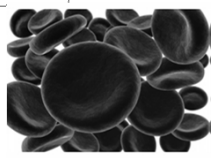
Arterial Blood Gas INTERPRETATION



By
Nena Bonuel, MSN, RN, CCRN, CNS, ACNS-BC
Nurse Specialist, Center for Professional Excellence

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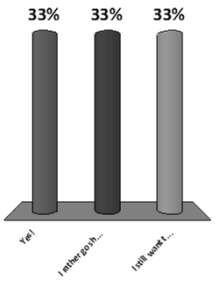
Are you ready to have fun?

1. Yes!
2. I rather go shopping☺
3. I still want to sleep☹



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Continuing Nursing Education
Disclosures to Participants

Title of Activity: ARTERIAL BLOOD GAS INTERPRETATION

I. Notice of requirements for successful completion:
90% passing score on the post-test and 1.0 CE will be awarded.

The evaluation tool will be emailed to each participant. The Email address provided on the sign in sheet upon registration will be used. The CE Certificate will be emailed upon completion of all evaluations. There will be a two week period provided for the online Zoomerang evaluation process.

https://www.zoomerang.com/Survey/WEB22EXK368GWE

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PURPOSE OF THE ACTIVITY

To increase the knowledge of the registered nurse in interpretation of the arterial blood gas to ensure appropriate nursing intervention is provided to the patient.

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OBJECTIVES

- Identify four disturbances of acid-base balance
- Discuss nursing interventions for patient with acid-base imbalances
- Describe how to interpret arterial blood gas values

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ACID – is a substance that donate H= to a base

Examples: hydrochloric acid, nitric acid, ammonium acid, lactic acid, acetic acid, and carbonic acid (H_2CO_3)

BASE- is a substance that can accept or bind H+

Examples: ammonia, lactate, acetate, and bicarbonate (HCO_3)

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pH reflects the overall H+ concentration in body fluids

The higher the number of H+ in the blood – the lower the pH

…more base than acid= fewer H+ and ↑ pH

The lower the number of H+ in the blood – The higher the pH

….more acid than base = more H+ and ↓ pH

The pH of water (H2O) is 7.4 - neutral

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The pH of blood is slightly alkalotic

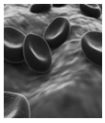
Normal range: 7.35 to 7.45

If the blood is acidic – the force of cardiac contractions diminishes

If the blood is alkaline – neuromuscular function becomes impaired

pH below 6.8 and above 7.8 – FATAL!

pH reflects the balance between the percentage of H+ and the percentage of HCO3



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REGULATING ACID-BASE BALANCE

Three Regulating Systems of body's pH:

- ***Chemical Buffers***
- ***The Respiratory system***
- ***The Renal system***

Chemical Buffers- substances that combine with excess acids or bases. They act immediately to maintain pH. They are the body's most efficient pH-balancing force.
Main buffers- bicarbonate, phosphate, and protein

Respiratory System- $CO_2 + H_2O = H_2CO_3$

- ***$PaCO_2$ (Partial pressure of arterial CO_2) –reflects the level of CO_2 in the blood***
  Normal $PaCO_2$: 35 -45 mmHg
  - ***↑ $PaCO_2$ – indicates hypoventilation from shallow breathing***
  - ***↓ $PaCO_2$ – indicates hyperventilation from shallow breathing***

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The RENAL SYSTEM

maintains acid-base balance by absorbing or excreting acids and bases
Kidney can produce and replenish HCO3

Normal HCO3: 22 -26 mEq/L

Unlike the lungs, the kidney may take 24 hours before starting to restore normal **pH**

COMPENSATING FOR IMBALANCES

ACIDOSIS – the blood has too much acid (or too little base)

ALKALOSIS - the blood has too much base (or too little acid)

Respiratory System - PaCO2 or serum CO2 levels

Metabolic System – HCO3

If pH remains abnormal, the respiratory or metabolic response is called "partial compensation"

If pH returns to normal, the response is called "complete compensation"

RESPIRATORY ACIDOSIS

Primary problem is alveolar hypoventilation
↓ **pH** < 7.35

↑ **PaCO2** > 45 mmHg

HCO3 – normal

CAUSES
- Acute pulmonary edema
- Central nervous system depression
- Chronic respiratory disease
- Disorders of respiratory muscles and chest walls
- Inadequate mechanical ventilation
- Over sedation
- Severe pulmonary infections

