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Nursing Management of Patients with Fluid, Electrolyte and Acid-Base Imbalances

Medical Surgical Nursing

Dehydration, fluid overload, sodium imbalance, potassium imbalance, calcium imbalance, magnesium imbalance, metabolic acidosis, metabolic alkalosis, respiratory acidosis and respiratory alkalosis.

For educational purposes only.

CHAPTER 21 / MEDICAL-SURGICAL NURSING 21. Nursing Management of Patients with Fluid, Electrolyte and Acid-Base Imbalances

1. Body fluid compartments and regulation

Total body water is commonly around 50-60% of adult body mass; approximately two-thirds is intracellular and one-third extracellular. Plasma and interstitial fluid form the main extracellular compartments. Osmosis moves water across semipermeable membranes, diffusion moves solutes down gradients, and active transport requires energy. The kidneys, thirst, antidiuretic hormone, renin-angiotensin-aldosterone system and natriuretic peptides regulate volume and osmolality.

2. Volume disturbances

Fluid volume deficit and dehydration

Definition and pathophysiology: Loss of extracellular volume from haemorrhage, diarrhoea, vomiting, burns or diuretics; dehydration specifically means water deficit.

Clinical features and investigations: Thirst, tachycardia, postural hypotension, oliguria, weight loss; assess perfusion, sodium, renal function and fluid history.

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Management and nursing care: Address cause; oral rehydration when safe or prescribed IV crystalloid; assess response and avoid excessive fluids in cardiac or renal disease.

Fluid overload

Definition and pathophysiology: Excess extracellular fluid from renal impairment, heart failure or excessive IV fluids.

Clinical features and investigations: Oedema, weight gain, dyspnoea, crackles, raised jugular venous pressure; evaluate oxygenation and renal function.

Management and nursing care: Position for breathing, escalate pulmonary oedema, implement prescribed diuretics/fluid restriction and monitor daily weight and output.

3. Electrolytes: typical adult serum ranges

Electrolyte	Reference range	Main role

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Na+	135-145 mmol/L	Extracellular osmolality and volume
K+	3.5-5.0 mmol/L	Cardiac and neuromuscular excitability
Total Ca	8.5-10.5 mg/dL	Muscle contraction, bone and coagulation
Mg	1.7-2.2 mg/dL	Enzyme function and cardiac stability
Cl-	98-106 mmol/L	Electrically balances sodium and contributes to acid-base balance

Hyponatraemia and hypernatraemia

Definition and pathophysiology: Low sodium often reflects excess water relative to sodium; high sodium often reflects water deficit.

Clinical features and investigations: Headache, confusion and seizures in severe cases; assess glucose, osmolality, volume and urine studies.

Management and nursing care: Treat underlying cause and prescribed fluid strategy; rapid correction can cause brain injury. Monitor serial sodium and neurological status.

Hypokalaemia and hyperkalaemia

Definition and pathophysiology: Low K may follow GI losses or diuretics; high K may follow kidney failure, cell lysis or medications.

Clinical features and investigations: Weakness and arrhythmias; ECG changes may occur but a normal ECG does not exclude danger. Check sample haemolysis.

Management and nursing care: Urgent assessment for severe abnormalities; administer ordered replacement or hyperkalaemia treatment, cardiac monitoring and repeat levels. Never give potassium by IV push.

Calcium imbalance

Definition and pathophysiology: Low calcium may arise from hypoparathyroidism or vitamin D deficiency; high calcium from hyperparathyroidism or malignancy.

Clinical features and investigations: Hypocalcaemia: tingling, tetany, prolonged QT; hypercalcaemia: constipation, thirst, confusion. Interpret ionized calcium when indicated.

Management and nursing care: Monitor ECG and symptoms; provide prescribed replacement or treatment of hypercalcaemia and its cause.

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Magnesium imbalance

Definition and pathophysiology: Deficiency from GI loss or drugs; excess with renal impairment or magnesium treatment.

Clinical features and investigations: Low: tremor, arrhythmia, refractory low K; high: weakness, diminished reflexes, respiratory depression.

Management and nursing care: Review renal function, ECG and reflexes; prescribed replacement or urgent treatment of toxicity.

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4. Acid-base balance and ABG

Normal arterial pH 7.35-7.45, PaCO2 35-45 mmHg and HCO3- 22-26 mmol/L (laboratory ranges vary). Lungs regulate CO2; kidneys regulate bicarbonate and net acid excretion. Buffers act promptly.

Disorder	Primary change	Typical cause
Respiratory acidosis	PaCO2 rises	Hypoventilation, opioid effect
Respiratory alkalosis	PaCO2 falls	Hyperventilation, hypoxaemia
Metabolic acidosis	HCO3- falls	DKA, diarrhoea, lactic acidosis
Metabolic alkalosis	HCO3- rises	Vomiting, diuretics

Example: pH 7.28, PaCO2 55, HCO3- 25 suggests primary respiratory acidosis. Evaluate compensation and mixed disorders in clinical context. Anion gap = Na - (Cl + HCO3); for 140, 104, 16 the gap is 20 mmol/L; interpret with albumin and local range.

5. IV fluid therapy and safety

0.9% saline and balanced crystalloids expand extracellular fluid; 0.45% saline supplies more free water; 5% dextrose in water behaves as free water after glucose metabolism and is not a resuscitation fluid. Hypertonic saline requires close protocol-driven monitoring. Check indication, prescribed volume/rate, compatibility, vascular access and response. Identify infiltration, extravasation, phlebitis, infection and overload. Record intake/output, weight, vital signs, electrolytes and creatinine.

6. Important Examination Questions

Long Answer Questions

1. 1. Discuss nursing management of fluid and electrolyte imbalance with clinical examples.

Short Answer Questions

1. 1. Differentiate deficit and overload
2. 2. explain four acid-base disorders
3. 3. describe IV fluid safety.

Very Short Answer Questions (with answers)

1. 1. Main intracellular cation? - Potassium.
2. 2. Normal arterial pH? - 7.35-7.45.

7. Quick Revision

- Assess volume status before choosing interventions.
- Never administer IV potassium by direct push.
- Correct sodium disorders under monitored protocols.

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8. Conclusion

Assess volume status before choosing interventions. Never administer IV potassium by direct push. Correct sodium disorders under monitored protocols.

Practice questions

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

1. Which transport process moves water across semipermeable membranes rather than moving solutes down their concentration gradient?

A. Diffusion of solutes

B. Active transport

C. Osmosis

D. Endocytosis

2. Which finding cluster most strongly suggests fluid overload?

A. Weight loss, thirst and postural hypotension

B. Dry mouth with oliguria after diarrhoea

C. Tingling and tetany without volume change

D. Weight gain, oedema, dyspnoea and crackles

3. What is the primary biochemical change in metabolic alkalosis?

A. A rise in HCO3-

B. A fall in HCO3-

C. A rise in PaCO2 as the primary cause

D. A fall in PaCO2 as the primary cause

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Answer key and explanations

1. C - Osmosis

Osmosis is water movement across a semipermeable membrane.

2. D - Weight gain, oedema, dyspnoea and crackles

Fluid overload may produce weight gain, oedema and respiratory congestion.

3. A - A rise in HCO3-

Metabolic alkalosis is characterized by a primary rise in bicarbonate.

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