

ORIGINAL ARTICLE

Therapeutic effects of intensive inpatient rehabilitation in advanced Parkinson's disease

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Key words

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Abstract

Background: The importance of rehabilitation therapy in Parkinson's disease is well recognized. However, the effects of an inpatient rehabilitation program for advanced Parkinson's disease have not been fully investigated.

Aim: To assess the effects of intensive inpatient rehabilitation.

Methods: We enrolled 31 patients (mean age 69.5 ± 9.4 years; mean disease duration 8.8 ± 6.4 years) with advanced Parkinson's disease, without severe cognitive impairment. The median Hoehn–Yahr stage was IV. Patients received 2 h of individualized rehabilitation for 6–7 days each week for 1 month. At hospital discharge, patients and caregivers were instructed to continue daily exercise.

Results: Motor and total scores of Functional Independence Measures significantly improved between admission and discharge in patients with stage III and IV disease, but not stage V. There was no significant effect of Hoehn–Yahr stage on improvements in Unified Parkinson's Disease Rating Scale scores, (total, part I, II or III), cognitive Functional Independence Measures or Berg Balance Scale.

Conclusion: Intensive inpatient rehabilitation was effective even in advanced Parkinson's disease. Intensive inpatient rehabilitation, together with home and day-care exercise, might counteract the progressive motor decline in Parkinson's disease.

Introduction

Because of the aging of populations in some countries, Parkinson's disease (PD) has become increasingly prevalent. Despite significant advances in medical treatments, patients with PD experience a gradual decline in mobility, which is especially problematic in the advanced stages. Other serious complications that commonly occur in advanced PD include pneumonia and bone fracture.^{1,2} Although the symptoms of PD are progressive, non-pharmacological strategies, such as patient rehabilitation programs, have been reported to be effective.^{3–5}

Rehabilitation therapy aims to preserve motor function, and lower the risk of complications, including falls, respiratory infections and disuse syndrome. It might also slow the progression of motor disability and improve patients' prognosis.^{4,5}

The purpose of the present study was to assess the effects of intensive inpatient rehabilitation for PD.

Methods

Patients. Between April 2008 and December 2015, 114 patients with PD were admitted to Hiroshima City

Rehabilitation Hospital, Hiroshima City, Hiroshima, Japan. All patients had received neurological treatment at outpatient clinics and were referred to our hospital for intensive rehabilitation therapy as a result of worsening symptoms. We excluded patients with complications, including bone fracture, pneumonia, stroke and psychotic symptoms. We also excluded patients with severe cognitive dysfunction who were unable to comply with the rehabilitation protocol. To evaluate the effects of non-pharmacological rehabilitation therapy, we analyzed clinical data for those patients whose medical treatment had not been adjusted. As a result, patients at Hoehn–Yahr (H–Y) stage I or II were excluded.

We recruited 31 patients (15 men, 16 women) to participate in the study. The mean age and standard deviation (SD) of patients was 69.5 ± 9.4 years. Diagnoses of idiopathic PD were confirmed by certified neurologists. The mean duration of disease was 8.8 ± 6.4 years. The median H–Y stage was IV (with seven at stage III, 18 at stage IV and six at stage V). Mini-Mental State Examination (MMSE) scores ranged from 16 to 30, with a mean of 25.3 ± 6.3 .

Written informed consent was obtained from all patients before inclusion. This study was approved by the ethical committee of Hiroshima City Rehabilitation Hospital.

Intervention. Conventional group rehabilitation is offered in an outpatient setting. However, in the present study, intensive rehabilitation was provided to inpatients on an individual basis. A total of 25 patients received 2 h of individual therapy for 6 days per week. The remaining six patients received therapy 7 days per week. The increase from 6 to 7 days of therapy was made after changes to the medical administration policy in April 2014.

Physical therapy was carried out, and aimed to improve mobility, posture, balance, muscle strength and range of joint motion. This was accompanied by auditory and visual cue training. Occupational therapy for activities of daily living (ADL) and hand functionality was provided. Speech therapy was carried out to improve vocal intensity, vocal quality and fluency, with music therapy carried out with some patients. The mean length of hospital stay was 29.2 ± 7.0 days.

After discharge from hospital, patients and their family members were instructed that patients should carry out individually tailored exercises at home for 20–60 min each day. Patients were also advised on fall prevention, feeding and care procedures.

To ensure that care insurance would cover the cost of the rehabilitation services, care conferences were held with patients, family members, caregivers, rehabilitation therapists and care managers before discharge from hospital.

Outcome measures. Patients were evaluated at admission and discharge from hospital. Motor function was assessed using the Unified Parkinson's Disease Rating Scale (UPDRS) Part III and the Berg Balance Scale (BBS). ADL were assessed using the UPDRS Part II and Functional Independence Measures (FIM) scores. The FIM was evaluated by nurses and therapists, BBS by physical therapists, and UPDRS by rehabilitation therapists and neurologists. In patients with "on-off" phenomenon, BBS was evaluated during "on" intervals. The measures were checked and confirmed during the clinical conference.

