

Acute Ischemic Stroke

Time is brain. Every minute a stroke goes untreated costs about 1.9 million neurons—call 911 the instant you see the signs.

THE ONE-LINE TRUTH

A clot plugs an artery inside the brain, cutting off oxygen; the brain cells fed by that artery start dying within minutes because the brain has no backup fuel tank.

The chain — how it unfolds

1. A clot lodges inside a brain artery. — why: Either a clot breaks off from the heart (cardioembolic, most often because atrial fibrillation (an irregular, quivering heartbeat) lets blood sit and clot in the left atrium) or a clot forms right on top of hard cholesterol plaque inside the brain artery itself (atherothrombotic). Less commonly, the artery wall tears (dissection) or a clot floats up from a narrowed carotid artery in the neck.
2. Blood flow to the tissue downstream stops or drops to a critical level. — why: Neurons have zero oxygen reserve. They depend on a constant supply arriving every second. When the pipe is blocked, oxygen delivery stops in that territory within seconds.
3. The center of the blocked territory (the core) dies within minutes; a stunned border zone (the penumbra) survives on a trickle of blood from collaterals. — why: The core is too far from any backup vessel. The penumbra sits close enough to collaterals to stay alive—but barely. That penumbra is what clot-busting treatment and thrombectomy are racing to save.
4. Function controlled by the dead or stunned region drops suddenly. — why: If the middle cerebral artery is blocked, the person loses strength and sensation on the opposite side of the body (face, arm, leg) and may lose the ability to speak or understand words (aphasia). If the posterior cerebral artery is hit, half the visual field goes dark (hemianopia). If the vertebral or basilar artery is blocked, balance, coordination, and consciousness can be lost.
5. Cytotoxic swelling (edema) (cell swelling) begins within hours. — why: Without oxygen, the sodium-potassium pumps inside neurons fail. Sodium and water flood into the cells, making them swell. The tissue gets puffy and presses on surrounding brain.
6. Hour by hour, more of the penumbra converts to permanent a patch of dead tissue (infarct) if flow is not restored. — why: Time is brain. Studies show that roughly 1.9 million neurons, 14 billion synapses, and 12 kilometers of nerve fibers are lost every minute a large-vessel stroke goes untreated.

7. Reperfusion therapy—tPA (clot-dissolving medicine) or mechanical thrombectomy (physically pulling the clot out with a wire basket)—restores blood flow. — why: tPA must be given within 4.5 hours of symptom onset (or within 4.5 hours of last-known-normal if the stroke was discovered on waking). Thrombectomy can be done up to 6 hours for most patients and up to 24 hours in select patients if imaging shows a large penumbra still alive. The earlier either treatment happens, the more brain is saved and the better the recovery.
8. After the acute event, secondary prevention starts to stop a second stroke. — why: The risk of another stroke is highest in the first 90 days. Treatment includes antiplatelet drugs (aspirin, clopidogrel) or anticoagulation (apixaban, rivaroxaban, warfarin) if atrial fibrillation (an irregular, quivering heartbeat) or another clotting source is found; a high-intensity statin (atorvastatin 80 mg or rosuvastatin 20–40 mg) to stabilize cholesterol plaques; blood pressure control (goal under 130/80 after the first few days); and smoking cessation, diabetes management, and lifestyle changes to lower all vascular risk.

