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Cognitive Factors Associated with Activities of Daily Living in Post-stroke Patients

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Abstract. [Purpose] The purpose of this study was to investigate the effect of cognitive function on Activities of Daily Living (ADL) of post-stroke patients. [Subjects] This study examined 60 stroke patients admitted to a rehabilitation department in Korea between January 2010 and October 2011. All patients were evaluated using the Modified Barthel Index (MBI), Mini-Mental State Examination (MMSE), and the Loewenstein Occupational Therapy Cognitive Assessment for Geriatric Population (LOTCA-G) upon admission. One-way ANOVA, correlation, and multiple regression analyses were used to analyze the data. [Results] There were significant differences between groups categorized by MMSE scores in MBI. Significant correlations were observed between MBI and area subscores of LOTCA-G, with the exception of memory. Regression analysis showed that perception was the primary explanatory variable of ADL performance. [Conclusion] Perception had the strongest correlation with and the highest explanatory power of ADL performance. Therefore, the LOTCA-G area of perception may be a useful indicator of the level of ADL performance of stroke patients.
Key words: Cognition, Stroke, Activities of daily living

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INTRODUCTION

In rehabilitation training, accurate assessment of cognitive function is vital to design strategies for the rehabilitation and prediction of activities of daily living (ADL), because stroke results in general impairment including physical and cognitive impairment[1]. Perceptive and cognitive impairments are the primary factors that hinder successful rehabilitation of stroke patients even though complete recovery of physical function has been achieved[2, 3]. Thus, training to improve cognitive function is essential for successful rehabilitation[4].

In practice, various tools are used to evaluate the cognitive impairment of stroke patients. The Mini-Mental State Examination (MMSE) is useful for evaluating patients with neurological deficits; it is widely utilized because of its ease of use and simplicity[5]. Appelros[6] studied the correlation of the MMSE scores a year after stroke onset with main types of stroke, pre-stroke cognitive impairment, unilateral neglect, functional outcome, and memory problems in 232 stroke patients. The results showed that although MMSE scores had a low correlation with memory problems, there was a strong correlation between MMSE scores and functional outcomes. Arciniegas et al.[7] also reported that MMSE is a useful assessment tool for measuring the cognitive performance of stroke patients.

However, MMSE does not distinguish between dementia and depression, and it is not a practical tool for making a definitive diagnosis[8]. MMSE can only assess the areas of basic functioning, such as orientation, memory, attention, calculation, language, comprehension and judgment[9]. In addition, executive dysfunctions like apraxia and language disorder, decrease the accuracy of evaluation, and it is difficult to identify mild cognitive dysfunction using MMSE[5].

The Loewenstein Occupational Therapy Cognitive Assessment (LOTCA) is a widely used assessment tool for accurate, and detailed evaluation of cognitive function. It not only allows the evaluation of basic cognitive skills but also allows the evaluation of high level functions[10–12]. LOTCA is a cognitive assessment battery which was developed from clinical experience at the Lowenstein hospital in Israel. It can assess each subset of cognitive function − orientation, perception, praxis, visuomotor organization, thinking operation, memory, and attention/concentration, and can evaluate the degree of cognitive impairment[10]. Recent studies have suggested that there are difficulties associated with the use of this battery for the elderly population. The LOTCA was difficult to manipulate, and the battery as a whole is too long. The Lowenstein Occupational Therapy Cognitive Assessment for Geriatric Population (LOTCA-G) has been developed in recent years to address these weaknesses[13]. The reliability and validity of LOTCA-G have been reported, and also the correlation between LOTCA-G and MMSE[11]. However, no reports are available of the association between LOTCA-G scores and ADL skills.

Therefore, we investigated the correlation between cognitive function as measured using the LOTCA-G and ADL skills assessed by Modified Barthel Index (MBI). The effect of each cognitive function subset on ADL performance was also assessed.

