The fertilized egg cell (zygote) and the cells of the very young embryo up until the eight-cell stage are totipotent (mentioned in detail in the stem cell types paragraph) these cells in the appropriate environment (the uterus) can form a normal and complete individual.[1]

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What Is Its Origin?

Scientists have long been trying to understand how the single-celled zygote develops to multiply and specialize into more than 200 types of cells that make up tissues. In the year 1981, stem cells were obtained for the first time, and they were from a two-day-old mouse embryo, whose body at that time consisted of dozens of similar cells in the so-called blastocyst stage.[5] As it was later found out as a result of research on animals the cells in this mass (blastocyst) can be grown in the laboratory - after isolation - on a continuous basis, and it maintains the characteristics of the stem cells.[6]

In addition, these cells grown in the laboratory, if returned to the fetus in its early stages, will divide to give most of its cells.[7]

What Characteristics Must a Cell Have to Be Considered a Stem Cell?

Experiments have shown that it must have definite characteristics, the most important of which is:

-The ability to renew itself.

-The ability to be another type of cell if asked to do so.

Types and Classifications of Stem Cells

It is divided into basic types from which other subtypes branch out:

Totipotent Embryonic Stem Cells

It is the group of cells that are formed after a very short period of fertilization of the egg, and this period is estimated in hours. The divisions of the fertilized egg begin until the embryo is formed in its first stages, then it consists of dozens of cells in a stage preceding the blastocyst. These cells are called embryonic cells with full potential, and each of these cells is characterized by its ability to produce an integrated embryo.

Pluripotent Stem Cells

Unlike totipotent embryonic stem cells, pluripotent embryonic stem cells are not able to produce a complete embryo when transplanted, but they give most of the cell types that make it up, except for the amnion in addition to the placenta. Research in this field, and especially on this type of cells, tells us promising steps in the journey of treating diabetes and possibly eliminating it, as there is hope to convert these cells into cells capable of secreting insulin, and then injecting them into the patient's pancreas.[8,9]

Fetal Stem Cells

Cells extracted from the tissue of 4–10-week-old fetuses. These cells are taken from aborted fetuses. The method of obtaining these cells is difficult compared to the previous isolation method, as they were isolated from the blastocyst cells.[9]

Type III cells are like Type II cells in one aspect and differ in another, as the laboratory that obtained them says that they do not differ in anything from pluripotent stem cells, and that, like them, they cannot turn into a complete embryo, but they form different types of tissues or most types of tissue except amniotic fluid and placenta. What differs in it is the method of obtaining it or extracting and isolating it.[4,8,9]

Adult Stem Cells

Or cells of tissue origin, found in the tissues of the adult organism, or in most of them, constantly multiply and compensate and renew what is lost in the tissues, but they may stop in the stage of aging to perform their function.[10,11]

Understanding the mechanism of its work and the reasons for its work and stopping will constitute a real revolution in the field of medicine, and for this reason, a lot of research has tended to control it or to control its early death and prolong its life.

GENETIC ENGINEERING AND BIOETHICS

Transgenic Animals

Experiments conducted on animals enabled researchers to carry out applications that study the role of genes in obtaining so-called transgenic animals. By using genetic modification, hundreds of animals, especially mice, were obtained by adding a specific gene to the zygote or fertilized egg to integrate into the genome and be Inherited, which will allow the possibility of studying its effects on the fetus later.[2,12,13]

Dolly Sheep

In 1983, Dolly, who was then on the cover of Nature magazine, caught the world's attention. Who is Dolly? And what characterized it to be immortalized as one of the most important intervals of natural evolution?

Dolly is a sheep that was produced - or was cloned more accurately - in July 1996 from the cells of another adult animal. What is meant by another animal here is that Dolly was not born of a father and a mother, instead she had three mothers.[14-16]

Dolly's cloning was known as industrial cloning, as it was processed in a laboratory, so it was the first animal to be cloned from mammals from somatic cells. Dolly's first mother was a Schottish black face sheep, from which an unfertilized egg cell was taken, and its genetic material was removed (by isolating the nucleus). The second mother was Finn-Dorset sheep, one somatic cell was also taken from her and the genetic material or nucleus was removed from her, but the difference between the first and second isolation is that we got rid of the nucleus of the somatic cell from the first animal, and we kept it from the second animal for the sake of the genetic material in it, This was followed by the merging of the nucleus of the second cell with the cell body (cell without its nucleus) of the first, and the resulting cell is called a hybrid cell. The cell division was stimulated by an electrical stimulus and began to multiply and divide until what is known as a blastocyte began to form, and thus we have obtained a certain number of hybrid cells.[14-16]

The question that arises now is: How will Dolly be born from this mass of cells (the blastocyte)? There seems to be a missing step, or maybe we missed something important on the way here.

