STANDARD OPERATING PROCEDURE

ADVANCED INTRAVENOUS TRAINING ARM (S401.100)

Table of Contents

1. Scope 2
2. Objective 2
3. Definitions 2
4. Responsibility 3
5. Procedure 4
   5.1. Diagram of the Advanced Intravenous Training Arm 4
   5.2. Diagram of Vinyl Bag in Upright Position 5
   5.3. Set-Up 6
   5.4. Preparation 6
   5.5. Removal of Fluid from the system 6
   5.6. Injection Preparation 7
   5.7. IV Exercises 7
   5.8. Subcutaneous Injection 7
   5.9. Intramuscular Injection 8
   5.10. Intradermal Injection 8
   5.11. Dis-assembly 8
   5.12. Cleaning and Maintenance 8
   5.13. Flow Charts 9
6. Precautions 21
7. References 21
8. Appendices 22
9. Revision History 22

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1. Scope

This Standard Operating Procedure (SOP) applies to the staff and students using the Advanced Intravenous Training Arm in the Pharmacy Practice Resource Unit (PPRU) at the Pharmacy Department, University of Malta.

2. Objective

To describe the procedure for set-up and use of the Advanced Intravenous Training Arm.

3. Definitions

3.1. Acromion: The outer end of the scapula (shoulder blade), extending over the shoulder joint and forming the highest point of the shoulder, to which the collarbone is attached. It is large and somewhat triangular in shape, flattened from behind forward, projecting at first laterally, and then curving forward and upward, so as to overhang the glenoid cavity (SOP/PD/234_01/A1).

3.2. Gauge: Diameter of the lumen of the needle, which is usually between 16 and 30G. The larger the number, the smaller the diameter.

3.3. Injections: Sterile solutions, suspensions or emulsions, presented in a suitable aqueous or non-aqueous vehicle intended for parenteral administration into body tissues.

3.4. Intradermal (ID) injection: Involves injection of small amounts of fluid into the dermal layer of the skin at an angle of 10-15° (SOP/PD/234_01/A2). This type of injection is used for diagnostic procedures (e.g. tuberculin testing), allergy tests and local administration of anaesthetics.

3.5. Intramuscular (IM) injection: Injection of a substance directly into a large muscle, generally the gluteal, deltoid or lateral thigh. When administering an IM injection the syringe needle is inserted deep into the selected site at an angle of 90° generally using a 22 gauge needle (SOP/PD/234_01/A2). The volume of injection should not exceed 5ml. This route of administration is suitable for both aqueous and oily suspensions and is commonly used as a route of administration for vaccination.

3.6. Intravenous (IV) Injection: Injection of a substance directly into the vein. The intravenous route uses a hypodermic injection for the purpose of instilling a single dose of medication, injecting a contrast medium or beginning an IV
infusion of blood, medication, or a fluid solution, such as saline or dextrose in water.

3.7. **Intravenous Infusion**: Drug administration through IV route at a constant rate over a determined time interval.

3.8. **Palpation**: Used as part of a physical examination in which a body part is felt or touched to determine its size, shape, firmness/tenderness, location, consistency or texture.

3.9. **Parenteral administration**: Administration of a substance by injection, infusion or implantation, through a route that bypasses the gastrointestinal system.

3.10. **Subcutaneous (SC) injection**: Injection of a substance into the layer of fat between the skin and muscle. When administering a SC injection the syringe needle is inserted at an angle of 45° using a 25-30 gauge needle (SOP/PD/234_01/A2). The injection fluid should not exceed 2ml in volume. The SC route is often used for administration of insulin in patients with diabetes mellitus. There are two sites for SC injections: the forearm area and the tricipital area of the upper arm.

