The Alberta College of Paramedics

Alberta Occupational Competency Profile (AOCP)
Upgrade "Gap" Training Program

Emergency Medical Technologist – Paramedic (EMT-P)

Arterial Blood Gas Samples Module

Study Guide

Table of Contents

Acknowledgements & General Information

INTRODUCTION

The overall goal of this program is to provide standardized upgrade "gap" education to ensure that all regulated practitioners of the Alberta College of Paramedics (College) meet the *Health Professions Act*, Paramedic Regulation and the scope of practice as defined by the Alberta Occupational Competency Profiles (AOCP) for the profession.

The Alberta Occupational Competency Profiles (AOCP) were developed through the facilitation of Dr. Bill DuPerron of Alberta Health and Wellness. Many College regulated practitioners were involved in compiling and organizing information about the roles and functions of paramedics, emergency medical technicians and emergency medical responders into the Profile.

The completion of the AOCP for the College is an important milestone for the profession. The document is a result of a collaborative partnership with the College and Alberta Health and Wellness plus the work and effort of members of the College.

The Competency Profile describes the vast expanse of competencies in Alberta at the present time as well as additional changes in scope of practice, which are identified in the Upgrade "Gap" Training Program. Each module in the "Gap" Training Program covers the additional competencies for a specific Competency Cluster as identified in the AOCP for each of the three disciplines regulated by the College. The Profile includes the knowledge, skills, attitudes, and judgments related to a variety of roles held by registered practitioners of the College.

BACKGROUND

The Health Professions Act (HPA) governs all regulated health professions in Alberta. The HPA was passed by the Alberta Legislature in May 1999 and in December 2001 the Order in Council proclaiming the Health Professions Act was signed by the Lieutenant Governor.

The HPA replaces a regulatory system (the *Health Disciplines Act*) that included multiple statutes that had different registration, continuing competence and investigation and disciplinary processes. Under the HPA, previous legislated exclusive scopes of practice will be eliminated and replaced with an "overlapping scope of practice" model based on restricted activities. Restricted activities are health services that only authorized persons may provide.

STRUCTURE OF THE HPA

The HPA will deal with processes such as registration, continuing competence, professional conduct, restricted activities, investigation and discipline that apply to all the professions. Each of the 28 professions will have their own regulation that will address in detail, profession specific areas such as required qualifications for entry into the profession. The Paramedic profession is expecting to be governed by the HPA in the near future.

ABOUT THE AOCP

Most of the competencies have been learned in basic education; other competencies have been acquired through advanced education, on the job training, and experience. All EMRs, EMTs and EMT-Ps have the basic competencies; however, competency on the job will vary depending on job requirements, and policy and procedure of the employing agency.

The Profile provides a cumulative view of the competencies within the Scope of Practice and within the general and specialized areas of that practice.

The College has developed the following educational module for upgrading the knowledge and skills of registered practitioners to meet the Alberta Occupational Competency Profiles (AOCP), the new Regulation and scope of practice.

HISTORY OF THE PROCESS

On March 4, 2000, the Paramedic Association of Canada adopted the National Occupational Competency Profile (NOCP), which included both a new classification and generic competencies for four professional designation levels of Paramedicine.

On March 22, 2000, the Alberta College of Paramedics' Council made the commitment that the Alberta College of Paramedics AOCP would meet or exceed the NOCP.

ACKNOWLEDGEMENTS

Alberta College of Paramedics
Continuing Competency Ad Hoc Education Committee Members:

Douglas Britton, MEM, EMT-P, Chair
Renee Linssen, EMR, Vice-Chair
William Coghill, MEM, EMT-P, CHCA
Ruth Farrow, EMT-P, MLT
Christine Patterson, MEM, EMT
Richard Poon, BSc., EMT-P, MEd
Marilyn Ringness, BSc., EMT-P
Barry Straub, EMT-P

Donna Lefurgey, CEO/Registrar
Laurie Mitchell, Registration Division Leader

Package Development and Design

Portage College Prehospital Care Programs
Lac La Biche, Alberta

In collaboration with…
Alberta College of Paramedics
Continuing Competency Ad Hoc Education Committee

