

# Steps for ABC analysis

- 3 cases -

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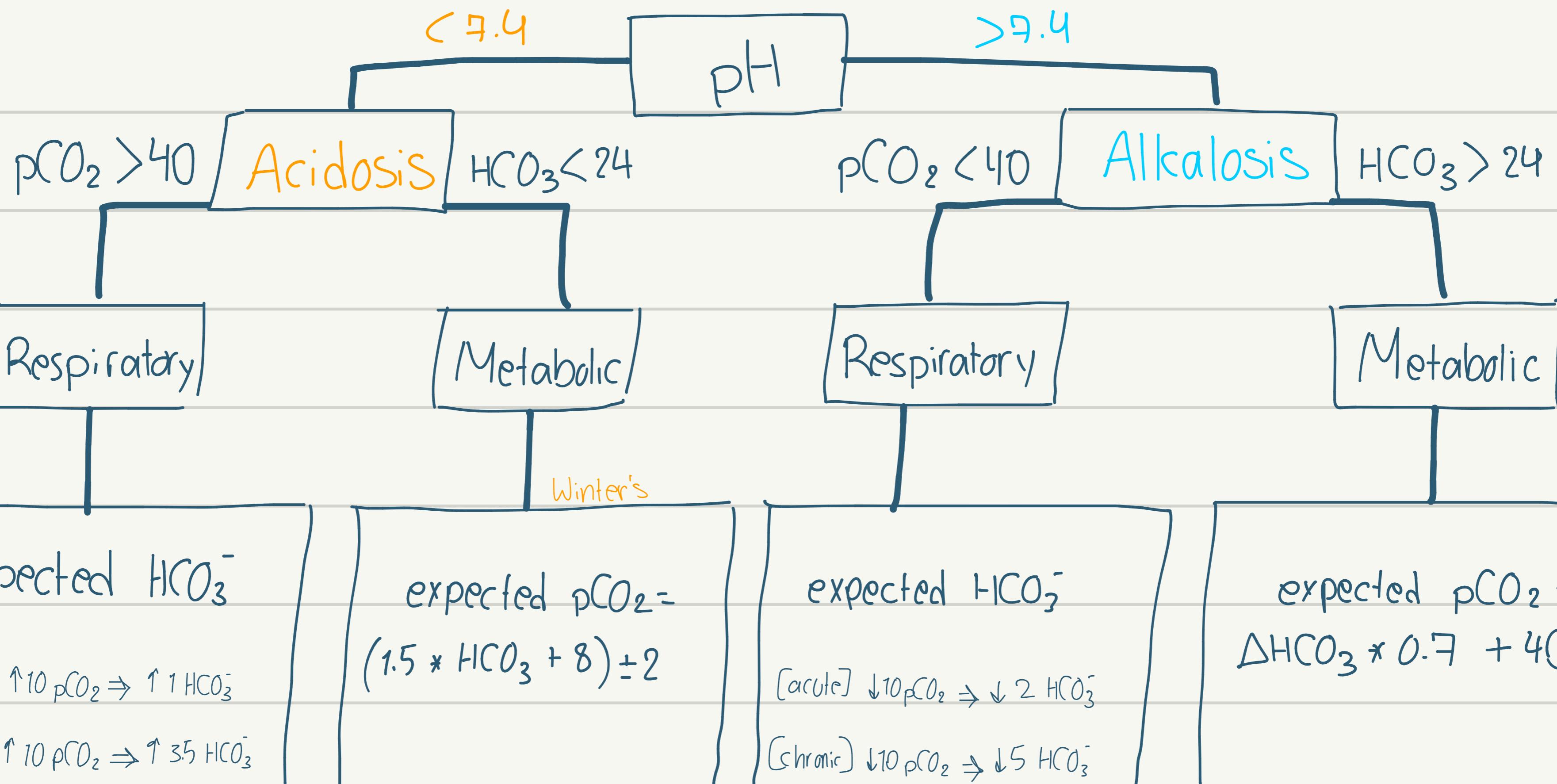
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# Steps for ABG Analysis

