

TITLE: INJECTION TECHNIQUES

| | |
|---|----|
| 1. Scope of the chapter | 2 |
| 2. Definitions | 2 |
| 3. Self-control questions – (answers): | 20 |
| 4. Sample cases | 20 |
| 5. Recommended literature: | 22 |
| 6. Requirements Injection techniques practice | 22 |
| 7. Test questions: | 23 |
| 8. Sources: | 25 |

1. Scope of the chapter

This chapter shows the main injection techniques for administration of drugs and vaccines. The chapter includes the anatomy knowledge, principles, techniques and the rules of injections.

2. Definitions

Intradermal injection

Injection technique, which is often used for skin testing. The needle is inserted into the dermis and the injectate is injected into the dermal layer of the skin.

Subcutaneous injection

Subcutaneous injection is administered into the subcutaneous tissue, the layer of skin underlying the dermis and epidermis.

Intramuscular injection

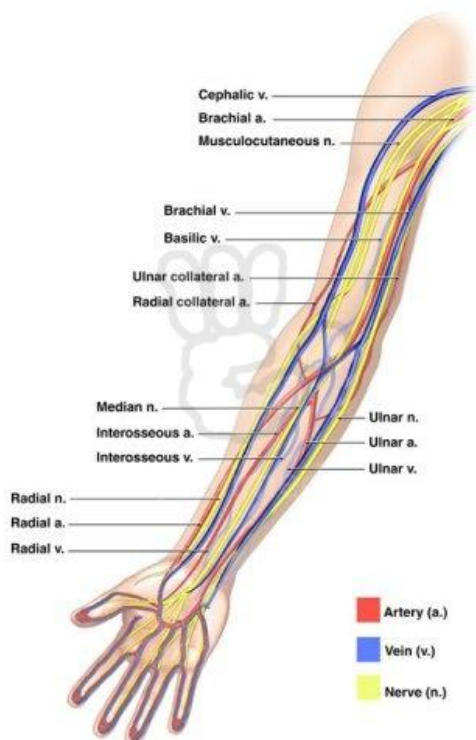
Injection technique, in which the substance is injected directly into the muscle. Depending on the chemical properties of the drug, the medication may either be absorbed quickly or more gradually.

Intravenous:

intravenous simply means “within vein”
abbreviation: i.v.

It means the injection of liquid solution into the vein. Intravenous injection provides the most rapid and complete form of drug absorption.

Anatomy review:



Blood vessels and nerves of the arm

Mammalian skin is composed of two primary layers: epidermis and dermis. The epidermis is a stratified squamous epithelium. The dermis is the layer of skin beneath the epidermis that consists of connective tissue. Below of dermis a subcutaneous fat layer is situated with different thickness depending on body weight. This contains the superficial venous system. Among the often used peripheral veins on the arm the cephalic, basilic and median cubital veins are usually well identified.

General viewpoints:

By injection a variety of substances, including antigens, drugs, solutions can be delivered into the different tissues of the body. The substances will be absorbed and distributed in the whole body.

General rules for injections:

1. Before opening the ampoules check carefully to be certain that the solution to be administered is the one intended to be injected!
2. The opened drug solutions should be used within a short time.

3. In case of powder ampoules the solvent should be injected into the glass containing the powder. Before pumping up the drug solutions, shake the glass and check to be dissolved all of the powder.
4. For pumping up and administration of solutions use different needle.
5. During pumping up the needle should not touch the external surface of ampoule.
6. Evacuate air and air bubbles from the syringe.
7. Before drug administration the skin should be cleansed.

The intradermal injection

The used material delivered into the dermal layer of the skin. These injections are often used for skin testing, because it permits easy interpretation of results. Proper technique provides valuable clinical information.

Indications:

1. Intradermal injections in the form of skin tests may be used to determine whether a patient has one of the following conditions:
 - a. A bacterial infection caused by tuberculous or non-tuberculous mycobacteria.
 - b. A fungal infection, particularly coccidiomycosis and bronchopulmonary aspergillosis.
 - c. A specific reactivity to an extrinsic allergen.
2. Skin tests may also be used in the evaluation of delayed hypersensitivity.

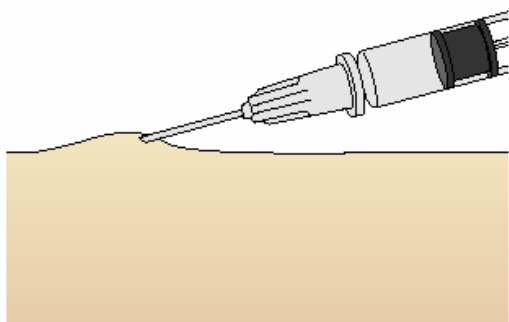
Contraindications:

1. Patients with a documented positive tuberculin skin test do not need to be retested.
2. Patients with severe skin disease at the proposed injection site should not be tested.
3. Patients being evaluated for fungal disease should not be tested with histoplasmosis or blastomycosis antigens since these antigens may confound serologic testing.

