

Pathophysiology of Sodium and Volume Disorders (9 States)

1. Hypovolemic Hypotonic Hyponatremia

Water and sodium are both lost, but sodium loss is greater. This results in decreased extracellular fluid volume and low serum sodium. Common causes include diuretics, vomiting, diarrhea, and third-spacing. ADH is released due to hypovolemia, further worsening hyponatremia by water retention.

2. Euvolemic Hypotonic Hyponatremia

Total body water increases slightly while total body sodium remains the same, leading to dilutional hyponatremia. ADH is inappropriately secreted despite normal volume. Classic causes: SIADH, hypothyroidism, adrenal insufficiency.

3. Hypervolemic Hypotonic Hyponatremia

Both sodium and water increase, but water gain is greater. Effective circulating volume is low (e.g., due to heart failure or cirrhosis), triggering RAAS and ADH. This leads to water retention, worsening hyponatremia.

4. Hypovolemic Isotonic (Normal Sodium)

Sodium and water are lost proportionally, maintaining normal serum sodium. Plasma osmolality remains stable, but ECF volume is reduced. Seen in mild volume loss or early fluid losses before serum sodium shifts.

5. Euvolemic Isotonic (True Normal)

Normal sodium and water balance. No pathology present. This represents the physiological baseline state.

6. Hypovolemic Hypertonic Hypernatremia

Water is lost more than sodium. Results in increased serum sodium and decreased volume. Seen in conditions like sweating, osmotic diuresis, or diarrhea without adequate water intake. ADH tries to conserve water.

7. Euvolemic Hypertonic Hypernatremia

Pure water loss without sodium loss. Total body sodium is normal, but water deficit leads to elevated serum sodium. Typical in diabetes insipidus (central or nephrogenic). Thirst is the main defense mechanism.

8. Hypervolemic Hypertonic Hypernatremia

Excess sodium intake with water retention, but sodium gain > water gain. Usually iatrogenic (e.g., hypertonic saline, sodium bicarbonate). Can also be due to mineralocorticoid excess.

N. Normal Sodium and Volume (Center of Diagram)

Homeostasis is maintained with balanced water and sodium. No ADH or RAAS activation. This is the normal physiological condition.

