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Immuno-Oncology Treatment for Cancer

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A B S T R A C T

The four primary forms of cancer treatment up until recently were surgery, radiation, chemotherapy, and targeted therapies. By encouraging the immune system to destroy cancer cells, immuno-oncology (IO) has become a novel and significant alternative to traditional cancer therapy methods within the last ten years. The US Food and Drug Administration and the European Medicines Agency greatly accelerated their approval of this recently created cancer medication in 2019, which has led to its rapid growth.

The goal of cancer immunotherapy, also known as immuno-oncology, is to enhance and treat cancer by stimulating the immune system. Inside the immune system's natural state. It involves using fundamental studies on cancer immunology and the expanding field of oncology subspecialization. Cancer immunotherapy makes use of the fact that tumor antigens, which are chemicals on the surface of cancer cells that immune system antibody proteins may attach to and identify, are frequently present in cancer cells. Typically, proteins or other macromolecules (such as carbohydrates) are tumor antigens. While mutated antibodies bind to tumor antigens that identify and target cancer cells so that the immune system may either destroy or stop them, normal antibodies bind to foreign viruses. Immunotherapy for cancer has varying degrees of clinical success depending on the type of cancer; for instance, certain subfamilies of stomach cancer respond well to treatment, whereas immunotherapy is ineffective against other subspecies.

Keywords: cancer, tumours, immuno-oncology, immunotherapy

Introduction

Cancer

The body's aberrant cells proliferating out of control is called cancer.

Cancer can be divided into five main categories:

- **Carcinomas:** originate in the tissues lining the internal organs or in the skin.
- **Sarcomas:** these grow in the connective tissues such as bone, cartilage, fat, or muscle.
- **Leukemia:** it starts in the bone marrow and blood.
- **Lymphomas:** the immune system is the source.
- **Central nervous system cancer:** primarily affect the brain and spinal cord.

Treatments for caner-

Options depend on the type of cancer, its stage (if the cancer has spread) and general health. The goal of treatment is to kill as many cancerous cells while minimizing damage to normal cells nearby.

The four main treatments are:

1) **SURGERY:** directly removing the tumor
2) **CHEMOTHERAPHY:** using chemicals to kill cancer cells
3) **RADIATION:** using X-rays to kill cancer cell.
4) **IMMUNOTHERAPHY:** Boosting immune system

Cancer immunotherapy strengthens the immune system's natural ability to combat cancer. Today's highly active and exciting field of cancer immunotherapy has the potential to fulfill the long-standing goal of finding, creating, and delivering safe and effective treatments that significantly improve the lives of patients battling the disease.

Immunotherapy-

Biologic therapy or biotherapy are other names for immunotherapy. It is a medical procedure that targets specific immune system components to combat illnesses like cancer.

- Stimulating your own immune system
- Giving you immune system components

Cancer immunotherapy-

It is the immune system's rejection of cancer. The fundamental idea is to incite the patient's immune system to combat the disease-causing malignant tumor cells.

Why cancer immunotherapy -

Our immune system is made up of various organs, unique cells, and compounds that work together to keep infections and other diseases at bay. Our bodies are filled with substances and immune cells that work to keep infections at bay. Microorganisms such as bacteria, viruses, and parasites are like enemy foreign armies that are not supposed to be in your body. They attempt to infiltrate your body in order to exploit host resources and cause damage. Our body's defense mechanism is our immune system. Because cancer cells don't differ enough from normal cells, the immune system may not recognize them as alien. On occasion, the immune system may identify cancer cells, but the body may not mount a powerful enough defense to eradicate the cancer. To combat this, scientists have discovered strategies to boost the immune system's ability to identify cancer cells and intensify its defenses, enabling the immune system to eliminate them.

Lab-produced antibodies and other immune system components are used in immunotherapy. Once within the body, they strengthen the immune system. The antibodies themselves specifically target proteins that aid in the growth of cancer cells. The antibodies cause cancer cells to either die off or cease growing by attaching to proteins that support cancer. Another name for these kinds of antibodies is TARGETED THERAPY.

