Making Sense of Arterial Blood Gases

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What do ABG’ s show?

- Partial pressure oxygen (PaO_2)
- Oxygen Saturation (SaO_2)
- Partial pressure carbon dioxide ($PaCO_2$)
- Acid base balance (pH)
- Bicarbonate (HCO_3)
- Base Excess (BE)

Acid Base Balance

- Acidosis (low pH <7.35)
- Alkalosis (high pH >7.45)
- Can be respiratory or metabolic
  - Metabolic acidosis

    HCO_3 <22mEq/L & $PaCO_2$ 4.5-6.0mmols
  - Metabolic alkalosis

    HCO_3 >28mEq/L & $PaCO_2$ 4.5-6.0mmols
  - Respiratory acidosis

    HCO_3 22-28mEq/L & $PaCO_2$ >6.0mmols
  - Respiratory alkalosis

    HCO_3 22-28mEq/L & $PaCO_2$ <4.5mmols

Causes of acidosis

Respiratory

- Poor gas exchange due to disease
- Depressed respiratory centre causing hypoventilation

Metabolic

- Ingestion of too much alcohol (acetaldhyde Ò acetic acid)
- Excessive loss of bicarbonate (e.g. severe diarrhoea)
- Increased lactic acid (e.g exercise, shock, starvation, ketones)
- Renal failure due to excess hydrogen not being eliminated

Causes of Alkalosis

Respiratory

- Hyperventilation
- Brain tumour / injury due to abnormal respiratory control

Metabolic

- Vomiting of acidic contents of stomach
- Intake of excessive antacids
- Prolonged diuretic therapy
- Severe constipation too much HCO_3 is reabsorbed via colon

Respiratory & Renal Compensation

When an acid-base imbalance occurs due to inadequate functioning of the buffering systems (kidneys or lungs) the other system attempts to compensate

- Lungs compensate for metabolic acid-base imbalances
- The kidneys compensate for respiratory acid-base imbalances

	Respiratory Acidosis	Metabolic Acidosis	Respiratory Alkalosis	Metabolic Alkalosis
pH	Ô	Ô	Ó	Ó
$PaCO_2$	Ó	Ô	Ô	Ó
HCO_3	Ó	Ô	Ô	Ó

Base Excess (BE)

- The base excess is used for the assessment of the metabolic component of acid-base disorders, and indicates whether the patient has metabolic acidosis or metabolic alkalosis.
- A negative BE indicates a metabolic acidosis (primary or secondary to respiratory alkalosis)
- A positive BE indicates a metabolic alkalosis (primary or secondary to respiratory acidosis)

Normal Blood Gas Values

- pH 7.35 – 7.45
- $PaCO_2$ 4.5 – 6.0 Kpa
- PaO_2 11 – 14 Kpa
- SaO_2 94% - 98% (< 70 years of age)
  92% - 98% (> 70 years of age)
- HCO_3 22 - 26
- BE - 2 - +2

Respiratory Failure

Failure to maintain adequate oxygenation & adequate clearance of carbon dioxide.

- Type I Respiratory Failure (hypoxaemic)
  - Oxygenation Failure (PaO_2 **ê**)
  - PaO_2 < 8 kPa
- Type II Respiratory Failure (hypercapnic)
  - Ventilatory Failure (PaO_2 **ê**; $PaCO_2$ **é**; pH **ê**)
  - PaO_2 < 8 kPa + $PaCO_2$ >6.0 kPa (+/- Ph < 7.35)

ABG's on air

pH	7.32
$PaCO_2$	8.9 kPa
PaO_2	6.1 kPa
SaO_2	83%
HCO_3	32
BE	+ 8

ABG's on air

pH	7.30
$PaCO_2$	9.3 kPa
PaO_2	5.8 kPa
SaO_2	81%
HCO_3	24
BE	+ 6

ABG's on air

pH	7.49
$PaCO_2$	3.9 kPa
PaO_2	12.2 kPa
SaO_2	96%
HCO_3	20
BE	- 9

LTOT assessment - COPD

ABG's On air	
pH	**7.38**
$PaCO_2$	**4.9 kPa**
PaO_2	**7.1 kPa**
SaO_2	**88%**
HCO_3	**28**
BE	**+ 4**

- What additional information is required?
- Is LTOT indicated?
- What will you do next?

LTOT assessment - COPD

ABG's on 2L (nc)	
pH	7.34
$PaCO_2$	6.3 kPa
PaO_2	9.7 kPa
SaO_2	96%
HCO_3	28
BE	+ 4

ABG's on 1L (nc)	
pH	7.37
$PaCO_2$	4.9 kPa
PaO_2	8.7 kPa
SaO_2	93%
HCO_3	28
BE	+ 4