Evaluation of Cognitive Functions and Daily Living Activities of Elderly Diabetics under Intensive Insulin Therapy

Yoğun İnsülin Tedavisi Alan Yaşlılarda Bilişsel Fonksiyonların ve Günlük Yaşam Aktivitelerinin Değerlendirilmesi

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ABSTRACT

Objective: Our aim was to evaluate the cognitive functions and daily living activities of the elderly diabetics who were under a basal-bolus intensive insulin therapy.

Methods: Our study included 108 patients admitted to our outpatient clinic who are over 65 years of age and under an intensive insulin therapy. Minimental state examination (MMSE), activities of daily living (ADL), and instrumental activities of daily living (IADL) scales were used to evaluate cognitive functions and daily living activities. Fasting glucose and HbA1c levels were measured and history of hypoglycemia was recorded.

Results: MMSE revealed 24 patients (22.2%) with impaired cognitive functions. Patients with impaired cognitive functions were significantly prone to more hypoglycemic episodes and lower functionality.

Conclusion: Due to the complexity of intensive insulin therapy regimen, cognitive functions and functionality of the elderly diabetics should be carefully examined before deciding on intensive insulin therapy. *(JAREM 2015; 5: 47-51)*

Keywords: Elderly diabetics, intensive insulin therapy, cognitive functions, functionality

ÖZET

Amaç: Amacımız yoğun insülin tedavisi alan yaşlılarda bilişsel fonksiyonları ve günlük yaşam aktivitelerini değerlendirmekti.

Yöntemler: Çalışmamıza 65 yaş üstü polikliniğimize başvuran, yoğun insülin tedavisi almakta olan toplam 108 hasta alındı. Minimental durum değerlendirmesi (MMDD), günlük yaşam aktiviteleri (GYA), enstrümantal günlük yaşam aktiviteleri (EGYA) testleri; bilişsel fonksiyonlar ve günlük yaşam aktivitelerini değerlendirmede kullanıldı. Açlık glukozu ve HbA1c ölçümleri yapıldı ve hipoglisemi sorgulandı.

Bulgular: MMDD ile 24 hastada (%22,2) bilişsel fonksiyonların bozulmuş olduğu gösterildi. Bozulmuş bilişsel fonksiyonlara sahip hastalarda hipoglisemi sıklığı artmış, işlevsellik ise azalmıştı.

Sonuç: Yoğun insülin tedavi rejimlerinin karmaşıklığı nedeniyle yaşlı diyabetiklerde bu tedavilere karar verilmeden önce bilişsel fonksiyonlar ve işlevsellik dikkatli bir şekilde değerlendirilmelidir. *(JAREM 2015; 5: 47-51)*

Anahtar Sözcükler: Yaşlı diyabetikler, yoğun insülin tedavisi, bilişsel fonksiyonlar, işlevsellik

INTRODUCTION

According to the World Health Organization, 2.1% of the world's population suffer from diabetes, of whom 97% have type 2 diabetes. It was reported that 23.6 million people were diabetic in the United States in 2007 (7.8% of the whole population). Based on the data of the Turkish Diabetes Epidemiology Study (TURDEP-I), the prevalence of impaired glucose tolerance and diabetes mellitus were 6.7% and 7.2%, respectively (1). TURDEP-II reports have shown that the prevalence of diabetes in the adult Turkish population has amounted to 13.7%. The recently completed TURDEP-II study has pointed out that the incidence of diabetes has increased by 90% in the last 12 years in Turkey as compared with the incidence of diabetes mentioned in TURDEP-I (2). It reveals that diabetes has proved to be increasingly problematic both worldwide and in our country. Incidence and prevalence of diabetes increase with increasing age. Diabetics at the age of <65 years account for approximately 40% of all diabetics. Of the geriatric population, 20% have impaired glucose tolerance. Moreover, 10% of the elderly population suffer from undiagnosed diabetes (3).

