# Introductions

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- Graduate of University of Central Oklahoma
- Director of Respiratory Care and Outpatient Services
- Employed at St. Anthony for 11 years
- Serve on the Advisory Committees & as Adjunct Faculty Member at Rose State College, Francis Tuttle Technology Center & Platt College Respiratory Care programs

# Understanding the ABG

Goal: Participant will be able to interpret an ABG and understand the causes of abnormal ABG's

## Training Objectives

- Review basic interpretation of arterial blood gases (ABGs) and state the normal values.
- Identify metabolic & respiratory acidosis and describe treatment.
- Identify metabolic & respiratory alkalosis and describe treatment.
- Review different types of oxygen administration devices
- Discuss different types of breathing treatments & their uses
- Describe proper use of Metered Dose Inhalers (MDIs) & other appartus

# Objective #1

**Review basic interpretation of arterial blood gases (ABGs) and state the normal values.**

**ARTERIAL BLOOD GASES (ABGs) -- What do we learn about our patient's from them???**

- An indication of our patient's acid-base status.
- If there is an imbalance present, we can learn the system origin (Respiratory or renal/metabolic) of the imbalance.
- An impression of the ability of the body to regulate pH.
- A reflection of the patient's oxygenation status.

**Review basic interpretation of arterial blood gases (ABGs) and state the normal values.**

- There are 6 primary components in arterial blood gas results:
  - 4 are used to establish the nature of the patient's acid-base status or disorder if one exists.
  - 2 allow us to evaluate the patient's oxygenation status
- Let's name them all!!!

**Review basic interpretation of arterial blood gases (ABGs) and state the normal values.**

- **NORMAL VALUES FOR ABGs**
  - **pH 7.35 - 7.45**
  - **$PaCO_2$ 35 - 45 mmHg**
  - **$HCO_3$ 22 - 28 mEq/L**
  - **BE +2 to -2**
  - **$PaO_2$ 80 - 100 mmHg**
  - **$SaO_2$ 95 - 100%**
- **Literature advocates a four-step approach to successfully interpreting ABGs**

**A FOUR STEP APPROACH TO ACID/BASE**

| | | | |
|---|---|---|---|
| Step 1 -- Check against each normal | pH<br>$PaCO_2$<br>$HCO_3$<br>BE/BD | acid 7.35 - 7.45 base<br>base 35 - 45 acid<br>acid 22 - 28 base<br>acid -2 - +2 base | Note that $PaCO_2$ readings move in the opposite direction to the other 2 readings we are looking at. |
| Step 2 -- Determine primary problem | pH | Is the pH acid or base? | Indicates whether the patient has a primary acidosis or alkalosis. |
| Step 3 -- Determine type of problem by matching with pH | $PaCO_2$<br><br>$HCO_3$ | Which of these 2 results match the acid or base derangement of the pH? | If $PACO_2$ matches, the problem is respiratory.<br><br>If $HCO_3$ matches, the problem is metabolic. |
| Step 4 -- Determine compensation | Absent?<br><br>Partial?<br><br>Complete? | *What is happening to the nonmatching value?<br>*Moving in opposite direction trying to return the pH?<br>*pH is normal but prior abnormality remains? | *If nonmatching is normal and pH is abnormal, compensation is absent. (acute condition)<br>*Nonmatching is abnormal & pH is abnormal = partial compensation.<br>*Nonmatching is normal & pH has now normalized + complete compensation (chronic disorder) |

## EVALUATE OXYGENATION

- $PaO_2$ -- the partial pressure of oxygen dissolved in the plasma. Represents only 2 to 3% of oxygen actually carried in the blood but is an important indicator of potential tissue oxygenation.
- $SaO_2$ -- The percentage of $O_2$ that hemoglobin (Hb) is carrying compared to the amount it could carry. Can be determined by ABG analysis as well as by Pulse Oximetry ($SpO_2$)
- Note: when considering SpO2, you must know the Hb level; if Hb low, a patient is at risk for hypoxia even with 95 to 100% saturations
- Supplemental oxygen -- ABG values assume the patient is breathing room air. Supplemental oxygen should increase $PaO_2$ provided cardiac output, lungs, and vascular systems are intact.

## Let's try interpreting....

| | | | |
|---|---|---|---|
| **pH** | **7.19** | **low/acid** | **match** |
| **PaCO2** | **65** | **high/acid** | **match** |
| **HCO3** | **24** | **normal** | **nonmatch or no compensation** |
| **PaO2** | **45** | **low** | **needs supplemental oxygen** |
| **SaO2** | **90** | **low** | **a little higher due to R shift secondary to acidosis** |

# Objective #2

**Identify metabolic & respiratory acidosis and describe treatment.**

## NAME THIS TUNE??????

| | | | |
|---|---|---|---|
| **pH** | **7.23** | **Step 1** | **Low pH indicates acidosis** |
| **$PaCO_2$** | **31** | **Step 2** | **Low $PaCO_2$ rules out respiratory therefore we assume metabolic acidosis** |
| **$HCO_3$** | **16** | **Step 3** | **Low $HCO_3$ confirms above assumption of metabolic acidosis** |
| | | **Step 4** | **Low $PaCO_2$ indicates attempts to compensate but pH remains abnormal** |

