The Latest Advancements in Immunotherapy for Adult Leukemia

The new therapies include immune checkpoint inhibitors; therapeutic vaccines; CAR T-cell therapies; and “conjugate” drugs.

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Immunotherapy has long been a mainstay in the treatment of leukemia. Transplants of donor stem cells—which are used to treat some patients with acute lymphocytic leukemia (ALL), acute myeloid leukemia (AML), chronic lymphocytic leukemia (CLL), or chronic myeloid leukemia (CML)—work, to a large extent, by furnishing patients with a new immune system. When the donor cells are infused into a patient, they mature into healthy blood cells, including white blood cells, which are the core of the immune system’s fighting force against leukemia.

As scientists have learned more about the intricate workings of the immune system, they’ve developed new forms of immunotherapy that have been approved for the treatment of leukemia or are being clinically tested in patients. These agents include immune checkpoint inhibitors, which expose tumor cells to an immune system attack; therapeutic vaccines, which train certain immune cells to attack cancer cells; CAR T-cell therapies, which consist of immune system T cells that have been genetically engineered to latch onto and kill tumor cells; and “conjugate” drugs, which yoke anticancer agents to immune system antibodies that directly target cancer cells.

Here are some of the latest advances in immunotherapies for leukemia and the related conditions myelodysplatic syndrome and myeloproliferative disorders:

Acute Leukemia

In 2017, the U.S. Food and Drug Administration (FDA) approved gemtuzumab ozogamicin, a conjugate drug for patients newly diagnosed with AML that produces a protein called CD33. The agency also approved three immunotherapy therapies for patients with ALL:

- Blinatumomab, an antibody agent for patients with relapsed, treatment-resistant B-cell ALL;
- Inotuzumab, a conjugate drug that unites an antibody with a cancer-fighting antibiotic, for patients with B-cell ALL;
- Tisangenlecleucel, a CAR T-cell therapy for patients under age 26.

Therapeutic vaccines for AML are also showing promise. In a clinical trial co-led by Dana-Farber's Donald Kufe, MD, a personalized vaccine stimulated powerful immune responses against tumor cells and resulted in protection from relapse in a majority of adult patients with AML. The vaccine is made by fusing tumor cells to dendritic cells, which display cancer-related proteins to the immune system and can spark a vigorous immune attack on cancer.

Chronic Leukemia

There has been less research into immunotherapies for patients with chronic leukemia, largely because these cancers can often be successfully treated with targeted therapies. No immunotherapies for chronic leukemia have received FDA approval for use as standard treatment.

Myelodysplastic Syndromes (MDS)

Formerly known as pre-leukemia or smoldering leukemia, this group of diseases arises when abnormal cells in the bone marrow produce defective blood cells. About one in three patients with MDS goes on to develop AML. A clinical trial is currently under way, led by Jacqueline Garcia, MD, in which patients receive the immune stimulator ipilimumab in combination with standard treatments.

Myeloproliferative Diseases

Myeloproliferative diseases occur when the bone marrow produces too many deformed red or white blood cells or blood platelets. Dana-Farber's Matthew Davids, MD, MMSc, is leading a phase 1 trial of the safety and proper dose of nivolumab or the checkpoint inhibitor ipilimumab in patients with myeloproliferative diseases, MDS, or various types of leukemia that have relapsed after a donor stem cell transplant.

Immunotherapies as Post-Transplant Treatment

Immunotherapies are also being studied in patients whose disease has relapsed after a donor stem-cell transplant. In a small, phase I trial, researchers led by Davids and Dana-Farber's Robert Soiffer, MD, found that treatment with ipilimumab is feasible in patients with relapsed hematologic cancers after a donor stem-cell transplant, although some participants had adverse side effects. Many of the participants, including several with extramedullary AML, had long-lasting responses to the treatment.

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