LEARNING MODULE FOR

NURSE/TECHNOLOGIST ASSISTING IN CARDIAC CATHETERIZATION & CORONARY ANGIOPLASTY

(DELEGATED MEDICAL FUNCTION)

CC 10-012 and CC 10-019

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This learning module provides the Registered Nurse (RN)/Technologist with the theory and practice necessary to perform the Delegated Medical Functions (DMF) of assisting with Cardiac Catheterization and Coronary Angioplasty. After completing the learning objectives, the RN/Technologist will demonstrate competency according to the proficiency standards.

PURPOSE:

The RN/Technologist will demonstrate the knowledge of the theory and skills related to assisting the interventional Cardiologists/Radiologists before, during and following Cardiac Catheterization and PTCA procedures.

All Delegated Medical Functions are under the direct supervision of the physician.

LEARNING OBJECTIVES:

Following the completion of the learning objectives, the learner will be able to:

1. Discuss the anatomy of the femoral/radial/brachial vascular systems.
2. List the potential sites for arterial cannulation.
3. Discuss the complications common to femoral/radial/brachial arterial cannulation.
4. Discuss the complications common to femoral venous cannulation.
5. Describe the procedure for the placement and flushing of the sheath introducer.
6. Discuss the purpose of sheath flushing.
7. List the possible complications of sheath placement.
8. Discuss the operation of the angiographic contrast delivery system (ACIST ®)
9. Discuss the reasons for the nitroglycerin intra-coronary injections and possible side effects.
10. Discuss the operation of the inflation device.
11. Discuss the theory surrounding arterial cannulation.
12. Discuss the theory surrounding venous cannulation.
13. Demonstrate sheath placement and flushing.
14. Demonstrate flushing catheters through the manifold.
15. Demonstrate intra-arterial contrast injections.


17. Demonstrate angioplasty balloon inflation under direct physician supervision.

18. Discuss groin compression following sheath removal (cath only).

19. Demonstrate radial band monitoring following radial sheath removal.

20. Discuss the operations and risk involved of a 3-way manifold as it is connected to the left heart kit (used for patients with latex allergies)

METHOD:

The following steps will be utilized to provide knowledge and skills of cardiac catheterization and coronary angioplasty:

1. Review Purpose, Learning Objectives and Theory sections of this learning module and complete the multiple choice test.

2. Be instructed by the physician on the skills outlined.

3. Perform the skills outlined for a total of 10 procedures each for cardiac catheterization and coronary angioplasty.

4. Document the initial certification of this Delegated Medical Function.

Recertification

1. The Nurse/Technologist will complete two angioplasty procedures and two cardiac catheterization procedures with a designated physician (additional procedures may be deemed necessary by the designated physician to confirm continued competency).

2. The Nurse/Technologist will review this learning module annually and will:
   2.1. Complete the multiple choice test.
   2.2. Be tested by the physician on the theory and skills outlined.
   2.3. Document their recertification.
PROFICIENCY STANDARDS:

To be certified as competent to perform the procedures of Cardiac Catheterization and Coronary Angioplasty, the Nurse/Technologist will successfully:

a. complete the learning objectives
b. complete a written and/or verbal test
c. perform all aspects of the Proficiency Standard Skills Checklist

Completion of the above objectives is confirmed by the Health Services Manager and/or the approved physician.

THEORY:

Throughout the theoretical content of this document, the term, "cardiac catheter" refers only to the pigtail catheter and diagnostic catheters requiring Judkin's Technique.

The Cardiac Catheterization Unit is a suite where diagnostic and therapeutic procedures are performed on conscious patients who, although sedated, are generally concerned and apprehensive. Cardiac Catheterization is a diagnostic procedure performed to identify patients with cardiac disease. Although the techniques for diagnostic cardiac catheterization were developed over 60-70 years ago, they have not changed substantially since. Indications for cardiac catheterization may include: determination of coronary artery disease (most common indication) prior to cardiac surgery or percutaneous coronary interventions; investigation of cardiac structural abnormalities such as valvular, congenital heart defects, prior surgical/percutaneous structural interventions/repairs; evaluation of pericardial disease or cardiomyopathies.

