Therapeutic Cloning: its applications, advantages and disadvantages

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Abstract: This paper describes my research in Therapeutic Cloning. It uses literature to give detailed discussion of cloning. It also discusses applications of cloning such as curing diseases. Furthermore, the study gave a detailed discussion of the various advantages of Therapeutic cloning such as its ability to allow doctors do a cheap and readily available organ transfer. An example is Parkinson's or Alzheimer's disease, leukemia, and even the production of whole complex tissues and organs from simple cells. It also provides disadvantages of this practice such as the painful process of egg extraction and being an expensive procedure. Furthermore, the paper gives a discussion of the ethical issues associated with Therapeutic cloning. An example of ethical issues associated with cloning includes producing identical human beings in the lab.

1. Introduction

1.1 Cloning

Asexual reproduction of genetically similar cells, tissues, or replicas of DNA is referred to as cloning in biological terms. Gene cloning is a technique that can be used to create identical genes and DNA fragments that may be utilized in genetic engineering [1]. Gene cloning is not the only type of cloning that exists. Reproductive cloning is defined as the ability to make a new human who has precisely the same genetic information as the nucleus that was donated. On the other hand, therapeutic cloning allows scientists to grow a mature cell of a given living organism in a short period [1]. The development of reproductive and therapeutic cloning directly results from current discoveries and studies into how the cell cycle is regulated.

1.2 History of cloning

Cloning was formerly considered to be an impossible activity. However, scientists have made significant advancements in the technologies employed in bioengineering due to their extensive study and improvement in modern technology. Such technologies and advances in biotechnological studies have made cloning possible, making scientists come up with various identical organisms. For instance, scientists successfully cloned a sheep called Dolly. Upon the successful cloning of Dolly, the field of agricultural cloning of animals was completely transformed in the late 90s, specifically in 1997. Despite the Dolly being the first animal to be successfully cloned, the sheep was by far the most well-known successful clone. Following the Dolly generation, many additional animals were cloned, including dogs, goats, rabbits, horses, cats, pigs, and mules, among other organisms [1]. In addition, Japanese scientists were successful in 2006 in creating heart and brain cells from adult stem cells [2]. These advancements suggest that scientists are actively studying means of circumventing the present restrictions and ethical problems associated with cloning technology and coming up with improved and new techniques and ways in this field.

On2nd September2019, Dr. Nakauchi Hiromitsu of Japan became the first person to be granted official authorization to create an animal embryo containing human cells, which he then transplanted into surrogate animals [3]. This was after the prohibition on the creation of chimeras was lifted for more than fourteen days by the Japanese government. New laws also permit the transplanting of embryos into animals which was previously prohibited. Therefore, as much as there are many

controversies and ethical concerns about cloning, cloning therapy will continue to be allowed by various institutions worldwide. This will help in treating many people.

1.3 Therapeutic cloning

In contrast to the creation of an individual organism, the goal of therapeutic cloning is to generate cells that are mature and of diverse types as well as specialized and functional tissues in a shorter period [1]. Scholars provide that therapeutic cloning is a sure way to be used in the future by doctors aiming to create new tissues and cells for medical treatments [2]. Therapeutic cloning can aid in the regeneration or creation of a variety of new tissues or cells, including nerve cells that can allow cure or treatment for patients suffering from diseases such as Parkinson's or Alzheimer's disease, leukemia, and even the production of whole complex tissues and organs from simple cells.

2. Applications of Therapeutic cloning

Therapeutic cloning is a potential approach in tissue engineering, and it can allow for the creation of organs from scratch. This can help remove medical challenges such as scarcity of organs during organ transplantation and immune rejection. Organs that can be cloned include patient-specific parts such as skin sections and blood arteries [4], [5]. Furthermore, researchers developed a five-step protocol in 2006 that allowed embryonic stem cells of humans to differentiate into endocrine cells capable of producing pancreatic hormones that are useful in treating diabetes and those who have little insulin in their body [6]. This has been useful in treating diabetic diseases such as Mellitus. Scientists can produce such hormones by coming up with markers and agents that imitate the organs responsible for producing them in a sterile environment. Creating a new organ can also be made externally and then transferred to a patient that has a failed organ.

