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Safe injection techniques

Article 498. Workman B (1999) Safe injection techniques. *Nursing Standard*. 13, 39, 47-53.

In this article Barbara Workman describes the correct technique for safe intradermal, subcutaneous and intramuscular injections.

Aims and intended learning outcomes

As knowledge to support nurses' everyday practice increases, it is appropriate to reappraise routine procedures. This article revises nurses' knowledge of the guiding principles for safe intradermal (ID), subcutaneous (SC), and intramuscular (IM) injections. It outlines the procedures used to select appropriate anatomical sites, and considers the idiosyncrasies of medications and patients' special needs that may influence the choice of injection site. Issues related to the preparation of the patient and skin, and use of equipment, are discussed. Ways to reduce patient discomfort during the procedure are also suggested. The nurse is encouraged to review critically his or her injection technique in the light of evidence-based principles, to provide the patient with safe and effective care. After reading this article you should be able to:

- Identify the safe anatomical sites for ID, SC and IM injections.
- Locate the specific muscles for IM injections and explain the rationale for their use.
- Give sound reasons for your method of skin preparation.
- Discuss ways to reduce patient discomfort during an injection.
- Describe the nursing care a patient requires to avoid complications associated with injections.

Introduction

Giving injections is a regular and commonplace activity for nurses, and good injection technique can make the experience for the patient relatively painless. However, mastery of technique without developing the knowledge base from which to work can still put a patient at risk of unwanted complications.

Giving an injection was once the province of doctors, but with the advent of penicillin in the 1940s it became an extended role activity of the nurse (Beyea and Nicholl 1995). It is now such a routine nursing activity that nurses can become complacent about it. With increasing demands upon nurses to practise evidence-based care, it is appropriate to reappraise such a fundamental procedure.

Drugs are given via the parenteral routes because they are usually absorbed faster than by the oral route, or, like insulin, are altered by ingestion. Some drugs, for example, medroxy-progesterone acetate or fluphenazine are released over a long period of time and need a route that will absorb the drug steadily.

There are four main considerations regarding injections: the route, site, technique and equipment.

The intradermal route

The intradermal route provides a local, rather than systemic, effect and is used primarily for diagnostic purposes such as allergy or tuberculin testing, or for local anaesthetics.

To give an ID injection a 25-gauge needle is inserted at a 10-15° angle, bevel up, just under the epidermis, and up to 0.5ml is injected until a wheal appears on the skin surface (Fig. 1). If it is being used for allergen testing, the area should be labelled indicating the antigen so that an allergic response can be monitored after a specified time lapse. The sites suitable for intradermal testing are similar to those for subcutaneous injections (Fig. 2) but also include the inner forearm and shoulder blades (Springhouse Corporation 1993). When testing for allergies, it is essential to ensure that an anaphylactic shock kit is easily accessible in case the patient develops a hypersensitive reaction (Campbell 1995).

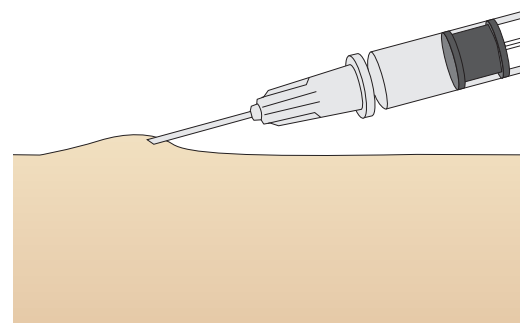


Fig. 1. Skin wheal caused by intradermal injection



Tony Stone

Supported by an educational grant from Becton Dickinson

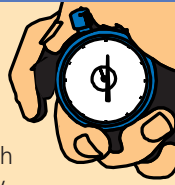
key words

- Injection
- Nursing: procedures

These key words are based on the subject headings from the British Nursing Index. This article has been subject to double-blind review.

TIME OUT 1

Revise the signs and symptoms that may occur in anaphylaxis. What actions does your trust policy state you should take in a case of anaphylactic shock? Which drugs do you administer that may trigger an allergic response?



