

Pediatric Fluid and Electrolyte Imbalances: A Case Study Approach

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Learning Objectives:

1. Identify 2 mechanisms of fluid and electrolyte regulation in the acutely ill child.
2. Describe the clinical manifestations and acute care management of the acutely ill child with a disturbance in fluid balance.
3. Describe the clinical manifestations and acute care management of common electrolyte imbalances.

Summary of Key Points

I. Introduction

- a. Total body water
- b. Intracellular Fluid
- c. Extracellular Fluid

II. Regulation of Fluid & Electrolyte Balance

- a. Renal
- b. Hormonal
 - i. Antidiuretic Hormone (ADH)
 - ii. Aldosterone
 - iii. Natriuretic Factors

III. Assessment of Fluid & Electrolyte Balance

IV. Fluid Volume Deficit

- a. Causes
- b. Clinical manifestations and severity of deficit

Clinical Manifestations	Mild Fluid Deficit	Moderate Fluid Deficit	Severe Fluid Deficit
Mental Status/General Appearance * ❖ Infants and young children ❖ Older children and adults	Thirsty, alert, restless Thirsty, alert, restless	Thirsty, restless or lethargic but irritable to touch Thirsty, alert	Lethargic, somnolent Usually conscious, apprehensive
Radial pulse	Normal rate and strength	Rapid and weak	Rapid, feeble, sometimes impalpable
Heart Rate	Normal or mild tachycardia	Tachycardia	Severe tachycardia that may progress to bradycardia
Respirations	Normal	Normal to rapid	Deep and rapid
Fontanel & Eyes	Normal	Slightly depressed	Severely sunken
Systolic blood pressure	Normal	Orthostatic hypotension	Severe hypotension
Skin elasticity	Pinch retracts immediately	Pinch retracts slowly	Pinch retracts very slowly (>3 sec)
Tears *	Present	Present or absent	Absent
Mucous membranes *	Moist	Dry	Very dry
Urine output	Normal	Oliguria	Oliguria or anuria

Body weight loss (%)	3-5	6-9	≥ 10
Estimated fluid deficit (mL/kg)	30-50	60-90	≥ 100

c. Management

V. Electrolyte Imbalances

Electrolyte Imbalance	Causes	Clinical S&Sx	ECG Findings	Management
Hyponatremia <i>Na < 135 mEq/L</i>	<ul style="list-style-type: none"> • Vomiting/diarrhea • NG suction • ↓ Na intake • fever • excessive diaphoresis • ↑ water intake • burns & wounds • renal disease • DKA • Malnutrition 	<ul style="list-style-type: none"> • Lethargy • Muscle cramps • N/V • Disorientation • Seizures • Coma 	<ul style="list-style-type: none"> • N/A 	<ul style="list-style-type: none"> • Treat underlying cause • Frequent neuro assessments • Fluid replacement (if applicable) • 3% saline • Monitor Na levels
Hypernatremia <i>Na > 145 mEq/L</i>	<ul style="list-style-type: none"> • ↑ Na intake • renal disease • fever • ↑ insensible water loss • Diabetes insipidus • Hyperglycemia 	<ul style="list-style-type: none"> • Irritability/agitation • Dry, sticky mucous membranes • Flushed skin • Lethargy/confusion • Seizures • Coma • Muscle weakness • Muscle twitching • Intense thirst 	<ul style="list-style-type: none"> • N/A 	<ul style="list-style-type: none"> • Treat underlying cause • Frequent neuro assessments • Strict I&O • Slow correction of fluid deficit (if applicable) • Monitor Na levels
Hypokalemia <i>K⁺ < 3.5 mEq/L</i>	<ul style="list-style-type: none"> • ↓ K intake • Starvation • Malabsorption syndromes • GI losses • Diuresis • Nephritis • Alkalosis 	<ul style="list-style-type: none"> • Muscle weakness, cramping, stiffness, paralysis, hyporeflexia • Hypotension • Lethargy • Irritability • Tetany • N/V • Abdominal distention • Paralytic ileus • Irregular, weak pulse 	<ul style="list-style-type: none"> • Flattened, inverted T waves • Presence of U-waves • PVC's 	<ul style="list-style-type: none"> • Determine & treat cause • Monitor ECG • Frequent neuromuscular assessments • K⁺ replacement • Monitor acid-base status
Hyperkalemia <i>K⁺ > 5.5 mEq/L</i>	<ul style="list-style-type: none"> • ↑ K intake • Renal disease/failure • Adrenal insufficiency • Metabolic acidosis • Severe dehydration • Burns • Crushing injuries • Hemolysis 	<ul style="list-style-type: none"> • Muscle weakness • Ascending paralysis • Hyperreflexia • Confusion • Apnea • N/V • Diarrhea • ↓ cardiac function 	<ul style="list-style-type: none"> • Tall, peaked T waves • Widened QRS • Prolonged PR interval • Ventricular arrhythmias • Asystole 	<ul style="list-style-type: none"> • Determine & treat cause • Monitor ECG • Administer IV fluids • D/C K⁺ containing fluids/meds • Ca Glu 100mg/kg • Insulin 0.1u/kg + Glucose 0.5g/kg • Na Bicarb • Kayexalate

