Steps for ABG analysis

- 3 cases -

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Steps for ABG Analysis

1. What is the pH? < acidosis / alkalosis
2. What is the primary disorder present? < metabolic / respiratory
3. Is there appropriate compensation?
4. Compensation acute / chronic ? [only in resp. disorders]
5. Is there an anion gap? يسكل مواظب!
6. Yes! check delta-delta gap
7. What is your differintial for this clinical process?

Normal Values

• pH	7.35 - 7.45	7.4
• pCO_2	35 - 45	40
• HCO_3^-	22 - 26	24
• AG	8-12	10
• Albumin	4	4

pH

< 7.4 → Acidosis

- $pCO_2 > 40$ → Respiratory
  - expected HCO_3^-
    - [acute] ↑10 pCO_2 ⇒ ↑1 HCO_3^-
    - [chronic] ↑10 pCO_2 ⇒ ↑3.5 HCO_3^-
- $HCO_3 < 24$ → Metabolic
  - Winter's
  - expected $pCO_2 = (1.5 * HCO_3 + 8) \pm 2$

> 7.4 → Alkalosis

- $pCO_2 < 40$ → Respiratory
  - expected HCO_3^-
    - [acute] ↓10 pCO_2 ⇒ ↓2 HCO_3^-
    - [chronic] ↓10 pCO_2 ⇒ ↓5 HCO_3^-
- $HCO_3 > 24$ → Metabolic
  - expected $pCO_2 = \Delta HCO_3 * 0.7 + 40$

- if expected pCO_2 > given → concomitant respiratory Alkalosis
- if expected pCO_2 < given → concomitant respiratory Acidosis
- if expected pCO_2 = given → NO underlying pathology

بكل مواطن

$AG = Na - Cl - HCO_3$

- $8 < AG < 12$ ⇒ Namal AG
- $AG > 12$ ⇒ High AG
  - $\Delta AG = \Delta HCO_3 \pm 6$
    - $\Delta AG = \Delta HCO_3$ → normal
    - $\Delta AG > \Delta HCO_3$ → metabolic Alkalosis
    - $\Delta AG < \Delta HCO_3$ → NAGMA
      - albumin < 4
        - corrected AG = Δalbumin * 2.5
      - albumin = 4 ⇒ normal

- The End -

Example 1:

70 year old male smoker complains of acute onset SOB you did an ABG with the results shown below:

$pH = 7.3$ $pCO_2 = 60$ mmHg $Na = 135$ $Cl = 100$ $HCO_3 = 30$

↓ ↓ ↑

acidosis respiratory

* expected HCO_3

- acute ↑10 pCO_2 → ↑1 HCO_3 ⇒ $HCO_3 = 24 + 2 = 26$
- chronic ↑10 pCO_2 → ↑3.5 HCO_3 ⇒ $HCO_3 = 24 + 7 = 31$ chronic ✓

↳ chronic respiratory acidosis pH must be normal!

.. we have acute on top of chronic

* AG = Na - Cl - HCO_3

= 135 - 100 - 30 = 5 ↓

∴ check albumin levels to calculate corrected AG

not given in the question

Example 2:

22 y/o female presented with 4-hours numbness ?? in both hands typical of previous episodes of anxiety

ABG: pH = 7.48 pCO_2 = 30 pO_2 = 86 Na = 140 Cl = 110 HCO_3 = 22

pH = 7.48 ↓ alkalosis

pCO_2 = 30 ↓ respiratory

* expected HCO_3

- acute ↓ 10 pCO_2 → ↓ 2 HCO_3 ⇒ HCO_3 = 24 - 2 = 22 acute ✓
- chronic ↓ 10 pCO_2 → ↓ 5 HCO_3 ⇒ HCO_3 = 24 - 5 = 19

* AG = 140 - 110 - 22 = 8 normal

↳ Acute respiratory alkalosis with appropriate compensation

resp. alkalosis ⇒ ↓ ionized Ca [Ca binds albumin vs H]

⇒ hypocalcemia ⇒ numbness!

