



# Arterial Blood Gas Puncture (Respiratory Therapy)

## Site Applicability

St. Paul's Hospital  
Mount Saint Joseph Hospital

## Practice Level

Respiratory Therapist

## Requirements

Respiratory Therapists (RT) will be available to provide arterial blood gas sampling services on all nursing units and clinical areas of St. Paul's Hospital and Mount Saint Joseph Hospital.

Arterial punctures are a shared responsibility between Medical and Respiratory Therapy staff, and whenever possible, the medical resident or medical student intern should make the first attempt at obtaining any routine samples. If the RT is unsuccessful at obtaining an arterial sample after two attempts, a second therapist or physician should be requested to attempt the procedure.

The RT will assume primary responsibility for all STAT arterial blood gas requests. In the event the therapist cannot respond to a STAT request within a reasonable period of time, they may defer the request to the ordering physician.

New employees to PHC Respiratory Services that are unable to demonstrate prior clinical education or experience in performing arterial blood gas punctures will be required to complete the approved TRU Arterial Blood Gas Certification Training which includes the witnessed successful performance of two arterial puncture procedures.

## Need to Know

The radial artery is the preferred site for sampling and all effort must be made to obtain a radial arterial sample due to the following factors:

- The artery is easily accessible
- The artery is superficial and therefore easier to palpate
- There is collateral blood flow
- This site has the lowest associated risk of complications

The femoral artery will be the secondary site of choice for arterial blood gas punctures, and should be used in cases where collateral circulation to the hand is inadequate, or in the case of extremely



hypotensive patients (e.g. cardiac arrest). Where possible, femoral punctures will not be performed on awake and coherent patients. Inform the physician if the femoral artery is the only site available.

The brachial artery is the last site of choice for obtaining blood gas samples due to the increased risks associated with this location, which includes the lack of collateral circulation and the proximity of the nerve to the brachial artery. Inform the physician if the brachial artery is the only site available.

A modified Allen test must be performed whenever possible prior to performing radial artery punctures. This test is used to assess for the presence of collateral circulation to the hand and wrist via the ulnar artery. If adequate collateral circulation cannot be demonstrated, an alternative arterial blood gas site must be selected. The test may be performed passively if the patient is unconscious or unable to assist.

### **Potential Complications of Arterial Puncture**

- Thrombus
- Hemorrhage
- Hematoma
- Arteriospasm
- Infection
- Pain
- Peripheral nerve damage

### **Indications**

- Identification and monitoring of acid-base disturbances
- Measurement of the partial pressures of oxygen (PaO<sub>2</sub>) and carbon dioxide (PaCO<sub>2</sub>)
- Assessment of the response to therapeutic interventions
- Detection and quantification of the levels of abnormal hemoglobins (e.g. Carboxyhemoglobin and methemoglobin)
- Procurement of a blood sample in an acute emergency setting when venous sampling is not feasible.

### **Contraindications**

- Negative modified Allen test
- Local infection, thrombus, aneurysm, or distorted anatomy at the puncture site
- Fractures in the immediate area
- Gross edema
- Burns
- Numerous previous punctures



- Recent arterial line removal
- Patient refusal of the procedure
- Femoral grafts
- Sites distal to a surgical shunt
- Coagulopathy

## Equipment and Supplies

- SafePICO Self-fill Syringe
- Alcohol swab
- 2x2 Sterile gauze
- Personal Protective Equipment as appropriate
- Biohazard specimen bag
- Small rolled towel (optional)
- 1 x 3 inch Adhesive bandage (optional)
- 23g x 1 ½ inch needle (for femoral punctures only)

## Procedure

### Modified Allen Test:

#### Steps

1. Lift the patient hand upwards and instruct them to open and close their hand several times.
2. With the patient's fist clenched, apply direct pressure to both the radial and ulnar arteries then instruct the patient to lower and open their hand.
3. While maintaining pressure on the radial artery, release the pressure over the ulnar artery and observe the hand for the return of colour:
  - a. Return of colour in less than 7 seconds indicates patency of the ulnar artery and an intact superficial palmar arch; this is interpreted as a positive modified Allen test.
  - b. Return of colour between 8 to 14 seconds indicates the test is neither positive nor negative.
  - c. Return of colour after 15 seconds or more, indicates an abnormal test and an alternate puncture site should be considered.

### Procedure for Radial Artery Puncture

#### Steps

1. Verify physician's order in CST Cerner and review patient chart for pertinent information, including anticoagulant therapy, and contraindications to ABG sampling.
2. Verify the correct patient by identification and generate ABG specimen label:
  - a. Using a workstation on wheels, open PowerChart for the appropriate patient.