Equipment needed:

1. Tuberculin syringe,
2. Needle, 27 gauge, 0,5 inch,
3. Applied antigens
4. materials for skin disinfection
5. gloves
6. Sterile gauze pads
7. Containers for used needles and hazardous waste

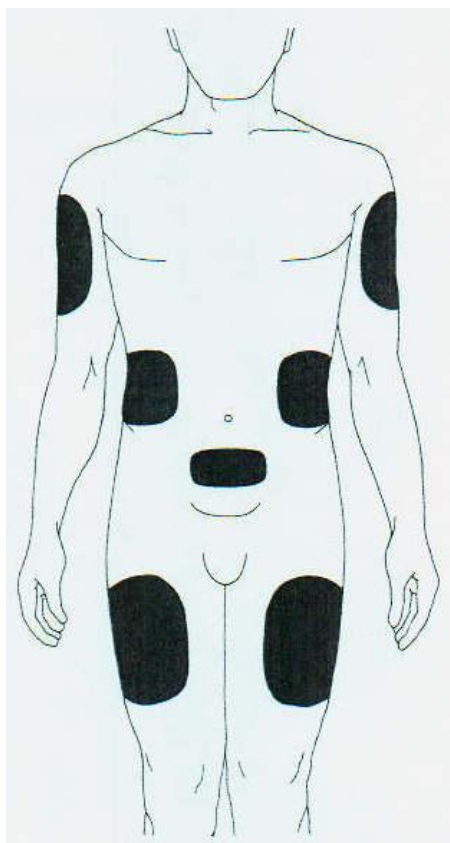
For dermal injection the skin of the ventral forearm is used most frequently. For extensive allergen testing, the skin on the back of the forearm, the back and the abdominal wall can be used as well.



During intradermal injection the angle between the needle and the skin should be between 10 and 15 degrees.

The subcutaneous injection

Drugs are injected subcutaneously when slow absorption and long duration of action are desired or when a bleeding diathesis makes intramuscular injection hazardous. The most often administered drugs are the insulin, heparin, low molecular weight heparin (LMWH) by subcutaneous injection. Only 1-2 ml solution may be injected subcutaneously. The most common sites are the tissues of the upper arms, anterior thighs, and over the lower abdominal wall. When repeated injections are given, the sites should be rotated to prevent local reactions.



Common sites for subcutaneous injections

Contraindications:

1. Subcutaneous injections should not be given to patients who have severe skin disease at the proposed injection site.
2. Do not administer drugs subcutaneously for patients with circulatory shock, because the absorption of drug is uncertain. After restoration of circulation the absorption can be rapid and the large amount of absorbed insulin can cause hypoglycaemia.

C. Equipment needed

1. materials for skin disinfection
2. Syringe of appropriate size for the volume of injection
3. Needle, 25 to 27 gauge, 3/4 to 1 inch.
4. Solution to be injected. The subcutaneously administered drugs are usually marketed in prefilled syringes
5. Gloves
6. Self-adhesive bandage.
7. Containers for used needles and hazardous waste

The intramuscular injection

Intramuscular injections are used when parenteral delivery is necessary and an intermediate rate of onset and duration of action are acceptable or desirable. Oil solutions can be administered through this way, the absorption time is several days, it usually provides a prolonged effect. Maximum 5 ml solution can be administered by this technique.

Contraindications:

1. Intramuscular injections should not be administered to patients with dermatitis or cellulitis at the proposed injection site.
2. Intramuscular injections are contraindicated in patients with congenital and acquired bleeding disorders and in patients who are undergoing anticoagulant therapy.

Sites for intramuscular injection

The usual sites for intramuscular injections are the gluteal muscles, the deltoid muscle of the upper arm, and less often, the vastus lateralis muscle of the thigh. Care must be taken to avoid vascular and neural structures in these locations (see below).

1. Gluteal muscle. Gluteal injection is preferred in adults and in children over two years of age for two reasons: (1) because the gluteal muscles can hold a large volume of injectate, and (2) because

the overlying skin is thin and relatively insensitive to pain. However, some vaccinations, particularly the hepatitis B vaccine, produce an inadequate antibody response in the gluteal region. Infants who have not been walking for at least one year have poorly developed gluteal tissues that should not be used for injection.

