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Original Article / Özgün Araştırma

Functional recovery in stroke patients with and without diabetes mellitus

Diabetes mellitusu olan ve olmayan inmeli hastalarda fonksiyonel iyileşme

Nurdan Paker, Derya Buğdaycı, Berna Çelik, Feride Sabırlı, Ayşe Nur Bardak

Department of Physical Medicine and Rehabilitation, İstanbul Training and Research Hospital Physical Therapy and Rehabilitation, İstanbul, Turkey

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ABSTRACT

Objectives: This study aims to compare the outcomes of the functional recovery in diabetic and non-diabetic patients with stroke in an inpatient rehabilitation setting.

Patients and methods: A total of 118 patients (43 males, 75 females; mean age 63.9±10.7 years; range 30 to 83 years) with stroke were included in this prospective study between January 2010 and December 2013. The patients were divided into two groups: diabetics (n=46) and non-diabetics (n=72). Demographic data, duration of stroke, etiology and blood glucose levels of all study population were recorded. Functional status was evaluated with the Functional Independence Measurement (FIM) on admission and at discharge. The Mini-Mental State Examination (MMSE) scale was used for the initial assessment of the cognitive status. The Hospital Anxiety and Depression Scale (HADS) was used for the evaluation of mood. All patients were rehabilitated using the Bobath method in combination with proprioceptive neuromuscular facilitation (PNF) techniques.

Results: The mean stroke duration was 5.7±2.45 and 5.6±2.48 months in the non-diabetic and diabetic groups, respectively ($p>0.05$). The mean FIM scores on admission were 41.5±14.17 and 42.3±16.81 in the non-diabetic and diabetic groups, respectively ($p>0.05$). The mean length of stay was 25.2±8.72 and 24.7±8.94 days in the non-diabetic and diabetic groups, respectively ($p>0.05$). No statistically significant difference in the motor FIM, HADS anxiety and depression, and MMSE scores was found on admission between the groups ($p>0.05$). There was a statistically significant improvement in the motor FIM scores in both groups at discharge ($p<0.05$). The increase in the motor FIM scores after rehabilitation in the non-diabetic group was statistically significantly higher compared to the diabetic patients ($p<0.01$).

Conclusion: Our study results showed a significant functional improvement in both diabetic and non-diabetic patients with stroke at discharge. However, the increase in the functional independence level was higher in the non-diabetics.

Keywords: Diabetes mellitus; functional independence; rehabilitation; stroke.

ÖZ

Amaç: Bu çalışmada yatarak rehabilitasyon tedavisi sırasında diyabeti olan ve olmayan inmeli hastalarda fonksiyonel iyileşme sonuçları karşılaştırıldı.

Hastalar ve yöntemler: Ocak 2010 - Aralık 2013 tarihleri arasında yapılan bu prospektif çalışmaya 118 inmeli hasta (43 erkek, 75 kadın; ort. yaş 63.9±10.7 yıl; dağılım: 30-83 yıl) dahil edildi. Hastalar diyabeti olanlar (n=46) ve olmayanlar (n=72) olmak üzere iki gruba ayrıldı. Tüm çalışma grubunun demografik verileri, inme süreleri, etyolojileri ve kan glukoz düzeyleri kaydedildi. Fonksiyonel durum, yatış ve taburculuk sırasında Fonksiyonel Bağımsızlık Ölçeği (FBÖ) ile değerlendirildi. Başlangıçta kognitif durumun değerlendirilmesinde Mini Mental Durum Değerlendirme (MMSE) Ölçeği kullanıldı. Duygudurum değerlendirilmesinde Hastane Anksiyete Depresyon Ölçeği (HADS) kullanıldı. Tüm hastalar Bobath yöntemi ile birlikte proprioseptif nöromusküler fasilitasyon (PNF) teknikleri kullanılarak rehabilite edildi.

