

Can CAR T Cell Therapy Be a Good Way of Treating Other Diseases

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Abstract. CAR T-cells (CARs) have been used to treat a variety of cancers since their discovery in the late 1980s. Because of its efficacy, it has been used as a focus of research and a breakthrough point in cancer treatment, and its principles can also be a way to treat other types of diseases. Therapeutic trials focusing on different diseases and proving its effectiveness in treating different diseases or having been put into medical trials have shown that it works as part of the immune system to treat diseases other than cancer. The ability of CARs therapy to treat other diseases has been successful in different clinical and other trials, and in the future it may be possible to combine it with other therapies or immunotherapies (such as immune checkpoint inhibitors or chemotherapy) to treat other The ability of CARs to treat other diseases may contribute to space exploration and other important steps in human history.

Keywords: CAR T cell, other diseases, treatment.

1. Introduction

CARs therapy has been approved by the FDA for different cancers. When the therapy was first discovered in the 1980s, it was tested for treating cancer, until 2017, when it was finally approved for the treatment of cancer. Though, after such a long term of testing, CARs was finally able to treat cancer as a type of therapy, it was believed that it had more potential than only treating cancer, what if we could use it to treat more than cancer to treat other diseases, asthma, or even the ones that are what we thought to be impossible to cure. Chimeric antigen receptors are a therapy that expresses the antigen-modified receptor for specific diseases on its surface [1]. CARs therapy has made great progress in treating cancer and is being tested in lab and having clinical trials in treating different kinds of diseases[2], but, there are still problems that need to be solved such as its inefficiency in treating solid tumors or the happening of antigen loss which could both lead to a failed CARs. There has been four generations of CARs. The first generation of CARs appeared between 1989-1993 by Zelig Eshhar and Gideon Gross. In the next 30 years, generations have developed in their composition. The second generation of the therapy have enhanced their anti-tumor activity, the third generation improved in its functioning of the receptors and in the presence of vivo. And the forth generation are boosted in many ways such as antitumor activity and cytokine activity.

2. Different types of diseases that have been test-treated with CARs therapy

Since the discovery of CARs, immunotherapy has come to a revolution. CARs is inputted with the antigen of the tumor cells that are needed to be treated. With human modification, the therapy has been quite efficient in treating cancers, even though only a limited type of cancer. CARs therapy is a newly developed immunotherapy that is often used to treat fluid cancer such as leukemia, it lacks efficiency in treating solid tumors since human technology cannot identify the most efficient antigen that can be used to present to the it's receptors. CARs also known as chimeric antigen receptors T cell can be specialized in treating a specific cancer by being presented with the specialized antigen from the tumors and then producing the cytotoxic T cells. People believe that CARs can be used to treat different autoimmune diseases and viral infections such as the allergy, asthma, different infectious diseases, HIV, and even COVID-19. CARs are used to treat autoimmunity by using the chimeric autoantibody receptor (CAAR) T cells which are also called the B-cell antibody targeting

receptors (BAR) to target the specific B cell that has the specific autoimmunity receptors, which would kill the surface immunoglobulin memory B cells directly[3,4].

There are also experiments on how CARs therapy treats asthma. Asthma is mainly caused by the Th2 immune response. CARs therapy IgE which is produced by B cells is vital for the pathogenesis of allergic disease. The pathogenesis of allergic asthma has a relatively low number of Tregs and immunosuppressive activity[3,5]. CARs also has the ability to treat different infectious viruses by using the function of CD 8+ T cells, such as the chronic hepatitis B virus, which is a type of disease that usually doesn't cause a significant response, which can form liver cancer. There are also other experiments for different infectious diseases such as the Chronic hepatitis C virus or the human cytomegalovirus, for treating different diseases, the therapy can be guided to grow the specific receptors that are needed for killing the intruders[6]. CARs therapy has also been tested with Human immunodeficiency virus type 1(HIV-1), by combining CARs therapy with combination viral therapy. Comparing different uses of CAR T cell therapy, it is obvious that CARs therapy has pointed out many new ways of treating different diseases [7].

3. Comparing difference between the original way and CARs therapy in treating different diseases

3.1. The difference in treatment for autoimmune diseases

Comparing the original way of treating different diseases such as autoimmune diseases which was treated with corticosteroids, or other anti-inflammatory drugs, and immunosuppressant drugs. Which could cause indigestion, or stomach ulcers which could lead to further internal bleeding. Using the CARs therapy that contains the chimeric antibody receptors (CAAR) has a high efficiency in treating autoimmunity diseases since the CAAR also known as the B cell antibody targeting receptor, which differs from the scFv domain. CAAR can be a target for the autoimmune B cells, which carry specific autoantigens that do not cause immunosuppressive. Using the CAR T cell therapy, or CAAR T cell therapy to be more specific. This treatment was tested in vivo efficacy of Dsg3EC1-4 CAAR T cells which opposes the human CD19 + nalm-6 B cells that indicate anti Dsg3BCRs which were cloned from polycythemia vera patients. Through the tests, the limitations of CAR T cell therapy treating cancer do not affect CAAR T cell therapy to treat autoimmune diseases [4].

3.2. The difference in treatment for asthma

Asthma can be cured through using asthma medicines or immunotherapies, which are allergy shots and sublingual immunotherapy (SLIT), though sometimes when using the sublingual shots at home and other places such as aq school may cause infections due to the environment. For curing asthmas, CARs therapy is used as a cellular treatment that uses the chimeric antigen receptor-redirection cytotoxic T cells, which have a high efficiency in reducing the Aryl hydrocarbon receptors and reduce inflammation in airways[5].