SUBJECTS AND METHODS

A total of 60 stroke patients (34 men, 26 women) who were admitted to the stroke unit of a rehabilitation department in Korea between January 2010 and October 2011 were included in this study. All patients were admitted from acute care wards after their medical conditions had stabilized, usually within 3 weeks after stroke onset. The exclusion criteria were: significant difficulties in language expression or comprehension, severe dementia, serious visual impairment or hearing disorder.

Cognitive function was measured using the Loewenstein Occupational Therapy Cognitive Assessment for Geriatric Population (LOTCA-G) and the Mini-Mental State Examination (MMSE).

LOTCA-G is primarily used by occupational therapists to assess cognitive function after stroke and other brain injuries. It has a standardized battery of perceptual tests which are used to assess persons with brain injuries (head injury, stroke). LOTCA-G consists of 7 major areas containing 24 items. The items are specifically related to the patient's rehabilitation potential. The areas investigated are orientation, perception, praxis, visuomotor organization, thinking operation, memory and attention and concentration. Each subset is scored, and the total score ranges from 24 to 104. The test provides information about the patient's abilities and deficiencies and about his/her capacity to cope with everyday and occupational tasks[10].

MMSE is a used for the assessment of the cognitive functions. MMSE evaluates the following six areas: orientation, memory, attention, calculation, language, and construction functions. The total score ranges between 0–30[5].

ADL performance was measured using the Modified Barthel Index (MBI).

The Modified Barthel Index (MBI) evaluates 10 different areas of ADL: feeding, transfer, grooming, toilet use, bathing, mobility, stair climbing up and down, dressing, and bowel and bladder control. The total score ranges between 0–100. A higher score shows better performance of ADL[14].

LOTCA-G assessment was conducted within the first week of admission by three occupational therapists. A therapist examined patient's cognitive function, one on one, in a very quiet room to enable them to concentrate. A therapist sat across the table from or side by side depending on the patient's attitude. The praxis test was performed sitting face to face due to the nature of the test. The LOTCA-G assessment took 30 to 40 minutes to complete.

Data analysis was performed using SPSS for Windows version 18.0. Descriptive statistics were used to describe patient's characteristics. One-way ANOVA was used to compare differences in parameters related to the cognitive (MMSE) level. Pearson's correlation coefficient was used to assess the relationship between MBI and LOTCA-G. Multivariate regression analysis was used to identify factors related to ADL performance. A significance level of 0.05 was used.

Table 1. Demographic data

Variables	M ± SD
Gender	
Female /Male (%)	26/34 (43.3/56.7)
Affect side	
Left / Right (%)	33/27 (55.0/45.0)
Type of stroke	
Infarction/ Hemorrhage (%)	34/26 (56.7/43.3)
Age, years	66.11 ± 11.47
Duration	181.26 ± 188.23
MMSE	16.45 ± 7.51
MBI	46.00 ± 19.94
LOTCA-G	
Orientation	8.50 ± 5.15
perception	21.06 ± 6.24
Motor praxis	9.35 ± 2.94
Visuomotor organization	14.36 ± 5.97
Thinking operation	3.61 ± 2.18
Memory	8.73 ± 3.07
Attention & Concentration	2.65 ± 1.11
MAS (upper extremity)	1.83 ± 1.44
MAS (lower extremity)	1.72 ± 1.36
Elbow flexor[a]	3.13 ± 1.50
Wrist extensor[a]	2.55 ± 1.68
Knee extensor[a]	3.46 ± 1.34
Ankle dorsiflexor[a]	2.45 ± 1.68

Duration: Days between stroke onset and assessment, MMSE: Mini-Mental State Examination, MBI: Modified Barthel Index, LOTCA-G: Loewenstein Occupational Therapy Cognitive Assessment for Geriatric Population, MAS: Modified Ashworth Scale, [a]: by Manual Muscle Test (MMT)

RESULTS

Demographic data of subjects are summarized in Table 1.