The population of the elderly patients at the age of ≥65 years has been increasing throughout the world. Access to healthcare services by the elderly has been rising with increase in age of the population (4). Thus, the evaluation and care of the elderly need careful attention. An increase in life expectancy raises the significance of improving the quality of life and maintaining functional independence in the elderly (5).

It is essential to perform a thorough geriatric assessment periodically in an elderly patient to establish proper diagnosis and to initiate treatment for improving the quality of life and maintaining functional independence (6). The geriatric assessment includes multidisciplinary diagnostic procedures to determine the medical, psychological, and social status as well as functional capacity and to plan treatment and long-term care (7, 8). An interdisciplin-

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ary approach and objective standardized tests are required for medical diagnostic analysis and for identifying the quality of life as well as functional and mental status in the elderly (5).

Owing to all these evaluations, following benefits can be achieved: prolongation of life span, maintenance and improvement of functional status and quality of life, decrease in hospital and nursing home care, decrease in mortality and hospital costs, and low dependence for activities of daily living (ADL) (9-11). Advanced age and its adverse effects on mental state and functional capacity must be kept in mind while initiating the therapy, following-up the therapy, or planning alterations of the therapy of diabetes mellitus.

We sought to analyze cognitive functions, ADL, and instrumental activities of daily living (IADL) of the elderly on receiving (intensive) insulin four times a day presenting to the Outpatient Department of the Şişli Hamidiye Etfal Training and Research Hospital.

METHODS

This single-center, cross-sectional study included 108 patients at the age of >65 years receiving insulin four times a day presenting to the Outpatient Department of the Şişli Hamidiye Etfal Training and Research Hospital for the routine control of diabetes between February and June 2013. Patients with known cognitive dysfunction and diabetes-related micro-and macrovascular complications were excluded from the study. The local ethics committee approved the study. The ethics committee approval was obtained for this study from the Ethics Committee of the Ümraniye Training and Research Hospital (Date-number: 20/12/2012-49). All patients gave their informed consent.

The aim of the study was specified for each patient included in the study. Subsequently, the study data were collected taking oral and written informed consent from the patient and the caregiver (such as spouse, child, relative, care giver). After recording various demographic data (such as age, sex, marital status) and diagnosis of chronic diseases, the short-and long-forms of the standardized mini-mental state examination (SMMSE) were used to evaluate cognitive function, and the Barthel Index of ADL scale and Lawton–Brody IADL scale were performed to assess the ADL face-to-face by the researcher. The validated Turkish versions of the three tests were used (12-14). In addition, glucose and HbA1c levels were examined in routine controls, and the history of hypoglycemia were recorded. Laboratory tests were performed at the biochemistry laboratory of the Şişli Hamidiye Etfal Training and Research Hospital. The HbA1c test was performed by HPLC method using the 1-TOSOH G8 device (TOSOH G8, Tosoh Biosciences, Tokyo, Japan), and glucose levels were examined by the 1-COBAS 701 device (COBAS 701, Roche Diagnostics, Basel, Switzerland). With regard to investigation of hypoglycemia, the patients were divided into two main groups depending on the severity of hypoglycemia, i.e., mild and severe. The former included patients who had symptoms of dizziness, light-headedness, and cold sweats at home or at work requiring oral glucose intake without the need for hospitalization or without coma; the latter included those who required intravenous glucose replacement following admission to emergency department because of severe hypoglycemia or coma.

Statistical Analysis

For statistical analyses, SPSS (Statistical Package for Social Sciences for Windows, Chicago, IL, USA) 12.0 program was used. Evaluation of data, descriptive statistical methods (mean, standard deviation, frequency, and percentage) as well as qualitative data were compared by Chi-square test. Quantitative data were evaluated using one-way analysis of variance (one-way ANOVA), and Student's t-test was used to compare independent samples. Results were evaluated at 95% confidence interval, and the significance level was set at $p<0.05$.

RESULTS

Our study was performed on 108 patients, 28 males (25.9%) and 80 females (74.1%); mean age, 71.3±5.8 years; of the 108 patients, 69 were married (63.9%) and 39 were single (36.1%), of whom 38 were widowed (35.2%) and one was (0.9%) never married.