Selective coronary angiography is the only method generally available to study intraluminal anatomy of the coronary arteries in living persons. The introduction of a widely applicable and safe selective coronary angiographic technique approximately 30 years ago, the development of high-quality magnification cineradiography and the advent of practical catheter based intervention have led to incredible growth of coronary angiography both as a clinical and research tool.

A group of procedures performed through a percutaneous approach to treat coronary artery disease in the Cardiac Cath Lab is commonly referred to as percutaneous coronary interventions (PCI) and includes angioplasty, intracoronary stenting and atherectomy. With evolution of more sophisticated equipment and increased operator expertise, there has been greater application of PCI in the management of coronary artery disease. Thus, selected patients with multi-vessel disease, total occlusions, tandem lesions and complex branch disease are now potential candidates for PCI. As well as being a routinely scheduled elective procedure, PCI has emerged as a primary intervention in the treatment of the patient presenting with acute myocardial infarction, provided certain timelines are met.
The technique for angioplasty has undergone many technical modifications since the first one performed in 1979. This procedure is a non-surgical treatment for coronary disease in which the affected occluded coronary artery is dilated without a traumatic surgical procedure. However, 1-2% of patients will require emergency bypass surgery because of inability to maintain artery patency and a similar number will experience a myocardial infarction. Success rates have increased and the risk of unexpected vessel closure have fallen dramatically in the 1990s with the widespread use of intracoronary stents deployed upon standard angioplasty catheters. Four important questions must be asked when these procedures are being considered:

1. Can the procedure be performed with a high probability of success?
2. Will a successful result benefit the patient?
3. Is it better than other available treatment options?
4. Can the procedure be performed safely?

Assessment/Preparation/Positioning the patient for Femoral/Radial/Brachial approaches catheterization/PCI:

The posterior tibial and dorsalis pedis pulses should be assessed for strength and quality prior to a femoral approach and this information will be used to evaluate for complications post procedure. A doppler may be used if unable to palpate the pulses. For the femoral approach the patient is placed in the supine position as far toward the head of the catheterization table as possible with the arms at the sides. The legs are spread slightly so that the knees are 8-12 inches apart to facilitate access to the groin. The skin is then prepped and draped according to protocol. Although both the right and left groins are prepped, the right groin is generally used. The circulating nurse may need to assist the patient in placing the arms behind the head during the procedure for lateral projections as the arms will appear in the X-ray field when at the sides. The obese patient may require the addition of an arm board for comfort due to the narrow table. It may be necessary to retract a protruding abdomen toward the chest and taping it in place in a criss-cross fashion and securing the tape to the catheterization table.

It is important to ensure that an Allen’s test has been conducted for suitability prior to deciding on the radial/brachial approach. The right wrist is the extremity preferred by most physicians when choosing radial access. The arm is abducted at a 70° angle on an arm board with the hand in a “palm-up” position. The wrist may be hyperextended on a roll of sterile towels if desired. The arm is then prepped and draped according to protocol. The arm is placed at a 45-60° angle to the body after arterial access is gained. This position will facilitate movement of the catheter at the entrance to the subclavian artery. At times the physician may ask to have the arm board moved to aid in catheter manipulation. The left and right groin areas are prepped and draped in the same manner as the femoral approach. Should it become necessary to revert to the femoral approach due to a failed radial cannulation, it would not be necessary to stop the case to re-prep and drape.

Theoretical Knowledge of Arterial Cannulation
Although the nurse/technologist will not perform arterial/venous cannulation, it is important that s/he is well versed in the procedure.

**Procedure**

**A Femoral Approach:**

The physician will identify the skin crease in the inguinal region and then use it to palpate the inguinal ligament and the femoral arterial pulsation. The femoral artery should be cannulated just before it crosses the inguinal ligament in the groin. In obese patients, the inguinal ligament is frequently above the skin crease, and in thin people it is frequently below.

Once the femoral arterial pulsation is identified as it crosses the ligament, the artery should then be fixed with the middle and index fingers of the left hand. The physician will raise a wheal of skin by injecting 2% lidocaine. S/he will then infiltrate with the needle towards the femoral artery pulse aiming to make contact with the artery under the middle finger. If there is blood return, the physician will withdraw the needle slightly to infiltrate the arterial wall and then adjust the needle slightly higher and lower to anaesthetize a length of artery. S/he will then infiltrate medially and laterally to the artery.

