J. Phys. Ther. Sci. 36: 352–358, 2024

The Journal of Physical Therapy Science

Original Article

Factors influencing the prognosis of patients with acute cerebral infarction who received usual care: a multicenter prospective cohort study

Hirofumi Sato, RPT, MS[1)], Shinsuke Okawa, RPT, BS[1)], Reina Kakehata, RPT, BS[1)], Asuka Takayama, RPT, BS[1)], Katsunobu Okuma, RPT, MS[1)], Kazuhiro Fukata, RPT, PhD[2)], Hiroshi Miki, RPT, MS[3)], Yohei Kobayashi, RPT, BS[4)], Koki Hasegawa, RPT, BS[5)], Tadamitsu Matsuda, RPT, PhD[6)], Yuji Fujino, RPT, PhD[6)*]

[1)] *Department of Rehabilitation, Saitama Citizens Medical Center, Japan*
[2)] *Department of Rehabilitation, Musashidai Hospital, Japan*
[3)] *Department of Rehabilitation, Tokyo Saiseikai Central Hospital, Japan*
[4)] *Department of Rehabilitation, Saitama Sekishinkai Hospital, Japan*
[5)] *Department of Rehabilitation, Sainokuni Higashiomiya Medical Center, Japan*
[6)] *Department of Physical Therapy, Faculty of Health Science, Juntendo University: 3-2-12 Hongo Bunkyo-ku, Tokyo 113-0033, Japan*

Abstract. [Purpose] The prognostic factors for patients with acute stroke who received usual care (mobilization ≥48 h after admission) remain unclear. This study aimed to investigate the prognostic factors that predict functional outcomes using evaluations performed immediately after onset in patients with acute cerebral infarction who received usual care from admission until discharge. [Participants and Methods] Participants with acute cerebral infarction admitted to five acute care hospitals in Tokyo and Saitama, Japan and prescribed physical therapy were included. Participants information, functional evaluations, and progress were recorded during the first physical therapy session, mobilization, and discharge. Participants who received usual care were assigned to either the good- or poor-outcome group based on the Modified Rankin Scale at discharge. [Results] In total, 161 Participants receiving usual care (mobilization ≥48 h after admission) were included. Reinfarction and the First National Institutes of Health Stroke Scale score were identified as independent predictors of functional outcome at hospital discharge in participants who received usual care (median, 22.0 d). The cutoff NIHSS score was 4. [Conclusion] Our results provided evidence that the National Institutes of Health Stroke Scale score and reinfarction are useful predictors of functional outcomes in participants who received usual care.

Key words: Cerebral infarction, Usual care, Functional prognosis

(This article was submitted Jan. 15, 2024, and was accepted Mar. 11, 2024)

INTRODUCTION

Early and high-frequency mobilization is necessary for the rehabilitation of patients with acute stroke as it improves activities of daily living (ADL) and functional prognosis[1, 2]. Several studies that compared an early mobilization group to a usual care group reported that the early mobilization group had significantly improved Barthel Index (BI) scores, Modified Rankin Scale (mRS), and reduced hospital stay without worsened functional prognosis or mortality[3, 4]. In contrast, a meta-analysis of early mobilization in patients with stroke reported that early mobilization was not effective in improving mRS (relative risk [RR]: 0.96; 95% confidence interval [CI]: 0.86–1.06) or preventing complications (RR: 1.04; 95% CI:

*Corresponding author. Yuji Fujino (E-mail: y.fujino.pb@juntendo.ac.jp)

0.52–2.09) 3 months after stroke onset[5]. Overall, the results of previous studies have been inconsistent, and it remains unclear whether early mobilization promotes better outcomes than the usual mobilization time. Nonetheless, it is generally agreed that early mobilization in patients with acute stroke is an important factor in acute phase rehabilitation because it prevents complications and disuse atrophy.