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

## Normal Values

• pH	7.35 - 7.45	7.4
• $\text{pCO}_2$	35 - 45	40
• $\text{HCO}_3^-$	22 - 26	24
• AG	8-12	10
• Albumin	4	4

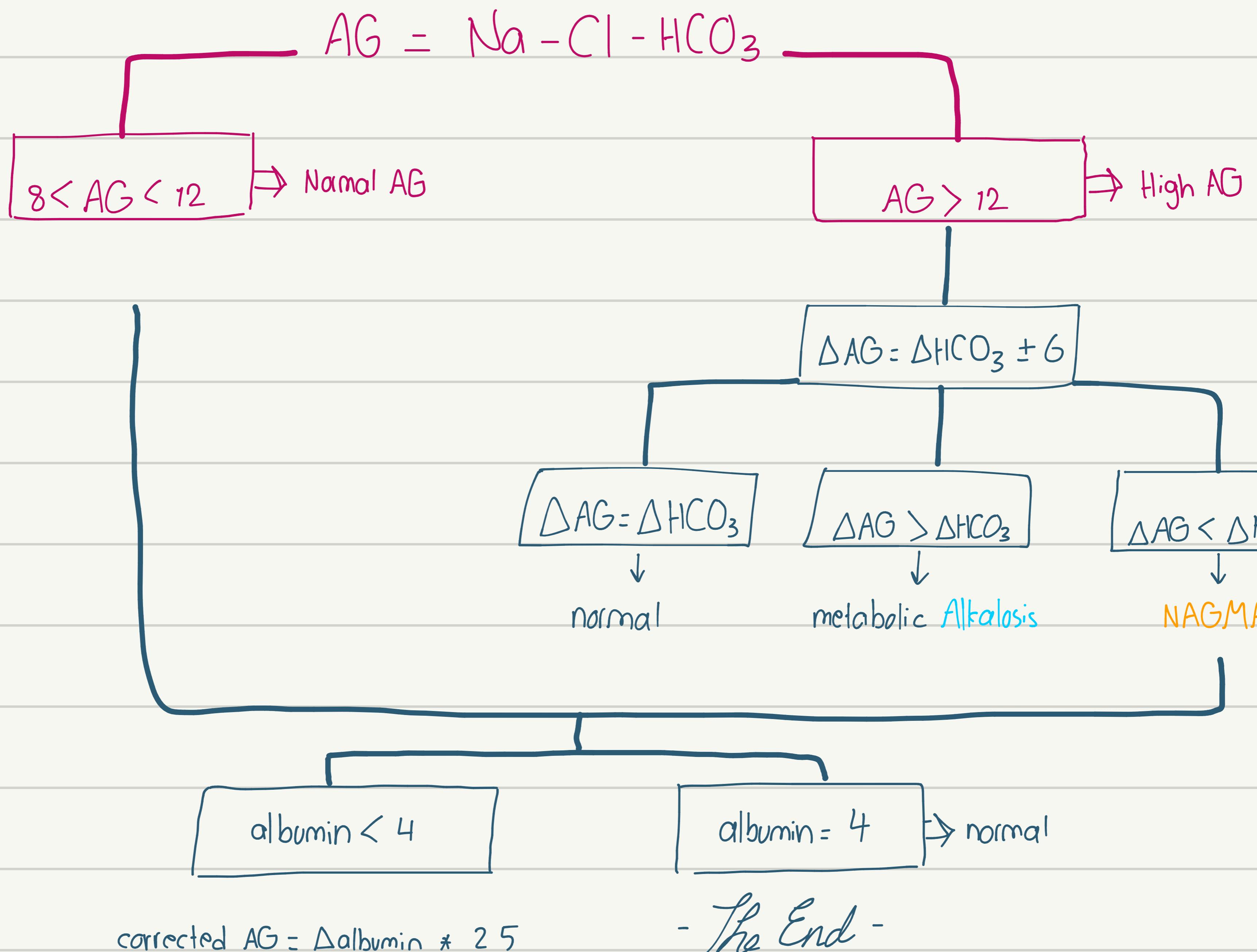


if expected  $\text{pCO}_2 >$  given  $\rightarrow$  concomitant respiratory Alkalosis