3.3. The difference in treatment for infectious diseases

Normally, when treating different infectious diseases, such as viral infections, bacterial infections and other types of infections, we can use medicine such as antibiotics and, other special medications. But antibiotics can, not only cure our diseases but also kill our body cells, which are quite harmful to the delicate human body. High doses of antibiotics can also cause antibiotic immunity and create super bacteria or super viruses that cannot be killed by normal drugs or antibiotics. [6] When treating infectious diseases, CD8+ cytotoxic T cells are tempting and fit the conditions for using the CARs therapy, due to its ability to kill things that are identified not from the body. Tests have been done on mice. The CARs that had been engineered for treating the HBV virus had a quick response only causing the transient liver damage [6].

3.4. The difference in treatment for treating human immunodeficiency virus.

Human immunodeficiency virus is known for causing the immune system to disable and make it easier for other diseases and viruses to invade the human body. Currently, there is no clear treatment for HIV viruses to be cured since the immune system can do nothing neither, only AIDs blocking drugs. CARs therapy has been tested for curing the HIV viruses for anti-HIV CD4+ CARs had been designed and was able to suppress the replication of the HIV. Currently, there are clinical trials being running to find out about the safety of CARs treating HIV.

COVID-19 had an outbreak in 2020, for now, vaccines are the only way of treating and preventing the infection of COVID-19. And yet allergies can be caused by the vaccine therefore the vaccine still has some issues. When treating COVID-19, the chimeric antigen receptor technology on natural killer cells was used, since they are designed for killing intruders of the body, CAR NK cells target the spike protein of the COVID-19 virus currently there is only one clinical trial that shows a promising therapy for treating COVID-19[7].

4. The discussion of CARs therapy.

CARs therapy, as a newly discovered type of immunotherapy, is focused on treating liquid tumor cells such as leukemia. CARs therapy has difficulties because of the lack of effective antigens that can be used to modify normal T cells chimeric antigen receptors. Right now, because cancer has not been defeated, most of the focus is put on ways of improving CARs therapy for treating cancer. CARs therapy can treat other diseases that are not very often not realized. Since tumor cells and other intruders both produce antigens when being broken down into parts that can be used by CARs therapy. Different tests above taken by different scientists have proven that the therapy can, not only be used to treat cancer but also treat other diseases.

T cells as a part of our immune system have always been important to us, even though their activation process takes up time. But T cells are efficient against most diseases and have the ability to duplicate themselves into memory T cells that can remember specific intruders and prevent humans from getting infected. CARs therapy is modified from CD8+ T cells which are already cytotoxic T cells, is later designed for only the cancer that is needed to cure and prevented from attacking other normal cells, which can prevent autoimmunity happening in CARs. Since CARs does not have the high affinity receptors.

Even though CARs therapy is a great immunotherapy, its disadvantage is still quite serious. Such as CARs therapy are very expensive, therefore, many people in different areas of the world might not have the wealth to buy CARs. CARs also has a serious problem when used, we lack the antigen that can be given to the CARs, therefore, sometimes the therapy cannot be fast enough to treat the cancer at the right time[1,8-10].

Another problem that the CARs therapy face is there might be an antigen loss in the tumor cells and the treatment can no longer determine whether the cell is infected by the cancer. When comparing other treatments to immunotherapies, such as radioactive therapy, which is a way of treating cancer that can do a lot of harm to the human body in the process. Radioactive therapy will release huge amounts of radiation that can cause many serious problems in the process, thus radiation therapy takes a long time with many treatment cycles that take up to 3 to 6 months. Other therapies such as chemotherapy, will also do great harm to the human body since the chemicals that are used will not only kill cancer cells but also kill normal cells in our body. Chemotherapy will take around 4 to 8 cycles in a full treatment without promising that the tumor will be gone.

Compared with the above, CARs therapy does not need to worry about harming body since the T cell of CARs treatment comes from body, therefore, it is impossible that CARs will hurt your own body cells. CARs therapy can work together with other therapies such as the immune checkpoint inhibitor therapy, which can work together in order to have a higher efficiency in treating the tumor cell. It might be possible that with the development and the advance of CAR technology, it might be possible that, using the technology of dual antigen receptor of CARs Immune checkpoint inhibitors

can work with the antigen receptors to increase the efficiency in identifying tumor cells from normal cells.

5. Conclusion

CARS therapy can not only treat cancer but other diseases as well, even the ones that are impossible to treat right now. Therefore, knowing that CARs therapy has the possibility of treating some diseases that were used to be impossible, hope will be given to many others. Even though there are still many limitations such as the lack of experiential data to support the treatment for different diseases, which cannot prove that CARs therapy can be effective for all kinds of diseases. In the future, CAR T cells might be a way to treat all the diseases that we are infected with, it might be possible that they will become a part of us, as the immune system, CARs might have the ability to self-generate inside patient's own body to encounter different diseases. It might even replace what we have, or even evolve as a part of us to live on and pass on to the next generation of humans. Sadly, even though CARs therapy is very effective, there are still many diseases that it faces that cannot be cured, even cancers, CARs therapy relies on the antigen of the disease, and finding the most effective antigen is very time taking, therefore, the therapy that still needs to progress, in the future, we hope that artificial intelligence can work together with CARs therapies along side other therapy, to have a higher, riskless way of fully treating cancer and other diseases without sequelae.

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