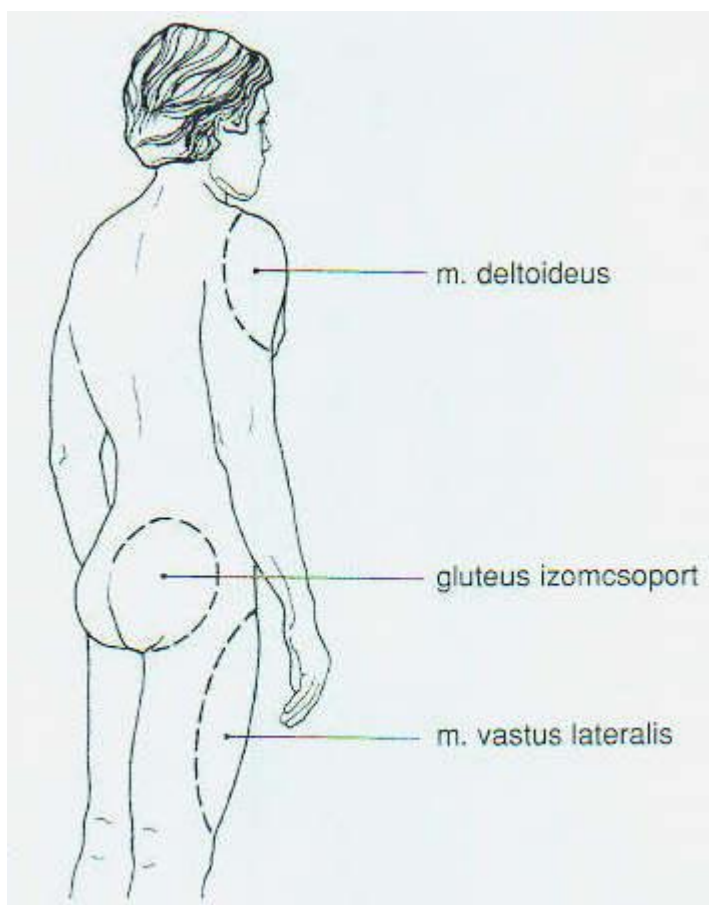
The appropriate area for injection is lateral and superior to a line between the femoral head and the posterior superior iliac spine. Inject only into the upper outer quadrant of the buttock to avoid injury to the sciatic nerve, which runs under the gluteus maximus muscle. Use a ventral gluteal site in bedridden supine patients, including patients in traction. To identify the appropriate site, face the patient and place the left hand on the patient's right hip (or vice versa) in such a way that the thumb is over the greater trochanter and the index finger is on the superior anterior iliac spine. Give the injection in the triangle created by spreading the index and middle fingers.

2. Deltoid muscle. Since the muscle mass of the upper arm is smaller than that of the gluteal region, pain and tenderness are more common with deltoid injections. Large volumes and irritating solutions should not be given in this area.

Administer injections into the midline mass of the deltoid muscle, midway between the acromion and the groove that borders the deltoid muscle inferiorly.

3. Vastus lateralis muscle. This muscle is the preferred injection site in infants. It may also be used in adults.

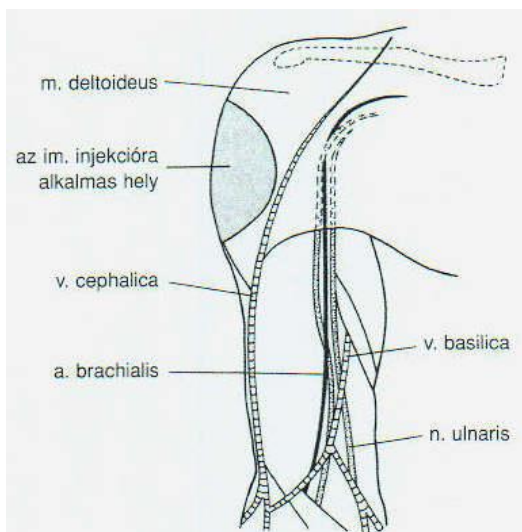
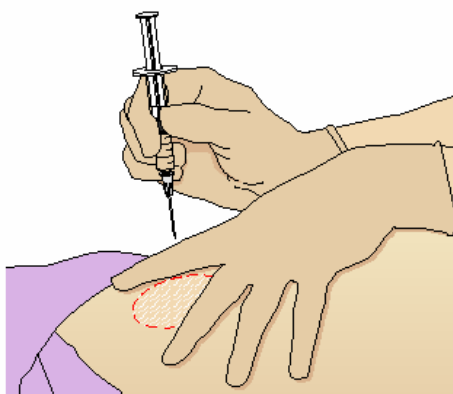
Give vastus lateralis injections directly into the bulk of the muscle in the middle third of the area between the greater trochanter and the tibial plateau at the knee. Make injections straight into the muscle to a depth of approximately one inch.



