Critical Care Therapy and Respiratory Care Section

Category:	Clinical
Section:	Diagnostics
Title:	Collection of Arterial Blood for Laboratory Analysis
Policy #:	02
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1.0 INTRODUCTION

Arterial blood is presented to all organs for their metabolic needs; its composition is uniform throughout the body. The composition of venous blood is conditioned by the metabolic activity of the tissue which it drains and therefore varies among different parts of the body. The largest difference between arterial and venous blood is its oxygen content, but pH and carbon dioxide content also vary. All differences between arterial and venous blood are magnified when the general or local circulation is impaired.

Arterial blood is obtained via arterial line sample or by puncture of the radial or brachial artery in order to measure arterial blood gases and acid-base status of the patient. Only those individuals who have been certified in arterial blood gas collection by the Section's Medical Director may obtain arterial samples.

2.0 SAFETY

Universal precautions must be observed when collecting blood specimens. Specimens from any patient could be infected with bloodborne pathogens.

2.1 Specific Recommendations for Arterial Puncture

2.1.1 Barrier Protection

Barrier protection should be routinely used to prevent skin and mucous membrane contamination. Universal precautions guidelines should be followed.

2.1.2 Unintentional (Accidental) Injury

Extreme care should be taken to avoid unintentional injuries caused by needles, scalpel blades, common laboratory instruments. In the event of an unintentional injury, the event must be immediately reported using established reporting guidelines.

2.1.3 Cleansing Hands

The therapist must wash hands and other skin surfaces thoroughly and immediately if contaminated with blood, and wash hands immediately after the gloves are removed.

3.0 SPECIMEN COLLECTION

3.1 The Patient

3.1.1 Physiologic Status

The patient should be as physiologically stable as possible when the blood specimen is collected.

3.1.2 Temperature

Blood gas results are to be "corrected" to patient temperature by adjustingthe analyzer setting to the correct temperature of the patient. The patient temperature must be obtained prior to performing blood gas analysis.

3.1.3 Ventilation

Ideally, a patient's ventilation should be stable during collection. If the patient is breathing spontaneously, promote physical and mental comfort by quiet and reassuring talk. The patient should be in a comfortable position with a stabilized breathing pattern for at least five minutes before a sample is drawn.

3.1.4 Inspired Oxygen Concentration (FIO2)

Patients receiving supplemental oxygen should be maintained on the same settings for at least 20 minutes before sampling.

3.1.5 PEEP and CPAP

Patients on positive end-expiratory pressure (PEEP) or continuous positive airway pressure (CPAP) should be maintained on the same PEEP or CPAP settings for at least 20 minutes before arterial sampling.

4.0 HAZARDS OF ARTERIAL PUNCTURE

4.1 Hematoma

Because of the higher pressure in the arteries compared to veins, more blood is apt to leak through the puncture site. On the other hand, elastic tissue in the arterial wall tends to cause closure of the puncture more rapidly. The danger of hematoma or external bleeding is greatly enhanced in patients receiving anticoagulant therapy, or in those patient's with platelet counts below $100{,}000/mm^3$.

4.2 Arteriospasm

Arteriospasm is a reflex constriction of the artery in response to pain or other stimuli; occasionally it may be induced by anxiety. Although it is transient, it may make it impossible to obtain blood, even though the needle is properly located in the lumen of the artery.

4.3 Thrombosis

A thrombus forms if the intima of the vessel is injured. This is most likely to happen if a needle or cannula is left in place for some time. The presence or absence of collateral vessels is important to determine the primary site for arterial puncture.

5.0 PRINCIPLE

5.1 Single Arterial Puncture

Arterial blood is obtained anaerobically by inserting a short-beveled, sharp needle, directly attached to a syringe, into an artery. The system should be leakproof and free of air bubbles. With 23 gauge or larger needles, the pressure in the artery will force blood into a well-lubricated syringe so that suction is not necessary. Excessive suction lowers the gas pressure of the sample and, therefore, the partial pressure of the individual gases.

5.2 Indwelling Arterial Needle Cannulae or Flexible Catheters

5.2.1 When repeated measurements of arterial blood gases are required, a needle cannula or catheter may be inserted and fixed in the artery and left there for several days.

5.2.2 A pressurized flush system is used to prevent clot formation at the tip or in the lumen of the catheter.

5.2.3 0.9% sodium chloride solution is used when the patient's platelet count less than 100,000/mm^3.

