Approach to Acid–Base Disorders

RENAL & VOLUME STATUS

+2.5

KEY DECISION RULE

Albumin-corrected anion gap[2,12]

mmol/L added to the AG per 10 g/L albumin below 40 g/L (4 g/dL)

Abnormal pH, HCO3 or PaCO2 on a blood gas or chemistry panel

→ Gas + lytes: pH <7.35 acidemia, >7.45 alkalemia; primary process; VBG pH ~0.03 below ABG[1,3]

→ Winter's PaCO2 = 1.5×HCO3 + 8±2; anion gap = Na − (Cl + HCO3), correct for albumin[1,2,12]

→ **Shock, toxin, acute ↑CO2 or extreme pH?**

Yes →

Emergency: ABCs, ICU, poison centre[1,12]

- pH <7.20 or >7.60: arrhythmia, shock[12]
- Drowsy or acute ↑PaCO2: NIV/intubate[1]
- Shock or sepsis + lactate >2 mmol/L: fluids[7,9]
- Toxic alcohol suspected: fomepizole ± HD[6]
- Salicylate: IV NaHCO3; intubated: keep RR high[4,10,12]
- Salicylate HD: AMS, >7.2 mmol/L (>6.5 if AKI)[10,12]

→ **Acidemia: NaHCO3 only if able to ventilate; recheck gas, K, iCa**

Then: which primary disorder?

	High-AG acidosis AG ↑	Normal-AG acidosis Cl ↑	Metabolic alkalosis HCO3 ↑	Respiratory PaCO2 ↑ or ↓
CAUSES	• **Lactate: shock, ischemia, metformin** • **Ketoacidosis: DKA (incl. SGLT2i), alcohol** • **Toxic alcohols, salicylate; uremia**	• Diarrhea, GI fistula, ileal conduit • Large-volume 0.9% saline • RTA; acetazolamide	• Vomiting, NG suction • Diuretics; low K or Mg • Mineralocorticoid excess	• **High PaCO2: opioids, COPD, weakness** • **Low PaCO2: sepsis, PE, hypoxemia** • Pain, anxiety, pregnancy, cirrhosis
CLUES	• Osm gap >10: toxic alcohol; can be normal[6] • Respiratory alkalosis + tinnitus: salicylate • ΔAG vs ΔHCO3: hidden second process[1]	• Diarrhea or saline load in history • High K, diabetic CKD: type 4 RTA[12]	• Volume-depleted: vomiting, diuretics • Hypertension with low K	• PaCO2 +10: HCO3 +1 acute, +4 chronic[1,12] • PaCO2 −10: HCO3 −2 acute, −4 chronic[1,12]
WORKUP	• Lactate, β-hydroxybutyrate, creatinine • Salicylate, ethanol, measured Osm[6]	• UAG neg: GI or proximal RTA; pos: distal[5,12] • Urine pH, K; Ca/Cr for type of RTA[12]	• Urine Cl: low = saline-responsive[11] • Renin, aldosterone if hypertensive[11]	• ABG: venous PCO2 is unreliable[3] • CXR, drug screen; CTPA if PE likely
MANAGE	• Lactate: restore perfusion; DKA protocol[7] • Fomepizole ± HD for toxic alcohol[6] • NaHCO3 if pH ≤7.20 + AKI 2–3 (not DKA)[8,9]	• Stop saline; balanced crystalloid[9] • Alkali for RTA 1–2; type 4: lower K[12]	• 0.9% saline + KCl if Cl-responsive[12] • Overloaded: acetazolamide[12] • Aldosterone excess: amiloride or MRA[12]	• NIV or ventilate; reverse opioids • No NaHCO3 for respiratory acidosis[12] • Alkalosis: treat hypoxemia, pain, cause

Stethopedia
stethopedia.ca/approach/acid-base

Evidence [1] Berend 2014, N Engl J Med [2] Figge 1998, Crit Care Med [3] Byrne 2014, Respirology [4] Stolbach 2008, Acad Emerg Med [5] Batlle 1988, N Engl J Med [6] Kraut 2018, N Engl J Med [7] Kraut 2014, N Engl J Med [8] Jung 2025, JAMA [9] Prescott 2026, Crit Care Med [10] Juurlink 2015, Ann Emerg Med [11] Emmett 2020, Clin J Am Soc Nephrol [12] Manual 2024–25, pp. 102–103