

SIADH · Syndrome of Inappropriate ADH

SIADH means the kidneys keep too much water even though blood salt is already low. Urine stays concentrated when it should be watery. Fix mild cases by limiting water to 800–1000 mL per day. Severe cases (seizures, confusion, sodium under 120) need 3% hypertonic saline given slowly in the ICU or tolvaptan (a drug that blocks ADH at the kidney). Always hunt for the cause: lung cancer, brain injury, or certain medicines (carbamazepine, SSRIs, cyclophosphamide).

THE ONE-LINE TRUTH

The body releases too much ADH hormone even when it should not, so the kidneys hold extra water and blood salt drops dangerously low.

The chain — how it unfolds

1. A tumor (small-cell lung cancer), brain injury (meningitis, bleeding (hemorrhage)), lung infection (pneumonia), or drug (SSRI, carbamazepine) keeps ADH pouring into the blood even though plasma osmolality is low (under 280 mOsm/kg). — why: ADH release is supposed to shut off when blood gets too watery, but the broken control switch — whether it is a rogue tumor making ADH, an injured hypothalamus misfiring, or a drug amplifying ADH signals — ignores the feedback loop and keeps the faucet open.
2. ADH travels to the kidney collecting ducts and forces aquaporin-2 water channels into the cell walls, pulling water out of urine back into the bloodstream. — why: The kidney obeys the hormone signal. It does not know the signal is inappropriate — it just follows orders. Urine becomes concentrated (osmolality often 300–600 mOsm/kg, higher than plasma) and scanty, even though the body needs to dump water to raise blood sodium.
3. Water retention dilutes the blood, and plasma sodium drops below 135 mEq/L (hyponatremia). Total body water rises slightly, but blood pressure stays normal because the increase is modest and evenly distributed. — why: You are not adding salt loss (kidneys actually waste some sodium via ANP), you are adding water gain. The math is simple: same amount of salt dissolved in more water equals lower concentration. Clinically, this shows as low serum sodium and low serum osmolality (under 280) on labs.

4. Low blood sodium creates an osmotic gradient: water moves from blood (low particle concentration) into brain cells (higher concentration inside) trying to balance the difference. Brain cells swell. — why: Cell membranes are leaky to water but not to sodium. Water always flows toward the side with more dissolved particles. When blood sodium falls, the inside of the neuron becomes relatively saltier than the outside, so water rushes in, bloating the cell like a water balloon.
5. Swollen brain cells press against the rigid skull, raising intracranial pressure. Patients develop headache, nausea, vomiting, confusion, trouble walking (ataxia), and in severe cases (sodium under 120, acute drop) seizures or coma. — why: The skull cannot expand. Swelling compresses neurons and disrupts electrical signaling — that is why thinking gets foggy and muscles misfire. Severe swelling can push the brainstem down through the foramen magnum (herniation), stopping breathing and heart rate — this is the fatal endpoint if untreated.
6. Over 24–48 hours (if the drop is slow), brain cells fight back by pumping potassium, chloride, and organic molecules out, shrinking themselves and easing symptoms even though sodium stays low. — why: Adaptation buys time and explains why chronic SIADH patients can tolerate sodium of 125 and still walk around. But adaptation is a double-edged sword: if you correct sodium too fast (more than 8–10 mEq/L in 24 hours), water leaves cells faster than osmolytes can return, ripping myelin off brainstem nerves and causing osmotic demyelination syndrome (locked-in state, paralysis, death).
7. Diagnosis requires four findings together: low serum sodium (under 135), low serum osmolality (under 280), urine osmolality inappropriately high (over 100, often over 300), and urine sodium over 40 mEq/L, all in a patient who is euvoletic (normal skin turgor, no swelling (edema), no dehydration) with normal thyroid, adrenal, and kidney function. — why: Each clue confirms the mechanism. Low serum sodium + low serum osmolality = dilution. High urine osmolality when serum is dilute = kidneys holding water (ADH effect). High urine sodium = ANP wasting salt to prevent volume overload. Euvolemia rules out dehydration (which also raises ADH appropriately) and heart failure or cirrhosis (which cause dilutional low sodium (hyponatremia) by different paths). You must exclude hypothyroidism and adrenal insufficiency because they mimic SIADH but need different treatment.

8. Treatment is find and fix the cause (stop the offending drug, treat the pneumonia, resect the tumor) plus restrict free water to 800–1000 mL per day so kidneys can slowly catch up and urine output exceeds intake, concentrating the blood naturally. — why: If you keep pouring water in, the kidneys cannot dump it fast enough against high ADH — sodium will keep falling. Fluid restriction lets the body correct itself over days. For severe acute SIADH (sodium under 120, seizures, coma), give 3% hypertonic saline IV in the ICU at a controlled rate (aim to raise sodium 4–6 mEq/L in the first few hours, then stop or slow to avoid overshooting 8 mEq/L in 24 hours) to stop brain herniation. Tolvaptan or conivaptan (V2 receptor antagonists, 'vaptans') block ADH at the kidney and trigger a large water diuresis — useful for refractory cases but risky because sodium can shoot up too fast if not monitored hourly.

