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Prediction of Discharge Destination after Long-term Rehabilitation

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ABSTRACT

Objective : To assess whether the National Institutes of Health Stroke Scale (NIHSS) score determined at admission to rehabilitation during the postacute phase of stroke has value for predicting home discharge after long-term rehabilitation.

Subjects and Methods : The subjects were 163 poststroke patients (mean age : 74±13 years, 68 men and 95 women) in whom long-term rehabilitation was provided daily. Clinical data, including NIHSS score determined at admission for rehabilitation, were collected retrospectively. Variables that showed a significant association with discharge destination on univariate analysis were subjected to multivariate analysis to identify predictors of home discharge. The frequency of home discharge was also compared between patients with left cerebral lesions and those with right cerebral lesions after stratification into 4 NIHSS score categories.

Results : Age at admission, percentage of patients living with other individuals, duration of hospitalization, and NIHSS score at admission for rehabilitation differed significantly between patients discharged to home and patients transferred to other facilities. Multivariate logistic regression analysis identified young age, living with another person, and lower NIHSS score at admission as independent predictors for home discharge. Stratification of patients by means of 5-point NIHSS categories showed a higher frequency of home discharge for patients with left-sided lesions than for those with right-sided lesions.

Conclusions : The NIHSS score at admission to the rehabilitation department significantly influences the discharge destination after long-term rehabilitation. (Jikeikai Med J 2011 ; 58 : 37-43)

Key words : stroke, rehabilitation, discharge destination, National Institutes of Health Stroke Scale score, multivariate analysis

INTRODUCTION

The introduction several years ago throughout Japan of the "stroke pathway" system, which promptly conveys patient information from the acute care hospital to the rehabilitation department by means of a brief form, has allowed speedier and more efficient transfer of stroke patients to rehabilitation departments after acute management[1]. However, some patients still cannot be discharged from rehabilitation centers despite having undergone long-term rehabilitation[2]. During the care of stroke patients, earlier identification of those expected to respond to long-term rehabilitation in the acute phase, such as the day of admission to acute care hospital, may lead to greater functional improvement, promoting more efficient use of medical resources. The patient's condition can change during the

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acute phase of stroke because of effective treatment or the development of complications. More than half of stroke patients have some complications during the acute phase[3,4]. Considering the possibility of such clinical changes, it might be more meaningful and useful to predict patient outcome, such as discharge destination, just before or at admission to rehabilitation centers in the postacute phase than in acute phase.

The National Institutes of Health Stroke Scale (NIHSS) is a 15-item impairment scale, with a maximum score of 42 points, designed to evaluate key components of neurological status in stroke patients. After the approval by the Japanese health authorities in 2005 of the intravenous injection of tissue plasminogen activator for the treatment of acute ischemic stroke, the NIHSS has become a routine part of acute clinical practice in Japan, as in the United States and several European countries[5,6]. The NIHSS, which has been reported to be associated with high interrater reliability, is used both as an objective measure of the effectiveness of acute management and as a predictor of long-term clinical outcome of stroke patients when determined during the acute phase[7,8]. For example, The Northern Manhattan Stroke Study showed that the NIHSS score during the acute phase is an important factor influencing discharge destination following acute care[9]. Schlegel et al. have shown that the NIHSS score determined within 24 hours of stroke onset correlates significantly with discharge destination from the acute-care hospital[10]. Furthermore, Sato et al.[11] have shown that a low NIHSS score within 3 days after stroke onset is an independent and significant predictor of favorable outcome and that the optimal cutoff scores of the NIHSS for favorable outcome differed between patients with lesions in the anterior circulation and those with lesions of the posterior circulation. To our knowledge, however, there is no information on the predictive value of the NIHSS in the postacute phase of stroke, i.e., the usefulness of NIHSS applied in the postacute phase as a predictor of outcome of long-term rehabilitation remains unknown. Furthermore, whether the predictive power of NIHSS score differs between patients with left cerebral lesions and those with right cerebral lesions is unknown, although 1 study has demonstrated that the relationship between the size of the acute lesion and the NIHSS score differs between these 2 groups of patients[12].

