

TBI · Traumatic Brain Injury

A plain-English guide for you and your family

WHAT IS HAPPENING

Your brain sits inside a hard skull, floating in fluid that cushions it. Tiny blood vessels bring in oxygen and food, and special brain cells send signals back and forth to run every part of your body—thinking, moving, seeing, remembering. The brain also keeps its own blood flow steady even when your blood pressure changes, a built-in safety system called autoregulation. When a blow to the head happens—from a fall, car crash, or hit—the brain can get hurt in two ways. One way is a bruise or bleed in one spot, called a focal injury; the other is damage spread through many tiny nerve fibers, called a diffuse injury. Either way, blood vessels tear, brain cells swell, and pressure starts to build inside the skull. Because the skull is a hard box with nowhere to expand, that rising pressure squeezes the brain and can cut off blood flow. The body fights back by trying to push more blood in and keep oxygen flowing, but if the swelling keeps going the brain can herniate—meaning soft brain tissue gets shoved through openings in the skull and gets crushed. Early on you might feel confused, forget things, have a bad headache, or throw up. Later, if pressure climbs high, you can show stiff posture, slow breathing, and wide pupils—a red-flag pattern called Cushing's triad. Every one of these signs is the body trying to survive the squeeze. The goal of treatment is to stop that second wave of injury by keeping pressure down, oxygen up, and blood flow steady while the brain heals.

What you might feel

- Headache that won't go away or gets worse
- Confusion or trouble remembering things
- Dizziness or trouble keeping balance
- Nausea or vomiting
- Feeling sleepy or hard to wake up
- One pupil bigger than the other, or pupils that don't shrink in bright light
- Weakness or numbness on one side of the body
- Clear or bloody fluid dripping from the nose or ears
- Seizure (sudden shaking, stiffening, or loss of awareness)

- Trouble speaking or slurred words

Call the doctor right away if...

- Glasgow Coma Scale score below 9 (deep unconsciousness — the brain is badly hurt and the person can't protect their airway)
- One pupil much bigger than the other or pupils that stay wide and don't react to light (sign of a brain bleed pressing on the nerve)
- Repeated vomiting or vomiting that starts hours after the injury (rising pressure inside the skull)
- Seizure after the head injury (the brain's wiring is misfiring from the damage)
- Clear or pink fluid leaking from nose or ears (skull fracture letting brain fluid escape)

What the care team will do

- Check airway patency and oxygen saturation every 15 minutes; prepare intubation equipment at bedside if Glasgow Coma Scale is 8 or below.
- Assess pupils every hour: measure size in millimeters, check if both are equal, and shine a light to see if they get smaller.
- Elevate the head of bed to 30 degrees and keep the head and neck in straight midline alignment; avoid neck twisting or flexion.
- Maintain mean arterial pressure between 65 and 70 mmHg with IV fluids or vasopressors as ordered; avoid blood pressure dropping below MAP 65.
- Monitor for and immediately report repeated vomiting, new seizure activity, or worsening drowsiness to the provider.
- Avoid actions that raise intracranial pressure: suctioning longer than 10 seconds, tight cervical collar, coughing, straining, or agitation.
- Keep the environment quiet and dim; cluster care activities so the patient has rest periods between assessments.
- Have mannitol or 3 percent hypertonic saline ready at bedside if ordered; know the dose and how to give it fast through a large IV.

Medicines you may be given — and why

Mannitol

Mannitol is a sugar-alcohol that pulls extra water out of swollen brain tissue and into the blood, then flushes it out through the kidneys. When brain tissue swells after a traumatic injury, pressure inside the skull rises and squeezes the brain. Mannitol creates a pull (osmotic

gradient) that draws the extra fluid away from the brain and into the bloodstream, lowering the dangerous pressure.

Hypertonic saline (3% sodium chloride)

Hypertonic saline is a concentrated salt solution that pulls extra water out of swollen brain tissue by creating a strong salt pull (osmotic gradient). After traumatic brain injury, the brain swells and pressure inside the skull rises. The high-salt IV solution draws water from the swollen brain into the bloodstream, lowering the dangerous pressure and protecting the brain from being crushed.

Levetiracetam (Keppra)

Levetiracetam calms overexcited brain cells to prevent seizures in the first week after a severe traumatic brain injury. When the brain is injured, damaged cells can fire electrical signals wildly and out of sync, like a short circuit, causing a seizure. Levetiracetam binds to a protein (SV2A) on brain cells that controls how neurons release their chemical messengers, stabilizing the cells so they don't fire too easily.

Phenytoin (Dilantin)

Phenytoin stabilizes brain cells by blocking the sodium channels (tiny gates) on neurons that let electrical signals fire. After a traumatic brain injury, damaged brain cells can fire wildly, causing seizures. Phenytoin locks these gates in a closed position after a neuron fires, stopping the cell from firing again too quickly and preventing the chaotic electrical storm of a seizure.

Propofol

Propofol is a powerful sedative that calms the brain by boosting the effect of GABA (the brain's main calming chemical messenger). After a severe traumatic brain injury, the brain can become overactive, raising pressure inside the skull and causing more damage. Propofol opens GABA receptors (the locks that GABA normally turns) for longer, making brain cells much less excitable. This lowers brain metabolism, reduces oxygen and glucose demand, and helps bring down dangerous intracranial pressure.

Where this information comes from

- Brain Trauma Foundation Guidelines for Management of Severe TBI, 4th Edition 2016
- CDC Guideline on Diagnosis and Management of Mild Traumatic Brain Injury (2018)
- American College of Emergency Physicians Clinical Policy on Mild TBI
- Cochrane Review on interventions for traumatic brain injury

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