Full Length Research Paper

Diabetes Objective Control and Education (DOCE) Project Study: Continued education and multiprofessional care in type 1 diabetes contribute to long-term glycemic control?

Mirnaluci Paulino Ribeiro Gama[1,2]*, Marcelo Bettega[3], Aniele Cristine Ott Clemente[3] and Lucianna Ribeiro Machado Thá[1]

[1]Endocrinology Service, DOCE Project Outpatient Clinic of the Hospital Universitário Evangélico de Curitiba, Curitiba, PR, Brazil. *Corresponding author. E-mail: mirnaluci.gama@yahoo.com. Tel: +55 41 33363952.
[2]Endocrinology Service and Diabetes Unit of the Hospital Universitário Evangélico de Curitiba, Curitiba, PR, Brazil.
[3]Depatment of Internal Medicine, Hospital Universitário Evangélico de Curitiba, PR, Brazil.

The purpose of this study was to assess the effectiveness of continued education and multiprofessional care for type 1 diabetes mellitus patients as a strategy for long-term glycemic control evaluated by glycosylated hemoglobin (A1C) levels. This study is a retrospective, observational study of the Diabetes Objective Control and Education (DOCE) Project. A group of 74 patients accompanied by family member attended multiprofessional appointments and an epidemiologic profile of the group was created. The analyzed variables were age, body mass index (BMI), height, duration of disease, age at diagnosis, duration of follow-up, current and baseline A1C, and the relationship between the period of follow-up and the variation in A1C. Mean age at diagnosis was 10.4±7.3 years, and duration of disease was 5.6±6.3 years. Mean age was 16±9.3 years, while mean BMI was 20.3±5.3. Mean duration of follow-up was 27.5±15.6 months. Baseline and current A1C were 10.5±1.8 and 8.2±1.7, respectively. A significant reduction in A1C was observed with the follow-up by the DOCE Project (p=0.00436). Other significant correlations were found between duration of treatment and reduction of current A1C (p=0.00000001) and duration follow-up and A1C reduction (p=0.00000003). Continued education and multiprofessional care for type 1 diabetes mellitus patients is an effective method for long-term glycemic control.

Key words: Diabetes mellitus, glycosylated hemoglobin (A1C), education, glycemic control.

INTRODUCTION

Type 1 diabetes mellitus (DM1) accounts for 10% of all cases of diabetes worldwide (Halimi and Benhamou, 2004). Incidence rates varying between 7.6 and 12.6/100,000 were found in two studies conducted in Brazil (Campos et al., 1998; Ferreira et al., 1993).

In DM1, as demonstrated by several studies including the Diabetes Control and Complications Trial (DCCT), adequate glycemic control along with glycosylated hemoglobin (A1C) levels <7% prevents chronic micro-angiopathic complications (The Diabetes Control and

Complications Trial Research Group, 1993). However, the low socioeconomic status of the population and the limited education of the patients view about disease and its complications are some of the factors that hamper glycemic control and increase the mortality rates deriving from those complications (Secrest et al., 2011). Therefore, a multidisciplinary approach is critically important in the follow-up of this chronic disease, for patient motivation, improved control and fewer hospitalizations, and the psychological aspects of the disease, thus improving patient quality of life (Laron et al., 1979).

Education about the disease is one of the key to a good control. The insulin-dependent patient with diabetes needs to be educated in order to adjust insulin dosage in the context of a healthy diet without prohibitions. The Diabetes Objective Control and Education (DOCE) Project study is based on the Dose Adjustment for Normal Eating (DAFNE) study, which educates patients with diabetes to live with their illness freely along with quality of life (DAFNE Study Group, 2005).

Previous experiences have shown that education regimens for type 1 diabetes patients are effective in reducing A1C values. However, continued education is indispensable for sustaining the reduced values (Koplatadze et al., 2003; Santiprabhob et al., 2008). Therefore, the aim of the present study was to assess whether type 1 diabetes patients participating in a continued, longer education project at a teaching hospital show better glycemic control and lower A1C levels.

