



What do patients prefer: insulin pumps or multiple daily injections and structured education?

A retrospective audit and patient questionnaire

LF Clark*, JC Bilbie, P Abraham

Introduction

Continuous subcutaneous insulin infusion (CSII) is an alternative means of delivering insulin to multiple daily dose injections (MDI) to patients with type 1 diabetes mellitus (T1DM). Potential advantages of CSII over MDI include better glycaemic control including less glycaemic variability, better awareness of hypoglycaemia and improved quality of life.¹ Patients should ideally undergo a structured education programme prior to commencing CSII.

In NHS Grampian, in order to be considered for CSII therapy, patients must be using MDI and then complete a Dose Adjustment For Normal Eating (DAFNE) structured education course (introduced in Grampian in 2005) and be adept in the general principles of diabetes self-management and specific skills, such as carbohydrate counting, insulin adjustment and correction. We sought to assess the input required from both patients and professionals, and patients' perceptions and experiences of these treatments.

Method

A review was done of the records of the 21 patients with T1DM, under the care of the NHS Grampian Pump Service, who had sequentially undergone MDI, then DAFNE and are now treated with CSII. Patients' records included outpatient diabetes clinic notes, hospital notes and laboratory data. Initial data recorded focused

ABSTRACT

Potential advantages of continuous subcutaneous insulin infusion (CSII) over multiple daily injections (MDI) include improved glycaemia, and reduced frequency and severity of hypoglycaemia. In our hospital, to be considered for CSII, patients must be using MDI, and then undergo a Dose Adjustment For Normal Eating (DAFNE) structured education course.

We reviewed the records of the 21 patients with type 1 diabetes who had sequentially undergone MDI, then DAFNE and are now treated with CSII.

HbA_{1c} improved as patients increased the intensity of the management of diabetes despite reductions in total daily insulin dose. Patients did a similar number of home blood glucose tests per day and spent a similar amount of time managing their diabetes. Contacts with health care team members were the same for all modalities in the first three months but reduced for those on MDI with or without having completed a structured education course, while contacts with the health care team remained higher on pumps. Patients were generally satisfied with all modalities of treatment and would recommend each modality.

The input into the management of diabetes from both patients and health care professionals remained high even after the initial stages of being commenced on CSII therapy. This reflects the additional input needed in assessing the various basal rates and other ratios. However, patient preference was in favour of pumps in this select group who had sequentially experienced all three options. Copyright © 2011 John Wiley & Sons.

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KEY WORDS

patient preference; pumps; multiple daily injections; structured education

on the insulin pump including: pump manufacturer and model, date of CSII initiation and reason for pump panel allocation. Standard parameters used to measure diabetes control were recorded pre-MDI, pre-DAFNE and pre-CSII (within six months of each intervention) and within six to 12 months after commencing CSII. These included: HbA_{1c}, lipid profile (LDL, HDL and total cholesterol), weight and insulin daily dose. Factors associated with adverse outcomes were explored including hypoglycaemia, admissions

to hospital (measured in the last year), hyperglycaemia admissions to hospital (measured in the last year), hypoglycaemia severity and hypoglycaemia awareness. The number of outpatient visits was also ascertained (measured in the last year). The same data were recorded for pre- and post-DAFNE. Patients also completed three questionnaires: the Problem Areas In Diabetes (PAID) questionnaire,² Symptoms Awareness of Hypoglycaemia questionnaire,³ and a questionnaire designed by JCB, relating to satisfaction and clinical

Dr Louise F Clark, MB ChB, BSc(MedSci) Hons, MRCP(UK), Specialist Registrar in Diabetes and Endocrinology
Dr Joshua C Bilbie, MB ChB, BSc Hons, 5th year medical student (elective project)
Dr Prakash Abraham, MD, MSc,

FRCP(Edin), Consultant Diabetologist
Department of Diabetes, Aberdeen Royal Infirmary, Aberdeen, UK

Aberdeen Royal Infirmary, Foresterhill, Aberdeen AB25 2ZN, UK;
email: louiseclark@nhs.net

*Correspondence to: Dr Louise Clark, Department of Diabetes, Ward 27/28,

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Patient preference: CSII or multiple daily injections and structured education?

