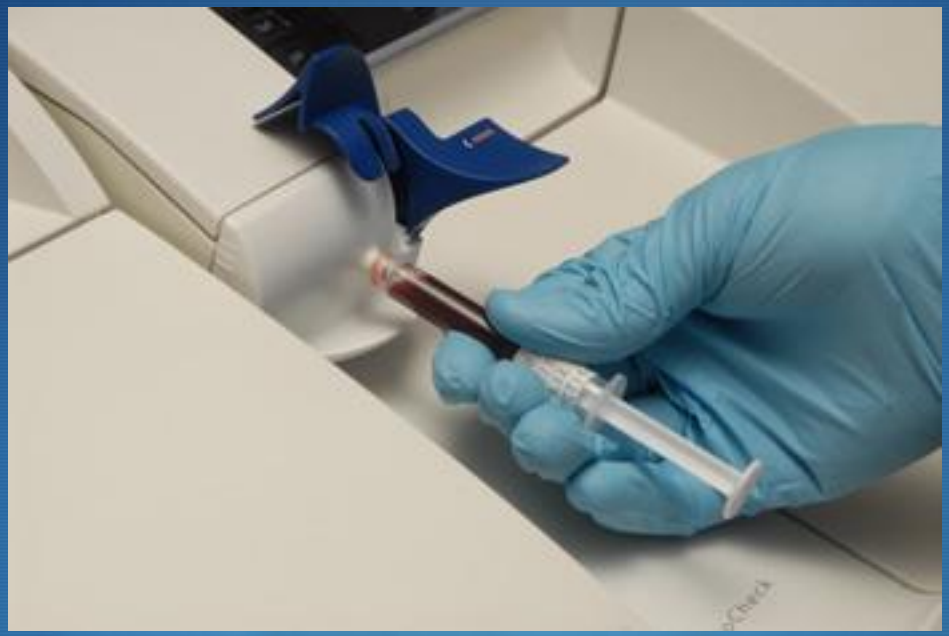

ABG Interpretation

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Overview

- An ABG analysis evaluates how effectively the lungs are delivering oxygen to the blood and how efficiently they are eliminating carbon dioxide from it.
- The test also indicates how well the lungs and kidneys are interacting to maintain normal blood pH (acid-base balance).

Overview cont.

- ABG's are usually done to assess:
- respiratory disease and other conditions that may affect the lungs, and to manage patients receiving oxygen therapy (respiratory therapy)
- In addition, the acid-base component of the test provides information on kidney function too.

Indications

- Respiratory failure - in acute and chronic states.
- Severe illness leading to metabolic acidosis including; cardiac, liver and renal failure, burns, multi-organ failure, sepsis, hyperglycemia, toxins.
- Acute Asthma SaO_2<92%
- Ventilated patients
- Patients involved in sleep studies
- Any severely unwell patients.

Contraindications

- AV fistula (dialysis)
- Negative Allen's Test
- Fractured wrist
- Poor peripheral circulation (PVD)

Procedure

- Direct arterial puncture usually radial artery, alternatives include femoral and brachial in emergency settings and the ulnar and dorsalis pedis.
- Essential to ensure collateral flow (Allen's Test)
- Explain the procedure to the patient - it is painful.
- If there is time then local anaesthesia can be used.
- ABG syringes usually come prepacked and are heparinised. Some contain a vacuum and thus the plunger does not always need to be pulled.

Procedure cont.

- The wrist is extended - a pillow under the hand may improve comfort.
- Palpate the artery and hold fingers firmly over the pulsation.
- Then introduce the needle at a 45° angle slowly with the bevel facing upwards, aiming for the point of maximum pulsation.
- Once you hit the artery, try to obtain at least a 1 ml sample.
- Once you have taken your sample and withdrawn the needle, apply firm pressure for a minimum of 2 minutes

Procedure Cont.

- If multiple samples are required then an indwelling arterial cannula can be placed.
- Allow the patient to titrate with the oxygen for 5-10 minutes (30 minutes if they have chronic obstructive pulmonary disease (COPD)) before taking a sample.
- Remember ICE!!!!!