The subcutaneous route

The subcutaneous route is used for a slow, sustained absorption of medication, up to 1-2ml being injected into the subcutaneous tissue. It is ideal for drugs such as insulin, which require a slow and steady release, and as it is relatively pain free, it is suitable for frequent injections (Springhouse Corporation 1993). Figure 2 shows suitable locations for SC injections.

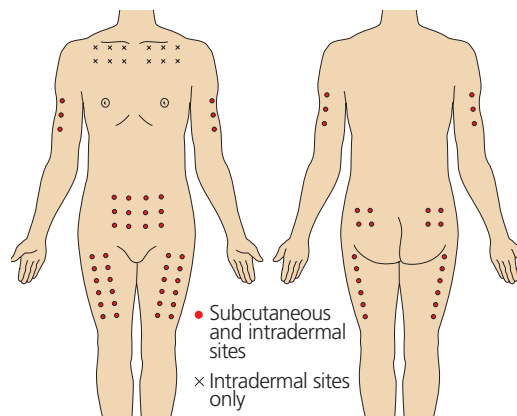


Fig. 2. Anatomical sites for intradermal and subcutaneous injections

Traditionally, SC injections have been given at a 45° angle into a raised skin fold (Thow and Home 1990). However, with the introduction of shorter insulin needles (5, 6 or 8mm), the recommendation for insulin injections is now an angle of 90° (Burden 1994). The skin should be pinched up to lift the adipose tissue away from the underlying muscle, especially in thin patients (Fig. 3). Some studies using computerised

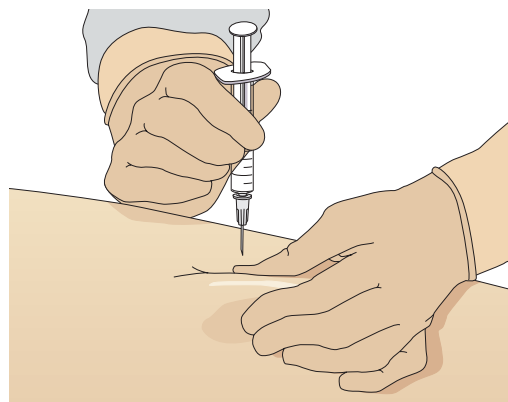


Fig. 3. 'Pinch up' of a skin fold during subcutaneous injection

tomography to monitor the destination of the injections, have found that SC injections can be inadvertently administered into muscle, especially in the abdomen and the thigh (Peragallo-Dittko 1997).

Insulin that is injected into muscle is absorbed more rapidly and can lead to glucose instability and potential hypoglycaemia. Hypoglycaemic episodes may also occur if the anatomical location of the injection is changed, as insulin is absorbed at varying rates from different anatomical sites (Peragallo-Dittko 1997). Therefore insulin injections should be systematically rotated within an anatomical site – for example, using the upper arms or abdomen for several months, before there is a planned move elsewhere in the body (Burden 1994). When a diabetic patient is admitted to hospital, the current injection area should be assessed for signs of inflammation, oedema, redness or lipohypertrophy, and observations recorded in the nursing notes.

It is no longer necessary to aspirate after needle insertion before injecting subcutaneously. Peragallo-Dittko (1997) reported studies that found blood was not aspirated prior to SC injection, indicating that piercing a blood vessel in a SC injection was very rare. Additionally, patient education literature from the manufacturers of insulin devices does not advocate aspiration before injection. It has also been noted that aspiration before administration of heparin increases the risk of haematoma formation (Springhouse Corporation 1993).

TIME OUT 2

Consider the admission documentation relating to diabetic patients in your clinical area. How do you record their rotation of injection sites? How do you monitor if their chosen site is still effective? Discuss the implications of your findings with a colleague.



