Comparison of the Results of Early and Delayed Inpatient Stroke Rehabilitation

İnmeli Hastalarda Erken ve Geç Dönemde Rehabilitasyon Sonuçlarının Karşılaştırılması

Berat Meryem ALKAN, Canan ÇULHA*, Hanife ÇAĞLAR YAĞCI**

Atatürk Training and Research Hospital, P.M.R. Clinic, Ankara, Turkey
*Ankara Physical Medicine and Rehabilitation Training and Research Hospital, 3rd P.M.R. Clinic, Ankara, Turkey
**Acıbadem Hospital Bağdat Street Medical Center, İstanbul, Turkey

Summary

Objective: This study was designed to investigate the best time to start rehabilitation and to identify the predictors of functional outcomes after rehabilitation in patients with stroke after their first cerebrovascular accident.
Materials and Methods: A total of 138 stroke patients who had their first stroke were divided into 5 groups according to the time elapsed from the cerebrovascular accident to the onset of rehabilitation (first 20 days, 21-40, 41-60, 61-80, and 81-100 days). Motor status of the patients was evaluated with the Brunnstrom Recovery Scale (BRS) and their functional status was assessed using the Functional Independence Measure (FIM) at admission and discharge. There was no statistically significant difference among the groups in terms of age, gender, localization of the lesion, etiology, and motor and functional status at baseline as well as additional systemic diseases. According to the results of rehabilitation, efficiency (average increase in FIM per day) and effectiveness (proportion of potential improvement achieved during rehabilitation of the groups) were calculated.
Results: There was no statistically significant difference among the groups in terms of efficiency and effectiveness. Correlation analysis revealed that efficiency showed negative correlations with shoulder subluxation while efficiency showed a positive correlation with BRS scores of the lower extremities and effectiveness. However, effectiveness showed positive correlations with efficiency, baseline FIM scores, and BRS scores of the hands, arms, and the lower extremities while it was inversely correlated with shoulder subluxation and bladder incontinence.
Conclusion: We concluded that starting stroke rehabilitation at any time within the first 100 days following the first stroke did not affect the results of rehabilitation. Therefore, we assume that starting stroke rehabilitation even after a delayed period also seems to be as efficacious as early rehabilitation. *Turk J Phys Med Rehab 2013;59:7-12.*
Key Words: Stroke rehabilitation, effectiveness, efficiency

Özet

Amaç: Bu çalışma ilk defa serebrovasküler olay geçiren inmeli hastalarda, rehabilitasyona başlamak için en uygun zamanı belirlemek ve rehabilitasyon sonrası fonksiyonel sonuçları etkileyen faktörleri araştırmak amacıyla yapılmıştır.
Gereç ve Yöntem: İlk kez inme geçiren 138 hasta, serebrovasküler olay ile inme rehabilitasyona başlama arasında geçen süreye göre 5 gruba ayrıldı. Hastaların motor seviyeleri Brunnstrom skalasıyla, fonksiyonel durumları ise Fonksiyonel Bağımsızlık Ölçümü (FBÖ) ile yatış ve taburculuk sırasında değerlendirildi. Gruplarımız arasında yaş, cinsiyet, dizabilite, etiyoloji, lezyon yeri, inme şiddeti ve diğer sistemik hastalıklar gibi rehabilitasyon sonuçlarını etkileyebilecek değişkenler açısından fark yoktu. Rehabilitasyon sonuçlarına göre rehabilitasyonun verimliliği [efficiency (Günlük ortalama FBÖ'deki artış)] ve etkinliği [effectiveness (gruplarda rehabilitasyon sırasında ulaşılan potansiyel iyileşme oranı)] hesaplanmıştır.
Bulgular: Gruplar arasında verimlilik ve etkinlik değerleri yönünden istatistiksel açıdan anlamlı bir fark bulunmadı. Korelasyon analizlerinde verimlilik değeri, omuz subluksasyonu varlığıyla negatif ilişkiliyken, alt ekstremite Brunnstrom ve etkinlik değerleri ile pozitif ilişkili bulundu. Etkinlik değeri ise verimlilik, başlangıç FBÖ, Brunnstrom el, Brunnstrom üst ekstremite ve Brunnstrom alt ekstremite değerleri ile pozitif korele bulunurken, omuz subluksasyonu ve idrar inkontinansı varlığı ile negatif korelasyon gösterdi.
Sonuç: İlk inme sonrasındaki 100 gün içinde, rehabilitasyon programına başlamak rehabilitasyon sonuçlarımızı olumsuz etkilemedi. Bu nedenle inme rehabilitasyonuna geç dönemde başlanmasının da erken rehabilitasyona benzer şekilde etkili olduğunu düşünmekteyiz. *Türk Fiz Tıp Rehab Derg 2013;59:7-12.*
Anahtar Kelimeler: İnme rehabilitasyonu, verimlilik, etkinlik

