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The application of gene editing in treating cancer

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Abstract. Current gene editing technology mainly involves inserting, replacing or deleting DNA sequences to change the genetic material of an organism, and its most common aspects are using this technology to mass-produce some drugs, such as insulin, or using gene editing to change some nutrients in plants to help others. This article use a literature review and, expects to give an extensive outline of the utilizations of quality altering in medication, with a specific spotlight on its utilization in cancer disease treatment. The paper finds that gene editing technology has emerged as a powerful tool in the field of medicine, revolutionizing the treatment of diseases, including cancer and some systemic diseases. There are many different diseases in the world that currently have no cure, because medicine needs to go through many stages before it can be brought to market and given to people, but through gene editing technology can greatly help alleviate or even reverse these diseases. Other than that, this research deepens our understanding of biology, thereby contributing to the future connection between biotechnology development and medicine, and helping more patients with difficult and complex diseases.

Keywords: Ene editing, medicine, cancer, DNA sequence, CRISPR.

1. Introduction

The technology of gene editing is not as common in today's society as ordinary drugs, but if the technology grows and develops to a certain stage, it may lead humanity to a new stage. In today's society, many drugs take a decade or more to research, and need to go through layers of testing before they are finally used to treat major diseases. But now there are many difficult and complex diseases in society that cannot be cured by drugs, such as cancer or systemic diseases or a series of serious diseases such as leukemia. Cancer is caused by changes in the genome of tumor cells. So in gene editing technology there is a technology called CRISPR/Cas9 gene editing technology, which can achieve precision gene editing, and then edit the genome to explore the mechanism of tumor development and development. This procedure involves just complex nuclease proteins and short RNA as site-explicit endonuclease catalysts and can target practically any genomic site. Lately, this framework has been progressively applied to disease exploration and treatment and has accomplished astounding outcomes.

Using the research method of Literature review, this paper mainly studies how gene editing technology is developed and applied in cancer research and treatment, and further studies what convenience CRISPR/Cas9 technology provides for cancer research and treatment and some of its effects. Whether the study of this tool can effectively prevent or treat cancer in the near future.

The main significance of this article is to do some deeper research on gene editing and CRISPR/Cas9 technology. It also provides more ideas and some recommendations for the treatment of cancer, in

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addition to allowing more people to understand and know the application of gene editing technology in medicine and the effective treatment of diseases.

2. Introduction to gene editing therapy

As a new science and technology, gene editing technology involves a wide range, and has become a more popular new technology in the field of biology [1]. Gene therapy mostly involves replacing defective genes adding new genes or modifying gene sequences in an endeavor to fix sicknesses or improving the body's ability to fight disease, or using artificial nuclease technology to add and splice biological genes. This technology is the innovative frontier of contemporary life science technology. With the continuous growth of gene editing technology systems, human beings can have more high-end technology to fix sicknesses and facilitate all aspects of the world. Quality treatment holds guarantee for a great many infections, including malignant growth, coronary illness, diabetes, hemophilia and AIDS. CRISPR-Cas9 innovation is a novel and profoundly exact quality altering instrument that is changing disease examination and treatment. Scientists are utilizing this innovation to concentrate on how disease develops and track down new possible restorative systems, and this treatment is likewise going through clinical preliminaries in malignant growth patients. Conventional quality altering innovation depends on the standard of DNA homologous recombination, utilizing outer benefactor quality pieces to take out or add target quality parts. The main principle of genome editing technology refers to the addition, deletion, decoration or substitution of specific gene fragments in living organisms, so the predetermined DNA succession is changed into the normal genome arrangement, lastly the quality sections are altered or even make hereditary impacts [1]. At the same time, gene editing has many ethical problems. For example, the most well-known gene-edited baby event in 2018 mainly involved an associate professor at the Southern University of Science and Technology who genetically edited a pair of newborn babies to make them naturally resistant to HIV after birth. This incident has aroused a wide range of academic and public discussions around the world. In recent years, gene editing technology has played an advantage in the fields of human disease treatment, health care, the food industry, and the crop industry. However, while bringing welfare to human beings, it also inevitably has huge ethical risks. The future promotion and development of this technology will be closely related to everyone. By and large, quality altering advances principally incorporate zinc finger nuclease, record activator-like impact factor nuclease and grouped consistently blended short palindromic rehash succession (CRISPR) innovation. In addition to gene editing for cancer, insulin was first discovered in the pancreas of cows and pigs, but it takes a lot of pancreas to make a few milligrams of insulin. However, through gene editing technology, insulin can be produced in large quantities to meet the needs of patients. All you need to do is to cut the gene fragment that normally produces insulin in the human body into the bacteria so that the rapid reproduction of the bacteria can quickly obtain a large amount of insulin, which is very efficient and convenient. In terms of human somatic cells, gene editing technology can deepen people's understanding of the molecular process that controls the occurrence and progression of diseases. Further understanding of gene editing technology carried out in laboratories on human cells, tissues, embryos and gametes provides an important way to further understand human gene function, DNA repair mechanism, and the link between genes and diseases. Cancer spread and the relationship between genetic diseases and genes. Basic research on gene editing technology could also improve human understanding of mammalian reproductive and developmental processes. Studying human germ cells can also provide a detailed understanding of human development and fertility issues, thereby bringing fertility possibilities to people who are not easily pregnant [1]. Although gene editing has made breakthrough progress in the treatment of hereditary sicknesses, cancer, infectious diseases, etc., the editing of germ cells and embryonic cells has always been controversial, and the ethical issues of gene editing are also one of the factors limiting its application [2]. The emergence of gene editing greatly facilitates medical research and treatment, and the cost is also greatly reduced compared to the development of medicine [3].