The intramuscular route

Intramuscular injections deliver medication into well perfused muscle, providing rapid systemic action and absorbing relatively large doses; from 1ml in the deltoid site to 5ml elsewhere in adults (these values should be halved for children). The choice of site should take into consideration the patient's general physical status and age, and the amount of drug to be given. The proposed site for injection should be inspected for signs of inflammation, swelling, and infection, and any skin lesions should be avoided. Similarly, two to four hours after the injection, the site should be checked to ensure there has been no adverse reaction. If injections are repeated frequently, the sites should be documented to ensure an even rotation. This reduces patient discomfort from over-use of any one area and lessens the likelihood of the development of complications, such as muscle atrophy or sterile abscesses resulting from poor absorption (Springhouse Corporation 1993).

Older and emaciated patients are likely to have less muscle than younger, more active patients, and therefore the proposed sites should be assessed for sufficient muscle mass. If the patient has reduced muscle mass it is helpful to 'bunch up' the muscle before injecting (Fig. 4).



Fig. 4. 'Bunch up' of muscle in emaciated or older patients

There are five sites that are available for IM injections. Figure 5(a-d) shows details of how to identify anatomical landmarks for each of these sites. These include:

- The deltoid muscle of the upper arm, which is used for vaccines such as hepatitis B and tetanus toxoid.
- The dorsogluteal site using the gluteus maximus muscle, the traditional site in the UK (Campbell 1995). Unfortunately complications are associated with this site as there is a possibility of damaging the sciatic nerve or the superior gluteal artery if the needle is misplaced. Beyea and Nicholl (1995) cited several studies that have used computerised tomography to confirm that even in mildly obese patients, injections into the dorsogluteal area are more likely to be into adipose tissue rather than muscle, and consequently slow the absorption rate of the drug.
- The ventrogluteal site is a safer option which accesses the gluteus medius muscle. An extensive review of the research into IM injections recommends this site as the primary location for IM injections as it avoids all major nerves and blood vessels and there have been no reported complications (Beyea and Nicholl 1995). Additionally, the ventrogluteal site has a relatively consistent thickness of adipose tissue over it: 3.75cm as compared to 1-9cm in the dorsogluteal site, thus ensuring that a standard size 21-gauge (green) needle will usually penetrate the gluteus medius muscle area.
- The vastus lateralis is a quadriceps muscle situated on the outer side of the femur. This site has been the primary site for children, but risks associated with this muscle include accidental injury to the femoral nerve and muscle atrophy through over-use (Springhouse Corporation 1993). Beyea and Nicholl (1995) suggested that this site is safe for children up to seven months old, but then the ventrogluteal site is the optimum choice.

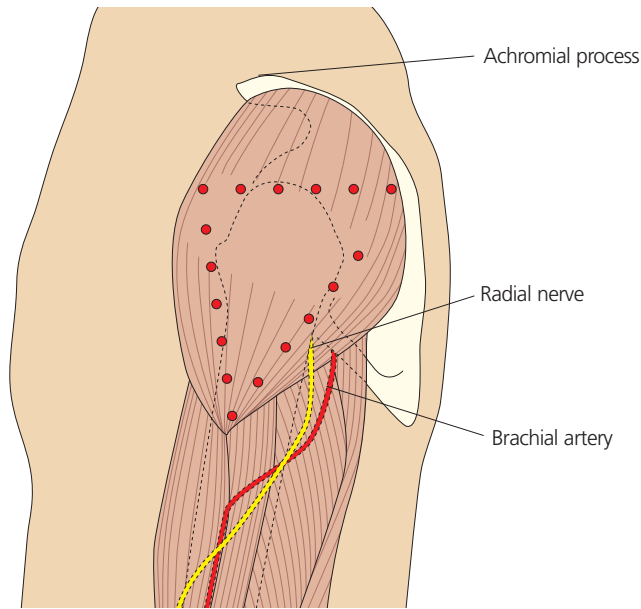
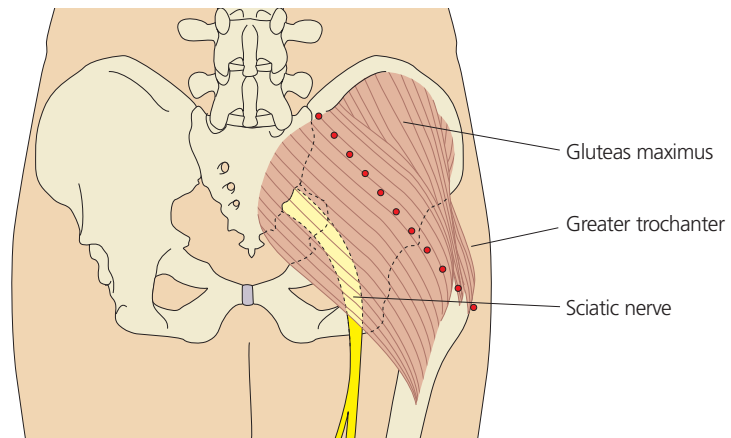