Early mobilization reportedly improves functional prognosis and walking ability[6, 7] and prevents disuse atrophy and complications[8]. In patients with acute stroke, the autoregulation of cerebral circulation is disrupted[9] and autonomic regulation is impaired[10, 11]. Changes in blood pressure during early mobilization may worsen a stroke. Clinically, some patients receiving usual care regain their walking ability and have good mobilization outcomes. Currently, unified reports on early mobilization in patients with acute stroke are lacking. To date, a certain number of patients have received usual care (median first mobilization time: 33.3 hours)[12]. In this study, there was slight difference in independence and functional outcome between the early mobilization group and the usual care group. There is skepticism about the effectiveness of early mobilization; therefore, we think it is important to investigate the effects of rehabilitation in patients receiving usual care. Based on previous studies[6, 7], we hypothesized that neurological severity and other factors would be prognostic factors, regardless of whether early mobilization was possible or not. Further studies on the factors associated with good outcomes can provide evidence that will help avoid risks in the early mobilization of patients with acute stroke. Therefore, we thought that avoiding risky courses of action and ensuring uniform mobilization would promote safe, secure, and delay-free rehabilitation. Examining the prognostic factors in patients receiving usual care is important for promoting effectiveness of rehabilitation.

The purpose of this study was to investigate prognostic factors in patients with acute cerebral infarction receiving usual care from the time of disease onset until the time of mobilization, rather than in the early mobilization group.

PARTICIPANTS AND METHODS

This was a multicenter prospective cohort study conducted in accordance with the Declaration of Helsinki. Approval for this study was obtained from the ethics committee of each institution (Saitama Citizens Medical Center: 2016-02, Saitama Medical University International Medical Center: 16-123, Tokyo Saiseikai Central Hospital: 28-52, Saitama Sekishinkai Hospital: 28-18, and Sainokuni Higashiomiya Medical Center: 17).

Five acute care hospitals in Tokyo and Saitama participated in this study. Participants with acute cerebral infarction who were hospitalized at each institution and prescribed physical therapy (PT) between January 1 and June 30, 2017, were included in this study. Details of the study were given as hard copy to all participants, and they each signed an informed consent form. For participants who were unable to sign the informed consent form, the signature of one of their family members was obtained.

We recruited participants with first-time cerebral infarction who were independent in ADLs before admission (pre-onset ADL), at least 18 years old, and consent to participate in this study has been obtained. The average age of all participants was 71.81 ± 11.42 years. Participants with subtentorial lesions were excluded from this study. As many hospitals in Japan are closed on Sundays, patients with cerebral infarction were excluded if they reported for admission on a Saturday because of concerns about delayed mobilization. Pre-mRS ≥3 cases, deaths during hospitalization, and cases with missing data were also excluded based on previous study[13].

PT was prescribed by a doctor, and mobilization started as early as possible. Mobilization was defined as "out of bed" (i.e., when the body is not in contact with the bed), as in previous studies[1, 5, 7]. Detailed mobilization criteria, such as participants' blood pressure, were not set. After a participant was stabilized, standing and walking exercises were performed, and orthoses were used as appropriate. For participants who had difficulty with mobilization, we performed range of motion and muscle strengthening exercises to prevent disuse syndrome and performed respiratory physiotherapy exercises to prevent respiratory complications.

The evaluations were conducted at the first PT session, first mobilization, and end of the PT sessions (evaluation at discharge). Components of the evaluation and its method were discussed by the representatives of each facility, and efforts were made to ensure uniformity. The evaluation items included age; sex; mRS; etiology; lesion side; hyperacute cerebral infarction treatment (thrombolysis [t-PA], thrombus retrieval, or both); cerebral infarction-related complications; nutritional status (as determined based on measurement of serum albumin [Alb]); National Institutes of Health Stroke Scale (NIHSS) score; upper limb, hand, and lower limb Brunnstrom Recovery Stage (BRS); presence of consciousness disorder; trunk control test (TCT); revised version of the Ability for Basic Movement Scale (ABMS II) score; Scale for Contraversive Pushing (SCP) score; Functional Ambulation Category (FAC); BI; PT commencement date; mobilization commencement date; and the average number of PT sessions per day.