History

The idea that the immune system can recognize and manipulate tumor growth can be traced back to 1893, when William Coley used live micro organism as an immune stimulant to treat most cancers, but interest in most cancers immunotherapy has been moderate due to limited scientific efficacy. This limited efficacy is due to tumor cells' ability to avoid recognition and elimination by the immune system, allowing them to become embedded within the host. Over the previous few years, significant progress has been made in understanding how most cancers evades the immune Machine, which in turn provides new approaches to preventing most cancers immune evasion in lieu of killing most cancers cells. The use of chimeric antigen receptor (CAR) T cells, immune checkpoint therapy, blocking antibodies to c of ytotoxic T lymphocyte antigen-four (CTLA-4) and programmed dying-1 (PD-1), and other techniques has resulted in the most recent medical breakthrough. These advancements tip the scales in favor of the immune system in the elimination of most cancer cells. With the help of science, cancer immunotherapy was named 2013's Breakthrough of the Year after clinical trials demonstrated its potential to save lives.Furthermore, the efficacy of these treatments highlights the need for careful deciphering of basic immunology in order to successfully translate it into clinical practice for the majority of cancer treatments. The purpose of this Review Series is to provide a succinct summary of several current developments in cancer immunology and immunotherapy, as well as to explain how new understanding of the mechanisms underlying immune evasion in the majority of cancers may open up new avenues for the development of innovative and effective treatments. We hope that by placing basic mechanistic research in a medical context, those criticisms will be of use to most cancer immunologists as well as practicing oncologists

Types of immunotherapies

Several types of immunotherapy are used to treat the cancer given by the following**.**

a. Immuno checkpoint inhibitors: -

Which act as antibodies' blockers. These immune system test sites are normal and maintain very low immune responses. These medications enable the body's cells to react to cancer more forcefully by inhibiting it.

b. T-cell transfer therapy

Which is a therapy that improves your T cells' innate capacity to combat cancer. Your tumor's immune cells are eliminated during this treatment. The ones that are most effective in fighting your cancer are chosen or altered in a lab to more effectively target your cancer cells, multiply into bigger clusters, and be injected back into your body through a vein. Other names for T cell transfer therapy include immune cell therapy, adoptive immunotherapy, and cell therapy.

c. Monoclonal antibodies

Which are laboratory-made proteins made to target particular cancer cell types. Certain monoclonal antibodies damage the immune system and mark cancer cells to make them look better. Like that Immunotherapy includes the use of monoclonal antibodies. Another name for monoclonal antibodies is antibodies.

d. Vaccines

Which strengthen your body's defenses against cancer cells in order to combat cancer. Vaccines are not the same as those that aid in infection prevention.

e. Immune modulators

Which strengthen the immune system's defenses against cancer. Certain agents target particular areas of the immune system, while others have a typical effect on the immune system. The study and creation of treatments that support the immune system's ability to combat cancer is known as immuno-oncology. Our immune system, which defends us against pathogens, fungi, and viruses, is a sophisticated network of organs, cells, and molecules. The immune system is capable of identifying and eliminating foreign materials as well as attacking aberrant cells.

There are two main components of the immune system:

- Congenital antibodies, innate immune system, immediate immune system and toxins.
- Flexible vulnerability is a learned defense system that grows as a result of exposure to an external object. Mutable antibodies work in two ways.

Classification of Immunotherapy:

a) Monoclonal antibodies (MABs):

One kind of immunotherapy is MABs. They work by bringing the immune system into action and supporting it in its battle against cancer. Particular MABs are more focused than others. By blocking signals, they can, for instance, prevent the division of cancer cells. Blood proteins called antibodies help in the body's defense against disease. Monoclonal simply refers to a single type. Therefore, a monoclonal antibody (MAB) is made up of many copies of a single antibody. A MAB locates and identifies particular proteins on cells in order to function. While some focus on cancer cells, others attack immune system cell proteins. Every MAB is specific to one protein. Their actions vary based on which protein they are targeting. Their actions vary based on which protein they are targeting. MABs serve as immunotherapy in a multitude of capacities.

Have many functions. They can:

- cause the immune system to target and eliminate cancerous cells
- Influence cells to aid in the immune system's assault of cancerous although cancer cells are abnormal, the immune system has a hard time identifying them because they come from normal cells. Certain MABs adhere to cancer cells, which facilitates their location by immune system cells. ADCC, or antibody-dependent cell-mediated cytotoxicity, is the term for this process. Other MABs function by interacting with immune system cells. Consider checkpoint inhibitors as an example of an immunotherapy. The way that checkpoint inhibitors function is by blocking proteins that stop the immune system from attacking cancer cells.

