ORIGINAL RESEARCH

DOES THE FREQUENCY OF THE SELF -MONITORING OF BLOOD GLUCOSE INFLUENCE GLYCEMIC CONTROL IN TYPE 2 DIABETIC PATIENTS?

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ABSTRACT

Objective: The aim of this study was to evaluate the effects of different intervals of the self-monitoring of blood glucose (SMBG) on glycemic control in a selected type 2 diabetic population.

Methods: Type 2 diabetic patients with disease duration >1 year who were on insulin treatment for at least 6 months and were already applying SMBG were included in the study. A total of 118 patients were enrolled and classified into groups based on SMBG frequencies as once in a week, once in two weeks, once in a month and not at all. At the end of the 12 weeks glycemic control was assessed with measured blood glucose and A1c levels.

Results: After 3 months of monitorization, A1c levels significantly decreased in group 1 ($p < 0.005$) and group 2 patients ($p < 0.05$) and no change or even an increase was observed in other groups. Reported hypoglycemic events were rare in all patients.

Conclusion: SMBG is important for the achievement of glycemic goals and simplifying SMBG may help to overcome problems of compliance and cost.

Keywords: Self monitoring of blood glucose, Type 2 diabetes mellitus, Glycemic control

TİP 2 DİYABETİK HASTALARDA KENDİ KENDİNE KAN GLUKOZ İZLEM SIKLIĞI GLİSEMİK KONTROLÜ ETKİLER Mİ?

ÖZET

Amaç: Kendi kendine kan şekeri ölçümü insülinle tedavi edilen tüm diyabetik hastalar için önerilmektedir. Her ne kadar tip 1 diyabetik hastalar için standart takip programları belirlenmiş ise de tip 2 diyabetik hastalar için standart bir kan glukoz takip programı yoktur. Bu çalışmanın amacı tip 2 diyabetik hastalarda kendi kendine kan glukoz ölçüm sıklığının glisemik kontrol üzerine olan etkilerini değerlendirmektir.

Yöntem: Bu çalışmaya kendi kendine kan şekeri ölçümü yapan insülin kullanan tip 2 diyabetik 118 hasta dahil edilmiştir. Hastalar kan şekeri ölçüm sıklıklarına göre haftada bir (n=49), onbeş günde bir (n=33), ayda bir (n=14) ve hiç ölçüm yapmayan (n=22) olarak gruplara ayrılmıştır. Hastalara ölçüm tekniği konusunda eğitim verildikten sonra kan şekeri ölçümlerini yaparak insülin dozlarını ayarlamaları istenmiştir. Hiç kan şekeri ölçümü yapmayan hastalardan 3 aylık dönemlerde açlık ve tokluk kan şekeri ölçümleri istenmiştir. 3 aylık takip dönemi sonunda hastalar kan şekerleri ve A1c düzeylerindeki değişim açısından tekrar değerlendirilmiştir.

Bulgular: Hastaların demografik özellikleri, kullanmakta oldukları insülin tipleri ve dozları açısından farklı olmadığı görülmüştür. Bazal A1c düzeyleri tüm grıuplarda benzer bulunmuştur. Kendi kendine kan şekeri ölçümü yapan hastaların komplikasyon oranları daha düşüktür. Haftada bir ve onbeş günde bir kendi kendine kan şekeri ölçümü yapan hastaların 3. ay sonunda A1c düzeylerinde anlamlı bir düzelme görülürken ($p < 0,001$ ve $p = 0,017$) ayda bir ölçüm yapan ve hiç ölçüm yapmayan grupların A1c düzeylerinde değişim olmamıştır.

Sonuç: İnsülin kullanan tip 2 diyabetik hastalarda kendi kendine kan glukoz ölçüm sıklığı arttıkça glisemik kontrol daha iyi sağlanabilmektedir.

Anahtar kelimeler: Kendi kendine kan şekeri ölçümü, Tip 2 diabetes mellitus

INTRODUCTION

The American Diabetes Association (ADA) recommends the self -monitoring of blood glucose (SMBG) for all type 1 and type 2 diabetic patients treated with insulin[1]. SMBG improves the efficacy of treatment and provides better glycemic targets. SMBG also prevents hypoglycemic episodes and enables a better adjustment of medications in a better way.