Therapeutic cloning has also been applied in a mouse model to test if it can treat Parkinson's disease. The process has been successful, and there is a good chance that it will be applied clinically in people to treat neurodegenerative disorders and ailments requiring demyelination in the future. When dopaminergic neurons degrade, Parkinson's disease manifests as persistent tremor and muscle stiffness, which impairs movement and causes the patient to become immobile [7].These scientists derived two ntESC lines from mouse cells, which were induced to divide and differentiate into GABAminergic, motor, dopaminergic neurons, and serotonergic in vitro (outside of the living organism and in an artificial environment) [7]. These neurons formed synapses and exhibited normal physiological properties outside the living organism (Barberi et al., 2003). In the study, 6-hydroxydopamine-induced Parkinson-like lesions in mice were caused by dopaminergic neurons directly injected into the cortical striatum of the animals. Eight weeks after the implantation, 80 percent of the ntESC produced neurons were still alive, as opposed to just 40 percent of the stem cell-derived neurons [7]. It has thus been demonstrated that the therapeutic cloning strategy is more lasting as a cell replacement therapy. It can be used to cure cortical atrophy caused by Alzheimer's disease or stroke.

Therapeutic cloning can also be used to create animal models of human illnesses for scientific investigation. The achievement of Wolf and Mitalipov in generating a monkey from the cell nucleus provided evidence that abnormalities that are caused by genes can be cloned (copied or replicated) into another animal and studied extensively to come up with better solutions and treatment [8]. This can lead to the production of human patient-specific genetic ailments in animal models that can allow for easier testing of drugs and their side effects. Such techniques have made it easier to transfer the nucleus of a person's skin biopsy into a mouse or a monkey to produce an oocyte with a patient-specific expression of the disease. As a result, clinical trials can be conducted on the animal model to determine the most effective medical approach.

The death toll from cardiovascular disease (CVD) in 2002 was almost the same as the combined death tolls from pneumonia, accidents, influenza, cancer, and diabetes mellitus [1].However, researchers have discovered two methods of improving heart health by using stem cells. They start by cultivating the stem cells in a culture dish to mature into heart muscles. Patients with hereditary cardiac problems can have their stem cell-derived heart muscle used in trials to help researchers discover new

treatments for them. Second, stem cells have the potential to restore damaged cardiac tissue. The notion of transplanting fresh cells has been tested in the laboratory through the use of stem cell therapy. After experiencing heart attacks that result in the loss of cardiac muscle cells, researchers have attempted to devise methods of improving cardiac function by “remuscularizing” the injured heart wall through cloning [9]. It is also possible to heal injured cardiac muscle by transferring different types of stem cells into patients.

3. ADVANTAGES and dISADVANTAGES of Therapeutic cloning

3.1 Advantages

Stem cell research has played a significant role in advancing therapeutic cloning and has shown to be highly beneficial. Stem cells are useful because they can differentiate into various types of cells. While adult stem cells have a limited growth potential, embryonic stem cells have a far higher developmental or differentiation potential and can be used to generate almost every cell type [10]. In order to build established cell lines, stem cells can be employed to initiate cell division to produce numerous distinct cell types that can be transferred to patients. Therapeutic cloning has the potential to be used extensively for replacement tissue development, a critical technique in treating disorders such as Parkinson's [11].

When the egg is fertilized, it separates into two eggs, each becoming an embryo. A stem cell can be taken from the embryo during this procedure. Any tissue or organ can be generated from these stem cells, which can be used to treat a wide range of illnesses and disorders. Through this procedure, fresh skin can be generated externally for grafting onto a burnt patient. It also allows healthy organs and tissues to be grown outside the human body to replace diseased or damaged ones [12]. According to Sivandzade & Cucullo, neurons can be generated to aid in the treatment of people suffering from diseases such as Parkinson's and Alzheimer's diseases [12].