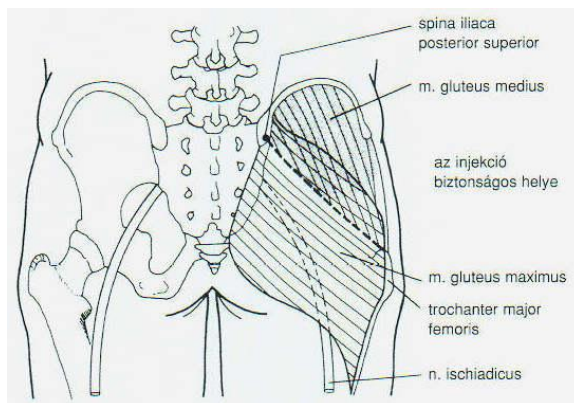
Sites for intramuscular injections

Equipment needed

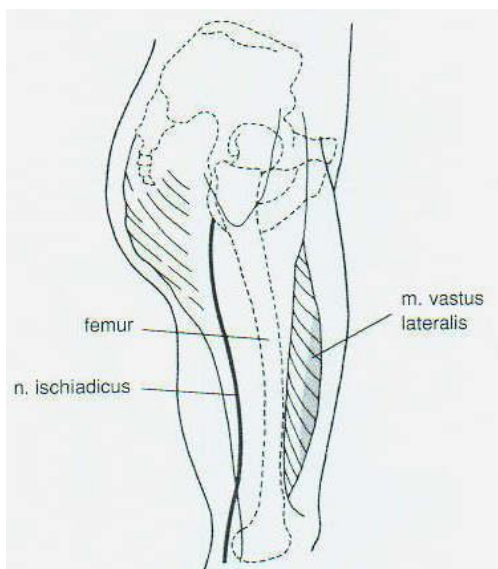
1. materials for skin disinfection
2. Syringe of appropriate size for applied volume
3. Needle, 22-gauge, 1,5-inch. If the patient is very obese, a longer needle may be required.
4. Solution to be injected, in case of powder ampoules the solution. The solution is not always included! In this case check the summary of product characteristics!
5. Gloves
6. Self-adhesive bandage
7. Containers for used needles and hazardous waste



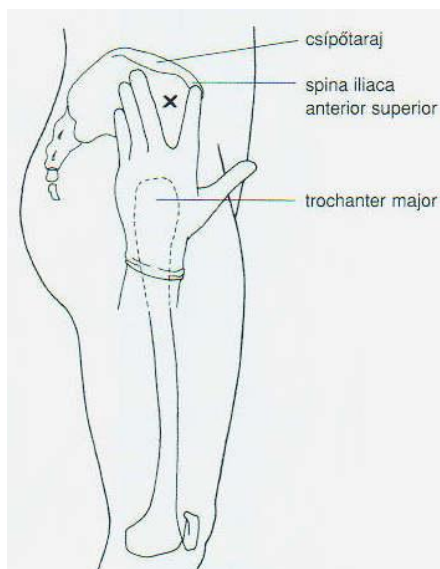
Anatomy of the deltoid muscle region.



Anatomy of the gluteal region



Anatomy of the vastus lateralis muscle region



Method for defining the ventral gluteal region for intramuscular injection

The intravenous injection

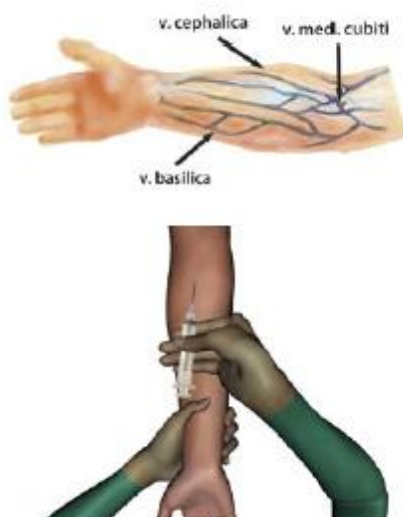
Intravenous injections provide the most rapid and complete form of drug absorption. here is possibility to administer large volume. Oil solution cannot be administered intravenously. Although the veins of the antecubital fossa are most commonly selected as sites of intravenous injection in adults, any peripheral vein that can be distended with the use of a tourniquet may be used for this type of injection.

Contraindications

1. Dermatitis or cellulitis at the proposed injection site is a contraindication.
2. Irritating medications, such as erythromycin, or substances, such as potassium, which produce dangerous toxicity at high levels, should not be given by bolus intravenous injection. Instead, these medications should be given by slow intravenous infusion.
3. If multiple intravenous injections are necessary, an intravenous line should be placed.

