

Leukemia and Lymphoma

Learn the leukemia and lymphoma patterns first — each type grows differently and needs different treatment — then treat the exact disease you have.

THE ONE-LINE TRUTH

Leukemia is when one white blood cell in the bone marrow loses its growth controls and multiplies out of control, crowding out normal blood cells.

The chain — how it unfolds

1. Marrow crowding causes low counts of all blood cells (pancytopenia) — why: The broken cell clones multiply wildly and fill the bone marrow, stealing space and nutrients from normal stem cells. The marrow cannot make enough red cells (anemia), white cells (leukopenia, especially dangerously low infection-fighting cells (neutropenia)), or platelets (thrombocytopenia). This triad — low counts across the board — is called low counts of all blood cells (pancytopenia), and it explains the next three dominoes.
2. Anemia causes fatigue, pale skin, shortness of breath, and fast heartbeat — why: With too few red cells, your blood cannot carry enough oxygen to muscles and organs. Muscles tire quickly (fatigue, weakness). Skin and gums look pale. Your heart pumps faster (tachycardia) and you breathe faster (dyspnea on exertion) to try to deliver what oxygen you have. If anemia is severe, you may feel dizzy, get chest pain (angina), or even faint.
3. Dangerously low infection-fighting cells (Neutropenia) causes life-threatening infections — why: Neutrophils (a type of white cell) are your front-line defense against bacteria and fungi. With too few neutrophils (neutropenia, especially absolute neutrophil count below 500), even normal skin and gut bacteria can invade and cause sepsis (blood infection). You get high fevers but often no pus or obvious infection site. Neutropenic fever is a medical emergency — untreated, it can become septic shock and multi-organ failure in hours.
4. A low platelet count (Thrombocytopenia) causes bleeding into skin, gums, gut, and brain — why: Platelets plug holes in blood vessels. With too few platelets (thrombocytopenia, especially below 20,000), you bleed easily: pinpoint bleeding spots (petechiae) (tiny red dots under the skin), purple bleeding blotches (purpura) (larger purple bruises), nosebleeds, bleeding gums, heavy periods, blood in stool or urine. Below 10,000, spontaneous bleeding into the brain or gut becomes a real risk and can be fatal.

5. Lymph node masses cause pain, airway squeeze, and SVC syndrome — why: In lymphoma (or leukemia with big nodes), clumps of cancer cells pile up in lymph nodes in the neck, chest, belly, or groin. The swollen nodes press on nearby structures: throat (causing trouble swallowing), airway (causing cough, wheezing, a high-pitched noise on breathing in (stridor)), or the superior vena cava (the big vein bringing blood back to the heart), blocking blood return and causing face and neck swelling, bulging veins, and shortness of breath (SVC syndrome, an oncologic emergency).
6. Hyperleukocytosis makes blood thick and clogs tiny vessels — why: In some acute leukemias, the white cell count climbs above 100,000 (hyperleukocytosis). The blood becomes thick and sludgy, like honey instead of water. It jams up in the tiniest vessels in the lungs (causing shortness of breath, low oxygen) and brain (causing confusion, vision loss, stroke). This is called leukostasis, another oncologic emergency — leukapheresis (filtering the blood) or urgent chemotherapy is needed to bring the count down fast.
7. Tumor lysis syndrome poisons the kidneys and heart — why: When chemotherapy kills billions of cancer cells at once (especially in fast-growing leukemias and lymphomas like ALL, Burkitt lymphoma, high-grade NHL), the cells burst open and dump their insides into the blood: potassium (causing dangerous heart rhythms), phosphate (which binds calcium, dropping it dangerously low and causing muscle spasms, seizures), and uric acid (which crystallizes in the kidneys, causing acute kidney injury). This cascade is called tumor lysis syndrome. It can kill within hours if not caught early. Prevention includes IV fluids, allopurinol or rasburicase (to lower uric acid), and close monitoring of electrolytes and kidney function.
8. None of this is random — every symptom flows backward from the one broken cell — why: Tired, pale, infected, bruised, swollen nodes, thick blood, electrolyte chaos — every single finding traces back to that first mutation that broke the growth controls. The body is not randomly falling apart; it is trying to compensate (pump faster, fight harder, clot with less) while the cancer spreads. When you see a weird lab or symptom, ask yourself: 'Which domino is this?' and trace it back upstream. That is how you learn to recognize the pattern early, before the patient crashes.

Spot it — what you see, and why

- Swollen lymph nodes that don't hurt: Cancer cells crowd into the lymph nodes (the body's filter stations) and make them puff up, but because the swelling happens slowly without infection, there's no pain signal.
- Fever that comes and goes without any infection: Cancer cells release chemicals called cytokines (messenger proteins) that reset the brain's temperature thermostat higher, triggering fever even though there's no germ causing it.