Spot it — what you see, and why

- Sudden face droop on one side: A clot blocks blood flow to the motor cortex (the brain's movement control room), so the nerve signals that tell one side of the face to move stop working. The face sags because those muscles no longer get their orders.
- Sudden arm or leg weakness on one side: The corticospinal tract (the highway carrying movement commands from brain to muscles) loses its blood supply, so signals can't travel down. The arm or leg goes weak or numb because the brain can't tell it what to do.
- Slurred speech or trouble finding words: Broca's area (the speech-making zone) or Wernicke's area (the understanding-words zone) is starved of oxygen. Words get jumbled, slurred, or lost because those brain centers can't do their job without fuel.
- Loss of vision on one side in both eyes: The optic radiations (cables carrying sight signals) or the occipital cortex (the seeing center at the back of the brain) lose blood. One half of the visual field in both eyes goes dark, like a curtain dropping on one side.
- Sudden dizziness, loss of balance, or trouble walking: The cerebellum (balance control center) or brainstem (coordination highway) is cut off from blood. Without these working, the body can't coordinate movements or stay steady.
- Sudden severe headache unlike any before: This can signal a bleeding-driven (hemorrhagic) stroke (bleeding inside the skull instead of a clot). Blood leaking into the brain irritates tissues and raises pressure, causing intense pain. Must rule out bleeding before giving clot-busting medicine.

Red flags — act now

- Sudden severe headache with the deficit—may be bleeding in the brain instead of a clot; get an emergency CT scan immediately before giving any blood thinner
- Neurologic symptoms getting rapidly worse after starting tPA—suggests bleeding inside the skull from the clot-buster; stop the infusion, repeat CT right away, and reverse the medicine with clotting factors and platelets
- Coma with tiny pinpoint pupils—basilar artery stroke cutting off blood to the brainstem; very high risk of death; secure the airway and consider emergency thrombectomy to pull the clot out
- Blood pressure above 185/110 before giving tPA—too high increases bleeding risk; must lower it carefully with IV medicine like labetalol or nicardipide before starting the clot-buster
- Seizure at the moment stroke symptoms start—raises the chance the clot will turn into bleeding later; confirm with imaging before giving reperfusion therapy

Treat it — in this order

1. IV alteplase (tPA) 0.9 mg per kilogram of body weight, maximum dose 90 mg, given within 4.5 hours of last-known-well time → Alteplase dissolves the fibrin threads holding the clot together, like unraveling a tangled net. Blood flow rushes back into the starving penumbra, and brain cells that were on the edge of death start working again. Many people regain speech or movement within hours.
2. IV tenecteplase 0.25 mg per kilogram (maximum 25 mg) as a single push over 5 seconds, within 4.5 hours → Tenecteplase works the same way as alteplase—it breaks up the clot—but you give the entire dose in one quick push instead of an hour-long drip. The AcT and NOR-TEST trials showed it works just as well, and many stroke centers now prefer it because it is faster and simpler.
3. Mechanical thrombectomy: threading a catheter up through the groin artery into the brain, then using a tiny cage (stent retriever) or suction tube to pull the clot out → For large-vessel blockages, thrombectomy is the most powerful treatment we have. It physically yanks the clot out of the artery. The HERMES meta-analysis pooled seven trials and proved that one in three people treated with thrombectomy will walk out of the hospital independent, compared to one in five with medical therapy alone. With blood flow (perfusion) imaging, you can offer it up to 24 hours after stroke onset if there is still a large penumbra (DAWN and DEFUSE-3).

4. Let blood pressure run high: systolic up to 220 mmHg and diastolic up to 120 mmHg before reperfusion → When an artery is blocked, high pressure forces blood through tiny side channels (collaterals) around the blockage, keeping the penumbra alive a little longer. Lowering pressure too soon can make the starved blood flow (ischemia) worse, like turning down the water pressure when you are already getting a trickle.
5. Aspirin 325 mg by mouth, started 24 to 48 hours after tPA (or right away if no tPA was given) → Aspirin stops platelets from clumping together. The CAST and IST trials showed it lowers the chance of another stroke in the first two weeks by about 1 percent—a small but real benefit when you are treating thousands of people.

Your top priorities at the bedside

1. Confirm last-known-well time with a reliable witness — why: Drives every treatment decision.
2. Activate the stroke alert - CT within 25 min of arrival — why: Every minute of delay costs brain.
3. Hold oral intake until swallow screen is passed — why: Aspiration is the #1 preventable cause of post-stroke pneumonia.