Differences in ADL performance (MBI) related to cognitive level (MMSE)

There were significant differences between groups categorized in MBI by MMSE (p=0.001). The results of the post hoc test show significant differences in MBI between the severe cognitive impairment group (MMSE score: ≤9) and the moderate cognitive impairment group (MMSE score: 10–20), between the severe cognitive impairment group (MMSE score: ≤9) and the mild cognitive impairment group (MMSE score: 21–24), between the severe cognitive impairment group (MMSE score: ≤9) and the cognitively intact group (MMSE score: ≥25), between the moderate cognitive impairment group (MMSE score: 10–20) and the mild cognitive impairment group (MMSE score: 21–24), and

Table 2. ADL performance (MBI) related to cognitive level (MMSE)

Variables	MMSE[1] (n=12)	MMSE[2] (n=28)	MMSE[3] (n=11)	MMSE[4] (n=9)	F	p	Post hoc (LSD)
MBI	30.00 ± 14.66	43.92 ± 18.60	57.54 ± 19.68	59.66 ± 13.91	6.905	0.000	1-2, 1-3, 1-4, 2-3, 2-4

MMSE: Mini-Mental State Examination, MBI: Modified Barthel Index, 1severe cognitive impairment (MMSE score: ≤9), 2moderate cognitive impairment (MMSE score: 10-20), 3mild cognitive impairment (MMSE score: 21-24), 4cognitive intact (MMSE score: ≥25), 1-2: significant difference between MMSE1 and MMSE2, 1-3: significant difference between MMSE1 and MMSE3, 1-4: significant difference between MMSE1 and MMSE4, 2-3: significant difference between MMSE2 and MMSE3, 2-4: significant difference between MMSE[2] and MMSE[4]

Table 3. Correlation between MBI and LOTCA-G area scores

Variables	*r*
LOTCA-G	
Orientation	0.419***
Perception	0.472***
Motor praxis	0.342**
Visuomotor organization	0.464***
Thinking operation	0.439***
Memory	0.197
Attention & Concentration	0.387**

LOTCA-G: Loewenstein Occupational Therapy Cognitive Assessment for Geriatric Population, **p<0.01, ***p<0.001

between the moderate cognitive impairment group (MMSE score: 10–20) and the cognitively intact group (MMSE score: ≥25) (p<0.05) (Table 2).

Correlation between MBI and LOTCA-G; Multivariate regression − dependent variable (MBI)

The results show that the MBI total score was highly correlated with orientation (*r*=0.419, p=0.001), perception (*r*=0.472, p=0.000), motor praxis (*r*=0.342, p=0.008), visuomotor organization (*r*=0.464, p=0.000), thinking operation (*r*=0.439, p=0.000), and attention and concentration (*r*=0.387, p=0.002) (Table 3). Regression analysis showed that perception was the primary explanatory variable of ADL performance (β =1.508, p=0.000).

DISCUSSION

The ultimate goal of stroke rehabilitation is for patients to gain independence in performing ADL after returning to their communities and homes[15]. Thus, various studies concerning the ADL performance of stroke patients have been conducted.

ADL performance requires strength, mobility, coordination, and several fundamental cognitive skills[11], and it has been suggested that cognitive function has the greatest impact on ADL performance[16]. Zinn et al.[17] found that cognitively impaired patients had poor ADL performance compared to those without cognitive impairment at 6-month follow-up, despite having received similar rehabilitative care. Moreover, Alladi et al.[18] reported that cognitively impaired patients were unable to use their cognitive skills effectively during motor learning because cognitive function acts on motor processes in a complex and dispersed manner. Thus, in the present study, to determine the changes in ADL performance according to cognitive function[19]. The results show that MBI scores changed significantly with the MMSE total score (p=0.000). The results of the post hoc test show there were significant differences between the severe cognitive impairment group (MMSE score: ≤9) and the moderate cognitive impairment group (MMSE score: 10–20), between the severe cognitive impairment group (MMSE score: ≤9) and the mild cognitive impairment group (MMSE score: 21–24), between the severe cognitive impairment group (MMSE score: ≤9) and the cognitively intact group (MMSE score: ≥25), between the moderate cognitive impairment group (MMSE score: 10–20) and the mild cognitive impairment group (MMSE score: 21–24), and between the moderate cognitive impairment group (MMSE score: 10–20) and the cognitively intact group (MMSE score: ≥25) (p<0.05). To summarize, it is important to evaluate the cognitive function after stroke, because cognitive impairment heavily influences ADL performance.