The left hand, and particularly its middle finger, is left in place. The physician picks up the scalpel with a #11 blade and makes a small nick - approximately 2-3 mm long. S/he will spread the nick with a pair of hemostats and will position the front wall needle at 30-45 degrees to the skin. Through the skin, s/he nicks and aims for femoral artery pulsation under the middle finger. See Figure 1.

When there is pulsating blood return, the physician advances a "J" tipped wire through the needle. There should be no resistance to passage of the wire. If the wire cannot pass through the needle tip, two problems are common:

1. The needle is against the back wall. This is often resolved by delicately pulling the needle back, while gently advancing the wire until resistance to forward motion disappears.

2. The needle may not have been advanced quite far enough into the arterial lumen. If pulling back does not result in good blood return, gently advance until brisker blood return occurs and then attempt to advance the wire.

If the wire stops beyond the needle, it should not be forced. Fluoroscopy is performed. If the wire is obviously in a side branch, then the physician will withdraw, reposition and attempt to advance again. If the obstruction is in the iliofemoral system, then the physician will attempt to advance the wire or make the decision as to whether the wire has advanced far enough to place the arterial sheath. Irritation of the femoral nerve can occur when cannulating either the femoral vein or artery. This is identified by the patient complaining of
shooting pain down the affected leg. Repositioning of the front-wall needle is necessary. See Figure 2.

Although the femoral site was probably the most commonly utilized approach for left heart catheterization in the past, the radial approach is becoming the approach of choice in many cardiac catheterization lab centres.

Advantages to femoral approach
The femoral approach is faster to perform when compared to other vascular approaches and is easier to master. Several other advantages are large vessels which allow for the introduction of large catheters; ready access to virtually the entire central circulation with the appropriate catheter; and there are a multitude of catheters available for adapting the procedure to the patient.

Disadvantages
The abdominal aorta and the iliofemoral branches are generally more atherosclerotic and tortuous than upper extremity branches and can present problems for catheter passage. If there is a local vascular complication, repair will generally require surgical intervention in the operating room under general anaesthesia. Other potential complications include bleeding or hematoma formation, retroperitoneal hemorrhage, arterial occlusion and femoral neuropathy.
B. Radial approach:

Advantages: The radial approach is being used more frequently due to its easy access related to its superficial nature. The radial artery is not located near major nerves or veins and the bony surface below allows for good support when attempting to control bleeding. Even with an occlusion of the radial artery, no ischemia of the affected extremity would be evident due to the continuous nature of the radial and ulnar arteries through the palmer arches. See Figure 3.

![Figure 3](image-url)

The radial pulse is located and infiltrated with only as much Xylocaine as is necessary to numb the area. Larger amounts can obscure the pulse and make cannulation more difficult. Following puncture, the radial artery sheath is introduced. This sheath is longer than that used in femoral access as it promotes easier catheter manipulation and patient comfort by reducing the frequency of arterial spasm. Nitroglycerin 200-400 micrograms or
Verapamil 2.5 mg. is administered through the sheath before it is completely introduced to further reduce the occurrence of arterial spasm. Heparin or Bivalirudin may be administered at this time. The interventionalist will indicate the type and size of catheter s/he prefers to use.

*Advantages of radial approach:* Complications are less common when comparing the radial technique with the femoral approach.

*Disadvantages of radial approach:* Because the radial artery is much smaller in diameter when compared to the femoral artery, procedures requiring larger devices cannot utilize the radial approach.

**C - Brachial approach:**

A brachial entry should be selected only where the radial or femoral approaches are not possible. The brachial artery is smaller (3-5 mm in diameter) and more difficult to stabilize during cannulation (the course may change due to the mobility of the artery and the large amount of loose connective tissue in this area). The small amount of space at this site can also lead to uncontrolled hematoma formation resulting in compression syndrome and ischemia of the arm and hand. Accidental stimulation of the medial nerve can cause an “electric shock” sensation in the hand. See Figure 3.