The educational levels of the patients were as follows: 49 were primary school graduates (45.4%), 24 had no education (22.2%), 22 were literate (20.4%), 8 were high school graduates (7.4%), and 5 were college graduates (4.6%). A majority of patients were living with their spouses [59 (54.6%)], 32 (29.6%) with relatives (such as siblings and children), 13 were living alone (12%), and the others were living in nursing homes with caregivers (Table 1). When evaluating the SMMSE, 24.1% patients (n=26) showed cognitive dysfunction, and 75.9% (n=82) were found to have normal cognitive functions. For this reason, cases with a score on SMMSE of <24 were referred to the neurology department for confirming the diagnosis and for initiating treatment. Analyzing the results of MMSE, no significant difference was found comparing gender, marital status, and level of education ($p=0.246$ and $p=0.602$; $p=0.263$; $p>0.05$). A significant difference was detected in the rates of people living alone between the groups with and without cognitive impairment ($p=0.03$). Of patients with cognitive

Table 1. Sociodemographic characteristics of patients

Sociodemographic characteristics		Number (n)	(%)
Gender	Male	28	25.9
	Female	80	74.1
Marital status	Married	69	63.9
	Single	39	36.1
Education level	None	24	22.2
	Literate	22	20.4
	Primary education	49	45.4
	High school	8	7.4
	University	5	4.6
Living condition	Partner	59	54.6
	Relative	32	29.6
	Alone	13	12.0
	Caretaker	3	2.8
	Nursing home	1	0.9

Table 2. Comparison of mild hypoglycemic episodes according to MMSE levels

			Mild hypoglycemia in the last 3 months				
			None	1-3	≥4	Total	p
MMSE results	Impaired cognitive functions	Number (n)	6	13	7	26	0.00
		Percentage in ICF group (%)	23.1%	50%	26.9%	100%	
		Percentage in whole group (%)	5.6%	12.0%	6.5%	24.1%	
	Normal	Number (n)	58	21	3	82	
		Percentage in normal group (%)	70.7%	25.6%	3.7%	100%	
		Percentage in whole group (%)	53.7%	19.4%	2.8%	75.9%	

MMSE: Mini mental state examination; ICF: Impaired cognitive functions

Table 3. Comparison of severe hypoglycemic episodes according to MMSE levels

			Severe hypoglycemia in the last 3 months			
			None	1-3	Total	p
MMSE results	Impaired cognitive functions	Number (n)	19	7	26	0.003
		Percentage in ICF group (%)	73.1%	26.9%	100%	
		Percentage in whole group (%)	17.6%	6.5%	24.1%	
	Normal	Number (n)	77	5	82	
		Percentage in normal group (%)	93.9%	6.1%	100%	
		Percentage in whole group (%)	71.3%	4.6%	75.9%	

MMSE: Mini mental state examination; ICF: Impaired cognitive functions

impairment (n=26), none were found to be living alone. Of patients without cognitive impairment, 15.9% (n=13) were found to be living alone. No significant differences were found between the groups with or without cognitive dysfunction with respect to the mean glucose and HbA1c values based on MMSE (p=0.62, p=0.21). Although the mean glucose value of patients with cognitive dysfunction was 184.96±76.92, that of the other group was 177.98±58.0. The mean HbA1c was detected 9.06±2.02% in patients with cognitive dysfunction, whereas it was 8.64±1.33% in people without cognitive dysfunction (p>0.05).