RESEARCH DESIGN AND METHODOLOGY

The present study is a retrospective, observational study to assess the effectiveness of continued, guided education for patients with DM1 for long-term glycemic control. The database of the DOCE Project Study (Diabetes Objective Control and Education, Portuguese form of Diabetes Control and Educational Purpose) of the Hospital Universitário Evangélico de Curitiba was used. The DOCE study comprises two arms: a control group constituted by patients who refused to participate in the study and are seen in the outpatient clinic of the Endocrinology and Diabetes Service at the Hospital Universitário Evangélico de Curitiba and the strict control group with consultations with a multidisciplinary team every three months on an ambulatory basis. The end point of the study is education-discipline in managing the disease as demonstrated by reduction and stability in A1C values.

The medical visits focus on education and a review of all aspects of the disease with the patient, always in the presence of the family. The individual and his or her family are encouraged to clear all their doubts about the application of insulin, doses, handling and maintenance of the pens, doses and interactions with other indefinite-use medications. At each visit, patients blood glucose

values are discussed along with hypoglycemic and/or hyperglycemic episodes and their determinants. These data are related to the current insulin treatment and eventual improvements or deteriorations in the weight-for-stature curves and in glycemic control, as well as complaints reported by the patients or relatives. The study was approved by the Ethics Committee of the Hospital Universitário Evangélico de Curitiba.

A total of 74 patients constituted the sample of the DOCE Project in Curitiba. In order to create the epidemiologic profile of the patients, patients gender, age, family history, age at diagnosis, duration of disease, height, body mass index (BMI), duration of project follow-up, baseline and current A1C were also analyzed. The relation between the variation in A1C during the study period and the duration of follow-up was also assessed. The data were collected from the medical records of the DOCE Project at the Hospital Universitário Evangélico de Curitiba. The statistical analysis was performed with the aid of GraphPad Prism 5 software.

Simple frequency charts as well as Pearson linear correlation test and Student's t test for numerical variables and paired data were used in the analyses. For all comparisons, the level of significance was set at 5%.

RESULTS

Out of the 74 patients in the project, 45.9% have family history of diabetes. The mean age at diagnosis was 10.6±7.316 years. In total, 56.8% of the patients were diagnosed after an episode of diabetic ketoacidosis. Duration of disease ranged from 0 to 30 years, with an average of 5.65±6.352. Thirty-one patients (41.9%) were female and 43 (58.1%) were male whose age ranged from 5 to 51 years, with an average of 16.07±9.387 years. Marked concentration of patients in the second and third decades of life can be observed as shown in Figure 1.

With regard to anthropometric values, height ranged from 1.11 to 1.78 m (mean, 1.52 m; standard deviation (SD), 0.1936) and the BMI ranged from 12.9 to 45.5 (mean, 20.3; SD, 5.3575) were observed.

The follow-up period in the project ranged between 4 and 64 months (mean, 27.5±15.644 months). As shown in Figure 2, a large proportion of patients had more than one year follow-up, which means a minimum of 12 appointments.

Baseline and current HbA1C showed a mean decrease of 2.3131. Student's t test yielded a p-value of 0.00436, indicating a significant decline. The differences between values are given in Figure 3.

In order to assess the influence of treatment duration on the reduction of A1C, these two variables were analyzed. The comparison of the A1C values in the different lengths of time of the project reveals a correlation of 49.7%

Table 1. Correlation between HbA1c and duration of treatment.

Parameter		Baseline HbA1C	Current HbA1C	Variation in HbA1C	Duration of project (months)
Baseline HbA1C	Pearson correlation	100.00%	49.70%	56.70%	1.40%
	Level of significance	-	0.0000067	0.0000001	0.907
	Sample	74	74	74	74
Current HbA1C	Pearson correlation	49.70%	100.00%	-43.30%	-60.60%
	Level of significance	0.00001	-	0.00011	0.00000001
	Sample	74	74	74	74
Variation in HbA1C	Pearson correlation	56.70%	-43.30%	100.00%	59.00%
	Level of significance	0.00000014	0.00011459	-	0.00000003
	Sample	74	74	74	74
Duration of Project (months)	Pearson correlation	1.40%	-60.60%	59.00%	100.00%
	Level of significance	0.907	0.00000001	0.00000003	-
	Sample	74	74	74	74

