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Original Article

Short-Term Effects of Intensive Inpatient Rehabilitation in Patients with Brain Tumor: a Single-Center Experience

Hyo Sun Lee, Seungmi Yeo, Yun-Hee Kim, Won Hyuk Chang

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Correspondence to
Won Hyuk Chang
Department of Physical and Rehabilitation Medicine, Center for Prevention and Rehabilitation, Heart Vascular Stroke Institute, Samsung Medical Center, Sungkyunkwan University School of Medicine, 81 Irwon-ro, Gangnam-gu, Seoul 06351, Korea.
E-mail: wh.chang@samsung.com

HIGHLIGHTS

- This study provided that intensive inpatient rehabilitation could have potential to improve the functional levels in patients with brain tumor.
- The functional efficiency of intensive inpatient rehabilitation in patients with brain tumor was similar to that of subacute stroke patients.

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Short-Term Effects of Intensive Inpatient Rehabilitation in Patients with Brain Tumor: a Single-Center Experience

Hyo Sun Lee,[1] Seungmi Yeo,[1] Yun-Hee Kim,[1,2] Won Hyuk Chang[1]

[1]Department of Physical and Rehabilitation Medicine, Center for Prevention and Rehabilitation, Heart Vascular Stroke Institute, Samsung Medical Center, Sungkyunkwan University School of Medicine, Seoul, Korea
[2]Departments of Health Science and Technology, and Medical Device Management & Research, Samsung Advanced Institute for Health Sciences & Technology (SAIHST), Sungkyunkwan University, Seoul, Korea

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Correspondence to
Won Hyuk Chang
Department of Physical and Rehabilitation Medicine, Center for Prevention and Rehabilitation, Heart Vascular Stroke Institute, Samsung Medical Center, Sungkyunkwan University School of Medicine, 81 Irwon-ro, Gangnam-gu, Seoul 06351, Korea.
E-mail: wh.chang@samsung.com

ORCID iDs
Seungmi Yeo
https://orcid.org/0000-0002-9633-6179
Yun-Hee Kim
https://orcid.org/0000-0001-6101-8851
Won Hyuk Chang
https://orcid.org/0000-0002-4969-7895

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ABSTRACT

The objective of this study is to investigate the short-term effects of intensive inpatient rehabilitation in patients with brain tumor. Retrospective data from September 2015 to May 2017 was obtained in 65 patients with brain tumor who were transferred to the department of physical and rehabilitation medicine for comprehensive intensive inpatient rehabilitation. For comparison, data from 140 patients with subacute stroke were also obtained. To measure functional status, we collected data from the following tests: the Korean version of the Modified Barthel Index, the Motricity Index, the Korean Mini-Mental Status Examination, and the Functional Ambulatory Category. Functional efficiency of each assessment was calculated as the gain divided by the inpatient rehabilitation length of stay. Independent t-test was performed to compare functional outcomes between the brain tumor group and the subacute stroke group. There were significant improvements in all functional assessments in both the brain tumor group and the subacute stroke group ($p < 0.05$). In addition, there was no significant difference in the functional gain and efficiency in all assessments between the 2 groups. The results of the present study revealed that intensive inpatient rehabilitation could have potential to improve the functional levels in patients with brain tumor.

Keywords: Rehabilitation; Brain Neoplasms; Functional Outcome; Independency

INTRODUCTION

The incidence of brain and central nervous system (CNS) tumors appears to be gradually increasing worldwide [1,2]. The overall crude rate for brain and CNS tumors in Korea was 11.69 per 100,000 person-years in 2005, and the crude rate in children was 3.63 per 100,000 person-years [3]. In 2010, the rates increased to 20.06 per 100,000 person-years and 5.16 per 100,000 person-years, respectively [4]. This increase is likely a consequence of improvements in both diagnosis and clinical practice. Brain metastasis occurs in a large number of survivors, comprising 16%–20% of lung cancer patients, 5% of breast cancer patients, and 1%–2% of colorectal cancer patients [5].

Conflict of Interest
The authors have no potential conflicts of interest to disclose.