Module Creation and Research

Portage College Prehospital Care Programs
Lac La Biche, Alberta

In collaboration with…
Alberta College of Paramedics
Continuing Competency Ad Hoc Education Committee

About the Authors (Portage College)

Portage College (formerly Alberta Vocational Center, Lac La Biche) was established in 1968. The College currently offers over 30 certificate and diploma programs in six areas of study: Business, Human Services, Native Cultural Arts, Trades and Technical, Health and Wellness and Academic Upgrading. Over 1800 students are served annually through campuses in 13 northern Alberta communities, with another 1,300 taking short term or customized training programs each year.

Portage College has been offering prehospital care training program since the mid 1980s. Portage College is currently approved by the Alberta College of Paramedics for the following Paramedicine programs:

Emergency Medical Responder (EMR)
Emergency Medical Technician (EMT)
Emergency Medical Technologist-Paramedic (EMT-P)

Disclaimer

Portage College and the Alberta College of Paramedics have attempted to ensure that the information is in context relevant to the practitioner and is as concise as possible. Portage College has used a variety of resource materials in order to provide a solid base of up-to-date information.

If any of the information contained within this module contradicts the direction you have received from your employer/medical director, the policy of your employer should take precedence over the information in this module.

As a regulated practitioner of the Alberta College of Paramedics, while under the *Health Disciplines Act*, you may only deliver health services which fall within your scope of practice and is in accordance with the provisions of the *Health Disciplines Act* or the *Health Professions Act* when the HPA is implemented.

Any content contained in this module that is beyond your scope or not within your current competence does not authorize you to deliver those health services. That is, if a given health service is not within your scope of practice and/or you have not yet attained the competency, you may not deliver that health service.

Alberta Occupational Competency Profile (AOCP)

Training Program

Learning Goal

This educational training is intended to review and upgrade the competencies of The Alberta College of Paramedics registered practitioners in order to meet the requirements of the new regulation under the Health Professions Act (2000) including the Alberta Occupational Competency Profile (AOCP) and scope of practice.

Program Objective

To provide standardized education to registered practitioners to ensure that all regulated practitioners of the Alberta College of Paramedics meet the regulation and defined scope of practice for the profession.

Program Format

The Alberta Occupational Competency Profile (AOCP) training program will combine independent study modul*es* and scheduled lab skills assessment sessions. Certification will be granted on successful completion of all program requirements.

Independent Study Modules

There are ten EMTP – AOCP continuing education modules to be completed.

1. Intraosseous
2. Transcutaneous Pacing
3. Blood Products
4. Urinary Catheterization
5. Monitoring Chest Tubes
6. Arterial Blood Gas Samples
7. Intrapartal Examination
8. Suturing and Hemostat Application
9. Femoral Venipuncture
10. Nasotracheal Intubation

Lab Skill Assessment

All skills identified for each module will be assessed during the lab skills assessment for that module.

Exam

Mastery of the each module's content will be assessed through multiple-choice exams during the lab sessions. These exams are open book and can be found in each module following the module summary.

EMT-P – Arterial Blood Gas Samples Competencies

This module meets the following competencies of the Alberta Occupational Competency Profile (AOCP).

F-7 Obtain Arterial Blood Sample via Radial Puncture

F-7-1 Determine a history to obtain an arterial blood gas (ABG) collection by:

- Assessing the patient's illness
- Chronic Obstructive Pulmonary Disease (COPD)
- Pulmonary edema
- Adult Respiratory Distress Syndrome (ARDS)
- Myocardial Infarction (MI)
- Pneumonia
- Post Coronary Artery Bypass Surgery
- Changes in Respiratory therapy
- Resuscitation from cardiac arrest
- Prolonged anesthesia
- Assess ulnar circulation
- Perform the Allen test
- Ensure patient's arm is rested
- Instruct patient to clench hand
- Apply and hold pressure on radial and ulnar arteries
- Instruction to patient
- Observe for obvious blanching
- Release pressure from ulnar and radial arteries
- Observe for capillary refill