Side effects:

It may include;

- skin changes such as red and sore skin or an itchy rash
- diarrhea
- tiredness
- flu-like symptoms such as chills, fever, dizziness
- feeling or being sick

b) Checkpoint inhibitors

One kind of immunotherapy is checkpoint inhibitors. By preventing the proteins that stop the immune system from attacking cancer cells, they stop the immune system from attacking cancer cells. Checkpoint inhibitors are a class of monoclonal antibody or targeted drug. In certain situations, such as when an infection is present, certain checkpoint proteins help to activate T cells. Conversely, if T cells stay active for an extended period of time or respond to stimuli that they shouldn't, they may begin to destroy healthy cells and tissues. Other checkpoints therefore aid in telling T cells to switch off. Certain cancer cells have higher protein levels. These have the ability to inhibit T lymphocytes, which are meant to combat cancerous cells. Cancer cells are delaying the immune system as a result. Furthermore, the T cells are unable to identify or destroy cancer cells. Checkpoint inhibitors are medications that

obstruct checkpoint proteins. They keep the proteins found in cancer cells from hitting the stop button. This triggers the immune system again, enabling T cells to identify and eliminate cancer cells.

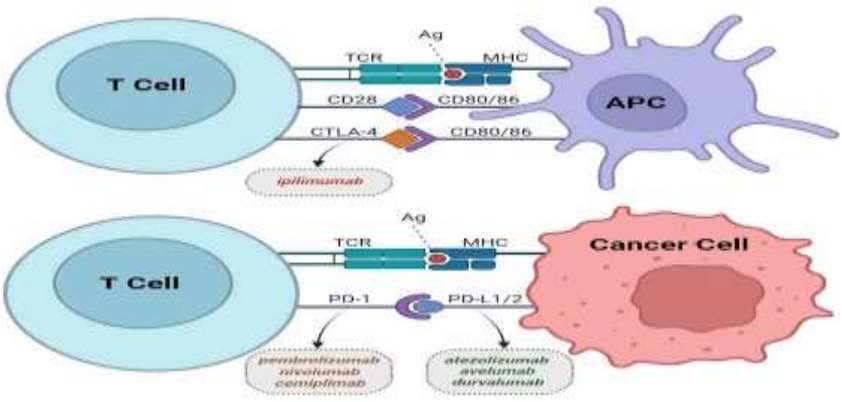

Fig. checkpoint inhibitors

Types:

These drugs block different checkpoint proteins including:

- CTLA-4 (cytotoxic T lymphocyte associated protein 4)
- PD-1 (programmed cell death protein 1)
- PD-L1 (programmed cell death ligand 1)

CTLA-4 and PD-1 are found on T cells. PD-L1 are on cancer cells.

I. PD-1:

Checkpoint inhibitors that block PD-1 include:

Nivolumab (Opdivo)

Pembrolizumab (Keytruda)

II. CTLA-4:

Ipilimumab (Yervoy) is a CTLA-4-blocking checkpoint inhibitor. It is used to treat advanced

Melanoma and renal cell carcinoma.

III. PD-L1:

Checkpoint inhibitors that block PD-L1 include:

Atezolizumab

Avelumab

Durvalumab

Merkel cell carcinoma (MCC) is a type of skin cancer that has spread to other parts of the body. Avelumab is one treatment for MCC. Additionally, it is used to treat some urinary system cancers (urothelial cancers). One treatment for non-small cell lung cancer (NSCLC) is durvalumab.

Side effects:

These medications enhance all immune cells, not only cancer-fighting ones. As a result, hyperactive T Cells may have unintended consequences. These might include:

- tiredness (fatigue)
- feeling or being sick
- dry, itchy skin, skin rash

- loss of appetite
- diarrhea
- breathlessness and a dry cough, caused by inflammation of the lungs

c) CAR T- cell Therapy

The treatment of chimeric antigen receptor T-cells is a challenging and specialized process. As part of this treatment, a professional collects and modifies your T cells. You'll get a drip that will return these cells into your circulation after a few weeks. After identifying the cancer cells, the CAR T-cells launch an assault on them. CAR T-Cells are designed to identify and target a particular protein on cancerous cells.

After being taken out of the patient's blood, T cells are genetically altered in the laboratory by adding a gene for a synthetic receptor (also known as a chimeric antigen receptor, or CAR). This facilitates the detection of particular antigens found on cancer cells. The patient then receives their CAR T cells back. Every CAR is customized to the antigen of a specific tumor since different types of tumors have different antigens. For instance, the cancer cells in some forms of lymphoma and leukemia have an antigen known as CD19. Because CAR T-cell therapies for certain tumors are meant to attach to the CD19 antigen, they cannot function in the absence of the CD19 antigen.

