

## ARTERIAL BLOOD GAS SAMPLING FOR TRAINED PROFESSIONALS

This guidance does not override the individual responsibility of health professionals to make appropriate decision according to the circumstances of the individual patient in consultation with the patient and /or carer. Health care professionals must be prepared to justify any deviation from this guidance.

### INTRODUCTION

Arterial blood gases are taken to evaluate the patient's oxygenation, ventilation and acid base balance using samples obtained from a single percutaneous needle puncture into a peripheral artery.

### THIS GUIDELINE IS FOR USE BY THE FOLLOWING STAFF GROUPS :

Medical staff, Respiratory Specialist Nurses, Specialist Practitioners, Critical Care Outreach Nurses; and Registered Nurses and Physiotherapists working in A&E, intensive and high care areas, MAU and respiratory wards.

### Lead Clinician(s)

Sarah Austin Respiratory Specialist Nurse

Approved by Clinical Management Committee on: 19<sup>th</sup> September 2012

Approved by Medicines Safety Group on: Not applicable

This guideline should not be used after end of: 30<sup>TH</sup> November 2017

### Key amendments to this guideline

Date	Amendment	By:
28/02/2012	Diabetic ketoacidosis is no longer an indication for areterial blood gas sampling and has therefore been removed	Sarah Austin
28/02/2012	Alcohol swabs have been changed to Chloraprep in line with infection control guideline	Sarah Austin
28/02/2012	The policy has been expanded to include medical staff	Sarah Austin
13/03/2012	Safety devices on ABG syringes should be used	Sharon Ellson
November 2016	Documents extended for 12 months as per TMC paper approved on 22 <sup>nd</sup> July 2015	TMC

## ARTERIAL BLOOD GAS SAMPLING FOR TRAINED PROFESSIONALS

### INTRODUCTION

Arterial blood gases are taken to evaluate the patient's:

- Oxygenation
- Ventilation
- Acid base balance

Arterial blood gas samples are usually obtained from a single percutaneous needle puncture into a peripheral artery although those who require frequent sampling may have an indwelling catheter in situ.

### Key measurements in Arterial Blood Gas Analysis

Measured parameters

- Hydrogen ion concentration – pH
- Oxygen tension-  $P_aO_2$
- Carbon dioxide tension - $P_aCO_2$

Calculated parameters

- Bicarbonate concentration( $HCO_3^-$ )
- Base excess
- Oxygen concentration

Normal arterial blood gas values	
$P_aO_2$	>10.6 kPa
$P_aCO_2$	4.7-6.0 kPa
pH	7.35-7.45
$HCO_3^-$	24-30 mmol/L
$S_aO_2$	≥95% +
Base Excess	-2 to +2

Oxford Handbook of Clinical Medicine 4<sup>th</sup> edition

### DETAILS OF GUIDELINE

#### Sites for Arterial Puncture

The radial artery is the usual site for arterial blood sampling because it is near to the surface, is easy to palpate and stabilise and usually has a good collateral supply from the ulnar artery (Williams 1998).

Other sites include the femoral artery, the brachial and axillary artery.

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For the purpose of this guideline the radial artery of the non-dominant hand is the artery of choice for nurses and physiotherapists performing arterial blood sampling. If neither of the radial arteries can be used for arterial blood sampling the nurse must contact the appropriate medical personnel and request patient review.

### Location of the radial artery

The radial artery is a branch of the brachial artery and can be palpated in the distal forearm. It is most accessible proximal to the proximal transverse crease on the lateral aspect of the wrist.

### Complications of arterial puncture

Immediate	Pain, Failure, Venous sampling, bleeding, haematoma
Late	Ischaemia, infection

(Girling & Hobbs 1997)

### Competencies required/criteria for competence

This policy is limited to Medical staff, Respiratory Specialist Nurses, Specialist Practitioners and Critical Care Outreach Nurses; and Registered Nurses and Physiotherapists working in A&E, intensive and high care areas, MAU and the respiratory wards of Worcestershire Acute Hospitals NHS Trust.