F-7-2 Demonstrate knowledge in determining methods used to obtain ABG collection by:

- Gathering the equipment
- Preparing the equipment for the procedure
- Record the patient's name, date, and time on the label
- Heparinize the syringe
- Collect ice to cool specimen

F-7-2 Demonstrate knowledge in determining methods used to obtain ABG collection by (continued):

- Explaining procedure to the patient
- Supporting the patient's wrist with a rolled towel
- Palpating for a strong pulse
- Clean the puncture site
- Holding the needle bevel up at 30 to 45 degree angle
- Puncturing the skin and the arterial wall in one motion
- Observe for blood flow in the syringe automatically
- Acquire pre-determined amount
- Withdrawing needle with direct pressure firmly over the puncture site until bleeding stops - at least 5 minutes
- Remove air bubbles from syringe
- Labeling sample and place in ice filled container
- Monitoring and dress the puncture site

F-7-3 Demonstrate knowledge and understanding to determine the amount of oxygen therapy the patient has received before ABG collection.

F-7-4 Demonstrate knowledge and understanding to determine potential complications by:

- Ensuring no more than two attempts at the same site
- Assessing for arterial spasm

F-7-5 Demonstrate knowledge and understanding in determining correct documentation by:

- Recording the result of the Allen's test
- Recording the time the sample was drawn
- Recording the site of the arterial puncture
- Recording the length of time pressure was applied to the site to control bleeding
- Recording the type and amount of oxygen therapy the patient was receiving

F-7-6 Demonstrate knowledge and understanding to determine arterial blood gases from lab results.

Arterial Blood Gas Samples Module Overview

Introduction

Understanding blood gases is essential core knowledge that the Paramedic requires when providing care to the critically ill patient. Blood gas results can help to differentiate a diagnosis for treatment and assess the efficacy of this treatment, while caring for the patient.

Learning Objectives

Upon completion of this module the Paramedic will be able to:

1. Demonstrate the knowledge and understanding of blood gases
2. Discuss and perform arterial blood gas collection via radial artery puncture

Learning Activities

Recommended Resources

Each module identifies specific content students must cover to meet the module learning objectives.

Key Terms

Students are to define the *Key Terms* identified for each learning objective.

Exam

Mastery of the module content will be assessed through a multiple-choice exam during the lab sessions. This exam is open book and can be found in this module following the module summary.

Lab Skills Practice

Students are to review the skills identified in the *Lab Skills Checklist* provided in Appendix A. Review of these checklists is essential preparation for the lab skill assessments, which are mandatory for successful completion of this module.

Objective 1

Demonstrate the Knowledge and Understanding of Blood Gases

BLOOD GASES SIMPLIFIED

Respiratory Acidosis: when breathing is inadequate and carbon dioxide (CO_2, a respiratory acid) accumulates in the blood. The extra CO_2 molecules combine with water to form carbonic acid, which contributes to an acidic pH.

- The treatment is to lower the PCO_2 by improving ventilation
- Causes: impaired ventilation due to lung dysfunction or impairment of the respiratory center of the brain

Respiratory Alkalosis: when breathing is increased to the point where too much CO_2 has been eliminated. As the level of CO_2 decreases in the blood, the blood pH increases.

- The treatment (if required) consists of emotionally supporting the patient and coaching them to slow their breathing rate
- Causes: anxiety, following ascent to high altitudes

Metabolic Acidosis: when normal metabolism is impaired, and acid is formed. The acid is not respiratory therefore, by definition it is "metabolic acid".

- The treatment is directed at the underlying cause. This may require neutralizing this excess acid with bicarbonate, or by allowing time for the body's buffer systems to work (excretion/metabolism)
- Causes: dehydration from vomiting/diarrhea, diabetes, cardiac arrest, and the use of some medications Respiratory acidosis, if untreated, can lead to metabolic acidosis

Metabolic Alkalosis: This is relatively rare. It occurs when excessive hydrogen ions (H+) are absorbed, resulting in an increase of the pH.