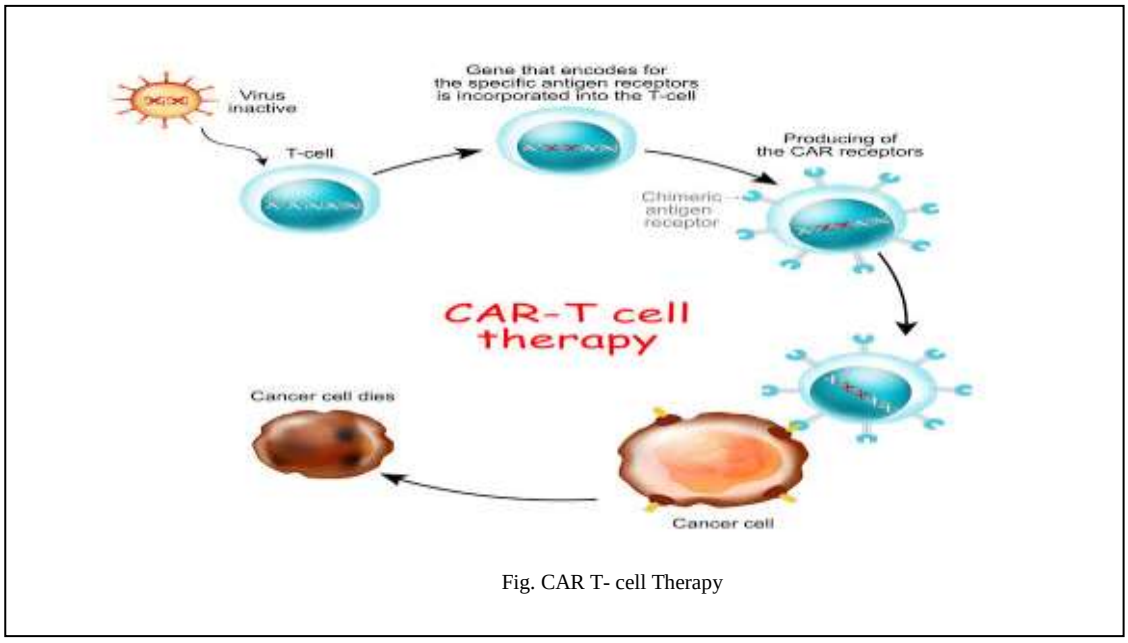

Fig. CAR T- cell Therapy

Side effects:

- Allergic reaction
- Cytokine-release syndrome
- Changes in the brain (neurological side effects)
- Increased risk of infection
- High uric acid levels in the blood, due to cancer cells breaking down quickly (tumour lysis).

d) Cytokines

The body contains a type of protein called cytokines, which support the immune system's operation. Cytokines like interleukin and interferon are produced by the body. Scientists have produced synthetic versions of these to cure cancer. Aldesleukin is the synthetic form of interleukin. Interferon and Aldesleukin work in several ways, including:

- interfering with cancer cells' ability to grow and multiply
- Activating the immune system and encouraging killer T cells and other cells to attack cancer cells.
- Encouraging cancer cells to generate substances that attract immune system cells to them.

I. Interferon

Intron A or interferon alpha are other names for interferon. Nowadays, interferons are rarely used. Rather, there has been an increase in the use of more recent immunotherapy drug types.However, interferon can be used to treat a variety of cancers, including:

- Kidney cancer (renal cell cancer)
- some types of leukemia
- skin (cutaneous) lymphoma

II. Aldesleukin

Aldesleukin is also known as interleukin 2, or proleukin. The most typical usage for it is in the management of kidney cancer. Additionally, it's used in clinical trials for many cancer types. It is injected under the skin.