Interpretation of Results

- Normal pH is 7.35-7.45
- Value <7.35 is acidotic
- Value >7.45 is alkalotic
- Acidosis & Alkalosis can be caused by a problem with the respiratory system or a metabolic cause
- Can also have combined respiratory/metabolic states

Is it Respiratory or Metabolic?

1. Respiratory Acidosis
   - Increased pCO2 >50
2. Respiratory Alkalosis
   - Decreased pCO2<30
3. Metabolic Acidosis
   - Decreased HCO3 <18
4. Metabolic Alkalosis
   - Increased HCO3 >30

Compensated or Uncompensated?

1. Evaluate pH—is it normal? Yes

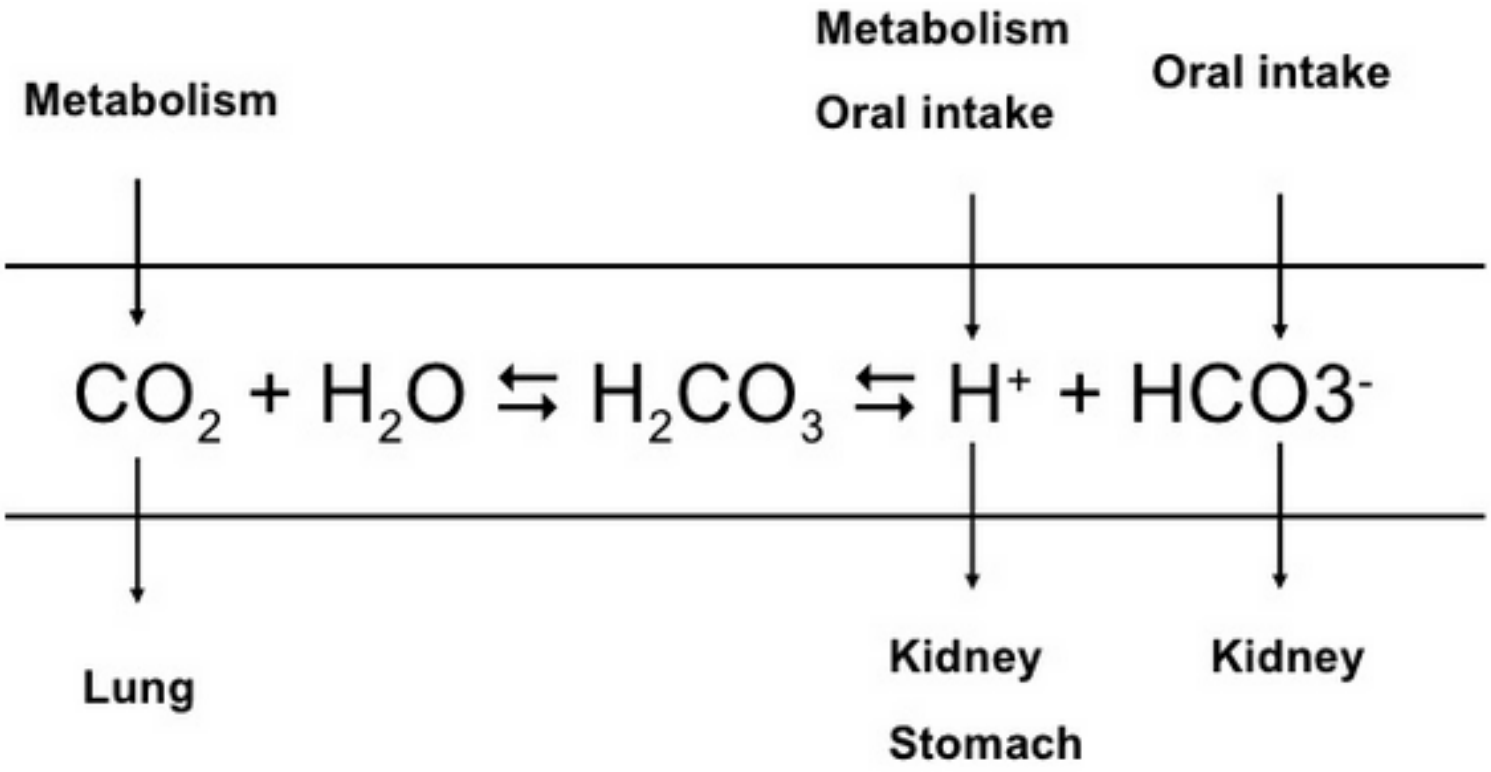
2. Next evaluate pCO_2 & HCO_3

   - pH normal + increased pCO_2 + increased HCO_3 = compensated respiratory acidosis
   - pH normal + decreased HCO_3 + decreased pCO_2 = compensated metabolic acidosis