Although many studies have reported that cognitive function affects ADL performance[11, 15, 17, 20], very little is known about the areas of cognitive function that directly affect ADL performance. Therefore, the present study examined cognitive areas affecting ADL performance using the LOTCA-G. The results show that the MBI total score was highly correlated with orientation (*r*=0.419, p=0.001), perception (*r*=0.472, p=0.000), motor praxis (*r*=0.342, p=0.008), visuomotor organization (*r*=0.464, p=0.000), thinking operation (*r*=0.439, p=0.000), and attention and concentration (*r*=0.387, p=0.002). We also found that various other sub-items of cognitive function influenced ADL performance. Perception was the primary explanatory variable of ADL performance according to regression analysis (β =1.508, p=0.000). Perception is a fundamental cognitive area in which object characteristics are identified and compared to established information to form a hypothesis[21]. It is believed that impairment of perception results in difficulties in ADL performance, and perception is a major predictive variable[22]. We speculated that stroke causes impairment of the perception of space, rendering patients confused about the relationship between their bodies and the surrounding environment and eventually influencing ADL performance of tasks such as dressing, personal hygiene, and walking. The results of a previous study suggest that perception training of parietal lobe-damaged hemiplegic patients improves independence of ADL performance[23]. Although impaired cognitive function of stroke patients may recover over time,

previous studies have reported that the cognitive function and ADL performance improve after cognitive training[24]. Thus, the detailed assessment of the cognitive function of stroke patients is necessary, and cognitive rehabilitation (especially perception) should be emphasized for stroke patients to improve their overall functional recovery.

Our study had several limitations regarding information on factors that may influence cognitive function. These include the lack of extensive demographic data (e.g., education levels, ethnicity, and socioeconomic status) and the fact that we did not try to ascertain potential confounding factors such as neuropsychiatric condition (i.e., depression, anxiety, and substance use). Future studies should include systematic evaluation of these.

