

# Dr. Hussein ABG seminar notes

Notes:

- Always check for correct lab results by comparing arterial HCO<sub>3</sub><sup>-</sup> and PvCO<sub>2</sub>, they should be close to each other
- Metabolic disorders compensation,
  - Calculate difference between PaCO<sub>2</sub> and HCO<sub>3</sub><sup>-</sup> it should be 15 (+-5)
  - Another way that's only correct in metabolic disorders is using the last 2 digits of Ph (7.xx) they also should be close to PaCO<sub>2</sub> value (+-5)
  - You could also use winter's formula too (Expected PaCO<sub>2</sub> = 1.5\*[HCO<sub>3</sub><sup>-</sup>] + 8 +-2)
- Compensation is not a disorder, example; if a patient has metabolic acidosis compensated by respiratory alkalosis; He has:
  - A) Metabolic acidosis  
**(Correct)**
  - B) Metabolic acidosis compensated by respiratory alkalosis **(Correct)**
  - C) Metabolic acidosis and respiratory alkalosis **(Wrong)!**
- Whenever you see values, calculate the anion gap!
- Normal values doctor uses are:
  - ArterialBG:
  - Ph:  
**7.4**
  - [HCO<sub>3</sub><sup>-</sup>]:  
**25 +-3 mEq/L**
  - [PaCO<sub>2</sub>]:  
**40 +-5 mmHg**
  - VenousBS:
  - Na+:  
**140**
  - Cl-:  
**105**
  - HCO<sub>3</sub>|CO<sub>2</sub>:  
**25 +-3**

Anion gap:  $\text{Na} - \text{Cl} - \text{HCO}_3 =$   
 $140 - 130 =$   
**10**

- Compensation usually never brings pH back to normal, if you see normal pH look for mixed disorders!
- Respiratory compensation:  
Increased PaCO<sub>2</sub>  
Acute increase; for every 10mmHg → +2 [HCO<sub>3</sub><sup>-</sup>]  
Chronic increase; for every 10mmHg → +4 [HCO<sub>3</sub><sup>-</sup>]  
Decreased PaCO<sub>2</sub>  
Acute decrease; for every 10mmHg → -2 [HCO<sub>3</sub><sup>-</sup>]  
Chronic decrease; for every 10mmHg → -4 [HCO<sub>3</sub><sup>-</sup>]

- Remember to calculate the delta delta if you have high anion gap to see if the change in the anion gap is responsible for the change in [HCO<sub>3</sub><sup>-</sup>] or there's another derangement;

First:  $\Delta \text{AG} = \text{Patient anion gap} - \text{normal anion gap}(10)$

Second:  $\Delta \text{AG} + \text{patient aHCO}_3$

If this yields a normal HCO<sub>3</sub><sup>-</sup> range (25 (+-5)) =

**No other derangement**

If this yields a value that's larger than normal HCO<sub>3</sub><sup>-</sup> range= **Superimposed metabolic alkalosis**

If this yields a value that's smaller than normal HCO<sub>3</sub><sup>-</sup> range=

**Superimposed normal anion gap metabolic acidosis (NAGMA)**

- HAGMA Differentials:  
DKA (Keto acids)  
Lactic acidosis (Lactic acid)  
Salicylates (Salicylic acid)  
Methanol  
Acetaminophen overdose (5-oxoproline in the urine)  
Methylene glycol ingestion
- Metabolic disorders questions:

1) 18 yo lady presented not feeling well, her blood sugar was 800mg/dl, ABG and venous samples yielded:

Ph: 7.24  
PaCO<sub>2</sub>: 26  
HCO<sub>3</sub><sup>-</sup>: 10  
Na: 140  
Cl: 105  
venous CO<sub>2</sub>: 9

Valid data (9 ~ 10)

What is the disorder? Metabolic acidosis

Is it compensated or not? YES

Compensated by respiratory alkalosis

*Remember; compensation is not a disorder!!*

AG = 140 - 105 - 10 = 25

HAGMA

delta anion gap: pt anion gap - normal anion gap = 15

15 + 10 = 25 normal, no superimposed disorder.