The aim of the present clinical study was to determine whether NIHSS score determined at admission to the rehabilitation department during the postacute phase influences discharge destination and predicts home discharge after long-term poststroke rehabilitation. In addition, the study investigated differences in the frequency of home discharge when stratified according to NIHSS categories between patients with left-sided cerebral lesions and those with right-sided cerebral lesions.

METHODS

Patients

This is a retrospective analysis of a prospectively enrolled consecutive cohort of adult poststroke patients who had unilateral cerebral lesions and were admitted for long-term rehabilitation to the Department of Rehabilitation, Southern Tohoku Group Tokyo Hospital, Tokyo, Japan, from April 2008 through March 2010. The department is linked to more than 20 acute care hospitals in the Tokyo area through the "stroke pathway" system. On the basis of this system, all patients were admitted for long-term rehabilitation after acute management. During hospitalization, patients were scheduled to receive physical therapy for 60 to 120 minutes and occupational therapy for 20 to 60 minutes on a one-to-one basis with a therapist, daily except Sundays. For patients with clinically prominent speech disturbances, such as aphasia and dysarthria, rehabilitative intervention by a language therapist was also provided. Patients were excluded from analysis if they had : bilateral cerebral lesions, been admitted to the department more than 60 days after the onset of current stroke, lived at nursing homes or hospitals before the onset of the current stroke, or had left the hospital against medical advice. The study protocol was approved by ethics committee of Southern Tohoku Group Tokyo Hospital.

Baseline and outcome evaluation

The following data were collected retrospectively from the medical records : patient's age, sex, time to admission to rehabilitation department after onset of stroke, presence of risk factors (hypertension, diabetes mellitus, dyslipidemia, history of previous stroke, cardiac disease, and smoking), presence of cognitive impairment (dementia, aphasia, and unilateral spatial neglect), living with another person or alone, subtype of stroke, side of cerebral lesion, period of

hospitalization, and NIHSS score at admission to the department. The presence of dementia was assessed with the Mini-Mental State Examination[13], and the diagnosis of aphasia or unilateral spatial neglect was based on neurological examination by the neurologist at the Department of Rehabilitation. The diagnoses of stroke subtype and of lesion side were made with magnetic resonance imaging, including diffusion-weighted imaging, of the brain in the acute phase, before admission to the rehabilitation department. The NIHSS was administered on the day of admission by department physicians or therapists. Before the study all the physicians and therapists of the department underwent training to standardize the scoring of the NIHSS. To evaluate outcomes, discharge destinations were classified as either the patient's own home (home discharge) or transfer to all other facilities, such as nursing homes and hospitals (other facilities). Also included in those discharged to other facilities were patients who required readmission to acute care hospitals because of the recurrence of stroke or the development of severe complications that could not be managed in the rehabilitation department and patients who died during the hospitalization.

Statistical analysis

All data analyses were performed with the Statistical Package for Social Sciences (SPSS, Inc., Chicago, IL, USA) version 17.0. To test for associations between discharge destinations and each of the individual patient characteristics, 2-sided univariate analysis was performed with Fisher's exact test for categorical variables, the unpaired Student's *t*-test for parametric continuous variables, and the Mann-Whitney U-test for nonparametric continuous variables. Variables that showed an association with discharge destination at a p value of less than 0.05 on univariate analysis were selected for multivariate analysis. Multivariate logistic regression analysis was employed to identify independent predictors of home discharge. For all items that remained independent predictors for home discharge after multivariate logistic regression analysis, receiver operating characteristic (ROC) curves were constructed and the area under the ROC curve (AUC) was calculated to determine the predictive value of the items for discharge destination. In addition, by means of Fisher's exact test, the frequency of home discharge was compared between patients with left cerebral lesions and those with right cerebral lesions after stratification according to 4 NIHSS score categories with 5-point intervals, as applied in the study by Fink et al.[12]. The relative risk of home discharge, which was adjusted for other variables shown on multivariate analysis to be independent predictors, was calculated using patients with an NIHSS score of 0 to 5 as the reference in each category. In both groups of patients, ROC curves for only the NIHSS score were also constructed to determine the optimal cutoff value for the NIHSS score for discriminating patients discharged home and those transferred to other facilities.