- Treatment is directed at the underlying cause.
- Causes: excessive use of diuretics or an overdose (i.e. milk of magnesia, sodium bicarbonate)

Base Within the Human Body

Bicarbonate (HCO_3^-): is the most common metabolic base.

- Dissociated in water, bicarbonate releases one ion (OH^-) and one CO_2 molecule

$$[OH^- + CO_2 \leftrightarrow HCO_3^-]$$

- Hydroxyl ions (OH^-) seek out hydrogen ions (H^+) and form water (H_2O)

$$[H^+ + HCO3^- \leftrightarrow H2O + CO_2]$$

Acid Within the Human Body

Carbonic Acid: carbon dioxide dissolved in water.

- CO_2 dissolved in water forms carbonic acid ($H_2CO_3^-$)
- Occurs primarily in the red blood cells
- CO_2 is referred to as a respiratory acid and is the only acid, which can be exhaled via the lungs
- Therefore, a high PCO_2 is the same as respiratory acidosis and vice versa

Lactic Acid: released during aerobic and anaerobic metabolism.

Ketones: formed when fats are metabolized for energy.

Common Terms

Acid: A substance releases hydrogen ions (H^+) when dissolved in water.

Base: A substance that releases hydroxyl ions (OH^-) when dissolved in water.

pH: The term pH is an abbreviation for "potential of hydrogen". It is a measure of the degree to which a solution is acidic or alkaline (basic).

- The hydrogen ion (H^+) concentration expressed as (–10 logarithm) of the moles of hydrogen ions (H^+) per litre.
- The logarithmic value means: As the pH changes one unit (e.g. 7.0 to 6) the hydrogen ion (H^+) changes tenfold (i.e. 0.0000001 to 0.000001)

Acidosis: A condition in which the blood is abnormally acidic; an abnormal increase in hydrogen ion (H^+) concentration in the body (when arterial pH is below 7.35).

Alkalosis: An abnormally high concentration of alkali or base in the blood (an arterial pH greater than 7.45).

Metabolism: The aggregate of all biochemical reactions that take place in living organisms, resulting in growth, generation of energy, elimination of wastes, and other bodily functions.

BUFFER SYSTEMS

There are 4 buffer systems within the body:

- Blood (Plasma & RBC)
- Respiratory (lungs)
- Renal (kidneys)
- Bone

Buffer systems are chemical 'sponges' that absorb hydrogen ions (acid) or hydroxyl ions (base) when they are excessive and release them when they are scarce. These buffer systems do not prevent major pH changes, but do moderate them. Acids and bases are found in the intracellular fluid (ICF) and extracellular fluid (ECF) of the body and exist as buffer pairs – consisting of weak acid and its conjugate weak base. The chemical components of a buffer system can combine with a strong acid and convert it to a weaker one.

The ICF is responsible for 97 to 99% of the body's total buffering of respiratory acid-base disorders. The intracellular contribution to buffering is less with metabolic disorders (60% for metabolic acidosis; 30% for metabolic alkalosis) but is still substantial. Table P-1 refers to the buffer pairs being in the ICF as this is where they are have the greatest contribution to the acid-base balance. However, due to ease at which fluid shifts between these two compartments, these buffer pairs can also be found in the ECF.

Table P-1 Primary Intracellular Buffer Pairs

Buffer Pairs	Buffer System	Reaction	Rate
HCO_3^-/ H_2CO_3	Biocarbonate	$H^+ + HCO_3 \leftrightarrow$ $H_2O + CO_2$	Instantaneous
Hb^-/HHb	Hemoglobin	$HHB \leftrightarrow$ $H^+ + Hb^-$	Instantaneous
$HPO_4^=$/ $H_2PO_4^-$	Phosphate	$H_2PO_4 \leftrightarrow$ $H^+ + HPO_4^-$	Instantaneous
Pr^-/HPr	Plasma proteins	$HPr \leftrightarrow$ $H^+ + Pr^-$	Instantaneous