Introduction

Every year, a significant number of stroke survivors are left with residual hemiplegia. A number of uncontrolled studies have suggested that the functional status in hemiplegia can be improved by rehabilitation programs (1,2). The purpose of stroke rehabilitation is to increase patients' functional independence despite impairment. Although rehabilitation can reduce disability by optimizing the performance on everyday tasks, many individuals are still significantly disabled and handicapped on discharge (3). In stroke rehabilitation, early prediction of the obtainable level of functional recovery is desirable so as to deliver efficient care, set realistic goals, and to provide proper discharge planning. Assessment of treatment effectiveness through outcome measures of different types is highly important to describe the consequent neurologic deficits, to monitor the effects of treatment and natural recovery, and to understand the relationship between reductions in disability and improvements in impairment (4,5). Stroke may cause physical and cognitive impairments. A number of previous studies indicate that age, functional status and disease duration on admission, presence of co-morbidities, and cognitive functions are likely to affect functional outcome in stroke (6-12).

Only a few studies were designed to investigate the efficiency of rehabilitation gains or the effectiveness of achieving rehabilitation potential (8,13,14). In this study we investigated the best time to start rehabilitation and to identify the relative importance of medical, functional, demographic and cognitive factors in predicting functional outcomes after rehabilitation in patients with stroke after their first cerebrovascular accident (CVA).

Materials and Methods

A total of 138 stroke patients, who had their first stroke and were admitted to our hospital during January 2002 and April 2004 for inpatient rehabilitation, were included in the study. Rehabilitation staff consisted of physicians (physiatrists, neurologists) neuropsychologists, nurses, physiotherapists, occupational and speech therapists, a social services care manager, dietitians, and support staff. In particular, the threshold criterion for hospital admission is the possibility to participate actively in rehabilitation and to tolerate daily rehabilitation treatment. Stroke has been defined as a sudden, non-convulsive, focal neurologic deficit persisting for more than 24 hours (15). The diagnosis of stroke was based on history, clinical examination, and neuroradiological findings (computed tomography [CT] or magnetic resonance imaging [MRI]).

Exclusion criteria included subarachnoid hemorrhage and presence of sequelae of previous cerebrovascular accidents or of other chronic disabling pathologic conditions (i.e. severe Parkinson's disease, polyneuropathy, severe cardiac, liver, or renal failure, cancer, and limb amputation). We excluded patients who had negative CT scans or MRI in the subacute phase also, to avoid enrolling patients with transient ischemic attacks and to reduce the impact of spontaneous recovery.

Neurologic and functional assessment:

The patients were assessed comprehensively by the members of the multidisciplinary team on arrival. In particular, at admission, all patients underwent clinical, neurologic, neuropsychological, and functional examinations. Motor status of the patients was evaluated with the Brunstrom Recovery Scale (BRS) and their functional status was assessed using the Functional Independence Measure (FIM) (16,17) at admission and discharge. The conceptual basis of this instrument is to determine the type and amount of human assistance required by a person with impairment and disability to effectively perform basic activities of daily living (ADL). The FIM consists of 18 items organized under six categories of function: self-care activities, sphincter control, mobility, locomotion, communication and social integration. Each item is scored on a standardized ordinal scale from one (completely dependent) to seven (fully independent) for a maximum potential total score of 126. Psychiatric evaluation of all patients was performed by the same neuropsychologist. Practical skills in ADL-based rehabilitation program for all patients were designed by the same physiatrist. Our patient's physiotherapy was performed for 60 minutes twice a day (120 min/day in total) and the same rehabilitation protocol was used in all patients. All rehabilitation treatment began within 24 hours of admission, and each triad of patients was treated by the same therapists. Our patients who need training for neglect, speech therapy, swallowing, and bowel and bladder dysfunction got individual training for these which also continued throughout the hospital stay.

