

Effects of Inpatient Rehabilitation on Functional Recovery of Stroke Patients: a Comparison of Chronic Stroke Patients with and without Cognitive Impairment

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Abstract. [Purpose] The purpose of this study was to investigate the effects of inpatient rehabilitation on functional recovery of chronic stroke patients with cognitive impairment. [Subjects] This study recruited 63 patients, who underwent a rehabilitation program after stroke between May, 2008 and May, 2010. Patients were divided according to the Mini Mental State Examination (MMSE) total scores into a cognitive impairment group (MMSE<21) and a non-cognitive impairment group (MMSE≥22). All patients were evaluated ADL performance, balance and walking ability at admission and discharge. [Results] The scores of Modified Barthel Index (MBI), Berg Balance Scale (BBS), and walking ability of chronic stroke patients with cognitive impairment improved significantly after 3 months of the rehabilitation program. [Conclusion] These results suggest that inpatient rehabilitation improves the functional recovery of chronic stroke patients with cognitive impairment.

Key words: Cognition, Rehabilitation, Stroke

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INTRODUCTION

Stroke is a major cause of disability among the elderly. Frequently, stroke survivors have cognitive and physical impairments that significantly limit personal activities in the family and social environments¹⁾. Cognitive function is the ability to understand events occurring in our daily lives and the broad intellectual needed skills to judge situations, determine something and adapt to circumstances²⁾. Cognitive impairment is common in post-stroke patients particularly if they are elderly³⁾. Cognitive impairment develops in 5% to 10% in older adults⁴⁾ and 12% to 56% in people with stroke⁵⁾. Also, prevalence of cognitive impairment due to stroke among the elderly is higher than that of Alzheimer's disease⁶⁾. In particular, most acute stroke patients experience a decrease in cognitive function, and 35.2% to 43.9% of stroke patients also experience declines in cognitive function between stroke onset and after 3 months⁷⁾. One third of them remain in a condition of decreased cognitive function⁸⁾.

Cognitive impairment in stroke patients results in difficulty in concentrating, causing confusion in processing external stimuli, eventually resulting in difficulties with problem solving^{9, 10)}. Cognitive impairment is the most important factor in memory loss¹¹⁾. Memory impairment makes continuous judgments difficult and decreases therapeutic efficiency⁹⁾. In particular, cognitive impairment has a bad effect on recovery of functional ability. Therefore, an early diagnosis of specific cognitive deficit could be of great importance in determining the appropriate discharge destination⁷⁾. De-

termining the appropriate discharge destination from a hospital stroke unit is largely based on the prognosis of deficits in activities of daily living and ambulation. Thus, the assessment of acute cognitive functioning post-stroke can play a role in determining the best discharge destination¹²⁾.

Many studies have emphasized the importance of cognitive function in rehabilitation. Bennet et al.¹³⁾ monitored cognitive function and ADL in stroke patients for six years. The results show that patients who had cognitive impairment at the initial evaluation performed basic ADL (transfer, hygiene, bathing, dressing, eating, toileting etc) poorly. Stephens et al.¹⁴⁾ also stated that a decrease in cognitive function and attention has a bad effect on performance improvement of ADL, and Ozdemir et al.¹⁵⁾ described that cognitive impairment slowed functional recovery. Cognitive impairment is the chief obstacle to return to the community and it affects motivation for participation in rehabilitation programs and ability to improve motor skills¹⁶⁾. A recent study showed that inpatient rehabilitation for stroke patients with cognitive impairment had effects on motor recovery and ADL performance¹⁷⁾. Another study reported that significant functional gains were made during rehabilitation in the motor FIM score, regardless of cognitive impairment¹⁸⁾.

However, the preceding studies focused on the acute stroke period and were targeted toward recovery of ADL function. It is difficult to conclude exactly that functional recovery was the result of rehabilitation because the results would have been influenced by spontaneous recovery in the acute stage of stroke.

Table 1. Subject characteristics

(N=63)

Parameters	CI group (n=35)	NCI group (n=28)
Gender		
Male/Female (%)	22/13 (62.9/37.1)	14/14 (50/50)
Paretic side		
Right/Left (%)	14/21 (40/60)	13/15 (46.4/53.6)
Type of stroke		
Infarction/Hemorrhage (%)	28/7 (80/20)	26/2 (92.9/7.1)
MAS (lower extremity)	0.65 (0.99)	0.50 (0.69)
Age, years	71.40 (10.13)	68.25 (9.23)
Duration, days	281.03 (105.63)	289.57 (131.02)
MMSE _{AD} score	13.77 (6.32)	25.43 (2.28)

NOTE. Values are n(%) or mean(SD). Abbreviation: CI group; Cognitively Impaired Group, NCI group; Non-Cognitively impaired group, MAS; Modified Ashworth Scale, _{AD}; Admission, MMSE: Mini Mental State Examination.

