Insulin therapy

by Rita Forde

DIABETES mellitus is a complex chronic multi system condition, which requires a multidimensional approach to its management. Fundamental to any management plan for people with diabetes are dietary adherence and the inclusion of exercise. For many, a diagnosis of diabetes is synonymous with the need to inject insulin. This is true for people with type 1 diabetes who commence insulin therapy at diagnosis as they do not produce insulin and are therefore dependent on an exogenous supply to sustain life. While those with type 2 diabetes do produce some insulin, they may over time require insulin therapy to maintain adequate blood glucose levels.

Intensive use of insulin to optimise glycaemic control can help to prevent or delay the complications associated with diabetes.\(^1\) As a result there has been an increase in the use of insulin therapy for the management of those with type 2 diabetes in recent years. However, when insulin therapy is used it is imperative that the dosage is individualised to the particular needs of the person and is balanced with their diet and exercise.

**Insulin**

Insulin is obtained from beef or pork pancreas, or may be produced chemically by recombinant DNA technology.\(^2\) Recently there has been an increase in the use of insulin analogues, which are developed by modifying the amino acid sequence of the insulin molecule. The various insulin types are differentiated by their time action profile. The types currently available are rapid acting, short acting, intermediate acting and long acting. In addition bi-phasic or pre-mixed insulin, which is a combination of either rapid or short acting insulin and intermediate acting insulin, are also available. While the various brands of insulin available in Ireland are not and the management of type 1 and type 2 in the various patient groups.

This month Rita Forde focuses on insulin therapy and the various insulins available. Injection sites, techniques and devices are also discussed.

**Insulin types available in Ireland**

- **Insulin analogues** (available as rapid acting or long acting types)
  - **Rapid acting analogues** (eg. Humalog, Novorapid, Apidra)
    - Once injected subcutaneously, insulin onset is almost immediate, action peaks in one to three hours; duration of action is four to five hours.\(^5\)
    - It is recommended to eat immediately following injection and to avoid eating between meals
  - **Long acting analogues** (eg. Lantus, Levemir)
    - Action of insulin commences approx one to two hours post injection and lasts 20-24 hours.
    - Peculiar to this insulin is the absence of a peak in the action profile, resulting in a constant background (basal) insulin.
    - This insulin is more frequently used now and is less likely to cause nocturnal hypoglycaemia

- **Short acting/soluble insulin**
  - Following SC injection, takes 30 minutes for the onset of action; Peak of action is two to five hours; duration of action is six to eight hours\(^4\)

- **Intermediate acting/isophane insulin** (eg. Insulatard, Humulin I, Insuman Basal)
  - A crystalline substance is added to this insulin to retard the action.
  - This results in a cloudy appearance and when left undisturbed crystals form. Prior to administration it is essential that the insulin crystals be suspended evenly. This is achieved by gently rolling the insulin between the hands until it has a uniform cloudy appearance
  - Once injected, onset of action is one to one and a half hours; maximum effect is from four to 12 hours; the duration is 20-24 hours\(^5\)

- **Long acting insulin** (eg. Ultratard)
  - Suspended in zinc, which retards the absorption rate. As with intermediate acting insulin, it is essential that this type of insulin be gently rolled between the hands to achieve a uniform cloudy appearance prior to administration
  - Once injected, onset of action is about four hours; peak of action is eight to 24 hours; duration is usually > 24 hours.\(^7\) This insulin is rarely used today and is supplied on a named patient basis only

- **Premixed/bi-phasic insulin** (eg. Mixtard, NovoMix, Insuman Combi, Humalog Mix)
  - These have a number after the name of insulin, denoting the percentage of soluble insulin to isophane, protamine or crystalline insulin; eg. Mixtard 30 contains 30% soluble and 70% isophane insulin
  - Following an SC injection of a premixed insulin the time action is similar to that of the unmixed soluble and isophane insulin\(^4\)
  - Remember that time action is accelerated when insulin is injected intramuscularly.\(^2\) Many factors affect the rate of absorption of insulin, including injection site, injection technique, exercise and body temperature

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identical, there are similarities between them. The Table outlines the insulin types, rather than specific brands available.

**Injection sites**

Insulin should be administered by subcutaneous injection. The subcutaneous layer is situated between the fatty layer under the skin and the muscle layer below it. The recommended sites for injection are: the upper and lower abdomen avoiding the umbilical region; the upper outer region of the thigh; and in some cases such as children, the upper outer quadrant of the buttock. Generally it is not recommended to use the arms for insulin injections as there is usually only a thin layer of subcutaneous tissue.

