



# Arterial Blood Gases

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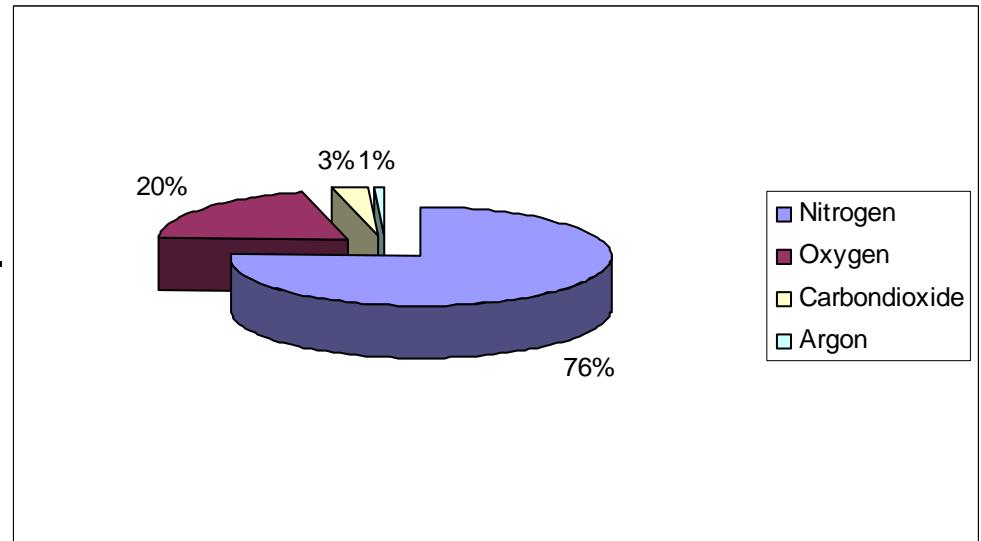
# Aims and Objectives

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- To understand the composition of gas in the air
- What does arterial gas analysis show?
- Indications for recording arterial blood gases
- Describe where acids come from and how they are eliminated from the body
- Normal values
- Describe how the body maintains the 'balance'
- Describe Acids/Alkaline/buffers
- How is it done?
- Nursing Considerations
- Arterial blood gases examples from clinical practice
- Questions

# What's in Air ?

- Nitrogen – 78%
- Oxygen – 21%
- Carbon dioxide – 0.03%
- Argon – 0.93%



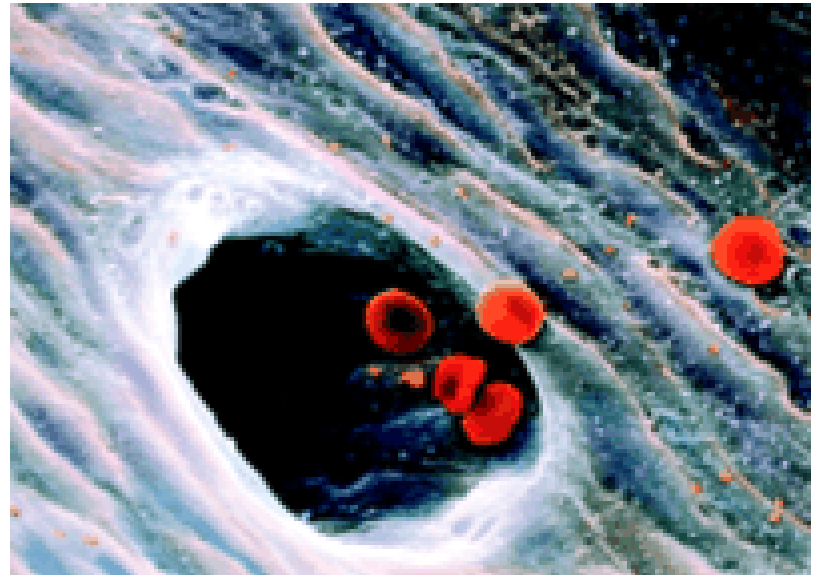
# What do ABG measure?

- Oxygenation levels
- Acid-base disturbances
- pH
- Partial pressure Oxygen
- Partial pressure carbon dioxide



# What do ABG measure?

- Also
  - Haemoglobin
  - Sodium
  - Potassium
  - Haematocrit
  - Base excess/deficit
  - Chloride
  - Lactate





So when would we do ABG?

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# A few examples ....

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- Respiratory monitoring
- Unstable patients
- Post cardiac arrest
- Intra-operatively



# What is an acid?

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# Acid and Bases made easy!

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- An acid provides hydrogen ions
- A base can accept hydrogen ions
- Acidity determined by amount of free hydrogen ions



# Where does the acid come from?

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- Acid is a by product of normal metabolism – cellular respiration.
- When cells produce energy (ATP) they release a hydrogen ion

(The Krebs cycle/Citric Acid Cycle)



# What is pH?

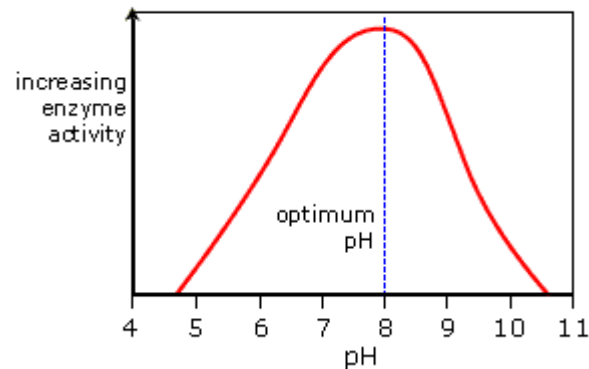
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- Scale of hydrogen ion concentration
- Low pH = ACID
- High pH = BASE
- What is the pH of water?