Compensated vs. Uncompensated

1. Is pH normal? No
2. Acidotic vs. Alkalotic
3. Respiratory vs. Metabolic
   - pH<7.30 + pCO2>50 + normal HCO3 = uncompensated respiratory acidosis
   - pH<7.30 + HCO3<18 + normal pCO2 = uncompensated metabolic acidosis
   - pH>7.50 + pCO2<30 + normal HCO3 = uncompensated respiratory alkalosis
   - pH>7.50 + HCO3>30 + normal pCO2 = uncompensated metabolic alkalosis

Buffering


Metabolism
Metabolism
Oral intake
Oral intake
$CO_2 + H_2O \leftrightarrows H_2CO_3 \leftrightarrows H^+ + HCO3^-$
Lung
Kidney
Stomach
Kidney

CO_2

- pCO_2 normally is maintained between 35-45 mm Hg. A dissociation curve similar to that for O_2 exists for CO_2 but is nearly linear over the physiologic range of $PaCO_2$. Abnormal PCO_2 is always linked to disorders of ventilation and is always associated with acid-base changes.
- Hypercapnia = Hypoventilation
- Hypocapnia = Hyperventilation

Anion Gap

- Anion gap - this is useful in any cause of metabolic acidosis.
- In plasma, the sum of the cations is normally greater than that of the anions by approximately 14 mmol/L (normal range 10-18 mmol/L).
- $(Na^+ + K^+) - (Cl^- + HCO_3^{-}) = \text{Anion Gap}$

Assessing Oxygenation

- Hypoxaemia- paO2 less than 60 mmHg
- Affected by age.
- Normal SaO2
  - Arterial: 97%
  - Venous: 75%

Important points for assessing tissue oxygenation

- This is the O2 that is really available at the tissue level.
- Is the total Hb normal?
  - Low Hb means the ability of the blood to carry the O2 to the tissues is decreased
- Is perfusion normal?
  - Low perfusion means the blood isn't even getting to the tissues