## METABOLIC ACIDOSIS

**Low pH & low $HCO_3$ -- Is the result of the loss of blood base or the accumulation of excessive blood acid. With the exception of lactic acidosis, it is rarely due to primary pulmonary disorder.**

| CAUSES | TREATMENT |
|---|---|
| RENAL FAILURE (Renal Tubular Acidosis) | Attempt to restore hydrogen ion excretion. |
| KETO-ACIDOSIS (Diabetic or Starvation) | Restore normal insulin and/or blood glucose levels |
| LACTIC ACIDOSIS -- oxygen deprivation | Reestablish circulation, ventilation, & oxygenation |
| Loss of bicarbonate via diarrhea or ileostomy loss | Treat the cause! |

## NAME THIS TUNE??????

| | | | |
|---|---|---|---|
| pH | 7.20 | Step 1 | Low pH indicates acidosis |
| PaCO2 | 65 | Step 2 | High PaCO2 indicates respiratory acidosis |
| HCO3 | 26 | Step 3 | Normal HCO3 confirms above |
| | | Step 4 | Normal $HCO_3$ indicates no attempt to compensate so problem is acute. |


## RESPIRATORY ACIDOSIS

- **Low pH with High $CO_2$ -- is caused by H+ accumulation as a result of hypercapnea.**

| CAUSES | TREATMENT |
|---|---|
| Hypoventilation (induced by drug overdose, head injury, neuromuscular disorder, kyphoscoliosis) | Restore ventilation either physiologically or mechanically. Reversal agents for overdose. |
| COPD | BiPAP, Bronchodilators, steroids, bronchial hygiene |
| Pulmonary Edema | Restore heart & alveolar-capillary membrane function, diuretics |

## Objective #3

**Identify metabolic & respiratory alkalosis and describe treatment.**

## NAME THIS TUNE??????

| | | | |
|---|---|---|---|
| pH | 7.48 | Step 1 | Almost normal but a bit high pH indicates alkalosis |
| PaCO2 | 48 | Step 2 | High $PaCO_2$ does not match pH. Problem is metabolic alkalosis |
| HCO3 | 31 | Step 3 | Elevated $HCO_3$ confirms above |
| | | Step 4 | High $PaCO_2$ indicates attempt to compensate. |


## METABOLIC ALKALOSIS

- **High pH & high $HCO_3$ -- primarily caused by a loss of H+**

| CAUSES | TREATMENT |
|---|---|
| Hypokalemia (decreased serum potassium) | Administer potassium if not contraindicated |
| Loss of H+ (nasogastric suctioning, vomiting, diuretic therapy, & steroid therapy) | Treat the cause of vomiting, reduce suction of nasogastric volumes, titrate medications |
| Exogenous IV or oral $NaHCO_3$ Bicarbonate administration | Discontinue administration if feasible |

## NAME THIS TUNE??????

| | | | |
|---|---|---|---|
| pH | 7.45 | Step 1 | pH is normal but is above 7.4 which indicates compensated alkalosis |
| PaCO2 | 30 | Step 2 | Low $PaCO_2$ matches pH. Problem is respiratory alkalosis |
| HCO3 | 22 | Step 3 | Normal $HCO_3$ confirms above |
| | | Step 4 | Low $PaCO_2$ with normal pH indicates complete compensation. |


## RESPIRATORY ALKALOSIS

- **High pH & low $PaCO_2$ -- caused by a primary loss of CO2 or $H_2CO_3$**

| CAUSES | TREATMENT |
|---|---|
| Neurogenic hyperventilation | If due to overdose with stimulatory drugs (acetylsalicylic acid), treat the overdose. If central neurogenic, this is often fatal. |
| Interstitial lung disease | Highly lethal disease -- systemic corticosteroids, cytotoxic agents, newer anti-inflammatories, oxygen |
| Pulmonary embolism, acute asthma, and severe hypoxemia | Oxygen enrichment, steroids, bronchodilators. |

## Objective #4

**Review different types of oxygen administration devices**

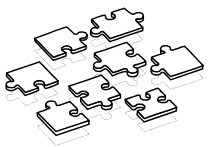
## OXYGEN ADMINISTRATION

- **REQUIRED COMPONENTS --**
  - Oxygen Source -- piped in bulk systems, compressed cylinders, liquid delivery devices, concentrator.
  - Flowmeter or Regulator to adjust the flow desired.
  - Appropriate delivery device based upon the degree of hypoxemia. Patient anatomy may also play a role.
  - Humidification???????

## OXYGEN DELIVERY DEVICES

| Device | Degree of Hypoxemia | Liter Flow & $FIO_2$ range | Special Consideration |
|---|---|---|---|
| Nasal Cannula | mild | 1 to 6 LPM $FIO_2$s of .21 to .44 | Avoid flows > 6LPM as this causes drying/discomfort |
| Medium Concentration | mild to moderate | 5 to 10 LPM $FIO_2$s of .30 to .6 | Minimum flow of 5 LPN to prevent rebreathing of $CO_2$ |
| Venturi Mask | mild to moderate | 4 to 12 LPM $FIO_2$of .24, .28, .35, .40, & .50 | Precise delivery of specific oxygen concentrations |
| NonRebreather or Partial Rebreather Mask | Moderate to severe | 7 to 15+ LPM $FIO_2$s of .5 to .9 | Flow must be sufficient to keep bag 1/2 inflated at inspiration |

## Questions & Answers



- **I'll be happy to address any questions you might have.**
- **Thanks for the opportunity to share this info with you!!!**