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 CO_2

If >45 then respiratory acidosis

If <35 then respiratory alkalosis

Step 4-Calculate the Simplified Strong Ion difference ($SID_{simplified}$)

$SID_{simplified}$=Na - Cl Normal Na=146 Cl=110

Do not use corrected chloride!

Low SID if <36 → Acidosis

High SID if >36 → Alkalosis

Metabolic acidosis (Low SID acidosis)	Met alkalosis (High SID)
Dilutional acidosis/ fluids with SID <24	Vomiting
Renal Tubular Acidosis	Nasogastric suction
Small Bowel Diarrhea	Diuretics
Carbonic Anhydrase inhibitor	Hyperaldosteronism
Compensation for respiratory alkalosis	Contraction 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 SIG ≈ UA^-

UA = (- Base Excess) + (SID – 36) + 2.5 (6.4- measured TS g/dL)) – Lactate

or

UA = (- Base Excess) + (SID – 36) + 4.2 (3.8 - measured TS g/dL)) – Lactate

SID - [HCO3-] - [Atot] = 0 There for SBE should ~ 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

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Step 7-Think about compensations

Primary disorder	Expected compensation
Metabolic acidosis	↓ $PaCO_2$ of 0.7mm Hg per 1mEq/L ↓ HCO_3 ± 3
Metabolic alkalosis	↑ $PaCO_2$ of 0.7mm Hg per 1mEq/L ↑ HCO_3 ± 2
Respiratory acidosis – acute	↑ HCO_3 of 0.15 mEq/L per 1mm Hg ↑ $PaCO_2$ ± 2
Respiratory acidosis – chronic	↑ HCO_3 of 0.35 mEq/L per 1mm Hg ↑ $PaCO_2$ ±2
Respiratory alkalosis – acute	↓ HCO_3 of 0.25 mEq/L per 1mm Hg ↓ $PaCO_2$ ± 2
Respiratory alkalosis – chronic	↓ HCO_3 of 0.55 mEq/L per 1mm Hg ↓ $PaCO_2$ ± 2

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