Oxygen Therapy

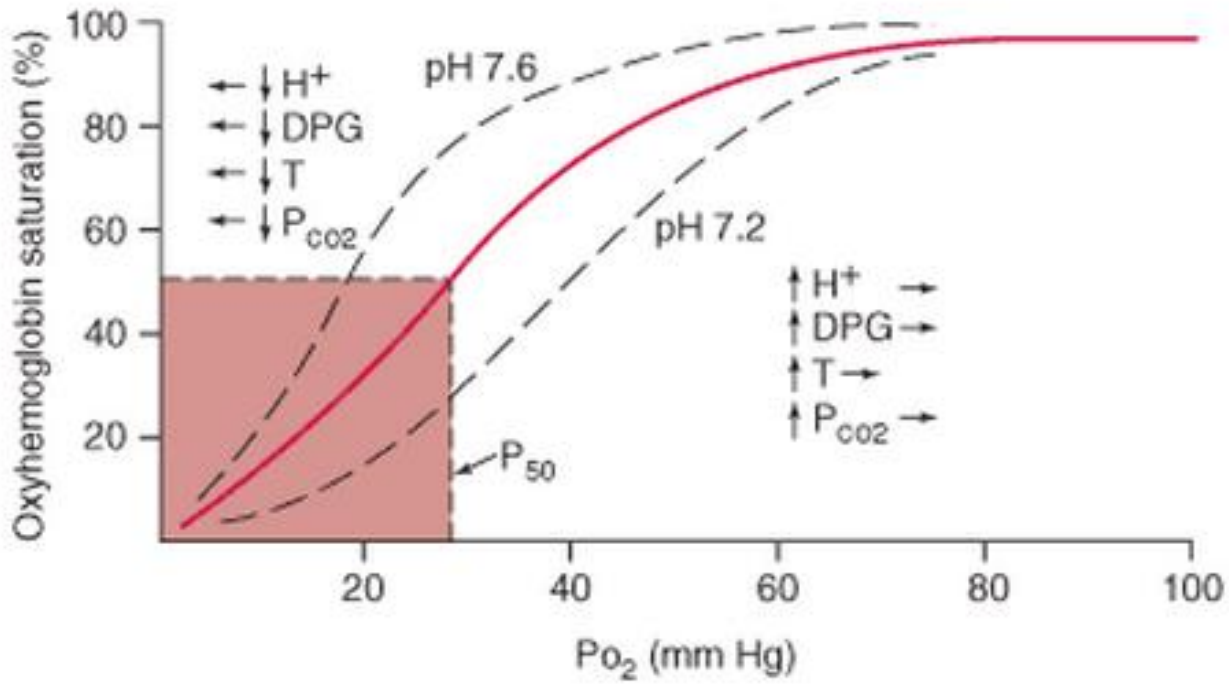
- Fraction of Inspired Oxygen (FiO2): This is the percent of oxygen a patient is inhaling. Room air FiO2 is 21%. By applying supplemental oxygen, the FiO2 can go as high as 100%.
- Est. of % of O_2 involved in exchange at alveoli.
- Indications for Oxygen Therapy:
  - To correct hypoxemia
  - To reduce oxygen demand on the heart
  - Suspected or acute marcardial infarction (MI)
  - Severe trauma
  - Post anesthesia recovery

Oxygen Therapy

- Nasal Cannula: The nasal cannula is the most common oxygen device used and the most convenient for the patient. A nasal cannula at 2lpm is usually a good place to start.
- You may at times need to estimate the FiO2. How to estimate FiO2 on a nasal cannula? For every liter per minute, the FiO2 increases by 4%.

Haemaglobin

Oxyhemoglobin dissociation curve.



Causes of Acidosis

- **Respiratory**
  - Hypoventilation
  - Impaired gas exchange
- **Metabolic**
  - Ketoacidosis
    - Diabetes
  - Renal Tubular Acidosis
    - Renal Failure
  - Lactic Acidosis
    - Decreased perfusion
    - Severe hypoxemia

Causes of Alkalosis

- **Respiratory**
  - Hyperventilation due to:
    - Hypoxemia
    - Metabolic acidosis
    - Neurologic
      - Lesions
      - Trauma
      - Infection
- **Metabolic**
  - Hypokalemia
  - Gastric suction or vomiting
  - Hypochloremia

Worked Examples

12 year old diabetic presents with Kussmaul breathing

- pH : 7.05
- pCO2: 12 mmHg
- pO2: 108 mmHg
- HCO3: 5 mEq/L
- BE: -30 mEq/L

17 year old w/severe kyphoscoliosis, admitted for pneumonia

- pH: 7.37
- pCO2: 25 mmHg
- pO2: 60 mmHg
- HCO3: 14 mEq/L
- BE : -7 mEq/L

9 year old w/hx of asthma, audibly wheezing x 1 week, has not slept in 2 nights; presents sitting up and using accessory muscles to breath w/audible wheezes

- pH: 7.51
- pCO2: 25 mmHg
- pO2 35 mmHg
- HCO3: 22 mEq/L
- BE: -2 mEq/L

7 year old post op presenting with chills, fever and hypotension

- pH: 7.25
- pCO2: 32 mmHg
- pO2: 55 mmHg
- HCO3: 10 mEq/L
- BE: -15 mEq/L

What Leads to What?

- PE
- Vomiting
- Severe diarrhea
- Cirrhosis
- Renal failure
- Sepsis
- Pregnancy
- Diuretic use
- COPD

- Metabolic alkalosis
- Metabolic acidosis
- Respiratory alkalosis
- Metabolic acidosis
- Met. Acid/ Resp. Alk
- Respiratory alkalosis
- Metabolic alkalosis
- Respiratory acidosis