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The Impact of Left Ventricular Ejection Fraction on Measures of Stroke Rehabilitation Outcome

Sol Ventrikül Ejeksiyon Fraksiyonunun İnme Rehabilitasyon Sonuçlarına Etkisi

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Summary

Objective: To evaluate the impact of left ventricular ejection fraction on stroke rehabilitation outcome measures.
Materials and Methods: Forty first-ever stroke patients admitted to the inpatient rehabilitation unit at a tertiary research hospital were enrolled in the study. On the basis of the left ventricular ejection fraction, the patients were grouped into two groups: (1) those with low ejection fractions (ejection fraction ≤50%) and (2) those with high ejection fractions (ejection fraction >50%). Thirteen patients had low ejection fraction and 27 had high ejection fraction. Admission and discharge functional status was measured with total, motor and cognitive components of the Functional Independence Measure™ (FIM). A Functional Ambulatory Scale was used to measure the ambulatory status of the patients upon discharge.
Results: The admission total, motor and cognitive FIM scores in both groups were not significantly different. However, the low ejection fraction group had significantly lower discharge motor, total FIM and functional ambulatory scores than did the high ejection fraction group.
Conclusion: A decreased left ventricular ejection fraction may impair walking ability and rehabilitation outcome in first-ever stroke patients. *Turk J Phys Med Rehab 2013;59:108-11.*
Key Words: Ejection fraction, stroke, rehabilitation

Özet

Amaç: Sol ventrikül ejeksiyon fraksiyonunun inme rehabilitasyon sonuçlarına etkisini araştırmak.
Gereç ve Yöntem: Üçüncü basamak araştırma hastanesinin rehabilitasyon ünitelerine başvuran, ilk kez inme geçiren 40 hasta çalışmaya alındı. Sol ventrikül ejeksiyon fraksiyonuna göre hastalar düşük ejeksiyon fraksiyonlu (ejeksiyon fraksiyon ≤%50) ve yüksek ejeksiyon fraksiyonlu (ejeksiyon fraksiyon >%50) olarak gruplandırıldı. On üç hastanın düşük ejeksiyon fraksiyonu, 27 hastanın yüksek ejeksiyon fraksiyonu vardı. Fonksiyonel Bağımsızlık Ölçeğinin™ (FBÖ) total, motor ve bilişsel komponenetleri kullanılarak başlangıç ve taburculuk fonksiyonel durum değerlendirmesi yapıldı. Fonksiyonel Ambülasyon Skalası kullanılarak taburculukta hastaların ambülasyon durumu değerlendirildi.
Bulgular: Başlangıç total, motor, bilişsel FBÖ skorları arasında istatistiksel fark yoktu. Ancak düşük ejeksiyon fraksiyonlu grubun taburculuk motor ve total FBÖ ve fonksiyonel ambülasyon skorları yüksek ejeksiyon fraksiyonu olan gruptan istatistiksel olarak belirgin düşüktü.
Sonuç: Düşük ejeksiyon fraksiyonu ilk kez inme geçirmiş hastalarda rehabilitasyon sonuçlarını ve yürüme fonksiyonunu bozabilir. *Türk Fiz Tıp Rehab Derg 2013;59:108-11.*
Anahtar Kelimeler: Ejeksiyon fraksiyonu, inme, rehabilitasyon

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Introduction

Cardiac disease is a frequent and often clinically significant condition associated with increased risk of stroke. It affects both the survival rate and the functional outcome of stroke (1-3). Atrial fibrillation, cardiac failure and ischemic heart disease have been found to be associated with decreased survival rates after stroke (1-3). The presence of congestive heart failure has been found to have a major impact on the course and outcome of patients undergoing rehabilitation for stroke (2). Congestive heart failure not only adversely influences the overall function and mobility task performance, but also affects the potential for achieving functional gains (4).

Energy expenditure during gait and postural control tasks in stroke patients is elevated (5,6). Impaired balance control puts an extra demand on energy expenditure during motor activities in stroke patients (6). Even common household tasks, such as making the bed and vacuuming are associated with considerably greater energy requirements among post-stroke women than among their healthy counterparts (5). A sufficient left ventricular systolic function is required to meet the increased energy requirements for gait, postural control and daily living activities. Left ventricular systolic function is commonly measured as the left ventricular ejection fraction. Evidence-based guidelines for heart failure make recommendations based upon this measurement (7). The aim of this study was to evaluate the impact of a low ejection fraction (ejection fraction ≤50%) on measures of stroke outcome. We compared patients who had low ejection fractions with those with high ejection fractions (ejection fraction >50%) and assessed functional recovery, ambulatory status and the duration of inpatient rehabilitation.