Table 1. Mean values during MDI (pre-DAFNE), post-DAFNE (6 months) course and following CSII therapy (6–12 months); n=21

	MDI	Post-DAFNE	Post-CSII
HbA _{1c} (%)*; (range)	9.02 (7.3–12.2)	8.59 (7.0–11.3)	8.02 (6.2–9.3)
Daily insulin dose (units); (range)	63 (34–126)	58.73 (27–120)	54.75 (30.2–99.0)
Weight (kg); (range)	83.2 (56–107)	81.17 (56.5–108)	84.39 (56–107.6)

* p<0.01 for CSII vs MDI and CSII vs DAFNE. All other comparisons = NS.

Table 2. Results of questionnaire designed for this study (mean scores shown); n=16 (out of 21)

Variable	MDI	Post-DAFNE	Post-CSII
No. of home blood glucose monitoring tests/day	6–10	6–10	6–10
Episodes of severe hypoglycaemia [†]	1	1	1
Length of time managing diabetes/day			
In first 3 months	30–60 min	30–60 min	30–60 min
After first 3 months	30–60 min	30–60 min	30–60 min
No. of contacts with health care team ^{††}			
In first 3 months	5–10	5–10	5–10
After first 3 months	<5	<5	5–10
Satisfaction with treatment (scale 0–8, 8 being very satisfied; see Appendix 1)*	5	6	7
Would recommend treatment (scale 0–8, 8 being 'Yes, definitely'; see Appendix 1)**	5	6	8

[†]Requiring third party intervention; ^{††}includes clinic visits and telephone calls with clinic doctor, GP, diabetes specialist nurse or practice nurse. n=16 (out of 21).

*p<0.01 for CSII vs DAFNE and CSII vs MDI; p=0.059 for DAFNE vs MDI.

**p<0.01 for CSII vs MDI; p<0.05 for CSII vs DAFNE and DAFNE vs MDI.

contact time, which was completed anonymously and returned by 16 patients. This questionnaire (Appendix 1, available online at www.practicaldiabetesinternational.com) was designed for this evaluation and so has not been validated or used before.

Statistical analysis was performed using analysis of variance with GenStat software (Version 12; Lawes Agriculture Trust, VSN International Ltd, Hemel-Hempstead, UK).

Results

Twenty-one patients had followed the NHS Grampian pathway of MDI followed by a DAFNE course then

CSII pump. All patients used the Medtronic Paradigm pump. There were 13 males and eight females with a mean age of 39 years (range 20–55 years). Of the 16 patients who completed the questionnaire designed by JCB, the mean length of time since diagnosis was 23.5 years (range 10–42 years); DAFNE courses had been completed one to six years ago, with CSII therapy commenced one to three years ago. Fourteen patients had been commenced on CSII therapy for hypoglycaemia while the remaining seven patients were commenced for sub-optimal glycaemic control despite attempts to improve on this.

As shown in Table 1, mean HbA_{1c} improved significantly following completion of a DAFNE course and improved further with CSII therapy. Daily insulin dose also decreased after the DAFNE course and again following commencement of CSII therapy. There was a small increase in weight when patients were established on CSII therapy though this may reflect the improved glycaemic control.

Admissions to hospital in this group were low with no admissions for hypoglycaemia in any group and three admissions for hyperglycaemia (one in the MDI group and two on CSII). There were no episodes of diabetic ketoacidosis in any group. All patients had hypoglycaemia awareness before and after commencing CSII therapy.

Thirteen patients completed the PAID questionnaire before and after starting CSII therapy. The mean pre-CSII score was 20.3 (range 3–67) with 10 patients showing an improved score (mean 17.6; range 2–62) with one unchanged and two showing a small deterioration (reduction in quality of life of 2 and 3).

Discussion

We have shown that in common with the meta-analysis by Pickup *et al.*⁴ glycaemic control improves with insulin pump therapy in comparison with MDI ± DAFNE. This group had a low incidence of hypoglycaemia but overall frequency and severity of hypoglycaemia decreased confirming previous reports.^{1,5–7}

The frequency of blood tests and time spent managing their diabetes remained high during and beyond the first three months on these treatments in this motivated group of patients (Table 2). The frequency of contact with the health care teams was higher in those using the pumps beyond the initial three months. This reflects the additional input needed in assessing the various basal rates and other ratios which may take between six to 12 months for some patients.

