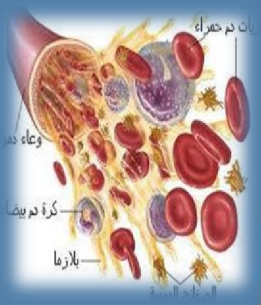
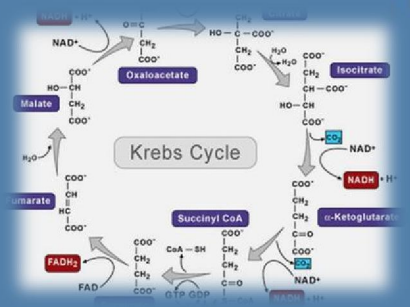
Al-Rasheed University College
Medical Analysis Department
Clinical Chemistry Lab.
Third Stage

كليـــــة الرشيد الجامعـــــــة
قســـــم التحليلات المرضيـــة
مختبر الكيميـــاء السريريـــة
المرحلـــــة الثالثـــــة





Lecture (11)

Arterial Blood Gases (ABG)

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2018

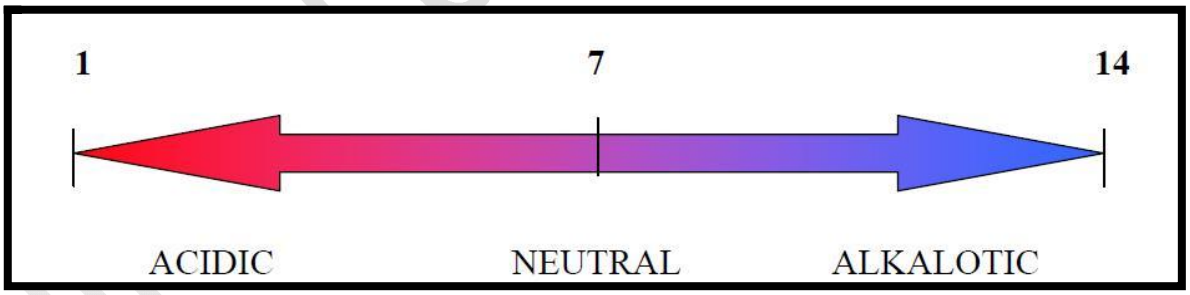
Arterial Blood Gases (ABG)

▶ Introduction:

Arterial blood gas analysis is an essential part of diagnosing and managing a patient's oxygenation status and acid-base balance. The usefulness of this diagnostic tool is dependent on being able to correctly interpret the results. This self-learning packet will examine the components of an arterial blood gas, what each component represents and the interpretation of these values to determine the patient's condition and treatment.

▶ Acid-Base Balance:

The PH is a measurement of the acidity or alkalinity of the blood. It is inversely proportional to the number of hydrogen ions (H^+) in the blood. The more H+ present, the lower the pH will be. Likewise, the fewer (H^+) present, the higher the PH will be. The PH of a solution is measured on a scale from 1 (very acidic) to 14 (very alkalotic). A liquid with a PH of 7, such as water, is neutral (neither acidic nor alkalotic).



The normal blood PH range is (7.35 - 7.45). In order for normal metabolism to take place, the body must maintain this narrow range at all times. When the PH is below 7.35, the blood is said to be acidic. Changes in body system functions that occur in an acidic state include a decrease in the force of cardiac contractions, a decrease in the vascular response to catecholamines, and a diminished response to the effects and actions of certain medications. When the PH is above 7.45, the blood is said to be alkalotic. An alkalotic state interferes

with tissue oxygenation and normal neurological and muscular functioning. Significant changes in the blood PH above 7.8 or below 6.8 will interfere with cellular functioning, and if uncorrected, will lead to death.

So how is the body able to self-regulate acid-base balance in order to maintain PH within the normal range? It is accomplished using delicate buffer mechanisms between the respiratory and renal systems.

▶ The Respiratory (Lungs) Buffer Response:

A normal by-product of cellular metabolism is carbon dioxide (CO_2). (CO_2) is carried in the blood to the lungs, where excess (CO_2) combines with water (H_2O) to form carbonic acid (H_2CO_3). The blood PH will change according to the level of carbonic acid present. This triggers the lungs to either increase or decrease the rate and depth of ventilation until the appropriate amount of (CO_2) has been re-established. Activation of the lungs to compensate for an imbalance starts to occur within 1 to 3 minutes.