Bulgular: Ortalama inme süresi diyabeti olmayan ve diyabeti olan grupta sırasıyla 5.7±2.45 ve 5.6±2.48 ay idi ($p>0.05$). Yatış sırasında ortalama FIM skoru, diyabeti olmayan ve diyabeti olan grupta sırasıyla 41.5±14.17 ve 42.3±16.81 idi ($p>0.05$). Ortalama yatış süresi, diyabeti olmayan ve diyabeti olan grupta sırasıyla 25.2±8.72 ve 24.7±8.94 gün idi ($p>0.05$). Gruplar arasında yatış sırasında motor FBÖ, HADS anksiyete ve depresyon ve MMSE skorları açısından istatistiksel olarak anlamlı bir fark saptanmadı ($p>0.05$). Taburculukta iki grupta da motor FBÖ skorlarında istatistiksel olarak anlamlı bir iyileşme saptandı ($p<0.05$). Rehabilitasyon sonrası motor FBÖ skorlarındaki artış, diyabeti olan hastalara kıyasla, diyabeti olmayan grupta istatistiksel olarak anlamlı düzeyde yüksek idi ($p<0.01$).

Sonuç: Çalışma sonuçlarımız, diyabeti olan ve olmayan inmeli hastalarda taburculukta anlamlı düzeyde fonksiyonel iyileşme olduğunu gösterdi. Ancak, diyabeti olmayan inmeli hastalardaki fonksiyonel bağımsızlık düzeyi, daha yüksekti.

Anahtar sözcükler: Diabetes mellitus; fonksiyonel bağımsızlık; rehabilitasyon; inme.

Corresponding author / *İletişim adresi*: Nurdan Paker, MD. İstanbul Fizik Tedavi ve Rehabilitasyon Eğitim ve Araştırma Hastanesi, Fizik Tedavi ve Rehabilitasyon Kliniği, 34147 Bahçelievler, İstanbul, Turkey. e-mail / *e-posta:* nurdanpaker@hotmail.com

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Incidences of cerebrovascular accident are high in patients with diabetes mellitus (DM).[1,2] Diabetes is a risk factor for stroke in patients younger than 65 years old. Stroke is 12 times more common in patients with diabetes mellitus. In patients over 70 years of age, the role of DM for stroke is lower because of other risk factors.[3] Neuroplasticity begins early after stroke. Rehabilitation may affect neuronal plasticity. Training and repeating exercises helps patients relearn motor abilities.[4] There is no clear evidence about the optimal timing and intensity of the rehabilitative training.[4,5]

There are some factors that affect the recovery in patients with stroke. The most important one is the extent of the neurologic lesion.[6] Advanced age is a factor in recovery but the results of the studies are conflicting.[7,8] Gender has no effect on the recovery in stroke.[9] Cognitive status, severe systemic illness, right hemiplegia with anosognosia, spasticity and urinary incontinence affect recovery.[6] There are conflicting studies about the effect of diabetes on functional prognosis.[1] Both diabetes and pre-diabetes were reported to have an effect on poor prognosis in acute stroke with ischemic etiology.[10] Mortality rates were reported to be high in smokers, diabetics and patients with low body weight. On the other hand, improvement was better in the obese and overweight subjects in a cohort study on women with DM.[11]

It is thought that the level of the functional recovery is low in the ischemic stroke patients with DM.[7,12] But it is not clear if this is related to DM or hyperglycemia.[12] Also the rate of disability was reported to be higher in stroke patients with DM.[12-15] However, there are some studies implying DM has no adverse effect on rehabilitation results.[16-19]

The aim of this study was to investigate the effect of DM on functional recovery in patients with stroke in the inpatient rehabilitation unit.

PATIENTS AND METHODS

One hundred eighteen patients with stroke (43 males, 75 females; mean age 63.9±10.7 years; range 30 to 83 years), who were admitted to the inpatient clinic between January 2010 and December 2013, were included in this study. The patients were divided into two groups: diabetics (n=46) and non-diabetics (n=72). The diagnosis of stroke was confirmed with cranial computerized tomography (CT) or magnetic resonance imaging (MRI) in all patients. The patients with recurrent stroke, the ones whose stroke duration >1 year, type 1 diabetics and patients with aphasia were excluded. Forty-six patients had DM diagnosed by a doctor. All of the patients had physiotherapy five days a week. They had speech therapy and occupational therapy if needed. The diet of the diabetic patients was designed under the control of a dietician. The demographic data such as age, body mass index, education level, stroke duration, length of stay (LOS), etiology and blood glucose levels were recorded. Functional level was assessed with a functional independence measurement (FIM) scale at admission and at discharge. Cognitive function was assessed with Mini Mental Examination (MMSE) test. For the screening of depression and anxiety Hospital Anxiety and Depression Scale (HADS) was used.

