Hyponatremia

Serum sodium (Na+) <135 mEq/L, often reflecting water imbalance or sodium loss, leading to neurological symptoms.

Epidemiology

- Common in hospitalized patients (~15-30%); higher in elderly, ICU.
- **Risk factors:** Diuretics, heart failure, liver/renal disease, substance use (alcohol, MDMA).
- **Severity:** Mild (130-134 mEq/L), moderate (125-129 mEq/L), severe (<125 mEq/L).

Pathophysiology

- Excess water relative to sodium dilutes plasma Na+.
- Osmotic shift causes cerebral edema, seizures, coma (severe cases).
- ADH dysregulation (e.g., SIADH, volume depletion) drives water retention.

Causes by Volume Status

Volume Status	Causes	Notes
Hypovolemic	- Diuretics (thiazides), GI losses (vomiting, diarrhea). - Cerebral salt wasting (post-neurosurgery). Poor oral intake, sepsis	Low urine Na (<20 mEq/L) in GI losses; high (>40 mEq/L) in diuretics, cerebral salt wasting.
Euvolemic	- SIADH: Malignancy (small cell lung cancer), CNS (stroke, SAH), drugs (SSRIs, MDMA), pain/stress. - Hypothyroidism. - Adrenal insuciency (Addison's): Cortisol deficiency increases ADH, causing water retention. - Psychogenic polydipsia. - Beer potomania (alcohol excess, low solute intake).	Urine Na >40 mEq/L, urine osmolality >100 mOsm/kg in SIADH, adrenal insuciency. Adrenal insuciency may appear hypovolemic in acute crisis (dehydration, hypotension).
Hypervolemic	- Heart failure, cirrhosis, nephrotic syndrome. - Renal failure (AKI, CKD).	Edema, low eective circulating volume; urine Na <20 mEq/L.

Volume Status	Causes	Notes
Other	- Pseudohyponatremia: Hyperglycemia (Na+ drops 1.6 mEq/L per 100 mg/dL glucose >200), lipids hyperlipidemia. - Rare: Fabry disease (renal involvement), Chagas disease (chronic HF).	Correct Na+ in hyperglycemia; check lipids for pseudohyponatremia.

Clinical Presentation and Physical Exam

Symptoms:

- **Mild:** Fatigue, nausea, headache.
- **Severe:** Confusion, seizures, coma (Na+ <120 mEq/L, rapid onset).

Exam:

- Volume Status:
  - **Hypovolemic:** Dry mucous membranes, tachycardia, low BP, sunken eyes.
  - **Euvolemic:** Normal or slightly low BP, no edema (adrenal insuciency may show subtle dehydration).
  - **Hypervolemic:** Edema, JVD, crackles (HF), ascites (cirrhosis).
- Neurological:
  - Lethargy, tremor, seizures, coma (severe).
- Substance Use:
  - Alcohol (beer potomania), MDMA (SIADH-like), history of binge drinking or drug use.
- Red Flags:
  - Na+ <120 mEq/L, acute onset (<48h), neurological symptoms.

Dierential Diagnoses

- **Hyperglycemia:** Corrected Na+ normalizes.
- **Hyperlipidemia:** Lipemic serum, normal osmolality.
- **SIADH vs. Psychogenic Polydipsia:** Urine osmolality dierentiates (>100 vs. <100 mOsm/kg).
- **Key Tip:** Assess volume status, onset (acute vs. chronic), and osmolality.

Diagnostic Workup

Labs:

- **Serum Na+:** Confirm <135 mEq/L; trend if correcting.
- **Serum Osmolality:** Low (<275 mOsm/kg) in true hyponatremia; normal/high in pseudohyponatremia.
- **Urine Na+:** <20 mEq/L (extrarenal loss, HF); >40 mEq/L (SIADH, adrenal insuciency).
- **Urine Osmolality:** >100 mOsm/kg (SIADH, adrenal insuciency); <100 mOsm/kg (polydipsia).
- Other:
  - Glucose (hyperglycemia), lipids (pseudohyponatremia), TSH (hypothyroidism), cortisol/ACTH stimulation test (adrenal insuciency), LFTs (cirrhosis).
  - Substance Use: Urine drug screen (MDMA), alcohol level (beer potomania).

Imaging:

- **CXR:** HF (pulmonary edema), malignancy (SIADH).
- **Head CT/MRI:** If CNS cause (stroke, SAH).
- **Key Tip:** Serum osmolality first, then volume status.

