Local implementation of a carbohydrate counting system

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ARTICLE POINTS

1 There are limitations to traditional basal bolus regimens.

2 Full DAFNE therapy is resource expensive and beyond the reach of many units and may preclude patients who cannot afford 5 days off work.

3 Small group teachings with close follow-up for two to four sessions were set up.

4 Glycaemic control and patient satisfaction at 1 year were directly comparable to published data, and with no additional funding or manpower.

5 Follow-up beyond 1 year essential to monitor sustainability of the programme.

KEY WORDS
- **Dose adjustment**
- **Carbohydrate intake**
- **Basal bolus regimen**
- **Blood glucose testing**

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Introduction

Empowering people with type 1 diabetes to take active participation in adjusting insulin dosages according to carbohydrate intake is an important part of improving diabetes control. We developed a programme to achieve this, using directed learning, in a shorter timeframe than other similar programmes. An improvement in HbA_{1c} in the order of a 1% reduction at 1 year was observed. This programme might offer an alternative to the 5-day concentrated education programmes for some people.

Following recognition of the benefits of insulin dose adjustment according to carbohydrate intake (Pieber et al, 1995) and the arrival of short-acting insulin analogues, formal protocols for dose adjustment have been introduced in many areas. In Guernsey (population approximately 60 000) a trial of such a protocol has now been underway for 16 months. Results from this small island population match the positive outcomes achieved by other centres, despite a more flexible approach. The patient training system is resource friendly in terms of manpower and financial expenditure.

It has been suggested that there should be uniformity in the adoption of dose adjusted regimens in order to evaluate outcomes effectively (DAFNE Study Group, 2002). However, there is an implicit assumption in this argument that very prescriptive and intensive courses are the most effective means to educate patients. Our experience with a small, but demanding population, is that in order to reach not only highly motivated patients, but also a broad cross-section of the population with type 1 diabetes, training should be flexible, succinct and impinge as little as possible into patients' working lives.

Limitations of the basal bolus regimen

The limitations inherent to the basal bolus regimen are well known. For many, this approach has not encouraged patients to take ownership of their diabetes management and to be truly flexible with insulin doses. Many individuals have adjusted their insulin doses to some extent, but lack any underpinning rationale. This often produces variable results, leading to feelings of frustration and disheartenment.

Local carbohydrate counting initiative

In Guernsey, the limitations of traditional basal bolus regimens and major developments in insulin and continuous insulin infusion therapy (CSII) prompted us to initiate a local programme for a more logical attitude towards insulin dosage and carbohydrate intake. The basic principle is the use of a baseline or background insulin, with calculation of bolus doses of rapid-acting insulin analogues according to carbohydrate intake. In addition, a correction bolus protocol is used to deal with glycaemic excursions.

Patients were recruited into the local programme from the diabetes clinic. A brief explanation of the system and requirements was given, and a more detailed information pack and enrolment instructions were sent to interested patients. Most of those recruited were already using a multiple injection regimen, but all had to satisfy the criteria of practising regular blood glucose testing.

Method

An initial 40 minute session with the dietitian, using groups of three to four people with their partners, allowed patients

Name **Date**

PROFORMA

Your current (average) total daily dose of insulin is ..... units
50% of this will be given as twice daily isophane (cloudy, long lasting insulin) making this ..... units at breakfast and ..... units at bedtime

Your insulin sensitivity factor (83/TDD insulin) = ... This indicates that an extra one unit of insulin lispro or Novorapid will drop your blood glucose approximately ..... mmol/l, when used as a correction bolus

You should use correction boluses when your blood glucose is >..... mmol/l and you should aim to correct to ..... mmol/l
For example, if your blood glucose was ..... mmol/l, correcting to ..... mmol/l would require ..... units of lispro/Novorapid insulin

Correction boluses should be timed, where possible and practical, with food/boluses
1) Your primary insulin to carbohydrate ratio is ..... units per 15 g portion
2) Your secondary insulin to carbohydrate ratio is ..... units per 15 g

Figure 1. A sample copy of the proforma given to each patient

to take on board the basics of carbohydrate assessment. Patients were asked to buy food weighing scales, and were given information booklets with typical portion data. They were asked to complete a food diary with their carbohydrate calculations and returned the following week to a multidisciplinary clinic to analyse them. This allowed discussion of any issues or problems that had arisen. A small number of patients required further help, but most had grasped the main principles very quickly and were then ready to progress to the next stage of insulin dose adjustment.

The proforma

Each patient was given a proforma designed to be an individual guide to the new style therapy of dose adjustment. It is divided into three sections. The first section sets the background insulin dose by using half of the original total daily dose (TDD). Initially, this was twice-daily isophane insulin, although many patients now use once-daily insulin glargine.

The second section determines the individual's insulin sensitivity factor, as calculated for continuous insulin infusion therapy, i.e. 83/total daily dose (*Figure 1*). This provides an easy method of estimating how much insulin a patient needs to reduce their blood glucose by 1 mmol/l. Patients can then calculate correction boluses if their blood glucose reading is too high. Initially, this is set at 14.0 mmol/l or over and is reduced incrementally as the patient becomes increasingly confident with the new process of dose adjustment. Patients are advised to give any necessary correction bolus at meal times by adding it to the meal time bolus.

