Acid/Base

Renal Tubular Acidosis: Hyperchloremic Metabolic Acidosis w/ +Urine AG

Not fitting?	Use the "delta gap" → [AG - 12] / [24 - bicarb] - compares diff btw measured and normal AG vs diff btw normal bicarb and measured bicarb to answer the question: is each decrease in the bicarb accounted for by an increase in the AG? ▪ If **yes**, then DGap = 0.8 to 2 → high AG metabolic acidosis (MAc) **alone** ▪ If **no** and DGap <0.4 → low/normal AG MAc **alone** ▪ If **no** and DGap 0.4-0.8 → low/normal AG MAc **and** high AG MAc ▪ If **no** and DGap >2 → high AG MAc superimposed on chronic **metabolic alkalosis** or **respiratory acidosis** with metabolic compensation
Treatment	Directed at underlying etiology; see Metabolism section for acute management

Metabolic Alkalosis

Chloride Responsive (urine Cl- <20 mEq/L)	Loss of gastric secretions (HCl): vomiting, NG tube drainage, thiazide and loop diuretics (urine chloride varies based on when drug was given), CF
Chloride Resistant (urine Cl-> 20 mEq/L)	• **w/ HTN**: primary hyperaldosteronism, CAH, renovascular HTN, Liddle's syndrome • **w/o HTN**: Bartter / Gitelman syndrome, severe K or Mg loss

Respiratory Acidosis

DDx	• CNS depression • Nervous/Muscular disorders (Guillain-Barre, myasthenia gravis, botulism, muscular dystrophy) • Acute and chronic lung disease
Workup/Management	ABG/VBG, CXR, SaO_2, escalate respiratory support as needed

Respiratory Alkalosis

DDx	• Anxiety • Hypoxia • Pain • Salicylates • Urea cycle disorders (during metabolic crisis, hyperammonemia increases respiratory drive)

Hyponatremia

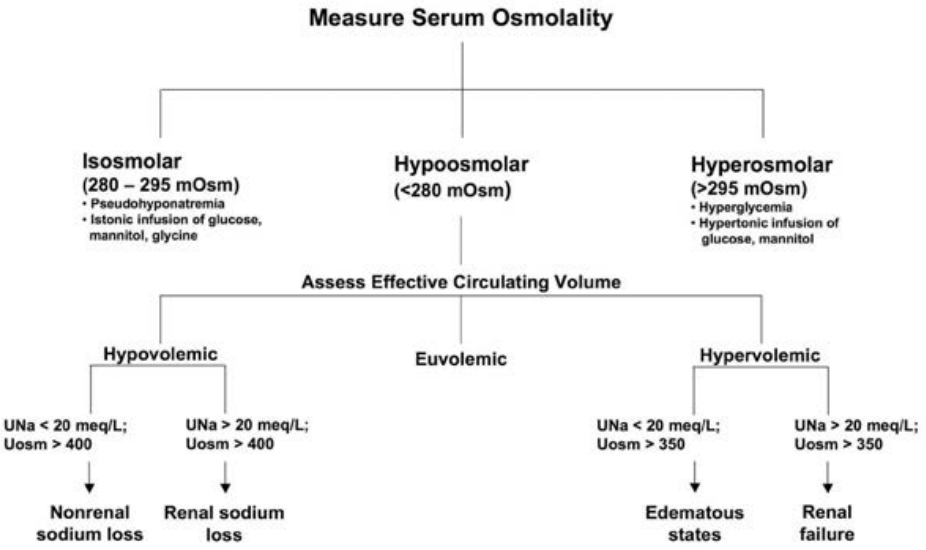
Definition

Mild: Na < 135
Moderate: Na < 130
Severe: Na < 120

Hypovolemic	Euvolemic	Hypervolemic
Nonrenal sodium losses GI Skin Sequestration Renal sodium losses Diuretics Cerebral salt wasting Mineralocorticoid/ Glucocorticoid deficiency	SIADH Psychogenic polydipsia Reset osmostat Drug-induced Hypothyroidism	Edematous states Nephrotic syndrome CHF Cirrhosis Renal failure (acute or chronic)

Hyponatremia continued on next page →

Hyponatremia

Definition	
Presentation	• Usu d/t underlying cause rather than symptoms from hyponatremia itself • Sx occur when hyponatremia evolves acutely (< 24h) & include N/V/HA → seizures, coma, and respiratory arrest
Workup	Chem 10, UA (proteinuria, hematuria, glucosuria), serum Osm (↓ in true hyponatremia. If ↑, look for hyperglycemia or other osms), urine Osm [if euvolemic, nl response to hyponatremia = suppress ADH → urine is maximally dilute (osmolality < 100 mosmol/kg, SG ≤1.003); abnormally conc urine + euvolemic hypoNa = SIADH; whereas ↑ ADH i/s/o hypovolemia = appropriate ↑ in ADH], urine Na (<20 = EABV depletion, >40 = SIADH, cerebral salt wasting, diuretic use, renal failure)
Treatment	Address underlying cause (volume if hypovolemic, fluid restriction if eu/hypervolemic), time course to match timing of onset (fast rx for onset <12h, slow rx for slow onset to prevent CPM) • **Acute, symptomatic**: ICU admit, 3% HTS to raise [Na] by 3-5 mEq/L (give ~TBW x 5 mEq/L x 2) • **Asymptomatic**: calc Na deficit [(140-actual Na) x weight in kg x 0.6 for males, 0.5 for females], then give IVF with missing Na content; should not exceed 0.6 mEq/L/hr rise in [Na] • **SIADH**: restrict free water intake to match insensible losses + UOP; use vaptans if severe

Hypernatremia

Definition	Serum sodium >145 mEq/L
Etiology	**Excessive water loss** (GI losses / Diuretics / Central or nephrogenic DI (see endocrine section) / Osmotic diuresis / Increased insensible losses / Impaired thirst mechanism) vs **excessive salt intake**
Clinical Manifestations	Lethargy, irritability, MS changes; typically presents w/ sx of underlying cause
Exam	Check volume status, neurologic exam, mental status
Workup	UA, chem 10, urine osm (appropriate response to hyperNa □ ↑ ADH □ concentrated urine. Inappropriately dilute urine i/s/o hyperNa □ think DI), serum osm (Uosm < Sosm □ think DI)
Management	• For **hypernatremic dehydration**, calc free water deficit: (Current Na/Desired Na -1) x TBW (weight in kg * 0.6 for males, 0.5 for females) = water deficit in liters; replace ½ of FWD w/in 24h, then remainder over next 1-2 days, and replace maintenance + ongoing losses. **Avoid** ↓ Na+ by >15 mEq/L over 24h (0.5 mEq/L/hr) d/t risk of cerebral edema. • **If due to DI**, see endo section for management