Statistical analysis. We analyzed the effects of intensive inpatient intervention by comparing clinical parameters at admission (adm) with those at discharge (disch) in relation to H-Y stage. We carried out a two-way analysis of variance (ANOVA) (adm/disch \times H-Y) with repeated measures, followed by Fisher's pairwise comparison.

We carried out a one-way ANOVA with Fisher's pairwise comparison to investigate differences between the three H-Y subgroups (stages III, IV and V) in age, duration of disease and MMSE scores. Statistical significance was set at $P < 0.05$.

All statistical analyses were carried out using Ekuseru-Toukei 2012 software (Social Survey Research Information, Tokyo, Japan).

Results

The characteristics of patients at admission to hospital and outcome measures are presented according to H-Y stage (Table 1). Table 2 shows the results of the two-way ANOVA with repeated measures. The factor effect of intervention (adm/disch) was significant for all parameters, except UPDRS Part IV. The interaction between intervention and disease severity (adm/disch \times H-Y) was significant for motor and total FIM scores. The result of each paired comparison suggests that motor and total FIM scores were significantly higher after 1 month in stage III and stage IV patients ($P < 0.05$), but not in stage V patients (Table 1).

Discussion

The present results show that intensive inpatient rehabilitation therapy was associated with improved motor function in advanced PD, with substantial improvements in FIM for H-Y stages III and IV.

Most rehabilitation strategies for PD focus on group training programs in outpatient clinics and home exercise routines at relatively early stages of the disease. A systemic

Table 1 Patients' backgrounds and outcome measures

H-Y	III (<i>n</i> = 7)		IV (<i>n</i> = 18)		V (<i>n</i> = 6)	
	Adm	Disch	Adm	Disch	Adm	Disch
Sex (male/female)	5/2		8/10		2/4	
Age (years)	63.1 \pm 14.9		70.4 \pm 6.5		74.3 \pm 6.2	
Duration of illness (years)	4.6 \pm 2.5		9.6 \pm 6.4		14.3 \pm 8.2	
MMSE	26.9 \pm 2.5		25.1 \pm 5		23.0 \pm 12.3	
Motor FIM	52.0 \pm 14.3	63.0 \pm 13.8*	47.2 \pm 13.5	56.3 \pm 14.3*	30.5 \pm 10.6	30.7 \pm 9.3
Cognitive FIM	26.0 \pm 4.2	27.6 \pm 3.1	25.0 \pm 5.1	27.2 \pm 5.1	21.7 \pm 8.3	22.5 \pm 7.1
Total FIM	78.0 \pm 16.6	90.6 \pm 15.6*	72.3 \pm 18.0	83.5 \pm 18.8*	52.2 \pm 15.2	53.2 \pm 13.0
UPDRS Part I	1.7 \pm 1.9	1.7 \pm 1.9	2.5 \pm 2.6	2.3 \pm 2.4	3.0 \pm 2.9	2.4 \pm 2.3
UPDRS Part II	17.0 \pm 4.7	15.7 \pm 4.8	21.3 \pm 7.1	19.8 \pm 6.5	27.6 \pm 5.7	26.2 \pm 7.1
UPDRS Part III	34.5 \pm 11.4	31.8 \pm 11.3	41.7 \pm 14.5	37.8 \pm 15.3	49.8 \pm 17.0	49.0 \pm 17.6
UPDRS Part IV	0.2 \pm 0.4	0.2 \pm 0.4	1.5 \pm 1.7	1.2 \pm 1.3	2.4 \pm 2.6	2.0 \pm 1.7
UPDRS total	53.3 \pm 16.6	49.7 \pm 17.1	66.6 \pm 22.2	61.2 \pm 22.6	82.6 \pm 17.4	79.6 \pm 19.6
BBS	40.0 \pm 10.6	47.4 \pm 8.7	27.0 \pm 10.9	32.2 \pm 10.3	11.3 \pm 9.0	15.3 \pm 10.5

Adm, admission; BBS, Berg Balance Scale; Disch, discharge; FIM, Functional Independence Measures; UPDRS, Unified Parkinson's Disease Rating Scale.

Data presented as mean \pm SD. * $P < 0.05$.

