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Original Article

Relationship between change in ADL during two weeks from admission and ADL at discharge in post-stroke patients admitted to Kaifukuki rehabilitation wards

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ABSTRACT

Hori H, Sonoda S, Watanabe M, Okuyama Y, Okamoto S, Okazaki H. Relationship between change in ADL during two weeks from admission and ADL at discharge in post-stroke patients admitted to Kaifukuki rehabilitation wards. Jpn J Compr Rehabil Sci 2019; 10: 82–87.

Objective: In post-stroke patients admitted to *Kaifukuki* (comprehensive inpatient) rehabilitation wards, we investigated whether the level of activities of daily living (ADL) at discharge differs depending on the change in Functional Independence Measure (FIM) score from admission to 2 weeks post-admission.

Methods: A total of 2,636 post-stroke patients were studied. Total scores of FIM motor subscale (FIMM) were divided into 7 grades (FIMM7) and total scores of FIM cognitive subscale (FIMC) were also divided into 7 grades (FIMC7). The FIMM7 or FIMC7 on admission and that at 2 weeks post-admission were compiled in a cross table, and the median values of FIMM on admission, FIMM at discharge, FIMM gain, and FIMM efficiency were calculated, and the differences were analyzed statistically.

Results: For both FIMM7 and FIMC7, as the difference in score between admission and 2 weeks post-admission became greater, more combinations showed significantly higher FIMM at discharge and higher FIMM gain/efficiency.

Conclusion: Patients showing improvement in FIMM or FIMC from admission to 2 weeks post-admission may have better ADL outcomes.

Key words: stroke, rehabilitation, convalescent stage, ADL, outcome prediction

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Introduction

Stroke is one of the major diseases that require rehabilitation, and outcome prediction in these patients is important [1, 2]. In Japan, *Kaifukuki* (comprehensive inpatient) rehabilitation wards (KRW) [3] have a total of more than 80,000 beds, and outcome prediction in KRW has become an issue. Although there are some articles that predict outcome at discharge from the data at the time of admission to KRW [4−6], there are few reports that additionally examine other changes such as change in level of activities of daily living (ADL) after admission [7−10].

ADL outcome is influenced by various inhibiting factors such as cognitive function decline and sensory impairment [1, 2, 11−13]. These factors exert diverse effects on outcome depending on various patient attributes [14]. However, except the article by Niki [10], previous studies have not presumed that the inhibiting factors themselves may change. We consider that it would be useful to examine how the ADL outcome alters if the inhibiting factors change after admission.

In the present study, we examined how the level of ADL at discharge varies depending on the change in Functional Independence Measure (FIM) [15] score during 2 weeks from admission to KRW, and report our findings here.

Subjects and Methods

The study population was 5,191 post-stroke patients who were admitted to and discharged from the KRW of our hospital between September 2004 and March 2017. Among them, 2,636 patients who had the first stroke with unilateral lesion, had no incidents such as relapse during hospitalization, and showed no decrease in total score of FIM motor subscale (FIMM) were extracted. All patients underwent the full-time integrated treatment program that provided training 7 days a week with the concept of

Table 1. Characteristics of 2,636 patients studied.

Male : Female	1,573 : 1,063
Cerebral infarction : cerebral hemorrhage : subarachnoid hemorrhage	1,177 : 1,338 : 121
Laterality of cerebral lesion; left : right	1,289 : 1,347
Age (years)	65.9±13.2
Duration from stroke onset (days)	36.0±26.0
Mean length of hospitalization (days)	65.4±40.6

Data are expressed as number of patients or mean ± SD.

engaging in active life all day [16]. Table 1 shows the characteristics of the subjects.

All subjects were assessed using the 18-item FIM measured on admission, 2 weeks post-admission, and at discharge, and the FIMM and the total score of FIM cognitive subscale (FIMC) were calculated. Histograms of FIMM and FIMC on admission were generated.

