Adult Acute Myeloid Leukemia (AML): Types and Treatment

This article is a more specific discussion of AML. Please be sure to read Leukemia: The Basics first, so you have a basic understanding of leukemia.

Acute myelogenous leukemia (AML) is a blood cancer that affects white blood cells, red blood cells, and/or platelets. AML may also be called acute myelocytic leukemia, acute granulocytic leukemia, or acute non-lymphocytic leukemia.

If your provider thinks you have AML, you will have tests done to find out which subtype (classification) of AML you may have. These tests may include:

- A bone marrow biopsy and aspiration.
- Cytogenetic tests, immunophenotyping, and molecular testing that tell your provider what type of AML you have.
- CT scan/MRI.
- A lumbar puncture (spinal tap) to see if there are any leukemia cells in your spinal fluid.
- MUGA scan.
- HLA testing for possible future bone marrow transplant.

Unlike other cancers, AML is not staged. It is classified based on genetic abnormalities (changes) in the cancer cells. The classification also helps your provider decide what kind of treatment you will need for your AML.

AML is classified using the World Health Organization (WHO) system. These are the different classifications (types) of AML.

**Acute myeloid leukemia (AML) and related neoplasms.**

- AML with recurrent genetic abnormalities.
  - AML with t(8;21)(q22;q22.1);RUNX1-RUNX1T1.
  - AML with inv(16)(p13.1q22) or t(16;16)(p13.1;q22);CBFB-MYH11.
  - APL with PML-RARA.
    - AML with t(9;11)(p21.3;q23.3);MLLT3-KMT2A.
    - AML with t(6;9)(p23;q34.1);DEK-NUP214.
    - AML with inv(3)(q21.3q26.2) or t(3;3)(q21.3;q26.2); GATA2, MECOM.
  - AML (megakaryoblastic) with t(1;22)(p13.3;q13.3);RBM15-MKL1.
  - Provisional entity: AML with BCR-ABL1.
  - AML with mutated NPM1.
  - AML with biallelic mutations of CEBPA.
    - Provisional entity: AML with mutated RUNX1.

- AML with myelodysplasia-related changes.
  - Therapy-related myeloid neoplasms.
    - AML, NOS.
    - AML with minimal differentiation.
    - AML without maturation.
    - AML with maturation.
    - Acute myelomonocytic leukemia.
    - Acute monoblastic/monocytic leukemia.
    - Pure erythroid leukemia.
- Acute megakaryoblastic leukemia.
- Acute basophilic leukemia.
- Acute panmyelosis with myelofibrosis.
- Myeloid sarcoma.
- Myeloid proliferations related to Down syndrome.
  - Transient abnormal myelopoiesis (TAM).
  - Myeloid leukemia associated with Down syndrome.
- Blastic plasmacytoid dendritic cell neoplasm.

**Acute leukemias of ambiguous lineage.**

- Acute undifferentiated leukemia.
- Mixed phenotype acute leukemia (MPAL) with t(9;22)(q34.1;q11.2); BCR-ABL1.
- MPAL with t(v;11q23.3); KMT2A rearranged.
- MPAL, B/myeloid, NOS.
- MPAL, T/myeloid, NOS.

**Myeloid neoplasms with germline predisposition without a preexisting disorder or organ dysfunction.**

- AML with germline CEBPA mutation.
- Myeloid neoplasms with germline DDX41 mutation.

**Myeloid neoplasms with germline predisposition and preexisting platelet disorders.**

**Myeloid neoplasms with germline predisposition and other organ dysfunction.**

**How is AML treated?**

Treatment for AML depends on many things. These include your age, your AML subtype, if you have had treatment for other cancers in the past, your overall health, and testing results. Your treatment may include some or all of the following:

- Chemotherapy.
- Targeted therapy.
- Immunotherapy.
- Stem cell transplant.

**Chemotherapy, Targeted Therapy, and Immunotherapy**

Chemotherapy for AML is broken down into three phases: induction phase, consolidation (or intensification), and maintenance phase.

- **Induction:** the goal of induction is remission. Remission is when there are less than 5% blast cells in the bone marrow.
- **Consolidation:** after a remission, you will enter this second phase of treatment. The goal of consolidation is to keep you in remission.
- **Maintenance:** some patients will need ongoing maintenance therapy depending on how much consolidation treatment they have received, as well as if they had a stem cell transplant. The goal of maintenance is to prevent relapse and keep you in remission.

The treatment is designed to wipe out the abnormally functioning leukemia cells. But this treatment also destroys many healthy cells. This puts you at risk for bleeding and infection, which can be life-threatening. In addition, chemotherapy medications can cause side effects such as mouth sores (mucositis), diarrhea, nausea/vomiting, and hair loss (alopecia).

If you are less than 60 years old, induction chemotherapy for AML is often a combination of medications: cytarabine with daunorubicin, idarubicin, fludarabine, or cladribine. The goal of this therapy is to put you in remission. If remission does not occur, induction chemotherapy can be repeated, or a different treatment plan can be given.
Sometimes these medications are combined with targeted therapies. Targeted therapies target specific mutations (changes) in cancer cells. Oral midostaurin and gilteritinib target a mutation on the FLT3 gene. Another mutation is in the IDH1 or IDH2 gene. IDH inhibitors including ivosidenib and enasidenib can be used in patients with AML with this mutation. Gemtuzumab ozogamicin is a monoclonal antibody that attaches to CD33, a protein found in most AML cells.

In consolidation, chemotherapy is continued for 4-5 more cycles (4-6 months). The types of medications you receive during this phase will depend on cytogenetic test results as well as risk status for relapse. The medications used during consolidation are the same but given in different doses.

