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Fluid, Electrolyte and Acid-Base Balance

Nursing Foundation

Body fluid compartments, fluid balance, dehydration, fluid overload, electrolyte imbalances, intravenous fluid therapy and acid-base disturbances.

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CHAPTER 21

CHAPTER 21 Fluid, Electrolyte and Acid-Base Balance

B.Sc. Nursing | Nursing Foundation I & II

Body fluids and regulation

Total body water is approximately 50-60% of adult body weight, varying with age and composition. Intracellular fluid is roughly two-thirds of body water; extracellular fluid one-third, principally interstitial fluid and plasma. Diffusion: solute moves down concentration gradient; osmosis: water movement across selectively permeable membrane; filtration: pressure-driven movement; active transport: energy-dependent transport. Kidneys, ADH, thirst, RAAS/aldosterone and natriuretic peptides regulate fluid balance.

Fluid imbalance

Volume deficit may follow vomiting, diarrhoea, bleeding, burns, sweating or low intake; signs include thirst, dry mucosa, tachycardia, reduced output, dizziness and hypotension. Dehydration specifically means water deficit and may coexist with volume depletion. Excess volume occurs with heart/kidney disease or excessive fluids; signs include oedema, weight gain, dyspnoea, crackles and raised venous pressure. Assess perfusion, respiratory status, daily weights, intake/output and clinical history; escalate deterioration.

Electrolyte reference ranges and problems

Electrolyte	Typical adult laboratory range and abnormality
Sodium	135-145 mmol/L; low/high levels may cause neurological symptoms.
Potassium	3.5-5.0 mmol/L; low/high levels may cause weakness and arrhythmias.
Chloride	98-106 mmol/L; associated with fluid and acid-base changes.
Total calcium	8.5-10.5 mg/dL; low may cause tetany, high constipation/confusion.
Magnesium	1.7-2.2 mg/dL; low may cause tremor and arrhythmias.
Phosphate	2.5-4.5 mg/dL; severe low levels can cause muscle weakness.

Use local ranges, assess trends, ECG and symptoms where indicated. Electrolyte replacement requires authorized prescription and monitoring; never administer potassium chloride as direct IV push.

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CHAPTER 21

Intravenous fluids and complications

Solution	Characteristics
0.9% normal saline	Isotonic crystalloid.
Ringer's lactate	Balanced, approximately isotonic crystalloid.
0.45% sodium chloride	Hypotonic crystalloid.
3% sodium chloride	Hypertonic; specialized indication and monitoring.
5% dextrose in water	Approximately isotonic in bag; acts as free water after glucose metabolism.
Albumin	Colloid used for selected indications.

Verify prescription, solution, rate, access, compatibility and pump settings. Monitor for infiltration (non-vesicant leakage), extravasation (vesicant leakage), phlebitis, infection, overload and electrolyte changes. Stop suspected extravasation and follow drug-specific protocol; do not flush. Assess IV site and balance regularly.

Acid-base balance and ABG

Typical arterial pH 7.35-7.45; PaCO2 35-45 mmHg; HCO3 22-26 mmol/L. Respiratory disturbances primarily change PaCO2; metabolic disturbances primarily change bicarbonate.

Disorder	Primary change; common cause
Respiratory acidosis	PaCO2 increased; hypoventilation.
Respiratory alkalosis	PaCO2 decreased; hyperventilation.
Metabolic acidosis	HCO3 decreased; ketoacidosis, selected renal/GI causes.
Metabolic alkalosis	HCO3 increased; vomiting, selected diuretics.

Interpret pH, PaCO2 and bicarbonate, identify primary process, evaluate expected compensation and mixed disorders with clinical context. Example: pH 7.28, PaCO2 55, HCO3 25 suggests primary respiratory acidosis. Treatment targets the underlying cause and requires clinical assessment.

Exam revision

1. 1. Explain fluid compartments and fluid balance.
2. 2. Describe electrolyte imbalances and IV solutions.
3. 3. Classify acid-base disorders and explain basic ABG interpretation.

Educational notes. Clinical skills require supervision, authorized orders and current facility protocols.

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Quick Revision

- Adult body water is approximately 50-60% of body weight; roughly two-thirds is intracellular.

- Diffusion moves solute down a gradient, osmosis moves water, filtration is pressure-driven and active transport requires energy.

- Assess volume status using perfusion, respiration, daily weight, intake/output and history.

- Typical adult sodium is 135-145 mmol/L and potassium 3.5-5.0 mmol/L; use local ranges and clinical context.

- Monitor IV therapy for infiltration, extravasation, phlebitis, infection, overload and electrolyte changes.

- Typical arterial pH is 7.35-7.45; respiratory disturbances primarily alter PaCO2 and metabolic disturbances bicarbonate.

Practice questions

Choose one best answer. The answer key and explanations follow the questions.

1. Which process describes water movement across a selectively permeable membrane?

A. Filtration
B. Diffusion
C. Osmosis
D. Active transport

2. Which primary change characterizes respiratory acidosis?

A. Increased bicarbonate
B. Decreased PaCO2
C. Decreased bicarbonate
D. Increased PaCO2

3. Which fluid is classified as a hypotonic crystalloid?

A. 0.45% sodium chloride
B. 0.9% normal saline
C. 3% sodium chloride
D. Albumin

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Answer key and explanations

1. C - Osmosis

Osmosis concerns water movement through a selectively permeable membrane.

2. D - Increased PaCO2

Respiratory acidosis primarily raises PaCO2.

3. A - 0.45% sodium chloride

The source classifies 0.45% sodium chloride as hypotonic.

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