Hyponatremia

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KEYWORDS

• Hyponatremia • Osmotic demyelination • Antidiuretic hormone
• Total body water

HOSPITAL MEDICINE CLINICS CHECKLIST

1. Hyponatremia is most commonly caused by abnormality in water handling by the kidney as opposed to a true sodium deficit; that is, renal water excretion is insufficient to offset water intake.
2. Hyponatremia is common and is associated with increased length of stay and mortality in inpatients.
3. The symptoms of hyponatremia are nonspecific and highly variable in severity.
4. Sodium is usually the major determinant of serum osmolality, therefore most cases of hyponatremia are hypotonic.
5. Assessment of volume status is key to the evaluation of hypotonic hyponatremia.
6. When possible, urine osmolality and urine sodium levels should be obtained before therapy. Thyroid-stimulating hormone and cortisol levels should be routinely obtained in the workup of euvolemic hyponatremia.
7. Acute, symptomatic hyponatremia should be treated promptly, and the response to treatment monitored closely.
8. Rapid correction of hyponatremia can cause severe neurologic sequelae caused by osmotic demyelination.

DEFINITION

1. What is hyponatremia?

Hyponatremia is defined as a serum sodium concentration less than 135 mEq/L. In the past, high serum lipid or serum protein levels could result in erroneously low serum

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sodium results (pseudohyponatremia). This artifactual phenomenon has been largely eliminated by the use of sodium electrode methodology in almost all laboratories in the United States.

2. How is hyponatremia classified?

Hyponatremia can be classified in multiple ways. The first step in classification is measurement of serum osmolality (**Table 1**). Hyponatremia with high serum osmolality (hypertonic hyponatremia) usually represents osmotic shifts attributable to hyperglycemia or marked azotemia. Hyponatremia in the setting of normal serum osmolality (isotonic hyponatremia) may occur with systemic absorption of isosmotic nonelectrolyte irrigation solution used during surgery, such as mannitol irrigation solution during transurethral resection of the prostate. Hyponatremia with low serum osmolality (hypotonic hyponatremia) is often regarded as true hyponatremia.

Unless hyperglycemia, azotemia, or unmeasured osmotic agents (eg, mannitol) are present, serum sodium is the major determinant of serum osmolality (Sosm), as shown by the equation:

$$\text{Sosm} = (2 \times [\text{serum Na}^+]) + ([\text{serum glucose}]/18) + (\text{BUN}/2.8)$$

where BUN is blood urea nitrogen. Therefore, most cases of hyponatremia are associated with low serum osmolality.

Hypotonic hyponatremia may be further subdivided based on the volume status of the patient into 3 categories: hypervolemic, euvolemic, and hypovolemic. These

Table 1
Classification of hyponatremia by serum osmolality and causes

Low Osmolality	Normal Osmolality	High Osmolality
Decreased effective arterial blood volume True volume depletion (vomiting, diarrhea, diuretic, bleeding) Decreased effective circulation volume (heart failure, cirrhosis)	Nonelectrolyte irrigation solutions Glycine Sorbitol (TURP, hysterectomy, laparoscopic surgery)	Marked hyperglycemia Serum sodium decreases 1.6 mEq/L for every increase of 100 mg/dL in glucose
SIADH	Pseudohyponatremia Largely eliminated by modern laboratory assays	Advanced renal failure with extremely high BUN
Hormonal changes Adrenal Insufficiency Hypothyroidism hCG during pregnancy (mild osmotic resetting)		
Exercise induced		
Renal failure		
Primary polydipsia		
Low dietary solute intake		

Abbreviations: BUN, blood urea nitrogen; hCG, human chorionic gonadotropin; SIADH, syndrome of inappropriate antidiuretic hormone hypersecretion; TURP, transurethral resection of the prostate.

Data from Refs.[8–11]