Results

The study cohort comprised 163 patients. No patient was excluded from the subject because of missing data. The mean age±SD of study subjects was 73.8±12.8 years, and 42% of subjects were women. A total of 65 patients had intracerebral hemorrhage, and 98 had cerebral infarction. The cerebral lesion was left-sided in 94 patients and right-sided in 69 patients. Time to admission to the rehabilitation department after onset ranged from 9 to 59 days, with a mean of 38 days. The NIHSS score at admission was 0 to 5 in 52% of patients, 6 to 10 in 20%, 11 to 15 in 15%, and ≥16 in 13%. Ninety-six patients (59%) were discharged home.

Univariate analysis

Patients returning home after long-term rehabilitation, when compared with patients transferred to other facilities, were significantly younger at admission, were more likely to be living with another person, and were admitted to the hospital for a shorter period (Table 1). In addition, the NIHSS score at admission was significantly lower in patients returning home than in those transferred to other facilities. No significant difference was found between the 2 groups of patients in any other characteristic (Table 1).

Multivariable analysis

Multivariate logistic regression analysis, which included age at admission, living with another person, period of hospitalization, and NIHSS score at admission, identified younger age at admission, living with another person, and lower NIHSS score at admission as independent and significant predictors for home discharge (Table 2). For each

Table 1. Univariate analysis of patients' characteristics. Comparisons between patients discharging home and being transferred to other facilities were performed using Fisher's exact test for categorical variables, unpaired Student's *t*-test for parametric continuous variables, and Mann–Whitney U test for non-parametric continuous variables, respectively. SD : standard deviation, IQR : interquartile range.

		Home discharge (n=96)	Other facilities (n=67)	P value
Age at admission (years), mean±SD		68.7±12.3	76.7±12.7	<.001
Female, *n* (%)		37 (39)	31 (46)	NS
Time to admission after onset, days, mean±SD		39.2±20.0	41.2±17.1	NS
Hypertension, *n* (%)		66 (69)	42 (63)	NS
Diabetes Mellitus, *n* (%)		20 (21)	13 (19)	NS
Dyslipidemia, *n* (%)		9 (9)	8 (12)	NS
History of previous stroke, *n* (%)		16 (17)	15 (22)	NS
Cardiac diseases, *n* (%)		18 (19)	18 (27)	NS
Smoking, *n* (%)		18 (19)	18 (27)	NS
Dementia, *n* (%)		26 (27)	24 (36)	NS
Aphasia, *n* (%)		15 (16)	15 (22)	NS
Unilateral spatial neglect, *n* (%)		13 (14)	12 (18)	NS
Living with another person, *n* (%)		77 (80)	40 (63)	<0.05
Subtype of stroke, *n* (%)	Intracerebral hemorrhage	39 (41)	26 (39)	NS
	Cerebral infarction	57 (59)	41 (61)	
Side of hemispheric lesion, *n* (%)	Left	59 (61)	35 (52)	NS
	Right	37 (39)	32 (48)	
Period of hospitalization (days) mean±SD		107.9±50.1	120.3±48.0	<.01
Median NIHSS score at admission (interquartile range)		4 (2–8)	9 (3–13)	<.001

Table 2. Multivariable analyses of the probability of home discharge. Four items that showed significant relationship with discharge destination in univariate analysis were selected for multivariate logistic regression analysis. OR : Odds ratio, CI : confidence interval.

	Adjusted OR	95% CI	p value
Younger age at admission (per year decrease)	1.10	1.05–1.18	<.001
Living with another person	3.62	1.47–8.92	<.005
Period of hospitalization (per day decrease)	0.98	0.94–1.02	NS
Lower NIHSS score (per point decrease)	1.22	1.05–1.29	<.001

1-point decrease in the NIHSS score, the odds of home discharge increased by 22% (odds ratio, 1.22 ; 95% confidence interval, 1.05–1.29 ; p<0.001). The AUC of the final model, which included age, living with another person, and NIHSS score, was 0.818.