Fig. 5a. Location of Deltoid muscle.
The densest part of the muscle can be found by identifying the acromial process and the point on the lateral arm in line with the axilla. The needle should be sited about 2.5cm below the acromial process at 90°. The radial nerve and the brachial artery must be avoided (Springhouse Corporation 1993). Asking patients to put their hand on their hip like a fashion model relaxes the muscle and makes it easier to access



(For the gluteus muscles, patients can lie on their side with their knees slightly flexed, or prone with their toes pointing inwards. If the legs are slightly flexed the muscles are more relaxed and the injection is less painful (Covington and Trattler 1997))

Fig. 5b. Location of dorsogluteal site.
Draw an imaginary horizontal line across from the top of the cleft in the buttocks to the greater trochanter of the femur. Then draw another line vertically midway along the first line, and the location is 'the upper outer quadrant of the upper outer quadrant' (Campbell 1995). That muscle is the gluteus maximus. The superior gluteal artery and sciatic nerve may be damaged by a poorly located injection. Typical volume is 2-4ml

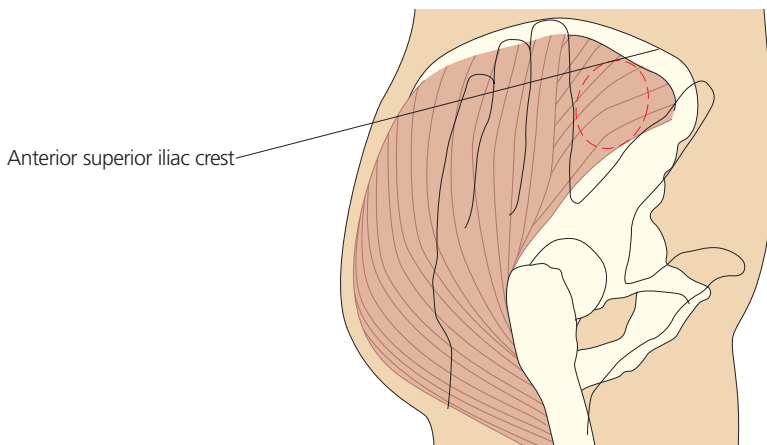


Fig. 5c. Location of ventrogluteal site. Place the palm of your right hand on the greater trochanter of the patient's left hip (or your left hand to patient's right hip). Extend your index finger to touch the anterior superior iliac crest and stretch the middle finger to form a V as far as possible along the iliac crest as you can reach (Beyea and Nicholl 1995). If you have small hands you may have difficulty reaching the iliac crest, so slide the palm of your hand up from the greater trochanter until you can reach the anterior superior iliac crest with your index finger (Covington and Trattler 1997). The needle should enter the gluteus medius muscle in the middle of the V at 90°. Typical volume is 1-4ml