Recent advances in chemotherapy, radiation therapy, and surgery have significantly lengthened average survival times in patients with brain tumors [6]. Despite these advances in treatment, significant functional impairment due to neurologic sequelae can occur in many brain tumor survivors [6]. Patients may require rehabilitation services for functional improvement and quality of life (QOL). A previous study reported that, among cancer patients who received inpatient rehabilitation, the most common cancer types were those of the brain and nervous system, and most cancer patients improved their function after inpatient rehabilitation [7]. In addition, following inpatient rehabilitation, brain tumor patients showed a comparable functional outcome to patients with stroke [8] or traumatic brain injury [9]. These studies [8,9] compared the functional independency with the functional independence measure (FIM) before and after inpatient rehabilitation. Similar to stroke, brain tumors can cause disorders in each functional domain, such as motor, cognition, and ambulation function [7]. Therefore, the potentials of inpatient rehabilitation should be assessed to improve each functional domain in patients with brain tumor. Transferring stroke patients with disabilities from an acute setting to an inpatient rehabilitation service is recommended as soon as they are medically stable [10]. Many guidelines on stroke care recommend that all patients with stroke should begin rehabilitation therapy as early as possible once medical stability is reached [11-15]. However, there is insufficient assessment of the effects of inpatient rehabilitation in patients with brain tumor in consideration of each functional domain with function independency. Therefore, the objective of this study is to investigate the short-term effects of intensive inpatient rehabilitation on physical disabilities and independency in patients with brain tumor compared with patients with subacute stroke patients.

MATERIALS AND METHODS

Study design and population

We conducted a retrospective study, reviewing the medical charts of patients with brain tumor or subacute stroke who were transferred to the department of physical and rehabilitation medicine for comprehensive intensive inpatient rehabilitation after acute management from September 2015 to May 2017. Patients were included in the study if they were at least 18 years of age, and patients were excluded if the duration of the intensive inpatient rehabilitation was less than 5 days. In addition, stroke patients were excluded if more than two months had elapsed since the stroke. Patients were excluded if they were admitted for rehabilitation that was unassociated with cancer or stroke.

The comprehensive intensive inpatient rehabilitation program included daily physical therapy (2 hours) and occupational therapy (1 hour), 5 days a week. This study was approved by the Samsung Medical Center Institutional Review Board (approval No. 2018-02-101).

Demographic data

Demographic data were obtained through chart review: 1) demographic data, including age, sex, inpatient rehabilitation length of stay (LOS), and discharge location; 2-1) tumor information, comprised of primary or metastatic lesion, location of tumor, and treatment of either surgery, radiation, and/or chemotherapy before the intensive inpatient rehabilitation for patients with tumor; 2-2) stroke type, lesion, side and duration for patients with stroke; and 3) discharge location.

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Functional outcome data

The initial data were assessed by a physiatrist within 24 hours of transfer to the department of physical and rehabilitation medicine. Within 24 hours of discharge, a physiatrist assessed the patients with the same measurements.

The Korean version of the Modified Barthel Index (K-MBI) was used to measure the independency of activities of daily living (ADL) [16]. It consists of 10 items: feeding, personal hygiene, bathing, dressing, toilet transfer, bladder control, bowel control, chair/bed transfer, stair climbing, and ambulation. The Motricity Index (MI) was used to gather information about motor impairment of affected limb(s) [17]. It consists of the motor power of pinch grip, elbow flexion, shoulder abduction, ankle dorsiflexion, knee extension, and hip flexion. The Korean Mini-Mental Status Examination (K-MMSE) was used to determine the severity of cognitive impairment and to document cognitive change occurring over time [18]. The Functional Ambulatory Category (FAC) was utilized to measure ambulation ability [19]. This 6-point scale evaluates ambulation status by determining how much human support a patient requires when walking, disregarding the use of a personal assistive device.

The functional gain of each assessment was calculated as the gain between the transfer and discharge functional scores, and the functional efficiency of each assessment was calculated as the functional gain divided by the inpatient rehabilitation LOS. The functional gain and efficiency have been used for comparative effectiveness research, because these measurements can be adjusted for meaningful evaluation across sites and settings [20].

Statistics

Statistical analysis was performed using SPSS version 24.0 (IBM Corp., Chicago, IL, USA). Paired t-test was performed to compare functional outcomes from transfer to discharge in each group, and independent t-test and χ^2 test were used to compare differences between the brain tumor group and the stroke group. In addition, analysis of variance was performed to compare functional outcomes among the three brain tumor subtype groups. Differences were regarded as significant when the p value was less than 0.05.

RESULTS

A total of 65 patients with brain tumor and 140 patients with subacute stroke were identified with the inclusion/exclusion criteria.