### Ensuring safe practice

Medical staff should have had their competencies completed as part of their medical training. All nurses and physiotherapists acting under this policy must have attended a course, which includes arterial blood gas sampling as part of the formal content, and must have completed 10 successful supervised attempts, of which the last 5 should be sequential before they can act independently.

Any nurse or physiotherapist acting under this policy must expect to perform at least 5 ABG samples per month in order to maintain their level of competence.

Nurses and physiotherapists working under this protocol are allowed a maximum of two attempts at blood gas sampling – if unsuccessful the patient must be referred to another practitioner. It is good practice for medical staff to limit their number of attempts if they are having difficulty obtaining a sample.

Arterial sampling must not be performed on limbs with evidence of:

- Peripheral vascular disease
- Infection
- Skeletal trauma
- Surgical shunt
- Raynaud's or Berger's disease

(Coombs 2001)

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### Patients Covered

There are a number of circumstances where a ward- based patient will require arterial blood gas (ABG) analysis:

- Assessment of supplementary oxygen requirements
- Prior to and during invasive and Non-Invasive Positive Pressure Ventilation
- Post cardiac arrest
- Poisoning
- Shock from any cause
- Acute renal failure

Arterial blood gas sampling should also be considered in the following clinical situations:

- Any unexpected deterioration in an ill patient
- Anyone with an acute exacerbation of a chronic chest condition
- Anyone with impaired consciousness
- Anyone with impaired respiratory effort
- Anyone with shock

Arterial blood gas samples were previously used to assess diabetic ketoacidosis, however venous samples are now considered to be reliable measures of pH and bicarbonate (in patients without respiratory problems), and Trust policy now recommends venous sampling for assessment of this condition.

As the person who obtains the sample is also the person who processes the sample, they have immediate access to the results. One of the limiting factors when devolving this task from doctors to non-medical staff is that the staff must be able to act on the information that is obtained from the sample.

The following are circumstances where nurses and physiotherapists would be able to take an arterial blood sample and be guided by protocol on how to act on the results:

- Monitoring a patient who has commenced NIPPV.
- Assessment for Long Term Oxygen therapy (LTOT)
- Assessment for supplementary oxygen therapy.
- Assessment of the deteriorating patient by a nurse practitioner or a member of the critical care out-reach team.

Nurses and physiotherapists should not perform arterial blood gas sampling under any other circumstances, except in an emergency when a doctor is in direct attendance and able to interpret the results immediately.

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### Procedure

#### Equipment

- Heparinised blood gas syringe with safety device and size 22G gauge needle
- Chloraprep SEPP (2% Chlorhexidine Gluconate w/v 70% Isopropyl Alcohol v/v)
- Tape
- Sharps box
- Patient label
- Gloves

This procedure requires two people – the clinician performing the procedure and analysing the sample and an assistant to support the patient's wrist in the appropriate position and to maintain pressure on the puncture site following the procedure. As the procedure is painful, the clinician should consider whether a capillary blood sample would be appropriate, especially where serial monitoring is required. Medical staff may consider using a local anaesthetic prior to arterial blood gas sampling.

#### Procedure


Action	Rationale
Explain the procedure to the patient (excludes emergency situation e.g. cardiac arrest)	To obtain informed consent and co-operation
Wash hands and put on protective gloves and an apron	To reduce the risk of infection
Position the patient in the semi-recumbent position	To decrease the risk of vasovagal response
Palpate the radial pulses in both wrists	To identify the most appropriate site
When the site is identified perform a modified "Allen's Test" (see below) If a patient is too ill to undergo the Allen's Test the nurse should seek the advice of a doctor about the appropriate arterial site for puncture	To assess the collateral arterial blood supply to the hand through the ulnar artery should the radial artery become thrombosed
For radial puncture the patient's wrist is gently extended and supinated with the help of an assistant. A rolled or folded towel may be used to help support the wrist in position	To expose puncture site and facilitate arterial puncture
Confirm the location of the artery by palpation and clean site with Chloraprep and allow to air dry	To reduce the risk of infection