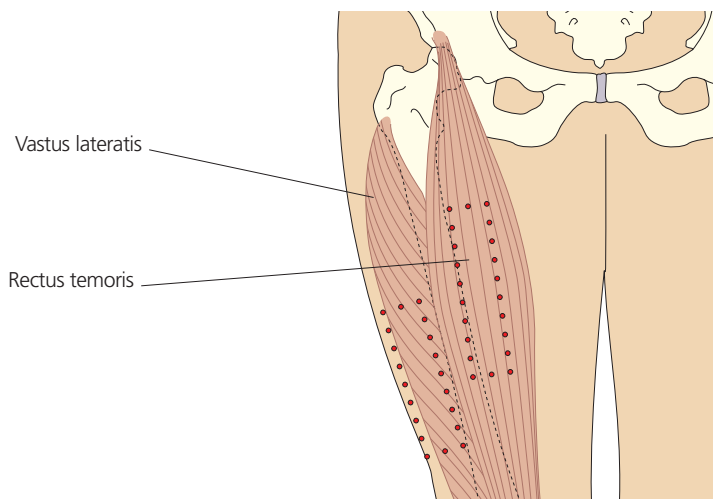


Fig. 5d. Location of the vastus lateralis and rectus femoris. In an adult the vastus lateralis can be located by measuring a hand's breadth laterally down from the greater trochanter, and a hand's breadth up from the knee, identifying the middle third of the quadriceps muscle as the injection site. The rectus femoris is in the middle third of the anterior thigh. In children and older people, or emaciated adults, the muscle may need to be bunched up in a handful to provide sufficient muscle depth (Springhouse Corporation 1993). Typical volume 1-5ml, infants 1-3ml

■ The rectus femoris is the anterior quadriceps muscle which is rarely used by nurses, but is easily accessed for self-administration, or for infants (Springhouse Corporation 1993).

TIME OUT 3

Using a colleague as a model, locate the anatomical landmarks for each of these five sites. If you are accustomed to using the dorsogluteal site only, consider how you could build up your confidence to locate and regularly use the ventrogluteal site instead.



Techniques

The angle of needle entry may contribute to the pain of the injection. Intramuscular injections should be given at a 90° angle to ensure the needle reaches the muscle, and to reduce pain. A recent study by Katsma and Smith (1997) found that nurses did not always ensure needle entry to the skin at 90° and they speculated that this would cause more pain for the patient, due to the needle shearing through the tissues. Hands positioned near the intended entry site results in fewer needle stick injuries and improves site accuracy.

Therefore, to ensure entry at the right angle, commence the injection with the heel of your palm resting on the thumb of the non-dominant hand, and by holding the syringe between the thumb and forefinger, a firm and accurate thrust of the needle at the correct angle can be achieved (Fig. 6).

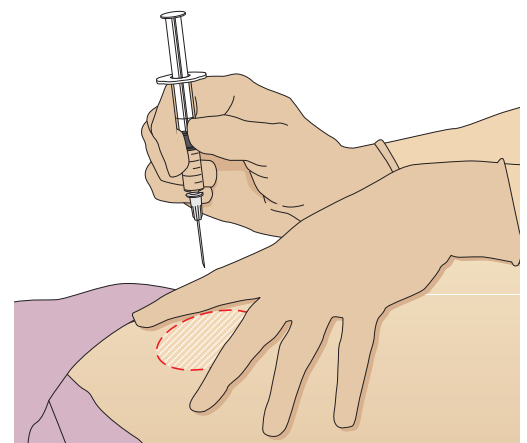


Fig. 6. IM injection ensuring a 90° entry in the ventrogluteal position

There has been little research in the UK into the effect of different injection techniques and nurses demonstrate a variety of techniques and disparate knowledge (MacGabhann 1998). The traditional method of giving an intramuscular injection has been to stretch the skin over the site to reduce the sensitivity of nerve endings (Stilwell 1992) and to insert the needle in a dart like action at 90° to the skin.

However, Beyea and Nicholls' (1995) literature review argued that the use of the 'Z track' technique results in less patient discomfort and fewer complications than the traditional method.

The Z track

The Z track technique was initially introduced for drugs that stained the skin or were particularly irritant. It is now recommended for use with the full range of IM medications (Beyea and Nicholl 1995) and is believed to reduce pain, as well as the incidence of leakage (Keen 1986).