The third section of the proforma specifies the number of units of quick-acting insulin analogue required for 15 g of carbohydrate in each meal. Initially, an arbitrary figure of 2 units per 15 g is set until individual requirements can be properly evaluated.

Follow-up care

For at least the first week, patients complete diaries in which they detail their blood glucose levels (at least four readings per day), carbohydrate intake, the calculated bolus doses of insulin, and any correction bolus used. Patients then return at weekly intervals on two or three occasions, where the following criteria are checked: the dose of background insulin, the adequacy of the bolus doses for meals and the suitability of the correction bolus system. Throughout the conversion, patients are encouraged to send queries by phone, fax or e-mail at any time.

Once patients feel confident, they are returned to routine diabetes clinic review 3 months after starting the programme. HbA_{1c} levels are checked at 6 and 12 months.

PAGE POINTS

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2 Each patient was given an individual guide to the new style of dose adjustment.

3 Patients returned to the clinic at weekly intervals on two or three occasions to check the suitability of the correction bolus system.

4 Patients were encouraged to send queries by phone, fax or email at any time during the conversion.

PAGE POINTS

1 64% of patients had at least a 1% reduction in their HbA_{1c} at 1 year (or 10% reduction of the initial figure if the HbA_{1c} was greater than 10%).

2 There was no change in the HbA_{1c} values of 30% of patients and 6% had a deterioration of their HbA_{1c}.

3 A total of 65% of patients reported a high degree of satisfaction with the programme.

4 This user friendly system may also be more attractive to the 'difficult to reach' and adolescent group than longer and more formal regimens.

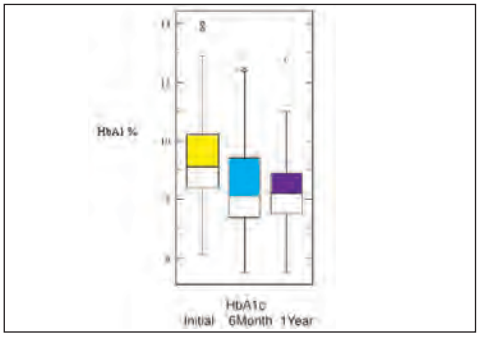

Figure 2. Comparison of HbA_{1c} levels of 45 patients over the conversion period

Outcomes

A total of 84 patients received the initial information pack. Data is analysed here on 45 patients at 1 year. Twenty-nine patients (64%) had at least a 1% reduction in their HbA_{1c} at 1 year (or 10% reduction of the initial figure if the HbA_{1c} result was greater than 10%). There was no change in the HbA_{1c} values of 13 (30%) patients and 3 (6%) had a deterioration of HbA_{1c} (*Figure* 2). In addition, 11 transferred to CSII. This subgroup will be subject to further study. Fourteen patients dropped out. The timescale for the conversion of patients to this system was measured in units of professional time (UPT), a unit being 15 minutes. On average, six UPTs were required to successfully convert most patients.

Further analysis of the data is underway, in particular whether weight gain is a problem and the incidence of troublesome hypoglycaemia. Anecdotally, one patient had profound hypoglycaemia with loss of warning signs and has since transferred to a pump. Initial indications are that there has been no significant weight gain in any patient and three patients have lost weight as their insulin regimen has become more effective, leading to a reduction in total insulin dosage. A total of 65% of patients reported a high degree of satisfaction with the programme on a local questionnaire.

Discussion

The UK DAFNE trials were based on a comprehensive and intensive educational programme, which places considerable demands on patients and professionals alike. This method, pioneered in Germany, has been shown to be effective at 1 year in terms of lowered HbA_{1c} and improved patient wellbeing. The drawbacks to this system are the substantial resources needed in terms of manpower and money. The Guernsey programme does not include a full educational package but is a skills based process designed to empower patients to manage their diabetes by adjustment of insulin dosage according to carbohydrate intake. Evaluation at 1 year, however, showed that the trial achieved similar results to the main DAFNE centres in reduction of HbA_{1c} levels. The timeframe within which this was achieved was on average six UPTs compared with a possible 80 UPTs in the DAFNE centres. Feedback from our patients is extremely positive, and no extra funding or manpower was needed.

As with other intensive trials for the management of diabetes (DCCT, 1993) there are encouraging results whilst professional input is high. Following outcomes beyond 1 year is therefore essential to test the sustainability of all the systems in use.

The patients who enrolled in the programme were a cross-section of the island population from fishermen to merchant bankers, the majority from Guernsey but some from outlying islands. These geographical factors plus the local employment legislation would have made attendance at a 5-day course difficult or impossible for many of our recruits. Such difficulties would not be confined to Guernsey.

Conclusions

Our carbohydrate counting system has produced outcomes that are comparable to published data and is resource friendly. It is based on directed learning techniques derived from CSII training and is an effective tool for patients who are happy with subcutaneous insulin. It is also a valuable learning strategy for prospective pump users. This user friendly system may also be more attractive to the 'difficult to reach' and adolescent group than longer and more formal regimens. Further reporting of results beyond 1 year will lend credence to the sustainability of the system as a reliable alternative to offer the population with type 1 diabetes. ■

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