

Chapter 3 - Blood Gases

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3.1 Introduction

Blood gas sampling and analysis plays a vital role in diagnosis of clinical problems and monitoring of possible treatment modalities such as supplemental oxygen (O₂) or assisted ventilation.

Blood gas analysis can measure several parameters, which can aid diagnosis when interpreted in relation to the clinical state of the patient. Blood gases reflect the ability of the cardiopulmonary system to maintain the relationship between cellular respiration and supply of O₂ and elimination of carbon dioxide (CO₂) via the lungs.

It is essential that inspired oxygen concentration is known and noted when performing any measurement of blood gases.

3.2 Nomenclature

P denotes partial pressure. Blood gases are all denoted by lower case letters; 'a' means arterial, 'v' venous, 'c' capillary and 'tc' measured transcutaneously.

For example:

- PaCO₂ = partial pressure of carbon dioxide in arterial blood
- PcCO₂ = partial pressure of carbon dioxide in capillary blood
- tcPO₂ = partial pressure of oxygen measured transcutaneously

3.3 Invasive Measurement of Blood Gases

3.3.1 Arterial Sampling

This procedure is routinely performed by medical staff and senior healthcare scientists and therefore this section is included for completeness.

Arterial samples may be taken from radial, brachial or femoral arteries although the radial is the most commonly used. The full procedure must be explained to the patient in order to obtain

their consent. If the procedure is to be performed in the lung function laboratory, and the patient's hospital notes are not available, their consent must be documented in the departmental file.

Allen's test

The modified Allen's test can be performed prior to sampling to determine there is adequate collateral circulation to the hand via the ulnar artery in the unusual event of a complicating thrombosis of the radial artery. The patient is questioned as to whether they are left or right handed and their opposite arm should be used due to possible discomfort. To do this, the operator should occlude both the ulnar and the radial arteries by pressing down over the wrist. The patient should then be instructed to make a fist and then open the hand. The palm of the hand will be blanched (pale and bloodless) and the pressure over the ulnar artery should be released. If the hand returns to a normal colour, the ulnar circulation is intact.

3.3.1.1 Equipment Requirements

For all invasive procedures, the equipment must be thoroughly prepared prior to the procedure. Equipment is outlined in Table 3.1 comparing the requirements for arterial and capillary sampling.

3.3.1.2 Procedure for Arterial Sampling

1. The patient should be comfortable in a supine or semi-recumbent position, facing the operator
2. The patient's arm is supported on a pillow with the wrist fully extended
3. The artery should be located by palpation
4. The puncture site should be prepared by rubbing lightly with a gauze swab
5. The needle should be advanced slowly at an angle of 45 degrees. Puncture of the artery is detected by blood entering the syringe under arterial pressure
6. A sample of 1 to 2 ml is required for analysis
7. Once the needle is withdrawn, cotton wool should be applied immediately, keeping pressure on the puncture site, and should be applied for 10 minutes
8. Air bubbles must immediately be expelled from the syringe according to the manufacturer's instructions before analysis
9. The needle must either be inserted into a bung or discarded in a sharps container immediately after use. If the needle is removed, the syringe should be capped immediately
10. The sample must be mixed to ensure anticoagulation
11. The sample should be analysed as soon as possible. If this cannot be done, it should be stored in an ice water slurry at 0°C and analysed within an hour