The area 1-2 cm. above the elbow crease is infiltrated with Xylocaine. Using an 18 g. needle with a plastic cannula, the brachial artery is punctured by going through the skin at a 45° angle. A guidewire is advanced into the artery, around the shoulder and into the aorta under fluoroscopy. The sheath-dilator assembly is delivered over the wire into the artery. The guidewire and dilator are removed and the sheath is aspirated and flushed. The brachial artery can accommodate up to a # 8 F. sheath. Heparin is administered IV or through the sheath. Remember to tell the patient that they will experience a brief burning sensation in the hand if the heparin is given through the sheath. The physician will indicate the type and size of catheter s/he will require to complete the procedure.

**Theoretical Knowledge of Femoral Venous Cannulation**

**Procedure**

The physician will identify the skin crease in the inguinal region and then uses it to palpate the inguinal ligament and the femoral arterial pulsation. If performing a right and left heart catheterization together, when injecting the local anaesthetic for the femoral artery, the physician should extend the wheal medially by 1-2 cm. Otherwise, the needle is inserted 1-2 cm medial to the femoral artery pulsation. Then leaving the left hand palpating the femoral artery, the physician infiltrates in a parallel line 1-2 finger breaths medial to the artery. It is useful to use the needle as a probing needle to locate the femoral vein and best angle of entry for the front wall needle. The front wall needle is then used to cannulate the femoral vein. Frequently a pop will be felt when the vein is entered. A syringe with a quantity of saline is attached and blood is aspirated. The physician removes the syringe
and advances the wire only if there is no resistance. Fluoroscopy is performed to confirm the wire is in the inferior vena cava to the patient's right of the spine.

**Sheath Placement and Flushing**

**Procedure**

The middle and ring fingers of the left hand are used to compress the artery or vein as the needle is removed and the wire then is secured by pinching between the thumb and index finger. The guidewire is wiped with a damp 4 x 4 gauze using the right hand and the puncture is enlarged by threading the dilator and sheath over the guidewire in a rotary fashion. The dilator and guidewire are then removed leaving the introducer in place in the femoral artery.

The side arm of the introducer is aspirated with a syringe until blood flows into the syringe. The aspirate is discarded and the side arm of the sheath is flushed with a 10 mL syringe of heparinized solution. Caution is taken against injecting air into the line. The syringe should be held with the barrel up so that any air in the syringe rises to the top and is less likely to be injected into the patient. The stopcock to the sideport is turned to the closed position and the syringe is disconnected.

**Vascular Sheaths**

Vascular sheaths come in a variety of lengths and sizes. In sheaths with side arms or extensions, the tubing is polyethylene and extends to a three-way stopcock providing separate ports for pressure monitoring and flushing. The sheath itself is made of a non-thrombogenic material, usually Teflon or polyethylene, which is extremely strong, thin, pliable and radiolucent. The tip of the sheath is advanced over the dilator into the vessel. There is a back-bleed valve at the hub of the sheath which allows for control of bleeding. It is important to moisten the catheter frequently to keep the hemostasis valve lubricated during catheter insertion and manipulation. Also, manual flushing of the sheath prevents thrombus or possible embolization.

In general, short sheaths of 10 cm length are used for the majority of diagnostic cases and angioplasties. However, in those with tortuous anatomy in the iliofemoral system, a long (30 cm) sheath is used under physician's direction in an effort to straighten out the iliofemoral segment and allow better transmission of torque to the cardiac and coronary catheters. At present with 5 or 6 French diagnostic catheters, 5 or 6 French sheaths are used except during valvular cases where simultaneous pressures from the catheter and side arms of the sheath are recorded. In this case, 7 French sheaths may be used. Angioplasties are done with 6, 7 or 8 French guiding catheters and so 6, 7 or 8 French sheaths are used. Cardiac biopsies using the internal jugular approach use 9 French sheaths to allow passage of the Stanford Biopettes or 7 French and Bipal.