4. **Responsibility**

4.1. The members of the Department of Pharmacy (staff and students) are responsible for following this SOP.

4.2. The designated Laboratory Officer or Laboratory Assistant is responsible for ensuring that this SOP is followed.
5. Procedure

5.1. Diagram of the Advanced Intravenous Training Arm

a: Attachment pins  
b: Advanced Intravenous Training Arm  
c: Blood bag  
d: Squeeze bulb  
e: Base with stand for blood bag
5.2. Diagram of Vinyl Bag in Upright Position

Tube A: Connects bag to the pump
Tube B: Connects bag to the arm
Tube C: Outlet from the arm
5.3. Set-Up

5.3.1. Assemble the veins in the grooves of the arm.
5.3.2. Put on the skin by rolling it up and over the wrist, starting from the bottom of the arm; use talcum powder to aid movement.
5.3.3. Place the arm on a table/flat surface.
5.3.4. Lift the hinged metal stand supporting the blood dispenser.
5.3.5. Move the metal stand into position until it rests on the Lucite® base; ensure that the tubing is not kinked.
5.3.6. Release the closed valve, near the shoulder of the arm which is normally closed to prevent leakage, to remove entrapped air in the veins.
5.3.7. Click the valve closed after the lines are completely filled with fluid; the simulator is ready for use.

5.4. Preparation

5.4.1. Ensure that the valve on Tube C is ‘clicked’ closed (SOP/PD/234_01/A3).
5.4.2. Place the stopper in Connector 1.
5.4.3. Hold the vinyl bag upside down and place the funnel in Connector 2.
5.4.4. Fill the bag with a sufficient volume of fluid.
5.4.5. Connect Tube B to Connector 2 and turn the bag to the upright position.
5.4.6. Place the bag on the stand as shown in section 5.2.
5.4.7. Remove the stopper from Connector 1 and insert Tube A.
5.4.8. Place the open-end of Tube C in a beaker, since during pumping water will leak from the outlet.
5.4.9. Open the valve and use the pump to fill the system with fluid; ensure that there are no air bubbles in the system.
5.4.10. Close the valve.
5.4.11. Continue to pump so as to build up pressure in the tubing; ensure that the vinyl bag remains soft to touch.

5.5. Removal of Fluid from the System

5.5.1. Remove Tube A from Connector 1 and insert the stopper.
5.5.2. Insert the end of Tube C into Tube A and open the valve.
5.5.3. Remove the bag from the stand and place it on a flat surface, level with the arm.
5.5.4. Use the pump to remove fluid from the system.
5.5.5. Hold the vinyl bag upside down.
5.5.6. Remove Tube B from Connector 2.
5.5.7. Empty the contents of the vinyl bag.
5.5.8. Remove Tube A from Tube C and remove stopper from Connector 1.

5.6. Injection Preparation

5.6.1. Wash hands thoroughly and wear disposable gloves.
5.6.2. Prepare a sterile syringe and needle using water.

5.7. IV Exercises

5.7.1. Apply the desired pressure to the veins via the squeeze bulb.
5.7.2. Locate the appropriate vein site and clean the skin with alcohol; avoid the use of povidone-iodine as this will cause the vinyl skin to become discoloured and brittle.
5.7.3. Apply the tourniquet 4-6 inches above the selected site.
5.7.4. Select a 20G cannula and a 21G needle for general infusion or a 14-18G cannula and a 19G needle for infusing large amounts of fluid.
5.7.5. Apply finger pressure to the vein distal to the puncture site.
5.7.6. Puncture the skin and the underlying vein with the needle; the bevel of the needle should be up and the needle should be angled at 20-30°; A pop will be felt as the needle enters the vein and blood return will be noticeable.
5.7.7. Stabilise the entry site as desired.
5.7.8. Insert a catheter through the needle if required.
5.7.9. Remove the needle and attach the infusion tubing to the catheter.
5.7.10. Remove the tourniquet.

5.8. Subcutaneous Injection

5.8.1. Forearm

5.8.1.1. Place the simulator with the palm of the hand facing upwards.
5.8.1.2. Palpate for the SC injection site according to SOP/PD/234_01/A4.
5.8.1.3. Wipe the area with an alcohol wipe.
5.8.1.4. Pinch up the padding representing the fatty tissue using the non-dominant hand and administer the SC injection into it.
5.8.1.5. Hold the syringe between the thumb and middle finger of the dominant hand and insert the needle at a 45° angle.
5.8.1.6. Push down the plunger of the syringe using the index finger of the dominant hand until the whole volume of water is administered.
5.8.1.7. Withdraw the needle at the same angle it was inserted.
5.8.2. Tricipital Area of Upper Arm

5.8.2.1. Place the simulator with the palm of the hand facing downwards (SOP/PD/234_01/A5).
5.8.2.2. Perform procedure in sections 5.8.1.2. to 5.8.1.7.