5.2.4 Heparin saline solution is used when the patient has a platelet count greater than 100,000/mm^3.

6.0 SELECTION OF THE SITE OF ARTERIAL PUNCTURE

6.1 Criteria for Selection of the Site

6.1.1 Collateral blood flow

6.1.2 Accessibility and size of artery

6.1.3 Periarterial tissue (danger of injury to adjacent tissue)

6.2 Site of Arterial Puncture

6.2.1 Guidelines

Arterial punctures by critical care therapists will be performed only in radial (preferable) or brachial arteries. **Femoral artery punctures will be done in selected cases by physicians or with a physician's special permission.**

6.2.2 Radial Artery

The radial artery is easily accessible at the wrist in most patients, and, in current practice, is the most commonly used site for arterial puncture in clinical situations. Collateral circulation to the hand in addition to the radial artery is normally provided by the ulnar artery, which may be absent in some individuals. The Allen test or the Doppler ultrasonic velocity detector may be helpful in evaluating this collateral circulation. In the absence of an ulnar artery, the radial artery should not be punctured.

6.2.3 Brachial Artery

The brachial artery may be difficult to puncture as it is located deep between muscles and connective tissues. Because of its deep location it is difficult to compress effectively, therefore hematoma formation is more common than at other sites.

6.2.4 Femoral Artery

The femoral artery is a large vessel which usually is superficially located in the groin and is easily palpated and punctured. Disadvantages are poor collateral circulation to the leg and increased chance of infection.

7.0 EQUIPMENT AND SUPPLIES

7.1 Arterial blood gas sampling kit with heparinized syringe, needle, alcohol wipe, and sterile gauze.

7.2 Cup with ice.

7.3 Patient identification label.

7.4 Sterile gloves.

7.5 A puncture-resistant disposal container in which to place used needles and disposable syringes with attached needles. The container should be made of rigid plastic, have a lid, and be clearly marked as a biohazard.

8.0 PROCEDURE

8.1 Check the patient's chart or the MIS computer to determine that there is an order for the arterial blood gas and for the value of the patient's most recent platelet count. If the platelet count is below 100,000/mm^3 anticipate having to maintain pressure on the site for more than five minutes.

8.2 Feel for radial pulses on both wrists to determine which will be the better site from which to draw. Do not perform an arterial puncture on an extremity which appears to have an inadequate blood supply.

8.3 Perform the Allen’s test on the hand which has been selected for the puncture. If the Allen’s test is positive meaning a determination of adequate

collateral flow the puncture may be done. The arm should be abducted with the palm facing up and the wrist extended about 30 degrees to stretch and fix the soft tissues over the firm ligaments and bone.

8.4 Remove the syringe cap and first pull back on the syringe and then express most of the heparin out of the syringe so that only a small amount of heparin remains (too much heparin will affect the accuracy of the arterial results). Recap the syringe until ready to perform the stick.

8.5 Prepare the puncture site aseptically. Put on sterile gloves and maintain sterile technique during the arterial puncture process.

8.6 Having already determined the optimal site to perform the arterial puncture, cleanse that area well with sterile alcohol swabs.

8.7 Remove the syringe cap and with the bevel of the needle pointing upwards, puncture the skin about 5 to 10 mm distal to the finger directly over the artery. The puncture angle should be approximately 45 degrees toward the direction of the blood flow.

8.8 Slowly advance the needle and syringe with one hand while continuing to palpate the artery with the other hand. When a flash of arterial blood is observed in the hub of the needle, do not advance the needle further.

8.9 While holding the syringe and needle stationary with one hand, gently pull back on the plunger of the syringe with the other hand to allow the syringe to fill. (NOTE: There are several types of AUTOSTICK blood gas kits on the market. The therapist should review the package insert for correct use of the product. The PULSATOR kit does not require pre-setting before sampling). Usually it is desirable to obtain one to two mls of blood.

8.10 As soon as the desired amount of blood has been obtained, the therapist should no longer aspirate the syringe, but should remove the needle and syringe rapidly and press down on the puncture site with sterile gauze.

8.11 Any air bubbles should be removed from the sample as quickly as possible, the syringe should be capped (not with a needle), labeled, and placed in the cup of ice until it can be run in the blood gas analyzer. It may require the assistance of a second person to briefly hold the site while the specimen is being prepared.

8.12 Pressure must be applied firmly on the puncture site with sterile gauze until blood no longer bleeds or oozes from the site. Most patients with normal coagulation parameters will require about five to ten minutes; patients with altered coagulation parameters may take more compression. In such cases, continue to firmly hold pressure on the site with gauze while checking to see if bleeding has ceased every five minutes.

8.13 Before leaving the patient bedside, a patient label must be affixed to the sample and the patient's current temperature should be written on it.

8.14 The sample should only be run by an authorized and competency proficient critical care therapist.

8.15 Brachial Artery Puncture

8.15.1 The patient's arm is fully extended and the wrist rotated until the maximum pulse is palpated with the index finger just above the skin crease in the antecubital fossa. The arterial pulse is then followed proximally by palpation with the middle finger for 2 to 3 cm (see Appendix A).

8.15.2 Skill in performing the puncture is required to avoid hitting the median nerve which carries sensory fibers and lies very close to the brachial artery.

8.15.3 Cleanse the site [see section 8.0 (5)].

8.15.4 Spread two fingers along the course of the artery which may be located by palpating the pulsations. Enter the skin just below the distal (index) finger and aim the needle along a line connecting the two fingers, using a 45 degree angle of insertion with the bevel up. The artery lies deep in the tissues, especially in obese individuals; it does not run parallel to the bone.