A total of 138 stroke patients (74 females, 64 males), who had their first stroke and were admitted to our hospital for inpatient rehabilitation, were included in the study. The patients were divided into 5 groups according to the time elapsed from the CVA to the onset of rehabilitation (first 20 days, 21-40, 41-60, 61-80, and 81-100 days). Table 1 presents demographic, medical, neurologic, neuroradiological, and functional findings of the five subgroups.

We calculated rehabilitation results using efficiency and effectiveness of treatment. Efficiency is the amount of increase in the rating score of each scale divided by length of rehabilitation stay; it shows the average improvement per day obtained during rehabilitation stay (8,13). Effectiveness reflects the proportion of potential improvement achieved during rehabilitation, calculated by the following formula: Effectiveness=(Discharge score-Initial score)÷(Maximum score-Initial score)-100. Therefore, if a patient obtains the top score after rehabilitation, effectiveness is 100% (8,13).

Data Analysis and Statistics

Baseline variables including sex, side of lesion, vocational status, type, side, and site of cerebral lesions, presence of cognitive impairment (hemi neglect, aphasia), depression, and comorbidities (heart disease, hypertension and diabetes) were compared among the five groups by means of the chi-square tests or analysis of variance. The Mann-Whitney U-test, the Spearman Rank correlation and linear regression analysis were used where appropriate. For these rehabilitation outcomes, between-group differences for participants with different onset-admission interval (OAI), intervals were calculated using the Kruskal-Wallis analysis for non-parametric data. The level of significance was p<0.05.

Results

No significant difference was found among the five subgroups for any parameter. In particular, FIM score at admission was similar among subgroups, as was type, side, and site of cerebral lesions. The mean age was 62.14±8.96 years. The mean FIM score at admission was 63.70±22.56. The mean FIM score of the whole sample at discharge was 88.76±23.56, global effectiveness on FIM was 43.35±22.67, and efficiency was 0.55±0.32.

Although efficiency was slightly higher in the group in whom rehabilitation was started within the first 20 days of stroke, there were no statistically significant differences among the groups in terms of efficiency and effectiveness (Kruskall-Wallis Test, p>0.05) (Table 2). Correlation analysis revealed that efficiency showed negative correlations with shoulder subluxation, while efficiency showed a positive correlation with BRS scores of the lower extremities and effectiveness (p<0.05). However, effectiveness showed positive correlations with efficiency, baseline FIM scores, and BRS scores of the hands, arms, and lower extremities, while it inversely correlated with shoulder subluxation and bladder incontinence (p<0.05) (Table 3). Comorbidities did not correlate with effectiveness (Table 4).

Discussion

This study was conducted on five subgroups of patients in whom rehabilitation was started on different times after stroke. Rehabilitation treatment was started in different periods since patients applied to our hospital for rehabilitation in quite different time periods after stroke. The patients in the five subgroups were not only matched for age and disability, but were also homogeneous for medical, neurologic, and neuroradiological findings. Besides, the same inpatient rehabilitation treatment was carried out by the same therapists for all the five subgroups. Although efficiency was slightly higher in the group in whom rehabilitation was started within the first 20 days of stroke, no statistically significant difference was found among the groups in terms of efficiency and effectiveness.

Inpatient rehabilitation outcomes were not influenced by the OAI in this study. The importance of early rehabilitation in stroke patients is put by many scientists in their researches, as it plays an important role in improving disease outcomes, as well as

Table 1. Demographics and charasteristics of the final sample.

	Group I n=18	Group II n=36	Group III n=36	Group IV n=19	Group V n=29	p value
Age (yrs)	68,31	78,19	68,14	66,41	63,15	NS*
Onset to admission	1-20	20-40	41-60	61-80	81-100	NS*
Males	50.0%	36.1%	44.7%	50.0%	56.7%	NS**
Right motor weakness	61.1%	61.1%	50.0%	62.5%	50.0%	NS**
Ischemic lesion	77.8%	77.8%	63.2%	81.3%	60.0%	NS**
Cortex lesion	80.9%	77.8%	77.8%	72.5%	68.8%	NS**
Aphasia	44.4%	41.7%	38.9%	31.6%	34.5%	NS**
Spasticity	0.0%	2.8%	5.6%	3.4%	3.6	NS**
Bladder incontinence	33.3%	36.1%	33.3%	26.3%	17.2%	NS**
Hypertension	61.1%	77.8%	75.0%	89.5%	79.3%	NS**
Heart Diseases	16.7%	16.7%	13.9%	15.8%	41.4%	NS**
Diabetes	22.2%	30.6%	22.2%	21.1%	20.7%	NS**
Depression	5.6%	6.9%	5.6%	5.3%	6.9%	NS**
Length of stay (days)	70.69	75.78	67.67	67.37	64.64	NS*

NS, Not significant; FIM, Functional Independence Measure. Categorical variables reported as percentage; continuous variables reported as mean; *Kruskal-Wallis Test was used;**Chi-Square Tests was used.