Mean=16.07
Std. Dev.=9.387
N=74
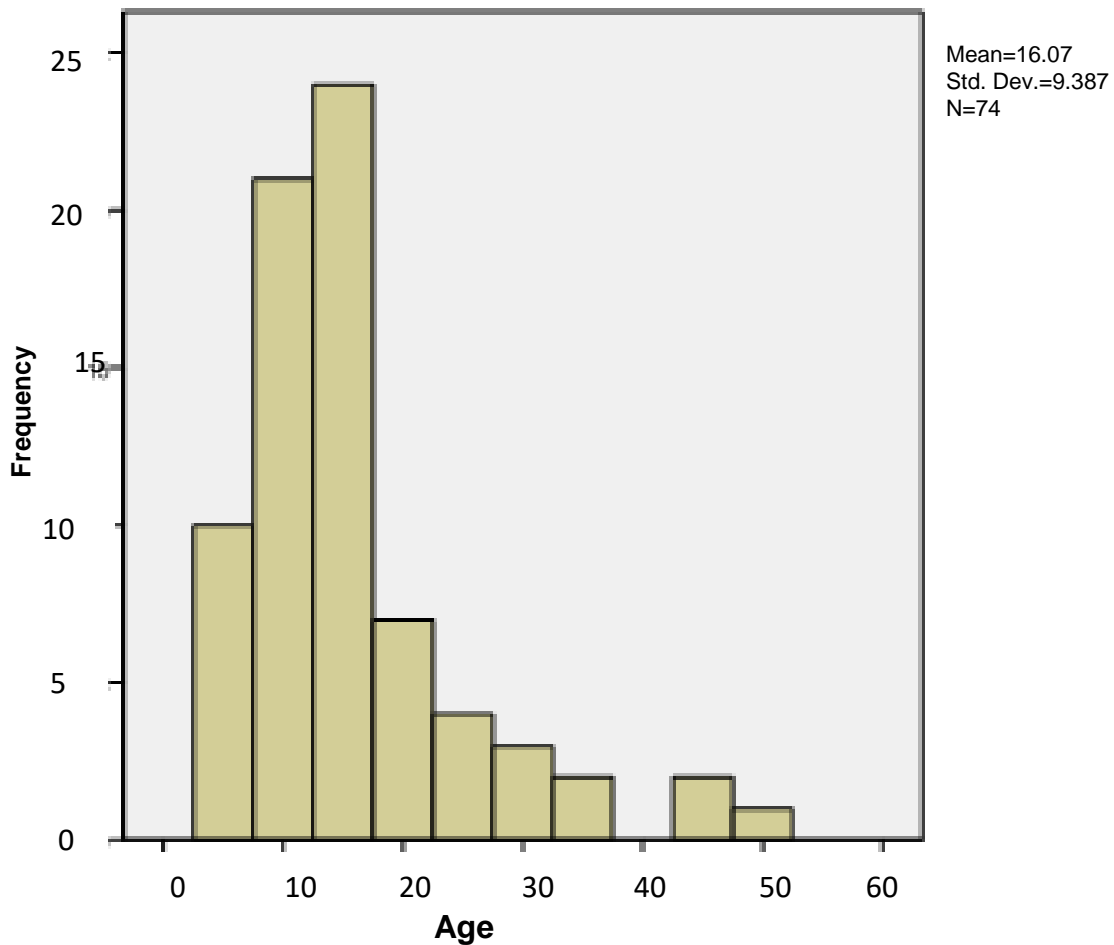
Figure 1. DOCE Project patients