

Policy #:	407 (PLH-407-05)	Effective Date:	9/30/2004	Reviewed Date:	8/1/2016
Subject:	ARTERIAL PUNCTURE PROCEDURE				
Approved by: Laboratory Director, Jerry Barker (electronic signature)					
Approved by: Laboratory Medical Director, Mark P. Burton, MD (electronic signature)					
Approved by: Affiliate Lab Medical Director, Chris Giampapa, MD (electronic signature)					
Approved by: Affiliate Lab Medical Director, Paul J. Sims, MD (electronic signature)					
Approved by: Affiliate Lab Medical Director, F.E. Williamson, MD (electronic signature)					

ARTERIAL PUNCTURE PROCEDURE

CLINICAL SIGNIFICANCE

The clinical significance of an arterial puncture, for the purpose of blood gases, is to determine if a patient is in an acidic or alkalotic state and to determine if a patient is well oxygenated. The clinical indications for arterial puncture are well documented in the professional literature, and a valid indication should be clearly present before the decision is made to obtain an arterial blood sample. The three recognized indications are as follows:

1. Assessment of the patient's acid/base balance (pH)
2. Assessment of the patient's ventilatory status (PaCO₂)
3. Assessment of the patient's oxygenation status (PaO₂)

SAMPLE

Heparinized arterial whole blood transported to the lab immediately. Blood Gas Kits are available in the lab.

PATIENT PREPARATION

1. Introduce yourself to the patient.
2. **BEFORE BEGINNING ANY PROCEDURE—ACCURATELY IDENTIFY THE PATIENT--**
Follow the proper protocol to identify the patient using the electronic patient identification system or make positive identification of the patient by checking hospital armband for patient's name and hospital number. Make sure the name and number correspond with the request label. When possible the patient's identity should be verified by asking the patient to identify him or herself. Any discrepancies must be clarified before the puncture is performed. If the patient is not wearing an armband, tell the nurse you are not permitted to draw the sample until the patient is wearing an armband. (Clients and walk-in outpatients in the stick room do not always have an armband. They should be identified by having them

state their full name and some other identifying piece of information-date of birth, Social Security number, street address, etc. This is the only permissible exception.)

3. Briefly explain arterial puncture to the patient. The patient should be informed that you need to draw a blood sample from an artery. Reassure the patient and proceed to answer any questions the patient may have regarding the arterial puncture. Be alert to patients who are excessively anxious. These patients will have the tendency to hyperventilate, thus altering blood gas values. On the other end of the spectrum is the so-called "Bullet Biter". This patient is dreading the procedure to the point of gritting his or her teeth and holding his/her breath until the procedure is over. Again, blood gas values may be altered and may not accurately represent the cardiopulmonary status of the patient.
4. Puncture Site Selection: Phlebotomists should only attempt punctures of the radial or brachial arteries. No other artery should be punctured. Always check the non-dominant arm (left arm in right-handed person) first and use radial arteries in that arm if possible. (Check above the bed, the armband, and on the patient's door for instructions concerning puncture site. For example, a sign may inform you that no punctures are to be performed in the right arm.) Select the artery with the most prominent pulse for puncture following the below criteria.
 - a) In the stable hydrated patient, collateral circulation should be your primary site-selection criterion. The only site which normally provides effective collateral circulation is the radial artery. The brachial artery bifurcates at the level of the elbow into the radial artery (which runs along the lateral aspect of the forearm) and the ulnar artery (which runs along the medial aspect of the forearm). This arterial blood supply system provides collateral circulation to the distal aspects of the forearm and the hand. In the event that either artery becomes occluded, blood flow to the limb and hand will continue through the other artery. To insure adequate collateral circulation, the Allen test should be performed on all patients when evaluating the radial artery as a possible puncture site. A positive Allen Test will provide documentation of collateral circulation from the ulnar artery and the test must be positive before the radial artery can be used for a collection site. Puncture site selection criteria should be strictly followed since the complication rate and severity of complications is directly related to the presence of collateral circulation to the hand via the ulnar artery.

Allen Test Procedure

1. *Compress the radial artery and ulnar artery of the same hand to obliterate pulses.*
2. *Choose one of the following methods to promote blanching of the hand:*
 - a) *Have patient clench and release a fist until blanching of the hand occurs and then with radial artery still compressed, release pressure on ulnar artery.*
 - b) *Elevate the patient's hand above the level of the heart with fist clenched until the hand is blanched, then lower the patient's hand below the level of the heart and have the patient open his or her hand.*
 - c) *In the unconscious or uncooperative patient, elevate, squeeze, and lower patient's hand until blanching occurs.*
3. If good collateral circulation is present, blood should return to the hand within 15 seconds as evidenced by the hand returning to its normal pink color. If a pink color

fails to appear, collateral circulation may be assumed to be inadequate and the radial artery, for a collection site, must not be used.

