

Diabetes Insipidus

Diabetes insipidus means the kidneys dump huge amounts of water every day, leaving the blood salty and the person desperately thirsty all the time.

THE ONE-LINE TRUTH

The body cannot hold onto water because either the brain stops making ADH (the hormone that tells kidneys to keep water in) or the kidneys ignore the ADH signal.

The chain — how it unfolds

1. The hypothalamus or pituitary gland stops making ADH, or the kidneys stop responding to it. — why: This is the single broken piece. Without ADH telling the kidneys to hold onto water, the system that keeps blood thickness steady is gone. In central DI, the hypothalamus (the ADH factory) or pituitary (the storage and release site) is damaged. In nephrogenic DI, the kidneys' ADH receptors (AVPR2, the docking site for ADH on collecting duct cells) or water channels (aquaporin-2, the gates that let water back into the blood) are broken.
2. The kidneys pour out huge amounts of dilute, pale pee all day and night (polyuria: 3 to 20 liters per day, sometimes more). — why: The collecting ducts stay closed to water because ADH is missing or ignored. Water that should be pulled back into the blood flows straight into the bladder as pee. The pee looks almost like water because it is so dilute (specific gravity less than 1.005, urine osmolality under 200 mOsm/kg, normal is 500 to 800).
3. Blood starts to get salty and thick (rising serum osmolality and sodium). — why: Water is leaving the body, but sodium and other particles stay behind, so the blood gets more concentrated, like soup left on the stove too long. Serum osmolality rises above 295 mOsm/kg, and sodium climbs above 145 mEq/L if the person cannot drink enough.
4. The hypothalamus senses the salty blood and turns on intense thirst (polydipsia). — why: The hypothalamus has osmoreceptors (salt sensors) that scream 'drink now' when blood gets even a little too thick. Thirst is the body's emergency backup to replace the lost water. People describe it as an unstoppable urge to drink, and they often prefer ice-cold water.

5. The person drinks huge amounts of water all day, matching what they are peeing out. — why: As long as they can drink freely, water in equals water out, so blood sodium stays near normal. But they are exhausted from constant drinking and peeing (every 1 to 2 hours, day and night), cannot sleep through the night, and must plan life around bathrooms and water access.
6. If the person cannot drink (unconscious, after surgery, no water nearby, broken thirst center, infant), blood sodium climbs fast (hypernatremia, over 145 mEq/L). — why: Water keeps pouring out as pee, but no water is coming in. Sodium rises above 145, then 150, then higher (can reach 160 to 180 in severe cases). Cells all over the body shrink as water is pulled out to try to dilute the blood. This is life-threatening.
7. Brain cells shrink, causing confusion, lethargy, irritability, muscle twitching, weakness, seizures, and coma. — why: When brain cells (neurons and glia, the supporting cells) shrink, they pull away from the skull and can tear tiny blood vessels (bridging veins), causing bleeding inside the skull (subdural or subarachnoid bleeding (hemorrhage)). Neurons misfire when they shrink, leading to seizures. Severe high sodium (hypernatremia) (over 160 mEq/L) carries high risk of permanent brain damage or death.
8. If you correct the high sodium too fast, the brain swells (cerebral swelling (edema)) and herniates, causing death. — why: After cells have adjusted to high salt by making new particles inside (idiogenic osmoles, emergency molecules the cell builds to pull water back in) to pull water back in, dropping sodium too quickly makes water rush into cells faster than they can get rid of those particles. The brain swells inside the rigid skull, leading to herniation (brain tissue squeezes through openings) and death. Always correct slowly: lower sodium by no more than 10 to 12 mEq/L in 24 hours, and no more than 18 mEq/L in 48 hours. Use the Adrogué-Madias formula to calculate how much free water or desmopressin to give.

Spot it — what you see, and why

- Very large amounts of watery pee (polyuria): Without enough vasopressin (also called ADH, the hormone made by the hypothalamus and stored in the pituitary that tells the kidneys to hold onto water), the kidneys let huge amounts of water escape—often 3 to 20 liters a day, which is like filling a big soda bottle ten times or more. The kidneys simply flush the water out instead of pulling it back into the bloodstream.
- Pee is very pale or clear: Because the kidneys are dumping so much water without pulling it back, the urine stays extremely diluted—it looks almost like water because very little waste is concentrated in it. Normally the kidneys concentrate urine to save water, but here that brake is missing.