Therapeutic cloning can repair organs in the body. In the United States alone, more than 100,000 individuals are waiting for an organ transplant at any one moment, with tens of thousands more waiting in other countries across the world [13]. The use of therapeutic cloning may reduce the need for patients to undergo lengthy treatment periods. Every day, more than 20 people lose their lives while waiting for an organ donation [14]. Individuals waiting for a kidney may have to wait up to 5 years, and in some circumstances, much longer, before they may find someone who is a direct match for their needs [15]. If therapeutic cloning were widely available, these waiting periods would be removed. Therapeutic cloning is the only feasible way to generate these critical organs in a controlled environment. Not only would this method shorten wait times, but it would also save money in the long run. There would be no chance of organ rejection following transplantation since the DNA from a cloned organ is identical to the DNA from the individual who received the organ.

With therapeutic cloning, one no longer has to be concerned about tissue rejection after receiving an implant. Using therapeutic cloning, it is possible to create an exact match between a human and a tissue or organ needing replacement [16]. It minimizes the probability of rejection to an absolute minimum. Despite the fact that the new tissues may be created using an embryo that had just been implanted, the cells split through the somatic components that had previously been removed are identical, resulting in an exact match between the two tissues. Therefore, therapeutic cloning has the potential to result in the regeneration of organs. When it comes to tissue differentiation, embryonic stem cells can develop or differentiate into various types of tissues that are useful in the medical setting. Researchers can route these cells into particular tissue types depending on the requirements of the patient with minimal adverse effects. For instance, replacing a ligament can be done in a matter of weeks rather than months, resulting in a shorter recovery period. Creating a new liver to replace one that has been destroyed by cirrhosis can be a viable option with therapeutic cloning. Skin transplants can create new skin without the formation of scar tissue after the procedure.

It has much beneficial potential in the treatment of inherited disorders. Because the DNA information in somatic cells is similar to that of the individual, any genetic abnormalities would be

passed on to the next generation. However, through therapeutic cloning, scientists can manipulate the genetic sequences of humans to correct the problems that are causing patients to suffer from genetic illnesses [16]. In light of the technological advancements that have enabled the therapeutic cloning procedure, the possibility of a whole new field of medical therapeutics has emerged that has enabled doctors to produce tissues that are disease-free.

With therapeutic cloning, it would no longer be necessary to use organs given by donors. According to our current medical system, someone has to die first for another person to benefit from a heart transplant. The ability to keep an organ alive at the time of the donor's death and the requirement for a match between the donor and the recipient, critically needed transplant organs are extremely rare and challenging to perform [17]. Gaille supports that overcoming all these problems would be possible by widespread acceptance and usage of therapeutic cloning within the medical community [16].

A preventative therapy approach is possible with this treatment technique [16]. When preventive efforts are performed rather than reactive measures, medical treatments are more effective and less expensive. Through therapeutic cloning, it would be possible to replace damaged cells with healthy cells that are genetically similar to the patient. This method offers the ability to prevent illness, lessen the chance of future health issues, and regulate genetic or chromosomal challenges that certain people may be born with, among other benefits.

3.2 Disadvantages

We need a comprehensive definition of what it means to be alive. Many people believe that life begins at fertilization or conception [18]. As a result, the concept of therapeutic cloning can be equated to an act of murder. Even though the embryonic stem cells would be removed after around four to five days, they cannot thrive independently. Some researchers believe that this method disrupts the normal evolution of life in an artificial manner [16]. Our culture would need to agree on how life should be defined before moving forward with therapeutic cloning.

The possibility of cell mutation exists at all times. It is true that Mother Nature is predictable and constant in many ways, yet she can also be surprising at times. For instance, mutations leading to the production of navel oranges were caused by a single mutation. This means that even when somatic cells are used to transfer pure genes, a genetic mutation can still occur unknowingly on its own. Because of these defects, embryos have failed to divide in the manner intended. Some have even been known to cause tumors when administered to a patient.

It would be necessary to have a large supply of eggs. The best estimates of the number of eggs required for therapeutic cloning put the total number of eggs required at more than 1 million [16]. According to estimates, over the past 20 years, up to 2018, more than 350,000 eggs have been put into cold storage in the U.S [16]. This indicates that only to begin the process of healing sickness, the supply of eggs would have to be increased by a factor of two. Once this is realized, we must acknowledge that the 1 million is an annual requirement. We would require an additional 980,000 eggs for storage to ease the cloning procedure, and this is an expensive and lengthy process.

