Simple Stewart-Fencl Approach to Acid-Base for Dogs

Step 1 - Get Blood

Emergency - Blood Gas, QuATs (Azo, TS, PCV, Glucose) +/- Lactate
Ideal - Blood Gas (Art or Venous), Lactate, Albumin, Phosphate, Ketones

Step 2 - Look at pH

If > 7.45 aka alkalemia then patient’s primary problem is an alkalosis
If < 7.35 aka academia then patient’s primary problem is an acidosis

Step 3 - Look at CO₂

If > 45 then respiratory acidosis
If < 35 then respiratory alkalosis

Step 4 - Calculate the Simplified Strong Ion difference (SID\textsubscript{simplified})

\[
\text{SID\textsubscript{simplified}} = \text{Na} - \text{Cl}
\]
Normal Na=146 Cl=110
Do not use corrected chloride!
Low SID if < 36 → Acidosis
High SID if > 36 → Alkalosis

Renal Tubular Acidosis: Calculate Urine Anion Gap (Urine Na + K – Cl); if negative, not an RTA
Type I-Urine pH > 5.55 (auto-immune, cirrhosis, idiopathic)
Type II-Urine pH < 5.55 (think myeloma, Wilson’s, Vit D deficiency, heavy metals)

Step 5 - Measure a Lactate

If > 2 then the patient has hyperlactatemia
Consider causes for Type A vs Type B hyperlactatemia

Step 6 - Calculate the Unmeasured Anions (UA)

For simplicity $\text{SIG} \approx \text{UA}^-$

\[
\text{UA} = (- \text{Base Excess}) + (\text{SID} - 36) + 2.5 (6.4 - \text{measured TS g/dL}) - \text{Lactate}
\]
or

\[
\text{UA} = (- \text{Base Excess}) + (\text{SID} - 36) + 4.2 (3.8 - \text{measured TS g/dL}) - \text{Lactate}
\]

\[
\text{SID} - [\text{HCO}_3^-] - [\text{Atot}] = 0 \text{ There for SBE should } \approx 0
\]

If UA > 5 then Metabolic Acidosis from Unmeasured Anions
- Salicylates, Acetate, Ketones, Uremic Acids, D-Lactate, Ethylene glycol, others
If UA < -5 then Metabolic Alkalosis
- Hypercalcemia, Hypermagnesemia, Hyperkalemia, Globulins, Bromide
**Step 7-Think about compensations**

<table>
<thead>
<tr>
<th>Primary disorder</th>
<th>Expected compensation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metabolic acidosis</td>
<td>↓ PaCO₂ of 0.7mm Hg per 1mEq/L ↓ HCO₃ ± 3</td>
</tr>
<tr>
<td>Metabolic alkalosis</td>
<td>↑ PaCO₂ of 0.7mm Hg per 1mEq/L ↑ HCO₃ ± 2</td>
</tr>
<tr>
<td>Respiratory acidosis – acute</td>
<td>↑ HCO₃ of 0.15 mEq/L per 1mm Hg ↑ PaCO₂ ± 2</td>
</tr>
<tr>
<td>Respiratory acidosis – chronic</td>
<td>↑ HCO₃ of 0.35 mEq/L per 1mm Hg ↑ PaCO₂ ± 2</td>
</tr>
<tr>
<td>Respiratory alkalosis – acute</td>
<td>↓ HCO₃ of 0.25 mEq/L per 1mm Hg ↓ PaCO₂ ± 2</td>
</tr>
<tr>
<td>Respiratory alkalosis – chronic</td>
<td>↓ HCO₃ of 0.55 mEq/L per 1mm Hg ↓ PaCO₂ ± 2</td>
</tr>
</tbody>
</table>

**Alternate equations:**

SIG = ([Albumin] X 4.9 – AG) in g/dL

SIG = ([Total Protein] X 2.9 – AG) in g/dL

Change in phosphorous mg/dL from normal (4mg/dL) = 0.58 X (4 – [Phosphorous])

Therefore:

SBE = (- Base Excess) + (SID – 36) + 2.5 (6.4- TS) + 0.58 (4 – Phos) – Lactate

**Human formulas for compensation:**

If primary is respiratory and you feel it is chronic metabolic compensation:

- Expected Δ BE = 0.4 x (Chronic Change in CO₂)

If the primary problem is metabolic acidosis

- Expected ↓ CO₂=Base Deficit

If the primary problem is metabolic alkalosis

- Expected ↑ CO₂=0.6 x Base Excess

- 0.08 decrease in pH = for every 10 mmHg increase in PaCO₂ acutely