

In the consultation room

Continuous subcutaneous insulin infusion

Gill Morrison, Philip Weston

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About this series

The aim of the “In the consultation room” series is to provide readers with brief, practical reviews of key aspects of diabetes care that should be covered in the clinic setting. A brief set of questions at the end allows readers to test their knowledge.

Authors’ introduction

Continuous subcutaneous insulin infusion (CSII), or insulin pump therapy, is an intensive insulin management system for individuals with type 1 diabetes. Given the increased use of CSII, we feel that it is essential that all healthcare professionals have insight into this technology, including practitioners working in primary care.

An insulin pump is a portable external insulin delivery system and is about the size of a small pager. The pump is attached to the user either via an infusion set that is connected to a cannula (see *Figure 1*) or via “patch pump” technology. The cannula is inserted by the user into subcutaneous tissue on the abdomen, upper outer buttocks, loin areas or the legs and then secured to the user’s clothing (Walsh and Roberts, 2006).

Insulin delivery

People using continuous subcutaneous insulin infusion (CSII) do not take any long- or intermediate-acting insulin. Although soluble insulin can be used in pump therapy, glycaemic control is superior if rapid-acting analogue insulin is used (Colquitt et al, 2003).

A plunger inside the pump pushes the insulin out on a continuous basis from a disposable cartridge (or “reservoir”), according to a pre-set dose variable programme known as the basal rate. The reservoir is filled by the user from a vial of insulin.

The basal rate is supplemented by bolus doses of insulin that are manually delivered via the pump. These bolus doses are used to correct elevated blood glucose values or to counteract the anticipated rise in glucose following the ingestion of carbohydrate.

Benefits of CSII

Many of the benefits of CSII are derived from it being a precision delivery tool that allows people with diabetes to fully participate in the management of their condition. Pump users can make decisions and adjustments to their insulin requirements according to daily life events on a moment-to-moment basis (NHS Technology Adoption Centre, 2012). Pump technology permits

temporary adjustments of dosage to accommodate changes in insulin requirements for periods of increased physical activity, infection and stress, and during menstruation (Walsh and Roberts, 2006).

In insulin pump therapy, the basal rate is tailored to accommodate the user’s insulin requirements, which can be set as low as 0.025 units per hour. Once the basal rate is matched to the user’s requirements, regular meals are no longer mandatory and can be skipped or delayed while still maintaining glycaemic stability (Bolderman, 2002; Walsh and Roberts, 2006).

The meal-time bolus doses can be adjusted so that they are delivered to match normal physiology and fit in with the glucose release from various food types, such as fatty foods and refined carbohydrates (Walsh and Roberts, 2006). Pump users must be able to accurately carbohydrate count so that bolus doses can be accurately calculated (Laurenzi et al, 2011).

Studies have demonstrated that CSII can improve glycaemic control, reduce the frequency of hypoglycaemia and improve quality of life (Farkas-Hirsch and Hirsch, 1994; Bode et al, 1996; Chantelau et al, 1997; Hirsch et al, 2005).

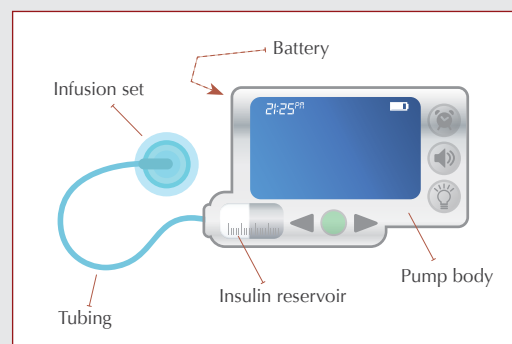


Figure 1. Diagram of an insulin pump.

Authors

Gill Morrison is Nursing Lead for CSII and Philip Weston is a Consultant Physician and Diabetologist, Royal Liverpool University Hospital, Liverpool.