Next, FIMM and FIMC were both divided into 7 grades, termed FIMM7 and FIMC7, respectively. For FIMM7, grades 1 to 7 were FIMM scores of 13 points, 14 to 26 points, 27 to 39 points, 40 to 52 points, 53 to 65 points, 66 to 78 points, and 79 to 91 points, respectively. For FIMC7, grades 1 to 7 were FIMC scores of 5 to 9 points, 10 to 14 points, 15 to 19 points, 20 to 24 points, 25 to 29 points, 30 to 34 points, and 35 points, respectively. For each combination of FIMM7 on admission and that at 2 weeks post-admission, the median values of number of patients, FIMM on admission, FIMM at discharge, FIMM gain (FIMM at discharge − FIMM on admission), and FIMM efficiency (FIMM gain ÷ days of hospitalization) were calculated and cross-tabulated. Columns with fewer than 10 patients were excluded from analysis. Then, each pair by row and by column was compared by Wilcoxon's test. In a separate analysis, each combination of FIMC7 on admission and that at 2 weeks post-admission was analyzed by the same method as described above for FIMM7.

Statistical analyses were performed using JMP (version 14, SAS Institute). This study was conducted after obtaining approval from the Ethics Committee of Fujita Medical University (approval number: HM19-006).

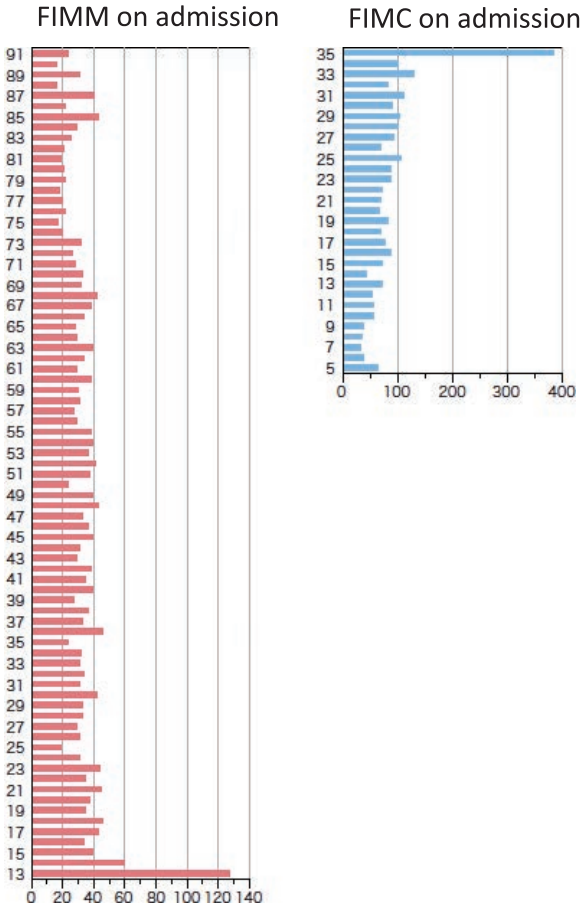

Figure 1. Histograms of FIMM and FIMC on admission.
FIMM and FIMC on admission and their distributions.

Results

Figure 1 shows the histograms of FIMM and FIMC on admission. The mode value for FIMM score was 13 points, and that for FIMC score was 35 points.

Table 2 shows the results of statistical analyses of all the combinations of FIMM7 on admission and FIMM7 at 2 weeks post-admission, for the number of patients (Table 2a), median FIMM on admission (Table 2b), median FIMM at discharge (Table 2c), median FIMM gain (Table 2d), and median FIMM efficiency (Table 2e). For FIMM on admission, FIMM at discharge, FIMM gain, and FIMM efficiency, combinations showing a significant difference ($p < 0.05$) when analyzed using Wilcoxon's test by row or by column are marked by asterisks (*).

When comparing cells in the same row, for the table of median FIMM on admission, compared with the cells in the diagonal line, the values of the cells on their right were significantly higher. For the tables of FIMM at discharge, FIMM gain, and FIMM efficiency, the values in the column on the right were significantly higher for all combinations. In other words, as FIMM7 improved, the median values of FIMM at discharge, FIMM gain, and FIMM efficiency became higher. When comparing cells in the same column, for FIMM on admission, the values in the lower cells were significantly higher. For FIMM at discharge, significant differences were observed only for FIMM7 grades 2 and 7. For FIMM gain and FIMM efficiency, significant

Table 2. Cross-tabulation of FIMM7.

