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Each year in the United States, approximately 20,000 people are diagnosed with acute myeloid leukemia (AML), a cancer of the blood and bone marrow.

Our bone marrow (the spongy tissue inside bones where blood cells are made) produces blast cells, “immature” (not fully developed) cells, which normally mature into white blood cells that fight infection. In AML, these blast cells do not mature. Symptoms of AML arise from this lack of mature white blood cells, as well as a lack of red blood cells and platelets (cells that circulate in the blood).

Symptoms of AML typically develop suddenly and without warning, and can include fatigue, fever, loss of appetite, anemia, recurrent infections, and bleeding problems. There is currently no screening test for early detection of AML.

AML is a cancer most often seen in older people, although about 20 percent of cases occur in people under the age of 45. In the vast majority of cases, susceptibility to AML does not run in families.

Treatment Options

Treatment options for AML depend on several factors, including its type, results of lab tests, and the person’s overall health. Once AML is diagnosed, you and your doctor will discuss the approach that is right for you, based on your individual circumstances.

No matter what treatment approach is chosen, it is essential that patients being treated for AML receive transfusion support—the transfusion of platelets and clotting factors such as fresh frozen plasma (FFP). The specific nature and schedule of the transfusion support is guided by the person’s bleeding history and results of blood tests. In addition to helping the blood to clot, transfusions can help reduce fatigue.

Chemotherapy

Chemotherapy has long been an effective treatment for AML, and continues to be an important treatment option for many patients.

Chemotherapy treatment for AML typically begins with “induction” (initial) chemotherapy, in which a combination of drugs is used to destroy the majority of the leukemia cells and bring blood counts to normal levels.

The types of chemotherapy most often given to treat AML are:

- **Cytarabine.** Cytarabine (Cytosar-U, Ara-C) is an “antimetabolite”; it prevents cancer cells from dividing.
- **Anthracyclines.** Anthracyclines (Cerubidine, Idarubicin, others) are a type of antibiotic used to treat many types of cancer; they are designed to damage the DNA in cancer cells, causing those cells to die. Mitoxantrone (Novantrone), while chemically different than an anthracycline, can be used interchangeably with anthracyclines in treatment of AML.
After induction therapy, “consolidation” chemotherapy (ongoing treatment) is then given for a period of time to destroy any remaining leukemia cells in the blood and bone marrow.

A common chemotherapy regimen for AML is called “7 + 3”; it consists of cytarabine given daily for 7 days, followed by an anthracycline given daily for 3 days. This treatment is administered intravenously (into a vein) and in an in-patient hospital setting.

In August 2017, the Food and Drug Administration (FDA) approved CPX-351 (Vyxeos), a combination of cytarabine and daunorubicin (an anthracycline) for treatment of newly-diagnosed therapy-related AML (t-AML), and for the treatment of AML with myelodysplasia-related changes; those changes cause the body to stop making enough healthy red blood cells and platelets.

Some patients are not good candidates for “7 + 3” or CPX-351, as they are intensive treatments. For those patients, other options are often used, such as low doses of Ara-C or treatments approved for myelodysplastic syndromes, which are conditions that can occur when the blood-forming cells in the bone marrow are damaged. These lower-intensity drugs generally have less severe side effects, but they may take longer to work, and still require significant transfusion support and frequent visits to the doctor.

For the comfort of the patient, one central intravenous “line” can often be placed for chemotherapy, blood transfusion support, and any other drugs given intravenously.

**Targeted Treatments**

Targeted treatments focus on specific molecules and cell mechanisms thought to be important for cancer cell survival and growth, taking advantage of what researchers have learned in recent years about how cancer cells grow. Targeted treatments are meant to spare healthy tissues and cause less side effects than chemotherapy.

There are three targeted treatments approved by the FDA as treatments for AML; others are currently being studied in clinical trials.
The FDA-approved targeted treatments are:

- **Midostaurin (Rydapt).** The FLT3 gene makes a protein that encourages cell growth. Approximately 30 percent of people with AML have a mutation in this gene, resulting in the increased growth of cancer cells. Midostaurin works by targeting (blocking) the action of the FLT3 protein; it is most effective when given in combination with chemotherapy. The presence of the FLT3 mutation can be determined from a bone marrow biopsy, or sometimes by a blood test.

- **Enasidenib (Idhifa).** Some people with AML have a mutation in the IDH2 gene that stops cells from maturing in the way they should. This mutation can be detected by a blood test. Approved by the FDA in August 2017, enasidenib works by helping leukemia cells mature into normal cells.

- **Gemtuzumab ozogamicin (Mylotarg).** An “antibody-drug conjugate,” gemtuzumab ozogamicin was approved by the FDA in September 2017 for the treatment of adults with newly diagnosed AML whose tumors “express” (contain) CD33 protein on their surface. Gemtuzumab ozogamicin delivers targeted chemotherapy, leading to the death of cancerous cells.

The FTL3 and IDH2 mutations occur only in leukemia cells, and cannot be inherited or passed on to children.