Buffer systems – blood

Blood as a buffer system is called the "Bicarbonate-Carbonic Acid System":

$$CO_2 + H_2O = H_2CO3 = H^+ + HCO3^-$$

- It is the first and fastest means of controlling acid-base balance in the body
- The majority of CO2 is transported as bicarbonate in the plasma
- Carbonic acid ($H_2CO_3^-$) dissociates into hydrogen and bicarbonate ions:

$$H^+ + HCO_3^- = H_2CO_3^-$$

Note: Because of this ability to dissociate, bicarbonate (HCO_3^-) is free to pick up another H^+ to form carbonic acid $H_2CO_3^-$ and travel to the lungs where the equation reverses and carbonic acid dissociates to be excreted as CO_2 and water H_2O vapor or travel to the kidneys where it dissociates into hydrogen ions (H+) and bicarbonate (HCO_3^-). The kidneys excrete the (H+) and the bicarbonate (HCO_3^-) is free to repeat the process in the blood.

CO_2 is transported in the blood as:

- CO_2 dissolved = 7%
- $HbCO_2$ = 23%
- HCO_3^- = 70%

Buffer system – lungs

- The respiratory system reacts within minutes to correct acid-base imbalances
- This is triggered by chemoreceptors within the brain stem that monitor and react to pH levels in the CSF
- The respiratory system is most effective in compensating for acute pH changes due to disease or injury

Buffer system – kidneys

- If the respiratory system cannot compensate and control the pH imbalance then the kidneys begin to act
- The renal system is much slower, taking hours or days to be effective in correcting the imbalance
- Kidneys regulate pH by excreting excess hydrogen (H^+) or bicarbonate (HCO_3^-) ions
- The kidneys operate on an exchange system; if one ion is excreted the other is saved

Table P-2 Buffer Systems

Organs	Mechanism	Rate
Lungs	Regulates retention or elimination of $C0_2$ and therefore bicarbonate (H_2CO_3) concentration	Minutes-hours
Ionic shifts	Exchange of intracellular potassium and sodium for hydrogen ions (H^+)	2-4 hours
Kidneys	Bicarbonate reabsorption and regeneration, ammonia formation, phosphate buffering	Hours-days
Bone	Exchanges of calcium, phosphate, and release of carbonate	Hours-days

Arterial Blood Gases - Normal Values

The buffer systems within the body are always in constant flux, working hard to maintain homeostasis. This means keeping our blood values within normal range:

- pH = 7.35 – 7.45
- PaO_2 = 90 – 100 %
- $PaCo_2$ = 35 – 45 mmHg
- HCO_3 = 22 – 26 mmHg

When homeostasis is interrupted, not only will this show as signs and symptoms in the patient, but it will also be reflected in the body's blood gases.

Although sampling the intracellular fluid (ICF) would be a more accurate assessment of pH, it would also be much more difficult and time consuming. Arterial blood is easy to sample. Its results can be considered a sort of 'average value' and is considered to be 'representative' of all ICF.

RESPIRATORY DERANGEMENTS

Respiratory Acidosis:
- CO2 is retained usually due to hypoventilation
- H_2CO_3- is formed in the blood

Respiratory Alkalosis:
- CO_2 is eliminated in excessive amounts due to increased respiratory rate
- This is usually a compensatory response to metabolic acidosis

To differentiate between Respiratory derangements ask yourself:

- What will happen to the pH in these situations?
- What are the buffer systems doing?

Acid Base Imbalance	**pH**	**$PaCO_2$**	**HCO_3^-**
Respiratory Acidosis	↓	↑	**Normal**
Respiratory Alkalosis	↑	↓	**Normal**
Respiratory Acidosis w/ Metabolic Compensation	↓	↑	↑

METABOLIC DERANGEMENTS

Metabolic Acidosis:
- Most common
- When the body's metabolism produces more acid than normal

Metabolic Alkalosis:
- Relatively rare
- Most common cause is excessive use of diuretics or an overdose (i.e. milk of magnesia, sodium bicarbonate)
- Too much bicarbonate (HCO_3^-) in the body
- This taxes the renal system and causes the buffer systems to use up its stores of carbonic acid

To differentiate between metabolic derangements ask yourself:

- What will happen to the pH in these situations?
- What are the buffer systems doing?