5.9. Intramuscular Injection

5.9.1. Locate the acromion process on the scapula (SOP/PD/234_01/A1).
5.9.2. Wipe the area beneath this process with an alcohol wipe.
5.9.3. Place the small finger of the non-dominant hand on the acromion process.
5.9.4. Move two finger-widths down and administer the injection in the centre of the deltoid muscle at an angle of 90° to its surface.
5.9.5. Push the plunger of the syringe until the whole volume of water is administered.
5.9.6. Withdraw the needle at the same angle it was inserted.

5.10. Intradermal Injection

5.10.1. Wipe the area with an alcohol wipe.
5.10.2. With a disposable 26G needle and syringe, inject a small amount of water directly under the skin; The needle bevel should be facing upward to produce a discrete, pale elevation of the skin approximately 6mm to 10mm in diameter.

5.11. Dis-assembly

5.11.1. Starting at the top of the arm, remove the skin by rolling it down and over the wrist to expose the veins; use talcum powder to ease movement.
5.11.2. Remove the veins from the grooves in the arm.

5.12. Cleaning and Maintenance

5.12.1. Clean the skin of the arm with a mild detergent or soap and water.
5.12.2. Dry the arm and lightly dust it with talcum powder; this will keep the training arm supple and easy to use.
5.12.3. Check that the tubes are not kinked if the venous system is blocked and if the blockage persists, remove from the shoulder and flush the veins with water.
5.13. Flow Charts

5.13.1. Set-Up

Start

Assemble the veins in the grooves of the arm

Put on the skin by rolling it up and over the wrist, starting from the bottom of the arm; use talcum powder to aid movement

Place the arm on a table/flat surface

Lift the hinged metal stand supporting the blood dispenser

Move metal stand into position until it rests on the base; ensure that tubing is not kinked

Release the closed valve, near the shoulder of the arm which is normally closed to prevent leakage, to remove entrapped air in the veins

Click valve closed after the lines are completely filled with fluid; simulator is ready for use

End
5.13.2. Preparation

Start

Ensure that the valve on Tube C is ‘clicked’ closed (SOP/PD/234_01/A3)

Place the stopper in Connector 1

Hold the vinyl bag upside down and place the funnel in Connector 2

Fill the bag with a sufficient volume of fluid

Connect Tube B to Connector 2 and turn bag to the upright position

Place the bag on the stand

Remove stopper from Connector 1 and insert Tube A

Place open-end of Tube C in a beaker, since during pumping water will leak from outlet

1
Open valve and use pump to fill system with fluid; ensure that there are no air bubbles in the system

Close the valve

Continue to pump to build up pressure in the tubing; ensure that vinyl bag remains soft to touch

End
### 5.13.3. Removal of Fluid from the System

-start

1. Remove Tube A from Connector 1 and insert the stopper

2. Insert the end of Tube C into Tube A and open the valve

3. Remove the bag from the stand and place it on a flat surface, level with the arm

4. Use pump to remove fluid from the system

5. Hold the vinyl bag upside down

6. Remove Tube B from Connector 2

7. Empty the contents of the vinyl bag

8. Remove Tube A from Tube C and remove stopper from Connector 1

-end
5.13.4. Injection Preparation

Start

Wash hands thoroughly

Wear disposable gloves

Prepare a sterile syringe and needle using water

End
5.13.5. IV Exercises

Start

Apply the desired pressure to the veins via the squeeze bulb

Locate appropriate vein site and clean skin with alcohol; avoid use of povidone-iodine

Apply tourniquet 4-6 inches above selected site

- General infusion
  - No: Use 14-18G cannula and 19G needle for infusion of large amounts of fluid
  - Yes: Use 20G cannula and 21G needle