Thus, the purpose of this study was to investigate the effects of inpatient rehabilitation on functional recovery in chronic stroke patients with cognitive impairment.

SUBJECTS AND METHODS

Sixty-three post-stroke patients (36 men, 27 women) admitted to the stroke unit of a geriatric neurologic rehabilitation department in Korea between May, 2008 and May, 2010 were recruited for this study. Subjects were recruited according to the following inclusion criteria: hemiplegia from a single stroke occurring at least six months earlier. The exclusion criteria were: aphasia, unconsciousness, visual loss and vascular dementia or Alzheimer's disease before stroke. Patient information was obtained from rehabilitation records.

Patients were divided into two groups according to the MMSE total scores¹⁷⁾. The first group consisted of cognitively impaired patients (CI group: MMSE<21, n=35, 71.40 years). The second group consisted of non-cognitively impaired patients (NCI group: MMSE≥22, n=28, 68.25 years) (Table 1).

All patients participated in the same rehabilitation program, 5 days per week in the stroke unit. The rehabilitation program consisted of physical therapy (30-minutes), occupational therapy (30-minutes) and/or speech-language therapy, if needed. Physical therapy aimed to increased the strength of the affected limbs, and improve balance, and walking ability. Physical therapists combine elements of Bobath neurodevelopmental treatment and proprioceptive neuromuscular facilitation techniques according to each patient's needs and performance. Occupational therapy, including group activities, was used to force the patients to use the skills learned in a variety of environments and to promote socialization. It involved learning to perform the daily activities of living in order to achieve the best possible quality of life. Occupational therapy also focused on orientation, attention, memory and problem solving of patients with the aim of improving their cognitive function. They were taught about time, place, and person over and over again to enhance their orientation, and were trained in number memory for attention, games of "Find the hidden pictures" and dice-play for memory. They also answered questions after

they listened and understood sentences or paragraphs that a therapist had read to them to improve their problem solving skills. Speech-language therapy focused on increasing skill of expression and comprehension.

Cognitive status was measured using the Mini Mental State Examination (MMSE). The MMSE is a widely used, reliable, and validated instrument used in screening for cognitive impairment¹⁹⁾. It examines a few aspects of cognition, is easily performed, and requires 5 to 10 minutes to administer. Contents include orientation, attention, learning, calculation, abstraction, information, construction and delayed recall. The MMSE is helpful in determining the need for further neuropsychologic assessment. A high degree of correlation has been shown between this and standard tests of cognitive function. ADL performance was measured using the Modified Barthel Index (MBI). MBI helps to evaluate 10 different areas of ADL: feeding, transfers, grooming, toilet use, bathing, mobility, stair climbing up and down, dressing, bowel and bladder control. Scores range between 0–100, and higher scores show better performance in ADL²⁰⁾. Balance ability was measured using the Berg Balance Scale (BBS). BBS is a valid and reliable instrument for measuring both the static and dynamic aspects of balance of elderly people with stroke²¹⁾. BBS scores range from 0 to 56 points and the higher the score, the better the balance. Walking level was assessed as: 1) dependent 2) maximal assistance 3) moderate assistance 4) minimal assistance 5) supervision 6) independent.

All statistical analyses were performed using SPSS version 18.0 software. Descriptive statistics were used to describe patient characteristics. Pre- and post-rehabilitation data were examined with the paired *t*-test or the Wilcoxon test within groups and the independent *t*-test or the Mann-Whitney test for between group comparisons. Results were considered significant at *p*<0.05. All data are shown as mean ± standard deviation.

