

1) Data valid and internally consistent

- draw ABG and electrolytes at similar time in the dynamic clinical process
- rule out lab error
- $[H^+]_{est} \cong [H^+]_{calc}$
- $[H^+]_{calc} = 24 pCO_2/[HCO_3^-]$

- $pH = -\log [H^+] = \log 1/[H^+] \quad 7.40 \pm 4 \text{ pH units} = 40 \pm 4 \text{ nEq/L}$
- $[H^+]_{est} : \Delta pH \text{ unit of } 0.10 \sim \Delta [H^+] \text{ of } 10 (\Delta 0.01 \sim \Delta 1)$, if pH in range of 7.1-7.5

2) Spot-check of pH

- Acidemia (acidosis) $pH < 7.35$ - Alkalemia (alkalosis) $pH > 7.45$

3) Acidosis

- Metabolic $\downarrow HCO_3^-$
- Respiratory $\uparrow pCO_2$

Alkalosis

- Metabolic $\uparrow HCO_3^-$
- Respiratory $\downarrow pCO_2$

4) Anion Gap

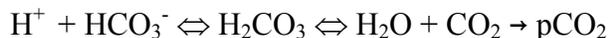
- Cations = Anions (unmeasured cations + Na^+ = unmeasured anions + $Cl^- + HCO_3^-$)
- Anion Gap = unmeasured anions – unmeasured cations
- $AG = Na - (Cl^- + HCO_3^-) = 12 \pm 2$
- Hyperchloremic Metabolic Acidosis vs. Elevated Anion Gap Acidosis
- MUDPILES MUDPIES

5) Δ Gap

- Δ in Anion Gap $\cong \Delta$ in HCO_3^-
- if, Δ in $\uparrow AG \gg \Delta$ in $\downarrow HCO_3^-$ 1^0 Metabolic Alkalosis
- if, Δ in $\downarrow HCO_3^- \gg \Delta \uparrow AG$ 1^0 Hyperchloremic Metabolic Acidosis

6) Compensation (Mandatory, Predictable, Non-negotiable with limits)

- Metabolic Acidosis
 Predicted $pCO_2 = 1.5[HCO_3^-] + 8 \pm 2$
- Metabolic Alkalosis
 Predicted $pCO_2 = 0.7(\Delta HCO_3^-) + 40$
- Respiratory Acidosis (Acute vs. Chronic)
 Acute - predicted $\Delta \uparrow HCO_3^-$ for a $\Delta \uparrow pCO_2$ (1 for every 10 mmHg)
 Chronic – predicted $\Delta \uparrow HCO_3^-$ for a $\Delta \uparrow pCO_2$ (3.5 for every 10 mmHg)
- Respiratory Alkalosis (Acute vs. Chronic)
 Acute -predicted $\Delta \downarrow HCO_3^-$ for a $\downarrow pCO_2$ (2 for every 10 mmHg)
 Chronic – predicted $\Delta \downarrow HCO_3^-$ for a $\downarrow pCO_2$ (5 for every 10 mmHg)



$pH = 6.1 + \log HCO_3^- / H_2CO_3$

$pH = 6.1 + \log HCO_3^- / pCO_2$

\therefore pH is dependant on the ratio of the HCO_3^- to pCO_2 20:1

Suggested Readings:

Narins RG, Emmett M. Simple and Mixed Acid-Base Disorders: A Practical Approach. Medicine (59) 3: 161-187.

Management of Life-Threatening Acid-Base Disorders Part 1. NEJM (338) 1: 26-34.

Management of Life-Threatening Acid-Base Disorders Part 2. NEJM (338) 2: 107-111.

A 60-year old man with a history of chronic alcoholism was admitted to the hospital with a history of abdominal pain and decreased mental status. The patient had a long history of alcohol ingestion and several bouts of alcoholic hepatitis. He was presently receiving no medication. Physical examination on admission revealed blood pressure of 130/80 mm Hg while supine and upright. His pulse was 100 beats per minute and regular. Respirations were 26 per minute and unlabored. The chest was clear to auscultation and percussion. Cardiac examination revealed no murmurs or gallops. Examination of the abdomen revealed a slightly enlarged liver but no evidence of ascites. Laboratory data obtained on admission revealed: Na⁺ 136 mEq/L, K⁺ 3.2 mEq/L, HCO₃⁻ 12 mEq/L, Cl⁻ 100 mEq/L, BUN 22 mg/dL, creatinine 1.4 mg/dL, glucose 100 mg/dL, pH 7.35, PaCO₂ 34 mm Hg. Serum osmolality was 320 mOsm/kg H₂O. Urine ketones were negative.

A 45-year-old man with a history of chronic alcoholism was admitted to the hospital because of an alteration in mental status and increased abdominal girth. Medications on admission included furosemide and spironolactone. Physical examination revealed a cachectic and icteric man who was extremely lethargic. Blood pressure was 100/60 mm Hg while supine and 80/50 mm Hg while upright. Pulse was 90 beats per minute and regular. Respirations were 22 per minute. The lungs were clear to auscultation and percussion. Examination of the heart revealed no murmurs or gallops. The abdomen was protuberant, and there was evidence of ascites as manifested by a fluid wave. There was 1+ pretibial edema. Laboratory data on admission revealed: Na⁺ 126 mEq/L, K⁺ 3.0 mEq/L, HCO₃⁻ 22 mEq/L, Cl⁻ 80 mEq/L. BUN 10 mg/dL, creatinine 0.9 mg/dL, bilirubin 16 mg/dL, albumin 2.5 g/dL, serum glutamic-oxaloacetic transaminase (SGOT) 150 international units, pH 7.45, and PaCO₂ 32 mm Hg.