Materials and Methods

This study was performed on 40 consecutive stroke patients who had suffered cerebral infarct or hemorrhage and were admitted to inpatient rehabilitation units within one year. Inpatient rehabilitation units are freestanding 90- and 24-bed hospitals, affiliated with a university hospital in Turkey. These units receive referrals from centers across the country and handle all stages of rehabilitation in all patients, regardless of age or stroke severity. The rehabilitation period is not predetermined.

We defined stroke according to the World Health Organization, as a vascular lesion of the brain that results in rapidly developing clinical signs or focal or global loss of brain function that persists for at least 24 hours or leads to death. In all patients, the diagnosis was confirmed by computed tomography or magnetic resonance imaging. Exclusion criteria were the following: previous history of stroke, previous episode of rehabilitation, medical instability, history of other neurologic disease, amputation, severe disabling arthritis, haemodialysis treatment, atrial fibrillation, left bundle brunch block or hypovolaemia. Demographic variables, age at the time of admission, gender and stroke onset-admission interval, duration of inpatient rehabilitation, side of lesion (dominant or non-dominant side involvement) and type of stroke (ischaemic or haemorrhagic) were recorded. Admission and discharge functional statuses were measured with the total, motor and cognitive components of the Functional Independence Measure™ (FIM) (8). The FIM instrument has been translated and adapted into the Turkish language. Its validity and reliability at measuring Turkish neurorehabilitation patients' level of disability have been documented (9). Functional gain (FIM gain) was recorded as the difference between the total FIM scores at discharge and the total FIM scores at admission. Pre-existing comorbid conditions were scored according to the Charlson index (10). The Turkish version of the Berg Balance scale, the validity and reliability of which has been established, was used to evaluate the patients' balance on admission (11). Motor functions of affected limbs were measured with the Motricity index, a scale which has been shown to have good validity and reliability with stroke patients, on admission and discharge (12). The functional ambulation scale was used to measure the ambulatory status of the patients at discharge (13,14).

Two-dimensional echocardiography was performed using commercially available equipment (Philips Sonos 7500, 1.8-3.6 mHz probe). A single, experienced operator carried out all measurements with patients in the left lateral position. Ejection fraction was measured by a modified Simpson method. Patients received comprehensive and intensive rehabilitation through a multidisciplinary approach consisting of daily living training, physical therapy and occupational therapy (usually 60 minutes each), nursing, recreational activities, psychosocial counseling and a physiatrist's evaluation and supervision. If necessary, speech-language pathology services were provided by another clinic. All the rehabilitation programming was completed within the department, except for speech therapy. Patients were discharged when further improvement in function was considered unlikely. This study was approved by the university ethics committee.

Descriptive statistics were presented as the means and standard deviations. The Mann-Whitney U test was applied to compare the ages, functional measures, the duration of inpatient rehabilitation, onset admission intervals, Charlson index, Motricity index, and Berg Balance scores in the groups. All statistical analyses were performed with SPSS 11.5 for Windows, and the significance level was set at 0.05.

Results

Patient characteristics are presented in Table 1. The mean ages of the patients with low ejection fractions and high ejection

Table 1. Patient characteristics.

	Ejection fraction ≤50%	Ejection fraction >50%
Number of patients	13	27
Age (year)	67.08±6.4	60.37±14.86
Gender (male/female)	7/6	14/13
Side of lesion		
Dominant hemisphere	8	13
Non-dominant hemisphere	5	14
Type of lesion		
Ischaemic	13	19
Hemorrhagic	0	8

fractions were similar. The mean duration between stroke onset and rehabilitation admission of the patients with low ejection fractions and high ejection fractions were 53.61±58.91 and 44.48±41.13 days, respectively, and these differences were not significant (p=.85). There were no significant differences between the low ejection fraction and high ejection fraction groups for the duration of inpatient rehabilitation, (45.61±29.62 and 47.37±25.73 days, respectively; p=0.68) or Charlson comorbidity index score (3.07±0.75 and 2.8±1.07, respectively; p=0.15).

The admission Berg balance score, admission and discharge FIM, Motricity index score and discharge functional ambulation scale of the patients with low ejection fractions and high ejection fractions are given in Table 2. The admission Motricity index and the motor and total FIM score of both groups were not significantly different. However, the discharge Motricity index and the motor and total FIM score of both groups were significantly different; the low ejection fraction group had a lower discharge Motricity index and lower motor and total FIM scores than did the high ejection fraction group. The high ejection fraction group had a significantly higher Functional Ambulation Scale score at discharge than did the low ejection fraction group. The FIM gains of the low ejection fraction and high ejection fraction groups were 17.46±15.05 and 22.59±21.21, respectively, and the differences were not significant (p=0.47).