Midostaurin and enasidenib are given in pill form; gemtuzumab ozogamicin is administered intravenously.

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**Stem Cell Transplant**

A stem cell transplant is a procedure in which diseased bone marrow is replaced with healthy bone marrow. It is an important treatment option for some people with AML.

In an allogeneic transplant, stem cells (blood cells that divide to make new blood cells within the bone marrow) are harvested (removed) from a donor. Donors are often a close relative such as a brother or sister, but sometimes can be an unrelated volunteer who has a compatible bone marrow.

The patient is given high doses of chemotherapy to destroy as many leukemia cells as possible. The stem cells are then “infused” (transplanted) into the body, where they travel to the bones and begin rebuilding bone marrow.

To prevent the rejection of donor cells and to ensure the transplanted cells do not cause an autoimmune disease such as graft-versus-host disease (GVHD), immunosuppressive drugs (cyclosporine, tacrolimus, others) are typically given for a period of time after the transplant.

Many older people are not able to tolerate the high doses of chemotherapy that are used in stem cell transplants. In that case, a “reduced-intensity” transplant may be performed. In this procedure (which is also called a mini-transplant), lower doses of chemotherapy are given, potentially with radiation. The patient then receives allogeneic (donor) stem cells.

To determine if stem cell transplant is the right treatment approach, doctors weigh a number of factors, including the risk of recurrence if a transplant is not performed, and how well the leukemia has responded to prior treatment approaches. A patient’s age and general physical health are also taken into consideration.
The Importance of Clinical Trials

Clinical trials are the standard by which we measure the worth of new treatments and the quality of life of patients as they receive those treatments. For this reason, doctors and researchers urge people with cancer to take part in clinical trials.

Your doctor can guide you in making a decision about whether a clinical trial is right for you. Here are a few things that you should know:

• Often, people who take part in clinical trials gain access to and benefit from new treatments.

• Before you participate in a clinical trial, you will be fully informed as to the risks and benefits of the trial, including any possible side effects.

• Most clinical trials are designed to test a new treatment against a standard treatment to find out whether the new treatment has any added benefit.

• You can stop taking part in a clinical trial at any time for any reason.

Treatment Side Effects

All cancer treatments can cause side effects. It’s important that you report any side effects you experience to your healthcare team so they can help you manage them. Report them right away—don’t wait for your next appointment. Doing so may improve your quality of life and allow you to maintain your treatment plan. It’s important to remember that not all patients experience all side effects, and patients may experience side effects not listed here.

Side Effects of Chemotherapy

The side effects of chemotherapy depend on the type and dose of drugs given and the length of time they are used, and can include:

• Infections
• Headaches
• Reduction in blood cell counts, with the need for transfusions of red blood cells or platelets
• Fatigue
• Bruising or bleeding
• Abnormal taste of food; loss of appetite
• Nausea
• Rashes
• Hair loss
• Diarrhea
• Mouth sores or painful swallowing
• Changes in the skin (dryness, rashes, darkening, or lines on the fingernails)
• Anxiety and sleeplessness
Side effects during “consolidation” chemotherapy are generally milder than during the “induction” phase, because the therapy is given to patients in remission who have normal blood counts and show no symptoms of leukemia.

**Side Effects of Targeted Treatments**

Drugs used in targeted treatments typically don’t have the same effect on the body as do chemotherapy drugs, but they can still cause side effects. It’s important to have a discussion with your health care team to understand the potential side effects of your treatment, how to reduce the risk of their occurring, and how to minimize their impact should you experience them.

**General Side Effects**

Some side effects may occur across treatment approaches. This section provides tips and guidance on how to manage these side effects should they occur.

**Managing Digestive Tract Symptoms**

**Nausea and vomiting**

- Avoid food with strong odors, as well as overly sweet, greasy, fried, or highly seasoned food.
- Nibble on dry crackers or toast. These bland foods are easy on the stomach.
- Having something in your stomach when you take medication may help ease nausea.
- Talk to your health care team about anti-nausea medications; some are designed to be taken before any symptoms occur.

**Diarrhea**

- Drink plenty of water. Ask your doctor about using drinks such as Gatorade that also provide electrolytes. Electrolytes are body salts that must stay in balance for cells to work properly.
- Over-the-counter medicines such as loperamide (Imodium A-D and others) and prescription drugs are available for diarrhea but should be used only when necessary and if suggested by your health care team.
- Choose foods that contain soluble fiber—for example beans, oat cereals, oranges, and flaxseeds.
- Low fat food choices are less likely to cause diarrhea than fatty, greasy, or fried foods. The fats you eat should come from healthy sources, such as olive oil, canola oil, olives, nuts, and seeds.
Fatigue can be a symptom of other illnesses, such as anemia, diabetes, thyroid problems, heart disease, rheumatoid arthritis, and depression. So be sure to ask your doctor if he or she thinks any of these conditions may be contributing to your fatigue.