Patient preference for pumps in this group who have sequentially been on MDI, DAFNE and then CSII was significantly in favour of pumps (Table 2). Hoogma *et al.* found that CSII was preferred and improved quality of life

**Key points**

- CSII is associated with better glycaemic control than MDI ± structured education
- CSII is preferred by patients and they are more likely to recommend this therapy modality to others despite the higher intensity of therapy
- CSII is associated with higher input of health care professionals even after the initial period of time on the new modality

in 272 patients in comparison with NPH based MDI.⁷ In this randomised crossover trial 89–92% would recommend MDI compared to 98–100% who would recommend CSII following their experience of these treatments.⁷ Similarly, the results of the PAID questionnaire in this study suggest that quality of life was improved using CSII.

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Declaration of interest

PA has received honoraria as an advisory board member of Medtronic Scotland.

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Appendix 1. Diabetes questionnaire

DIABETES QUESTIONNAIRE

Please answer all questions provided. Questions 3–8 have three parts (i, ii and iii), and therefore require 3 answers. Each question should be applied to the treatment (insulin, insulin after the DAFNE course and insulin pump) as can be re-called. It may be difficult to remember what it was like while on each treatment regime but we would appreciate you taking some time to think back and answer as accurately as possible.

QUESTION 1.

- i) What year were you diagnosed with type 1 diabetes mellitus?
- ii) What year did you undertake the Dose Adjustment For Normal Eating (DAFNE) course?
- iii) What year did you start using the insulin pump?

QUESTION 2. What was the reason for initiation of pump therapy? (Please tick the appropriate box)

- Disabling hypoglycaemia (low blood sugar) Persisting hyperglycaemia (high blood sugar)
- Other, please specify

QUESTION 3. What is the average number of blood sugar readings taken in a 24-hour time period while on each treatment? (Please tick the appropriate box)

- | | | | | | |
|----------------------------|-------------------------------|--------------------------------------|------------------------------|-------------------------------|---------------------------------------|
| i) Injections of insulin | <input type="checkbox"/> None | <input type="checkbox"/> Less than 3 | <input type="checkbox"/> 3–6 | <input type="checkbox"/> 6–10 | <input type="checkbox"/> More than 10 |
| ii) Injections after DAFNE | <input type="checkbox"/> None | <input type="checkbox"/> Less than 3 | <input type="checkbox"/> 3–6 | <input type="checkbox"/> 6–10 | <input type="checkbox"/> More than 10 |
| iii) Insulin pump | <input type="checkbox"/> None | <input type="checkbox"/> Less than 3 | <input type="checkbox"/> 3–6 | <input type="checkbox"/> 6–10 | <input type="checkbox"/> More than 10 |

QUESTION 4. What is the average number of severe hypos (low blood sugar requiring assistance by a third person) you have experienced in a 6-month time period while on each treatment? (Please tick the appropriate box)

- | | | | | | |
|----------------------------|-------------------------------|----------------------------|----------------------------|----------------------------|------------------------------------|
| i) Injections of insulin | <input type="checkbox"/> None | <input type="checkbox"/> 1 | <input type="checkbox"/> 2 | <input type="checkbox"/> 3 | <input type="checkbox"/> 4 or more |
| ii) Injections after DAFNE | <input type="checkbox"/> None | <input type="checkbox"/> 1 | <input type="checkbox"/> 2 | <input type="checkbox"/> 3 | <input type="checkbox"/> 4 or more |
| iii) Insulin pump | <input type="checkbox"/> None | <input type="checkbox"/> 1 | <input type="checkbox"/> 2 | <input type="checkbox"/> 3 | <input type="checkbox"/> 4 or more |

QUESTION 5. On average how much time do you spend per day managing your diabetes while on each treatment (e.g. thinking and/or adjusting about blood sugar level, monitoring blood sugar level, changing or adjusting equipment)? (Please tick the appropriate box)

A) Within the first 3 months of treatment:

