ABG

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Information needed

- From ABG :

PH , $PaCO_2$,PaO_2,HCO_3^- , …

- Electrolyte
- Albumin
- Compensatory mechanism
- Clinical correlation (very important)

Compensatory mechanism

- Tend to normalize PH
- Require normal lung/kidney
- Full compensation takes time (12-48 hr)
- Compensation is predictable
- Does not always return PH to normal(except in chronic respiratory alkalosis)

Analytic methods

- Traditional (anion gap , PaCo2/ HCO3)
- Base excess (deficit)
- Physiochemical (strong ion difference)

Traditional method (6 steps)

- Validity
- Acidemia or alkalemia
- Respiratory or metabolic
- Compensation
- Anion gap
- Delta gap

(1)Validity

PH	Approximate (H+)
7.00	100
7.05	89
7.10	79
7.15	71
7.20	63
7.25	56
7.30	50
7.35	45
7.40	40
7.45	35
7.50	32
7.55	28
7.60	25
7.65	22

- using the Henderseon-Hasselbach equation:

  $[H^+] = 24(PaCO_2)/[HCO_3^-]$

- Check O_2 saturation by pulse oximetry

(2) Is there alkalemia or acidemia present?

- pH < 7.35 **acidemia**
- pH > 7.45 **alkalemia**

• This is usually the primary disorder

• Remember: an **acidosis** or **alkalosis** may be present even if the pH is in the normal range (7.35 – 7.45)

(3)Is the disturbance respiratory or metabolic

- In primary **respiratory** disorders, the pH and $PaCO_2$ change **in opposite** directions

- In **metabolic** disorders the pH and $PaCO_2$ change in the **same** direction.

(4) Is there appropriate compensation for the primary disturbance

- **Respiratory acidosis:**
- **Acute :** Decrease in PH = **0.08 * (PaCO2-40)/10**
- every increase of 10 mmHg in PaCo2 the PH will decrease by 0.08
- Increase in HCO3 (PaCO2-40)/10 +/- 3

- **Chronic :** decrease in PH = **0.03* (PaCO2-40)/10**
- Every increase of 10 mmHg in PaCO2 the PH will decrease by 0.03
- Increase in HCO3 3.5 × (PaCO2-40)/10

Respiratory alkalosis:

- **Acute :** increase in PH **= 0.08 * (40-PaCO2)/10**
- every decrease of 10 mmHg in PaCo2 the ph will increase by 0.08
- Decrease in HCO3 2 × (PaCO2-40)/10

- **Chronic :** increase in PH **= 0.03* (40 - PaCO2)/10**
- Every decrease of 10 mmHg in PaCO2 the ph will increase by 0.03
- Decrease in HCO3 5-7 ×(40 - PaCO2)/10

- **Metabolic acidosis :**

expected PaCO2 :

(1.5 × HCO3) + 8 +/- 2

Or the last 2 digits of the PH

- **Metabolic alkalosis :**
- Increase in PaCO2 = 0.6-0.7 × (HCO3-24)

(5) Calculate the anion gap

- AG= [Na+]-([Cl-] + [HCO3-])-12 ± 2
- Don’t forget the albumin

(6) (ΔAG)

- **(AG – 12) – (24 – HCO3**) = 0

- If positive metabolic alkalosis
- If negative hyperchloremic acidosis

- **ΔAG/Δ[HCO3-]** = 1

- •If ΔAG/Δ[HCO3-] < 1.0, then a concurrent non-anion gap metabolic acidosis is likely to be present.
- •If ΔAG/Δ[HCO3-] > 2.0, then a concurrent metabolic alkalosis is likely to be present.

oxygenation

- PaO2 corrected for age = 101 – (age/3)
- **Mild** : <PaO2 expected for age to ≥ 60 mmHg PaO2
- **Moderate** : 59 - 55 mmHg
- **severe** : < 55 mmHg

Clinical cases

- (1) A 22 year old is evaluated for weakness ,weight loss and hypotension .

PH:7.32 ; Na+ 135 ; Cl- 101 ; PaCO2 24 ; K+ 4.5 ; HCO3- 12 ; PaO2:95

Which of the following is the best interpretation of the acid-base information ?

A.Anion gap metabolic acidosis

B. Anion gap metabolic acidosis+ metabolic alkalosis

C.Anion gap metabolic acidosis + respiratory alkalosis

D. Non-anion gap metabolic acidosis


DON'T PANIC!
IT'S UNDER CONTROL!

- Valid H+ 48 = PH 7.32
- Acidemia
- metabolic : low PaCO2 and HCO3-
- Respiratory compensation:

PaCO2= 1.5 ×12 + 8 ± 2 = 26 ± 2 (appropriate)

AG: 135-(101+12)=22 (increased)

Anion gap metabolic acidosis with appropriate respiratory compensation and normal oxygen saturation

- (2) 80 year old man with HTN,DM,and malnutrition admitted with cough , fever , and hypotension.BP 90/52 HR 115 RR 20 T 38.5C

PH:7.35 ; $PaCO_2$ 32 ; PaO_2 68 ; Na^+ 132 ; K^+ 4.0 ; Cl^-: 103 ; HCO_3 :17

Albumin :1.5 ; BUN 20 ; creatinine : 1.4

Which of the following acid-base disorders is present ?