There was a significant difference in the rates of mild hypoglycemia within the last 3 months between the groups with and without dementia symptoms (p<0.01). Of patients with normal MMSE results, 70.7% (n=58) of the patients had no history of mild hypoglycemia for the last 3 months, whereas 23.1% with cognitive dysfunction (n=6) had no history of mild hypoglycemia during the same period. Nevertheless, the rate of a history of mild hypoglycemia upto1–3 and ≥4 times within past 3 months in individuals with cognitive dysfunction was 50%, (n=13) and 26.9% (n=7), respectively. Compared with the other group without cognitive dysfunction, these rates were lower, i.e., 25.6% (n=21) and 3.7% (n=3) (Table 2). When rates of severe hypoglycemia were compared according to MMSE results, a significant difference was detected with regard to the history of severe hypoglycemia for the last 3 months between the groups with and without cognitive dysfunction (p=0.003). Both groups had no history of severe hypoglycemia episodes for ≥4 times within the last 3 months. Of these two groups with cognitive dysfunction, 73.1% (n=19) experienced no severe hypoglycemia over the last 3 months, while 26.9% (n=7) suffered from severe hypoglycemia for approximately 1–3 times during the same period. Of individuals without cognitive dysfunction, 93.9% (n=77) sustained no severe hypoglycemia in the last 3 months, whereas 6.1% (n=5) experienced severe hypoglycemia episodes for 1–3 times over the last 3 months (Table 3). Based on MMSE results, a significant difference was present between groups with and without cognitive impairment with respect to the mean scores of activities of basic daily living (ADL and Barthel) and the IADL (Lawton–Brody IADL; p<0.001, p<0.001, respectively). According to MMSE results, the mean ADL scores was 8.96±3.26 in patients with cognitive impairment, and it was found to be 2.85±0.8 in those without cognitive impairment. The mean IADL scores was 11.04±4.89 for the IADL of patients with cognitive dysfunction, while it was 15.30±2.53 in patients without cognitive dysfunction (Table 4).

DISCUSSION

We evaluated the cognitive function and ADL of diabetics at the age of >65 years on receiving intensive insulin therapy considering the hypothesis that appraisal of cognitive function and ADL, which are parts of multidisciplinary geriatric assessment, is of

Table 4. Evaluation of IADL and ADL scores with regard to cognitive functions

Groups		Number (n)	Average	SD	p
IADL	ICF +	26	11.04	4.887	0.000
	Normal	82	15.30	2.527	
ADL	ICF +	26	8.96	3.258	0.000
	Normal	82	2.85	0.799	

IADL: Instrumental Activities of Daily Living; ADL: Activities of Daily Living; ICF: Impaired cognitive functions; SD: standard deviation

paramount importance, particularly in patients on intensive insulin therapy or those who receive it. In the elderly, the rate of impaired cognitive function on intensive insulin therapy was found to be 24% in this study. Compared with patients with normal cognitive function, both mild and severe hypoglycemia rates were significantly higher in individuals with impaired cognitive function, even though they lived with relatives or caregivers. Again, it was observed that these patients had difficulty in their daily living activities and higher levels of dependency.

At presently, besides the utmost significance of glycemic monitoring, the quality of life is also accepted to be indicative of the well-being of the diabetics. In addition to the physiological effects of aging, a number of hurdles arise particularly when initiating or planning insulin therapy in the elderly with diabetes. To implement effective treatment and experience minimum complications while using insulin, it is necessary to properly and carefully adhere to the rules in many different phases of therapy prior to, during, and after insulin use. Given the complexity of insulin use, appropriate evaluation of the elderly patients is essential to improve their quality of life. We found that 24.1% of the patients had cognitive dysfunction from MMSE results. In 2003, Cankurtaran et al. (15) identified that from a total of 1255 elderly, 14.4% had dementia. Gurvit et al. (16) reported that the prevalence of dementia in people aged >70 years living in İstanbul was 20%. The worldwide incidence of dementia in people aged >65 years is 10%–15%, and it is 30%–50% in people aged >80 years (17). Compared with other data from Turkey and other countries, our higher levels may be because of the fact that our patients had diabetes and were on intensive insulin therapy (18). Studies on animals have shown that severe hypoglycemia causes damage to the neurons of CA1, subiculum, and dentate granule cell areas of the hippocampus. This region is, in particular, known to be important for learning and memory (19). In fact, hypoglycemia has a bidirectional association with cognitive dysfunction: cognitive impairment raising the risk of subsequent hypoglycemia (20), and a history of severe hypoglycemia also enhancing the incidence of cognitive impairment. With regard to both the history of mild and severe hypoglycemia, individuals with decline in cognitive function had lower MMSE scores. It is remarkable that although the mean fasting blood glucose and HbA1c values were not significantly different in cases with and without cognitive function, these two groups significantly differed with respect to the frequency of severe hypoglycemia, which potentially results in mortality. Given the effects of diabetes on cognitive function of patients aged >65 years, it is difficult particularly for those on intensive insulin treatment to perform complex functions, including monitoring their own glucose levels, changing insulin dosage, and conforming to the appropriate timing as well as adjusting contents of the diet. In 2012, in the consensus report published together by the American Diabetes Association (ADA) and the American Geriatrics Society (AGS), it has been recommended that dietary regimens be simplified, and that caregivers be included in therapy processes; hence, hypoglycemia occurrence should be carefully evaluated by close observation in patients with cognitive dysfunction (21). A study suggests that the more the decline in cognitive function and functional capacity, the more difficult for the elderly it to understand and adapt to the drug (22). These data also show us that close observation is of great importance in the elderly population with decline in cognitive function.

