

5

Table 2-1 EXTRACELLULAR FLUID VOLUME

Type of sign	Deficit		Excess	
	Moderate (5-10%)	Severe (>10%)	Moderate	Severe
Central nervous system	Sleepiness Apathy Slow responses Anorexia Cessation of usual activity	Decreased tendon reflexes. Anesthesia distal extremities Stupor Coma	None	None
Gastrointestinal	Progressive decrease in food consumption	Nausea, vomiting Refusal to eat Silent ileus and distension	At surgery: Edema of stomach, colon, lesser and greater omenta and small bowel mesentery	
Cardiovascular	Orthostatic hypotension Tachycardia Collapsed veins Collapsing pulse	Cutaneous lividity Hypotension Distant heart sounds Cold extremities Absent peripheral pulses	Elevated venous pressure Distension of peripheral veins Increased cardiac output Loud heart sounds Functional murmurs Bounding pulse High pulse pressure Increased pulmonary 2d sound Gallop	Pulmonary edema
Tissue	Soft, small tongue with longitudinal wrinkling Decreased skin turgor	Atonic muscles Sunken eyes	Subcutaneous pitting edema Basilar rales	Anasarca Moist rales Vomiting Diarrhea
Metabolic	Mild decrease temperature, 97-99°R	Marked decrease temperature, 95-98°R	None	None

Table 2-2. ACUTE CHANGES IN OSMOLAR CONCENTRATION

Type of signs	Hyponatremia (water intoxication)	Hypertremia (water deficit)
Central nervous system	<p align="center">① ADH ↑ ② ADH inappropriate ③ Renal failure ④ Hyperglycemia</p> <p>Moderate: Muscle twitching Hyperactive tendon reflexes Increased intracranial pressure (compensated phase)</p> <p>Severe: Convulsions Loss of reflexes Increased intracranial pressure (decompensated phase)</p>	<p align="center">① D.I ② Osm. diuresis ③ ↑ thirst ④ Diarrhea, I.L</p> <p>Moderate: Severe:</p> <p>Restlessness Delirium Weakness Maniacal behavior</p>
Cardiovascular	Changes in blood pressure and pulse secondary to increased intracranial pressure	Tachycardia Hypotension (if severe)
Tissue	Salivation, lacrimation, watery diarrhea "Fingerprinting" of skin (sign of intracellular volume excess)	Decrease saliva and tears Dry and sticky mucous membranes Red, swollen tongue Skin flushed
Renal	Oliguria progressing to anuria	Oliguria
Metabolic	None	Fever

Table 2-3. ACIDOSIS-ALKALOSIS

Type of acid-base disorder	Defect	Common causes	$\frac{BHCO_3}{H_2CO_3} = \frac{20}{1}$	Compensation
Respiratory acidosis	Retention of CO ₂ (Decreased alveolar ventilation) $\dot{V}_A = \frac{\dot{V}_{CO_2}}{P_a CO_2}$	Depression of respiratory center—morphine, CNS injury Pulmonary disease—emphysema, pneumonia	↑ Denominator Ratio less than 20:1	Renal Retention of bicarbonate, excretion of acid salts, increased ammonia formation Chloride shift into red cells
Respiratory alkalosis	Excessive loss of CO ₂ (Increased alveolar ventilation)	Hyperventilation: Emotional, severe pain, assisted ventilation, encephalitis	↓ Denominator Ratio greater than 20:1	Renal Excretion of bicarbonate, retention of acid salts, decreased ammonia formation
Metabolic acidosis	Retention of fixed acids or Loss of base bicarbonate	Diabetes, azotemia, lactic acid accumulation, starvation Diarrhea, small bowel fistulae	↓ Numerator Ratio less than 20:1	Pulmonary (rapid) Increase rate and depth of breathing Renal (slow) As in respiratory acidosis
Metabolic alkalosis	Loss of fixed acids Gain of base bicarbonate Potassium depletion	Vomiting or gastric suction with pyloric obstruction Excessive intake of bicarbonate Diuretics	↑ Numerator Ratio greater than 20:1	Pulmonary (rapid) Decrease rate and depth of breathing Renal (slow) As in respiratory alkalosis

Table 2-4. RESPIRATORY AND METABOLIC COMPONENTS OF ACID-BASE DISORDERS

Type of acid-base disorder	Acute (uncompensated)			Chronic (partially compensated)		
	pH	P _{CO₂} (respiratory component)	Plasma HCO ₃ ^{-*} (metabolic component)	pH	P _{CO₂} (respiratory component)	Plasma HCO ₃ ^{-*} (metabolic component)
Respiratory acidosis . . .	↓↓	↑↑	N	↓	↑↑	↑
Respiratory alkalosis . . .	↑↑	↓↓	N	↑	↓↓	↓
Metabolic acidosis . . .	↓↓	N	↓↓	↓	↓	↓
Metabolic alkalosis . . .	↑↑	N	↑↑	↑	↑?	↑

* Measured as standard bicarbonate, whole blood buffer base, CO₂ content or CO₂ combining power. The base excess value is positive when the standard bicarbonate is above normal and negative when the standard bicarbonate is below normal.