**Operation of the angiographic contrast delivery system (ACIST®)**
Refer to Appendix A for use of ACIST system

**Coronary Artery Contrast Injection via the Manifold for Latex Allergy Patients**

Refer to Appendix B for use of manifold instructions

**Intracoronary Nitroglycerin Injection**

Intracoronary nitroglycerin can be administered to the patient experiencing coronary spasm, severe ischemic pain or ECG changes indicating impending coronary artery closure during the procedure. Since nitroglycerin decreases systolic and mean arterial pressure and increases heart rate, care should be used to avoid inducing hypotension in patients with known or suspected severe aortic stenosis, left main coronary artery narrowing or hypertrophic cardiomyopathy. (Kern, 2003)

**Procedure**

Under the direct physician's supervision, pharmacy prepared nitroglycerin is used. Prepared nitroglycerin is at a concentration of 50 micrograms per mL. Draw up 10 mL of this concentrate in a 10 mL syringe with 20g 1 ½ inch needle labelled with a yellow sticker. The 10 mL control syringe is removed from the manifold. Attach the 10 mL syringe of prepared nitroglycerin to the manifold. Holding the syringe upright, tap syringe and withdraw from catheter or saline flush line to ensure there are no air bubbles. Inject the specified amount of nitroglycerin. The usual dose is 100-200 micrograms although up to 500 micrograms may be injected in patients with ischemia and high systemic arterial pressure. The primary side effect is hypotension that is usually reversed by fluid volume replacement intravenously or waiting 2-3 minutes as the systemic arterial vasodilation effect of the nitrates wear off.

**Angioplasty Balloon Inflation Under Direct Physician Supervision**

**Procedure**

The angioplasty balloon catheter when prepped, is left on negative pressure. When indicated by physician, connect the angioplasty balloon catheter to the inflation device which has been primed with contrast media and withdraw the syringe plunger to put the balloon on negative pressure. To inflate the balloon when required in the coronary artery, release the negative pressure, then turn the handle of the inflation device in a clockwise motion to gradually increase atmospheric pressure to desired atmosphere as directed by physician. As the balloon is inflated the "waist" at stenosis is observed fluoroscopically to double check the position of the balloon and to determine the pressure at which the waist is eliminated i.e. "popping pressure". To deflate, release and pull back quickly on plunger. Typical inflation times are approximately 1 minute although longer inflation of 3-15 minutes may be required. During inflation, monitor patient symptoms and electrocardiogram for ischemia and ectopy.
While the balloon is inflated, attention is paid to the pressure on the balloon inflation device. Normally, balloons are capable of holding the set pressure or only slowly will the set pressure fall. Sudden loss of pressure may indicate balloon rupture and the balloon should be deflated and the physician notified.

**Sheath removal and entry site Compression**

**A Femoral:**

Femoral arterial and/or venous sheath removal is a **Delegated Medical Function** and requires initial certification followed by annual re-certification. Please refer to *PCC Sheath Removal and Groin Compressor* (CC 10-009) for further information. Where the femoral route was used to conduct a PCI, the sheaths will remain in place for an additional four hours. In this case, the patient is returned to the unit with the sheath capped and covered with a transparent occlusive dressing to maintain the site until sheath removal.

**B Radial:**

Nitroglycerin is occasionally given through the sheath prior to sheath removal to reduce radial artery spasm. The physician places a radial band (plastic compression bracelet with a pressure pad) over the puncture site, removes the sheath and tightens the radial band to achieve hemostasis. The radial band is loosened and removed over a 3 hour period by the nurse. The loosening and removal of a radial band is a **Post-Entry Level Competency** and assessment of competency is required before engaging in this skill. While the patient remains in the Bay area in the cath lab prior to transfer to the nursing unit the nurse should monitor the affected limb q15 minutes for the following:

- Presence/quality of ulnar & radial pulses
- Capillary refill of thumb (should be less than 3 seconds)
- Pain/tingling in arm/hand
- Coolness/colour change
- Bleeding, swelling, hematoma at puncture site
- Proper placement of hemoband & pressure pad

For more information. Please refer to *Radial Artery Compression and Caring for the patient following a transradial cardiac Cath/angioplasty* (CC 10-065).