In Japan, one session of therapy lasts 20 min; PT, occupational therapy, and speech therapy can be performed for a maximum of 3 h (nine sessions) per day. Cerebral infarction-related complications (pneumonia, urinary tract infection, and deep vein thrombosis) were defined as complications diagnosed by a doctor after the start of PT that required treatment. Reinfarction and hemorrhagic infarction were also defined as infarctions diagnosed by a doctor after the start of PT that required a change in treatment (e.g., drugs, hyperacute cerebral infarction treatment) or change in resting level.

The collected data were recorded and stored on a computer by a representative from each facility. Based on a previous study[5], participants who could not be mobilized within 48 h were classified as the usual care group. Based on previous study[1, 3, 5, 6)], in the usual care group, participants with an mRS score <3 at discharge were assigned to the good outcome group (GOG), whereas those with an mRS score ≥3 at discharge were assigned to the poor outcome group (POG) for analysis. After testing for normality using the Shapiro–Wilk test, the Mann–Whitney U and χ^2 tests were performed to analyze differences between the GOG and POG. Multiple logistic regression analysis was performed to assess prognostic factors, and the variables that were significantly different between the GOG and POG were used as independent variables. To eliminate the influence of multicollinearity of the independent variables, Spearman's rank correlation test was performed; if the correlation coefficient was ≥0.7, one of the variables was excluded from the analysis, and variables with a variance inflation factor (VIF) of ≥4 points in the multiple logistic regression analysis were also excluded. Receiver operating characteristic (ROC) curves were calculated for continuous variables that were included in the multiple logistic regression analysis, and cutoff values were calculated using Youden's index. Categorical data, including sex (male or female), lesion side (right, left, or both sides), etiology (cardiogenic, atheroma, lacuna, or other), hyperacute cerebral infarction treatment (yes or no), presence of consciousness disorder (yes or no), and complications (yes or no), were treated with dummy variables.

Statistical analyses were performed using IBM SPSS Statistics (ver. 27.0; SPSS Inc., Tokyo, Japan). The level of significance was 5%. Participants with missing data were excluded from the analysis.

RESULTS

Among 887 participants hospitalized for cerebral infarction and scheduled for PT, 611 provided informed consent. Of these, 396 had acute cerebral infarctions. Participants who met the following exclusion criteria were excluded: those with a subtentorial lesion (n=79), those who were hospitalized on a Saturday (n=10), those who died during hospitalization (n=3), those with pre-onset mRS ≥3 (implying that they were dependent on caregivers; n=28), those with missing data (n=15), and those who underwent early mobilization (<48 h after admission; n=100). In total, 161 participants who received usual care (mobilization started ≥48 h after admission) were included in the analysis (Fig. 1).

Participants receiving usual care were divided into two groups: GOG (mRS score at discharge <3, n=83) and POG (mRS score at discharge ≥3, n=78).

The Mann–Whitney U and χ^2 tests were performed to compare variables between the GOG and POG (Table 1). The patients in the GOG were significantly younger and had lower pre-mRS scores; fewer complications, such as reinfarction and hemorrhagic infarction; lower NIHSS scores; and higher TCT, ABMS II, and BI scores than the participants in the POG. Although there was no significant difference in the number of days to first PT session, participants in the GOG were mobilized significantly earlier and underwent significantly fewer PT sessions than those in the POG. Hospital stays were significantly shorter and more participants were discharged in the GOG than in the POG.

Spearman's correlation analysis was performed for variables that were significantly different between the GOG and POG. The first hand (r=0.91, p<0.01) and upper-limb (r=0.88, p<0.01) BRS scores were positively correlated with the first lower-limb BRS score. In contrast, the first lower-limb BRS score (r=−0.70, p<0.01) and ABMS II (r=−0.78, p<0.01), TCT (r=−0.70, p<0.01), FAC (r=−0.69, p<0.01), and BI (r=−0.73, p<0.01) scores at the first mobilization were negatively correlated with the first NIHSS score. The first NIHSS score was included in the multiple logistic regression analysis, and the other variables were excluded (Table 2).

