CORRECT INSULIN INJECTION

The role of appropriate equipment in lipohypertrophy prevention
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Educating patients with diabetes is one of the most important tasks of medical
staff, including nurses. Nurses caring for diabetes patients provide crucial advice,
information, and support regarding lifestyle, diet, physical exercise, self-control,
and the correct way to take medication and handle insulin injection equipment.

Proper insulin injection is the key issue
for managing diabetes effectively. Recom-
mendations were presented in Rome in 2015
during a workshop entitled FITTER (Forum
for Injection Technique and Therapy: Expert
Recommendations), which was devoted to
insulin treatment and injection techniques.

The recommendations take into account
the results of the ITQ (Injection Technique
Questionnaire) multi-centre studies, which
were conducted in 42 countries and involved
more than 13,000 patients. They pertain to
needle length, injection techniques, preferred
insulin administration sites, and proper in-
jection.

Needle length recommendations:

- A 4 mm long needle is considered the safest option for pen injectors used on adults
  and children, regardless of age, gender,
  ethnicity, or BMI. This size can also be
  used safely and effectively on obese pa-
  tients, though in their case 5 mm needles
  are permitted as well.

- A 4 mm needle inserted perpendicularly
  is long enough to reach the subcutaneous
tissue with a very low risk of intramuscular
  or intradermal injection.

- Insertions with a 4 mm needle should be
  made perpendicularly, i.e. at an angle of
  no less than 90° to the skin surface, re-
gardless of whether or not a skinfold has
  been lifted.

- For small children (up to 6 years of age)
  and very slim adults, one should lift a skin-
  fold and insert the 4 mm needle at a right
  angle into this fold. For other patients, us-
  ing a needle of this length does not require
  lifting a skinfold.

- For children (over 6 years of age), adoles-
cents, and adults who are slim or of normal
  body weight (BMI 19–25), injections should
  always be made into a lifted skinfold, re-
gardless of needle length.

- For children over 6 years of age, a 45° injection

- The safest currently available syringe nee-
  dle that can be used with all patients is
  6 mm long.

- It is not recommended to use 6 mm syringe
  needles on small children (under 6 years
  of age) or very slim adults (BMI < 19) even
  on a lifted skinfold, due to a high risk of in-
  tramuscular injection. If 5 mm needles are
  used on a child and cannot be replaced
  with 4 mm needles, the injection should
  always be made into a lifted skinfold. How-
  ever, wherever possible, needles ≥ 5 mm in
  length should be replaced with 4 mm nee-
  dles if they are to be used on children. For
  children over 6 years of age, a 45° injection
with a 6 mm needle can be made instead of a skinfold injection, as the actual insertion depth will be approximately 4 mm. If a needle ≥ 6 mm is used for an arm injection, it is essential to lift a skinfold; this type of insertion therefore cannot be performed by the patient themselves.

When injecting, one should be careful that a depression does not form in the skin. This may result in an overly deep insertion and intramuscular injection.

Patients suffering from muscle tremor or other disorders which make it impossible to hold a 4 mm injector needle may require longer needles.

Needles with very thin walls can be used with all patients. They provide a significantly faster flow rate, while clogging, bends and breaks occur just as rarely as they do in traditional needles.

Lipodystrophy consists in the loss of adipose tissue at insulin injection sites over the course of insulin therapy.

**Recommended insertion points**

As recommended, insertions can be made in the abdomen, thighs, buttocks, or shoulders, and more precisely:

- the area of the abdomen within the following limits: approximately 1 cm above the pubic symphysis, approximately 1 cm below the lowest rib, approximately 1 cm away from the navel, and into the sides of the abdominal wall;
- the upper third anterior lateral aspect of the thigh;
- the posterior lateral aspect of the upper buttocks and flanks;
- the middle third posterior aspect of the arm.

Insertions should not be made through clothing. Lifting a skinfold is impossible in such cases; moreover, the patient cannot see the planned insertion site, making it more difficult to perform the injection correctly.

**How to administer insulin analogues**

In the case of fast-acting insulin analogues, the injection site has no effect on the rate of absorption and therefore they can be injected at any of the above injection sites.

However, insulin analogues should not be administered intramuscularly, even though studies have shown similar rates of absorption in adipose tissue and muscles at rest. The rate of absorption from active muscles, however, was not investigated.

Pending further testing, patients may inject long-acting insulin analogues at any common injection site. However, they must remember to use an appropriate technique to prevent intramuscular insulin injection, which can lead to significant hypoglycaemia.

**How to administer human insulins**

Soluble human insulin (i.e. regular insulin) is absorbed more slowly than fast-acting analogues. Intramuscular injection of neutral protamine Hagedorn (NPH) insulin and long-acting insulin must be avoided at all costs, as there is a risk of hypoglycaemia.

The preferred site for administering soluble human (regular) insulin is the abdomen, due to it having the fastest rate of absorption. The regular/NPH insulin mix should be injected into the abdomen to accelerate the absorption rate of short-acting insulin, in order to compensate for postprandial glycaemia excursions.

Should there be a risk of nocturnal hypoglycaemia, NPH insulin or NPH-containing insulin mixes should be injected into the thigh or buttock in the evening, due to the slower rate of NPH insulin absorption from these sites.

**Correct injection technique:**

1. Lift a skinfold.
2. Inject the insulin slowly at a 90° angle to the skin surface.
3. Fully depress the plunger and count to 10 before withdrawing the needle from the skin (when administering via a pen injector).
4. Withdraw the needle at the same angle as it was inserted in the skinfold.
5. Release the skinfold.
6. Dispose of the needle safely.
Insulin therapy in pregnant women

For pregnant women, specific studies are needed to identify the best practices for injecting insulin. The use of routine foetal ultrasound screening provides physicians with a simple means of determining the distribution of subcutaneous adipose tissue and then providing recommendations for injection.