- **Extreme thirst (polydipsia):** The body loses so much water through urine that the blood becomes more concentrated and salty. Special sensors in the hypothalamus (the brain's control center for thirst and water balance) detect this and fire up an intense thirst signal to make the person drink constantly and try to replace the lost fluid.
- **Getting up many times at night to pee (nocturia):** The kidneys keep dumping water around the clock, so the bladder fills repeatedly even during sleep. This forces the person to wake up multiple times every night to urinate, which wrecks sleep and leaves them exhausted.
- **Dry mouth and dry skin:** With constant water loss, the body becomes mildly dehydrated—tissues have less fluid than they need, so the mouth feels sticky and dry, and the skin loses its usual moisture and bounce.
- **Fatigue and weakness:** Repeated trips to the bathroom, broken sleep night after night, and the body's constant effort to keep up with fluid shifts all drain energy, leaving the person feeling tired, weak, and worn out.

Red flags — act now

- Sudden confusion, severe headache, or seizure—signs that sodium is dangerously high and brain cells are shrinking, which is a medical emergency
- Unable to keep up with thirst or unable to drink enough—risk of severe dehydration, shock, and organ damage
- Fast heart rate, low blood pressure, or dizziness when standing—signals that blood volume is dropping too low and the heart is struggling to pump enough
- New-onset diabetes insipidus after head injury, brain surgery, or brain infection—may mean damage to the hypothalamus or pituitary gland that makes vasopressin
- Infant or young child with fever, vomiting, or refusal to drink—babies dehydrate much faster and cannot tell you they are thirsty, so this is an emergency

Treat it — in this order

1. **Desmopressin (DDAVP) by nasal spray, tablet, or injection** → Replaces the missing ADH hormone so the kidneys can finally hold onto water. Urine output drops, urine becomes more concentrated, and serum sodium returns to normal. Thirst disappears because the body is no longer losing gallons of water every day.
2. **Free access to water and careful matching of fluid intake to urine output** → Prevents dangerous dehydration and high sodium by letting the patient drink as much as they lose. Keeps the blood from getting too thick and salty while the root cause is being diagnosed and treated.

3. Thiazide diuretic (like hydrochlorothiazide) plus a low-sodium diet for nephrogenic diabetes insipidus → Paradoxically, a diuretic (water pill) reduces urine output by causing mild volume depletion, which makes the kidneys reabsorb more water upstream in the proximal tubule (the first part of the kidney's filter tube) before urine ever reaches the broken collecting duct. A low-salt diet reduces the load of salt the kidneys have to filter, so less water is needed to wash it out.
4. Stop lithium or other nephrotoxic drugs immediately if they are the cause → Removes the toxin that damaged the kidney's ability to respond to ADH in the collecting duct. Over weeks to months, the kidneys may slowly regain function and urine output may decrease as the collecting duct cells heal.
5. Amiloride (a potassium-sparing diuretic) for lithium-induced nephrogenic diabetes insipidus → Blocks lithium from entering kidney collecting duct cells through the epithelial sodium channel (the same channel ADH uses), protecting the cells from further damage and reducing urine output. Works specifically when lithium is the culprit.

Your top priorities at the bedside

1. Monitor fluid intake and urine output every hour and compare the volumes to identify severe fluid imbalance — why: Patients can lose 3 to 20 liters of urine per day, and if intake does not match output, rapid dehydration occurs with hypovolemia (low blood volume), leading to shock, acute kidney injury, and death within hours
2. Check serum sodium level immediately and monitor every 4 to 6 hours, reporting any value above 145 mEq/L to the physician — why: High sodium (Hypernatremia) (high sodium) develops when water loss exceeds intake, causing brain cells to shrink, which triggers confusion, seizures, coma, and permanent brain damage if sodium rises above 160 mEq/L
3. Measure urine specific gravity with each void, reporting values below 1.005 that confirm dilute urine — why: Low specific gravity proves the kidneys are not concentrating urine despite dehydration, which is the defining feature of diabetes insipidus and distinguishes it from other causes of frequent urination like diabetes mellitus or diuretic use