Demographic characteristics of patients

The general characteristics of patients are presented in Table 1. Of patients with brain tumor, 48 had a primary brain tumor, 10 had a metastatic brain tumor, and 7 had a hematologic brain tumor. There was no significant difference in age, sex, or LOS at inpatient rehabilitation between the brain tumor group and the stroke group.

Functional outcomes after intensive inpatients rehabilitation

There was no significant difference in all functional measurements at admission discharge of inpatient rehabilitation between the brain tumor group and the stroke group. There were significant improvements in K-MBI, MI, K-MMSE, and FAC in the brain tumor group ($p < 0.05$). In the stroke group, all functional assessments were also significantly improved

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Table 1. General characteristics of patients

Characteristics	Brain tumor group				Stroke group (n = 140)
	Total (n = 65)	Primary brain tumor (n = 48)	Metastatic brain tumor (n = 10)	Hematologic brain tumor (n = 7)	
Age	56.8 ± 15.4	54.3 ± 15.5	67.0 ± 9.1	59.7 ± 17.5	63.8 ± 15.3
Sex (male:female)	37:29	23:26	7:3	7:0	80:60
Surgery	51 (78.5)	43 (89.6)	8 (80.0)	0 (0.0)	-
Chemotherapy	24 (3.9)	14 (29.2)	3 (30.0)	7 (100.0)	-
Radiation	23 (35.4)	15 (31.3)	5 (50.0)	3 (42.9)	-
LOS (day)	18.5 ± 6.7	19.3 ± 7.1	17.5 ± 5.7	14.1 ± 3.9	-
Stroke type (infarct:hemorrhage)	-	-	-	-	97:43
Stroke lesion (supratentorial:intratentorial)	-	-	-	-	105:35
Lesion side (right:left:bilateral)	-	-	-	-	50:66:24
Duration of stroke (day)	-	-	-	-	14.8 ± 10.6

Values are presented as ratio, number of patients (%), or mean ± standard deviation.
LOS, length of stay.

Table 2. Change of functional status after intensive inpatient rehabilitation

Tests		Brain tumor group (n = 65)	Stroke group (n = 140)	p value†
K-MBI	Admission	23.6 ± 21.0	27.7 ± 25,4	0.226
	Discharge	36.1 ± 27.0*	42.1 ± 28.6*	0.183
MI	Admission	64.9 ± 25.1	61.5 ± 29.6	0.423
	Discharge	70.4 ± 22.1*	66.6 ± 28.1*	0.305
K-MMSE	Admission	19.3 ± 9.0	18.0 ± 10.3	0.351
	Discharge	21.2 ± 9.0*	19.3 ± 9.0*	0.864
FAC	Admission	1.3 ± 1.2	1.3 ± 1.2	0.842
	Discharge	2.2 ± 1.4*	2.5 ± 1.4*	0.174

K-MBI, Korean version of the Modified Barthel index; MI, Motricity Index; K-MMSE, Korean Mini-Mental Status Examination; FAC, Functional Ambulatory Category.
*$p < 0.05$, compared with admission; †comparison between the brain tumor group and the subacute stroke group.

after rehabilitation ($p < 0.05$). However, there was no significant difference in K-MBI, MI, K-MMSE, and FAC at discharge of inpatient rehabilitation between the 2 groups (Table 2). In addition, there was no significant difference in functional gain and efficiency of K-MBI, MI, K-MMSE, and FAC between the brain tumor and subacute stroke groups (Fig. 1).