It involves pulling the skin downwards or to one side at the intended site (Fig. 7). This moves the cutaneous and subcutaneous tissues by approximately 1-2cm. When identifying the site for injection, it is important to remember that moving the skin may distract you from the intended needle destination. Therefore, once the surface location has been identified, you need to be able to visualise the underlying muscle that is to receive the injection, and aim for that location, rather than a distinguishing mark on the skin. The needle is inserted and the injection given. Allow ten seconds before removing the needle to allow the medication to diffuse into the muscle. On removal, the retracted skin is released. The tissues then close over the deposit of medication and prevent it from leaking from the site. Exercising the limb afterwards is believed to assist absorption of the drug by increasing blood flow to the area (Beyea and Nicholl 1995).

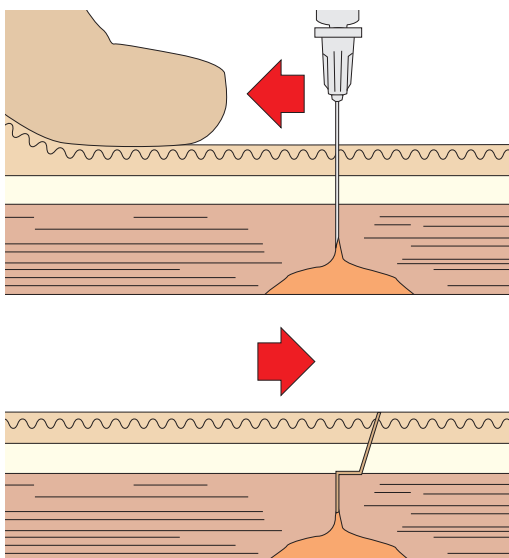


Fig. 7. Z track technique

Air bubble technique

This is a technique that was popular in the US. It arose historically from the use of glass syringes which required an added air bubble to ensure an accurate dose was given. It is no longer considered necessary to allow for the dead space in the syringe and

needle, as plastic syringes are calibrated more accurately than glass ones, and it is no longer recommended by manufacturers (Beyea and Nicholl 1995). However, two recent studies into depot (oil-based, slow release) injections in the UK (MacGabhann 1998, Quartermaine and Taylor 1995) compared the Z track with the air bubble technique, which is also intended to seal the medication in after injection. Quartermaine and Taylor (1995) suggested that the air bubble technique is more successful at preventing leakage than the Z track technique, but MacGabhann's (1998) findings were inconclusive.

There are issues related to the accuracy of the dose when using this technique – it may significantly increase the dose (Chaplin *et al* 1985). Further research on this technique needs to be undertaken as it is relatively new to the UK. However, if it is used, the nurse should ensure that patients' dosages are adjusted to accommodate the addition of the air bubble, and that the technique is used consistently to ensure an accurate dose.

Aspiration

Although aspiration is no longer recommended for SC injections, it should be practised in IM injections. If a needle is mistakenly placed in a blood vessel, the drug may be given intravenously by mistake and could cause an embolus as a result of the chemical components of the drug. Following insertion into the muscle, aspiration should be maintained for several seconds to allow blood to appear, especially if a narrow bore needle is used (Torrance 1989a). If blood is aspirated, the syringe should be discarded and a fresh drug prepared. If no blood appears, proceed to inject at a rate of approximately 1ml every ten seconds. This may seem slow, but it allows time for the muscle fibres to expand and absorb the solution. There should also be a ten second wait before withdrawal of the needle, to allow the medication to diffuse into the muscle before the needle is finally withdrawn. If there is seepage from the site, slight pressure using a gauze swab can be applied. A small plaster may be required at the site. Massage of the site should be discouraged because it may cause the drug to leak from the needle entry site and irritate local tissues (Beyea and Nicholl 1995).