- Soaking night sweats that drench your clothes and sheets: The same cytokines that cause fever also tell the hypothalamus (the brain's temperature control center) to dump heat by sweating heavily, often at night when the body is at rest.
- Losing more than 10 percent of your body weight without trying: Cancer cells burn a huge amount of energy and also release chemicals that kill your appetite and speed up how fast your body breaks down fat and muscle for fuel.
- Feeling exhausted all the time: Cancer crowds out the bone marrow (the spongy inside of bones where blood is made), so you make fewer red blood cells to carry oxygen, and the cancer itself steals nutrients and energy your body needs.
- Easy bruising or tiny red or purple dots on the skin: Cancer takes over space in the bone marrow so it can't make enough platelets (the tiny cells that plug holes in blood vessels), which means even small bumps cause bruises and capillaries (the tiniest blood vessels) leak under the skin.

Red flags — act now

- Fever, drenching night sweats, and losing more than 10 percent of your body weight in six months (called B symptoms — they mean the cancer is more aggressive)
- Trouble breathing, chest pain, or swelling in the face and neck (the cancer may be pressing on the big veins or windpipe in the chest)
- Sudden severe confusion, headache, or weakness on one side of the body (cancer may have spread to the brain or spinal cord)
- Bleeding that won't stop or bruises appearing all over without any injury (platelet count is dangerously low)
- Severe belly pain with a hard, swollen abdomen (the spleen or liver may be hugely enlarged or rupturing)

Treat it — in this order

1. IV fluids (150–200 mL/kg/day), allopurinol (or rasburicase in high-risk patients), and continuous heart monitoring → Prevents tumor lysis syndrome by flushing out potassium, phosphate, and uric acid that dying cancer cells dump into the blood when chemotherapy starts. Keeps kidneys working and prevents dangerous heart rhythms (arrhythmias from high potassium).
2. Leukapheresis (machine that spins extra white cells out of the blood) if symptomatic hyperleukocytosis is present → Thins the blood so it flows through tiny lung and brain blood vessels again, stopping the blockage that causes shortness of breath, confusion, or stroke.

3. Disease-specific chemotherapy regimen matched to cancer type and genetic markers: APL gets all-trans retinoic acid (ATRA) and arsenic trioxide; AML gets cytarabine + anthracycline (7+3 regimen); ALL gets multi-agent induction (vincristine, daunorubicin, asparaginase, steroid); diffuse large B-cell lymphoma (DLBCL) gets rituximab, cyclophosphamide, doxorubicin, vincristine, prednisone (R-CHOP); Hodgkin lymphoma gets doxorubicin, bleomycin, vinblastine, dacarbazine (ABVD); chronic lymphocytic leukemia (CLL) gets BTK inhibitors (ibrutinib) or BCL-2 inhibitors (venetoclax) → Kills the one broken cell that lost growth control, stopping the wild multiplication and letting normal bone marrow cells grow back. Each regimen is matched to the surface markers and gene mutations found in the biopsy.
4. Blood product transfusions (packed red cells for anemia, platelets for bleeding) and growth factors (G-CSF for severe dangerously low infection-fighting cells (neutropenia)) → Props up red cells so oxygen reaches your body and you stop feeling tired and dizzy. Raises platelet counts so bleeding stops. Boosts white cells (neutrophils) so infection risk drops while chemotherapy is killing marrow cells.
5. Infection prevention (prophylaxis): antibacterial (levofloxacin or cefepime if feverish (febrile) dangerously low infection-fighting cells (neutropenia)), antiviral (acyclovir for herpes simplex virus), antifungal (fluconazole or posaconazole), and Pneumocystis jirovecii pneumonia (PCP) prevention (trimethoprim-sulfamethoxazole) → Prevents bacteria, viruses, and fungi from invading and causing life-threatening infections while neutrophil counts are dangerously low ($< 500/\mu\text{L}$) from both the cancer and chemotherapy.

Your top priorities at the bedside

1. Check oxygen saturation and listen to lung sounds every 2 to 4 hours and watch for new shortness of breath or a high-pitched noise on breathing in (stridor) (a high-pitched breathing sound) — why: A big tumor mass in the chest can press on the airway or the white cell count can go so high that cells get stuck in the tiny lung blood vessels causing breathing failure
2. Monitor continuous telemetry (heart rhythm) and check potassium, calcium, phosphorus, and uric acid levels every 6 to 12 hours when chemotherapy starts — why: When cancer cells die fast they spill potassium and phosphorus into the blood causing deadly heart rhythms and the breakdown makes uric acid crystals that shut down the kidneys in tumor lysis syndrome
3. Give IV fluids at 150 to 200 milliliters per hour to keep urine output above 100 milliliters per hour and administer allopurinol or rasburicase as ordered before chemotherapy — why: Fast fluids wash uric acid and other waste out through the kidneys before crystals form and allopurinol or rasburicase (medicines that lower uric acid) prevent kidney failure from tumor lysis