2) 18 yo lady presented not feeling well, her blood sugar was 800mg/dl, and complained of severe diarrhea, ABG and venous samples yielded:

pH: 7.22  
PaCO<sub>2</sub>: 20  
HCO<sub>3</sub><sup>-</sup>: 5  
Na: 140  
Cl: 112  
venous CO<sub>2</sub>: 6

Valid data (6~5)

What is the disorder? Metabolic acidosis

Is it compensated or not? YES, compensated by respiratory alkalosis

AG = 140 - 118 = 22 = HAGMA

Delta ag = 12, 12 + 5 = 17 <Normal

Final dx: NAGMA + HAGMA

3) 18 yo lady presented not feeling well, her blood sugar was 800mg/dl, also complained of severe N/V, ABG and venous samples yielded:

pH: 7.32  
PaCO<sub>2</sub>: 30

HCO<sub>3</sub><sup>-</sup>: 18

Na: 140

Cl: 90

venous CO<sub>2</sub>: 16

Valid data (16~18)

What is the disorder? Metabolic acidosis

Is it compensated or not? Yes, by respiratory alkalosis

AG = 140 - 90 - 18 = 32

Delta ag = 22, 22+18= 40 >Normal

Final dx: HAGMA + Superimposed metabolic alkalosis

4) 18 yo presents with unknown drug overdose, ABG and venous samples yielded:

pH: 7.30

PaCO<sub>2</sub>: 10

HCO<sub>3</sub><sup>-</sup>: 10

Na: 140

Cl: 105

venous CO<sub>2</sub>: 9

Valid data (9~10)

What is the disorder? Metabolic acidosis

Is it compensated or not? No = mixed disorder with Respiratory alkalosis

AG = 140 - 114 = 26

Delta ag = 16, 16 + 10= 26 = normal

Final dx: HAGMA + Respiratory alkalosis

5) 18 yo lady presented with severe diarrhea, ABG and venous samples yielded:

pH: 7.28

PaCO<sub>2</sub>: 30

HCO<sub>3</sub><sup>-</sup>: 15

Na: 140

Cl: 115

venous CO<sub>2</sub>: 14

Valid data (14~15)

What is the disorder? Metabolic acidosis

Is it compensated or not? Yes, by respiratory alkalosis

AG = 140 - 129 = 11 Normal AG = no delta delta

Final dx: NAGMA due to the severe diarrhea

6) No stem, only ABG and venous sample;

pH: 7.55

PaCO<sub>2</sub>: 49

HCO<sub>3</sub><sup>-</sup>: 31

Na: 140

Cl: 100

venous CO<sub>2</sub>: 30

Valid data (30~31)

What is the disorder? Metabolic alkalosis

Is it compensated or not? Yes, by respiratory acidosis

AG = 140 - 135 = 10 no anion gap = no delta delta

Final dx: Metabolic alkalosis compensated by respiratory acidosis

*repeated; EXPECTED CO<sub>2</sub> is HCO<sub>3</sub> + 15 (+-5) for compensation on metabolic disorders*

- Respiratory questions:

1) 65 yo with COPD, presents as a regular visit, his ABG and venous samples yielded:

pH: 7.34

PaCO<sub>2</sub>: 60

HCO<sub>3</sub><sup>-</sup>: 32

No venous sample

What is the disorder? Respiratory acidosis

Is it compensated or not? Yes, by metabolic alkalosis

compensation = (+8), expected HCO<sub>3</sub><sup>-</sup> = 25 + 8 = 33 (+-5)

patient's HCO<sub>3</sub><sup>-</sup>: 32

Final dx: Respiratory acidosis compensated by metabolic alkalosis

2) 21 yo with acute asthma, his ABG and venous samples yielded:

pH: 7.55

PaCO<sub>2</sub>: 20

HCO<sub>3</sub><sup>-</sup>: 19

No venous sample

What is the disorder? Respiratory alkalosis

Is it compensated or not? Yes, by metabolic acidosis

compensation = (-4), expected HCO<sub>3</sub><sup>-</sup> = 25 - 4 = 21 (+-5)

patient's HCO<sub>3</sub>: 19

Final dx: Respiratory alkalosis compensated by metabolic acidosis

3) This question is advanced, emergency patient presents with these ABG and venous samples:

pH: 7.4

PaCO<sub>2</sub>: 40

HCO<sub>3</sub><sup>-</sup>: 25

Na: 140

Cl: 90

venous CO<sub>2</sub>: 24

What is the disorder? idek

Is it compensated or not? idek

Ag = 140 - 25 - 90 = 25!! = HAGMA

Please remember, anion gap present = calculate Delta delta

Delta AG = 15, 15 + 25 = 40 >Normal

Final dx: HAGMA with superimposed metabolic alkalosis

~ DKA + N/V (Possible cause..)

GOOD LUCK!