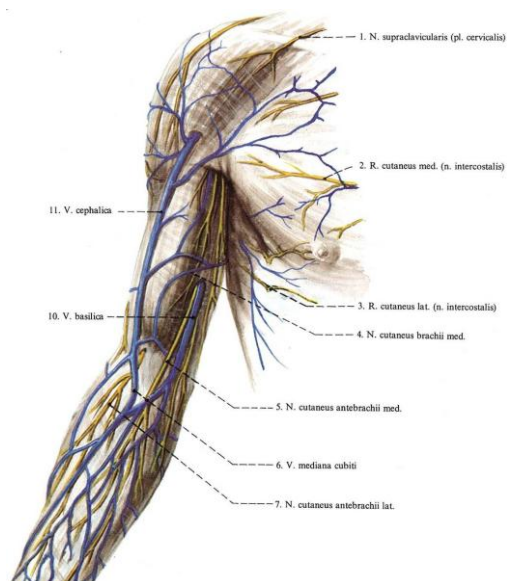
Equipment needed

1. Materials used for skin cleansing
2. Tourniquet.
3. Syringe of appropriate size for applied volume
4. Needle, 22-gauge, 1-2 inch. Such a needle will suffice for most medications.
5. Solution to be injected, in case of powder ampoule, the solvent.
6. Gloves
7. Self-adhesive bandage
8. Containers for used needles and hazardous waste

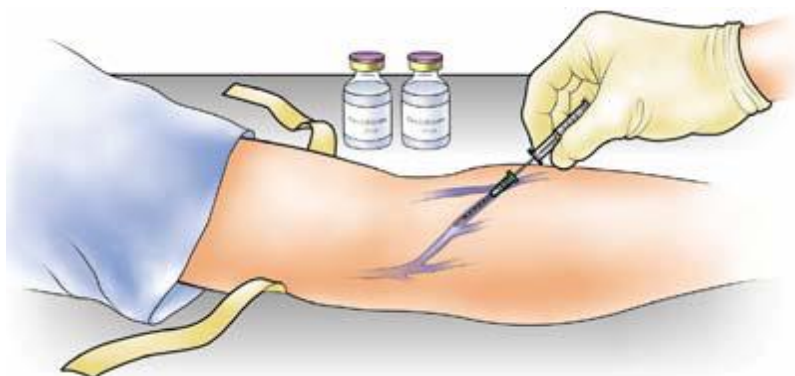


Sites for intravenous injection (upper figure) and technique (lower figure)

Sites: The basilic vein, the median cubital vein, and the median cephalic vein are usually evident. Veins of the forearm, hand, feet and the external jugular veins are also suitable. The vein that is most easily palpable, not the vein that is the most visible, should be selected for injection.



Superficial venous system of the arm



Technique of intravenous injection

Personnel required

One person can perform this procedure without assistance.

Procedure of injections

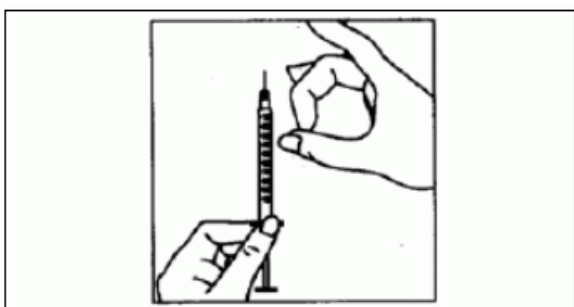
Things to do before injection

Wash the hands and use gloves in every cases.

Break down the neck of the ampoule. Modern ampoules are usually opened by snapping off the neck. If properly done, this last operation creates a clean break without any extra glass shards. In some cases the neck of the ampoule need to rasp before opening.

In case of rubber stoppered medicine bottle at first the aluminum cap should be removed and the rubber stopper disinfected. At pumping up the content of ampoules and glasses please comply with the rules of the sterile work. For pumping up and administration of solutions use different needle.

The air and air bubbles should be removed from the syringe to prevent air-embolization. Turn the syringe upside with needle. Inspect the medication in the syringe for air bubbles. Gently tap the barrel of the syringe. This will move any air bubbles trapped in the medication toward the needle. Push the plunger until the air bubbles are removed.



Venting of the syringe

. Prepare the skin with an alcohol wipe or a sterile gauze sponge soaked in 70% isopropyl alcohol. Use a circular motion proceeding from the puncture site and extending outwards for five centimeters. For antiseptic effect wait 15-30 seconds.



Prepare the equipment needed



Take up the gloves.

Procedure of intradermal injection

Select an area of smooth skin with minimal hair growth. The skin of the ventral forearm is used most frequently.

After disinfection injection site draw a measured amount of allergen into the syringe. Hold the skin taut between the thumb and forefinger of the non-dominant hand. Angle the needle only 10-15 degrees above the skin. Then pierce the skin and insert the needle into the dermis for about two-thirds of its length, and inject the allergen. A wheal should form immediately. The development of perifollicular puckering confirms that the antigen has been placed into the dermis. After injection withdraw the needle while push the injection site.

1. Clean the injection site with an alcohol wipe or with a gauze sponge soaked in 70% isopropyl alcohol using a circular motion. Clean five centimeters outwards from the proposed site. Wait until the skin dries.