In the multiple logistic regression analysis, two independent variables were included: the presence of reinfarction (odds ratio: 3.21, 95% CI: 1.01–10.2, p=0.048) and the first NIHSS score (odds ratio: 1.16, 95% CI: 1.04–1.29, p=0.01). Neither of these variables had a VIF >4 points (Table 3).

The ROC curve was calculated for the first NIHSS score. According to Youden's index, the cutoff value for the first NIHSS score was 4 points. The area under the curve was 0.82, sensitivity was 0.833, and specificity was 0.663 (Fig. 2).

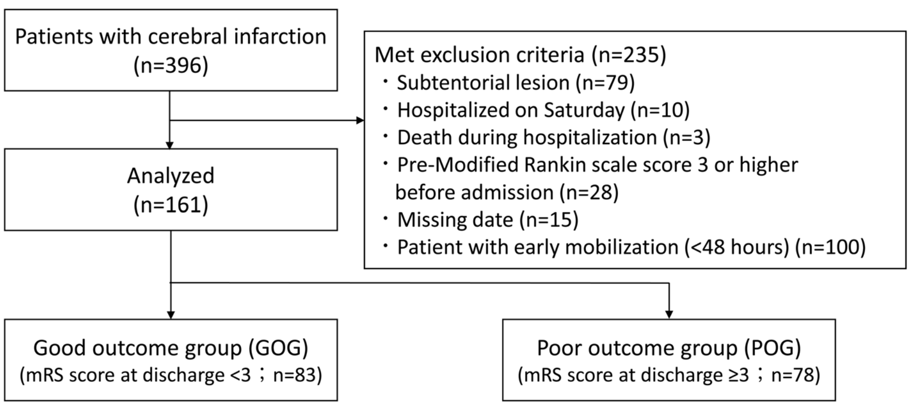

Fig. 1. Flow diagram for patient selection.

Table 1. Comparison between GOG and POG

	GOG (n=83)	POG (n=78)
Variable		
Age (years)	69.73 ± 12.05	74.03 ± 10.33*
Sex (male/female)	21/62	24/54
Pre-mRS (0/1/2)	70/3/4	56/8/14*
Lesion side (right/left/both)	40/41/2	34/40/4
Etiology (atheroma/cardiogenicity/lacuna/other)	32/25/23/3	28/30/17/3
Hyperacute stroke treatment (yes/no)	12/71	20/58
Albumin (mg/dL)	3.97 ± 0.42	3.93 ± 0.41
Medical history		
Cerebral infarction (yes/no)	16/67	12/66
Cerebral hemorrhage (yes/no)	1/82	4/74
Subarachnoid hemorrhage (yes/no)	0/83	0/78
Hypertension (yes/no)	47/36	41/37
Dyslipidemia (yes/no)	20/63	24/54
Diabetes (yes/no)	20/63	9/69
Stroke-related complications		
Respiratory infections (yes/no)	2/81	3/75
Urinary tract infections (yes/no)	0/83	1/77
Reinfarction (yes/no)	6/77	17/61*
Hemorrhagic infarction (yes/no)	81/2	63/15*
Functional evaluations		
Consciousness disorder (yes/no)	41/42	21/57**
First NIHSS score (points)	3.20 ± 4.11	10.88 ± 9.49**
First BRS of upper limb (I/II/III/IV/V/VI/non)	2/1/3/8/20/28/21	11/17/11/11/12/9/7**
First BRS of finger (I/II/III/IV/V/VI/non)	2/3/4/4/19/30/21	19/10/8/9/16/9/7**
First BRS of lower limb (I/II/III/IV/V/VI/non)	1/0/1/6/16/37/22	8/11/7/14/17/14/7**
First ABMS II score (points)	26.65 ± 4.85	17.45 ± 5.93**
First TCT score (points)	88.39 ± 22.29	39.56 ± 34.33**
First SCP score (points)	0.13 ± 0.69	1.41 ± 2.02**
First FAC (0/1/2/3/4/5)	8/1/14/30/20/10	41/16/14/4/1/2**
First BI score (points)	60.90 ± 26.76	19.36 ± 24.13**
NIHSS score at discharge (points)	1.33 ± 2.41	8.13 ± 7.06**
BRS of upper limb at discharge (I/II/III/IV/V/VI/non)	0/1/1/1/10/39/31	8/16/11/8/16/12/7**
BRS of finger at discharge (I/II/III/IV/V/VI/non)	0/2/0/3/9/38/31	15/13/5/11/15/11/8**
BRS of lower limb at discharge (I/II/III/IV/V/VI/non)	0/1/0/1/3/47/31	6/10/7/11/20/16/8**
SCP score at discharge (points)	0.07 ± 0.66	1.10 ± 1.74**
FAC at discharge (0/1/2/3/4/5)	0/1/1/2/20/59	18/21/10/21/6/2**
mRS at discharge (0/1/2/3/4/5)	18/27/38/0/0/0	0/0/0/21/43/14**
BI score at discharge (points)	95.66 ± 12.22	41.99 ± 31.97**
Progress		
First PT session (days)	2.92 ± 1.47	3.23 ± 3.25
First mobilization (days)	4.13 ± 1.80	6.82 ± 9.61**
Number of days in hospital (days)	21.63 ± 14.24	30.45 ± 18.20**
Average number of PT units per day (unit/days)	1.19 ± 0.56	1.54 ± 0.77**
Destination after leaving the hospital (home/transfer to another hospital)	62/21	4/74**

