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Subcutaneous injection technique: an evidence-based approach

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Abstract

Injections are routinely administered by nurses in acute care settings and in the community. Nurses require a thorough understanding of anatomy and physiology, pharmacological principles and equipment, and potential risks to the patient of injections. Nurses should also take an active approach to patient assessment before injecting medicines. This article, the first of two, provides an evidence-based review of injection administration, with particular reference to subcutaneous injections, and suggests a framework for best practice.

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Aims and intended learning outcomes

This article, the first in a series of two, addresses the topic of safe injection practice with particular reference to the subcutaneous technique. It draws on current research and evidence to inform a framework for best practice when injecting insulin and heparin through the subcutaneous route. It also addresses the nursing knowledge and skills required for good clinical decision making and a safe approach to clinical practice. After reading this article and completing the time out activities you should be able to:

- ▶ Identify aspects of injection technique that should form part of a standard assessment before administering any medications.
- ▶ Describe why the subcutaneous route is used for certain medications, including insulin and heparin.
- ▶ Suggest suitable sites for injection of common medications.
- ▶ List the main steps in injection technique that minimise potential adverse effects.
- ▶ Discuss the principles of patient assessment to maximise the success of all subcutaneous injections.

Introduction

Pre-registration nursing students are taught medicines management and injection technique. In clinical practice this is a skill widely used, and injections are administered routinely by nurses in acute care settings and in the community (Walsh and Brophy 2011). However, the literature suggests that nurses' practice tends to be 'in a way they are familiar with' or using a technique that

'they are comfortable with', and this may not reflect research or evidence. Further, guidance and policies in clinical practice fail to address gaps in research to support practice (Wynaden *et al* 2006).

It is recommended that injection technique be based on good clinical judgement, using the best available evidence (Wynaden *et al* 2006) and an individualised assessment of the patient (Small 2004). Nurses require a thorough understanding of anatomy and physiology, pharmacological principles and equipment in order to make good clinical decisions. Nurses should have an awareness of the potential risks to the patient of injections and take an active approach to patient assessment before injecting medicines. Evidence can help to guide practice, but acquiring knowledge to enhance clinical decisions and ensure safe practice is essential. There is currently a plethora of evidence, which at times does not reflect clinical practice.

This article combines the evidence to clarify good injection technique and offer recommendations for safer practice. It provides an overview of the subcutaneous injection skill, with a focus on two common drugs for injection: insulin and heparin. Although both of these medicines are delivered via the same route, the rationale for the injection technique and the patient assessment differ in each. A subsequent article will discuss good practice in intramuscular injection technique.

Complete time out activity 1

Indications for subcutaneous injections

Drugs given via the subcutaneous route are those that require slow, sustained absorption of a medication, such as insulin and low-molecular-weight-heparin solutions. The medication is injected beneath the epidermis into the fat and connective tissue underlying the dermis, where there is less blood flow and therefore a slower, steadier absorption rate compared with that of the intramuscular route (Hunter 2008).

Site of injection

The site of injection is an important consideration. The aim is to ensure the drug is released slowly and steadily into the subcutaneous fatty tissue, avoiding the muscle layer below (King 2003). Common subcutaneous injection sites include the lateral aspects of the upper arm and thighs

and the umbilical region of the abdomen (Hunter 2008). The lower part of the upper arm, either the lateral or the posterior aspect, should be used with short needles, 5-6mm, and injection can be performed without using the 'pinch-up' technique (Strauss *et al* 2002). Absorption is most rapid from the abdomen and is slower from the arms, slower still from the thighs and slowest from the hip and buttock areas (Frid and Linde 1992, Wood *et al* 2002).

The arms are favourable sites, with fewer blood vessels and painful sensations and less discomfort for the patient (Lister and Sarpal 2004). Injection sites in the thigh are best situated immediately under the greater trochanter of the femur (Strauss *et al* 2002), because the subcutaneous fat tends to thin out moving down the thigh, although patients have reported pain and frequent bleeding at this site (King 2003). The abdomen is probably the most common site of choice because the skin here has a thicker subcutaneous tissue layer (Chan 2001). Although the abdomen, thigh, arm and buttocks are all used for insulin injections, the abdomen and thighs are preferred, with a preference for using the abdomen in adults, and the thigh in children and adolescents (Hicks *et al* 2011).

In addition, as absorption varies from site to site, it is important to systematically rotate within a site each day (Workman 1999, King 2003). It is recommended that rotating is done by moving one finger-width from the site of the previous injection or alternating from left to right to avoid build-up of lipohypertrophies, which are caused by a possible growth factor effect of insulin and by local growth factors induced by trauma from blunt, re-used needles (Partanen and Rissanen 2000, King 2003, Diabetes UK 2008).