				<ul style="list-style-type: none"> • Dialysis • Monitor serum K levels • Evaluate acid-base status
Hypocalcemia <i>Ca < 8mg/dL</i> <i>iCa < 1.15</i>	<ul style="list-style-type: none"> • ↓ dietary Ca • Vitamin D deficiency • Renal insufficiency • Diuretics • Hypoparathyroidism • Alkalemia • ↑ serum protein 	<ul style="list-style-type: none"> • NM irritability • Tingling sensation • Chvostek's sign • Trousseau's sign • Tetany • Muscle cramps • Lethargy • Seizures • Hypotension 	<ul style="list-style-type: none"> • Prolonged QT interval 	<ul style="list-style-type: none"> • Treat/control cause • Monitor ECG • IV calcium supplements • Monitor Ca & Mg levels
Hypercalcemia <i>Ca > 10.5 mg/dL</i> <i>iCa > 1.34</i>	<ul style="list-style-type: none"> • Acidosis • Prolonged immobilization • Kidney disease • Hyperparathyroidism • Excessive administration 	<ul style="list-style-type: none"> • Lethargy • Stupor • Coma • Seizures • Anorexia • N/V • Constipation • NM hypotonicity 	<ul style="list-style-type: none"> • Shortened QT interval • Bradycardia • Cardiac arrest 	<ul style="list-style-type: none"> • Treat underlying cause • Monitor ECG • IV fluids • Loop diuretics
Hypomagnesemia <i>Mg < 1.4 mEq/L</i>	<ul style="list-style-type: none"> • ↓ intake (NPO) • Malabsorption syndromes • ↑ renal excretion 	<ul style="list-style-type: none"> • NM excitability • Tetany • Confusion • Dizziness • Headache • Seizures • Coma • Respiratory depression • ↑ HR 	<ul style="list-style-type: none"> • PVC's • V-tach • V-fib 	<ul style="list-style-type: none"> • Treat cause • IV Mg replacement • Monitor ECG • Neuromuscular assessments
Hypermagnesemia <i>Mg > 1.4 mEq/L</i>	<ul style="list-style-type: none"> • Chronic renal disease • ↓ GFR/↓ excretion • ECF deficit • ↑ administration of Mg containing drugs 	<ul style="list-style-type: none"> • Lethargy • Muscle weakness • ↓ swallow • ↓ gag • ↓ HR • ↓ BP 	<ul style="list-style-type: none"> • Prolonged PR • Prolonged QRS • Prolonged Qt • AV block 	<ul style="list-style-type: none"> • Treat cause • Monitor ECG • Administer Ca Glu • IV hydration • Dialysis

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