▶ The Renal (Metabolic) Buffer Response:

In an effort to maintain the pH of the blood within its normal range, the kidneys excrete or retain bicarbonate (HCO_3^-). As the blood PH decreases, the kidneys will compensate by retaining (HCO_3^-) and as the PH rises, the kidneys excrete (HCO_3^-) through the urine. Although the kidneys provide an excellent means of regulating acid-base balance, the system may take from hours to days to correct the imbalance. When the respiratory and renal systems are working together, they are able to keep the blood PH balanced by maintaining 1 part acid to 20 parts base.

▶ Components of the Arterial Blood Gas

The arterial blood gas provides the following values:

➲ **PH:-**

Measurement of acidity or alkalinity, based on the hydrogen (H+) ions present.
The normal range is: **7.35 - 7.45**
Remember:
PH > 7.45 = **alkalosis**
PH < 7.35 = **acidosis**

➲ **P (O_2):- partial pressure of oxygen**

The partial pressure of oxygen that is dissolved in arterial blood.
The normal range is: **80 to 100 mm Hg**.

➲ **Sa (O2):- oxygen saturation**

The arterial oxygen saturation.
The normal range is: **95% to 100%**.

➲ **P (CO_2):- amount of carbon dioxide**

The amount of carbon dioxide dissolved in arterial blood.
The normal range is 35 to 45 mm Hg.
Remember:
pCO_2 >45 = acidosis
pCO_2 <35 = alkalosis

➲ **HCO_3:-**

The calculated value of the amount of bicarbonate in the bloodstream.
The normal range is 22 to 26 mEq/liter
Remember:
HCO_3^- > 26 = alkalosis
HCO_3^- < 22 = acidosis

➲ **B.E.:- base excess**

The base excess indicates the amount of excess or insufficient level of bicarbonate in the system.
The normal range is [(-2) to (+2) mEq/liter].
Remember:
A negative base excess indicates a base deficit in the blood.

Steps to an Arterial Blood Gas Interpretation

❶ Identify whether the PH, p(CO_2) and HCO_3^- are abnormal. For each component, label it as "normal", "acid" or "alkaline".

❷ If the ABG results are abnormal, determine if the abnormality is due to the kidneys (metabolic) or the lungs (respiratory).

Cases to an Arterial Blood Gas (ABG) Interpretation

Case (1):-

A patient is a (55 year old) male admitted to your nursing unit with recurring bowel obstruction. He has been experiencing intractable vomiting for the last several hours despite the use of antiemetics. His arterial blood gas result is as follows: pH (7.50), pCO_2 (42), HCO_3^- (33)?

	Result	Reference Value	Identification
PH	7.50	(7.35 - 7.45)	
P (CO_2)	42	(35 - 45)	
HCO_3^-	33	(22 - 26)	

The two abnormalities: Kidneys (metabolic) + Alkalosis = Metabolic Alkalosis

Case (2):-

A patient is a (60 year old) female admitted to your nursing unit with sepsis. Here is her arterial blood gas result: is as follows: pH (7.31), pCO_2 (39), HCO_3^- (17)?

	Result	Reference Value	Identification
PH	7.31	(7.35 - 7.45)	
P (CO_2)	39	(35 - 45)	
HCO_3^-	17	(22 - 26)	

The two abnormalities: Kidneys (metabolic) + Acidosis = *Metabolic Acidosis.*

Case (3):-

A patient is a (34 year old) female admitted to your nursing unit with thyrotoxicosis. Her blood gas results are as follows: pH (7.50), pCO_2 (30), HCO_3^- (24)?

	Result	Reference Value	Identification
PH	7.50	(7.35 - 7.45)	
P (CO_2)	30	(35 - 45)	
HCO_3^-	24	(22 - 26)	

The two abnormalities: Respiratory (lung problem) + Alkalosis = *Respiratory Alkalosis.*

Case (4):-

A patient is a (19 year old) male admitted to your nursing unit with head injury. Her blood gas results are as follows: pH (7.38), pCO_2 (56), HCO_3^- (35)?

	Result	Reference Value	Identification
PH	7.38	(7.35 - 7.45)	
P (CO_2)	56	(35 - 45)	
HCO_3^-	35	(22 - 26)	

the two abnormalities: Respiratory (lungs) + Acidosis = Respiratory Acidosis