Comparison between patients with left-side and right-side brain lesions

In a categorical approach when stratified according to 4 NIHSS score categories, patients with left cerebral lesions tended to be discharged home more often than were patients with right cerebral lesions (Table 3). In particular,

Table 3. Frequency of home discharge in patients with left and right cerebral lesions. The frequencies of home discharge for patients with left and right lesions were compared using Fisher's exact test after stratification according to four NIHSS score categories with 5-point interval.

NIHSS score at admission	Patients with left lesions (n=94)	Patients with right lesions (n=69)	p value
0–5	83% (39 of 47)	63% (24 of 38)	<0.05
6–10	56% (10 of 18)	50% (7 of 14)	NS
11–15	47% (7 of 15)	40% (4 of 10)	NS
≥16	29% (4 of 14)	14% (1 of 7)	NS

Table 4. Adjusted relative risk reflecting the probability of home discharge. Relative risk was calculated using the category with NIHSS score of 0–5 as a reference and adjusted for age at admission and the availability of a living partner. Values in parenthesis represent 95% confidence interval. Relative risks in bold were statistically significant.

NIHSS score at admission	Patients with left lesions (n=94)	Patients with right lesions (n=69)
0–5	Referent	Referent
6–10 vs 0–5	0.72 (95% CI : 0.44–1.09)	0.81 (95% CI : 0.47–1.39)
11–15 vs 0–5	**0.51 (95% CI : 0.22–0.82)**	**0.46 (95% CI : 0.06–0.88)**
≥16 vs 0–5	**0.39 (95% CI : 0.17–0.94)**	0.18 (95% CI : 0.04–1.21)

the frequency of home discharge in the category with an NIHSS score of 0 to 5 was significantly higher in patients with left-sided lesions than in those with right-sided lesions (p<0.05). In patients with left cerebral lesions, the relative risk adjusted for age and the availability of a living partner indicated that the likelihood of home discharge in the categories of an NIHSS score of 11 to 15 and of ≥16 was significantly higher than that in the category of an NIHSS score of 0 to 5. Similarly, in patients with right cerebral lesions, the likelihood of home discharge in the category of an NIHSS score of 11 to 15 was significantly higher than that in the category of an NIHSS score of 0 to 5. The AUC of the ROC curve for the NIHSS score alone to predict home discharge was 0.741 in patients with left cerebral lesions and 0.713 in patients with right cerebral lesions. For patients with left cerebral lesions, the optimal cutoff value of the NIHSS score for home discharge was 7, with a sensitivity of 79% and specificity of 73%. For patients with right cerebral lesions, the optimal cutoff value of the NIHSS score was 4, with a sensitivity of 69% and a specificity of 66%.

Discussion

Several studies of the predictive value of patients' characteristics at admission to the rehabilitation department in the postacute phase of stroke for discharge destination have been published. Massucci et al.[14] have shown that certain clinical findings, such as cognitive impairment and dysphagia, at admission to rehabilitation department are significant predictors of discharge destination after long-term rehabilitation. Similarly, Frank et al.[15] have reported that the functional independence measures score in the postacute phase, the availability of another person living with the patient, and independent sitting balance are significant determinants of discharge destination from the rehabilitation department. However, these studies did not include the comprehensive neurological impairment scale as an item for analysis. The NIHSS score has been considered a reliable objective measure for comprehensive neurological estimation. Therefore, we aimed to clarify the predictive value of the NIHSS score determined during the postacute phase of stroke for discharge destination after long-term rehabilitation.

The results of the present study show that 3 factors—the NIHSS score determined at admission to the rehabilita-

tion department, age at admission, and the availability of a living partner—independently and significantly influence the discharge destination after long-term rehabilitation, with an acceptable predictive power, judging from the calculated AUC. However, the AUC for NIHSS score at admission was only slightly lower, both in patients with left cerebral lesions and those with right cerebral lesions, compared with those of 3 other items (age, availability of living partner, NIHSS score). Therefore, we believe that the NIHSS score at admission to the rehabilitation department is a predictor of home discharge after long-term rehabilitation, although the predictive power of the score obtained in the postacute phase was less than that of the score obtained in the acute phase[10,11]. It is possible that differences in patient population between those admitted to an acute care hospital and to a rehabilitation department contributed to the difference in the predictive power of the NIHSS score. Usually, patients with severe impairment at onset and considered during hospitalization at the acute care hospital to need transfer to nursing facilities are neither referred nor admitted to the rehabilitation department. In fact, our subjects did not include those with severe impairment with an NIHSS score of >29 at admission. This exclusion can make NIHSS-based discrimination of patients discharged home from those transferred to other facilities more complex and difficult. The finding that age and the availability of a living partner significantly influenced discharge destination was in agreement with previous reports[9-11].