Managing Fatigue

Fatigue (extreme tiredness not helped by sleep) is one of the most common side effects of many cancer treatments. If you are taking a medication, your doctor may lower the dose of the drug, as long as it does not make the treatment less effective. If you are experiencing fatigue, talk to your doctor about whether taking a smaller dose is right for you.

There are a number of other tips for reducing fatigue:

• Take several short naps or breaks.
• Take short walks or do some light exercise, if possible.
• Try easier or shorter versions of the activities you enjoy.
• Ask your family or friends to help you with tasks you find difficult or tiring.

There are also prescription medications that may help. Your health care team can provide guidance on whether medication is the right approach for your individual circumstances.

Managing Pain

There are a number of options for pain relief, including prescription and over-the-counter medications. It’s important to talk to a member of your health care team before taking any over-the-counter medication, to determine if it is safe and will not interfere with your treatments. Pain medications such as acetaminophen, non-steroidal anti-inflammatory drugs (NSAIDs), and aspirin can mask fever, which is an important symptom that could indicate infection.

AML carries a risk of bleeding problems, and your doctor may recommend that you avoid taking aspirin or NSAIDs, such as ibuprofen or naproxen, to treat any pain you may be experiencing, as these drugs can increase the risk of bleeding.

Loss of appetite

• To help maintain your weight, eat small meals throughout the day. Try to include protein in every meal.
• To keep from feeling full early, avoid liquids with meals or take only small sips (unless you need liquids to help swallow). Drink most of your liquids between meals.
• Keep high-calorie, high-protein snacks on hand such as hard-boiled eggs, peanut butter, cheese, ice cream, granola bars, liquid nutritional supplements, puddings, nuts, canned tuna, or trail mix.
• If you are struggling to maintain your appetite, talk to your health care team about whether appetite-building medication could be right for you.
Communicating With Your Health Care Team

As you manage your cancer, it’s important to remember that you are a consumer of health care. The best way to make decisions about health care is to educate yourself about your diagnosis and get to know the members of your health care team, including doctors, nurse practitioners, physician assistants, nurses, dietitians, social workers and patient navigators.

Here are some tips for improving communication with your health care team:

**Start a health care journal.** Having a health care journal or notebook will allow you to keep all of your health information in one place. You may want to write down the names and contact information of the members of your health care team, as well as any questions for your doctor. Keep a diary of your daily experiences with symptoms related to your illness or treatment.

**Prepare a list of questions.** Before your next medical appointment, write down your questions and concerns. Because your doctor may have limited time, you should ask your most important questions first, and be as specific and brief as possible.

**Bring someone with you to your appointments.** Even if you have a journal and a prepared list of questions or concerns, it’s always helpful to have support when you go to your appointments. The person who accompanies you can serve as a second set of ears. He or she may also think of questions to ask your doctor or remember details about your symptoms or treatment that you may have forgotten.

**Write down your doctor’s answers.** Taking notes will help you remember your doctor’s responses, advice, and instructions. If you cannot write down the answers, ask the person who accompanies you to do that for you. If you have a mobile device, ask if you can use it to take notes or record the conversation. Taking notes will help you review the information later.
MORE ABOUT AML

Frequently Asked Questions

Q: Am I more susceptible to infections when being treated for AML?
A: Yes, patients with AML have an increased risk of infection both from the disease itself and also its treatment. When white blood cells are abnormally low (a condition called neutropenia), an infection may progress rapidly and become serious. For this reason, it is important that people being treated for AML immediately report fevers or other signs of infection to their health care team.

During treatment, patients should avoid contact with those who have symptoms of a cold and should stay away from crowded places during cold and flu season.

The risk of foodborne infection can be reduced by avoiding foods that easily spoil or become moldy without an obvious change in smell or appearance. This includes berries that grow in the ground (such as strawberries and raspberries) and soft fruits that lack a thick peel. Undercooked ground beef, poultry, and eggs should be avoided during treatment, as should buffets and salad bars.

On a related note, cut flowers kept in water can expose patients to molds, and should be kept out of the house, but indoor plants do not need to be removed.

Q: I heard that mouth care is important during treatment for AML. What advice can you give me?
A: To minimize the risk of bleeding gums, the use of an extra-soft toothbrush (and no flossing) is recommended until platelet counts return to normal levels after therapy. Dry mouth is common in
AML chemotherapy treatments, and can be a risk factor for ulcers and inflammation. To avoid this, rinse with salt water after every meal and at bedtime (or more frequently if dryness progresses), use artificial saliva, and avoid drugs that dry the mouth, such as antihistamines and mouthwashes that contain alcohol.

**Q: If I am being treated for AML during flu season, should I get a flu shot?**

A: Flu shots are not “contraindicated” for people undergoing treatment for AML (meaning that the shots are generally safe), but their effectiveness is greatly reduced for those receiving chemotherapy. There are other measures that can reduce the risk of a viral illness, such as frequent hand-washing, avoiding people who have (or are just getting over) a cold, and a healthy diet. It is also important that family members and close companions of those receiving any type of cancer treatment get flu shots, to prevent catching and passing on the flu to the person in treatment.
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