2. Hold the wipe in your non-dominant hand.
3. Remove the cap from the needle.
4. Hold the syringe in your dominant hand up with needle.
5. Hold the skin taut between the thumb and forefinger of the non-dominant hand
6. Angle the needle only 10-15 degrees above the skin. Then pierce the skin and insert the needle into the dermis for about two-thirds of its length.



7. Inject the allergen. Don't aspirate the syringe, because the skin does not contains vessels.
8. After injection a wheal should form immediately, which disappear slowly.



9. Withdraw the needle and push alcoholic wipe onto the injection site.

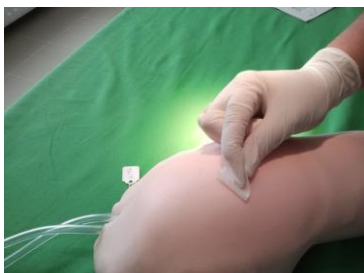


10. Do not use massage in the injection site.
11. Throw out the needle into a special container and syringe into container for hazardous waste.

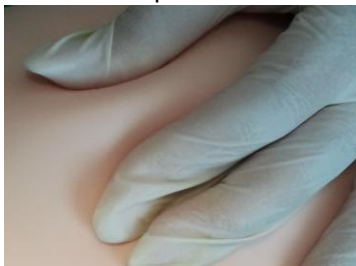
Procedure of subcutaneous injection

After cleaning the injection site grasp the tissue around the site between the thumb and forefinger, and form it into a roll above the underlying muscle. Angle the needle at about 45 degrees to the skin at approximately the midpoint of the roll. Pierce the skin quickly, and advance the needle readily until it is well inserted into the subcutaneous tissue. Aspirate to ensure a blood vessel has not been pierced and slowly inject the drug. Withdraw the needle while applying pressure over the site. The injection site should be pushed for several minutes to avoid bleeding.

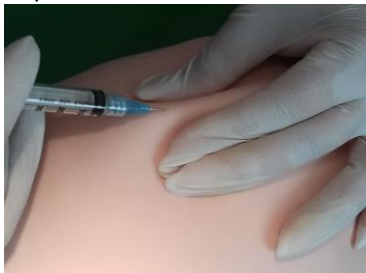
1. Clean the injection site with an alcohol wipe or with a gauze sponge soaked in 70% isopropyl alcohol using a circular motion. Clean five centimeters outwards from the proposed site. Wait until the skin dries.



2. Grasp the tissue around the site between the thumb and forefinger, and form it into a roll.



3. Angle the needle at about 45 degrees to the skin at approximately the midpoint of the roll. Aspirate to ensure a blood vessel has not been pierced.



4. Slowly inject the drug.



5. Withdraw the needle while applying pressure over the site.

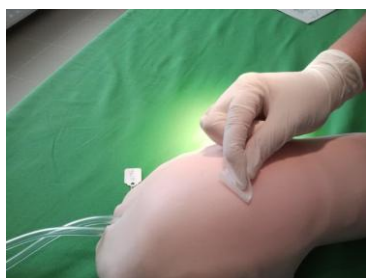


12. 6. Throw out the needle into a special container and syringe into container for hazardous waste.

Procedure of intramuscular injection

After skin disinfection pull the subcutaneous tissue slightly to one side, so that after injection it will move back to its original position, thus preventing medication from moving along the needle track up into the subcutaneous tissue and skin. Rapidly pierce the skin perpendicular to the surface and advance the needle to a depth of 0.5-1 inch, depending on the muscle mass at the injection site. Intramuscular injections in extremely obese patients may need to be deeper to reach the muscle. Aspirate to ensure that a blood vessel has not been entered. Inject the drug slowly, giving the tissues time to absorb and accommodate the solution. Withdraw the needle and massage the injection site briefly with an alcohol swab to promote absorption of the injected solution and to distract the patient from the pain. Stop the bleeding by applying firm pressure with an alcohol swab.

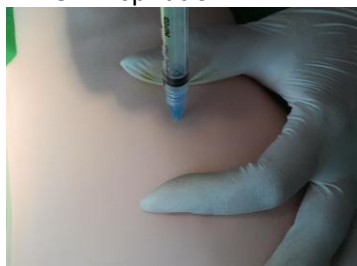
1. Cleansing of the skin



2. Puncture of the skin (90°)



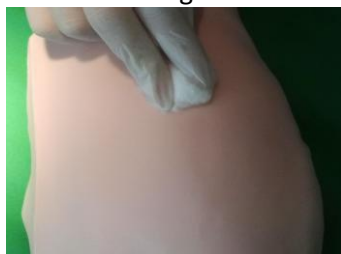
3. Aspiration



4. Injection



5. Massage



Procedure of intravenous injection

Place a tourniquet firmly around the limb proximal to the proposed injection site. After palpation of the vein cleanse the injection site with antiseptic solution. Hold the syringe and needle bevel up in the dominant hand at an angle of about 30 degrees to the skin and parallel to the course of the vein. Insert the needle into the vein and advance about 1 cm. Aspirate the syringe. Free return of blood ensures that the needle is correctly positioned. After removal of the tourniquet inject the medication slowly. Place a gauze pad lightly over the needle where it enters the skin and remove the needle from the vein. Apply pressure with the gauze pad for two minutes to avoid bleeding.