RESULTS

After completion of three months inpatient rehabilitation, MBI scores significantly increased from 36.80 to 47.60 in the CI group (*P*=0.000) and from 55.60 to 64.28 in the NCI

Table 2. Comparison of functional recovery measures within groups and between groups

Parameters	Values				Change Values	
	CI group (n=35)		NCI group (n=28)		CI group (n=35)	NCI group (n=28)
	Pre	Post	Pre	Post	Post-Pre	Post-Pre
MBI	36.80 (18.95)	47.60 (20.19)***	55.60 (15.92)	64.28 (19.68)***	10.80 (18.03)	8.68 (8.94)
BBS	19.14 (15.46)	26.60 (17.38)***	26.96 (12.69)	33.60 (11.13)***	7.45 (8.07)	6.64 (6.33)
Walking ability	2.00 (1.49)	2.97 (1.52)***	2.71 (1.21)	3.54 (1.10)**	0.97 (0.89)	0.78 (1.10)

NOTE. Values are mean(SD). Abbreviation: CI group; Cognitively Impaired Group, NCI group; Non-Cognitively impaired group, MBI; Modified Barthel Index, BBS; Berg Balance Scale, ** $p < 0.01$, *** $p < 0.001$.

group ($P=0.000$). BBS scores significantly increased from 19.14 to 26.60 in the CI group ($P=0.000$) and significantly increased from 26.96 to 33.60 in the NCI group ($P=0.000$). Walking ability significantly increased from 2.00 to 2.97 in the CI group ($P=0.000$) and from 2.71 to 3.54 in the NCI group ($P=0.000$). The change in MBI, BBS and walking ability were not significantly different between the CI group and the NCI group (Table 2).

DISCUSSION

Cognitive impairment in stroke not only limits performance improvements of ADL, but is also the biggest obstacle to return to the community²². The ultimate goal of stroke rehabilitation is for patients to independently perform ADL after return to the community. To achieve this goal, cognitive function, balance, performance of ADL and walking are essential factors²³.

Previous studies²⁴ used only Functional Independence Measures (FIM) to investigate differences in functional state of stroke patients with groups of cognitive impairment and non-cognitive impairment. This study measured MBI to find the effects of cognitive function on the functional state of chronic stroke patients with and without cognitive impairment. In addition, we evaluated BBS and gait level.

Rehabilitation attempts to that may minimize disability, enhance the likelihood of returning to the community and reduce social cost¹. In a study that compared ability to perform ADL of stroke patients receiving treatment in a general ward with that in a stroke rehabilitation ward, the result indicated that those in the stroke rehabilitation ward showed higher functional gains²⁶. However, a recent study stated that cognitive impairment does not lead to a decrease in the efficacy of rehabilitation, and has no effect on the treatment duration or functional recovery of the elderly²⁷. Other studies have suggested that stroke patients with cognitive impairment can gain functional outcomes through inpatient rehabilitation similar to those who have no cognitive impairment^{17, 18}.

Generally, most motor recovery after stroke occurs within 3–6 months of onset and 95% of patients reach their best level of walking ability within 11 weeks after stroke onset²⁸. However, researchers investigating the effects of inpatient rehabilitation on stroke patients with cognitive deficit have focused on the patients in the acute stage. Therefore it is difficult to exclude the influence of spontaneous recovery from their results. Thus, in our study we examined how inpatient

rehabilitation influences the functional recovery of chronic stroke patients who have cognitive impairment six months after onset. MBI, BBS, and walking ability of chronic stroke patients with cognitive impairment significantly improved after the 3-month rehabilitation program ($p < 0.05$), and there were no significant differences in the changes in MBI, BBS and walking ability between the two groups. Through previous studies investigating cognitive and physical function of stroke patients, it is known that as cognitive function improves, physical function progresses^{25, 29}. We consider the improvements seen in our present study arise from the fact that the rehabilitation training included a program to improve patients' cognitive function. Our result suggests that even when chronic stroke patients have cognitive deficit, they do not need management, but rather, they need therapeutic intervention. We consider ongoing rehabilitation training gives stroke patients a chance to return to their home and community. Furthermore, we think it helps functional recovery to combine intensive cognitive rehabilitation and other rehabilitation therapies in chronic stroke patients with cognitive impairment.

This study measured MBI, BBS and walking ability to investigate the effects which inpatient rehabilitation has on the functional recovery of chronic stroke patients with and without cognitive impairment. Our findings indicate that cognitive impairment has an effect on the functional state of stroke patients. Also, inpatient rehabilitation was effective for the functional recovery of chronic stroke patients with cognitive impairment.

Some limitations of our study need to be considered. First, we did not have a control group who received no rehabilitation intervention. This type of control group is not ethically permissible. Second, we observed that recovery occurred during the 3 months, but it may continue afterward. Third, MMSE was used in this study to evaluate cognitive function. It is an assessment which is used widely to evaluate cognitive function¹⁹. However, executive dysfunction like apraxia and language disorder decreases the accuracy of evaluation³⁰ and it is difficult to identify mild cognitive dysfunction³¹. Thus, we recommend that a future study investigates how cognitive impairment influences the functional recovery of stroke patients using subdivided cognitive assessments.

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