In the present study, we compared the frequency of home discharge between patients with left cerebral lesions and those with right cerebral lesions and determined the difference in optimal cutoff values of the NIHSS score for predicting discharge destination. Fink et al.[12] have studied the relationship between the NIHSS score and the volume of the acute lesion on magnetic resonance imaging and demonstrated differences in the clinical significance of the NIHSS score between patients with left cerebral lesions and those with right cerebral lesions. They also reported that lesions tend to be larger in patients with right-sided lesions than in patients with left-sided lesions when stratified according to NIHSS score categories, and the tendency was most apparent in those with an NIHSS score of 0 to 5. In other words, the NIHSS score was expected to be higher in patients with left-sided lesions than in those with right-sided lesions, provided the lesions were of similar size. The main reason for the finding was believed to be the greater influence on the total NIHSS score of the language center in the left cerebral hemisphere than that of neglect related to the right cerebral hemispheric damage. Fink et al. recommended that special attention be paid to this difference in clinical practice, especially in determining eligibility for treatment with tissue plasminogen activator. After the publication of the study by Fink et al., however, no other study has examined whether the significance of the NIHSS score as a predictor of outcome, such as discharge destination, differs between patients with left cerebral lesions and patients with right cerebral lesions. The present study found that the frequency of home discharge was generally higher in patients with left cerebral lesions than in those with right cerebral lesions for all NIHSS score strata, although the significance of the difference was found only in the category with an NIHSS score of 0 to 5. In addition, ROC analysis indicated that the cutoff value of the NIHSS score for predicting home discharge was higher in patients with left-sided lesions than in those with right-sided lesions. Although the exact reason for the observed differences is not clear at present, we propose the following mechanisms to explain these results. First, the volume of undamaged areas that can compensate for the neuronal deficit is probably larger in patients with left cerebral lesions than in those with right cerebral lesions after adjusting for the NIHSS score, based on the difference in the relation between lesion size and the NIHSS score between patients with left-sided lesions and those with right-sided lesions, as mentioned above. Second, the NIHSS score can be higher in patients with left-sided lesions than in those with right-sided lesion following adjustment for the severity of motor impairment, because the NIHSS score is more influenced by cognitive impairment in patients with left cerebral lesions than in patients with right cerebral lesions. This difference can also explain the difference in the cutoff value of the NIHSS score between the 2 groups of patients. We emphasize that the difference in the predictive value of the NIHSS score for outcome between patients with left-sided lesions and those with right-sided lesions should be taken into account when the NIHSS score is used as a predictor of clinical outcome.

Our study has several limitations. First, the sample was small and from a single institution, and, thus, the find-

ings need to be confirmed in larger studies of several institutions. Second, the time to admission to the rehabilitation department after stroke onset was relatively long, although there was no significant difference in the time to home discharge and the time to transfer discharge. Third, sufficient data on the socioeconomic status of participating patients were not available for thorough analysis other than the information about the availability of another person living with the patients. Other data, such as income and caregivers' occupation, reflecting the availability of caregivers' support, would have added further depth to the analysis.

In conclusion, our study has shown that discharge destination after long-term rehabilitation is significantly influenced by the NIHSS score at admission to the department, although the predictive value of the score for home discharge is relatively low when evaluated during the postacute phase of stroke. The results also show a higher frequency of home discharge in patients with left cerebral lesion than in patients with right cerebral lesions when stratified according to NIHSS score categories. Taking the latter difference into account, further studies of larger patient populations from various institutions across Japan are needed to confirm the significance of the NIHSS score in evaluating the postacute phase as a predictor of clinical outcome of long-term rehabilitation.

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