if expected  $\text{pCO}_2 <$  given  $\rightarrow$  concomitant respiratory Acidosis

if expected  $\text{pCO}_2 =$  given  $\rightarrow$  NO underlying pathology

if  $\text{pCO}_2$   $\neq$  given  $\rightarrow$  metabolic disorder



### Example 1:

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

$$\text{pH} = 7.3 \quad \text{pCO}_2 = 60 \text{ mmHg} \quad \text{Na} = 135 \quad \text{Cl} = 100 \quad \text{HCO}_3 = \underline{\underline{30}}$$

$\downarrow$        $\downarrow$

acidosis

respiratory

\* expected  $\text{HCO}_3$

$$- \text{acute } \uparrow 10 \text{ pCO}_2 \rightarrow \uparrow 1 \text{ HCO}_3 \Rightarrow \text{HCO}_3 = 24 + 2 = 26$$

$$- \text{chronic } \uparrow 10 \text{ pCO}_2 \rightarrow \uparrow 3.5 \text{ HCO}_3 \Rightarrow \text{HCO}_3 = 24 + 7 = 31$$

chronic ✓

↳ chronic respiratory acidosis pH must be normal!

.. we have acute on top of chronic

$$* \text{AG} = \text{Na} - \text{Cl} - \text{HCO}_3$$

$$= 135 - 100 - 30 = \boxed{5} \downarrow$$

∴ 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     $\text{pCO}_2 = 30$      $\text{pO}_2 = 86$      $\text{Na} = 140$      $\text{Cl} = 110$      $\text{HCO}_3 = 22$   
 $\downarrow$                    $\downarrow$   
alkalosis                respiratory

\* expected  $\text{HCO}_3$

- acute  $\downarrow 10 \text{ pCO}_2 \rightarrow \downarrow 2 \text{ HCO}_3 \Rightarrow \text{HCO}_3 = 24 - 2 = 22$  acute ✓

- chronic  $\downarrow 10 \text{ pCO}_2 \rightarrow \downarrow 5 \text{ HCO}_3 \Rightarrow \text{HCO}_3 = 24 - 5 = 19$

\* AG =  $140 - 110 - 22 = 8$  normal

↳ Acute respiratory alkalosis with appropriate compensation

resp. alkalosis  $\Rightarrow \downarrow$  ionized Ca [Ca binds albumin vs H]

$\Rightarrow$  hypocalcemia  $\Rightarrow$  numbness!

Hypoxia is the most  
important cause of ↑ ventilation  
 $\Downarrow$  resp. alkalosis

### Example 3:

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

• ABG:  $pH = 7.23$ ,  $PCO_2 = 17$ ,  $SB = 235$  on 50% VM

• BMP:  $Na = 123$     $Cl = 97$     $HCO_3 = 6$     $BUN = 119$     $Cr = 5.1$

\* acidosis

\* metabolic

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

$$= 1.5 * 6 + 8 = \underline{\underline{16}} \pm 2 \quad \checkmark \text{compensation}$$

$$* AG = 123 - 97 - 6 = \boxed{20} \uparrow$$

$\therefore$  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<sub>3</sub> = 18

+ acidosis

+ metabolic

$$\begin{aligned} * \text{expected } p\text{CO}_2 &= (1.5 \times \text{HCO}_3 + 8) \pm 2 \\ &= 35 \pm 2 \quad \checkmark \text{compensation} \end{aligned}$$

$$+ \text{AG} = 135 - 108 - 18 = 9 \quad \checkmark \text{normal}$$

→ 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

- ABC: 7.5, 44, 100
- BMP: Na = 138      Cl = 100       $\text{HCO}_3 = 30$
- Urine Na = 10