- b. Click the "Sunquest Collect" icon. Scan QR code on the wireless printer to pair as prompted.
  - c. Scan barcode on patient label. Select the appropriate specimen label from the displayed list (i.e. ABG) and print. Click 'Done –EXIT' to close program.
3. Gather appropriate supplies, perform hand hygiene/don appropriate PPE, and explain procedure to patient.
4. Verify the patient is receiving the correct oxygen therapy as per the ABG orders  
**Note: Where possible, wean the  $\text{FiO}_2/\text{O}_2$  therapy as per PHC Oxygen Therapy Guidelines to maintain a saturation level of greater or equal to 92%, allow 10 minutes for equilibration, then obtain the sample.**
5. Position the patient's arm and hyperextend the wrist slightly so that the radial artery is easily palpable and accessible (a small rolled towel may be used to improve access). Prepare the site with the alcohol swab.  
**Note: Have an assistant secure or hold down the patient's limbs if they are not coherent enough to follow directions, or if there are any concerns that the patient may move before, during, or after the procedure when risk of needle stick injury is highest.**
6. Prepare the vented syringe to the desired filling volume of approximately 1.5mL. Ensure the needle-protection device is attached and functional.
7. Palpate the chosen puncture area until the location of the radial artery has been established. Anchor the artery with two fingers.
8. Puncture the skin with the needle held at an angle of 30 to 45 degrees. Ensure the bevel of the needle is facing upwards and towards the direction of blood flow.
9. Advance the needle slowly until the arterial lumen has been entered and blood return is noted in the hub of the needle. If the artery is missed, withdraw the needle until the bevel is just below the surface of the skin and redirect into the lumen of the artery. Note:
  - **If at any point during the procedure the needle is withdrawn completely from the skin, it must be discarded and a new needle placed for subsequent puncture attempts.**
  - **If the artery is not punctured after 2 or 3 attempts at redirection, the needle should be withdrawn and pressure applied to the site with sterile gauze. Re-evaluate the puncture site.**
  - **If the vein is punctured, withdraw the needle and apply pressure to the site with sterile gauze. Discard syringe and re-evaluate the puncture site.**
10. Maintain the needle in position and allow the blood to passively fill the syringe.
11. Withdraw the needle, engage the needle protection device, and apply direct pressure over the puncture site with the sterile gauze. Maintain pressure on the site for a minimum of 5 minutes, or until bleeding has stopped.  
**Note: Maintain pressure for a minimum of 10 minutes if the patient has been receiving anticoagulants. Inform the physician if the bleeding is not controlled within 10 minutes.**
12. Clear any air bubbles from the sample and cap the syringe with the supplied cap from the ABG syringe kit. Do not recap the needle.



13. During the time that the pressure to the site is being applied, roll the syringe evenly to distribute the heparin.
14. Label the syringe with the ABG specimen label and place in biohazard bag.
15. Dispose of equipment and supplies. Place the needle in a sharps container. Remove gloves and perform hand hygiene.
16. Send the ABG sample to the laboratory via the pneumatic tube system, or arrange to have the sample hand delivered to the laboratory.

**Note: At Mount Saint Joseph Hospital the ABG sample may be analyzed by the RT using the Point of Care Analyzer.**

## Procedure for Femoral Artery Puncture

### Steps

1. Complete steps 1 through 4 as outlined under radial artery puncture steps.
2. Rotate leg slightly outward to facilitate easier access to the femoral artery. Prepare the site with an alcohol swab.

**Note: Have an assistant secure or hold down the patient's limbs if they are not coherent enough to follow directions, or if there are any concerns that the patient may move before, during, or after the procedure when risk of needle stick injury is highest.**

3. Prepare the vented syringe to the desired filling volume of approximately 1.5mL. Ensure the needle protection device is attached and functional.

**Note: A 23g x 1 ½" needle may need to be exchanged with the supplied needle for patients with excessive adipose tissue.**

4. Palpate the chosen puncture area until you have established the location of the femoral artery and anchor the artery with two fingers.
5. Puncture the skin with the needle held at an angle of 90 degrees, ensuring the bevel of the needle is facing towards the direction of blood flow.
6. Advance the needle slowly until the arterial lumen has been entered and blood return is noted in the hub of the needle. If the artery is missed, withdraw the needle until the bevel is just below the surface of the skin, and redirect into the lumen of the artery.

**Note: If at any point during the procedure the needle is withdrawn completely from the skin, it must be discarded and a new needle placed for subsequent puncture attempts.**

**If the artery is not punctured after 2 or 3 attempts at redirections,** the needle should be withdrawn and pressure applied to the site with sterile gauze. Re-evaluate the puncture site.

**If the vein is punctured,** withdraw the needle and apply pressure to the site with sterile gauze. Discard the syringe and re-evaluate the puncture site.

7. Maintain the needle in the position and allow the blood to passively fill the syringe.
8. Withdraw the needle, engage the needle-protection device, and apply direct pressure over the puncture site with the sterile gauze. Maintain pressure on the site for a minimum of 5 minutes, or until bleeding has stopped.