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3. The Application of Gene Editing in Cancer

Cancer is an unmanageable sickness with a high death rate, which has drawn in worldwide consideration. Dangerous growths are answerable for one out of six passings around the world, undermining large number of lives. Notwithstanding many energizing accomplishments in the field of disease therapy, including a medical procedure, radiation treatment, chemotherapy, designated biotherapy, and new blend treatments, high postoperative repeat rates, radiation/chemotherapy obstruction, and hurtful poisonous secondary effects remain hindrances to endurance and survival [4]. This prompts the turn of events and examination of CRISPR/Cas9 innovation. Utilizing CRISPR/Cas9 to take apart compound hereditary connections uncovers how disease responds to pharmacological treatment, which is a significant utilization of the technology [5]. CRISPR-Cas9 framework is a versatile invulnerable system that utilizes bacterial archaea to guard against unfamiliar nucleic acids [1]. The CRISPR genome altering framework perceives a particular DNA grouping by the objective succession carried on the sgRNA, which makes the CRISPR framework exceptionally unambiguous. The utilization of this innovation can be utilized to fix the quality change locales of sicknesses or to accomplish the capability loss of significant qualities. As of now, this innovation has been effectively applied to the treatment of an assortment of hereditary diseases [6]. To shield themselves from trespassers, for example, infections, these microorganisms catch sections of the intruders' DNA and store them as parts called CRISPR, or short palindromic rehashes that consistently group together. On the off chance that similar microorganisms attempts to go after once more, these bits of DNA (which become short bits of RNA) help a chemical called Cas find and cut the trespasser's DNA. In the lab, CRISPR apparatuses comprise of two fundamental jobs: guide RNA and DNA-cutting catalysts, most regularly Cas9. The researchers planned the aide RNA to mirror the DNA of the quality to be altered, called the objective quality. The aide RNA helps out the Cas and guides the Cas to the objective. At the point when the aide RNA matches the DNA of the objective quality, the Cas cuts the DNA [3].

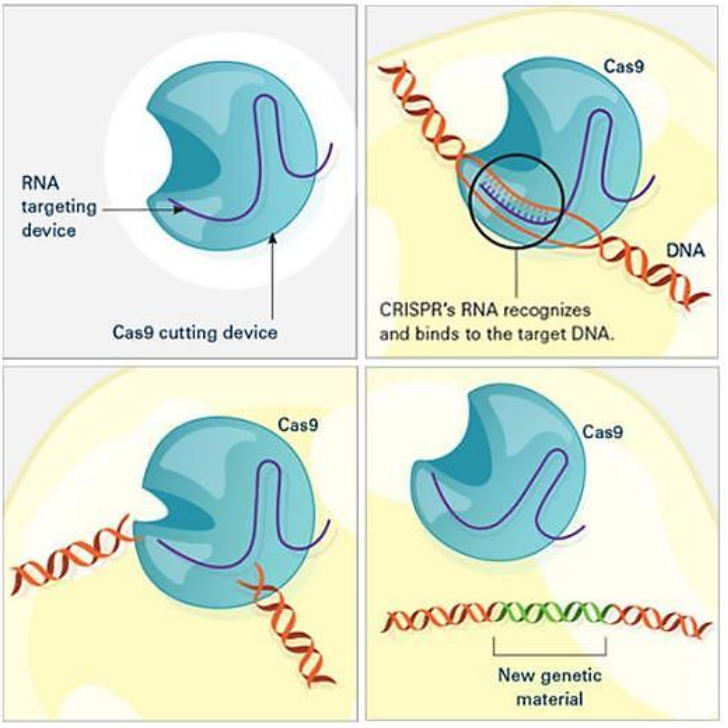

Figure 1. CRISPR consists of a guide RNA and the Cas enzyme [3].