\* Alkalosis

\* Metabolic

$$\begin{aligned} * \text{expected } \text{pCO}_2 &= \Delta \text{HCO}_3 + 0.7 + 40 \\ &= 44.2 \checkmark \text{compensation} \end{aligned}$$

$$* \text{AG} = 138 - 100 - 30 = 8 \checkmark \text{normal}$$

⇒ metabolic alkalosis with appropriate resp. compensation

## Case 1

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

CXR showed infiltrations

• ABG :  $\text{pH} = 7.31$ ,  $\text{PaCO}_2 = 10$ ,  $\text{pH} = 67$

• BMP :  $\text{Na} = 123$        $\text{Cl} = 99$        $\text{HCO}_3 = 5$

\* acidosis

\* metabolic

$$*\text{ expected } \text{pCO}_2 = (1.5 * \text{HCO}_3 + 8) \pm 2$$

$$= 15.5 \pm 2 > 10$$

no compensation = respiratory alkalosis

$$*\text{ AG} = 123 - 99 - 5 = \boxed{19} \uparrow$$

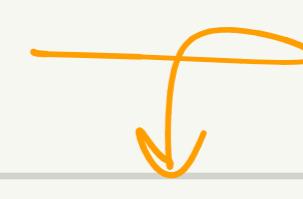
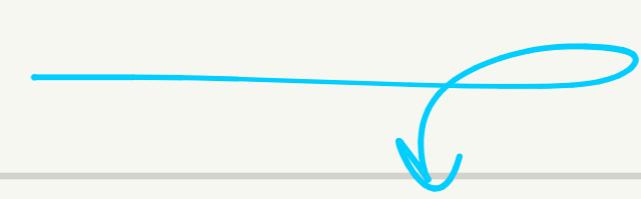
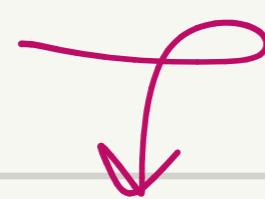
∴ HAGMA

$$*\Delta\text{AG} = \frac{\text{AG}}{\text{HCO}_3} \pm 6$$

$$19 - 12 = \frac{7}{24} - 5$$

$$7 < 19 \rightarrow \text{NAGMA}$$

↳ HAGMA with respiratory alkalosis  $\nmid$  NAGMA



DKA / lactic acidosis

pneumonia

due to diarrhoea

### Case 3

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

$$\text{pH} = 7.46 \quad \text{pCO}_2 = 17$$

$$\text{Na} = 133 \quad \text{Cl} = 84 \quad \text{HCO}_3 = 15$$

\* Alkalosis

\* Respiratory

\* expected  $\text{HCO}_3^-$

$$\text{- acute } \downarrow 10 \text{ pCO}_2 \rightarrow \downarrow 2 \text{ HCO}_3 \Rightarrow \frac{(40-17) \times 2}{10} = 4.6$$

$$\text{HCO}_3 = 24 - 4.6 = \boxed{19.4}$$

$$\text{- chronic } \downarrow 10 \text{ pCO}_2 \rightarrow \downarrow 5 \text{ HCO}_3 \Rightarrow \frac{(40-17) \times 5}{10} = 11.5$$

$$\text{HCO}_3 = 24 - 11.5 = \boxed{12.5}$$

✓ chronic

$$* \text{AG} = 133 - 84 - 15 = \boxed{34} \uparrow \quad \therefore \text{HAGMA}$$

$$* \Delta \text{AG} \stackrel{?}{=} \Delta \text{HCO}_3$$

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

22 > 9 → metabolic alkalosis

chronic resp. Alkalosis  $\Downarrow$  HAGMA  $\Downarrow$  metabolic Alkalosis

due to liver cirrhosis

DKA

vomiting

-The End-