Skin cleansing

Although it is known that cleansing a site with an alcohol-impregnated swab before parenteral injections reduces bacteria, there are inconsistencies in practice. Swabbing before a SC insulin injection predisposes the skin to be hardened by the alcohol. Previous studies suggest that such cleansing is not always necessary and that the lack of skin preparation does not result in infections (Dann 1969, Koivisto and Felig 1978).

Some trusts now accept that, if the patient is physically clean and the nurse maintains a high standard of hand hygiene and asepsis during the procedure, skin disinfection before an IM injection is not necessary. If

skin disinfection is practised, the skin should be cleaned with an alcohol swab for 30 seconds, and then allowed to dry for at least 30 seconds, otherwise it is ineffective (Simmonds 1983). Additionally, if the injection is given before the skin dries, not only does it increase pain for the patient, as the needle entry will make the site sting, the bacteria are not rendered inactive and may be inoculated into the injection site (Springhouse Corporation 1993).

TIME OUT 4

Locate your trust policy regarding giving injections. What does it recommend regarding skin cleaning? Compare it to the trust policy on insulin injection. Are the guidelines consistent? As a result of this, are there any actions you should take?



TIME OUT 5

Imagine you are supervising a student preparing to give his or her first injection. What special tips or advice could you give to help them develop their injection skills?



Equipment

Needles should be long enough to penetrate the muscle and still allow a quarter of the needle to remain external to the skin. The most common sizes for IM injection are 21 (green) or 23 (blue) gauge and 1.25 to 2 inches long. If a patient has a lot of adipose tissue, a longer size will be necessary to ensure it

reaches the target muscle. Cockshott *et al* (1982) found that women had up to 2.5cm more adipose tissue than men in the dorsogluteal site, and therefore a standard 21 by 1.5 inch (green) gauge needle would only have reached the gluteus maximus muscle in 5 per cent of women and 15 per cent of men.

Beyea and Nicholl (1995) recommended that needles should be changed after drawing up the drug, before the injection, to ensure that it is clean, dry and sharp. However, filter needles are advocated for drawing up medication from a glass vial to avoid potential minute shards of glass from entering the medication. When drawing up medication from plastic ampoules, a blunt-tipped needle can be used to avoid potential needle-stick injuries. A needle that has been blunted by piercing a rubber bung may cause local tissue trauma, and drug contamination during preparation may increase tissue sensitivity, and consequently, pain for the patient.

The syringe size is determined by the amount of fluid required for the drug. For injections less than 1ml, a low dose syringe should be used to ensure an accurate dose (Beyea and Nicholl 1995). For injections of 5ml or more, it is suggested that the dose should be equally divided between two sites (Springhouse Corporation 1993). Note that there are different syringe tip fittings for different applications.

Gloves and aprons

Some trusts' policies will require gloves and aprons to be worn during the injection procedure. It should be remembered that gloves are to protect the nurse from body fluids or the development of a drug-induced allergy, and they do not offer any protection against needle stick injuries.

Some people may become more clumsy when using gloves, especially if they first learnt the procedure without them. Extreme caution should be taken if preparing and giving injections without gloves to ensure that spillage does not occur. Needles, even clean ones, should never be re-sheathed, and immediate and careful disposal of equipment into a sharps container should take place on completion of the procedure. Be aware that needles can fall out of injection trays and into bedclothes when positioning patients during the procedure and may inadvertently cause a needle stick injury to staff or patients.

Clean disposable aprons may be worn to protect uniforms from spillage during drug preparation, and to prevent transfer of organisms between patients. Care should be taken to correctly dispose of aprons after the procedure to ensure spillage does not come into contact with the nurse's skin.