Continuous data are presented as mean value ± standard deviation (SD). Categorical data are presented as n. Significant difference *p<0.05, **p<0.01.
GOG: Good Outcome Group; POG: Poor Outcome Group; mRS: modified Rankin scale; NIHSS: National Institute of Health Stroke scale; BRS: Brunnstrom recovery scale; ABMS II: revised version of the Ability for Basic Movement scale; TCT: Trunk Control scale; SCP: Scale for Contraversive Pushing; FAC: Functional Ambulation Category; BI: Barthel Index; PT: Physical Therapy.

Table 2. Result of Spearman's correlation analysis

	r
Age vs. Pre-onset mRS	0.294**
Age vs. First NIHSS score	0.109
Age vs. Frist BRS of lower limb	−0.049
Age vs. First BRS of finger	−0.027
Age vs. First BRS of upper limb	0.004
Pre-mRS vs. First NIHSS score	0.194*
Pre-mRS vs. First BRS of lower limb	<0.01
Pre-mRS vs. First BRS of finger	0.014
Pre-mRS vs. First BRS of upper limb	0.004
First NIHSS score vs. First BRS of lower limb	−0.697**
First NIHSS score vs. First BRS of finger	−0.663**
First NIHSS score vs. First BRS of upper limb	−0.673**
First NIHSS score vs. First ABMSII score	−0.776**
First NIHSS score vs. First TCT score	−0.701**
First NIHSS score vs. First SCP score	0.637**
First NIHSS score vs. First FAC	−0.692**
First NIHSS score vs. First BI score	−0.731**
First NIHSS score vs. First BRS of upper limb	0.905**
Frist BRS of lower limb vs. First BRS of finger	0.878**

Significant difference *p<0.05, **p<0.01.
mRS: modified Rankin scale; NIHSS: National Institute of Health Stroke scale; BRS: Brunnstrom recovery scale; ABMS II: revised version of the Ability for Basic Movement scale; TCT: Trunk Control scale; SCP: Scale for Contraversive Pushing; FAC: Functional Ambulation Category; BI: Barthel Index.

Table 3. Result of Logistic regression analysis

	B	SE	OR	95% CI	
				Lower	Upper
Age	0.02	0.02	1.02	0.99	1.06
Pre-onset mRS	0.40	0.31	1.50	0.82	2.75
Reinfarction	1.17	0.59	3.23	1.02	10.27
Hemorrhagic infarction	1.79*	0.96	6.01	0.91	39.61
Consciousness disorder	0.44	0.41	1.56	0.70	3.48
First NIHSS Score	0.15**	0.06	1.16	1.03	1.29
First SCP score	0.42	0.27	1.52	0.89	2.58
First mobilization	0.13	0.07	1.14	0.99	1.31

Significant difference *p<0.05, **p<0.01.
B: regression coefficient; SE: standard error; OR: odds ratio; CI: confidence interval; mRS: modified Rankin scale; NIHSS: National Institute of Health Stroke scale; SCP: Scale for Contraversive Pushing.