Evaluation Flowsheet: Hyponatremia Workup

- **Step 1:** Measure serum Na+ (<135 mEq/L confirms).
- **Step 2:** Check serum osmolality:
  - **High (>295 mOsm/kg):** Hyperglycemia → Correct Na+ (add 1.6 mEq/L per 100 mg/dL glucose >200).
  - **Normal (275-295 mOsm/kg):** Pseudohyponatremia → Check lipids, proteins.
  - **Low (<275 mOsm/kg):** True hyponatremia → Proceed.
- **Step 3:** Assess volume status:
  - **Hypovolemic:** Urine Na+ <20 mEq/L → GI losses; >40 mEq/L → Diuretics, cerebral salt wasting.
  - **Euvolemic:** Urine osmolality >100 mOsm/kg → SIADH, adrenal insuciency (check cortisol); <100 mOsm/kg → Polydipsia.
  - **Hypervolemic:** Edema → HF, cirrhosis, nephrotic syndrome.
- **Step 4:** Cause-specific tests: TSH, cortisol/ACTH, CXR, drug screen (MDMA, alcohol).

- **Key Tip:** Avoid over-correction; monitor Na+ q4-6h in severe cases.

Treatment

General Principles:

- Correct slowly to avoid osmotic demyelination syndrome (ODS); max 8-12 mEq/L in 24h.
- Acute (<48h) or severe (Na+ <120 mEq/L, seizures): Faster correction (4-6 mEq/L in 1-2h).
- **Chronic (>48h) or mild:** Slower correction.

Acute/Severe (Symptomatic):

- **Hypertonic Saline (3%):** 100-150 mL IV bolus over 10-20 min, repeat q20-30 min until Na+ rises 4-6 mEq/L or symptoms resolve.
- Monitor:
  - Na+ q2-4h, stop if >8 mEq/L in 24h.
  - DDAVP (If Over-Correcting): 2-4 mcg IV to slow correction, per specialist.

Chronic/Asymptomatic:

- Hypovolemic:
  - Normal saline (0.9% NS) IV, 1-2 L, titrate to volume status; address cause (e.g., stop diuretics).
- Euvolemic (SIADH, Adrenal Insuciency):
  - SIADH: Fluid restriction (500-1000 mL/day); tolvaptan (15 mg daily) if refractory.
  - Adrenal Insuciency: Hydrocortisone (100 mg IV q8h in crisis, then taper), fludrocortisone (0.1 mg daily) for maintenance; cautious saline if dehydrated.
- Hypervolemic:
  - Loop diuretics (furosemide 20-40 mg IV), fluid restriction, treat underlying (e.g., HF with GDMT).
- Substance Use:
  - Beer potomania → IV saline + nutrition (increase solute); MDMA → Fluid restriction, monitor for SIADH.
- Rare Causes:
  - Fabry (enzyme replacement), Chagas (treat HF).
- **Key Tip:** Avoid hypotonic fluids (e.g., D5W) in true hyponatremia.

Complications

- **ODS:** Rapid correction (>12 mEq/L in 24h) causes pontine myelinolysis (dysarthria, paralysis).
- **Cerebral edema:** Severe hyponatremia Na+ <120 mEq/L).
- **Poor prognosis:** Na+ <115 mEq/L, underlying malignancy.

Prognosis

- **Mortality:** ~5-10% in severe cases (seizures, coma).
- Better outcomes with slow correction, addressing cause (e.g., HF, SIADH).

Key Pearls

- Serum osmolality first, then volume status.
- Correct Na+ 6-8 mEq/L in 24h; 4-6 mEq/L in 1-2h if severe.
- Na+ q2-4h in acute cases; avoid hypotonic fluids.
- Screen for substance use (alcohol, MDMA) and adrenal insuciency in euvolemic patients.

Treatment Table: Hyponatremia Correction Strategies

Type	Volume Status	Treatment	Correction Goal	Notes
Acute/Severe	Any	3% hypertonic saline (100-150 mL IV bolus), repeat q20-30 min.	4-6 mEq/L in 1-2h, max 8-12 mEq/L in 24h.	Na+ q2-4h; DDAVP if over-correcting.
Hypovolemic	Low	0.9% NS IV (1-2 L), address cause (e.g., stop diuretics).	6-8 mEq/L in 24h.	Monitor volume status, urine output.
Euvolemic (SIADH, Adrenal Insuciency)	Normal	SIADH: Fluid restriction (500-1000 mL/day), tolvaptan (15 mg daily) if refractory. Adrenal Insuciency: Hydrocortisone (100 mg IV q8h in crisis), fludrocortisone (0.1 mg daily).	6-8 mEq/L in 24h.	Check cortisol; cautious saline in adrenal crisis.
Hypervolemic	High	Loop diuretics (furosemide 20-40 mg IV), fluid restriction.	6-8 mEq/L in 24h.	Treat underlying (e.g., HF with metoprolol succinate).
Substance Use	Euvolemic	Beer potomania: IV saline + nutrition; MDMA: Fluid restriction.	6-8 mEq/L in 24h.	Monitor for SIADH (MDMA).

References

UpToDate: “Hyponatremia Evaluation and Treatment” (2025).

AACE Guidelines: Electrolyte Disorders (2023).

NEJM: “Hyponatremia” (Spasovski, 2014).

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