Discussion

Subjects with left ventricular systolic dysfunction may have reduced exercise capacity. There is often an inadequate increase in cardiac output during exercise, which limits maximal oxygen uptake and exercise tolerance (15). Stroke volume, at times, may increase normally during upright exercise, despite a decrease in left ventricular ejection fraction. Ventricular dilatation facilitates use of the Frank-Starling mechanism. However, with increasing exercise, stroke volume and cardiac output often cannot continue to meet the increased demands. Many patients with decreased left ventricular ejection fractions at rest can perform relatively normal levels of exercise (15). However, the hemiplegic population generally consists of older individuals who are often further deconditioned by the effects of acute illness and bed rest prior to active rehabilitation, and their exercise capacity is therefore typically reduced (16). McKay-Lyons and Makrides (17). have reported that the maximal oxygen uptake at one month post-stroke was only 60% of the normative values for sedentary, healthy individuals

Comprehensive rehabilitation programs usually include varying types and intensities of physical activity. A decreased left ventricular ejection fraction may affect the rehabilitation outcome after stroke. Kevorkian et al. noted that stroke patients with low ejection fractions had lower discharge FIM scores, lower FIM gains and lower FIM efficiencies compared with patients with high ejection fractions (18). Despite the identified differences between the low ejection and high ejection fraction groups, almost 70% of the low ejection fraction group progressed well enough to be discharged to the community; thus, these patients should not necessarily be excluded from an inpatient rehabilitation program if they are otherwise suitable. In the present study, patients with low ejection fractions had worse discharge motor, total FIM scores and functional ambulatory scale scores then did patients with high ejection fractions.

Previously, it has been indicated that heart diseases could adversely affect patients' abilities to participate in a therapeutic exercise program and achieve favorable outcomes (19). In our study, monitoring of stroke patients during routine therapeutic exercise was not conducted, thus the effects of left ventricular dysfunction on the participation in therapeutic exercise and tolerance of this participation were not determined. Insufficient participation in a therapeutic exercise program and decreased exercise tolerance may be the leading cause of low level walking abilities and low discharge motor and total FIM scores in stroke patients with low ejection fractions.

Functional level from admission to rehabilitation, motor impairment, balance and cognitive abilities are important predictors of discharge functional outcome (20-23). In the present study, admission motor scores, total FIM scores, Berg Balance scores and the Motricity index were lower in stroke patients with low ejection fraction compared with those in high ejection fraction patients, but the differences were statistically insignificant. Both groups had similar admission and discharge cognitive FIM scores and the duration of inpatient rehabilitation. The generalisability of the present study is limited because

Table 2. Admission Berg balance score, admission and discharge motor, cognitive and total FIM, motricity index score and discharge functional ambulation score of the patients.

	Ejection fraction ≤50%			Ejection fraction >50%			P
	Mean±sd	Median	(Min-Max)*	Mean±sd	Median	(Min-Max)*	
Admission Berg balance score	12.38±13.79	5	0-44	21.81±18.67	12	2 - 56	0.07
Admission total FIM	52.77±22.72	60	18-84	67.03±29.66	64	24-126	0.21
Discharge total FIM	70.23±25.46	73	18-101	89.62±23.86	92	35-126	0.03
Admission motor FIM	27.30±12.91	25	13-49	38.15±22.80	29	13-91	0.18
Discharge motor FIM	43.92±17.77	46	13-66	59.74±17.88	57	25-91	0.01
Admission cognitive FIM	25.46±11.29	29	5-35	28.15±9.35	33	6-35	0.54
Discharge cognitive FIM	27.07±10.65	35	5-35	29.78±7.81	33	9-35	0.72
Admission motricity index	21.23±21.43	22	1-64	38.31±33.90	23	1-100	0.21
Discharge motricity index	31.77±19.94	32	1-67	52.00±27.98	52	1-100	0.02
Discharge functional ambulation score	2.23±1.48	3	0-4	3.55±1.42	4	0-5	0.01

(Min-Max)* : Minimum-Maximum

of the small sample size. Despite this potential limitation, it appears that left ventricular systolic dysfunction affects walking ability, discharge motor and total FIM scores in stroke patients. Rehabilitation of those patients should be undertaken because a recordable amount of functional gain is possible with a comprehensive rehabilitation program.

Conflict of Interest

Authors reported no conflicts of interest.

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