Table 2 Results of two-way ANOVA with repeated measures

	Factor	d.f.	F-value	P-value
Motor FIM	Adm/disch	1	27.7459	0.0000**
	H-Y	2	8.0078	0.0018**
	H-Y × adm/disch	2	5.5702	0.0092**
Cognitive FIM	Adm/disch	1	6.1872	0.0191*
	H-Y	2	1.6225	0.2154
	H-Y × adm/disch	2	0.4524	0.6406
Total FIM	Adm/disch	1	30.7983	0.0000**
	H-Y	2	6.6052	0.0045**
	H-Y × adm/disch	2	5.0560	0.0133*
UPDRS Part I	Adm/disch	1	6.5000	0.0179*
	H-Y	2	0.2972	0.7457
	H-Y × adm/disch	2	1.8413	0.1812
UPDRS Part II	Adm/disch	1	13.3246	0.0013**
	H-Y	2	3.8998	0.0348*
	H-Y × adm/disch	2	0.0130	0.9871
UPDRS Part III	Adm/disch	1	14.7233	0.0008**
	H-Y	2	1.6980	0.2052
	H-Y × adm/disch	2	2.1434	0.1401
UPDRS Part IV	Adm/disch	1	2.9004	0.1020
	H-Y	2	2.7081	0.0879
	H-Y × adm/disch	2	0.6816	0.5157
UPDRS total	Adm/disch	1	16.4805	0.0005**
	H-Y	2	2.8456	0.0787
	H-Y × adm/disch	2	0.6751	0.5189
BBS	Adm/disch	1	19.1163	0.0003**
	H-Y	2	10.4213	0.0009**
	H-Y × adm/disch	2	0.5249	0.5999

* $P < 0.05$, ** $P < 0.01$.

review reported that in 50 of 51 studies included, rehabilitation interventions delivered at patients' homes or in outpatient clinics were associated with an improvement in at least one outcome measure compared with control interventions or no intervention.³ Another meta-analysis of studies evaluating the effects of physical therapy on PD reported a significant improvement in ADL and stride length, but not in neurological signs.⁶

Because motor symptoms gradually progress in PD, it is important to evaluate the long-term benefits of rehabilitation therapy. Sturkenboom *et al.*⁷ reported that 10 weeks of home-based, individualized occupational therapy led to an improvement in self-perceived performance in daily activities, which was maintained 3 months after therapy. Conversely, in patients with PD with H-Y stage II–III, UPDRS, ADL and motor scores were significantly improved by a 4-week intensive physical rehabilitation program, but had returned to baseline 6 months later without regular exercise.⁸ Such results suggest that motor disabilities are objectively improved by a regular program of physical rehabilitation, but improvements cannot be sustained without continued exercise after the program.

With respect to moderate and advanced PD, the short- and long-term effects of inpatient rehabilitation in patients at H-Y stage III have been previously described.^{9,10} Motor function improved after 4 weeks of inpatient physical therapy, comprising three sessions of 1 h for 5 days each week,

with total UPDRS and BBS scores changing from 40 to 28⁹ and 45.1 to 50.8,¹⁰ respectively. After daily home exercises for the subsequent year, total UPDRS and BBS scores were 41⁹ and 45.5,¹⁰ respectively. This suggests that motor function was mostly preserved. Furthermore, the daily medication dosage was reduced, and the second rehabilitation cycle administered after 1 year was as effective as the first intervention.⁹ These findings suggest that rehabilitative interventions might counteract the progressive worsening of symptoms. Interestingly, in patients with Parkinson's at H-Y stages I–IV, lower motor function at baseline was associated with a greater response to intensive inpatient rehabilitation over 6 weeks.¹¹ The present study showed that patients at H-Y stage V did not show significant improvements in FIM score. Insufficient therapeutic effects of rehabilitation might be linked to a higher frequency of complications, including joint contracture, sarcopenia and disuse syndrome. Additionally, the mean MMSE score in patients at H-Y stage V was below the optimal diagnostic cut-off (MMSE 24/25) for cognitive disorders in PD.¹² The lower cognitive function of these patients might have contributed to the difference in outcome after intensive rehabilitation. The present findings show that intensive rehabilitation is particularly important during stages III–IV of PD. At this stage, it can counteract symptomatic progression by preventing disuse syndrome and lowering the risk of severe complications, such as aspiration pneumonia or bone fractures.

A previous study has shown the effectiveness of a 6-month education and health promotion program in patients with PD. Patients delivered the intervention had a plateau in summary scores of their progression rate, a slight decrease in levodopa dose, and a reduction in number of doctor visits, hospital days and sick days compared with patients not receiving an active intervention.¹³ The authors concluded that a low-cost patient education program might be a useful adjunct to pharmacotherapy for PD, and could improve midterm outcomes.

The limitations of the present study were largely similar to those of previously reported studies.^{4,9} The lack of a control group and the small sample size were the key disadvantages.^{4,9} Another concern was patient compliance with home exercise programs.⁹ Randomized controlled trials with a large sample size are required to verify the role of individualized, intense rehabilitation programs. Furthermore, multi-center studies will be required to assess the cost-effectiveness and long-term effects of rehabilitation programs on the functionality and quality of life of patients with PD.

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