**Note: Maintain pressure for a minimum of 10 minutes if the patient has been receiving anticoagulants. Inform the physician if bleeding is not controlled within 10 minutes.**

9. Palpate the pulse distal to the puncture site to ensure continued adequate circulation to the lower leg.
10. Clear any air bubbles from the sample and cap the syringe with the supplied cap from the arterial blood gas kit. Do not recap the needle.
11. During the time that pressure to the site is being applied, roll the syringe evenly to distribute the heparin.
12. Label the syringe with the ABG specimen label and place in biohazard bag.
13. Dispose of equipment and supplies. Place the needle in a sharps container. Remove gloves and perform hand hygiene.
14. Send the ABG sample to the laboratory via the pneumatic tube system, or arrange to have the sample hand delivered to the laboratory.

**Note: At Mount Saint Joseph Hospital the ABG sample may be analyzed by the RT using the Point of Care Analyzer.**

## **Procedure for Brachial Artery Puncture**

### **Steps**

1. Complete steps 1 through 4 as outlined under radial artery puncture steps.
2. Extend the patient's arm at the elbow with the palm facing upwards. The puncture site will be just above the elbow crease in the antecubital fossa. Prepare the site with the alcohol swab.  
**Note: Have an assistant secure or hold down the patient's limbs if they are not coherent enough to follow directions, or if there are any concerns that the patient may move before, during, or after the procedure when risk of needle stick injury is highest.**
3. Prepare the vented syringe to the desired filling volume of approximately 1.5 mL. Ensure the needle-protection device is attached and functional.
4. Palpate the chosen puncture area until you have established the location of the brachial artery and anchor the artery with two fingers. The artery is easily palpable medial to the biceps tendon and lateral to the median nerve.
5. Puncture the skin with the needle held at an angle of 60 to 90 degrees, ensuring the bevel of the needle is facing towards the direction of blood flow.
6. Advance the needle slowly until the arterial lumen has been entered and blood return is noted in the hub of the needle. If the artery is missed, withdraw the needle until the bevel is just below the surface of the skin and redirect into the lumen of the artery.

**Note: If at any point during the procedure the needle is withdrawn completely from the skin, it must be discarded and a new needle placed for subsequent puncture attempts.**

**If the artery is not punctured after 2 or 3 attempts at redirections, the needle should be withdrawn and pressure applied to the site with sterile gauze. Re-evaluate the puncture site.**



**If the vein is punctured, withdraw the needle and apply pressure to the site with sterile gauze. Discard the syringe and re-evaluate the puncture site.**

7. Withdraw the needle, engage the needle-protection device, and apply direct pressure over the puncture site with sterile gauze. Maintain pressure on the site for a minimum of 5 minutes, or until bleeding has stopped.

**Note: Maintain pressure for a minimum of 10 minutes if the patient has been receiving anticoagulants. Inform the physician if bleeding is not controlled within 10 minutes.**

8. Palpate the pulse distal to the puncture site to ensure continued adequate circulation to the lower arm.
9. Clear any air bubbles from the sample and cap the syringe with the supplied cap from the arterial blood gas kit. Do not recap the needle.
10. During the time that pressure to the site is being applied, roll the syringe evenly to distribute the heparin.
11. Label the syringe with the ABG specimen label and place in biohazard bag.
12. Dispose of equipment and supplies. Place the needle in a sharps container. Remove gloves and perform hand hygiene.
13. Send the ABG sample to the laboratory via the pneumatic tube system, or arrange to have the sample hand delivered to the laboratory.

**Note: At Mount Saint Joseph Hospital the ABG sample may be analyzed by the RT using the Point of Care Analyzer.**

## Documentation

Document the procedure using the “ABG Collection” AdHoc Powerform in CST PowerChart.

## References

Arterial Puncture: Arterial Blood Gas Sampling - CE. Elsevier Clinical Skills (2024). St. Louis, MO. Elsevier. Retrieved November 28 2023 from [www.elsevierskills.com](http://www.elsevierskills.com)

Theodore, A. C. Arterial blood gases. In: UpToDate. Manaker, S, Finlay, G. (Ed), [UpToDate](http://UpToDate), Waltham, MA, 2023.



<b>Effective Date:</b>	30-SEP-1986
<b>Posted Date:</b>	28-NOV-2023
<b>Last Revised:</b>	28-NOV-2023
<b>Last Reviewed:</b>	28-NOV-2023
<b>Approved By:</b> <i>(committee or position)</i>	PHC Pulmonary Diagnostics Coordinator, Respiratory Services Professional Practice Leader, Respiratory Services Respiratory Education & Practice Coordinator, Respiratory Services
<b>Owners:</b> <i>(optional)</i>	PHC Respiratory Therapy