1. Cleansing of the skin



2. Tightens the skin to avoid it's movement.



3. Hold the syringe and at an angle of about 30 degrees to the skin and parallel to the course of the vein.



4. Aspirate the syringe! Free return of blood ensures that the needle is correctly positioned.



5. Inject the solution slowly.



6. Place a gauze pad lightly over the needle where it enters the skin and remove the needle from the vein.



Complications of injections

- The skin of the injection site should be intact, dermatitis or cellulitis is a contraindication. Non-sterile equipment (needle, syringe, solution) and inadequate disinfection can cause local infection.
- Technical error of injection may cause paravasation of injected solution, which cause tissue damage. . In case of intramuscular injection the injury of nerves or vascular structures will produce pain, paresthesias, and possible permanent damage to the site of injection. Careful attention to anatomic landmarks should prevent piercing these structures.
- Complications of iv. injections: hematoma, which caused by blood flow into tissues through of insertion site of the vein. If the needle slip out from the vein, and the drug is injected into tissues, it means paravenous injection. It can cause pain, edema, necrosis. Wet compresses or anesthetics (Novocain) can be used for reducing symptoms.
- Allergic reaction for the injected drug max occurs, anaphylactic reactions, oedema, rash, fever can be the consequence. If such a reaction occurs, cease the injection and reduce absorption by placing a tourniquet proximal to the injection site (if anatomically feasible).
- Sterile phlebitis (hyperosmotic solutions)
- Hematoma
- Intraarterial injection of the drug

Used drugs – non relevant

Documentation – non relevant

Special circumstances – non relevant

Ethical and legal issues – non relevant

3. *Self-control questions – (answers):*

Question: What are the ways of injections?

Answer: Intradermal, subcutaneous, intramuscular, intravenous

Question: Where should be injected the drug solution by these injection technique?

- | | | |
|----|---------------|--|
| a) | intradermal | Answer: into the upper layer of the skin |
| b) | subcutaneous | Answer: to the layer below the skin |
| c) | intramuscular | Answer: into muscles |
| d) | intravenous | Answer: into the circulation |

Question: What is the volume can be administered by different injection technique?

- | | | |
|----|---------------|-------------------------------|
| a) | intradermal | Answer: max 0,5 ml |
| b) | subcutaneous | Answer: 1-2 ml |
| d) | intramuscular | Answer: max 5 ml |
| d) | intravenous | Answer: no volume restriction |

Question: What degree should be angle the syringe at before piercing of skin at these injection technique?

- | | | |
|----|---------------|----------------|
| a) | intradermal | Answer: 10-20° |
| b) | subcutaneous | Answer: 45-60° |
| e) | intramuscular | Answer: 90° |
| d) | intravenous | Answer: 30-45° |

Question: What are the possible complications of injections?

Answer:

- Local infection
- Nerve damage
- Hematoma
- Pain
- Tissue damage
- Allergic reaction
- Venous inflammation

4. **Sample cases**

1. A 70 years old male patient gets anticoagulant therapy after abdominal surgery.

Which part of the body should be applied the injection to?

Answer: subcutaneous

Which area should be administered the infection at?

Answer: The most common site is the tissue of the lower abdominal wall. It should not be administered into the area around umbilicus because of periumbilical veins. Do not inject heparin into muscle because it can cause hematoma, pain and irritation.

2. A 18 years old woman need skin allergy test because of hay fever.

Which injection technique should be used?

Answer: intradermal

Which part of the body should be applied the injection to?

Answer: For evaluation of local reactions (intradermal edema, changes of the color of the skin) the site of intradermal injection should be well verified after the injection. The injection site should be hairless, injury-free, no heavily pigmented, The best area is the ventral side of the forearm or the upper regions of the back.

3. A 51 years old diabetic woman use insulin twice a day.

Which injection technique should be used?

Answer: subcutaneous

Which part of the body should be applied the injection to?

Answer: The most common sites are the tissues of the upper arms, anterior thighs, and over the lower abdominal wall. The injection site should be intact, injury- and inflammation-free. Do not give injection to skin over bone, larger nerve or vessels. The injection sites should be rotated, because if the injection is applied more times to the same place it cause tissue damage which worsens the drug absorption. Before injection check the skin surface to avoid inflammation, edema, bruise. Palpate the skin and look for nodules, edema and tenderness.

4. To a 40 years old male patient 4 ml oil injection should be given for postoperative pain relief.

Which injection technique should be used?

Answer: intramuscular

Which part of the body should be applied the injection to?