a. Number of patients

On admission \ 2 weeks post-admission	1	2	3	4	5	6	7	Total
1	73	48						121
2	1	344	121	21	3			490
3		1	192	188	42	4		427
4			2	156	245	52	5	460
5					155	229	39	423
6						199	150	349
7						1	270	271
Total	74	393	315	365	445	485	464	2541

b. Median FIMM on admission

On admission \ 2 weeks post-admission	1	2	3	4	5	6	7
1	13	13					
2		18	23	24			
3			30	35	36		
4				43	48	49	
5					56	60	61
6						69	73
7							85

c. Median FIMM at discharge

On admission \ 2 weeks post-admission	1	2	3	4	5	6	7
1	14	27.5					
2		33	55	74			
3			55	71	78.5		
4				69	77	83	
5					77	82	89
6						83	88
7							90

d. Median FIMM gain

On admission \ 2 weeks post-admission	1	2	3	4	5	6	7
1	1	14.5					
2		15	32	50			
3			23.5	35.5	42.5		
4				26	30	34	
5					20	22	27
6						13	14
7							4

e. Median FIMM efficiency

On admission \ 2 weeks post-admission	1	2	3	4	5	6	7
1	0.01	0.14					
2		0.18	0.33	0.53			
3			0.26	0.44	0.59		
4				0.32	0.41	0.53	
5					0.3	0.4	0.66
6						0.27	0.42
7							0.13

differences were found in all combinations for FIMM7 grades 3 to 7. Furthermore, in the table of FIMM at discharge, the values in a given row showed a progressive increase along the direction toward the right, in all the rows. Moreover, significant differences were observed between almost all the cell combinations in the same row.

Table 3 shows the same cross-tabulation as in Table 2 for all the combinations of FIMC7 on admission and FIMC7 at 2 weeks post-admission. For the number of patients (Table 3a), FIMM on admission (Table 3b), FIMM at discharge (Table 3c), FIMM gain (Table 3d), and FIMM efficiency (Table 3e), combinations showing a significant difference ($p < 0.05$) when analyzed using Wilcoxon's test by row and by column are marked by asterisks (*). For the tables of FIMM on admission and FIMM at discharge, significant differences were observed in almost all combinations when comparing the same row. When comparing the same column, however, significant differences were observed only when FIMC7 was high. For the table of FIMM gain, significant differences were found in many combinations both when comparing the same row and when comparing the same column, but there was no significant difference when comparing the same row in patients with high FIMC7. For the table of FIMM efficiency, significant differences were observed in almost all combinations both when comparing the same row and when comparing the same column.

Table 3. Cross-tabulation for FIMC7.

a. Number of patients

On admission \ 2 weeks post-admission	1	2	3	4	5	6	7	Total
1	176	26	3	2				207
2	1	231	41	3				276
3		4	308	62	10	1		385
4			3	270	89	6	3	371
5			2	2	351	95	12	462
6		1			1	432	60	494
7				2		5	339	346
Total	177	262	357	341	451	539	414	2541

b. Median FIMM on admission

On admission \ 2 weeks post-admission	1	2	3	4	5	6	7
1	14	18.5					
2		22	27				
3			31	37	56.5		
4				39	50		
5					47	54	60
6						60	62
7							73

c. Median FIMM at discharge

On admission \ 2 weeks post-admission	1	2	3	4	5	6	7
1	22	51					
2		46	61				
3			59	68.5	85		
4				70	80		
5					77	83	83.5
6						82	87
7							87

d. Median FIMM gain

On admission \ 2 weeks post-admission	1	2	3	4	5	6	7
1	7	27.5					
2		19	24				
3			21	27	26		
4				22	29		
5					24	27	22
6						20	22
7							13

e. Median FIMM efficiency

On admission \ 2 weeks post-admission	1	2	3	4	5	6	7
1	0.08	0.29					
2		0.22	0.38				
3			0.27	0.35	0.32		
4				0.31	0.41		
5					0.32	0.43	0.4
6						0.37	0.42
7						0.41	0.29

Discussion

The results of this study showed that patients who showed improvements in FIMM or FIMC from admission to 2 weeks post-admission tended to have better FIMM at discharge, FIMM gain and FIMM efficiency, compared with patients showing no improvement in FIMM or FIMC, respectively.

The factors related to outcome of stroke rehabilitation include ADL level, paralysis and cognitive function in the early stage [1, 2]. The present study used FIMM and FIMC to assess the changes after admission. Many reports have used the data of FIM score on admission to predict the outcome of rehabilitation [4, 5, 14, 17]. We selected FIMM and FIMC as outcome measures because the change in FIMM during 2 weeks of admission is considered to be a direct indicator of the degree of improvement, and the change in FIMC during the 2 weeks is considered to indicate the changes in the state of unilateral visuo-spatial neglect and other ADL-inhibiting factors related to cognitive function. Change in 2 weeks was chosen as the assessment criterion to allow earlier prediction of outcome.