divided by age (shown in years).
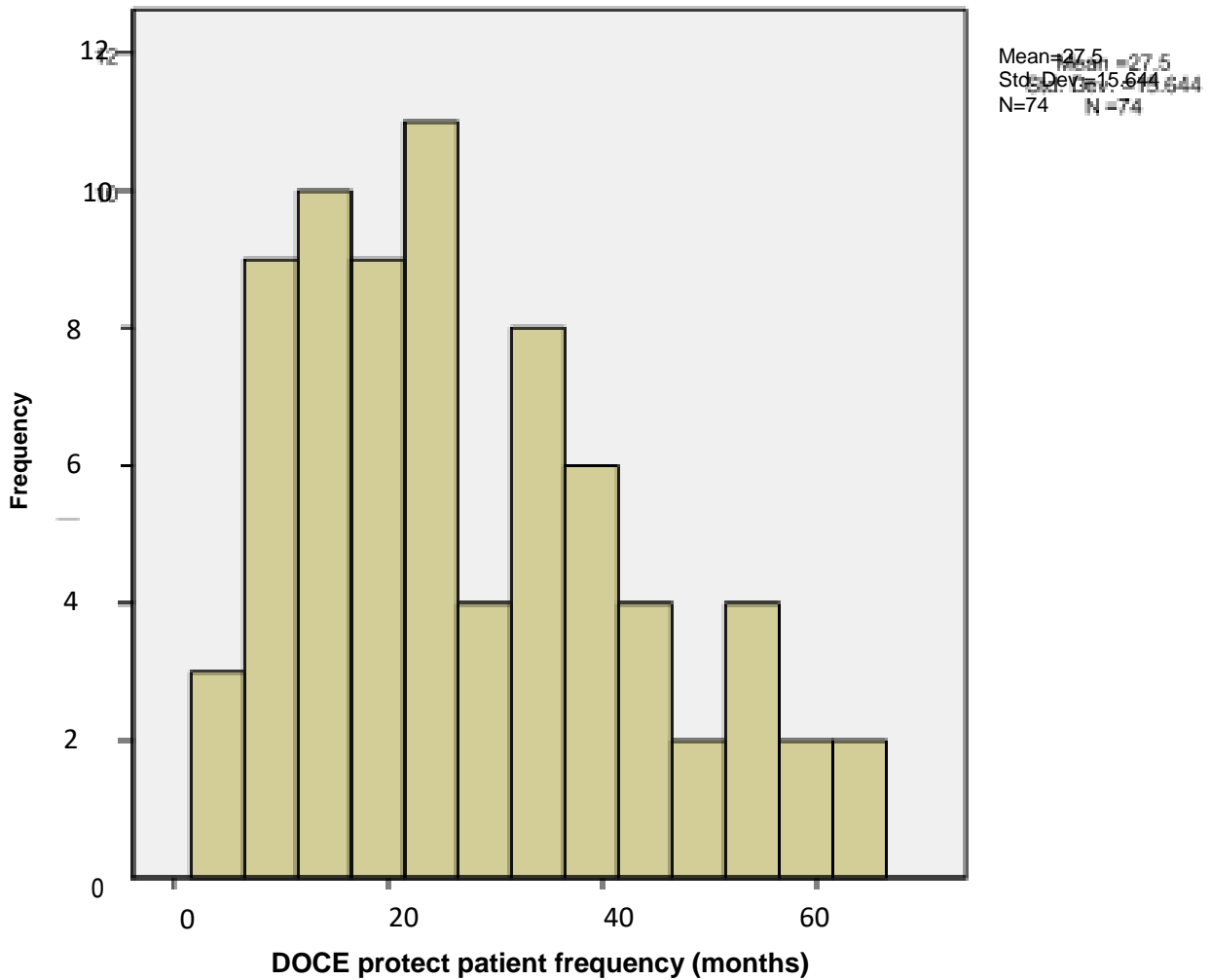
Mean=27.5
Std. Dev.=15.644
N=74