Answer: Amount of 4 ml solution can be injected only intramuscular or intravenous. However, intravenous injection of oil solution is contraindicated, so the only possibility the intramuscular injection.

5. A 50 years old patient stepped into a nail, which indicates a tetanus toxoid injection.

Which injection technics should be used?

Answer: subcutaneous

Which part of the body should be applied the injection to?

Answer: The most common sites of subcutaneous injections are the tissues of the upper arms, anterior thighs, and over the lower abdominal wall. The body mass index influences the thickness of the subcutaneous layer, which limit the location, the length of the needle and the angle.

5. *Recommended literature:*

M. S. Chesnutt – T. N. Dewar – R. M. Locksley:
Office and bedside procedures. Appleton & Lange, 1992 (page 40-54).

6. *Requirements Injection techniques practice*

The instructor's role

- The practice is designed for students to perform the injection techniques several times in their own hands.
- The instructor should expect from students the theoretical knowledge for practice. The practice does not serve the transfer of theoretical knowledge.

Specific tasks

- Description of equipment needed for injection techniques
- Description of personnel requirements for injection techniques.
- Demonstration of the methods of injection techniques (intra-dermal, subcutaneous, intramuscular, intravenous).
- Supervision of the examination carried out by students and correction of failures.
- Reviewing the video recording made of the practice with students, and the analysis of each case.

The student's role

- The student should prepare for the practice according to the best of his knowledge.
- The practice serves testing and exercise of injections on phantom device.

Specific tasks:

- Carry out the intradermal injection several times on phantom device
 - Carry out the subcutaneous injection several times on phantom device
 - Carry out the intramuscular injection several times on phantom device
 - Carry out the intravenous injection several times on phantom device
 - Reviewing the video recording made of the practice with the instructor, analysis of each cases.
 - It is recommended to carry out all the techniques several times to acquire necessary experience.
-

7. Test questions:

True or false questions

1. H During injection drugs are injected into tissues of the body to absorb and distribute in the whole body.
2. H Before injection the skin should be decontaminated.
3. H By subcutaneous injection the solutions are injected into the connective tissue under the skin.
4. H In case of intravenous injection the needle should be held at 60-65° to the skin above the vein.

Multiple choice

5. Indicate solutions usually injected subcutaneously (multiple choice; 2/4):
 - pain killers
 - heparin
 - tetanus toxoid
 - reagents for allergy tests
6. Which are not the possible complications of injections (multiple choice; 2/9)?
 - Local infections
 - Nerve damage
 - Hematoma
 - Arthritis
 - Pain
 - Bone fracture
 - Tissue damage
 - Allergic reaction
 - Phlebitis

Simple choice

7. How much solution may inject during subcutaneous injection maximum (simple choice):
 - 0,5 ml
 - 1 ml
 - 2 ml
 - 3 ml
 - 4 ml
 - 5 ml
8. How much solution may inject during subcutaneous injection maximum (simple choice):
 - 0,5 ml
 - 1 ml
 - 2 ml
 - 3 ml
 - 4 ml
 - 5 ml

9. Set in chronological order the following activities:

- Disinfection (3)
- don the gloves (2)
- Prepare the equipment needed (1)
- Insertion of needle (4)
- Injection of solution (6)
- Aspiration (5)
- Withdrawn of the needle (8)
- push sterile wipe onto the site of injection (7)

10. Set in pairs the following words:

- | | |
|----------------------------|----------------------------|
| A. 2 ml-syringe | 1. Skin test |
| B. Intramuscular injection | 2. Intramuscular injection |
| C. Complication | 3. Hematoma |
| D. Gluteal muscle | 4. Hold of needle in 90° |
| E. Intradermal injection | 5. Insulin |

Answer: A5, B4, C3, D2, E1

Relation analysis

11. During intradermal injection the syringe should not be aspirated, because the dermal layer of the skin does not contain blood vessels. (A)
 12. Before application of intravenous injection the tourniquet should be placed distal from the planned site of injection, because we make congestion with the tourniquet. (D)
 13. Injections should not apply into inflamed, injured skin, because in allergic patient toxic reactions may occur. (B)
 14. In diabetic patients using insulin the site of injection should be rotated, because the common sites of subcutaneous injections are the ventral side of the forearm and the upper region of the back. (C)
 15. For allergy test subcutaneous injections are used, because with subcutaneous injection the drug reach quickly the circulation. (E)
-

8. *Sources:*

R. Putz, R. Pabst: Sobotta: Atlas of Human Anatomy, Lippincott Williams &Wilkins, 2001

M. S. Chesnutt – T. N. Dewar – R. M. Locksley: Office and bedside procedures. Appleton & Lange, 1992 (page 40-54)

Martha Elkin – Anne Perry – Patricia Potter: Nursing interventions and clinical skills, 5th Edition, 2011.