**C Brachial:**

An arm board can be used to facilitate pressure application. If the radial pulse is noted to be weak or absent, nitroglycerin may be administered through the sheath prior to sheath removal. The sheath is removed by the physician and manual pressure is applied for 15-20 minutes (PCI sheath would be removed on the nursing unit 4 hours post procedure). The arm circumference is measured and marked to facilitate in the detection of hematoma formation. The radial pulse should be monitored and the site checked for bleeding/swelling q15 minutes while in the Bay area in the cath lab. The patient should be instructed to keep
the affected arm relaxed but straight. Although the patient is permitted sit up in bed, ambulation may be restricted for several hours.

REFERENCES:

Kells, C., Cardiac catheterization and angioplasty manual. Unpublished manuscript, Division of Cardiology, Department of Medicine, Victoria General Hospital, Dalhousie University.


TEST

1. Arterial Cannulation - Which is more medial?
   a. femoral vein
   b. femoral artery
   c. femoral nerve

2. What identifies the femoral artery for cannulation?
   a. inguinal ligament
   b. inguinal crease
   c. arterial pulse
   d. all of the above

3. When cannulating the femoral vein, insertion should be made:
   a. medial to femoral artery
   b. lateral to femoral artery
   c. through femoral artery
   d. none of the above

4. Correct arterial cannulation has been achieved when:
   a. the patient complains of pain
   b. there is a pulsating blood return
   c. there is a slow continuous blood return
   d. the colour of the blood is dark red

5. Correct venous cannulation has been achieved when:
   a. the patient complains of pain
   b. there is a pulsating blood return
   c. there is a slow continuous blood return
   d. the colour of the blood is bright red
6. The guidewire can be advanced when:
   a. there is resistance in the artery
   b. there is no resistance when advancing the wire in the artery
   c. when there is no blood return from the needle
   d. all of the above

7. Disadvantages of using the femoral artery approach include:
   a. tortuosity of iliac arteries
   b. surgical repair may be needed if there is a femoral blockage caused by the femoral approach
   c. obstruction of the femoral vein
   d. a and b
   e. a, b and c

8. Always inject nitroglycerin into the coronary artery when:
   a. there is coronary artery spasm
   b. the patient suffers extreme pain
   c. there is ECG evidence of coronary artery closure
   d. all of the above

9. What is the usual dose of nitroglycerin for coronary artery injection?
   a. 50 - 100 micrograms
   b. 10 - 20 micrograms
   c. 100 - 200 micrograms
   d. 300 - 500 micrograms

10. __________________________ is the main side effect of nitroglycerin following intra-arterial coronary injection.

11. Even with an occlusion of the radial artery, no ischemia of the affected extremity would be evident due to the ___________ nature of the _________ and _________ arteries through the _________ arches.

12. During a radial procedure, ___________ and ___________ is administered through the sheath before it is completely introduced to reduce the occurrence of arterial spasm.
13. All the selective coronary catheters are to be flushed with contrast media immediately before being positioned in coronary artery.
   a. True
   b. False

14. If a catheter is unused for a period of time, it should be flushed with saline every 10-15 minutes.
   a. True
   b. False

15. When injecting contrast media using the manifold system into the coronary artery:
   a. inject vigorously into the coronary artery
   b. keep the pressure line on the manifold turned to the position for pressure monitoring
   c. when arterial pressure drops, then inject the contrast into the coronary artery

16. If the physician asks for a "test" during coronary catheterization, then inject ______________________ a small amount to opacify the vessel.

17. Where a radial approach is planned, the skin prep should include:
   a. Right groin
   b. Selected arm
   c. Left and right groin
   d. Right side of neck

   Answer:
   a. a & b
   b. b & c
   c. b & d
   d. Only b

18. As proven by research, it is better to always deflate balloon catheter quickly.
   a. True
   b. False
19. During inflation, if patient suffers pain or ischemia, the balloon must be immediately deflated.
   a. True  
   b. False

20. The popping pressure indicates:
   a. the balloon has burst  
   b. the balloon "waist" has been eliminated  
   c. the vessel has dissected

21. Administering Heparin through a brachial sheath can cause:
   a. Immediate excessive bleeding at the puncture site.  
   b. A burning sensation in the hand.  
   c. Chest pain requiring nitroglycerin administration.  
   d. Temporary numbness of the affected extremity.