Figure 2. DOCE Project patient frequency (shown in months).

between baseline and current A1C (p=0.00001) concluded that patients participate in the project beginning treatment with higher A1C levels. On the other hand, a statistically significant (p=0.00000014) correlation of 56.7% between baseline A1C and the reduction in A1C found in the present study indicates that patients who initiate treatment with higher A1C values tend to show greater reduction.

Therefore, it is possible to infer that patients starting follow-up with higher baseline values exhibit a greater decrease; however, they still show elevated values when compared with the average. When relating A1C levels to length of follow-up, a significant correlation of -60.6% (p=0.00000001) is observed. A statistically significant (p=0.00000003) correlation of 59% between duration of project and A1C reduction was found as well. This confirms that the longer the duration of treatment, the greater the reduction in A1C levels.

DISCUSSION

The DCCT study had established the basis for glycaemic control in DM1, relying on a multiprofessional approach, The DCCT study had established the basis for glycemic control in DM1, relying on a multiprofessional approach, attitudes and patient-centered education (The Diabetes Control and Complications Trial Research Group, 1993; Brink et al., 2002; Leite et al., 2008).

Despite the recent and continuous advances in knowledge, majority of the patients with DM1 shows unsatisfactory glycemic control ((Silveira et al., 2001). Similarly, only 74% report adherence to dietary measures recommended for DM1 ((Diabetes UK, 2004).

Educational programs on DM1, aimed primarily at prevention and prevention plays a key role in the management of the disease. Given that only 20% of the children and adolescents manage to achieve A1C levels
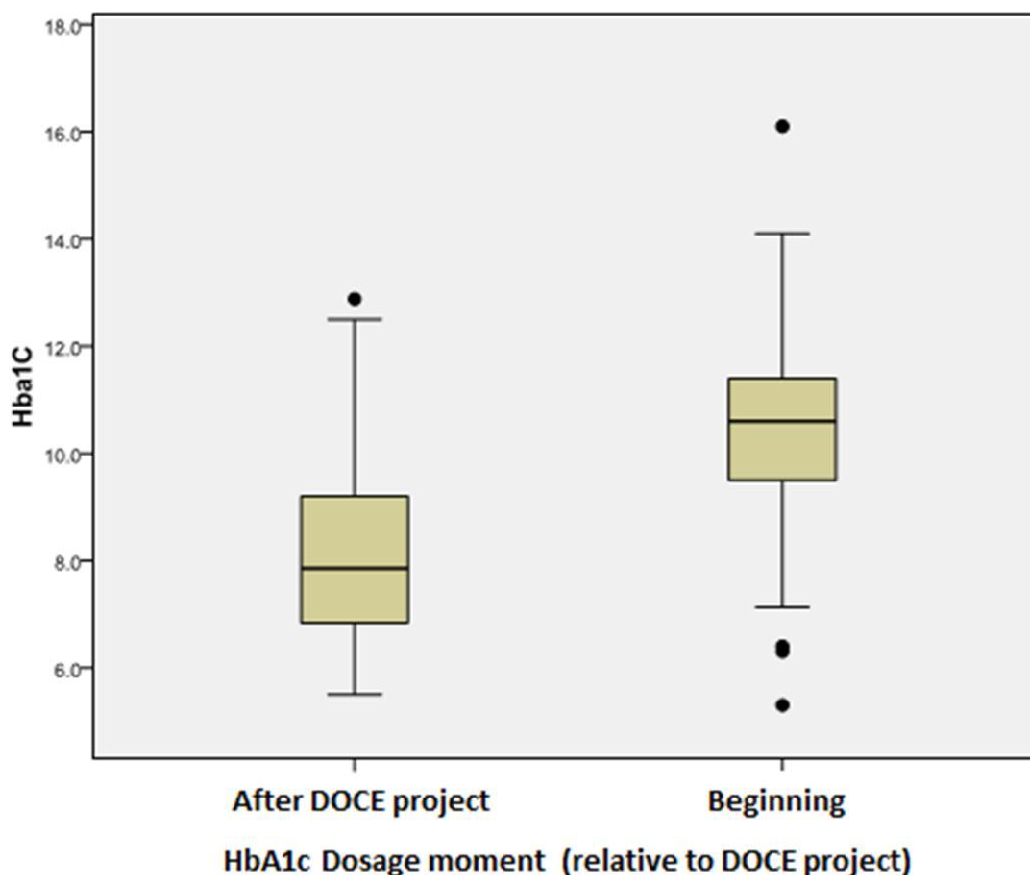
Figure 3. DOCE Project patients A1C values after and before the Project (shown in %).