SMBG has been applied with different measuring intervals and different timings[2,3]. It is evident that SMBG provides better glycemic control compared to patients not measuring their blood glucose[4]. Furthermore, increasing sampling frequency increases the likelihood of better A1c levels[5,6]. On the other hand, only 39.1% of insulin-treated type

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2 diabetic patients perform SMBG daily and 10% measure blood glucose two or more times per day[7]. This shows that there is an important compliance problem. Although ADA reinforces more efforts for appropriate use of SMBG, a change in strategy is needed to increase compliance.

Data from most studies are based on daily SMBG in both type 1 and type 2 diabetic patients but the consequences of increasing the measuring intervals of SMBG is not known. The aim of this study is to evaluate the effects of different intervals of SMBG on glycemic control in a selected type 2 diabetic population.

METHODS

The study was designed as open and prospective trial with a follow-up period of 12 weeks. Subjects were recruited from the outpatient endocrinology clinic of Marmara University Hospital. The recruitment of patients was completed in three months. Type 2 diabetic patients with a disease duration >1 year who were on insulin treatment for at least 6 months and were already applying SMBG were included in the study. Patients who were unable to continue SMBG for any reason or who were on oral antidiabetic medications were excluded. Pregnant or lactating women, patients with any chronic illness, drug or alcohol abuse were also not included. The use of drugs interfering with glucose metabolism such as glucocorticoids was also a reason for exclusion. Patients were asked not to change their dietary habits during the study period. The study was approved by the Ethics Committee of Marmara University Medical School and written informed consent was given by all subjects participating in the study.

A total of 118 patients were enrolled between November 2003 and January 2004. A one week run-in period was used for the education of patients in the use of blood glucose meters

(Medisense Optium Sensor-Abbott Laboratories). Patients were instructed to measure their blood glucose as often as they could. They were then classified into groups based on SMBG frequencies as once a week, once in two weeks, once a month and not at all. They were requested to measure blood glucose four times a day, before each main meal and at bed time without changing meal intervals. Obtained values were recorded in a diary. Patients were seen every four weeks. At each visit, patients were checked for the correct use of blood glucose meters and the self regulation of blood glucose was discussed. Height, weight, body mass index were recorded at the beginning of the study and at each visit. A1c levels were tested at the beginning and at the end of 12 weeks.

Data were analyzed using a SPSS program (version 11.0). Comparisons between groups were done using Mann-Whitney test. A p value less than 0.05 was considered significant. The results were expressed as mean±SD.

RESULTS

Patients measuring their blood glucose once in a week constitute group I, once in two weeks group II, once in a month group III, not at all group IV, respectively. The demographic characteristics of the study groups are shown in Table I. Mean age of the subjects in all groups was above 60 years. Patients in group 2 were younger than patients in group 4 (64±9 vs 70±10 years, p<0.05). Sixty one percent of the patients (n=72) were women. Disease duration in group 3 was longer than others (p<0.05). Mean duration of insulin use and mean insulin doses were similar. Microvascular complications were significantly less in group II patients and were found to be increased significantly in patients who did not monitor their blood glucose (p<0,001).

Table1: Demographic characteristics of study patients

	Group 1	Group II	Group III	Group IV
Age (years)	64±9	62±10*	66±10	70±10
Sex (M/F)	36/13	12/21	9/5	15/7
Disease duration (years)	13±7*	9±6	15±7	10±7
Duration of insulin use (years)	4±3	4±3	5±4	4±3
Mean insulin dose (U/day)	43±23	44±23	49±20	48±20
Rate of complications (%)				
Retinopathy	36.7	12.5†	57.1	54.5
Nephropathy	36.7	21.8†	64.2	54.5
Neuropathy	34.6	28.1†	64.2	45.4

*p<0.05, †p<0.001. GroupI patients measuring blood glucose once in a week, Group II once in two weeks, Group III once in a month, Group IV not at all.

