RESEARCH PAPER

Hyponatremia: A Comprehensive Clinical Review of Pathophysiology, Diagnosis, and Management

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ABSTRACT

Hyponatremia is the most common electrolyte disorder encountered in hospitalized patients and is associated with increased morbidity, mortality, and prolonged hospital stay. Its etiology is diverse, ranging from volume disturbances to hormonal dysregulation such as syndrome of inappropriate antidiuretic hormone secretion (SIADH). Accurate diagnosis requires a systematic approach integrating clinical assessment and laboratory parameters. This review outlines the classification, pathophysiology, diagnostic algorithm, and current management strategies for hyponatremia, emphasizing recent advances and practical clinical approaches.

Keywords: Hyponatremia, SIADH, Electrolyte imbalance, Osmolality, Sodium correction.

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1. Introduction

Hyponatremia, defined as serum sodium <135 mEq/L, is frequently encountered in both inpatient and outpatient settings. It is associated with significant neurological complications and increased mortality, particularly in critically ill patients. Despite its prevalence, it remains a diagnostic and therapeutic challenge.

2. Classification of Hyponatremia

Based on Serum Osmolality

- **Hypotonic hyponatremia** (most common)
- Isotonic hyponatremia (pseudohyponatremia)
- Hypertonic hyponatremia (e.g., hyperglycemia)

Based on Volume Status

- Hypovolemic
- Euvolemic
- Hypervolemic

3. Pathophysiology

Hyponatremia results from an imbalance between water intake and excretion, largely regulated by antidiuretic hormone (ADH).

Key mechanisms:

- Excess ADH secretion
- Impaired free water excretion
- Renal sodium loss
- Dilutional states

4. Common Etiologies

Hypovolemic Hyponatremia

- Gastrointestinal losses (vomiting, diarrhea)
- Diuretics (especially thiazides)

Euvolemic Hyponatremia

- SIADH
- Hypothyroidism
- Adrenal insufficiency

Hypervolemic Hyponatremia

- Heart failure
- Liver cirrhosis
- Nephrotic syndrome

5. Clinical Manifestations

Symptoms depend on severity and rapidity of onset:

- Mild: nausea, headache
- Moderate: confusion, lethargy

- Severe: seizures, coma

Acute hyponatremia (<48 hours) carries higher risk of cerebral edema.

6. Diagnostic Approach

Stepwise Evaluation

1. Measure serum osmolality
2. Assess volume status
3. Urine osmolality
4. Urine sodium

Key Laboratory Clues

- Urine osmolality >100 mOsm/kg → impaired water excretion
- Urine sodium >30 mEq/L → renal causes/SIADH

7. SIADH: A Common Cause

Diagnostic criteria:

- Euvolemic hyponatremia
- Low serum osmolality
- Inappropriately concentrated urine
- Normal adrenal and thyroid function

Common causes:

- CNS disorders
- Pulmonary diseases
- Drugs (SSRIs, carbamazepine)

8. Management Strategies

8.1 General Principles

- Identify and treat underlying cause
- Assess severity and symptoms
- Avoid rapid correction

8.2 Acute Symptomatic Hyponatremia

- **3% hypertonic saline**
- Goal: raise Na by 4–6 mEq/L in first 6 hours

8.3 Chronic Hyponatremia

- Fluid restriction (first-line in SIADH)
- Salt tablets
- Loop diuretics
- Vasopressin receptor antagonists (vaptans)

9. Rate of Sodium Correction

- Maximum correction:
  - **≤8–10 mEq/L in 24 hours**
- Rapid correction → **Osmotic demyelination syndrome (ODS)**

10. Special Situations

Hyponatremia in ICU

- Multifactorial
- Requires close monitoring

Drug-Induced Hyponatremia

- Common with SSRIs, antiepileptics

11. Recent Advances

- Use of vaptans in resistant cases
- Improved diagnostic algorithms
- Biomarkers for ADH activity

12. Clinical Implications

- Early diagnosis reduces complications
- Systematic approach improves outcomes
- Avoid overcorrection at all costs

13. Conclusion

Hyponatremia is a common yet complex electrolyte disorder requiring a structured diagnostic and therapeutic approach. Understanding its pathophysiology and adhering to evidence-based correction strategies are essential to prevent complications and improve patient outcomes.

References (Vancouver Style – Sample)

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