Through CRISPR-based vast screening, a quality need dataset for 14 human AML cell lines was produced and an overall methodology for characterizing mammalian quality organizations and

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engineered deadly connections was proposed [2]. Cas9-intervened genome altering has three necessities: (1) Single aide RNA (sgRNA) grouping, the CRISPR/Cas9 framework is the main CRISPR/Cas framework for genome altering, to some extent since it contains a related, effectively programmable sgRNA. It's only 20 nucleotides long. sgRNA consists of CRISPR RNA(crRNA) that has A mutually complementary sequence with A target site, and trans-activating crRNA (trans-activating crRNA, tracrRNA) is grouped into [1,7]. (2) There is a Cas9 protein with a nuclear localization signal. In order to perform genome editing function, the CRISPR/Cas9 system also needs a keying enzyme closely related to the two RNA groups, Cas9 ribonuclease. These RNA are expected to direct the Cas9 protein to the objective site and initiate the Cas9 nuclease. (3) Protospacer contiguous theme (PAM), sgRNA and Cas9 opal intersection to frame complex, sgRNA and Cas9 opal intersection to shape complex, and rigorously distinguish the objective reciprocal DN-A succession situated close to the 3 'terminal horizontal wing of the PIN, which is generally made out of NGG or Bother (N can be A, T, G or C). Then, at that point, DNA twofold strand breaks (DSBs) are triggered [7]. Tumorigenesis is a perplexing interaction including multi-quality and multi-stage changes, including initiation of proto-oncogenes, inactivation of cancer silencer qualities, microdeletions, micro repeats, rearrangements and structural abnormalities of chromosomes. Immunotherapy is one of the main forms of cancer treatment, which uses monoclonal antibodies or donor T cells with anti-tumor function to target the autoimmune system [2]. The most recent progressions have assisted with tending to one of the unmistakable worries about this technique which is the off-target mixes saw with dsDNA and have brought about additional examinations being completed for possibly more secure and more designated quality treatment, to make it accessible for the clinical preliminaries to successfully treat cancer [6].

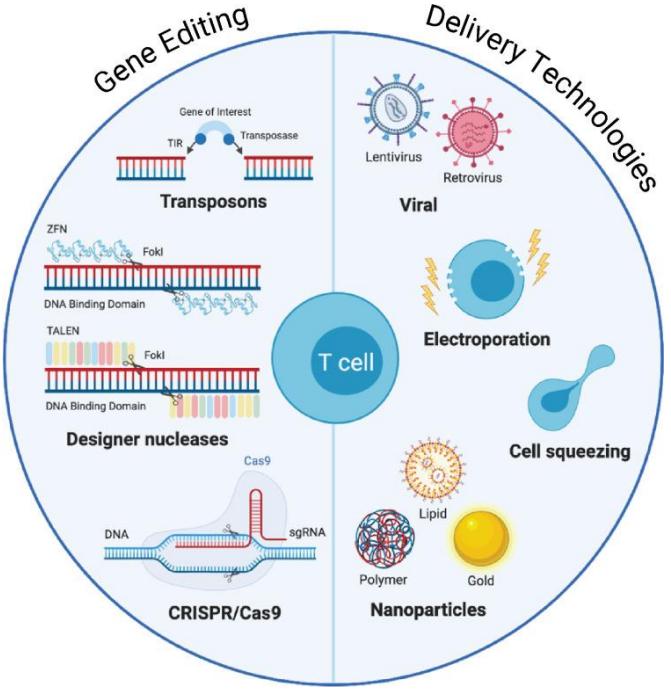

Figure 2. Delivery technologies for gene editing of T cells. Figure was created by the authors with BioRender.com [8].

Quality altering systems that have been investigated in White blood cells for applications in disease immunotherapy incorporate transposons, planner nucleases like zinc finger nucleases (ZFN) record activator-like effector nucleases (TALEN), and grouped routinely interspaced short palindromic rehashes (CRISPR)/Cas9. Notwithstanding popular transduction, novel conveyance frameworks, for example, electroporation, cell crushing, and nanoparticles — have been used in new immunotherapy methodologies to additional improve restorative efficacy [9].

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4. Conclusion

The research conclusion of this article is that the edited technology has made great achievements in the treatment of cancer, but it is in progress, and it has not been fully implemented into the real treatment stage, and more is in the experiment. CRISPR-Cas9 technology, for example, has made it easier to study cancer and its treatments and has made great academic breakthroughs, but it also faces huge ethical problems [10]. At the same time, it also provides new ideas for solving some diseases that cannot be solved by traditional therapies. In the future, many emerging technologies will be combined in clinical medicine practice, and it is believed that in the near future, CRISPR-Cas9 technology can be applied to real treatments, so as to help more patients avoid some problems similar to cancer or systemic diseases. There are also many shortcomings in this study. For example, the study in this paper may not be thorough enough in some aspects to give a very clear explanation. In the future, further studies will be conducted in this aspect to integrate various emerging technologies more closely with clinical medicine. All the ethical and moral issues of this technology are not elaborated in detail in this article, and more research and investigation will be done to improve this research.

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