Egg extraction is a painful operation that requires anesthesia [19]. Despite the fact that current pain control treatments are available, women report that egg retrieval or extraction is quite unpleasant [20]. Currently, many health insurance companies do not cover the costs of egg retrieval since it is deemed an optional procedure [21]. According to McHaney & Jacobson, the average price of extracting an egg in the U.S is around 10,000 USD, with the cost of medications for reducing pain ranging from 2,000 USD to 5,000 USD [22]. Unless the expenses of therapeutic cloning are subsidized in some way, only those with financial resources will be able to profit from its advantages.

Somatic cells do not possess the same characteristics as newly formed stem cells. The properties of the stem cells that appear, despite the fact that the nucleus information is updated to generate an efficient clone, are not necessarily as useful as the features of the stem cells that arise through the normal reproductive process. Adult stem cells have also been examined for therapeutic cloning to address this issue, although preliminary results have been ambiguous.

Eugenics may result in the emergence of new human catastrophes, experts warn. Those who support cloning feel that cloning individuals may be selected for their superiority and some egotistical

individuals are ready to imitate their own appearance. If the restriction is lifted and eugenics is implemented, a specialized institution to categorize and identify nationalities on a regular basis will be created. In many ways, this is not dissimilar to the Nazi eugenics doctrine. Moreover, if a cell from an original animal has diseases, then the new cloned cells from this animal may also contain these diseases as they will be passed over genetically. For instance, the sheep, Dolly, was a genetic duplicate (clone) of a six year old sheep. Dolly lived to be six years old before she died. This is the lower end of the usual life expectancy of a sheep. The cloned sheep was diagnosed with arthritis at the age of 5, and it is believed that the disease came from the donor's DNA. Therefore, such activities can be risky in humans.

4. Ethical issues

In today's world, gene cloning is a rigorously controlled method that is widely approved and commonly employed in many laboratories around the globe. However, both reproductive cloning and therapeutic cloning involve significant ethical concerns, particularly regarding the possible use of these technologies in people [23]. When it comes to reproductive cloning, the possibility of making a human who is identical to another person genetically and has previously lived or is still alive and existing is a real possibility. These ideas of individual freedom, individuality, and autonomy may be in tension with long-standing religious and social ideals concerning human dignity, and they may even be in violation of the principles of individual dignity and human dignity in general [24].

Furthermore, it is difficult to guarantee the health and safety of a cloned person from an ethical standpoint. Cloning involves some level of cell and gene manipulation, which has a substantially larger risk of accidental loss of some genetic material. British scientists have achieved success after 227 failed attempts with the cloned sheep Dolly. Sadly, Dolly died too soon. Scientist still doesn’t have a way to support the safety of cloned animals.

While therapeutic cloning can help individuals suffering from sickness or damage, it would need the development of human embryos in the test tubes. This is a controversial procedure [5]. Some believe that employing this technology to collect embryonic stem cells is unethical, regardless of whether the cells are utilized to treat ill or damaged individuals. Additionally, the fact that cloning a human only requires female egg cells, reproduction can continue as long as there is a woman. This means any woman can be fertile without males rendering male procreation of human unimportant component. This can have an influence on the traditions of family ethics.

5. Conclusion

In conclusion, cell cloning refers to the process of reproducing genetically identical DNA, cells, or tissues through asexual reproduction. Cloning genes and DNA fragments is a process that may be used to make similar genes and DNA fragments that can then be used in genetic engineering experiments. Therapeutic cloning, accomplished via the technique of somatic cell nuclear transfer, provides a source of transplantable cells for researchers. Therapeutic cloning has the potential to improve the development of tissues and organs that are compatible with the immune system of patients. Therapeutic cloning has been applied in treating diseases such as heart diseases, among other genetically transferred diseases, through the use of stem cells and transplantations. Therapeutic cloning has some advantages, such as easier generation of matching organs with those of recipients, thus helping save lives. It also has some disadvantages, such as being an expensive process, painful process of egg extraction, and the possibility of passing harmful genes into the recipients. Additionally, there are ethical concerns regarding therapeutic cloning. These concerns include religious and social ideals concerning human dignity in replicating people. Also, it is difficult to guarantee the health and safety of a cloned person.

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