If you are over 60 and your provider feels, based on your overall health and your cytogenetic testing, you can tolerate standard induction chemotherapy, you would receive the same therapies listed above. The doses of the medications may be different than if you were younger.

If you are over 60 and can’t receive intensive induction based on cytogenetics and other health factors, other medications are used to treat your AML. The goal of getting into remission remains the same. Two targeted therapies used to treat older patients with AML include venetoclax and glasdegib. Other medications used in those over 60 include idarubicin, daunorubicin, mitoxantrone, gemtuzumab ozogamicin, ivosidenib, enasidenib, decitabine, azacitidine, midostaurin and clofarabine. The medications you receive depends on the results of your cytogenetic tests. If you are over 60, consolidation treatment is also given. Medications used in consolidation are similar to those used in induction but may be given in lower doses and over different time periods.

Medications used in the maintenance phase include oral azacytidine or sorafenib.

Acute Promyelocytic Leukemia (APL or APML)

APL is a type of AML. The treatment for this subtype has changed a lot in the past 20 years. A medication called all-trans retinoic acid (ATRA) is used only in this subtype of AML. ATRA is given in combination with arsenic trioxide in the induction phase. Gemtuzumab ozogamicin is also used in combination with ATRA and arsenic trioxide to treat APML. In patients with pre-existing heart problems, daunorubicin and cytarabine at lower doses may also be used. These medications are used through the induction and consolidation phases.

One serious side effect of APML is called DIC (disseminated intravascular coagulation). In DIC, the body makes blood clots where it should not and quickly uses up the components needed for blood clotting. This leads to bleeding at the same time as these clots are being formed. If you develop DIC, you will need blood product transfusions and emergent treatment of the leukemia. The condition is a result of the leukemia, so it must be treated for the DIC to get better.

Supportive Care

Some people cannot receive treatment for AML based on their health conditions. The risks of the therapy outweigh any potential benefits. In these cases, supportive care is given. Supportive care is not curative. It does not put you in remission from AML. The goal of supportive care is to maintain your quality of life. This includes treatment with blood and platelet transfusions and hydroxyurea. Hydroxyurea is used to lower the white blood cell count, which can help relieve symptoms caused by a high count, such as pain.

Measurable/Minimal Residual Disease (MRD) Testing

Measurable or minimal residual disease (MRD) testing is used to see if the cancer treatment is working and to guide further treatment plans. MRD tests use highly sensitive methods to look for any remaining cancer cells that cannot be seen in routine tests. Currently, MRD testing is being studied so treatment teams can better understand how to use it.

Bone Marrow Transplant

After consolidation, your team may recommend an allogeneic bone marrow transplant from a matched sibling or unrelated donor. The decision to have a bone marrow transplant is based on the subtype of AML, as well as cytogenetic factors of your AML, donor availability, your age, and your health. Transplant is used more often in those under 60 years old but is being studied in those over 60 who have lower risk cytogenetics and are in good overall health.
**Complications & Concerns of Leukemia and Treatment**

Some people with AML will have a very high white blood cell count at diagnosis. This is called leukocytosis. This can cause symptoms, including headache, shortness of breath, and pain. In some cases, chemotherapy will be started right away to lower the white blood cell count. In some people, pre-treatment testing to confirm the diagnosis and your ability to tolerate the treatment may take some time. In these cases, you may need leukopheresis. Leukopheresis removes white blood cells from the blood. A medication called hydroxyurea may also be used to lower the white blood cell count.

Leukemia puts you at a higher risk of infection (because your white blood cell count is low) and bleeding (because your platelet count is low). Treatment of leukemia should help your abnormal blood counts, but your counts may get worse before they get better. You will likely get blood and platelet transfusions, antibiotics, and will need to be extra careful to avoid infection or bleeding.

**Hand washing** is the best way to prevent infection. You and your visitors should wash your hands often. You may also have some restrictions on eating some types of fresh fruit and vegetables or receiving fresh flowers or plants while in the hospital. *(See the gift guide for ideas on what to send a patient with these restrictions)* This may sound odd, but these items can bring in bacteria and may put you at higher risk of infection. Ask any sick family members to hold off on visiting until they feel better.

In most cases, some type of infection or fever will happen. If it does, you will have some tests done to look for where the infection is in your body. These tests can include blood, urine, and stool cultures, and a chest x-ray. Antibiotics may be started or adjusted if they are already being given.

Over the course of your treatment, you may need either blood (for low hemoglobin levels) or platelet (for low platelet counts) transfusions. If you have a low hemoglobin count (also called anemia), you may feel fatigued, short of breath, or look pale. A low platelet count (also called thrombocytopenia) can lead to bleeding. This can be as small as gums bleeding when brushing the teeth or a nosebleed, or dangerous bleeding, such as a stroke. Be careful and try to avoid bumping into things. Don’t shave with a razor (an electric razor is okay to use with caution) and avoid any activities that increase the risk of bleeding or bruising. You should always inform your healthcare team if you have symptoms of anemia or thrombocytopenia.

**Clinical Trials**

You may be offered a clinical trial as part of your treatment plan. To find out more about current clinical trials, visit the OncoLink Clinical Trials Matching Service.

**Making Treatment Decisions**

Your care team will make sure you are included in choosing your treatment plan. This can be overwhelming as you may be given a few options to choose from. Friends and family can help you talk through the options and the pros and cons of each, but they cannot make the decision for you. You need to be comfortable with your decision — this will help you move on to the next steps. If you ever have any questions or concerns, be sure to call your team.

OncoLink is designed for educational purposes only and is not engaged in rendering medical advice or professional services. The information provided through OncoLink should not be used for diagnosing or treating a health problem or a disease. It is not a substitute for professional care. If you have or suspect you may have a health problem or have questions or concerns about the medication that you have been prescribed, you should consult your health care provider.