Another Scottish Blackface was the third mother of Dolly, whom we do not know yet. It is the ewe who will embrace the last mass of cells that we obtained from a hybrid of two cells from two different animals, and we call her Surrogate mother. The Blastocyst is implanted in her and Dolly comes to life after several months. Dolly was not like his surrogate mother; Dolly was like Finn-Dorset whose genetic material was taken by isolating and implanting his nucleus. What we mean here is the similarity of the genetic information of the two animals, in addition to some phenotypes of course. Dolly lived seven years until she gave birth in 1998 followed by three ewes in 1999.[14-16]

What Sparked the Interest of Societies in General and Especially the Scientific Community after Dolly's Cloning?

Is there a cause for fear in that experience? And what are its repercussions? What scientists have done with Dolly is one of the results of the development of genetic engineering technology, which came as a natural outcome of two scientific revolutions: The first began with the discovery that genetic material is contained in the deoxyribonucleic acid (DNA), and this was followed by the discovery of the genetic code, by which we mean the sequence of the four nitrogenous bases that store genetic information. The second was the discovery of restriction enzymes, which can cut DNA in the intended places.[17] As a result of being able to read and identify the gene codes, attempts were followed to prepare them in the laboratory or to extract them from other living organisms for the purpose of reshaping or synthesizing them through genetic surgery. Sometimes the purpose is to plant these genes in microorganisms to translate them into human proteins. Through genetic engineering, humans have been able to program many micro-creatures, the most important being bacteria, making them biological factories that produce antibiotics, drugs, vaccines, proteins, hormones, enzymes, and many other products.[18,19]

Genetic engineering enabled man to manipulate genetic material to serve his ambitions and goals. Gene surgery is at the mercy of their hands, which -in addition to what we mentioned- can change some biological functions, add other specifications and deletions from the organism, for example, intelligence and growth rates can be manipulated, or even the production of what is known as the gigantic man or giant human being!

Some have also warned of disastrous consequences that are not considered, such as the occurrence of uncontrollable fatal mutations, the leakage of microorganisms (microbes or viruses) that wreak havoc on the planet and all those living on it, or the possibility ti be used in wars as a destructive biological weapon or what is known as "weapon of mass destruction". Genetic engineering is impressive as much as it raises fears, it provides miraculous solutions to many human dilemmas, but at the same time its consequences cannot be predicted, also there is a danger in its uses and applications, not to mention the immorality of those practices and their social, religious and moral violations, which prompted legislative systems to enact laws to regulate the conduct Of those researches and how to develop them without endangering human life.[20,21]

The poet and writer Robert Penn Warren said: "The end of man is knowledge, but there is one thing he can't know. He can't know whether knowledge will save him or kill him. He will be killed, all right, but he can't know whether he is killed because of the knowledge which he has got or because of the knowledge which he hasn't got and which if he had it, would save him."

TOTIPOTENT AND PLURIPOTENT EMBRYONIC STEM CELLS

Which Types Can Be Used Legally and Ethically, and Which Cannot?

It is important to understand what type of stem cells specifically is not forbidden to work on and which it is. Also, it is good to remember that stem cell experiments using animals are not like human ones. Experimentations on animals are not just allowed to be implemented, but also the governments encourage it due to their several applications which are vast and even needed. Many fields will be affected by the progress of regenerative medicine and stem cell trials, especially the health and economic levels. Advanced technological and biotechnological companies started using these cells in animal reproduction a long time ago, particularly to keep and save unique animal strains, like horses and cows. Now, many companies have stem cells from many animals, and the properties for the genre, gender, strength, and phenotypes all were listed in a catalog and are to be given when it is asked. When they got those stem cells, they will implant them in the uterus of the surrogate animal.[1,4-6]

Working on human stem cells is still forbidden by all the laws of countries. The type we are talking about here is totipotent stem cells. yet, pluripotent stem cells, and after debates lasted long about them, the decision was taken by the USA to allow use for scientific research, which was on August 9th, 2001, and that was accompanied by four conditions that must be met:

1) The cells were obtained from embryos that were artificially fertilized, i.e., they were not taken from embryos of normal pregnancy.