- B. Before making a brachial collection the RN must be notified and asked if the patient is on thrombolytic or other anticoagulant therapy. The doctor must give permission to collect ABGs brachially if the patient is on therapy or other anticoagulant therapy.
- C. The femoral artery should not be used as a collection site by a phlebotomist. Only a physician should attempt a puncture of the femoral artery.
- D. Superficial vessels are easier to palpate, stabilize, and puncture. Both the radial and brachial arteries can present in a superficial manner, however, the radial artery will prove to be easier to isolate due to the fact that the wrist can be hyperextended to a greater degree than the elbow. This will also allow better stabilization of the artery in preparation for puncture.
- E. Proximity to periarterial tissues can cause pain. In cases of extreme patient anxiety, there is a probability that the patient may be excessively reactive to the puncture, jerking his or her arm at the time of needle insertion. In such patients, the brachial artery will prove to be the site of choice.
- F. Vessel size is only an important consideration in shock patients and during cardiopulmonary resuscitation settings where pulses are absent or difficult to locate in the extremities. In the dehydrated patient, pulses may be faint or undetectable, often making palpation difficult or impossible. During CPR efforts, patient pulses may be absent except for the pulses produced by external chest compressions. Such pulses will be faint at best.

PREPPING THE PUNCTURE SITE

1. Wash hands.
2. Put on gloves.
3. Prep the area with an iodine prep pad. Thoroughly prep the area with an alcohol swab using a circular motion moving away from the planned puncture site.

PROCEDURE

1. The most critical step for successful puncture of the radial artery without complication is proper positioning technique.
 - a. The patient should be positioned comfortably either in the sitting, supine, or semi-fowlers position. His or her arm should rest comfortably on a flat surface.
 - b. The wrist of the selected arm should be hyperextended approximately 60 degrees over an arterial positioner, arm board, or a rolled towel. This will stabilize the arm and help to isolate the artery, reducing the likelihood of the artery rolling from beneath the needle.
2. Since arteries are deep vessels, they cannot be visualized as would be the case with veins. Therefore, they must be palpated using the index and middle fingers. The path of the artery should be determined. It is not uncommon for arteries to take tortuous paths and appear in anomalous locations. Therefore, it is essential to palpate both proximal and distal to the puncture site. There are two commonly used techniques for palpation of the radial artery. Technique A: The artery is palpated in the crease of the wrist using the index and middle fingers. Once the artery path is determined, the fingers are moved proximally 1-2 cm, and the puncture is made just distal to the index finger.

Technique B: The artery is palpated in the same manner as in technique A. Once the artery path has been determined, the two fingers are separated 3-4 cm. The puncture site will be located midway between the two fingers.

Helpful Hint: Arteries have surrounding muscular sheaths which allow them to actively expand and contract. If the artery is not properly isolated by hyperextension of the wrist these muscular sheaths may cause the artery to roll from beneath the needle at the point of puncture. In thin patients whose arteries are especially prone to rolling, it is helpful to slide your two palpating fingers slightly medial on the artery. Instead of applying downward pressure while palpating, apply pressure at a 45 degree angle. This will "trap" the artery, preventing it from rolling.

3. Open ABG collection set and remove syringe from package. Attach 22 gauge short bevel needle to syringe, keeping needle in sterile protective cap. Holding syringe vertical, slide plunger up and down several times. Gently tap syringe to remove air bubbles. Remove the cap and eject remaining heparin. Do not leave a measurable quantity of heparin in the syringe.
4. To perform the actual puncture; hold the syringe with the 22 gauge short bevel needle as if holding a pencil. The bevel of the needle should be up, and the needle should be held at a 45 degree angle from the skin surface with the needle pointing toward the patient. Holding the needle toward the patient will prevent injury in the event that the patient would jerk his or her arm away from the phlebotomist during the puncture. Stabilize the wrist in the position that presents the maximal pulse. After proper positioning and palpation, the patient should be informed that he/she is about to feel a "stick" or "sting" and that he/she should resist the urge to jerk the arm or tighten the arm muscles. (Tightening the forearm could change the alignment of the artery.) Once prepared, the needle insertion should proceed in the smooth fashion so that the needle traverses to the subcutaneous tissue level. At a 35-40 degree angle pierce the skin at the puncture site and slowly advance the needle in one plane. Upon entering the artery, a flash of blood will appear in the hub of the needle. At this point, discontinue advancement of the needle. The syringe should fill in a pulsating fashion. Avoid any unnecessary movement of the syringe while filling is taking place.
Helpful Hint: If a flash occurs but filling stops prior to complete filling of the syringe, slightly retract the syringe. Frequently the needle bevel will go through the posterior wall of the artery. Retracting the syringe will place the needle bevel back in the artery and allow filling to continue.
5. If the puncture attempt is unsuccessful or incomplete, the needle should be repositioned in an effort to obtain a sample without removing the needle completely.
Step 1: Slowly remove the needle until the top of the needle bevel is just beneath the skin. (Proceed slowly as the needle bevel is short and it is easy to completely remove the needle.)
Step 2: Repalpate the artery and reassess needle position.
Step 3: Slowly reposition the needle, being careful not to advance the needle tip into subcutaneous tissues while repositioning.
Step 4: Smoothly advance the repositioned needle until a flash appears in the hub of the needle or filling continues. Allow filling to continue until the desired sample has been collected.