An important aspect of insulin administration is to rotate the injection sites. This will help to avoid the development of lipohypertrophy or lipoatrophy, which results in the ‘lumpy’ appearance of the area injected and also alters the absorption rate of insulin. The absorption rate differs between sites. The abdomen for example has a faster rate of absorption than the thigh, therefore people with diabetes are advised to inject their rapid or short acting insulin in the abdomen and the longer acting insulin in the thigh. It is important to remember that the rate of absorption can increase due to several factors such as exercise or increased temperature. Any person commencing insulin therapy is advised about this, particularly regarding holidaying in warmer climates.

**Injection devices**

There are a variety of insulin administration devices available. Traditionally insulin was administered using an insulin syringe and needle. These syringes were specifically designed and marked in insulin units. Today, many people still use this method, although there has been an increase in the production of other devices. Most insulin administration devices contain approximately 300 units of insulin. Many use cartridges, which can be placed within the device (NovoPen, Innovo, Humapa and OptiPen Pro, AutoPen). Disposable devices are also available (FlexPen, InnolEt, Optiset, Humalog Pen). Once the insulin is used the whole device is discarded. Most of these devices are pen shaped, but more recently the designs take cognisance of people with limited hand fine motor movement and visual impairment (eg. Innolet). All of these devices have specific instructions for use, but it is generally agreed that prior to dialling a dose of insulin for injection, a test dose should be expelled to ensure the device is functioning correctly. The OptiSet has a unique feature which facilitates setting an insulin dose which can then be used for further injections. This pen does not require a test dose to be expelled prior to each injection.

There is a variety of needle lengths available to accommodate the wide variation in the population who use them. It is important that individuals receive the length best suited for them. Using a needle length that is too long or too short will result in the insulin being deposited in either the muscle or the adipose tissue layer, resulting in an alteration in the time action of the insulin.

Many devices have additional appliances which can be attached to assist use for specific groups such as older people and the young. Some devices include a magnifier for insulin pens and a needle remover. Others are supplied with additional accessories to assist those with compromised manual dexterity when turning the dial to set the dose and to administer the insulin.

There has been an increase in the use of continuous subcutaneous insulin infusion (CSII) or insulin pumps in Ireland over the past five years. An insulin pump is a small battery operated device that is connected to the body by a thin plastic tube which is inserted under the skin. This pump administers a small amount of insulin continuously which can be adjusted when needed, such as meal times. The use of this device requires specialist care and education. While insulin pumps have revolutionised insulin therapy for many people, they are not suitable for everybody.

**Injection technique**

**Needle and syringes:** Prior to an injection, the person’s hands and injection site should be clean and dry. The top of the insulin vial or cartridge should be cleaned with 70% isopropyl alcohol. All insulin, except rapid and short acting, should be gently rolled between the palms of the hands to resuspend the insulin. When using a needle and syringe, an amount of air, equal to the insulin dose should be injected into the vial, to avoid creating a vacuum. When mixing insulin, the soluble insulin should be drawn up first – remember ‘clear before cloudy’.

**Insulin pens:** All pen devices have specific instructions for use, which are individually reviewed with all people commencing insulin therapy. Reusable insulin pens are supplied via diabetes clinics and the insulin pen fills and the disposable devices are sourced at the person’s pharmacy.

Insulin should be injected into the subcutaneous layer. Most individuals will need to lightly grasp a fold of skin to form a pinch between the thumb and index finger. The needle should be inserted at a 90° angle. This should be maintained throughout the injection and for five to 10 seconds afterwards, then the needle removed. Routine aspiration to check for blood prior to administering the insulin is not necessary.

Insulin in current use by an individual may be kept at room temperature for up to 30 days. All other supplies of insulin should be stored in a refrigerator, avoiding contact with the freezer. If insulin is accidentally frozen or exposed to extremes of temperature it should be discarded, as it will no long be effective. Insulin and all injection equipment should be kept out of reach of children.

**Monitoring blood glucose levels**

It is advisable that people who require insulin would monitor their blood glucose levels. Improved, accurate and reliable home blood glucose monitors are now available. There is an array of meters that are designed to meet specific needs of all individuals. Many of the newer meters can test blood sugar levels in a little as five seconds and use less blood than previously.

The aim of diabetes management is to provide education, training and care that will enable people with diabetes to develop the knowledge and skills to actively manage their diabetes and allow them to make informed choices in collaboration with their healthcare providers.

Rita Farde is advanced nurse practitioner – diabetes at the Mater University Hospital, Dublin

References