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Treating of Cancer with Chimeric Antigen Receptor (CAR) T-Cell Immunotherapy

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Introduction

Chimeric antigen receptor (CAR) T-cell therapy is a method of modifying immune cells called T cells (a kind of white blood cell) in the lab so that they can detect and destroy cancer cells. Because it includes changing the genes inside T cells to help them attack cancer, CAR T-cell therapy is sometimes referred to as a sort of cell-based gene therapy. This form of treatment can be quite beneficial in the treatment of certain types of cancer, even when other treatments have failed [1].

The immune system detects foreign substances in the body by looking for proteins called antigens on the cell surfaces. T cells, which are immune cells, have proteins called receptors that adhere to foreign antigens and help other sections of the immune system kill the foreign substance. Antigens and immunological receptors have a similar relationship to a lock and key. Each foreign antigen has a unique immune receptor that can bind to it, similar to how a lock can only be opened with the correct key. Antigens are found on cancer cells as well, but if your immune cells lack the appropriate receptors, they won't be able to bind to the antigens and help destroy the cancer cells.

T cells are extracted from the patient's blood and genetically modified in the lab by adding a gene for a man-made receptor (called a chimeric antigen receptor or CAR). This aids in the identification of specific cancer cell antigens. After that, the CAR T cells are returned to the patient. Because various tumors have distinct antigens, each CAR is tailored to the antigen of a given tumor. The cancer cells in certain types of leukemia and lymphoma, for example, have an antigen called CD19. CAR T-cell treatments for certain tumors are designed to connect to the CD19 antigen and will not work if the CD19 antigen is missing.

Methodology of (CAR) T-cell Therapy

Collecting the T-cells: A treatment called leukapheresis is used to remove white blood cells (which contain T cells) from the patient's blood. Patients commonly lie in bed or recline in a reclining chair during this operation. Because blood is taken through one line, the white blood cells are separated, and the blood is subsequently reintroduced into the body through the other line, two IV lines are required. A unique form of IV line called a central venous catheter, which has both IV lines built in, is sometimes utilized. During the process, the patient must remain seated or lying down for 2 to 3 hours. During leukapheresis, blood calcium levels might decline, causing numbness, tingling, and muscle spasms [2].

CAR T-cell production: T cells are isolated, delivered to the lab, and changed by adding the gene for the specific chimeric antigen receptor after the white cells have been removed (CAR). As a result, they are known as CAR T cells. In the lab, these cells are then cultivated and multiplied. The high number of CAR T cells required for this therapy can take many weeks to produce.

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Getting a CAR T-cell injection: CAR T cells will be returned to the patient once enough have been created. The patient may be given chemotherapy a few days before the CAR T-cell infusion to assist reducing the amount of other immune cells. This increases the chances of CAR T cells becoming activated and fighting cancer. Because CAR T cells perform best when there is cancer cells to assault, this chemotherapy is usually not particularly strong. When CAR T cells connect to cancer cells, their numbers rise, allowing them to help destroy even more cancer cells [3].

CAR T-cell Therapy's Most Common Adverse Effects

Too much immune system activation, known as cytokine release syndrome (CRS), can be exceedingly damaging to a cancer patient. CRS usually appears a few days to two weeks after CAR T-cell infusion and goes away in a few days to weeks. CRS has a wide range of effects on persons who are getting CAR T-cell treatment. Some people just have a high-grade fever, while others have low blood pressure and/or oxygen levels and require intensive care unit (ICU) treatment, which may include the use of machines to keep them alive. Doctors have improved their control of CRS, thus being admitted to the ICU after CAR T-cell therapy is no longer as prevalent. Tocilizumab, a medication that inhibits an essential cytokine called IL-6, has improved CRS treatment. CRS, on the other hand, is still a risk of CAR T-cell therapy and can be fatal [4].

The cytokines can sometimes harm the brain following CAR T-cell therapy, generating a condition known as immune effector cell-associated neurotoxicity syndrome (ICANS). ICANS can cause a variety of symptoms, such as mild to severe disorientation, tremors, and, in rare cases, seizures. It also has the potential to cause memory loss. ICANS is almost invariably linked with CRS and usually develops later than CRS, between 1 and 4 weeks following CAR T-cell infusion. Although ICANS is reversible, some symptoms may take longer to go.

The person with cancer is often “out of the woods” for more serious problems after 2 to 4 weeks following a CAR T-cell infusion. They must, however, remain in close proximity to the treatment centre for a period of time as directed by their doctor. The doctor will check to see if the CAR T cells worked after around three months.

It's vital to remember that CAR T cells kill any cells they're directed at, even healthy cells. For several months after therapy, this frequently results in a weakened immune system. This could result in infections that are only observed in patients with severe immunodeficiency. In this period of recovery, a person undergoing CAR T-cell therapy should be extra vigilant and report any fevers or other symptoms to their doctor [5].

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