REFERENCES

1) Smith-Knapp K, Corrigan JD, Arnett JA: Predicting functional independence from neuropsychological tests following traumatic brain injury. Brain Inj, 1996, 10: 651–662. [Medline] [CrossRef]
2) Uhlmann RF, Larson EB: Effect of education on the mini-mental state examination as a screening test for dementia. J Am Geriatr Soc, 1991, 39: 876–880. [Medline]
3) Freidl W, Schmidt R, Stronegger WJ, et al.: Mini mental state examination: influence of sociodemographic, environmental and behavioral factors and vascular risk factors. J Clin Epidemiol, 1996, 49: 73–78. [Medline] [CrossRef]
4) Carter LT, Oliveira DO, Duponte J, et al.: The relationship of cognitive skills performance to activities of daily living in stroke patients. Am J Occup Ther, 1988, 42: 449–455. [Medline] [CrossRef]
5) Mungas D: In-office mental status testing: a practical guide. Geriatrics, 1991, 46: 54–66.
6) Appelros P: Characteristics of Mini-Mental State Examination 1 year after stroke. Acta Neurol Scand, 2005, 112: 88–92. [Medline] [CrossRef]
7) Arciniegas DB, Kellermeyer GF, Bonifer NM, et al.: Screening for cognitive decline following single known stroke using the Mini-Mental State Examination. Neuropsychiatr Dis Treat, 2011, 7: 189–196. [Medline] [CrossRef]
8) Tombaugh TN, McIntyre NJ: The mini-mental state examination: a comprehensive review. J Am Geriatr Soc, 1992, 40: 922–935. [Medline]
9) Blostein PA, Jones SJ, Buechler CM, et al.: Cognitive screening in mild traumatic brain injuries: analysis of the neurobehavioral cognitive status examination when utilized during initial trauma hospitalization. J Neurotrauma, 1997, 14: 171–177. [Medline] [CrossRef]
10) Katz N, Itzkovich M, Averbuch S, et al.: Loewenstein Occupational Therapy Cognitive Assessment (LOTCA) battery for brain-injured patients: reliability and validity. Am J Occup Ther, 1989, 43: 184–192. [Medline] [CrossRef]
11) Zwecker M, Levenkrohn S, Fleisig Y, et al.: Mini-Mental State Examination, cognitive FIM instrument, and the Loewenstein Occupational Therapy Cognitive Assessment: relation to functional outcome of stroke patients. Arch Phys Med Rehabil, 2002, 83: 342–345. [Medline] [CrossRef]
12) Cermak SA, Katz N, McGuire E, et al.: Performance of Americans and israelis with cerebrovascular accident on the Loewenstein Occupational Therapy Cognitive Assessment (LOTCA). Am J Occup Ther, 1995, 49: 500–506. [Medline] [CrossRef]
13) Katz N, Elazar B, Itzkovich M: Construct validity of a geriatric version of the Lowenstein Occupational Therapy in geriatrics. Phys Occup Ther Geriatr, 1995, 13: 31–46. [CrossRef]
14) Küçükdeveci AA, Yavuzer G, Tennant A, et al.: Adaptation of the modified Barthel Index for use in physical medicine and rehabilitation in Turkey. Scand J Rehabil Med, 2000, 32: 87–92. [Medline] [CrossRef]
15) Özdemir F, Birtane M, Tabatabaei R, et al.: Cognitive evaluation and functional outcome after stroke. Am J Phys Med Rehabil, 2001, 80: 410–415. [Medline] [CrossRef]
16) Tsuji T, Liu M, Sonoda S, et al.: Newly developed short behavior scale for use in stroke outcome research. Am J Phys Med Rehabil, 1998, 77: 376–381. [Medline] [CrossRef]
17) Zinn S, Dudley TK, Bosworth HB, et al.: The effect of poststroke cognitive impairment on rehabilitation process and functional outcome. Arch Phys Med Rehabil, 2004, 85: 1084–1090. [Medline] [CrossRef]
18) Alladi S, Meena AK, Kaul S: Cognitive rehabilitation in stroke: therapy and techniques. Neurol India, 2002, 50: S102–S108. [Medline]
19) Rabadi MH, Rabadi FM, Edelstein L, et al.: Cognitively impaired stroke patients do benefit from admission to an acute rehabilitation unit. Arch Phys Med Rehabil, 2008, 89: 441–448. [Medline] [CrossRef]
20) Tatemichi TK, Desmond DW, Stern Y, et al.: Cognitive impairment after stroke: frequency, patterns, and relationship to functional abilities. J Neurol Neurosurg Psychiatry, 1994, 57: 202–207. [Medline] [CrossRef]
21) Cooke DM, McKenna K, Fleming J, et al.: Criterion validity of the Occupational Therapy Adult Perceptual Screening Test (OT-APST). Scand J Occup Ther, 2006, 13: 38–48. [Medline] [CrossRef]
22) Bernspång B, Asplund K, Eriksson S, et al.: Motor and perceptual impairments in acute stroke patients: effects on self-care ability. Stroke, 1987, 18: 1081–1086. [Medline] [CrossRef]
23) Anderson EK, Choy E: Parietal lobe syndromes in hemiplegia. Am J Occup Ther, 1970, 24: 13–18. [Medline]
24) Carter LT, Howard BE, O'Neil WA: Effectiveness of cognitive skill remediation in acute stroke patients. Am J Occup Ther, 1983, 37: 320–326. [Medline] [CrossRef]