If the puncture attempt is unsuccessful after repositioning, a second attempt can be made. If still unsuccessful after second attempt, terminate the procedure. Excessive attempts at

repositioning should be avoided due to the increased possibility of needle occlusion from clot formation which will prevent syringe filling.

6. After enough blood has filled syringe (usually about 3ml is adequate) withdraw needle and immediately apply pressure directly to puncture site with clean gauze pad. While continuing to hold pressure on the puncture site, properly remove the needle, hold the syringe vertically, gently tap syringe, and advance the plunger to remove air bubbles. Cap syringe with stopper provided in ABG kit. Roll syringe between palms of hand to mix blood with the heparin that is coating the syringe. Continue to hold direct pressure to the puncture site for a minimum of 5 minutes. After 5 minutes, examine the puncture site for bleeding, which may be transcutaneous or subcutaneous in nature. Direct pressure should be continued until all bleeding has ceased. (See **COMPLICATIONS OF ARTERIAL PUNCTURES** in this procedure.) After bleeding ceases, cover puncture site with sterile bandage.
7. Record patient's name, account number, FIO₂, ventilatory parameters, Allen test result, puncture site, time/date, and your initials on the ABG label.
8. After the sample is properly labeled, return to the patient for final assessment. Evaluate the site to assure that all bleeding has stopped. Repalpate the artery to assure that there is a pulse present in the punctured artery. Absence of a pulse may indicate vessel obstruction. Offer final reassurance to the patient and address any questions or concerns that the patient may have.
9. Deliver the properly labeled blood sample to the lab immediately (30 minutes maximum).
NOTE: Any patient who has ABGs drawn in the lab stick-room should be asked to remain the area for 30 minutes. At the end of 30 minutes, re-check the patient's arm for any abnormalities.

COMPLICATIONS OF ARTERIAL PUNCTURES

NOTE: You should **NEVER** attempt an arterial stick or a stick to a foot vein without an order from the physician. An arterial stick is very traumatic to the patient and can result in serious, permanent damage to the circulation in that limb and to the nerves in that area.

However routine this procedure may appear, the practitioner should be well aware of the possible associated complications. The great majority of complications can be avoided by utilizing proper techniques. Complications can range from relatively minor in severity (e.g. subcutaneous hematomas) to life and limb threatening (e.g. thrombus migration and arterial laceration). The observed complications of arterial puncture are:

1. **Bleeding:** Bleeding can result in any patient in which proper post-puncture technique is not carefully followed.
HELPFUL HINT: One helpful hint in determining whether puncture site pressure has been applied long enough is to apply pressure directly to the radial artery distal to the puncture site. If the puncture site has not completely clotted, this will cause site bleeding to reappear, thus indicating the need for additional pressure on the puncture site. This technique will alleviate scenarios in which undetected bleeding may become heavy or lead to the development of hematomas. Patients at high risk for post-puncture bleeding include:
 1. Patients receiving anticoagulation therapy
 2. Patients with platelet dysfunction
 3. Hemophiliacs
 4. Patients in liver failure

5. Patients with Vitamin K deficiency
2. Infection: Any procedure resulting in violation of the patient's defense mechanisms can result in infection. Clearly, improper site preparation and/or improper procedure technique can result in subcutaneous infection.
3. Vessel Obstruction: Of all the complications presented to this point, vessel obstruction is the least preventable. However, proper needle insertion technique can reduce the complication rate significantly. Obstruction of the vessel can result from the dislodging of arteriosclerotic plaque from the artery wall. Excessive needle manipulation will increase the likelihood of this occurring.
4. Vessel Laceration: Rare in incidence, this complication results from excessive needle manipulation while the needle bevel is below the surface of the skin. This laceration can be complete or partial. Severe bleeding that does not cease with the appropriate amount of direct pressure should raise suspicion of artery laceration.

SOURCES OF ERROR

1. Venous puncture instead of arterial puncture.
2. Air bubbles left in syringe.
3. Heparin left in syringe.
4. Clotted specimens

REFERENCES

Gerald F. Dixon, MD, FCCP, John W. Waite, BS, RRT, CCT, Deryl E. Gulliford KS, RRT, RCT

Acknowledgements: James Shearhan, MS, RRT, CCP