Although HbA1c levels are expected to correspond to controlled blood glucose levels, unlike blood sugar levels, HbA1c levels were not correlated with MMSE scores, possibly because of our comparatively small sample size.

However, a recent study conducted on 1983 nondiabetic postmenopausal females established a significant association between HbA1c levels and dementia and reported that HbA1c levels could be considered as a follow-up marker for dementia (23).

In short, functional capacity is the ability of an individual to cope with conditions in which she/he lives and to provide care for himself or herself. The World Health Organization expressed that the best way to measure health status in the elderly is to evaluate "loss of functions" (24). Considering the functional capacity of our patients, the mean scores of the group established as having cognitive dysfunction by the Barthel's scale, by which basic daily living activities are evaluated, were significantly higher than the group without cognitive dysfunction. Furthermore, the mean scores were detected to be significantly lower in the group with cognitive impairment by the Lawton–Brody IADLIADL scale assessing competence in skills. This result indicates that those diagnosed with cognitive dysfunction have dependency and incompetence in performing the complex ADL. The study conducted by Maty et al. (25) to assess the loss of function in the elderly females with diabetes indicated that participants had significant disabilities to perform basic ADL and IADL. On querying about the expectations of the elderly with type II diabetes, the answer obtained was that the patients wanted to primarily and independently fulfill the ADL (26). Wu et al. (27) compared the performance of ADL in healthy individuals with that of the diabetics and found that more than 74% of the diabetics had a disability in performing the basic ADL, and that more than 50% had a disability in performing the instrumental ADL. In a study conducted in the United States, it was indicated that 79.1% elderly were found to be independent in the ADL. However, those with lower MMSE scores were found to have a poor performance of daily living (28). We observed that of the diabetics aged >65 years receiving four insulin injections a day, those with lower MMSE scores tended to experience mild and severe hypoglycemia, and at the same time, they tended to experience a loss of functionality. Therefore, to maintain the quality of life and to administer effective treatments, it is necessary to take into account the cognitive functions and ADL of the elderly diabetics for receiving heavy insulin therapy prior to treatment or even at follow-up, regardless of progression.

CONCLUSION

As the age of the population increases, the prevalence and incidence of diabetes increase; thus, the treatment of diabetes requires more attention and care in the elderly than in the youngsters. The difference is caused by physiological effects of aging and diabetes. It is essential to meticulously deem the potential of success of therapy in the elderly on insulin or to start using it. Because intensive insulin therapy is patient-centered rather than physician-centered, assessing whether cognitive function and functional capacity deserve treatment contributes to the success of the treatment and thereby to the patient's expected active lifespan. Considering these aspects, primary care is of great significance both for preventive healthcare (preventive medicine) and for a thorough analysis of patients.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Ümraniye Training and Research Hospital (Date-number: 20/12/2012-49).

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