< 7.5%, while 48% of them have A1C > 9%.

In view of this challenging scenario, patient care should rely on their ability to interpret their own test results, identify biorhythm patterns in glycemic control and find ways to ensure adequate physical activity and diet. These measures increase the success rate of the treatment (The Diabetes Control and Complications Trial Research Group, 1993; Brink et al., 2002). The family is instrumental in the success of the treatment and should always be included (Leite et al., 2008).

The literature also refers to the individualization of specialized medical follow-up and interaction with the patient's family as factors of good compliance with non-pharmacological measures, such as the required diet. A total of 82% of the patients who follow a diet stated that their meal plan was introduced by a trusted specialist; this rate is statistically significant (Silveira et al., 2001).

Despite these well-established foundations, no effective standardized educational program for DM1 exists on a world level (Norris et al., 2001). The major studies in this field combined educational and behavior intervention, adapted to patient's sociocultural setting, coupled with support for intensive insulin treatment

(Norris et al., 2001; Murphy et al., 2006). In that sense, the individualized approach proved superior in terms of glycemic control compared with the group treatment when the same methodology of clinic visits was used (Rickheim et al., 2002).

In this context, the DOCE Project emerges as an educational program aimed at changing the approach to DM1 patients, in a study based on the largest city in Southern Brazil.

Our DM1 patients are mostly children or adolescents. This age group demands intensive educational assistance so that independence and self-reliance are developed for greater efficacy of the therapeutic approach. The initial approach, immediately after diagnosis, is essential, since treatment tend to be established over the first years following diagnosis; resistance to changes increase over the course of the disease (Delamater et al., 2007).

Nascimento et al. (2011) in a nationwide study, reviewed available data in the literature concerning factors that influence the adequate management of type 1 DM from the children's perspective. They reported lack of knowledge and the fear of prejudice as negative factors for the appropriate management of DM1. The importance of multiprofessional,

individualized follow-up in this age group is emphasized, since the literature reports moderate depression and anxiety in school children diagnosed with DM1 (Delamater et al., 2007). Follow-up in the school should be closely monitored, in order to establish an environment of encouragement and trust (Diabetes UK, 2004).

Even for adolescents, the interaction between patient, family and school environment shows positive results, which are more favorable as the patient's independence is encouraged and they feel that the responsibility for the management of the disease can be shared (Wysocki et al., 2001).

Considering that we have adult patients, it is worth noting that managing these patients may not be simpler than managing younger individuals, as is often thought (Leite et al., 2008). Adults show resistance to learning techniques and even to the professional-patient interact-tion that is attempted over the course of the appointments.

The psychological aspect is further characterized by the high prevalence of depression as a comorbidity, with 25 to 70% (Fisher et al., 2007). In light of these facts regarding the behavior of patients with diabetes towards their illness, we have established a *motto* of diabetes for the diabetic-living with quality of life and guided freedom as in the DAFNE study of the United Kingdom.

Many authors highlight the difficulty in maintaining adequate levels of A1C, even in centers of reference (Jose et al., 2009). Other previous national and international studies also demonstrated the inadequacy of the treatment for young patients (Liberatore Junior et al., 2008; Paulino et al., 2006; Weyhreter et al., 2008). The literature conspicuously lacks results for long-term glycemic control in these patients in the absence of a supportive educational program. We believe that such scenario can be changed with the implementation of educational programs following proper methodology for handling glycemic control over the long term and promoting multidisciplinary support for patients and their families, as is the case with the DOCE Project, and in accordance with guidelines of the International Diabetes Center (IDC) (Strock et al., 2004).

Weight control in the face of a more liberal diet with education

The BMI of our patients ranged from 12.9 to 45.5 (mean, 20.3±5.3575). Overweight, diagnosed as BMI between 25 and 29.9 kg/m^2, was found in 32.43%, while obesity, defined as BMI > 30 kg/m^2, was present in 8.1% of the patients.
In a study with 170 DM1 patients including adults, adolescents and children, overweight was found in 21% and obesity in 2.9% of the patients (Moraes et al., 2006). According to Arcanjo et al. (2005) who evaluated 72 patients with DM1, mean age of 22.72±9.60 years, the

BMI of these DM1 patients averaged 21.1±3.1 kg/m^2. Marques et al. (2011) noted BMI above normal in 14.1% of the patients in a study with 84 subjects with DM1, 90% of whom had inadequate glycemic control. Liberatore Junior et al. (2008) recorded a 16% prevalence rate of overweight in the DM1 patients.