A. Anion gap metabolic acidosis

B. Normal anion gap metabolic acidosis

C. Normal anion gap metabolic acidosis+ respiratory alkalosis

D. Anion gap+ normal anion gap metabolic acidosis

- Valid
- Acidemia
- Metabolic
- Respiratory compensation:

$PaCO_2 = (1.5 \times 17) + 8 \pm 2 = 33$

Anion gap= 12 !!!

Corrected for albumin you add 5-6

Anion gap metabolic acidosis with mild arterial hypoxemia

- (3) 60 year old lady with peripheral vascular disease and hypertension complains of left leg discomfort

BP 168/96 HR 90 RR 25 T 38

PH 7.55 ; PaCO2 15; PaO2 98 ; Na+ 135 ; K+ 3.8 ; Cl 101 ; HCO3 13

Which acid-base disorder is/are most likely ?

A. Acute respiratory alkalosis

B. Chronic respiratory alkalosis

C. Acute respiratory alkalosis + metabolic alkalosis

D. Acute respiratory alkalosis+ metabolic acidosis

- Valid
- Alkalemia
- Respiratory
- Acute or chronic

Acute : 0.08 ×(25/10)=0.2 +7.40= PH7.60

Chronic:0.03 ×(25/10)= 0.075 +7.40=PH 7.475

$HCO_3 = 2 \times 25/10 = 5$; expected $HCO_3 = 24 - 5 = 19$

AG 21

Δ AG = (21-12)-(24-13)= -2

Acute respiratory alkalosis and anion gap metabolic acidosis

- (4) 60 year old man with COPD , pulmonary HTN and RV dysfunction presents with chest pain and hypotension .

PH : 7.38 ; PaCO2 :57 ; PaO2:45 ; Na+ 134 ; k+:3.5 ; Cl: 77 ; HCO3:33

What is the acid-base disorder ?

- Valid
- Acidemia
- Respiratory
- Chronic 0.03 × 1.7= 0.05
  Expected ph is 7.35
- HCO3 3.5 × 1.7 = 6 expected HCO3 = 30

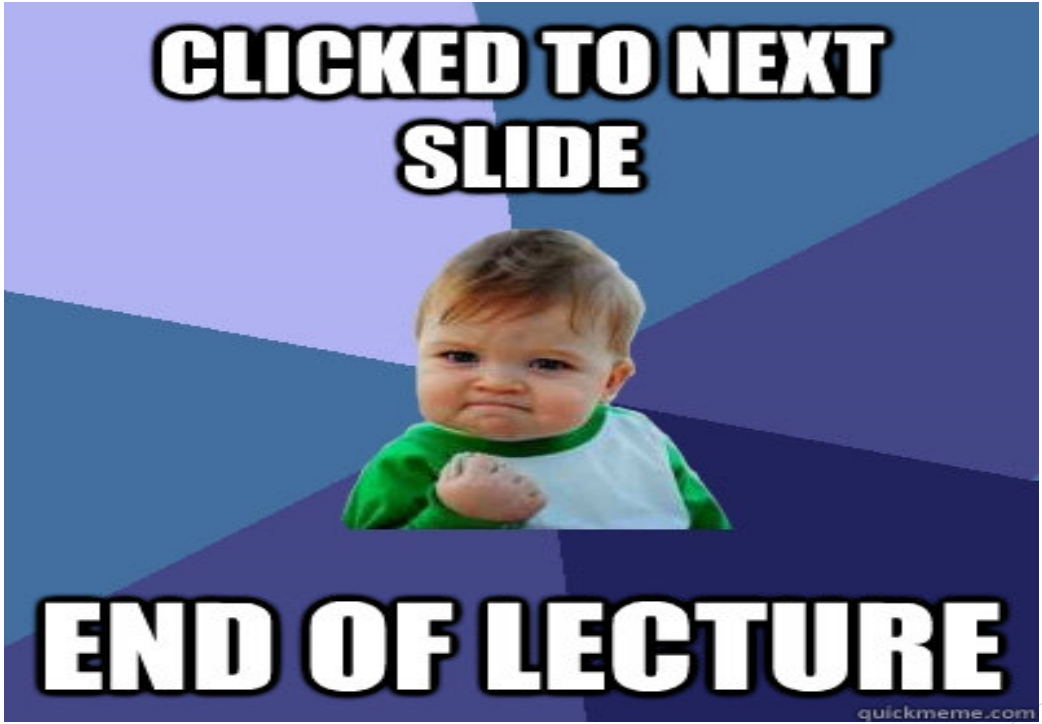
AG =24

ΔAG =12-(24-33)= 21

?????????

- chronic respiratory acidosis + anion gap metabolic acidosis(increase AG) + metabolic alkalosis (increase Δ AG)

- Likely this patient COPD with chronic $PaCO_2$ retention with hypotension and use of diuretics


CLICKED TO NEXT SLIDE
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Thanks