The abdomen is a safe site for insulin administration in pregnant women. Owing to the reduction in adipose tissue caused by uterine expansion, pregnant women (regardless of the type of diabetes) should use 4 mm needles for pen injectors.

In the first trimester of pregnancy, there is no need to change the insulin administration site or technique. In the second trimester, insulin can be injected into the lateral walls of the abdomen, avoiding areas of subcutaneous tissue surrounding the foetus. In the third trimester, insulin can be injected into the abdomen as long as a skinfold can be lifted. The patient can also administer insulin to the thigh, upper arm, or lateral walls of her abdomen.

Skin complications of insulin therapy

Skin complications include inflammatory lesions, allergic reactions, lipoatrophy, and hypertrophy of the subcutaneous tissue. The incidence of skin lesions has been determined to be 0.06–12/100 patients/year. Inflammatory lesions may be of a limited and transitory nature, manifesting themselves in the form of skin irritation and redness. The most serious is inflammation that leads to an abscess at the insertion site. Skin abscesses are usually associated with repeated injections in the subcutaneous tissue for more than 3 days. Infectious complications are more common in patients with chronic poor control and glycosylated haemoglobin above 10%. Abscesses are often formed when the injection is made at a “dirty” site, e.g. on the buttocks at or below the anus line. Immediate change of injection site and local application of antibiotics are recommended. Allergic lesions are usually the result of an allergy to sticking plasters.

Hypertrophy of subcutaneous tissue occurs sporadically in patients treated with an insulin pump. This is usually associated with infusion into a single site, especially in patients with underdeveloped subcutaneous tissue and small children, who have a limited area available for insertion.

Lipodystrophy consists in the loss of adipose tissue at insulin injection sites over the course of insulin therapy. Factors increasing the risk of post-insulin lipodystrophy include:

- using the same injection sites;
- using the same needle multiple times;
- making injections via long needles, for patients with a high body mass index (BMI);
- being female;
- having a long history of diabetes;
- having a long history of insulin therapy.

Lipohypertrophy means the thickening of skin at injection sites caused by insulin administration. The etiopathogenesis of this condition remains unclear, but both tissue trauma associated with needle use and the lipogenic effect of insulin may be significant. The disease leads to hypertrophy of adipose cells, which contain small drops of fat. This condition may reduce the effectiveness of insulin absorption. Clinically, the patient develops nodules or painless hypertrophic tumours, which are painless, and the skin above them does not show any lesions. Lipohypertrophy occurs in slim and young patients, especially those with type 1 diabetes mellitus. The risk increases with the duration of the disease.

How to prevent lipohypertrophy

The first symptoms of lipohypertrophy may be difficult to notice, as its onset is gradual. However, nurses should be attentive to any large fluctuations in glycaemia as well as any frequent unexplained hypoglycaemia episodes in the patient. In such cases, the insulin injection sites must always be carefully examined. Palpation of the area around the injection site allows for the detection of lesions.

Education is very important in prevention and treatment of lipohypertrophy. The
provision of appropriate knowledge by a diabetes nurse or diabetes educator and the verification of the practical application of this knowledge by the patient can prevent or significantly reduce the occurrence of this complication.

The most common mistake made by patients — and the main factor in the onset of lipohypertrophy — is to inject insulin at a single location, without observing the principles of site rotation. Patients often overuse the areas that are most convenient for them, such as the abdomen. Administration of insulin into hypertrophied subcutaneous tissue also makes patients insensitive to pain, thereby predisposing them to choose this place for further injections.

Also, improper injection technique and poor needle length selection increase the risk of post-insulin lipohypertrophy. Another mistake, which patients often justify on economic grounds (although another reason can be lack of knowledge), is the repeated use of the same needle.

Should a patient change the needle at each injection?

An insulin needle is a disposable product. It is tightly sealed to maintain its sterility. After opening the needle cover and making the injection, the needle should be removed from the pen injector and safely disposed of in a manner that does not expose others to a risk of infection. One such method is to dispose of the needles in special containers and return these to medical waste disposal points.

Repeated use of the same needle exposes patients to risk of:

- infection (once a needle has been used, it is no longer sterile);
- needle clogging (insulin may crystallize inside the needle);
- air bubbles entering the insulin cartridge (air can enter the cartridge via a needle left in a pen injector, which may result in incorrect dosing if the air is not removed before injection);
- imprecise dosage (this applies to insulin in suspension, as leakage of a less concentrated fraction of insulin through the needle left in the pen injector may lead to changes in the concentration of insulin remaining in the cartridge);
- pain (after several injections, the sharp end of the needle deforms in a hook-like manner and loses its special friction-reducing coating);
- lipodystrophy (use of a blunt needle damages the skin and subcutaneous tissue and may cause an inflammatory reaction at the injection site).

Treatment of lipohypertrophy

Treatment of lipohypertrophy consists in relieving the burden on the affected areas. Sometimes, a change of insulin may also be necessary. It is crucial, however, that the patient be educated and re-educated; this is an important element of prevention.

Patients treated with insulin should be aware of the possibility of this complication arising and have the skill and habit of examining injection sites by themselves. Carers and family members should also be trained in lipohypertrophy prevention. It is essential to train patients to change injection sites regularly and, if one area is preferred, to advise them to maintain a distance of 1 cm between subsequent injections. In very advanced cases of lipohypertrophy, surgical intervention may be required to remove affected tissue.

Literature to be obtained from the authors.
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