Acid Base Imbalance	pH	$PaCO_2$	HCO_3^-
Metabolic Acidosis	↓	**Normal**	↓
Metabolic	↑	**Normal**	↑
Metabolic Alkalosis w/ Respiratory Compensation	↑	↑	↑
Metabolic and Respiratory Acidosis	↓	↑	↓
Metabolic and Respiratory Alkalosis	↑	↓	↑

Objective 1: Key Terms

- Acid
- Base
- pH
- Acidosis
- Alkalosis
- Metabolism
- Buffer Systems
- Respiratory Acidosis
- Respiratory Alkalosis
- Metabolic Acidosis
- Metabolic Alkalosis

Objective 2

Discuss and Perform Arterial Blood Gas Collection via Radial Artery Puncture

The previous objective reviewed how both respiratory and metabolic derangements affect the body's homeostasis and how it's buffer systems work to correct it. This objective will cover the indications, contraindications and the procedure for arterial puncture for the purpose of obtaining a blood gas sample.

Indications

Any patient requiring blood gases for assessment of illness or efficacy of treatment including patients suffering from chronic pulmonary obstructive disease (COPD), pulmonary edema, acute respiratory distress syndrome (ARDS), myocardial infarction, and pneumonia. Also those patients who have had changes in respiratory therapy, recent coronary bypass graft surgery (CABG), prolonged anesthesia or have been resuscitated from cardiac arrest.

Sites Used for Obtaining an ABG Sample

Sites are chosen based on the degree of risk for neurovascular injury. The radial artery has the least risk of neurovascular injury. Other sites that can be used but have a higher degree of risk are the brachial and femoral arteries.

Complications

The following are potential complications as a result of arterial puncture:

- Arterial spasm.
- Ischemic changes to the hand and wrist.
- Impaired circulation to extremity

***Note:** performing the Allen Test prior to the procedure and ensuring there is adequate collateral circulation supplied from the ulnar artery can avoid these

- Hemorrhage/Hematoma (maintain continuous firm pressure for 10 minutes on the site after the procedure)
- Infection (proper preparation of the site and using an aseptic technique during the procedure will avoid this)
- Nerve injury (can be avoided with proper landmarking, technique and knowledge of anatomy)

Contraindications

The most important contraindication to this procedure is any patient with inadequate collateral blood flow through the ulnar circulation (Note: this can be a normal anatomic variant in 3% of the population). Because of this, the ***Allen Test*** must be used to assess ulnar circulation prior to doing this procedure.

- Positive Allen test (see next page), indicating that only one artery supplies the hand
- Cellulitis or other infections over the radial artery
- Absence of palpable radial artery pulse
- Coagulation defects (a relative contraindication)

Allen Test

1. Have the patient elevate their hand while making a fist for 20 seconds

2. With the patient's fist still closed, hold the patient's wrist (pronated) in both hands, apply firm pressure to both the radial and ulnar arteries using the index and middle fingers of both your hands

3. Ask the patient to open his hand (it should be blanched white)

4. Release only the ulnar compression.

a. ***Normal result:*** the patient's hand flushes (color returns to normal) immediately (within 5-7 seconds).

b. ***Abnormal result (positive Allen Test):*** The patient's hand will remain blanched white until the radial compression is released. (DO NOT PERFORM PROCEDURE: There is risk of serious hand ischemia if the radial vessel should spasm).

Procedure for Arterial Puncture

1. Perform the Allen Test to confirm good collateral circulation.

2. Set up the equipment.
    a. Heparinize the syringe.
        i. Use a 3 ml syringe and 21 gauge needle
        ii. Draw up 0.5 ml of heparin (1000 IU/ml)
        iii. Rotate the syringe and work plunger to distribute the heparin.
        iv. Minimal heparin should remain (0.15 ml).