22. Following radial sheath removal and hemoband application, the affected extremity should be monitored for the following:
   a. Capillary refill, presence/quality of ulnar and radial pulse.  
   b. Pain/tingling, coolness/colour change  
   c. Bleeding, swelling, hematoma and correct placement of hemoband and pressure pad.  
   d. All of the above.

23. To ensure against injecting air into the sheath side arm:
   a. hold the syringe in an upright position and tap the syringe  
   b. completely fill the syringe with heparinized saline so there can be no room for air bubbles  
   c. there is no danger to the patient when air is injected into the side arm of the sheath introducer

24. The pigtail catheter can be advanced into the left ventricle by the nurse or technologist.
   a. True
b. False

25. The nurse or technologist will advance the catheter in the right ventricle.
   a. True
   b. False
ANSWERS

1. a
2. d
3. a
4. b
5. c
6. b
7. d
8. d
9. c
10. hypotension
11. continuous, radial, ulnar, palmer
12. Verapamil, Nitroglycerin
13. a
14. b
15. a
16. vigorously
17. b
18. a
**PROFICIENCY STANDARDS SKILLS CHECKLIST**

**TITLE:** Nurse/Technologist Assisting in Cardiac Catheterization & Coronary Angiography

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<tr>
<th>Arterial Cannulation:</th>
<th>YES</th>
<th>NO</th>
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<tbody>
<tr>
<td>a. Identifies the inguinal crease.</td>
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<tr>
<td>b. Identifies the inguinal ligament.</td>
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<thead>
<tr>
<th>Venous Cannulation:</th>
<th>YES</th>
<th>NO</th>
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<tbody>
<tr>
<td>a. Identifies the inguinal crease.</td>
<td></td>
<td></td>
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<tr>
<td>b. Identifies the inguinal ligament.</td>
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<tr>
<th>Sheath Placement and Flushing:</th>
<th>YES</th>
<th>NO</th>
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<tr>
<td>a. Able to control the excess bleeding by applying pressure to the artery or vein while removing the front wall needle.</td>
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<tr>
<td>b. Removes blood from wire by wiping with a wet 4 x 4 gauze.</td>
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<tr>
<td>c. Dilates the puncture site and advances the sheath by threading dilator and sheath over the guidewire in a clockwise rotating fashion.</td>
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<tr>
<td>d. Removes dilator and guidewire while maintaining sheath position.</td>
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<tr>
<td>e. Aspirates 5 mL of blood from the side arm of the sheath introducer using a 10 or 20 mL syringe held in an upright position, then turn stopcock off.</td>
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<td>f. Discards aspirate into a discard bowl.</td>
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<tr>
<td>g. Connects the side arm of the introducer with a 10 mL syringe of heparinized saline held in an upright position and aspirates until a small amount of blood flows into the syringe then injects 5 mL of heparinized saline into the side arm.</td>
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<tr>
<td>h. Turns the stopcock to an off position and disconnects syringe.</td>
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<tr>
<th>Flushing Through the Manifold:</th>
<th>YES</th>
<th>NO</th>
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<tr>
<td>a. Demonstrate the ability to use and operate the 2-way and the 3-way</td>
<td></td>
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<tr>
<td>YES</td>
<td>NO</td>
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<tr>
<td>-----</td>
<td>----</td>
<td></td>
</tr>
<tr>
<td>manifold.</td>
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<td></td>
</tr>
<tr>
<td>b. Connects the 10 mL control syringe to a 2-way or 3-way manifold and fills syringe with heparinized solution by manipulating stopcocks of the flush port on the manifold.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. Ensures the manifold is air bubble free by flushing through the distal port.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d. Connects distal port of the 2-way or 3-way manifold to the hub of the inserted catheter.</td>
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</tr>
<tr>
<td>e. Aspirates and taps the manifold until a small amount of blood flows into the upright held manifold system.</td>
<td></td>
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<tr>
<td>f. Ensures injectate is bubble free, then maintaining upright position, injects 6 mL of heparinized flush into the catheter, turns stopcocks to appropriate positions to stop back flow.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Coronary Artery Contrast Injection:**