Equipment

There is wide use of insulin pens and pre-loaded heparin syringes, where the needle is much smaller and therefore the recommended angle of injection is 90° when using a 5, 6 or 8mm needle (Workman 1999). The 8mm needle length is commonly used (Hicks *et al* 2011) and there is no medical rationale for the use of needles any longer than this (Kreugal *et al* 2007) – smaller needles are becoming more popular. Among insulin pens, the 8mm needle is now prevalent, and 5 and 6mm needles are becoming the standard length



1 Use a textbook to review the anatomical structures of the skin. What might be the important considerations when giving a subcutaneous injection?

2 Compare the insulin syringes with the heparin syringes in your practice area, especially the size of the needles used or integrated into these devices.

3 List three adverse effects of subcutaneous injections and indicate how these may be best avoided.

for people with diabetes (Strauss *et al* 2002, Hicks *et al* 2011, Robb and Kanji 2012).

Complete time out activity 2

Robb and Kanji (2012) identified that the use of a 5mm insulin syringe instead of a 3mm tuberculin syringe did not reduce significantly either hematoma size or pain of injection. It is important to note, however, that subcutaneous medications can be inadvertently injected into muscle. The nurse should therefore consider the equipment and needle size before injecting, to ensure the needle is long enough to penetrate the skin and subcutaneous tissue without penetrating the muscle.

Technique

The recommended angle of injection for subcutaneous injections is 90° (Nicol *et al* 2004, Hicks *et al* 2011), bearing in mind that this is dependent on the amount of subcutaneous tissue (Hunter 2008) and the size of the needle. Figure 1 illustrates the angle of approach and depth of subcutaneous injections.

It is vital to minimise any risk of the muscle being penetrated during the injection. This can be largely avoided by 'lifting the skin' away from the muscle layer. The skin should be lifted between the thumb and two fingers of one hand (Workman 1999, King 2003, Hicks *et al* 2011). It is not necessary to draw back on the plunger to ensure the needle is not in the vein because it is unlikely a blood vessel will be pierced (Nicol *et al* 2004, McAskill and Goodhand 2007). The area should not be massaged following the injection (Hunter 2008) because this can cause bruising in the case of heparin, and with insulin, increase absorption time.

Complete time out activity 3

Risks of subcutaneous injections

Although the subcutaneous route is relatively pain-free (Hunter 2008), over-injection can lead to these sites being more painful (Hicks *et al* 2011). Poor injection technique can lead to adverse outcomes for the patient: site pain and bruising can occur from local tissue trauma. Rotation of sites is therefore recommended to avoid irritation, scarring, hardening of tissue and pain. Incorrect injection technique – even when using the correct needle length – can lead to injectable therapies being poorly absorbed (Hicks *et al* 2011). Reducing discomfort to

a minimum can be achieved with a sharp, short needle, penetrating taut skin quickly without any drag (Hanas 1998).

Heparin and insulin injections

Although both heparin and insulin are administered subcutaneously, there are important differences between them.

Complete time out activity 4

Heparin

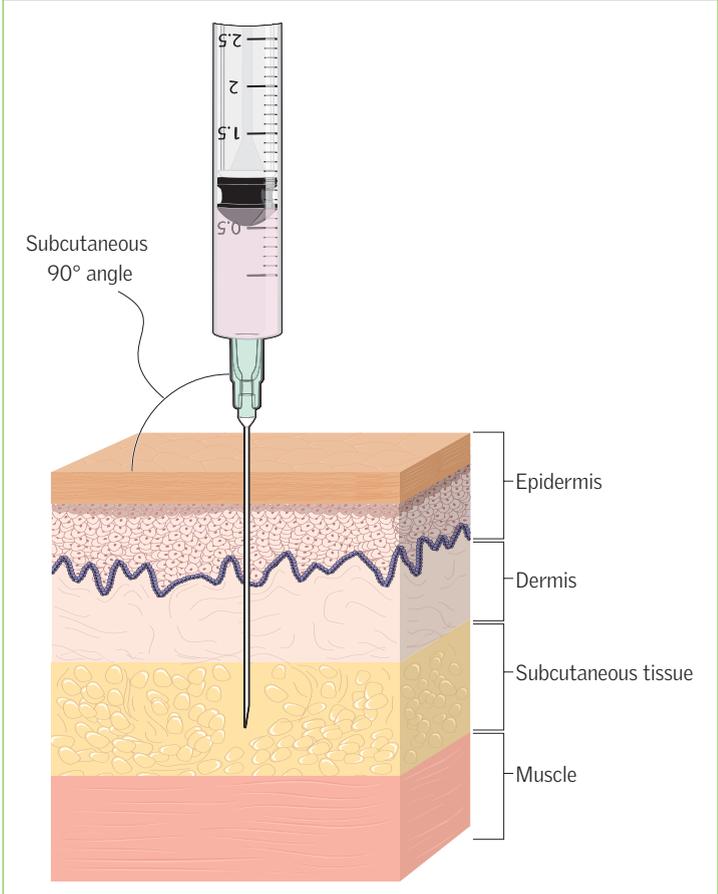
Low-molecular-weight heparins such as enoxaparin sodium are available in pre-filled syringes in a range of dosage forms and strengths, for example 40mg in 0.4mL. Pre-filled syringes and graduated pre-filled syringes are for one-time use only and are available with systems that shield the needle after injection. The air bubble should not be expelled from pre-filled syringes,