# Why do we need a constant pH?

## Acid is a product of metabolism

The body is continually producing acid as a by product of metabolism. However, it must also maintain a narrow range of pH values necessary for normal enzyme activity



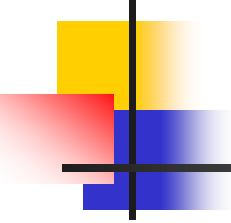


pH

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- Normal values for ABG

7.35-7.45



# How is acid and base controlled ?

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- Homeostatic pH of human blood is Controlled through 3 mechanisms
- Respiratory Renal Chemical
- Narrow range: 7.35 —7.45



# Acidosis $\text{pH} = < 7.35$

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- An abnormal process causing a relative increase in hydrogen ions and thus decrease in pH

- Increase in acid or decrease in base

## Examples

- Metabolic examples – chronic renal failure (not enough bicarbonate)
- Respiratory examples – Inadequate respiration (excess carbon dioxide)



# Alkalosis pH = > 7.45

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- An abnormal process causing a relative decrease in hydrogen ions and thus increase in pH

- Decrease in acid or an increase in base

## Examples

- Metabolic alkalosis – Vomiting ( loss of acid)
- Respiratory alkalosis – Hyperventilation ( loss of carbon dioxide)





# Buffers

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- Systems to change strong acids into weak acids and bases
- Work within a fraction of a second
- Carbonic acid system
- Phosphate
- Haemoglobin
- Proteins



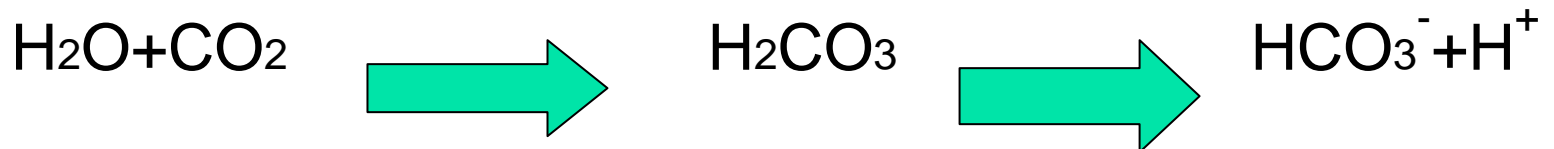
# Carbonic acid system

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Bicarbonate – ‘the mop’

- $\text{HCO}_3^-$
- Collects  $\text{H}^+$  ions and neutralises them

The most important buffer system in the body is the carbonic acid-bicarbonate system





# Normal Values

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pH	7.35-7.45
PaO <sub>2</sub>	>10.6kPa (80-100mmHg)
PaCO <sub>2</sub>	4.7 – 6.1Kpa
Bicarbonate	18-22
Base	-2 to +2

# How do you perform a ABG?

- Arterial blood gases (ABG) are samples of blood taken from the radial, brachial or femoral artery or an arterial catheter
- ABG provide essential information on cardio-respiratory conditions.  
i.e Oxygen and Carbon dioxide



# What to do when you get the sample !

- Gloves on !
- Ensure syringe heparinised
- Expel all air (absorbs oxygen in bubbles)
- Mix gently to avoid separation of sample
- Do not shake – haemolysis of red cells (potassium release)
- Analyse within 10 mins (60 mins on ice)
- Temperature correction – debatable if beneficial
- Trend is key not individual results

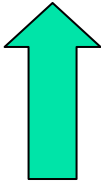





# Nursing Considerations

- Is patient fully aware of procedure?
- Pain?
- Anticoagulant therapy?
- Only 2 attempts  
very painful  
procedure



# Making it easy !

	Acidosis	Alkalosis
Respiratory	CO <sub>2</sub> 	CO <sub>2</sub> 
Metabolic	Bicarbonate/base excess 	Bicarbonate/Base excess 



Questions ?

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# ABG analysis made easy!

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- First look at pH – is it normal, acid or base?
- Then look at PaCO<sub>2</sub> – is it normal, acid or base?
- Next the Bicarbonate – is it normal acid or base?

# An example!



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- Tim – 67 admitted with chest infection
  - Ph 7.3 – ACID
  - PaCO<sub>2</sub> - 8.9kpa - ACID
  - PaO<sub>2</sub> – 10.4 kpa – LOW
  - Bicarbonate HCO<sub>3</sub> – 30mmol/l – BASE



# A word about compensation ...

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- The body wants to maintain a normal pH – so will take action to normalise pH where possible.
- Compensation can only be said to have occurred when the pH is still normal