RESPIRATORY ALKALOSIS

Primary problem is alveolar hyperventilation

↑ **pH** > 7.35

↓ **PaCO2** <45 mmHg

HCO3 – normal

CAUSES

- Anxiety
- Early sepsis
- Excessive mechanical ventilation
- Exercise
- Fear
- Heart failure
- Hypermetabolic states such as fever
- Hypoxemia
- Liver failure
- pain

METABOLIC ACIDOSIS

Primary problems are increased acid and decrease bicarbonate (HCO3)

↓ **pH** < 7.35

↓ **HCO3** < 22mEq/L

PaCO2 – normal

CAUSES

❑**Increased acid results from:**

- Anaerobic metabolism
- Hyperalimentation
- Ketoacidosis
- Renal failure
- Salicylate intoxication
- Severe sepsis
- starvation

❑Decreased **HCO3** results from:

- Anhydrase inhibitors such as acetazolamide
- Diarrhea
- Hyperkalemia
- Intestinal fistulas

METABOLIC ALKALOSIS

Primary problems are increased HCO3 and decrease acid

↑ **pH** > 7.35

↑ **HCO3** > 26mEq/L

PaCO2 – normal

CAUSES

❑**Increased HCO3 results from:**

- **Excessive ingestion of antacids**
- Excessive use of bicarbonate
- Lactate administration in dialysis

❑ **Decreased acid results from:**

- Hyperaldosteronism
- Hypokalemia
- Hypochloremia
- Loop or thiazide diuretics
- Nasogastric suction
- Steroids
- vomiting

ABG analysis is a diagnostic test that helps you assess the effectiveness of your patient's ventilation and acid-base balance.

The results also help you monitor your patient's response to treatment.

ABG analysis provides several test results, but only three are essential for evaluating acid-base balance: **pH**, **PaCO2**, and **HCO3**.

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Memorize these normal values for adults

pH: 7.35 – 7.45

PaCO2: 35 – 45 mmHg

HCO3: 22 – 26 mEq/L

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Remember, the key to interpreting ABG values at the bedside is consistency.

Follow these four simple steps every time:
Step 1: List the results for the three essential values: pH, PaCo2, and HCO3.

Step 2: Compare them with normal values. If a result indicates excessive acid, write an **A** next to it. If a result indicates excessive base, write a **B** next to it. And if the result indicates a normal balance, write an **N** next to it. The pH will tell you whether the patient has acidosis or alkalosis.

Step 3: If you've written the same letter for two or three results, circle them.

If you circle pH and PaCO2, your patient has a **respiratory disorder.** If you circle pH and HCO3, your patient has a **metabolic disorder.** If you circle all three results, our patient all three results, your patient has **a combined respiratory and metabolic acid-base disturbance**.

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Interpreting arterial blood gas values

DISORDER	pH	PaCO2	HCO3	COMPENSATION
Respiratory Acidosis	↓	↑	N	HCO3 > 26 mEq/L
Respiratory Alkalosis	↑	↓	N	HCO3 < 21 mEq/L
Metabolic Acidosis	↓	N	↓	PaCO2 > 45 mmHg
Metabolic Alkalosis	↑	N	↑	PaCO2 < 35 mmHg

PaCO2 = partial pressure of arterial carbon dioxide
HCO3 = bicarbonate
↑ = Increase level ↓ = decreased level N = normal level

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Step 4: To check for compensatory, look at the result you didn't circle. If it has moved from the normal value in the opposite direction of those circled, compensation is occurring. If the value remains in the normal range, no compensation has occurred.

Once compensation is complete, the pH will return to normal.

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Interpreting arterial blood gas values

DISORDER	pH	PaCO2	HCO3	COMPENSATION
Respiratory Acidosis	↓	↑	N	HCO3 > 26 mEq/L
Respiratory Alkalosis	↑	↓	N	HCO3 < 21 mEq/L
Metabolic Acidosis	↓	N	↓	PaCO2 > 45 mmHg
Metabolic Alkalosis	↑	N	↑	PaCO2 < 35 mmHg

PaCO2 = partial pressure of arterial carbon dioxide
HCO3 = bicarbonate
↑ = Increase level ↓ = decreased level N = normal level

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Factors that make ABGs results inaccurate:

- Using improper technique to draw the arterial blood sample
- Drawing venous blood instead of arterial blood
- Drawing a ABGs sample within 20 minutes of a procedure, such as suctioning, or administering respiratory treatment.
- Allowing air bubbles in the sample
- Delaying transport of the sample to the lab.