Table 2. Comparison of efficiency and effectiveness.

	Group I n=18	Group II n=36	Group III n=36	Group IV n=19	Group V n=29	p value
Efficiency (mean) (SD)	0.67±0.38	0.5±0.34	0.60±0.32	0.53±0.27	0.49±0.25	0.478 NS
Effectiveness (%)	43.70±20.97	41.79±29.56	47.68±21.10	44.86±18.70	38.70±17.98	0.532 NS

NS, not significant. Kruskal-Wallis Test was used in statistical analysis.

Table 3. Initial correlations in predicting rehabilitation outcomes in 138 patients with first stroke, p and r values.

Independent variable	Efficiency (increase/day)		Effectiveness (%)		Initial FIM Scores	
	p value	r value	p value	r value	r value	p value
Effectiveness	0.000*	0.745	-	-	0.000*	0.388
Initial FIM score	0.535	-0.53	0.000*	0.388	-	-
Age	0.895	0.011	0.298	-0.089	0.01*	-0.203
Etiology	0.314	-	0.117	-	0.476	-
Side of paralysis	0.854	-	0.960	-	0.568	-
Length of rehabilitation stay	0.692	-0.045	0.789	-0.026	0.476	0.070
BRS hand	0.224	0.104	0.000*	0.320	0.000*	0.565
BRS arm	0.173	0.117	0.000*	0.364	0.000*	0.629
BRS lower extremity	0.013*	0.211	0.000*	0.480	0.000*	0.627
Aphasia	0.317	0.086	0.247	0.099	0.145	-0.125
Neglect	0.847	-0.017	0.941	0.006	0.518	-0.056
Shoulder subluxation	0.050*	-.0167	0.011*	-0.216	0.128	-0.130
Bladder incontinence	0.264	0.096	0.014*	-0.209	0.000*	-0.360

*Significant at p<0.01.

Etiology and side of paralysis were evaluated with Chi-Square Tests. Spearman's correlations tests were used in evaluation of other parameters.

Table 4: Initial comorbidities in predicting rehabilitation outcomes in 138 patients with first stroke.

Effectiveness (%)		
Hypertension (76.8%)	p value	0.359
	r value	0,087
Diabetes (23.9%)	p value	0.136
	r value	0.121
Heart diseases (21.0%)	p value	0.053
	r value	0.165
Peripheral vascular disease (3.6%)	p value	0.858
	r value	0.015

NS, not significant at p>0.05. Spearman's correlations test was used.

improving the quality of life in future (18-24). Paolucci et al. showed that inpatient rehabilitation within the first 20 days after stroke was associated with a significantly higher probability of excellent therapeutic responses than rehabilitation starting later (8). Rehabilitation in multi-profile hospitals is performed by the principle of specialist team of rehabilitation ensuring the required specialist consultation (25). The effect of early rehabilitation in patients with hemiplegia is well known as it increases the possibility of recovery or compensation of dysfunctions (24,26). Like us, Gagnon et al. showed that OAI may not be a relevant prognostic factor of inpatient stroke rehabilitation outcomes (27). The effect of early or delayed initiation of inpatient rehabilitation after CVA may not favorably or adversely impact rehabilitation outcomes, respectively (27). There is a precedent regarding the efficacy of late intervention. Miyai et al. showed that multidisciplinary rehabilitation resulted in comparable functional gains in patients with stroke, no matter whether it was started within 3 months (average: 2 months) or after 3 months (average: 9 months) (28). In patients with hemiplegia should not be delayed the admission to a rehabilitation facility from an acute care facility. This suggestion corroborates that individuals who are medically stable following a first stroke should be rapidly transferred to a rehabilitation facility offering an intensive stroke rehabilitation program (27).