Hypoxia is the most important cause of ↑ ventilation ∴ resp. alkalosis

Example 3:

65 y/o male with CKD presented with nausea, diarrhea and acute respiratory distress

- ABG: 7.23, 17, 235 on 50% VM
- BMP: Na = 123 Cl = 97 HCO_3 = 6 BUN = 119 Cr = 5.1

* acidosis

* metabolic

* expected $pCO_2 = (1.5 * HCO_3 + 8) \pm 2$

$= 1.5 * 6 + 8 = 16 \pm 2$ ✓ compensation

* AG = 123 - 97 - 6 = 20 ↑

∴ HAGMA

* $\Delta AG \stackrel{?}{=} \Delta HCO_3 \pm 6$

$20-12 \stackrel{?}{=} 24-6$

$8 < 18 \pm 6$

↳ HAGMA with appropriate compensation and NAGMA

⊗ may be seen in cases of hypoalbuminemia

Example 4.

68 y/o man who recently took antibiotics for skin infection presented with 10 episodes of watery diarrhea for 5 days

- ABG : 7.34 , 34 , 80
- BMP : Na = 135 Cl = 108 HCO_3 = 18

* acidosis
* metabolic
* expected pCO_2 = $(1.5 * HCO_3 + 8) \pm 2$
  = 35 ± 2 ✓ compensation

* AG = $135 - 108 - 18$ = 9 ✓ normal

↳ NAGMA with appropriate respiratory compensation

severe diarrhea from antibiotics

→ probably pseudomembranous colitis!

Example 5:

20 y/o student presented with excessive vomiting after binge drinking

- ABG : 7.5 , 44 , 100
- BMP : Na = 138 Cl = 100 HCO_3 = 30
- Urine Na = 10

* Alkalosis
* Metabolic
* expected pCO_2 = $\Delta HCO_3 * 0.7 + 40$
  = 44.2 ✓ compensation

* AG = 138 − 100 − 30 = 8 ✓ normal

↳ metabolic alkalosis with appropriate resp. compensation

Case 1

35 y/o man, DM, presented with diarrhea and cough

CXR showed infiltrations

- ABG : 7.31 , 10 , 67
- BMP : Na = 123 Cl = 99 HCO_3 = 5

* acidosis

* metabolic

* expected $pCO_2 = (1.5 * HCO_3 + 8) \pm 2$

$= 15.5 \pm 2 \quad > 10$

no compensation = respiratory alkalosis

* $AG = 123 - 99 - 5 = \boxed{19}$ ↑

∴ HAGMA

* $\Delta AG \overset{?}{=} \Delta HCO_3 \pm 6$

$19 - 12 \overset{?}{=} 24 - 5$

$7 < 19$ → NAGMA

↳ HAGMA with respiratory alkalosis & NAGMA

↓ ↓ ↓

DKA / lactic acidosis pneumonia due to diarrhea

Case 3

45 y/o noncomplient patient with DM and cirrhosis presents with vomiting

pH = 7.46 pCO_2 = 17

Na = 133 Cl = 84 HCO_3 = 15

* Alkalosis
* Respiratory
* expected HCO_3^-

- acute ↓ 10 pCO_2 → ↓ 2 HCO_3 ⇒ $\frac{(40-17)\times 2}{10} = 4.6$

$HCO_3 = 24 - 4.6 = \boxed{19.4}$

- chronic ↓ 10 pCO_2 → ↓ 5 HCO_3 ⇒ $\frac{(40-17)\times 5}{10} = 11.5$

$HCO_3 = 24 - 11.5 = \boxed{12.5}$

✓ chronic

* AG = 133 - 84 - 15 = $\boxed{34}$ ↑ ∴ HAGMA

* $\Delta AG \stackrel{?}{=} \Delta HCO_3$

$34-12 \stackrel{?}{=} 24-15$

$22 > 9$ → metabolic alkalosis

↳ chronic resp. Alkalosis ß HAGMA ß metabolic Alkalosis

due to liver cirrhosis DKA vomiting


The End