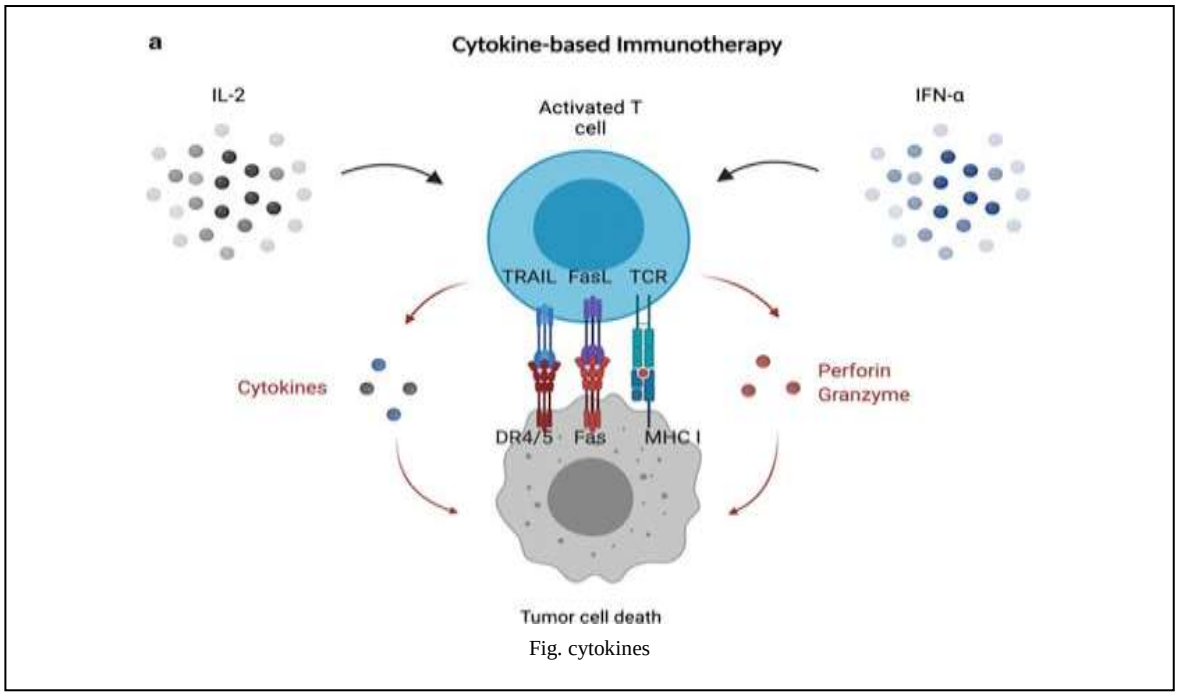

Fig. cytokines

Side effects:

The side effects of interferon and aldesleukin include:

- a drop in blood cells causing an increased risk of infection, bleeding problems, tiredness and breathlessness
- flu-like symptoms
- diarrhea
- tiredness and weakness (fatigue)
- feeling sick
- loss of appetite
- Aldesleukin can also cause low blood pressure

Advantages of immunotherapy:

1. Some cancers (like skin cancer) don't respond well to radiation or chemotherapy but start to go away after immunotherapy.
2. Other therapies you have, like chemotherapy, may work better if you also have immunotherapy.
3. It causes fewer side effects than other treatments. This is because it targets just your immune system and not all the cells in your body.

Disadvantages of immunotherapy:

1. The area where the medication goes into your body could hurt, itch, swell, turn red, or get sore.

2. Some types of immunotherapy rev up your immune system and make you feel like you have the flu, complete with fever, chills, and fatigue.
3. Cause problems like swelling, weight gain from extra fluids, heart palpitations, a stuffy head, and diarrhea.

Conclusion

IO is changing the treatment of both solid and hematological tumors by taking a completely different approach to cancer therapy. This new therapy approach is still in its early stages, so considerable work needs to be done to optimize the use of these cutting-edge medications, lessen their adverse effects, and figure out how to incorporate them into the current standard of care. It will also be challenging to integrate them into healthcare systems in a way that is both financially viable and increases patient availability, given their high cost. The latest revolution in immunology has been centered on ICPs, as evidenced by the multiple approvals of two important antibodies (pembrolizumab and ipilimumab, respectively) for the inhibition of PD-1/PD-L1 and CTLA-4. Due to their efficacy, IO medications and conventional therapy have been discussed extensively. Some patients experience significant side effects from the ICP is, despite their possible therapeutic value. While they are not the same as those experienced with conventional cancer treatments, these side effects are frequent. Because of this, monitoring long-term results and anticipating and controlling these adverse effects are becoming more and more important aspects of clinical research. This need to result in management guidelines for these novel medicines and motivate clinicians to incorporate them into treatment regimens as quickly as feasible.

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