Comparison of Insulin Pump and Multiple Daily Injection Regimens in Type 1 Diabetic Patients

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Abstract

This study was conducted to assess the efficacy and effectiveness of CSII therapy in type 1 diabetic Saudi children and to compare it with multiple daily injection (MDI) of insulin.

Intensive insulin therapy was initiated in 22 type 1 diabetic Saudi children. CSII was started in 14 children through insulin pump therapy between October 2002 and December 2004 and 8 patients were started on MDI, which included bedtime glargine (Lantus®) and premeal lispro (Humalog®) insulin injections between May 2004 and December 2004.

The children on CSII and MDI therapy were followed for a mean duration of 12 months and 9 months respectively. There was a significant reduction in HbA1c and mean blood glucose level during CSII and MDI therapy compared with CI therapy, however the reduction in HbA1c among children on CSIItherapy was more significant in comparison to MDI therapy.

Intensive insulin therapy by either CSII or MDI is efficacious in improving the glycemic control in type 1 diabetic Saudi children. CSII therapy had more favorable effect on HbA1c reduction than MDI therapy in this group of patients.

Introduction

Since the introduction of CSII in the late 1970s, it has become apparent that the use of insulin pump therapy has many potential benefits for children with type 1 diabetes. It offers a more physiological way to deliver insulin and, therefore potentially improves the longterm outcome [1]. Several studies showed that insulin pump therapy improves glycemic control and decreases episodes of recurrent DKAs [2]. Some recent reports showed that lower HbA1c was more achievable with CSII than with glarginebased MDI treatment [3]. To our knowledge, this is the first study that compares the use of insulin pump therapy in Saudi children with MDI therapy.

Methods

Twenty two children with type 1 diabetes were selected for intensive insulin therapy. Selection criteria included diabetic children with poor diabetic control who had HbA1c above 8.5%, those who are willing to monitor blood glucose frequently and willing to count carbohydrates. All patients were followed up at the Diabetes Clinic at King Faisal Specialist Hospital and Research Center. All patients were on CI therapy that included two injections of insulin per day; NPH and regular insulin before shifting them to CSII or MDI according to patient and family preference.

Fourteen Saudi children with type 1 diabetes mellitus were selected and started on MiniMed® insulin pump therapy between October 2002 and December 2004. Eight patients were started on MDI, which included bedtime glargine (Lantus®) and premeal lispro (Humalog®) insulin injections between May 2004 and December 2004.

All patients were initially instructed to check blood glucose 8 times per day; pre and postmeals, bed time and in the early morning for the first few months of CSII initiation, and then 5 times of blood glucose monitoring were required. All patients were trained by a diabetic dietitian on carbohydrates counting and food nutrition labels reading.

Statistical analyses were performed using the paired comparison T test to evaluate the differences between CSII, MDI and CT treatment levels of HbA1c and blood glucose levels. The tests were two tailed and p value of <0.05 was taken as significant.

Results

All patients had type 1 diabetes mellitus for a mean duration of 6 years (range from 2 to 12 years). The age of the children on CSII ranged from 4 to 16 years (mean 12.8). They were followed on insulin pump therapy for a mean duration of 12 months (range from 2 to 26 months). The age of the children on MDI ranged from 7 to 12 years (mean 9). They were followed up on MDI therapy for a mean duration of 9 months (range from 8 to 13 months).

During the 12 months prior to insulin pump therapy initiation, the mean HbA1c was 10.2 % + 1.2 and the mean blood glucose level was 233 mg/dl + 39. Six months post insulin pump therapy, the mean HbA1c dropped to 7.5 % + 0.7 ($p < 0.0001$) and the mean blood glucose level improved to 156 mg/dl + 32 ($p < 0.0001$).

The second group of children who decided to be on MDI therapy had a mean HbA1c of 10.1% + 1.2 and a mean blood glucose level of 236 mg/dl + 40, prior to MDI initiation. Six months post-MDI, the mean HbA1c dropped to 8.5 % + 0.5 ($p < 0.0005$) and the mean blood glucose level improved to 176 mg/dl + 30 ($p<0.006$). Mean HbA1c reduction was 2.7% in CSII treatment group, however in MDI regimen the mean HbA1c reduction was 1.6% ($p<0.016$).

Discussion

Several reports suggest that nearnormal glycemic control prevents or delays complications of diabetes, which has led to dramatic increase in CSII orMDI use. However, the number of insulin pump users among Saudi children or those on glarginebased MDI treatment is still small. Lack of patient/family motivation, health care team enthusiasm and proper technical support are among the contributing factors for that. In this article, we report our experience with 22 Saudi children who were selected and started on either CSII or MDI treatment regimen and proved that both modalities are extremely effective in treating type 1 diabetic Saudi children.

Several studies showed that intensive diabetes management with CSII is a durable and effective means of optimizing glycemic control in pediatric patients [4] and may be superior to MDI [5]. However other reports showed no significant difference in metabolic control between the two modalities of intensive insulin therapy [6]. In this trial, we observed that the glycemic control and HbA1c are significantly better in CSII group of children. We believe that CSII regimen is more practical for Saudi children than MDI therapy because of wide inconsistency in eating habit and frequent snaking that cannot be covered by MDI regimen.

Hypoglycemia is a serious risk associated with intensive therapy and occurs with both CSII and MDI. Early studies suggested that the risk of hypoglycemia with CSII was greater or similar to that of conventional diabetes management and MDI [7]. More recently, however reports have suggested that severe hypoglycemia may be reduced by CSII as much as 4 fold compared with MDI treatment with no reduction in glycemic control [8]. None of our patients in this study developed disabling hypoglycemia such as hypoglycemic coma or convulsion on MDI or CSII therapy.

Among the possible hazards of CSII is the susceptibility of these patients to rapidly develop attacks of diabetic ketoacidosis (DKA). Children on CSIIhave reduced tolerance to the interruption of CSII due to relatively small amount of insulin deposited in the subcutaneous tissue. Several studies showed that DKA is more common in CSII patients than in those using CI therapy [9]. In our group of patients none of them develop DKA on CSII or MDItherapy requiring hospital admissions or emergency room visits. Mild episodes of DKA were successfully managed at home by increasing the rate of basal insulin infusion in insulin pump patients or taking extra lispro injections in MDI children.

We believe that CSII modality is more superior to MDItreatment in reducing the rate of hospital admissions secondary to DKA.

Blood glucose was controlled in the majority of children by one to 2 basal insulin infusion rates. Some of the children required a higher basal insulin infusion rate during the early hours of the morning to cover for the early morning hyperglycemia secondary to counterregulatory hormones rise (dawn phenomenon) and other children required a lower basal insulin infusion rate during the sleeping hours to avoid hypoglycemia at nighttime. One of the advantages of CSII therapy in comparison to MDI treatment that the basal insulin rates in pump therapy can be adjusted according to the patient need.

The present study showed that CSII and MDI regimens are effective in improving the metabolic control in type 1 diabetic Saudi children. The results of this local experiment are encouraging to implement these modalities of intensive insulin therapy in all candidate diabetic Saudi children.

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