ROLE OF THE NURSE

Identify patients at risk for acid-base disturbances

Also those at risk for:

- Significant electrolyte imbalances
- Net gain or loss of acids
- Net gain or loss of bases
- Ventilation abnormalities
- Abnormal kidney function

ELECTROLYTES

VS

MENTAL STATUS

RESPIRATION

FLUID BALANCE

TREAT THE UNDERLYING CAUSE

METABOLIC ACIDOSIS

- Diabetic patient- glucose control and control of insulin levels
- Poisoning – eliminate toxin from the blood
- Sepsis – antibiotic therapy, fluid administration, and surgery
- Treat acidosis directly – fluid therapy (mild)
  Bicarbonate IV as prescribed
  (severe cases)

METABOLIC ALKALOSIS

- Electrolyte imbalance (frequent offender) – replace fluid, sodium, and potassium

TREAT THE UNDERLYING CAUSE

RESPIRATORY ACIDOSIS

- The goal is to improve ventilation
  - administer drugs such as **bronchodilators** to improve breathing
  - Use of **mechanical ventilation** in severe cases
  - Maintain **good pulmonary hygiene**

RESPIRATORY ALKALOSIS

- The goal is to slow the breathing rate
  - **Anxiety** – encourage patient to slow down his/her breathing. Some patient may need an anxiolytic
  - **Pain** causing rapid shallow breathing- provide pain relief

Breathing into a paper bag allows patient to rebreathe CO2 raising the level of CO2 in the blood.

Case Study # 1

Sandi Holliman, 32, comes to the emergency department (ED) with acute shortness of breath and pain on her right side. She smokes two pack of cigarette a day and recently started taking birth control pills. Her blood pressure is 140/80 mmHg, her pulse is 110 beats/minute, and her respiratory rate is 44 breath/minute. Her ABGS values as follows:

pH – 7.50,
PCO2 – 29 mmHg
PaO2 – 64 mmHg
HCO3 – 24 mmHg
SaO2 – 86%

What is your ABG Analysis?

Interpretation: These ABGs values reveal respiratory alkalosis without compensation.

The patient's pH and PaCO2 are alkalotic and her HCO3 is normal, indicating no compensation.

You would administer O2 therapy as ordered to increase SaO2 to more than 95%.

Encourage patient to breathe slowly and regularly to decreased CO2 loss, administer an analgesic, as ordered, to ease pain, and support her emotionally to decrease anxiety.

Based on the clues, the probable cause is pulmonary embolism.

Case Study # 2

Edgar Jones, 22, is brought to the ED for an overdose of a Trycyclic
Antidepressant. He is unconscious and has a respiratory rate of 5 to 8 breaths/minute. His ABG values are as follows:

•pH: 7.25
•PaCo2: 61 mmHg
•PaO2: 76 mmHg
•HCO3-: 26 mmHg
•SaO2: 89%

What is your ABG Analysis?

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nterpretation: These ABG values reveal respiratory acidosis without compensation. T

he patient's pH and PaCO2 are acidotic and his HCO3 is normal, indicating no compensation.

You would administer O2 as ordered.
The patient may be intubated to protect his airway and placed on a mechanical ventilator.
You would also treat the underlying cause by performing gastric lavage and administer activated charcoal.

This patient's condition may progress to metabolic acidosis. If so, you would give sodium bicarbonate to reverse the acidosis.

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Case Study # 3

Maurice Jones, 62, has type I diabetes. He has not been feeling well for the last 3 days and has not eaten or injected his insulin. He is confused and lethargic. His respiratory rate is 32 breaths/minute, and his breath has a fruity odor. His serum glucose level is 620 mg/dL. While receiving 40% O2, his ABG values are:

•pH: 7.15
•PaCo2: 30 mmHg
•PaO2: 130 mmHg
•HCO3: 10 mmHg
•SaO2: 94%

What is your ABG analysis?