- | | | | | |
|----------------------------|---|------------------------------------|------------------------------------|--|
| i) Injections of insulin | <input type="checkbox"/> Less than 30mins | <input type="checkbox"/> 30–60mins | <input type="checkbox"/> 60–90mins | <input type="checkbox"/> Other, please specify |
| ii) Injections after DAFNE | <input type="checkbox"/> Less than 30mins | <input type="checkbox"/> 30–60mins | <input type="checkbox"/> 60–90mins | <input type="checkbox"/> Other, please specify |
| iii) Insulin pump | <input type="checkbox"/> Less than 30mins | <input type="checkbox"/> 30–60mins | <input type="checkbox"/> 60–90mins | <input type="checkbox"/> Other, please specify |

B) After 3 months of treatment:

- | | | | | |
|----------------------------|---|------------------------------------|------------------------------------|--|
| i) Injections of insulin | <input type="checkbox"/> Less than 30mins | <input type="checkbox"/> 30–60mins | <input type="checkbox"/> 60–90mins | <input type="checkbox"/> Other, please specify |
| ii) Injections after DAFNE | <input type="checkbox"/> Less than 30mins | <input type="checkbox"/> 30–60mins | <input type="checkbox"/> 60–90mins | <input type="checkbox"/> Other, please specify |
| iii) Insulin pump | <input type="checkbox"/> Less than 30mins | <input type="checkbox"/> 30–60mins | <input type="checkbox"/> 60–90mins | <input type="checkbox"/> Other, please specify |

QUESTION 6. On average how many contacts (including appointments and telephone calls) did you have with the diabetes care team while on each treatment (including Diabetes Consultant, Diabetes Specialist Nurse and Dietitian) over each time period? (Please tick the appropriate box)

A) Within the first 3 months of treatment:

- | | | | | |
|----------------------------|--------------------------------------|-------------------------------|--------------------------------|---------------------------------------|
| i) Injections of insulin | <input type="checkbox"/> Less than 5 | <input type="checkbox"/> 5–10 | <input type="checkbox"/> 10–15 | <input type="checkbox"/> More than 15 |
| ii) Injections after DAFNE | <input type="checkbox"/> Less than 5 | <input type="checkbox"/> 5–10 | <input type="checkbox"/> 10–15 | <input type="checkbox"/> More than 15 |
| iii) Insulin pump | <input type="checkbox"/> Less than 5 | <input type="checkbox"/> 5–10 | <input type="checkbox"/> 10–15 | <input type="checkbox"/> More than 15 |

B) After 3 months of treatment:

- | | | | | |
|----------------------------|--------------------------------------|-------------------------------|--------------------------------|---------------------------------------|
| i) Injections of insulin | <input type="checkbox"/> Less than 5 | <input type="checkbox"/> 5–10 | <input type="checkbox"/> 10–15 | <input type="checkbox"/> More than 15 |
| ii) Injections after DAFNE | <input type="checkbox"/> Less than 5 | <input type="checkbox"/> 5–10 | <input type="checkbox"/> 10–15 | <input type="checkbox"/> More than 15 |
| iii) Insulin pump | <input type="checkbox"/> Less than 5 | <input type="checkbox"/> 5–10 | <input type="checkbox"/> 10–15 | <input type="checkbox"/> More than 15 |

(Questionnaire continued on next page)



Appendix 1. Diabetes questionnaire (continued from previous page)

QUESTION 7. How satisfied were you with your diabetes treatment while on each treatment? (Please circle the appropriate number)

i) Injections of insulin	Very satisfied	8	7	6	5	4	3	2	1	0	Very dissatisfied
ii) Injections after DAFNE	Very satisfied	8	7	6	5	4	3	2	1	0	Very dissatisfied
iii) Insulin pump	Very satisfied	8	7	6	5	4	3	2	1	0	Very dissatisfied

QUESTION 8. Would you recommend each treatment to other patients with type 1 diabetes? (Please circle the appropriate number)

i) Injections of insulin	Yes, definitely	8	7	6	5	4	3	2	1	0	No, definitely not
ii) Injections after DAFNE	Yes, definitely	8	7	6	5	4	3	2	1	0	No, definitely not
iii) Insulin pump	Yes, definitely	8	7	6	5	4	3	2	1	0	No, definitely not

THANK YOU – Please return the completed questionnaire in the pre-paid envelope provided by the 15th of February 2010