Predict of associated factors relevant to functional outcomes for stroke patients is important to the establishment of an effective continuing care program (19). For this study, side of paralysis and stroke etiology as indicators of pathology were not significant predictors of outcome measured as rehabilitation efficiency and achievement of rehabilitation potential. Although it is known that patients with intracerebral hemorrhage have a worse outcome in the acute stage, no significant difference was found between stroke etiology (ischemia or hemorrhage) and recovery rates. Other studies (13,29) have also found no correlation between stroke pathology and motor and functional outcome.

Regarding functional ability, our study revealed that effectiveness, age, BRS hand/arm/lower extremity scores and bladder incontinence were found to be significantly associated with baseline FIM scores. Hankey et al. (30) reported that the most important predictors of disability after stroke were increasing age, baseline Barthel Index (BI) score, severity of hemiparesis and recurrent stroke. A study from Thailand revealed that total FIM scores at the time of discharge and total gain in FIM scores are highly correlated with the total FIM scores at the time of admission and age (31). Our study also shows that FIM total score at admission can be used for stroke patients as an indicator of functional impairment and the amount of care needed. It can also aid in early patient selection

and in the determination of the necessary rehabilitation periods. This study shows that the most significant predictors of functional gain were FIM admission score, BRS hand scores and BRS lower extremity scores. This result is similar to that of the study of Lin et al. (32) in 2000, which revealed that arm motor recovery stage could significantly predict rehabilitation efficiency and effectiveness. In addition, older age (30,33) as well as the length of stay (34) were also found to be predictors of outcome. Paolucci et al. showed that rehabilitation training is effective also for very old patients, although less than for younger ones (7). Likewise Luk et al., we also found that the total FIM scores in admission were inversely correlated with age. No significant difference was observed between the changes in FIM scores and age. Age was not an independent predictor for a better outcome (35).

Comorbid diseases are common among patients after stroke. They have been shown to have a negative correlation with functional outcome, however, their impact on functional outcome was not clear (36). The most frequently seen comorbid conditions in our patients were hypertension (76.8%), diabetes mellitus (23.9%), heart disease (21%), and peripheral vascular disease (3.6%). In our patients, functional outcomes were not significantly influenced by the occurrence of medical problems. The most frequent complications observed were depression, shoulder subluxation, aphasia, neglect, and bladder incontinence. In our study, we found that the ability of speech and mental condition did not affect rehabilitation results. Shoulder subluxation and bladder incontinence were found to be inversely correlated with efficiency and effectiveness. Furthermore, bladder incontinence was inversely correlated with admission FIM score.

Shoulder pain and subluxation are both common complications after CVA. Subluxation is likely to manifest a shoulder at risk of becoming painful, although studies have found no definitive correlation between shoulder pain and subluxation. In patients with hemiplegia, shoulder pain and subluxation remain a important problem for the successful rehabilitation (37). After a stroke, the development of painful hemiplegic shoulder is associated with severe disease and poorer functional outcome (38-42). Incontinence has previously been identified as an important prognostic indicator of functional ability. Barer (43) reported that continence was a more powerful predictor of survival and discharge home than was the severity of paresis. Recently the other study found that the association between urinary incontinence and the total FIM instrument score was demonstrable and urinary incontinence has been used as a predictor of total FIM score (44). Patients with hemiplegia who regained continence earlier were admitted to rehabilitation units faster than incontinent patients, but continence did not predict discharge functional outcomes (45). Also the others studies shown that stroke patients who remained incontinent throughout rehabilitation had lower functional abilities on discharge and made fewer gains throughout the rehabilitation effort (46,47).

The clear limitation of our study is that we could not have a control group who received no rehabilitative intervention. This type of control group is not ethically permissible. Another limitation is the limited number of patients in the subgroups.

Further studies conducted on larger number of patients will provide more convincing results.

Conclusion

These data on effectiveness of stroke rehabilitation imply that early start is preferable. A variety of physiotherapy interventions improve functional outcomes, even when applied lately after stroke. Age does not appear to be an important factor in improvement although older patients tend to have more severe strokes. Admission FIM scores, initial motor scores, shoulder subluxation and urinary incontinence are the best predicting factors for rehabilitation outcome. Further investigation is also necessary to determine which patient will benefit from a rehabilitation program and which will not. Controlled clinical trials are essential if the role of rehabilitation, its indications, its contraindications, and its outcome predictors are to be more adequately understood.

Conflict of Interest
Authors reported no conflicts of interest.

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