4 Reflect on your own practice: consider a patient in your care, where the administration of a low-molecular-weight heparin injection is indicated for the prevention of deep vein thrombosis. How do you determine the site for injection?

FIGURE 1

Preferred angle of injection and penetration of the needle for subcutaneous injections



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as this is designed to remain next to the plunger to ensure the whole dose is administered (Hunter 2008).

The manufacturer's guidelines recommend that patients be lying down during administration (Sanofi-Aventis 2011). The recommended site for injection is on the right or left side of the abdomen, 5cm away from the umbilicus. This is to avoid the umbilical veins and reduce the risk of bleeding (Chan 2001, Christensen *et al* 2003, Zaybak and Khorshid 2008). Any area with scars or bruising should also be avoided. Enoxaparin sodium is licensed for administration into the abdominal wall only. The abdominal skin usually has thicker subcutaneous tissue (>25mm) than the arms and legs and has minimal muscular activity – therefore the risk of injection into the muscle is reduced. The abdominal site also provides a larger area to accommodate a greater number of injections (McGowan and Wood 1990, Chan 2001, Zeraatkari *et al* 2005) and administration should be alternated between the left and right anterolateral and left and right posterolateral abdominal walls (Sanofi-Aventis 2011).

Complete time out activity 5

The whole length of the needle should be introduced into a skin fold held between the thumb and forefinger, and the skin fold should be held throughout the injection (Hunter 2008). It is recommended that the injection site is not rubbed following completion of the injection, to avoid bruising (Chan 2001).

The volume of injectate is dependent on the dose and can range from 0.4mL up to 1-2mL. It should be administered at a speed that prevents harm and discomfort to the patient (Chan 2001). This can be achieved by injecting slowly. The manufacturer's guidelines for enoxaparin sodium suggest a duration of 30 seconds. However, a slower injection speed can reduce the risk of bruise formation (Chan 2001, Zaybak and Khorshid 2008).

Insulin

The way the insulin injection is performed is as important to good glycaemic control as the type and dose of insulin administered (Partanen and Rissanen 2000, Strauss *et al* 2002). The crucial factor is to ensure the injection is given subcutaneously and not intradermally or intramuscularly (Hunter 2008), and that it goes into the fatty tissue

(Pemberton and Holman 1989, Frid *et al* 1990, Thow and Home 1990, Strauss *et al* 2002). As long as the injection goes into the fat, it does not matter if insulin is injected just under the epidermis or just above the muscle (Frid and Linde 1992).

Complete time out activity 6

A further consideration with insulin is the site of injection. This is important because, as previously stated, absorption is most rapid from the abdomen, is slower from the arms, slower still from the thighs and slowest from the hip or buttock area (Frid and Linde 1992, Wood *et al* 2002).

Self-administration of insulin is common practice, with the 'insulin pen' now dominating injection equipment (Hicks *et al* 2011). However, there is still a skill to be learned when considering the subcutaneous route and safe injection technique. Patients who self-administer should be educated on the importance of rotating and assessing injection sites for daily and multiple injections. Injection pen devices allow people to manage their injectable therapies easily, safely and accurately (Bohannon 1999). However, people with diabetes frequently use incorrect injection techniques (Hicks *et al* 2011).

For insulin therapies to work optimally, correct injection technique is essential. Making a lifted skin fold decreases the chance of injecting into the muscle. The best way to do this is to lift the skin between the thumb and two fingers of one hand (Workman 1999, King 2003, Hicks *et al* 2011). The skin should be held until the solution has been injected; releasing the skin fold too soon can increase the risk of injecting into the muscle (Hicks *et al* 2011). This is also known as the 'site and time rule' (Hicks *et al* 2011), which means waiting at least ten seconds before removing the needle from the skin. This minimises any leakage of the injected drug.