DISCUSSION

The results of this study showed that reinfarction and the first NIHSS score (with a cutoff value of 4 points) were prognostic factors among patients with cerebral infarction who received usual care.

Neurological disorders assessed using the NIHSS have been reported to be a strong predictor of functional prognosis in participants with acute cerebral infarction. Inoa et al.[14] studied BI scores 3 months after discharge in patients with anterior circulation and posterior circulation cerebral infarction. They reported that the cutoff value for a good BI score was an NIHSS score of 8 in anterior circulation and 4 in posterior circulation at disease onset. Similarly, many studies have reported that the NIHSS score is a predictor of ADL[15–17]. In this study, the NIHSS score has a similar prognostic impact in participants with acute cerebral infarction who received usual care as reported in previous studies. In addition, participants with an NIHSS score ≤4 were more likely to have favorable outcomes than those with an NIHSS score >4. This information could be used for decision-making regarding early mobilization in participants with acute cerebral infarction. For example, participants

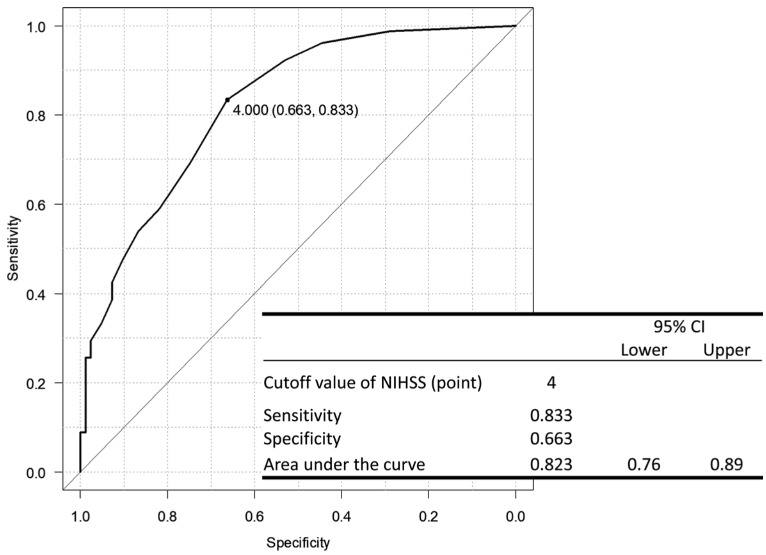

Fig. 2. Results of the ROC curve and cutoff values.
NIHSS: National Institutes of Health Stroke Scale; ROC: receiver operating characteristic; CI: confidence interval.

with an NIHSS score >4 would help to consider treatments such as aggressive early mobilization and electrical stimulation to improve prognosis.

Hilz et al.[11] reported that the severity of neurological disorders affects the regulation of circulation. Autonomic dysregulation and associated high systolic blood pressure at admission were independently associated with mortality and worsening of neurological disorders 10 days after admission[18, 19]. In the present study, NIHSS score and factors that exacerbate neurological disorders, such as reinfarction and hemorrhagic infarction, were higher in the POG than in the GOG. Autonomic dysregulation may have caused reinfarction or hemorrhagic infarction. These results support the results of previous studies and suggest that worsening of neurological disorders due to reinfarction or hemorrhagic infarction may be a factor affecting the prognosis of participants with cerebral infarction receiving usual care.

There are many reports on the role of age and rehabilitation intensity in the prognosis of participants with cerebral infarction, with younger and those receiving higher rehabilitation intensity having better ADLs[20, 21]. In contrast, the results of our multiple logistic regression analysis showed that age and rehabilitation intensity were not prognostic factors in participants with acute cerebral infarction receiving usual care. Although there was a significant difference in age, the mean difference was small (GOG was 69.73 ± 12.05 years, POG was 74.03 ± 10.33 years). The fact that reinfarction was extracted in the multiple logistic regression analysis suggests a strong influence of factors that inhibit functional recovery, such as brain plasticity. As a result, we suggest that factors indicative of neurological severity, such as the NIHSS, were also extracted in the multiple logistic regression analysis.