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Table II: Change in glycemic parameters during study

	Group I	Group II	Group III	Group IV
Rate of hypoglycemia (%)				
Basal	12*	6†	0	0†
Week 12	2*	3†	0	4†
A1c (%)				
Basal	7.3±1.4	7.4±1.3†	7.8±1.2	7.8±1.1
Week 12	6.5±0.6	6.9±0.7†	6.8±1.3	6.8±1.6

P<0.005, †p<0.05, Group I patients measuring blood glucose once in a week, Group II once in two weeks, Group III once in a month, Group IV not at all.

Baseline A1c levels were above 7% in all groups, without a significant difference between groups. After 3 months of monitorization, A1c levels significantly decreased in group 1 (p<0.005) and group 2 patients (p<0.05) and no change or increase was observed in other groups. Changes in A1c levels were similar in group I and II (Table II). The reduction in A1c levels was more prominent in women than in men (p<0.05). A1c levels improved as patients' education status increased (p<0.05). Patients who had had at least one microvascular complication had A1c levels higher than those who did not (p<0.05). On the other hand, A1c levels were improved by frequent monitorization even in these complicated patients (p<0.05). Reported hypoglycemic events were rare in all patients and were almost equal in each group. A significant decrease was observed in hypoglycemic episodes in group I (Table II).

DISCUSSION

The results of this study confirm the importance of SMBG in insulin-treated type 2 diabetic patients. Glycemic control improves as frequency of monitorization increases. These results are in accordance with previous studies [2,3].

SMBG is recommended for all type 1 and insulin using type 2 diabetic patients in the ADA annual revisions. It is stated that SMBG should be an integral component of diabetes therapy and should be included in the management plans [1]. Most of the major clinical trials point out that tightness of glycemic control plays a central role in the prevention of both microvascular and macrovascular complications in type 1 and type 2 diabetes mellitus [8,9]. Most of these trials include and recommend SMBG as part of the treatment plan. Besides providing tight glycemic control, SMBG also allows patients to self monitor their response to treatment. Being a part of treatment can increase the compliance of patients. In addition, SMBG may help to prevent hypoglycemic episodes and allows management of treatment plans.

The frequency and timing of SMBG change with the needs of the patients to achieve glycemic targets. ADA recommends 3 or more blood glucose measurements per day for type 1 and gestational diabetic patients [1]. There is no optimal frequency of SMBG in type 2 diabetic patients. It is recommended that SMBG should be frequent enough to facilitate the achievement of appropriate glycemic control and prevent hypoglycemia [1]. Most of the studies done with type 2 diabetic patients demonstrate that SMBG provides better achievement of glycemic targets. These studies suggest that the frequency of SMBG should be at least once daily and indicate that better glycemic control is achieved as the frequency of measurements increases. There is no data on the effect of less frequent measurements on glycemic control. This is the first study investigating the outcome of various sampling intervals and showing that sampling once in one or two weeks improves glycemic control in a short period of time. The results of this study are important and should be carefully interpreted. It does not deny the importance of more frequent monitorization. SMBG with more frequent intervals provide a better control but increasing the frequency may lead to poor compliance. Only 10% of patients do the samplings two or more times per day irrespective of glycemic status [7]. In our study, compliance was 100%. Another important problem is acquirement of test strips. Only 20% of type 1 diabetics and 17% of insulin treated type 2 diabetic patients obtain enough test strips to measure their blood glucose [3]. This may be an important issue when state insurance reimburses only one test strip per day for insulin dependant type 2 diabetic patients. Considering the problem of compliance, measurement of blood glucose at least once in two weeks with four measurements per day would be a relevant message of this study.

Limitations of this study are brief study duration, small sample size and having no group performing daily SMBG. Furthermore the results

cannot be extrapolated for a longer term. This study should be verified with future studies that take into account these limitations.

In conclusion, SMBG is important for the achievement of glycemic goals and this can be attained by measuring blood glucose at least once in two weeks, with four measurements done on each day. Since poor compliance and failure to reimburse test strips may be an obstacle in reaching glycemic targets, simplifying SMBG should be an important and prior issue for physicians.

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