This study was approved by the local ethical committee and written informed consent was obtained from the patients. The study was conducted in accordance with the principles of the Declaration of Helsinki.

Statistical analysis

All data was analyzed using SPSS for Windows version 10.0 software (SPSS Inc., Chicago, IL, USA). Data analysis included frequencies and was given in mean ± standard deviation, minimum and maximum. The Mann-Whitney U test, Spearman's correlation test and paired t test were used for the comparison of parametric and non-parametric results. P values of less than 0.05 were considered statistically significant.

RESULTS

The demographic and clinical characteristics are shown in Table 1. There was no statistically significant difference in terms of the age, sex, education level, stroke etiology and duration, hemiplegic side and LOS ($p>0.05$). Body mass index values were higher in the diabetic group than of the non-diabetics ($p<0.05$). The mean glucose level was significantly higher in the diabetic group ($p<0.001$) (Table 1). There was no statistically significant difference in terms of motor FIM, MMSE and HADS anxiety and depression scores at admission ($p>0.05$) (Table 2). Mean duration of DM was 116.2±95.85 (12-420) months.

Functional independence measurement scores increased from 42.3 to 45.4 in the patients with DM and it increased from 41.5 to 46.7 in non-diabetics after inpatient rehabilitation. Functional improvement was statistically significantly less in the diabetic group than of the non-diabetic group at discharge ($p<0.01$).

In the diabetic group a statistically significant negative correlation was found between FIM gain and

Table 1. Clinical characteristics

	Non-diabetes mellitus (n=72)				Diabetes mellitus (n=46)				
	n	%	Mean±SD	Min.-Max.	n	%	Mean±SD	Min.-Max.	*p*
Age (years)			64.9±11.2	30-83			62.3±9.7	41-79	>0.05
Gender									
Female	46	66			29	63			
Male	26	34			17	37			>0.05
Body mass index (kg/m²)			25.8±4.9	18-50			27.6±5.5	17-48	0.048
Etiology									
Ischemic	56	78			41	89			
Hemorrhagic	16	22			5	11			
Localization									
Middle cerebral artery	65	90.3			41	87			
Anterior cerebral artery	3	4.2			2	4.3			
Posterior cerebral artery	2	2.8			3	6.5			
Brain stem lesion	2	2.8			1	2.2			
Hemiplegic side									>0.05
Right	29				19				
Left	43				27				
Stroke duration (mos)			5.7±2.5		1-11		5.6±2.5	1-11	>0.05
Brunnstrom									>0.05
Upper limb (admission)			2.6±1.3				2.7±1.5		
Lower limb (admission)			3.2±1.3				3.0±1.3		
Length of hospital stay (days)			25.2±8.7	14-60			24.7±8.9	7-60	>0.05
Blood glucose level (mg/dL)			77.6±9.1	58-108			107.0±40.3	51-224	<0.001

SD: Standard deviation; Min.: Minimum; Max.: Maximum.

the initial FIM (p=0.037, r=-0.305). In this group there was no significant correlation between FIM gain and blood glucose level (p>0.05).

DISCUSSION

In this study, functional status improved significantly in all patients with stroke, however, the level of recovery at discharge was less in the diabetic patients. The average FIM values increased from 41.5 to 46.7 in non diabetics and from 42.3 to 45.4 in diabetics after inpatient rehabilitation (p<0.01). Piernik-Yoder and Ketchum,[20] reported that functional recovery, length of stay and usage of rehabilitation services were statistically significantly different in stroke patients with diabetes in a retrospective study. The diagnosis of diabetes has been obtained from the ICD-9 codes. They concluded that improvement of the functional status as measured by FIM was lower in stroke patients with DM than that of the non-diabetics. Length of stay was reported as shorter in the patients without DM. Moreover, the patients with DM who were admitted to the rehabilitation units were found to be younger than those without DM in the same study.[20] In this study diabetic patients were also younger than non-diabetics. But there was no statistically significantly difference between the groups in term of age.