Although the effect of early mobilization has already been investigated in previous studies[2–4], we showed that the timing of the first mobilization did not affect the prognosis of participants with acute cerebral infarction receiving usual care. This result could hold significance for participants receiving usual care and could be explained by the fact that the timing of mobilization is not crucial for functional recovery, whereas the prevention of complications and disuse is important. There was no significant difference in complications between GOG and POG, suggesting that complication prevention initiated immediately after cerebral infarction onset was effectively implemented.

One of the limitations of this study is the lack of uniformity in the timing of the evaluation. There was a significant difference in the timing of the final evaluation between the GOG and POG, with a mean difference of approximately 10 days. Regarding consciousness disorders and final SCP, it is possible that they improved with the number of hospitalization days. If the timing of the evaluations was standardized, the factors influencing functional prognosis may have been different; thus, standardization of the timing of evaluation and comparing the early mobilization group should be considered in the future. In addition, we were unable to conduct a detailed investigation of higher brain dysfunction and cognitive function in this study. A previous study reported that many patients with cerebral infarction who required assistance in basic activities and walking had significantly lower cognitive function[22]; this should also be considered in future studies. Moreover, it may be necessary to examine not only the rehabilitation intensity based on the number of rehabilitation sessions but also the content of the exercise program, in a strictly controlled manner.

Early mobilization is considered necessary to prevent complications and disuse, but the results of this study, along with those of previous studies, suggest that early mobilization is not effective in all cases. Moreover, it was suggested that among participants receiving usual care, those with low NIHSS and no reinfarction were appropriately scheduled for early discharge.

However, in those with high NIHSS or reinfarction, high dose-response rehabilitation may be more effective for providing appropriate inpatient care and reducing the total hospitalization period. In the future, it will be desirable for many professionals involved with these patients to collaborate and promote comprehensive research.

In conclusion, in this multicenter, prospective cohort study, we investigated the factors that influence the prognosis of participants with acute cerebral infarction who received usual care during hospitalization. The prognosis of patients with acute cerebral infarction was affected by the first NIHSS score and occurrence of reinfarction, but not by the progress of rehabilitation or other factors. In addition, the cutoff value for the first NIHSS score was 4. In future studies, it would be desirable to control the timing of the evaluation, assess other related factors, and include more patients with higher brain dysfunction.

Funding

This work was supported by JSPS KAKENHI Grant Number 21K17499.

Conflict of interest

None.

