

Hyponatremia: Causes, Symptoms, Diagnosis and Treatment

Hyponatremia is defined as a **serum sodium concentration < 135 mmol/L** (or mEq/L). It is the **most common electrolyte disorder**, particularly in **hospitalized patients**, the **elderly**, and those with **chronic illnesses**.

Sodium: Role and Physiology

- **Primary ECF cation**; normal range: **135–145 mEq/L**
- <10–14 mEq/L found intracellularly

Physiological Functions of Sodium

Function	Description
ECF volume regulation	Maintains blood volume and pressure
Osmolality control	Major determinant of serum osmolality (normal: 275–295 mOsm/kg)
Nerve & muscle function	Facilitates action potentials in excitable tissues
Acid-base balance	Part of sodium bicarbonate (NaHCO₃) buffer system

Sodium Regulation

- **Intake:** Primarily via diet; also from **IV fluids**, medications
- **Minimum requirement:** ~**500 mg/day**
- **Excretion:**
 - **Renal** (primary)
 - **GI tract** (vomiting, diarrhea, fistulas)
 - **Skin** (sweating – typically negligible but ? with exercise/heat)

? *The kidneys can excrete nearly sodium-free urine when intake is low, or retain sodium during high losses.*

Hyponatremia Classification

1. Based on Serum Osmolality

Type	Serum Osmolality	Common Causes
Hypotonic (most common)	? <275 mOsm/kg	Water retention, diuretics, SIADH
Isotonic	275–295	Hyperlipidemia,

Type (pseudohyponatremia) Hypertonic	Serum Osmolality ? >295	Common Causes hyperproteinemia Hyperglycemia, mannitol (osmotic shift)
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2. Based on Volume Status

Type	Description	Causes
Hypovolemic hypotonic	Na ⁺ and water loss; water loss < Na ⁺ loss	Diuretics, GI losses, burns, adrenal insufficiency
Euvolemic hypotonic	Water gain only; no edema	SIADH, hypothyroidism, psychogenic polydipsia
Hypervolemic hypotonic	Na ⁺ and water gain; water gain > Na ⁺ gain	Heart failure, liver cirrhosis, nephrotic syndrome

Pathophysiology

- Water moves into cells due to ? serum osmolality ? **cellular swelling**
- **Cerebral edema** is the most dangerous complication
- In hyperglycemia: ? extracellular glucose ? water shifts out of cells ? **dilutional hyponatremia**

? High-Yield Causes

Category	Specific Causes
GI losses	Diarrhea, vomiting, NG suction
Renal losses	Diuretics (esp. thiazides), adrenal insufficiency
SIADH	CNS injury, malignancy (e.g., small cell lung cancer), drugs (SSRIs, carbamazepine)
Psychogenic polydipsia	Excessive water intake
Post-op state	? ADH secretion
CHF, cirrhosis, nephrotic syndrome	Hypervolemic states with effective volume depletion

Clinical Features

Depends on **onset** and **severity**. More rapid ? in Na⁺ leads to worse symptoms.

Sodium Level	Symptoms
130–135 mEq/L	Often asymptomatic or mild GI symptoms
125–129	Nausea, headache, malaise
115–124	Lethargy, confusion, muscle cramps, weakness
<115	Seizures, coma, respiratory arrest, death

? Symptoms stem from cerebral edema due to water shifting into brain cells.

Diagnostic Workup

1. Serum sodium
2. Serum osmolality
3. Urine sodium
4. Urine osmolality
5. Volume status assessment (clinical exam)

Example Diagnostic Patterns

Type	Serum Osmolality	Urine Na+	Urine Osmolality
SIADH	?	>40 mEq/L	>100 mOsm/kg
Hypovolemic (e.g., diarrhea)	?	<20 mEq/L	>450 mOsm/kg
Psychogenic polydipsia	?	<20 mEq/L	<100 mOsm/kg
Hyperglycemia	?	Variable	Variable

? Management of Hyponatremia

General Principles

- Treat underlying cause
- Assess symptoms and rapidity of onset
- Avoid rapid correction to prevent **osmotic demyelination syndrome (ODS)**

Treatment by Severity:

Severity	Treatment
Mild/asymptomatic	Fluid restriction, oral NaCl tablets
Moderate (symptomatic)	IV normal saline ± loop diuretic
Severe (e.g., seizures)	IV 3% hypertonic saline cautiously + furosemide

? Correct Na+ at ? 8–10 mEq/L over 24 hours

Specific Management

- **SIADH:** Fluid restriction, salt tablets, loop diuretics, **vasopressin receptor antagonists**

(e.g., tolvaptan)

- **Adrenal insufficiency:** Glucocorticoid replacement
- **Heart failure/cirrhosis:** Fluid and sodium restriction, treat underlying disease

High-Yield Clinical Pearls

- **Thiazide diuretics** are a common cause of hyponatremia in elderly
- **SIADH** is the most common cause of **euvolemic hyponatremia**
- **Psychogenic polydipsia** presents with dilute urine and low serum osmolality
- **Rapid correction** of chronic hyponatremia risks **central pontine myelinolysis**
- Hyponatremia + low cortisol = **suspect Addison's disease**

Mnemonics

“SALT LOSS” for symptoms of hyponatremia:

- **S**tupor/seizures
- **A**pprehension
- **L**ethargy
- **T**endon reflexes ?
- **L**imp muscles (weakness)
- **O**rthostatic hypotension
- **S**tomach cramps
- **S**eizures/coma