Disadvantages of CSII

There are at least two major potential disadvantages of pump therapy:

- 1 As CSII therapy only uses rapid-acting insulin, blood glucose will start to rise if the flow of insulin is interrupted – owing to blocked or kinked cannula tubing or some other cause – even for a short time. Should the user not then intervene, the blood glucose values will continue to rise and ketoacidosis can develop (Tolone et al, 1996; Bolderman, 2002).
- 2 The cannula is left in for 2–3 days. As it is a foreign object causing a break in the natural barrier of the skin, the user is at risk of developing an infection at the cannula site. In the worst-case scenario, an abscess may develop at an infusion site which may require surgical drainage (Bolderman, 2002; Walsh and Roberts, 2006). Within the Liverpool cohort the risk of abscess formation is <0.3% over 10 years (unpublished data).

In addition, it is important to note that, in order for CSII to be successful, the pump user must take responsibility for the management of their diabetes on a day-to-day basis. The level of expertise of the professional team providing support and education for the pump user will also be critical a factor (Department of Health, 2001; NICE, 2008).

Individual suitability for CSII

For NHS funding of CSII, a person with type 1 diabetes must meet NICE (2008) criteria.

For individuals aged 12 years or older: attempts to achieve target HbA_{1c} levels with multiple daily injection (MDI) therapy must have resulted in “disabling hypoglycaemia”; or HbA_{1c} levels must have remained at 69 mmol/mol (8.5%) or above on MDI therapy despite a “high level of care”.

For individuals aged under 12 years: MDI therapy must be considered impractical or inappropriate; individuals are expected to undergo a trial of MDI therapy between the ages of 12 and 18 years. However, despite NICE criteria for CSII, the selection of individuals who are suitable for insulin pump therapy is a difficult and potentially controversial area of practice for healthcare professionals.

Day-to-day practicalities

To finish the piece, we present a selection of queries that might be faced most frequently in primary care.

My pump is not working – what should I do?

Part of the education programme for converting individuals onto CSII should prepare a user for such an eventuality. If the pump fails, the user must immediately convert back onto insulin injections. To facilitate this, he or she must have a ready supply of either isophane or long-acting analogue insulin and pens or syringes. The individual should contact the insulin pump company to arrange the delivery of a replacement pump.

How can I get more cannulas?

Users are responsible for ordering their own supplies either via their insulin pump service provider or directly from the insulin pump company customer services department.

My battery is dead – what can be done?

Pump users should always carry a spare battery for their pump. Appropriate batteries are readily available from a suitable retail outlet for insulin pumps. ■

Further reading

- Morrison G, Weston P (2012) Have pump, will travel. *Journal of Diabetes Nursing* **16**: 176–84.

Authors' conclusion

Insulin pump therapy is an effective treatment for some people with type 1 diabetes, but analytical skills and knowledge must be acquired by the user in order for it to be successful, which necessitates appropriate selection, structured education and ongoing support.

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Questions to test your knowledge

Choose one answer only.

1. Which of the following statements is true regarding the basal rate?
 - a) The basal rate is individualised
 - b) If the basal rate is correctly set then the pump user can omit meals and maintain glycaemic targets
 - c) Bolus doses are delivered via the pump in addition to the basal rate
 - d) All of the above
2. Under NICE (2008) guidance, people with which type of diabetes can be funded by the NHS for insulin pump therapy (provided that they satisfy the criteria)?
 - a) Type 1 diabetes
 - b) Type 2 diabetes
 - c) Maturity-onset diabetes of the young
 - d) Any type of diabetes
3. What does the abbreviation CSII stand for?
 - a) Current subcutaneous insulin infusion
 - b) Continuing subcutaneous insulin installation
 - c) Continuous subcutaneous insulin infusion
 - d) Constant subcutaneous insulin infusion
4. Which of the following types of insulin provide superior glycaemic control when used in an insulin pump?
 - a) Long-acting analogues
 - b) Rapid-acting analogues
 - c) Soluble insulin
 - d) Biphasic insulin
5. Which of the following are potential causes or consequences of insulin pump therapy complications?
 - a) Diabetic ketoacidosis
 - b) Cannula-site infection
 - c) Blocked or kinked cannula tubing
 - d) All of the above