REFERENCES

1) Bernhardt J, Churilov L, Ellery F, et al. AVERT Collaboration Group: Prespecified dose-response analysis for A Very Early Rehabilitation Trial (AVERT). Neurology, 2016, 86: 2138–2145. [Medline] [CrossRef]
2) Powers WJ, Rabinstein AA, Ackerson T, et al.: Guidelines for the early management of patients with acute ischemic stroke: 2019 update to the 2018 guidelines for the early management of acute ischemic stroke: a guideline for healthcare professionals from the American Heart Association/American Stroke Association. Stroke, 2019, 50: e344–e418. [Medline] [CrossRef]
3) Li Z, Zhang X, Wang K, et al.: Effects of early mobilization after acute stroke: a meta-analysis of randomized control trials. J Stroke Cerebrovasc Dis, 2018, 27: 1326–1337. [Medline] [CrossRef]
4) Matsui H, Hashimoto H, Horiguchi H, et al.: An exploration of the association between very early rehabilitation and outcome for the patients with acute ischaemic stroke in Japan: a nationwide retrospective cohort survey. BMC Health Serv Res, 2010, 10: 213. [Medline] [CrossRef]
5) Tao X, Xinyuan Y, Shu O, et al.: Efficacy and safety of very early mobilization in patients with acute stroke: a systematic review and meta-analysis. Sci Rep, 2017, 26: 1–8.
6) Franceschini M, Fugazzaro S, Agosti M, et al. Italian Study Group on Implementation of Stroke Care (ISC Study): Acute phase predictors of 6-month functional outcome in Italian stroke patients eligible for in-hospital rehabilitation. Am J Phys Med Rehabil, 2018, 97: 467–475. [Medline] [CrossRef]
7) Cumming TB, Thrift AG, Collier JM, et al.: Very early mobilization after stroke fast-tracks return to walking: further results from the phase II AVERT randomized controlled trial. Stroke, 2011, 42: 153–158. [Medline] [CrossRef]
8) Langhorne P, Stott D, Knight A, et al.: Very early rehabilitation or intensive telemetry after stroke: a pilot randomised trial. Cerebrovasc Dis, 2010, 29: 352–360. [Medline] [CrossRef]
9) Rose JC, Mayer SA: Optimizing blood pressure in neurological emergencies. Neurocrit Care, 2004, 1: 287–299. [Medline] [CrossRef]
10) Barron SA, Rogovski Z, Hemli J: Autonomic consequences of cerebral hemisphere infarction. Stroke, 1994, 25: 113–116. [Medline] [CrossRef]
11) Hilz MJ, Moeller S, Akhundova A, et al.: High NIHSS values predict impairment of cardiovascular autonomic control. Stroke, 2011, 42: 1528–1533. [Medline] [CrossRef]
12) Langhorne P, Collier JM, Bate PJ, et al.: Very early versus delayed mobilisation after stroke. Cochrane Database Syst Rev, 2018, 10: CD006187. [Medline]
13) de Haan R, Limburg M, Bossuyt P, et al.: The clinical meaning of Rankin 'handicap' grades after stroke. Stroke, 1995, 26: 2027–2030. [Medline] [CrossRef]
14) Inoa V, Aron AW, Staff I, et al.: Lower NIH stroke scale scores are required to accurately predict a good prognosis in posterior circulation stroke. Cerebrovasc Dis, 2014, 37: 251–255. [Medline] [CrossRef]
15) Johnston KC, Wagner DP, Wang XQ, et al. GAIN, Citicoline, and ASAP Investigators: Validation of an acute ischemic stroke model: does diffusion-weighted imaging lesion volume offer a clinically significant improvement in prediction of outcome? Stroke, 2007, 38: 1820–1825. [Medline] [CrossRef]
16) Sonoda S, Saitoh E, Nagai S, et al.: Stroke outcome prediction using reciprocal number of initial activities of daily living status. J Stroke Cerebrovasc Dis, 2005, 14: 8–11. [Medline] [CrossRef]
17) Kwah LK, Harvey LA, Diong J, et al.: Models containing age and NIHSS predict recovery of ambulation and upper limb function six months after stroke: an observational study. J Physiother, 2013, 59: 189–197. [Medline] [CrossRef]
18) Mäkikallio AM, Mäkikallio TH, Korpelainen JT, et al.: Heart rate dynamics predict poststroke mortality. Neurology, 2004, 62: 1822–1826. [Medline] [CrossRef]
19) Geeganage C, Tracy M, England T, et al. for TAIST Investigators: Relationship between baseline blood pressure parameters (including mean pressure, pulse pressure, and variability) and early outcome after stroke: data from the Tinzaparin in Acute Ischaemic Stroke Trial (TAIST). Stroke, 2011, 42: 491–493. [Medline] [CrossRef]
20) Rejnö Å, Nasic S, Bjälkefur K, et al.: Changes in functional outcome over five years after stroke. Brain Behav, 2019, 9: e01300. [Medline] [CrossRef]
21) Yagi M, Yasunaga H, Matsui H, et al.: Impact of rehabilitation on outcomes in patients with ischemic stroke: a nationwide retrospective cohort study in Japan. Stroke, 2017, 48: 740–746. [Medline] [CrossRef]
22) Kwakkel G, Wagenaar RC, Koelman TW, et al.: Effects of intensity of rehabilitation after stroke. A research synthesis. Stroke, 1997, 28: 1550–1556. [Medline] [CrossRef]