Box 1. Twelve steps towards a painless injection

- Prepare patients with appropriate information before the procedure, so that they understand what is happening and can comply with instructions
- Change the needle after preparation of the drug and before administration to ensure it is clean, sharp and dry, and the right length
- Make the ventrogluteal site your first choice, to ensure that the medication reaches the muscle layer (in adults and children over seven months)
- Position the patient so that the designated muscle group is flexed and therefore relaxed
- If cleaning the skin before needle entry, ensure skin is dry before injecting
- Consider using ice or freezing spray to numb the skin before injection, particularly in young children or needle-phobic patients
- Use the Z track technique (Beyea and Nicholl 1995)
- Rotate sites so that right and left sites are used in turn, and document rotation
- Enter the skin firmly with a controlled thrust, positioning the needle at an angle as near to 90° as possible, to prevent shearing and tissue displacement
- Inject medication steadily and slowly: about 1ml per ten seconds to allow the muscle to accommodate the fluid
- Allow ten seconds after completion of injection to allow the medication to diffuse and then withdraw needle at the same angle as it entered
- Do not massage the site afterwards, but be prepared to apply gentle pressure with a gauze swab

TIME OUT 6

Make a list of all the ways that you know of reducing pain from injections. Compare it with Box 1. How could you incorporate more of these pain reducing measures into your practice?



Reducing pain

Patients are often afraid of receiving injections because they perceive that it will be painful. The pain of IM injections may be registered in the pain receptors in the skin, or the pressure receptors in the muscle. Torrance (1989b) listed a number of factors which cause pain:

- The needle.
- The chemical composition of the drug or its solution.
- The technique.
- The speed of injection.
- The volume of drug.

The techniques summarised in Box 1 will help to reduce pain.

Patients may have a needle or injection phobia which causes them anxiety, fear and increased pain every time they require an injection (Pollilio and Kiley 1997). Good technique, appropriate patient information and a calm and confident nurse will help to reduce anxiety. Distraction or behaviour modification techniques may be useful, particularly for long courses of treatment, and the use of needleless systems may reduce needle related anxiety (Pollilio and Kiley 1997). It has been suggested that numbing the skin with ice or freezing sprays before inserting the needle may reduce pain (Springhouse Corporation 1993), although this is a technique currently unsupported by research evidence.

Nurses need to be aware that patients may experience syncope or dizziness after a routine injection, even if otherwise apparently fit and well. Ascertaining the patient's history and usual response to injections, ensuring that the area is safe and that a couch is readily available for them to lie down, will reduce the risk of injury. Experience suggests that those most prone to fainting, though not exclusively, are teenagers and young men.

TIME OUT 7

Review the potential complications that have already been discussed. Make notes of the nursing actions you can take to prevent them.



Complications

Complications that occur as a result of infection can be largely prevented by strict aseptic precautions and good hand-washing practice. Sterile abscesses may occur as a result of frequent injections to one site or poor local blood flow. Sites that are oedematous or paralysed will have limited ability to absorb the drug and should not be used (Springhouse Corporation 1993).


Careful choice of location will reduce the likelihood of nerve injury, accidental intravenous injection and resultant embolus from the composition of the drug (Beyea and Nicholl 1995). Systematic rotation of sites will prevent needle myopathy or lipohypertrophy (Burden 1994). An appropriate needle size and a

preference for the ventrogluteal site, will ensure that the medication is delivered to the muscle, rather than adipose tissue. The use of a Z track technique will reduce pain and the skin staining associated with some drugs (Beyea and Nicholl 1995).

Professional responsibilities

Once a parenteral drug has been given it cannot be retrieved. The appropriate checks should be made to ensure the drug dose tallies with a valid prescription, and the patient's identification. Identification of the right patient for the right drug, in the right dose, at the right time, via the right route is essential to prevent medication errors. All drugs should be prepared according to the manufacturer's instructions, and nurses need to ensure they are aware of the actions, contraindications and side effects of the drug. The nurse should use his or her professional judgement to determine the suitability of the medication for the patient at that time (UKCC 1992).

Conclusion

Giving an injection safely is considered to be a fundamental nursing activity, and yet it requires knowledge of anatomy and physiology, pharmacology, psychology, communication skills and practical expertise. There is research available to support many current practices and reduce the risks of complications, but there are still areas where evidence to support practice needs to be developed. This article has emphasised the research-based practices that are known, to encourage nurses to incorporate best practice into an everyday procedure .

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