2) The embryo that was used to obtain stem cells should be from extra embryos, i.e., it is no longer necessary for *in vitro* fertilization.

3) This be done with the consent of the parents, they know and allow the embryo to be converted into stem cells.

4) To ensure that the consent of the parents is not due to achieving financial gain in any form whatsoever.[17]

BIOETHICS

Ethics is the idea of right, and wrong behavior and accepted moral standards. It is applicable to all sorts of business, accounting, and customer service.[22] Bioethics is the word made up of two parts. The word, "ethics" deals with ethical issues and questions like, "What should we do? Are all things considered?" and the word, "bio" refers to life. In general, it deals with the application and conclusion that can be drawn from the health-related life sciences. Bioethics is not restricted only to local affairs that can be solved by a local society but are global issues that show its effect worldwide.[23]

The primary moral query raised by the production and application of human embryonic stem cells (hESCs) is the status of hESCs. It is actually necessary to destroy early embryos (blastocysts) in order to extract hESCs from them. As a result, we need to decide whether or not a human embryo is regarded as having the same human dignity and right to life as a human person who is born, which raises the importance of moral issues of human exploitation, instrumentalization, and mortality. Despite the vast arguments here, there is still no ethical consensus on the issue of human embryos when it comes to both the restriction on killing and the respect for human dignity. Research cloning (the acquisition of embryos for research by nuclear transfer in enucleated egg cells) and egg-cell donation are further hotly debated topics in hESC research. Cloning research or what is known as "therapeutic cloning" appeared to have been involved in the development of therapeutic applications for a long time. yet, human cloning research is a blatant example of exploiting people for gain, because achieving that needs more harmful embryo research. Exploiting and killing people are not the only unwelcome outcomes, human reproductive cloning is also an undesirable thing to be started which is typically viewed as unethical, and that in turn was raising many concerns again.[24] If this method for therapeutic applications had proven effective, there would have been a high demand for donated egg cells. Women's health and vulnerability to exploitation are at stake when they donate their eggs. Human dignity is thought to be extremely violated by the other alternative, which is to create human-animal hybrids.[25] These ethical concerns no longer seem essential given the technique's apparent failure. The fundamental question of how to see human embryos morally is still being debated in ethics.

Obtaining stem cells from the embryo and implanting them in the laboratory made the matter more sensitive, especially since these cells were implanted for long periods while preserving their original characteristics as stem cells, as they could multiply in test tubes without changing any of their

characteristics. It took twenty years of experimentation on animals until hESCs began to be obtained, which is not a short period, but it is normal in sensitive discoveries that are transmitted from animals to humans. The reason for global interest in stem cells is due to several reasons, including the expectation of scientists to use them to replace lost cells from a person in the later stages of his life, because the loss of these cells is the cause of many diseases, such as diabetes, and heart diseases, whether that result from the loss of cells from the heart muscle itself Or those resulting from the loss of cells in the brain. This interest reached its peak when scientists discovered, for the first time, the existence of stem cells specific to every organ in the human body. It compensates for the deficiency that occurs in it due to the loss of cells, as it is present in the blood, skin, pancreas, and liver, and perhaps surgeons know this more than others, as they see the ability of organs to regenerate and compensate because of eradication.

In conclusion, stem cell research raises several ethical concerns, such as those related to the origins and creation process of the cells and the limited availability of stem cells from the human body. Human embryos and fetuses are the ideal sources of stem cells since they can be further differentiated into a variety of tissues and organs, giving a person new life. The cells obtained from the aborted fetuses could be used to culture the fetal stem cell lines in a lab to sidestep the ethical issues. If not deemed immoral, the alternative method might be the isolation of stem cells from a blastocyst that is 5–7 days old. In this way, the moral dilemmas surrounding the use of hESCs could be resolved, reducing human suffering, and eliminating serious ethical questions. Animal research with stem cells is still a thriving field in the stem cell and science community, as the rules of the International Society for Stem Cell Research 2021 seek to encourage the responsible advancement of these activities.

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