Apply finger pressure to the vein distal to the puncture site

Puncture skin and underlying vein with the needle; needle bevel should be up and angled at 20-30°; pop will be felt as the needle enters the vein and blood return will be noticeable
1. Stabilise entry site as desired
2. Insert a catheter through needle if required
3. Remove needle and attach infusion tubing to the catheter
4. Remove the tourniquet

End
5.13.6. Subcutaneous Injection

Start

Forearm

Place simulator with the palm of the hand facing upwards

Tricipital area of upper arm

Place the simulator with the palm of the hand facing downwards

Site of SC injection

Palpate for the SC injection site according to SOP/PD/234_01/A4

Wipe the area with an alcohol wipe

Pinch up the padding representing the fatty tissue using the non-dominant hand and administer the SC injection into it

Hold syringe between thumb and middle finger of the dominant hand and insert needle at a 45° angle

Push down plunger of syringe using index finger of the dominant hand until the whole volume of water is administered

Withdraw the needle at the same angle it was inserted

End
5.13.7. Intramuscular Injection

1. **Start**

2. Locate the acromion process on the scapula

3. Wipe the area beneath this process with an alcohol wipe

4. Place the small finger of the non-dominant hand on the acromion process

5. Move two finger-widths down and administer injection in the centre of the deltoid muscle at an angle of 90° to its surface

6. Push plunger of the syringe until the whole volume of water is administered

7. Withdraw needle at the same angle it was inserted

8. **End**
5.13.8. Intradermal Injection

1. Start
2. Wipe the area with an alcohol wipe
3. With a disposable 26G needle and syringe, inject a small amount of water directly under the skin; needle bevel should be facing upward to produce a discrete, pale elevation of the skin approximately 6-10mm in diameter
4. End
5.13.9. Dis-assembly

Start

Starting at the top of the arm, remove the skin by rolling it down and over the wrist to expose the veins; use talcum powder to ease movement

Remove veins from the grooves in the arm

End
5.13.10. Cleaning and Maintenance

Start

Clean with a mild detergent or soap and water

Dry the arm

Lightly dust with talcum powder

Check that the tubes are not kinked if the venous system is blocked and if blockage persists remove from the shoulder and flush veins with water

End
6. Precautions

6.1. Ensure that there are no air bubbles in the system both during preparation after opening the valve and when filling the system with fluid using the pump.

6.2. Care should be taken to ensure that the vinyl bag remains soft to touch after pumping to build up pressure in the tubing.

6.3. Do not use needles larger than 22G so as not to reduce the skin/vein life.

6.4. Watch the vinyl bag during pumping to prevent the pressure inside from building up too much; If the bag becomes fully inflated release some of the pressure using the valve.

6.5. Fill the system initially with water; when the simulator is acclimatised blood concentrate can then be used.

6.6. Do not use povidone-iodine to clean the skin as this will cause the vinyl skin to become discoloured and brittle.

6.7. Do not use ballpoint pens, ink or markers because indelible marks will remain.

6.8. Store in a cool area in the box provided and do not stack or keep heavy materials on the box since improper storage may damage the training arm.

7. References

8. Appendices

SOP/PD/234_01/A1 – Diagram of the acromion and scapula

SOP/PD/234_01/A2 – Diagram showing angles of injections

SOP/PD/234_01/A3 – Diagram of clip in open and closed position

SOP/PD/234_01/A4 – Diagram showing injection site on palm facing upwards

SOP/PD/234_01/A5 – Diagram showing injection site on palm facing downwards

9. Revision History

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<tr>
<th>Version Number</th>
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SOP/PD/234_01/A1 – Diagram of the acromion and scapula
SOP/PD/234_01/A2 – Diagram showing angles of Injections
SOP/PD/234_01/A3 - Diagram of clip/valve in open and closed position

Closed

Open
SOP/PD/234_01/A4 - Diagram showing injection site on palm facing upwards
SOP/PD/234_01/A5 - Diagram showing injection site on palm facing downwards

ID Injection Site

Upper Arm SC Injection Site