

## Fluids and Electrolytes

### Assumption

The student understands the distribution of fluids and electrolytes in the body compartments, and the role of the kidneys in regulating fluid and electrolyte balance.

### Goal

The student will be able to understand the basic fluid and electrolyte abnormalities and how to treat them in the context of an inpatient setting.

### Objectives

By the end of the core surgical clerkship, the student will be able to:

1. List the normal range of serum electrolytes (Na<sup>+</sup>, K<sup>+</sup>, Mg<sup>+</sup>, Ca<sup>++</sup>, and Cl<sup>-</sup>).
2. List the most common endogenous factors that affect renal control of sodium and water excretion.
3. List the signs and symptoms of hypovolemia.
4. List and describe the objective ways of measuring fluid balance.
5. List the electrolyte composition of the following solutions:
  - a. Normal (0.9%) saline
  - b. 1/2 normal saline
  - c. 5% dextrose in water
  - d. Ringer's lactate
6. Compare and contrast various resuscitation strategies for patients who are hypovolemic versus other states of shock. *\*Refer to Shock module.*
7. Describe strategy for replacement of GI losses (ostomy, fistula, etc.) *\*Refer to Nutrition module.*

### Problems

1. In the following situations, indicate whether serum Na, K, HCO<sub>3</sub>, Cl will remain stable (0), rise considerably (++) , rise moderately (+), fall moderately (-), or fall considerably (--):
  - a. Excessive gastric losses
  - b. High volume pancreatic fistula
  - c. Small intestine fistula
  - d. Biliary fistula
  - e. Diarrhea
2. In the following situations, indicate whether serum and urine Na, K, HCO<sub>3</sub>, Cl, and osmolality will remain stable (0), rise considerably (++) , rise moderately (+), fall moderately (-), or fall considerably (--):
  - a. Acute tubular necrosis
  - b. Dehydration
  - c. Inappropriate ADH secretion (SIADH)
  - d. Diabetes insipidus
  - e. Congestive heart failure
3. Describe the possible causes, appropriate laboratory studies needed, and treatment of the following conditions:
  - a. Hyper/hyponatremia
  - b. Hyper/hypokalemia
  - c. Hyper/hypomagnesemia

**Fluids and Electrolytes** (continued)

**Problems** (continued)

- d. Hyper/hypochloremia
- e. Hyper/hypocalcemia

**Skills**

1. Interpret serum electrolytes and treatment.
2. Identify EKG abnormalities consistent with hypokalemia, hyperkalemia, hypomagnesemia.
3. Be able to initiate fluid resuscitation in adult and pediatric patients.

**Teaching Hints**

1. Present case problems and have students identify the most likely electrolyte abnormality.
2. Have students develop an algorithm to treat the conditions with special attention to recognizing the need for resuscitation and volume repletion, followed by addressing the maintenance needs with focus towards correction of specific metabolic and electrolyte abnormalities.
3. Utilize case-based scenarios (CHF, C-diff colitis, etc.) with a full body mannequin in a SIM lab or flipped classroom.

**Prevention**

Discuss the following:

1. Early recognition of hypovolemic conditions (e.g., emesis, fistula output, ostomy output, diarrhea).
2. Recognition of additional challenges that occur when normal renal function is disrupted by concurrent conditions (e.g., diuretic use, acute tubular necrosis [ATN] from medications, SIADH from head trauma or cancer).

**Special Considerations**

Discuss fluids and electrolytes as they relate to these situations:

1. Pediatric resuscitation
2. Burn resuscitation (adult and pediatric)
3. Massive transfusion protocol