When injecting with a pen device, the same technique should be adopted: the needle should be kept in the skin, with a lifted skin fold, for at least ten seconds after delivering the drug (Hicks *et al* 2011) to reduce risk of leakage or dribbling from the pen.

Insulin should always be injected at a 90° angle to ensure the medication is deposited into the subcutaneous layer (King 2003). Injecting into the muscle below the subcutaneous tissue can accelerate absorption, increasing the risk of hypoglycaemia (Polak *et al* 1996, Birkebaek *et al* 2008, Hicks *et al* 2011). Insulin injections into the subcutaneous tissue allow



5 Access the information leaflet or manufacturer's guidelines for the commonly used low-molecular-weight heparin in your practice area. Does your practice policy reflect the leaflet's recommendations?

6 Consider the injection sites into which you have administered insulin. Do they vary or tend to be only the arm or abdomen? How is the injection site rotation reflected in your documentation?



7 Are insulin injections routinely given at a 90° angle in your clinical area? How would you promote this in nursing practice?

8 Now that you have completed the article, you might like to write a reflective account. Guidelines to help you are on page 62.

for optimal absorption and a more predictable rate of insulin absorption, which can result in better glycaemic control (Hofman *et al* 2007). It is important to rotate injection sites to decrease the development of lipohypertrophy, which can result in poor glycaemic control (Chowdhury and Escudier 2003). International recommendations take into account emerging evidence relating to insulin absorption in addition to the importance of site rotation and needle depth (Frid *et al* 2010).
Complete time out activity 7

Patient assessment

Patient assessment is vital when considering the site and angle of injection to ensure the site is free from any signs of inflammation, swelling, redness or lipohypertrophy and lipoatrophy (wasting of subcutaneous tissue) (Hicks *et al* 2011). Any areas where there is evidence of inflammation, scarring, or abrasions or lesions should not be used for injections (Workman 1999, Jamieson *et al* 2002). Where areas of

lipohypertrophy are identified, these sites should not be used for at least three months (Hicks *et al* 2011); however, these areas may be less painful than less commonly used sites, which may explain why patients inject into them (King 2003).

Examining the patient and regularly inspecting used injection sites should include careful palpation, because not all areas of lipohypertrophy are obvious (Hicks *et al* 2011). In addition, if the patient's weight has changed or if the patient is an older person (Hicks *et al* 2011), needle length might need to vary, depending on injection site. This assessment is also necessary for obese, cachectic or thin patients.

Assessment should include a discussion of technique with the patient and exploration of any adverse effects he or she may be experiencing, especially if these are new or different. If a patient experiences bruising or bleeding, this might indicate he or she is injecting into the muscle or reusing needles (Hicks *et al* 2011). Patients should be aware

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BOX 1

Framework for safe practice for subcutaneous injections

- ▶ Wash hands to minimise risk of infection to the patient.
- ▶ Check the patient's identification, as per hospital policy.
- ▶ Prepare the patient and obtain consent.
- ▶ Position patient either sitting or lying down.
- ▶ Check the drug, formulation, indication, route, volume and side effects.
- ▶ Assess the skin and the patient's condition.
- ▶ Consider rotation of injection sites and assess those that are repeatedly used for injection.
- ▶ Consider equipment and familiarity with insulin pens and pre-filled heparin syringes, and follow the manufacturer's guidelines.
- ▶ Consider the recommended injection site: abdomen or thigh.
- ▶ Inject at a 90° angle, dart-like, into the hub of the needle and at 1mL per second (Chan 2001, Hofman *et al* 2007, Hunter 2008).
- ▶ Ensure the fold of skin is injected into and released only when the needle is removed.
- ▶ Wait at least ten seconds before withdrawing the needle, following the 'site and time' rule.
- ▶ Do not massage or rub the site afterwards unless otherwise indicated.
- ▶ Reassess for therapeutic effect and/or any side effects.
- ▶ Document accurately and appropriately.

of the most suitable injection sites and be informed about the medication itself, its action and side effects (Hunter 2008). Sharing information with the patient informs the patient and also provides an opportunity to reveal any concerns, poor technique and anxieties, as well as assessing the patient's knowledge.

Box 1 lists a proposed framework for safe practice for administering subcutaneous injections.

Conclusion

The subcutaneous injection technique requires skill, knowledge and a good understanding of the indications for the injection. This article has provided an overview of this using insulin and heparin subcutaneous injections, and has outlined a framework on safe practice for practitioners. A subsequent article will discuss safe practice for administering intramuscular injections **NS**

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