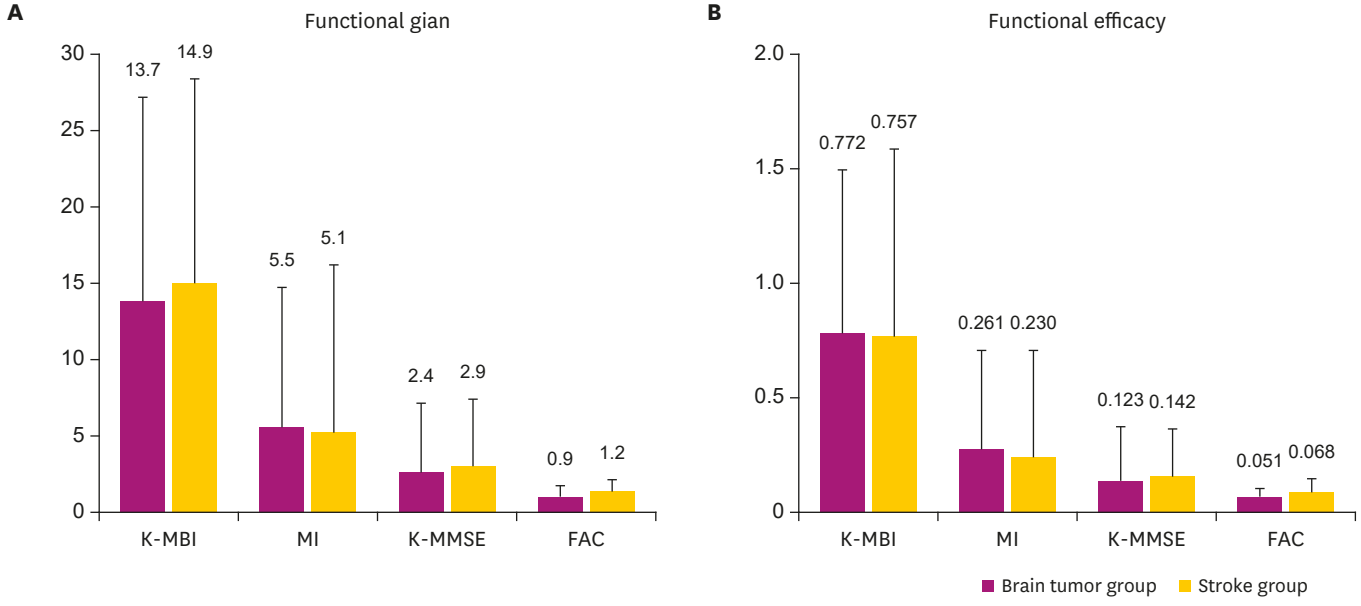

Fig. 1. Functional gain and efficiency of intensive inpatient rehabilitation in brain tumor and stroke groups.
K-MBI, Korean version of the Modified Barthel Index; MI, Motricity Index; K-MMSE, Korean Mini-Mental Status Examination; FAC, Functional Ambulatory Category.

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Table 3. Change of functional status after intensive inpatient rehabilitation

Tests		Primary brain tumor (n = 48)	Metastatic brain tumor (n = 10)	Hematologic brain tumor (n = 7)	p value†
K-MBI	Admission	22.1 ± 21.6	27.9 ± 22.8	26.0 ± 14.0	0.636
	Discharge	34.6 ± 27.5*	37.7 ± 26.6*	44.2 ± 26.7*	0.711
	Gain	14.0 ± 14.1	9.8 ± 7.8	18.2 ± 15.8	0.471
	Efficiency	0.7556 ± 0.7628	0.5032 ± 0.3902	1.1847 ± 0.7767	0.192
MI	Admission	63.6 ± 27.0	66.8 ± 20.5	71.0 ± 17.7	0.751
	Discharge	69.9 ± 23.4*	72.2 ± 20.1*	71.0 ± 17.7	0.955
	Gain	6.3 ± 10.0	5.4 ± 7.2	0.0 ± 0.0	0.247
	Efficiency	0.2917 ± 0.4713	0.2967 ± 0.4713	0.0000 ± 0.0000	0.253
K-MMSE	Admission	19.9 ± 9.5	18.7 ± 9.4	16.7 ± 2.3	0.672
	Discharge	21.3 ± 9.5*	21.3 ± 9.6*	20.3 ± 4.1*	0.962
	Gain	2.1 ± 5.2	2.6 ± 3.2	3.6 ± 3.9	0.745
	Efficiency	0.1032 ± 0.2577	0.1539 ± 0.2191	0.2074 ± 0.2483	0.547
FAC	Admission	1.2 ± 1.1	1.2 ± 1.5	1.4 ± 1.0	0.916
	Discharge	2.1 ± 1.3*	2.5 ± 1.6*	2.3 ± 1.3*	0.754
	Gain	0.9 ± 0.7	1.3 ± 1.4	0.9 ± 0.7	0.360
	Efficiency	0.0459 ± 0.0418	0.0655 ± 0.0680	0.0643 ± 0.0673	0.394

K-MBI, Korean version of the Modified Barthel index; MI, Motricity Index; K-MMSE, Korean Mini-Mental Status Examination; FAC, Functional Ambulatory Category.
*$p < 0.05$, compared with admission; †comparison among 3 groups.