Stöllberger et al.,[21] concluded that the increase in the Barthel index scores were higher in the group without DM as compared with the diabetic patients in a multicenter prospective study including 992 patients with acute stroke (p=0.04). Furthermore, the level of

Table 2. Functional status, cognitive and emotional status of the patients

	Non-diabetes mellitus		Diabetes mellitus		
	Mean±SD	Min.-Max.	Mean±SD	Min.-Max.	*p*
Admission mFIM	41.5±14.2	14-74	42.3±16.8	18-78	>0.05
Discharge mFIM	46.7±14.0	18-75	45.4±16.3	20-78	>0.05
Difference mFIM	5.1±4.2	0-16	3.0±3.0	0-12	0.008
Mini mental state examination	22.3±4.9	9-29	21.4 ±5.7	8-29	>0.05
HADS-Anxiety scores	10.5±4.9	0-19	11.4±5.7	2-24	>0.05
HADS-Depression scores	7.8±4.1	0-17	8.6±4.1	0-18	>0.05

SD: Standard deviation; Min.: Minimum; Max.: Maximum; mFIM: motor Functional Independence Measurement; HADS: Hospital Anxiety and Depression Scale.

functional improvement was reported to be lower in the patients with DM in the same study.

Sweetnam et al.,[22] concluded that there was something wrong in remapping of the somatosensory cortex and plasticity in diabetic mice with ischemic stroke. A higher disability rate and poor activities of daily living (ADL) performance was reported as measured by the Barthel index and the Rankin scale in the diabetic patients with first stroke attack in a multicenter prospective study which took place in seven countries. Moreover, it was stated that Rankin scores between 2-5 before stroke, older age and urinary incontinence were found to be related with disability in the same study.[15]

Newman et al.,[14] reported a relationship between DM and higher disability rates in a study in which 3,680 patients with mild to moderate stroke who were evaluated twice: at the third month and two years post-stroke. Also they concluded that the diabetic patients had worse cognitive status in the same study. Jia et al.,[15] reported that DM was an independent risk factor both for the mortality and dependence as measured by the modified Rankin scale at six months post-stroke in multivariate regression analysis.

The patients with DM were found to have lower ADL, mobility, hand function and participation as evaluated by Stroke Impact Scale at the third month after stroke in a previous study.[8] In another study it was concluded that comorbidities, including DM, correlated inversely with the functional improvement in stroke.[23] Length of stay was stated to be longer in stroke patients with DM in some studies.[15,20] In this study, LOS was not statistically significantly different in two groups.

In contrast to the results of the studies above, in some other studies it was suggested that there was no difference in term of functional recovery between patients with and without diabetes who had acute stroke.[16-19] A significant improvement was reported at discharge as measured by Barthel Index and Fugl-Meyer Assessment Scale in the diabetic and non-diabetic patients who had acute stroke in a previous study. There was no significant difference in terms of motor and functional recovery between diabetic and non-diabetic patients in the same study. Moreover, it was stated that DM had no negative effect on the recovery in acute and post-acute stroke period.[16] No significant difference was found in terms of independence as measured by modified Rankin scale in the acute stroke patients with or without diabetes in another study.[17]

Functional gain was better in the stroke patients with DM whose admission FIM was higher in this study. There are conflicting results about the relationship between blood glucose level and functional improvement in the literature.[24-28]

Moreover, there was no correlation between fasting blood glucose levels and functional recovery in the diabetic group in this study. In some previous studies a relationship has been reported between the fasting blood glucose level and functional improvement.[24,25,28] Functional level evaluated using the modified Rankin scale was reported to be worse in stroke patients with pre-stroke bad glycemic control in a multicenter study.[24] A relationship was reported between high blood glucose levels and low recovery rate after three months in a previous study in which 624 patients who admitted within three hours of the acute ischemic stroke attack.[25] Functional recovery was reported to be less in stroke patients with hyperglycemia and unknown diabetes in a previous review.[28]

The strength of this study is that it is a prospective study. On the other hand, the study has some limitations. One of the limitations is that it is not a multicenter study. The other limitations are the relatively small number of patients and the lack of the longer follow-up period.

As a result of this study, a significant functional improvement was found in diabetic and non-diabetic patients with stroke after inpatient rehabilitation. The functional recovery level was lower in patients with DM as compared to patients not suffering from DM at the time of discharge. For this reason adding special rehabilitation interventions to the conventional stroke rehabilitation program may be useful for the stroke patients who have DM.

Declaration of conflicting interests

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