Note: *Some health regions now have specific ABG kits that do not require the use of a heparinized syringe.*

3. Place a small towel roll under the patient's wrist for support.

4. Clean the radial artery entry site.
    a. Use a providone/iodine solution (Betadine).
    b. Once dry and wipe site with an alcohol swab.

5. Needle entry.
    a. Identify the radial artery with gentle pressure.
    b. Have the patient dorsiflex their wrist.
    c. Angle the needle and syringe 45 degrees to the patient's arm.
    d. Enter the skin just distal to the palpated artery site in one fluid motion.
    e. Slowly advance the needle until spontaneous blood enters.

6. Arterial blood collection.
    a. Hold the needle steady until 1-2 ml of blood is obtained.
    b. Allow the syringe to fill itself (avoid aspirating).
    c. If flow ceases:
        i. Slowly with draw the needle 1-2 mm
        ii. Reattempt entry into the artery.

7. Withdrawing the needle.
    a. Withdraw the needle form the site.
    b. Immediately apply pressure with gauze over the site.
    c. Hold pressure at the entry site for 5 minutes.

8. Sample preparation for the lab.
    a. Express any air bubbles from the syringe.
    b. Cork the needle or remove the needle and cap the syringe.
    c. Gently roll the syringe between your fingers to Heparinize the sample.
    d. Immediately place the sample on ice to cool.

9. Label the sample.
    a. Patient identification.
    b. Sample acquisition time.
    c. Patient's SPO_2 at the time the sample was drawn.
    d. Patient's body temperature.

10. Deliver the sample quickly to the lab.

Objective 2: Key Terms

- Allen Test
- Indications
- Complications
- Contraindications
- Radial Artery
- Ulnar Artery
- Heparinize

Summary

Arterial blood gas results are an essential component to the assessment and treatment of critical patients. With the evolution of our profession from the Health Disciplines Act to the Health Professions Act and the recent restructuring of EMS by Alberta Health and Wellness, the use of skills like arterial blood gas collection by Paramedics may become more prevalent.

Exam

1. The term pH refers to:
   a. A measurement of the acidity or alkalinity of a solution
   b. A condition in which the blood is abnormally acidic
   c. An abnormally high concentration of alkali or base in the blood
   d. The aggregate of all biochemical reactions that take place in living organisms, resulting in growth, generation of energy, elimination of wastes, and other bodily functions

2. Acidosis is:
   a. A measurement of the acidity or alkalinity of a solution
   b. A condition in which the blood is abnormally acidic
   c. An abnormally high concentration of alkali or base in the blood
   d. The aggregate of all biochemical reactions that take place in living organisms, resulting in growth, generation of energy, elimination of wastes, and other bodily functions

3. Alkalosis is:
   a. A measurement of the acidity or alkalinity of a solution
   b. A condition in which the blood is abnormally acidic
   c. An abnormally high concentration of alkali or base in the blood
   d. The aggregate of all biochemical reactions that take place in living organisms, resulting in growth, generation of energy, elimination of wastes, and other bodily functions

4. Metabolism is:
   a. A measurement of the acidity or alkalinity of a solution
   b. A condition in which the blood is abnormally acidic
   c. An abnormally high concentration of alkali or base in the blood
   d. The aggregate of all biochemical reactions that take place in living organisms, resulting in growth, generation of energy, elimination of wastes, and other bodily functions

5. What effects will hypoventilation have on a patient's pH and $PaCO_2$?
   a. The pH will go up to compensate for the increased acidity caused by the increased $PaCO_2$
   b. The pH will go down as the $PaCO_2$ increases
   c. The pH will go up to compensate for the increased acidity leaving the $PaCO_2$ unchanged
   d. The pH will rise as the $PaCO_2$ decreases

6. Sites used to obtain an ABG sample are chosen based on the degree of risk for neurovascular injury. Of the following arteries, which is the most commonly used?
   a. Temporal
   b. Carotid
   c. Subclavian
   d. Femoral