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Interpretation: These ABG values reveal Metabolic acidosis with partial compensation.

The patient's pH and HCO3 indicate acidosis. His PaCO2 is lower than normal, reflecting the lung's attempt to compensate.
Because the pH is abnormal, you know compensation is not complete.

Once upon a time there was a land known as ABG. Everyone there was related with only a limited number of names for the population.
They were also very polite and had their own etiquette for learning each other's names.

All of the people in the land of ABG have a first name, a middle name, and a last name.

You just have to look at them one name at a time.

The Last Name

- **First, look at her pH (normal is 7.35 - 7.45)**
- **If her pH is < 7.35; her name is ACIDOSIS**
- **If her pH is > 7.45; her last name is ALKALOSIS**

**(NOTE: To have an absolutely perfect last name; her pH needs to be 7.40.
So, keep in mind that if her pH is 7.35 - 7.39 she's thinking about marrying into the ACIDOSIS family.
If her pH is 7.41 - 7.45 she's thinking about marrying into the ALKALOSIS family)**

The First Name

Now that you know your patient's last name, you would like to also learn her first name.

Look at her pH again.
- **If it is 7.35 - 7.45 (normal) then her first name is COMPENSATED.**
- **If the pH is < 7.35 or > 7.45 then her first name is UNCOMPENSATED.**

The Middle Name

Name Alert: These people are all related and you have many patients with the same first and last name.

A middle name will give you more information.
First you need to look at the CO2 and HCO3-.
Remember :
normal CO2 35 – 45
and
HCO3- 22 - 26.

1. **The middle name will either be Respiratory or Metabolic.**
2. **If the CO2 is < 35 or > 45 , her middle name is RESPIRATORY.**
3. **If the HCO3- is < 22 or > 26, her middle name is METABOLIC.**

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The Family Feud

1. **pH and HCO3- are "kissin' cousins" they like to go in the same direction**
2. **CO2 is the "black sheep" pH runs the opposite direction when it sees him coming.**

THEREFORE:

- ❑ **Decreased pH with decreased HCO3-: ACIDOSIS**
- ❑ **Increased pH with increased HCO3-: ALKALOSIS**
- ❑ **Decreased pH with increased CO2-: ACIDOSIS**
- ❑ **Increased pH with decreased CO2-: ALKALOSIS**

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pH = 7.60 CO2 = 30 HCO3- =22

pH = 7.35 CO2- = 50 HCO3- = 25

pH = 7.55 CO2- = 40 HCO3- = 30

pH = 7.35 CO2- = 45 HCO3- = 21

pH = 7.49 CO2 = 40 HCO3- = 29

LAST NAME pH (7.35-7.45)	MIDDLE NAME CO2-35-45 HCO3- 22-26	FIRST NAME pH
ACIDOSIS (pH < 7.35)	**RESPIRATORY** CO2 <35 or >45	**COMPENSATED** pH (7.35-7.45)
ALKALOSIS (pH>7.45)	**METABOLIC** HCO3 <22 or >26	**UNCOMPENSATED** pH < 7.35 or > 7.45

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pH: 7.25
PaCO2: 56 mmHg
PaO2: 80 mmHg
HCO3: 15 mmHg
SaO2: 93%

What is your ABG analysis?

THANK YOU!

POST-TEST

Interpret the following ABG result

1. pH = 7.31 PaCO2 = 48 HCO3- = 24_____
2. pH = 7.47 PaCO2= 45 HCO3- = 33 _____
3. pH = 7.20 PaCO2 = 36 HCO3- = 14_____
4. pH = 7.50 PaCO2 = 29 HCO3- = 22_____
5. pH = 7.23 PaCO2 = 59 HCO3- = 22 _____
6. pH = 7.50 PaCO2 = 38 HCO3- = 30 _____
7. pH = 7.40 PaCO2 = 41 HCO3- = 25.5 _____
8. pH = 7.49 PaCO2 = 44 HCO3- = 34 _____
9. pH = 7.35 PaCO2 = 40 HCO3- = 23 _____
10. pH = 7.60 PaCO2 = 33 HCO3- =23 _____

NAME:_____**UNIT:**_____**SCORE:**___