The SEARCH study reported that 34% of the adolescents with DM1 presented with overweight or obesity, a similar rate as for the young patients that did not have diabetes (33%) (Liu et al., 2010). A Belgian study evaluating a cohort of adults with DM1 found prevalence of 41.9 and 32.1% of overweight in men and women, respectively, and 9 and 16.7% of obesity, respectively (Van Gaal et al., 2002).

Patient age, duration of disease, diagnosis and length of participation in the project

The patients in the present study had a mean age at diagnosis of 10 years. In a study by Silveira et al. (2001) with 126 DM1 subjects, the most frequent age at diagnosis ranged between 11 and 15 years, with 31% of the diagnoses established in that age range.

Diabetic ketoacidosis (DKA) as the first clinical manifestation of the disease was present in 56.8% of the cases. In the aforementioned cited study, this rate was 18%; however, it was mostly associated with worse socioeconomic status (Silveira et al., 2001).

Two studies about DM1 and DKA reported that 25.5% of the patients under 20 years of age were diagnosed with DM1 after an episode of DKA, and 19% of all hospitalizations for DKA were due to newly-diagnosed DM1 (Rewers et al., 2008; Elmehdawi et al., 2010). It remains unclear why some patients develop this condition while others do not.

A recent study showed some factors associated with an increased risk for developing DKA-among them, age below five years, lower BMI, diagnostic delay or error, late initiation of treatment, difficulty of access to health care (Usher-Smith et al., 2010). On the other hand, the presence of a first-degree relative with the disease and higher schooling of parents helps to reduce the incidence of DKA, probably as a result of greater awareness regarding DM1 (Usher-Smith et al., 2010).

Of the 74 patients participating in the DOCE project, 66 (89.18%) had at some time been hospitalized after an episode of DKA; the mean for hospitalizations/patient was 0.73. The number of times the patients were hospitalized as a result of that complication ranged from 0 (no hospitalization) to 3 hospitalizations in some cases. In the cohort of patients studied by Elmehdawi et al. (2010), an average of 1.23 DKA episodes was found; for which 9.876% of the patients had two or more episodes of DKA.

Mean baseline A1C was 10.539. A reduction of 2.3131 was noted, with a final mean of 8.226, which was significantly lower following the multidisciplinary interventions.

In a study on the efficacy of education for patients on insulin, these received educational support with one monthly session for six months, after which A1C levels were evaluated (Jenhani et al., 2005). A1C values at this moment were ≤ 8 in 61.2% of the cases, while only 33% of the patients had baseline A1C within that range (Jenhani et al., 2005).

In an experiment with camps for type 1 diabetes patients, were effective in providing education to patients with DM1 and reducing A1C levels. This approach, however, was effective only for the first three months after the camp (baseline A1C of 9.0±1.8%; A1C three months after camp of 8.2±1.7 with p<0.001; A1C six months after camp of 9.2±2.5 with p<0.2). This demonstrates the importance of continued education in order to maintain adequate glycemic control (Koplatadze et al., 2003; Santiprabhob et al., 2008).

The mean follow-up period for our patients was 27.5 months; four months was the minimum duration of the project, and 64 months the maximum. Lower A1C values were found for patients with a longer follow-up period. Table 1 expresses more accurately the findings of this study regarding the relation between A1C and duration of the project. This finding confirms that the process of continued education including educational and behavioral interventions, in conjunction with support for intensive insulin treatment, produce beneficial effects in the management of DM1.

IMPLICATIONS

The DOCE Project was shown to be a very useful tool to aid and foster glycemic control in DM1 patients with freedom and quality of life, as demonstrated through the reduction in A1C and stabilization at lower levels, although the target levels were not achieved.

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