Spot it — what you see, and why

- Low sodium in the blood (hyponatremia): The pituitary gland (a tiny organ at the base of the brain) releases too much ADH (a hormone that tells the kidneys to hold onto water). When the kidneys hold onto too much water, the blood gets watered down, so the sodium (a key salt that helps muscles and nerves work) gets diluted and drops too low.
- Nausea and vomiting: When sodium drops too low, brain cells swell because water shifts into them. The swelling bothers the brain's nausea center (the area postrema, a spot near the brainstem that triggers the vomit reflex).
- Headache: Brain cells swell when sodium is low because water moves into the cells. The swelling stretches the skull's lining (the meninges) and the blood vessels around the brain, which makes your head ache.
- Confusion or trouble thinking clearly: The prefrontal cortex (the front part of the brain that handles planning and focus) and the hippocampus (the brain's memory center) work best when sodium levels are just right. When sodium drops, their signals slow down and get scrambled, so thinking gets foggy.
- Muscle cramps or weakness: Muscles need sodium to squeeze and relax. When blood sodium is too low, the nerves that tell muscles to move can't fire correctly, so muscles feel weak or cramp up.
- Seizures: If sodium drops very low very fast, brain cells swell so much that neurons (the brain's message-sending cells) fire chaotically. That runaway electrical storm is a seizure.

Red flags — act now

- Seizure (sudden shaking or loss of awareness)
- Severe confusion or not responding when you speak to the person
- Sodium level below 120 mEq/L or dropping very fast (more than 10 points in 24 hours)

- Trouble breathing or very slow breathing
- Coma (cannot be woken up)

Treat it — in this order

1. Fluid restriction to 800–1000 mL per day (all liquids — water, juice, IV fluids, soup) → Cuts the amount of water coming into the body. Because the kidneys can't dump water properly in SIADH (ADH is forcing them to hold it), less water in means blood sodium slowly rises as the body uses and breathes out water. This is safe and works in mild to moderate cases (sodium 125–134 mEq/L, no severe symptoms).
2. Treat the underlying cause — remove tumor, stop the triggering medicine (SSRI, carbamazepine, NSAID, cyclophosphamide), or treat lung infection → Stops ADH from being made or released. Once the source is gone, ADH levels drop, the kidneys start dumping water again, and blood sodium climbs back to normal on its own. This is the only true fix.
3. 3% hypertonic saline IV, 100 mL bolus over 10 minutes, for severe symptoms (seizure, coma, or sodium below 120 mEq/L) → Very salty IV fluid raises blood sodium fast — about 4–6 mEq/L in the first few hours. This pulls water out of swollen brain cells and stops seizures. Guideline goal: raise sodium by 4–6 mEq/L in the first 6 hours, then slow down. Maximum safe rise is 8 mEq/L in 24 hours to avoid osmotic demyelination syndrome (brain damage from correcting sodium too fast).
4. Oral sodium chloride tablets (1–2 grams three times a day) plus loop diuretic (furosemide 20–40 mg once or twice daily) → Salt tablets add sodium directly to the blood. The loop diuretic (a water pill that blocks the kidney's ability to concentrate urine) forces the kidneys to dump dilute urine, which gets rid of extra water but keeps the salt you just gave. Together, blood sodium rises steadily. This combo works when fluid restriction alone is not enough.
5. Tolvaptan (a vasopressin V2-receptor antagonist, or 'vaptan') 15 mg once daily, only in hospital → Blocks ADH receptors in the kidney so ADH can't tell the kidneys to hold water. The kidneys dump water (aquaresis — water-only urine) and blood sodium rises without adding extra salt. Works when fluid restriction and salt pills fail. FDA-approved only for euvolemic or hypervolemic low sodium (hyponatremia) in hospitalized patients.

Your top priorities at the bedside

1. Check mental status every 2 to 4 hours using the Glasgow Coma Scale and watch for new confusion, sleepiness, or seizure activity — why: Low sodium makes brain cells swell with extra water; when sodium drops below 120 mEq/L or falls too fast, brain swelling causes seizures, coma, and death if not caught early

2. Measure and record every drop of fluid the patient drinks and every milliliter of urine output on a strict intake-and-output flowsheet — why: Fluid restriction to 800-1000 mL per day is the main treatment; tracking intake and output shows if restriction is working and prevents sneaking extra fluids that worsen low sodium
3. Weigh the patient at the same time every morning on the same scale wearing the same clothes — why: Daily weight shows total body water; patients should lose 0.5 to 1 kg per day on fluid restriction, proving the kidneys are getting rid of extra water and sodium levels are rising