<table>
<thead>
<tr>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Demonstrates the ability to operate the 3-way manifold to fill control syringe with contrast.</td>
<td></td>
</tr>
<tr>
<td>b. Using the same techniques needed for flushing the manifold, injects dye when the physician orders.</td>
<td></td>
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<tr>
<td>c. Resumes pressure monitoring by manipulating the stopcock to an appropriate position for arterial pressure.</td>
<td></td>
</tr>
</tbody>
</table>

**Intracoronary Nitroglycerin Injection:**

<table>
<thead>
<tr>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Able to state indications for intracoronary Nitroglycerin injection.</td>
<td></td>
</tr>
<tr>
<td>b. Demonstrate the proper injection technique for injecting intracoronary nitroglycerin as per physician's order.</td>
<td></td>
</tr>
<tr>
<td>c. Able to state side effects of intracoronary nitroglycerin injection.</td>
<td></td>
</tr>
</tbody>
</table>

**Advancing/Withdrawing Angioplasty Guidewires:**

<table>
<thead>
<tr>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Demonstrates the ability to maintain the designated wire position as indicated by physician. Actual advancing/withdrawal is not permitted.</td>
<td></td>
</tr>
</tbody>
</table>

**Angioplasty Balloon Inflation Under Direct Physician Supervision:**

<table>
<thead>
<tr>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Explains the function of this inflation device.</td>
<td></td>
</tr>
<tr>
<td>b. Demonstrates the operation and technique of the inflation device.</td>
<td></td>
</tr>
</tbody>
</table>
Appendix A

Operation of the angiographic contrast delivery system (ACIST®)

1. Switch on the system (toggle switch on Power Supply)
   The boot process takes approx. 50 secs
2. Select Cardiac or Peripheral mode
3. Press ‘Start’ and the ram will calibrate (automatic process)
4. When prompted insert the syringe and press ‘Done’
   The wiper will be engaged
5. Connect the BT kit and follow the instructions as described

ATP54 connection

1. Connect hand controller
2. Connect high pressure line
3. Calibrate hand controller – press OK and within 5 secs depress C button on hand controller fully
4. Purge the line
   - Press OK shortly, the system will inject a small amount of contrast. After the purge press the lower (saline) button of the hand controller and allow the flush to time out (10 secs), tap the line and three way stopcock during the flush in order to ‘de-bubble’.
5. Place the three way stopcock on patient mid-chest level and zero calibrate

Catheter connection

Wet connection

1. Press the saline flush button and during the flush, connect the catheter (this is the favored method in the UK) (preference = squirt contrast)
   Drawback is waste of contrast.

Dry connection (Acist recommended method)

1. Attach the catheter
2. Turn stopcock to the right (close distal port)
3. Attach a syringe partially filled with saline, aspirate the catheter and flush catheter accordingly
Appendix B

Flush Catheter Through the Manifold – for patients with latex allergies

**Procedure**

Refer to Figure 4 for the ports of the manifold which attach to the catheter leading to the patient, the transducer, the flush line and the contrast line. The control syringe is connected to the proximal end of the three-sided port manifold. All connections are Luer-Lok.

*To Flush the Catheter Through the Manifold* - Before the manifold is connected to the catheter in the patient, arrange the stopcocks to allow flush fluid to flow toward the distal end or patient end of the system. Check the entire system for bubbles. Tap areas you can't see to locate hidden bubbles. Turn long arrow toward flushline to withdraw heparinized saline into the syringe.

After the guidewire is removed from catheter, it is wiped with a damp gauze and placed on table. The catheter is aspirated and flushed with heparinized saline taking care to avoid bubbles as with arterial sheaths. Attach to manifold and aspirate into control syringe - tapping to dislodge any bubbles made while making connections. Care is taken to introduce as little blood as possible into control syringe since there is a risk of clots in control syringe. Cardiac catheters are flushed with saline solution while coronary catheters while initially flushed with saline to eliminate air bubbles are flushed with contrast.

If the catheter is unused for a period of time, it should be flushed with saline to eliminate any contrast and every 3-5 minutes subsequently to maintain patency. The right heart catheter may be left "on flush" by opening the flush line through the manifold and then regulating the rate by using the roller clamp. In general, it is best to manually flush left heart catheters or coronary catheters manually every 3-5 minutes because there is less risk of introducing air bubbles into the patient.