7. Which of the following is **NOT** a potential complication as a result of arterial puncture?
   a. Nerve injury
   b. Ischemic changes to the hand and wrist
   c. Occult bleeding (especially from brachial and femoral artery punctures)
   d. Temporal artery spasm

8. Prior to obtaining an ABG sample, an Allen Test is performed to ensure the patient's hand has adequate collateral circulation. The artery being assessed is the:
   a. Ulner artery
   b. Allen artery
   c. Radial artery
   d. Brachial artery

9. The practitioner should insert the needle at an angle of :
   a. 10 degrees
   b. 30 degrees
   c. 45 degrees
   d. 90 degrees

10. Once an ABG sample is obtained, information on the label should include:
    a. Patient ID, acquisition time and blood pressure
    b. Patient ID, blood pressure and SPO_2
    c. Patient ID, acquisition time and SPO_2
    d. Patient ID, blood type and SPO_2

Glossary of Terms

Objective 1: Key Terms

Acid – A substance releases hydrogen ions (H+) when dissolved in water

Base - A substance that releases hydroxyl ions (OH^-) when dissolved in water
pH - A measure of the acidity or alkalinity of a solution
Acidosis - A condition in which the blood is abnormally acidic
Alkalosis - An abnormally high concentration of alkali or bases in the blood
Metabolism - The aggregate of all biochemical reactions that take place in living organisms, resulting in growth, generation of energy, elimination of wastes, and other bodily functions

Buffer Systems - A chemical 'sponge' that absorbs hydrogen (H^+) acid or (OH^-) base when they are excessive and releases them when they are scarce
Respiratory Acidosis – An acidosis caused by hypoventilation
Respiratory Alkalosis – An alkalosis caused by hyperventilation
Metabolic Acidosis – Acidosis caused by the accumulation of acids (with the exception of carbonic acid) or the loss of basis, including bicarbonate
Metabolic Alkalosis – An alkalosis caused by an excessive loss of hydrogen ions or gain of basis

Objective 2: Key Terms

Allen Test – A test to confirm good collateral circulation
Indications – A sign or circumstance that points to or show the cause, treatment, etc.. of a disease
Complications – one or more disease concurrent with another
Contraindications – Any condition that renders a particular line of treatment improper or undesirable
Radial Artery – Located on the lateral aspect of the forearm
Ulnar Artery – Located on the medial aspect of the forearm
Heparinize – To treat with heparine

References

Acid base tutorial [n.d.]
<www.acid-base. com (2005, February)

Marieb, E., (2004). Human Anatomy and Physiology (6th ed.). San Francisco: Pearson Benjamin Cummings

Martini, F., & Bartholomew, E., (2000) Essentials of Anatomy and Physiology (2nd ed.). Upper Saddle River: Prentice-Hall

Miller – Keane (1997), *Encyclopedia & Dictionary of Medicine, Nursing & Allied Health* (Sixth Edition), Philadelphia, P.A.:W.B.Saunders Company

Appendix A

Lab Skills Checklist

RADIAL ARTERY PUNCTURE

- ❑ Apply PPE precautions
- ❑ Perform patient assessment
- ❑ Obtain history and baseline vital signs
- ❑ Determine treatment plan
- ❑ List indications, contraindications and complications for this procedure
- ❑ Explain procedure to patient/family and obtain consent
- ❑ Perform the Allen Test to confirm good collateral circulation
- ❑ Assemble equipment/ supplies and prepare patient for procedure
- ❑ Place a small towel roll under the patient's wrist for support
- ❑ Clean the radial artery entry site
- ❑ Identify the radial artery with gentle pressure
- ❑ Angle the needle and syringe 45 degrees to the patient's arm and enter the skin just distal to the palpated artery site in one fluid motion. Slowly advance the needle until spontaneous blood enters
- ❑ Hold the needle steady until 1-2 ml of blood is obtained
- ❑ Withdraw the needle and apply direct pressure for 5 minutes
- ❑ Properly label the sample and ensure prompt delivery to the lab

Comments:

Instructor Name & Initials: _____ *Date:* _____