In the brain tumor group, there were significant improvements in K-MBI, K-MMSE, and FAC in the primary brain tumor, the metastatic brain tumor, and the hematologic brain tumor group ($p < 0.05$). In addition, MI showed a significant improvement in the primary brain tumor and the metastatic brain tumor group ($p < 0.05$). There was no significant difference in functional gain and efficiency of K-MBI, MI, K-MMSE, and FAC among the three brain tumor groups (Table 3).

Discharge location after intensive inpatient rehabilitation

Following rehabilitation in our center, 28.8% of the brain tumor group was discharged to home, and 50% of the brain tumor group remained hospitalized in other departments of Samsung Medical Center, a nursing hospital, or other rehabilitation hospitals. On the other hand, 41.0% of patients in the stroke group were discharged home, which was higher than the percentage of brain tumor patients discharged home.

DISCUSSION

The results of this study demonstrate that patients with brain tumor showed functional improvements in independency, cognition, motor, and ambulatory function after short-term intensive inpatient rehabilitation. In addition, these improvements were similar to those experienced by subacute stroke patients, in whom there has been well-defined evidence of rehabilitation's effect to improve function [21]. This study provides evidence that short-term intensive inpatient rehabilitation could be effective for functional improvement in patients with brain tumor.

Brain and nervous system tumors are the most common cancer types in patients who receive inpatient rehabilitation [7]. Many patients with brain tumor show neurologic deficits from the tumor itself as well as complications after surgery, radiation therapy, and chemotherapy [6]. Some brain tumor patients need rehabilitation interventions to manage their impairments [2]. Therefore, both supportive care and neuro-rehabilitation based programs should be provided to patients with brain tumor. Previous studies reported that

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the functional improvement after inpatient rehabilitation in patients with brain tumor was the same as that of patients with stroke [22] or traumatic brain injury [9]. The present study supported these findings of effects of inpatient rehabilitation for patients with brain tumor to improve independency of ADL cognition, motor, and ambulatory function. In addition, inpatient rehabilitation effectively improved function despite brain tumor subtype.

The American Society of Clinical Oncology (ASCO) guidelines recommend that palliative chemotherapy should be administrated only for solid tumor patients with good performance status [23], because chemotherapy administered to patients with poor performance status resulted in low response rates, high rates of toxic effects, and short survival [24]. A previous report suggested that functional dependency might have a relationship with poor survival in patients with metastatic brain tumor [25]. Patients with brain tumor who show the improvement after intensive inpatient rehabilitation might have more chances to allow chemotherapy to prolong survival and promote QOL. The rate of discharge home after intensive inpatient rehabilitation was significantly lower in the brain tumor group than the stroke group. However, this lower rate of discharge home in the brain tumor group could not mean poor outcome of intensive inpatient rehabilitation. Approximately half of the patients with brain tumor in this study were transferred to other departments to receive additional chemotherapy after inpatient rehabilitation. The results of this study could support the importance of inpatient cancer rehabilitation to lengthen survival times and increase functional improvement. However, this study cannot demonstrate the effect of inpatient rehabilitation on length of life in patients with brain tumor. Further studies will be needed to clarify the extension of survival times in patients with brain tumor.

This study had some limitations. The functional outcome in patients with brain tumor could be influenced a lot of factors such as tumor location, pathology, previous treatment history before rehabilitation, and premorbid functional level [26]. Especially, we classified brain tumors to only three categories such as primary, metastatic, and hemotologic brain tumor due to a relative small number of patients. The lack to conduct more detail considerations of other influencing factors was a imitation of this study. We did not compare functional improvement with brain tumor patients who received medical care without intensive inpatient rehabilitation. In addition, we did not assess specific complications and symptoms, such as fatigue and sleep disturbance, which occur commonly in patient with brain tumor. This study could not assess the long-term effect of intensive inpatient rehabilitation in each group. These limitations were due to the retrospective design of this study. Therefore, an additional study with a prospective study design with long-term follow-up is needed. In spite of these limitations, the results of this study show the importance of inpatient rehabilitation in patients with brain tumor.

CONCLUSION

The results of the present study revealed that intensive inpatient rehabilitation could have potential to improve the functional levels in patients with brain tumor. In addition, the functional efficiency of intensive inpatient rehabilitation in patients with brain tumor was similar to that of subacute stroke patients. This study provides practical consideration for the recommendation of intensive inpatient rehabilitation in patients with brain tumor.

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