

# ARTERIAL BLOOD GAS ANALYSIS

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# Normal Arterial Blood Gas Values

<b>Component</b>	<b>Range</b>
Acid-base	
pH	7.35 - 7.45
pCO <sub>2</sub>	35 - 45 mm Hg
HCO <sub>3</sub>	22 - 26 mEq/L
BE	± 2mEq/L



# Normal Arterial Blood Gas Values (cont.)

- Oxygenation Status
- PaO<sub>2</sub>
  - 80 - 100 mm Hg
- SaO<sub>2</sub>
  - 95-100%
- Hgb
  - 13.5-17 g/dl (males)
  - 12-15 g/dl (females)



# ABG Norms (cont.)

## pH

- 7.35 – 7.40 normal (acidic)
- 7.41 – 7.45 normal (basic) alkaline
  
- pH 7.38 – normal (A)
- pH 7.43 – normal (B)
- pH 7.35 – normal (A)
- pH 7.45 – normal (B)



# Step 1 ABG Analysis

- **Evaluate pH**
- pH = 7.35 - 7.45; midpoint = 7.40
- If less than 7.40 = acid
- If greater than 7.40 = base (alkaline)
- If normal (7.35-7.45) mark (n)
- If pH is normal, determine from midpoint (7.40)
- 7.35-7.40 = acid      7.37 label N/a
- 7.41-7.45 = base      7.43 label N/b



# Step 2

- **Evaluate pCO<sub>2</sub>** carbon dioxide/acid (Respiratory)
- **High CO<sub>2</sub> (acid) = acid**
- pCO<sub>2</sub> = 35 - 45 mm Hg
- If less than 35 mm Hg = base (alkaline)
- If greater than 45 mm Hg = acid
- If normal (35-45) label (N)
- If < 35 label (B)      ↓ 28 (B)
- If > 45 label (A)      ↑ 55 (A)



# Step 3

- **Evaluate  $\text{HCO}_3$**  Bicarbonate/Base (Metabolic)
- **High  $\text{HCO}_3$  (base) = base**
- $\text{HCO}_3 = 22 - 26 \text{ mEq/L}$
- If less than 22 mEq/L = acid
- If greater than 26 mEq/L = base (alkaline)
- If normal (22-26) mark (N)
- If < 22 label (A)      ↓ 18mEq/L (A)
- If > 26 label (B)      ↑ 30mEq/L (B)



# Step 4

- Determine Imbalance
- pH            7.50
- CO<sub>2</sub>    25
- HCO<sub>3</sub>        25



## Step 4 (cont.)

- Determine Imbalance
- Pick the labeled component ( $\text{CO}_2$  or  $\text{HCO}_3$ ) that matches the pH label

- pH                      7.50 greater than 7.45 (B) ↑

-  $\text{CO}_2$  (Acid)        25 less than 35 (B) ↓

□ ↑ 45 = acid; ↓ 35 = base

-  $\text{HCO}_3$  (Base)                      24 normal (22-26) (N)

□ ↑ 26 = base; ↓ 22 = acid

-  $\text{CO}_2$  matches pH = Respiratory

Resp. Alkalosis                      Base/Alkalosis



## Step 4 (cont.)

- Determine Imbalance
- Pick the labeled component ( $\text{CO}_2$  or  $\text{HCO}_3$ ) that matches the pH
- pH            7.32 less than 7.35
- $\text{CO}_2$     50    normal (35-45)
- $\text{HCO}_3$         30 greater than 26 (22-26)



## Step 4 (cont.)

- pH 7.32 (A) ↓
- CO<sub>2</sub> 50 (A) ↑
- HCO<sub>3</sub> 30 (B) ↑
  - Pick the labeled component that matches the pH
  - Respiratory acidosis
    - pH and CO<sub>2</sub> have inverse relationship



# Step 5

- Determine Compensation

- **No compensation**

- Look at the component that doesn't match the pH which is  $\text{HCO}_3$  - if in normal range = no compensation

- Example

• pH	7.32	A↓	7.35-7.45
• $\text{CO}_2$	50	A↑	35-45
• $\text{HCO}_3$	30	B	22-26



- Respiratory Acidosis with partial compensation

# Step 5 (cont.)

- Partial Compensation

- If the component that does not match the pH is above or below normal, and the pH is also not in normal range, then partial compensation exists

• pH	7.32 ↓ A	7.35-7.45
• CO <sub>2</sub>	50 ↑ A	35-45
• HCO <sub>3</sub>	30 ↑ B	22-26



- Respiratory Acidosis with partial compensation

# Step 5 (cont.)

- Full or Complete

- If the pH is normal full compensation has occurred!!!

- Example

• pH	7.35 normal ↓ (a)	7.35-7.45
• CO <sub>2</sub>	50 ↑ A	35-45
• HCO <sub>3</sub>	30 ↑ B	22-26



- Respiratory Acidosis with full compensation

# Step 6

- Determine oxygenation status
  - Evaluate  $pO_2 = 80-100$  mm Hg
    - Is it normal?
    - What is the client's baseline?
    - Is it an acceptable range for this client?
  - Evaluate  $SaO_2 = 95-100\%$ 
    - Is it normal?
  - Evaluate Hemoglobin (Hgb)
    - female 12-16 g/dl; male 14-18 g/dl
    - Are there enough oxygen carriers?



## Step 6 (cont.)

- Determine oxygenation
  - PaO<sub>2</sub> amount of oxygen dissolved in plasma
    - 2%
  - SaO<sub>2</sub> how much hemoglobin is saturated with oxygen
    - 98% oxygen carrying capacity



# Step 7

- **Evaluate client to place blood gas analysis in proper context**
  - Does client's clinical picture match the acid-base and oxygen interpretation?
  - Does the client have a chronic disorder that is associated with long-term alterations in ABGs?
  - Are there any acute processes occurring that need to be taken into consideration?
  - Does the client have fever?



# Pneumonic

- R respiratory
- O opposite
- M metabolic
- E equal



# Pneumonic (cont.)

- pH **7.48**↑ **B** 7.35-7.45
- CO<sub>2</sub> 35 (normal) 35-45
- HCO<sub>3</sub> **30**↑ **B** 22-26
- Both arrows are moving in same direction so it's a metabolic imbalance
  - Metabolic Alkalosis no compensation
  - Arrows moving in same direction (metabolic equal)



# Pneumonic (cont.)

- pH 7.32↓ A
- CO<sub>2</sub> 55↑ A
- HCO<sub>3</sub> 30↑ B
- CO<sub>2</sub> matches pH so Resp. Acicosis with partial compensation
- Arrows are moving in opposite direction pH ↓ & CO<sub>2</sub> ↑ (resp. opposite)

# Mixed Acid Base Imbalance

- pH 6.8 A ↓
- CO<sub>2</sub> 90 A ↑
- HCO<sub>3</sub> 15 A ↓
  - **RULE:** when CO<sub>2</sub> or HCO<sub>3</sub> value is:
    - In a direction opposite to its predicted direction
    - Not close to the predicted value during normal compensatory activity 