8.15.6 After the puncture, compress the artery against the humerus, if possible, for a minimum of five minutes to stop bleeding. Effective compression of the brachial artery may be difficult but is obviously important.

8.16 Femoral Artery Puncture See Guidelines Section 6.2.1

8.16.1 The femoral artery is located quite superficially in the inguinal triangle, just below the inguinal ligament. The patient should lie flat with both legs extended. The pulsating vessel should be palpated with two fingers.

8.16.2 Cleansing of the puncture site [see section 8.0 (5)] should be very thorough because of the often heavy contamination of this area. The area around the puncture site should be shaved, if necessary.

8.16.3 The palpating fingers are spread 2 to 3 cm apart along the course of the artery to anchor the vessel. The needle puncture is made perpendicular to the skin surface, or at an angle against the blood stream, between two fingers.

8.16.4 Compression of the artery after the puncture is required as in Section 8.12. Pressure dressings are not an acceptable substitute. Inspect the site of puncture to ascertain that no hematoma is developing, and that the distal circulation is intact.

8.17 Technique for Specimen Removal from Arterial Catheters

In order to prevent clotting in the arterial catheter, the flush solution is continuously infused through the arterial catheter. To obtain a blood specimen, this flush solution must first be interrupted.

8.18 Precautions

Precautions must be taken to:

8.18.1 Prevent introducing any air into the system.

8.18.2 Ensure that all connections are secure.

8.18.3 Complete removal of "dead-space" contents of the catheter and connectors prior to withdrawing the specimen.

8.18.4 Properly prepare the sampling syringe with heparin or use dry heparinized syringe.

8.18.5 Avoid any air in the syringe.

8.19 Aspiration

8.19.1 The catheter contents are aspirated with a syringe to ensure that only fresh, undiluted arterial blood fills the catheter.
This is normally accomplished by having a stopcock connected between the catheter and the infusion line.

8.19.2 Approximately 1ml of fluid should be drawn back into a "waste" syringe and discarded.

8.20 Withdrawing Specimen

A second heparinized arterial syringe is then placed on the stopcock and the blood specimen is slowly withdrawn into the syringe. The syringe is removed. Free of air bubbles it is capped, iced, labeled and analyzed.

8.21 Infusion

Approximately 1 to 1 and one half ml of flush solution is infused through the catheter to ensure that it is being cleared of blood. When a positive pressure infusion device is used, it is recommended that small increments of the flush solution be infused slowly, recognizing the possible danger of embolization to the central circulation. The normal infusion rate is then resumed.

9.0 POST PROCEDURE

9.1 Discard any excess materials brought to the bedside for the arterial stick.

9.2 Ascertain that the patient is in a comfortable position post procedure.

10.0 CHARTING

10.1 Inpatients

10.1.1 After running the arterial sample according to the CCTRCS procedure manual, write the blood gas result on the CCTRCS Patient Daily Sheet.

10.1.2 Write the results on the Patient/Nursing Flowsheet at the bedside along with the settings or oxygen type in the space provided and discuss any immediate concerns about unexpected values with the physician and nurse caring for the patient.

10.2 Outpatients

10.2.1 After running the arterial sample according to the CCTRCS procedure manual, generate a copy from the LDS of the sample and place it in the outpatient chart.

10.2.2 In the "Progress Notes" section of the patient's chart, document the time, date, site where puncture was performed, note that the Allen's test was performed, the results of the blood gas, and any complications of the procedure (i.e., hematoma, etc.).

10.2.3 Telephone the results to the ordering physician.

11.0 PROCEDURE NOTES

11.1 Certification Process

Therapists may perform arterial punctures only after the following required activities:

11.1.1 Attendance at a lecture of anatomy, technique and complications of arterial punctures.

11.1.2 Supervised performance of a minimum of one successful arterial stick by the Section Chief or a Supervisor (depending upon previous experience).

11.1.3 Successful completion of established written competencies (85% or greater).

11.1.4 Performance of arterial sticks will be continually evaluated and assessed through quality data provided by the Laboratory Data System (LDS).

12.0 REFERENCES

12.1 National Committee for Clinical Laboratory Standards: Percutaneous Collection of Arterial Blood for Laboratory Analysis, Second Edition, Document H11-A2.

12.2 National Committee for Clinical Laboratory Standards: Clinical Laboratory Technical Procedure Manuals, Second Edition, Document GP2-A2.

12.3 Shapiro, Barry A, Harrison, Walton: Clinical Application of Blood Gases (Third Ed: Year Book Medical Publishers) 1993.

12.4 Ehrmeyer, Sharon S, Shrout, Joan B,: Blood Gases, pH and Buffer Systems Fundamentals of Clinical Chemistry, 2d ed. Philadelphia, Saunders, 1976.

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