#### Arterial blood gas sampling for trained professionals

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Expel excess heparin and any air bubbles by holding the syringe vertically and the needle uppermost.	To fill the dead space within the needle and syringe and to coat the syringe with heparin. Excess heparin can alter the pH of the blood
The artery is then fixed using the index finger of the non-dominant hand, and the needle, bevel up, (with heparinized syringe assembled) is introduced through the skin at an angle of 30-45°. The needle is then passed through the wall of the artery (warn the patient that this may be uncomfortable). On entering the artery the syringe will fill spontaneously. Withdraw approximately 1.5-2ml of blood. If no blood obtained, withdraw needle slowly, observing for pulsation at the base of the needle.	
Withdraw the needle and immediately apply firm pressure with a gauze swab for a minimum of 5 minutes or longer if site bleeds (10 minutes if anticoagulated)	To decrease the risk of bruising and bleeding
Expel any air bubbles from the syringe, dispose of the needle into the sharps box and cap the syringe. Attach the addressograph label.	Air bubbles result in gas equilibration between the air and the arterial blood leading to a decrease in PaCO <sub>2</sub> and an increase in PaO <sub>2</sub> (Williams 1998) To ensure proper identification of sample
Remove gloves and apron and wash hands	To reduce the risk of infection
Note the patient's inspired oxygen concentration (FIO <sub>2</sub> ) – usually expressed as a percentage (e.g. 24%) and temperature.	To ensure that results are correct for the patient
The sample should be analysed immediately according to the protocol from the Biochemistry department.	The cellular constituents of blood remain metabolically active so arterial gas tensions in the sample will change. If the sample cannot be analysed within 15 minutes it should be cooled to 5°C by placing sample on crushed ice—it can then be stored for up to one hour without any clinically significant effect on the result (Williams 1998)

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<p>Details of the procedure including informed consent, site and number of attempts made should be recorded and signed for in the nursing record.</p> <p>The main ABG results should be recorded in the patient's notes</p> <ul style="list-style-type: none"><li>• Ph</li><li>• <math>P_aCO_2</math></li><li>• <math>P_aO_2</math></li><li>• <math>HCO_3^-</math></li><li>• Base Excess</li></ul>	<p>To maintain effective communication</p>
<p>The nurse must act on the results in accordance with the following protocols</p> <ul style="list-style-type: none"><li>• NIPPV Policy</li><li>• Oxygen Policy</li><li>• Long term Oxygen Therapy (LTOT)</li></ul>	
<p>In any other circumstances a doctor must be contacted as soon as possible to discuss the implications of the results</p>	<p>To ensure that the results are interpreted correctly and the patient receives the appropriate treatment</p>

### Modified Allen's Test

This test is performed to check the adequacy of the ulnar artery as collateral blood supply to the hand.

Hold the patient's hand above the level of their heart and apply enough pressure with your fingers to both the radial and ulnar arteries to occlude them. Ask the patient to make a clenched fist and relax it several times.



When the hand appears blanched, ask the patient to unclench the hand and lower it. The whole hand should appear pale.



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The hand is opened and the pressure on the ulnar artery is released while maintaining pressure on the radial artery. Measure the elapsed time until the hand returns to normal colour. More than 6 seconds is classified as delayed.



If the test shows delay on only one hand, perform the arterial puncture on the other. If both hands show delay, the arterial puncture may have to be performed on an alternative site (Tape T 1996).

### MONITORING TOOL

The respiratory specialist nurse will provide training for this skill and competency must be demonstrated before this skill can be undertaken. Competency will be reviewed annually as part of staff appraisal and adherence to the guideline is the remit of the ward/department manager.

### REFERENCES

Coombs M (1997) Making sense of arterial blood gases **Nursing Times** Vol 97, No 27 p36-38.

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Tape G (1996) Arterial puncture for blood gas analysis in **Procedural Skills for Internal Medicine** (Wigton R S, Tape T eds) Mosby, St Louis

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