Examination of the histograms of FIMM and FIMC on admission confirmed that the number of patients with FIMM of 13 points was markedly large, while the number with FIMC of 35 points was also large. We

considered that these findings indicated the floor effect of FIMM and the ceiling effect of FIMC. Therefore, we analyzed the FIMM of 13 points and the FIMC of 35 points independently, then divided the remaining scores into ranges of 13 points each for FIMM and 5 points each for FIMC and assigned a change of 1 point on average for each item to obtain the classification of FIMM7 and FIMC7 grades.

In the present study, the cross tables of FIMM or FIMC on admission versus those at 2 weeks post-admission were analyzed by row and by column. When interpreting the data in the row direction, we examined how FIMM changed in patients with the same score range on admission by comparing their differences in score changes during the first 2 weeks of admission. When discussing the data in the column direction, we assessed how FIMM differed in patients who had the same score range at 2 weeks post-admission by determining whether the score range was achieved by improvement or whether it remained unchanged from the time of admission.

In the cross tables of FIMM7 on admission versus FIMM7 at 2 weeks post-admission, patients whose FIMM7 increased after the first 2 weeks, in other words, patients located in the cells on the right of the diagonal cells in Table 3, generally showed higher scores in FIMM at discharge, FIMM gain, and FIMM efficiency. Among these data, FIM at discharge was not different among cells in the same column in many patients, and none of the values in the adjacent left column exceeded those in the right column. These findings suggest that the data of FIMM at 2 weeks post-admission alone predicts the trend of FIMM at discharge better than the data of FIMM on admission alone. This may be due to the fact that the FIM scores of "actually doing" ADL inevitably show large deviations immediately after patients are transferred to the KRW, which would be a factor that adversely affects the accuracy of outcome prediction. Regarding FIMM efficiency, patients with improved FIMM7 after 2 weeks of admission showed higher FIMM efficiency, suggesting that adding FIMM7 improvement at 2 weeks to the indices obtained at 2 weeks post-admission would improve the accuracy of predicting FIMM efficiency. This result supports the report of Niki [10] who used the data at 2 weeks and 1 month after admission additionally to predict the outcome in acute stroke patients, and pointed out the inadequacy of reports using the data on admission alone to predict outcome.

We found that when FIMC7 improved at 2 weeks post-admission compared to that on admission, FIMM at discharge, FIMM gain, and FIMM efficiency also improved. This finding may be a result of improvement of all symptoms such as attenuation of brain edema, or mitigation of the influence of inhibiting factors of cognitive function. The latter raises the issue that inhibiting factors have been assumed to remain unchanged during hospitalization [11, 12]. It is obvious that if an inhibiting factor that is present on admission disappears, the final ADL level will be higher than that predicted on the assumption that the inhibiting factor present on admission continues to exert an effect. However, although several articles have shown that the rate of possession of inhibiting factors changes from admission to discharge [18, 19], only Niki [10] applied the change in inhibiting factors during hospitalization to outcome prediction, and presented combinations of prediction from the state on admission, prediction at 2 weeks and prediction at 1 month after admission all together.

As reported by Okamoto et al. [14], the influence of inhibiting factors is not uniform but differs depending on the ADL level of the patients. In addition, as demonstrated in our present study, if the inhibiting factors improve during hospitalization, a better outcome may be achieved. Hence, the influence of inhibiting factors on ADL outcome is not simple. Further studies are warranted to explore methods of predicting outcome that take into consideration this complex influence.

Limitations of the study

In this study, 7 grades of FIMM7 and 7 grades of FIMC7 were used. Due to the broad ranges, the prediction is not sufficiently accurate for predicting the outcome of individual patients. If, in order to improve accuracy, the processing were to be performed using the crude FIMM scores of 13 to 91 points or crude FIMC scores of 5 to 35 points, the number of combinations would be enormous; the number of cases required for such analysis could not be secured this time. In the future, we will increase the number of cases and conduct a study with more finely classified grades.

This study examined the changes from admission and did not consider the number of days from onset. If the study period was set as the number of days from onset, additional study of the degree of spontaneous recovery since onset would have been possible. On the other hand, considering that active rehabilitation starts from the time of admission, it is also meaningful to set the time of admission as the starting point, as in the present study. Since a research system for studying a combination of both would be very complex, we limited the observation of change from admission to discharge in this study.

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