

Functional recovery of stroke patients with postacute care: a retrospective study in a northern medical center

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Abstract

Background: Taiwan's NHI Administration proposed a nationwide postacute care-cerebral vascular disease (PAC-CVD) program, which transfers stroke patients at postacute phase in medical centers to community hospitals. Its aim is mainly to prevent a prolonged stay in medical centers, which usually results in higher medical costs. The present study evaluated the 3-months functional outcomes of stroke patients receiving PAC-CVD.

Methods: We retrogradely retrieved patients' data from Stroke Registry of a Northern medical center. Patients admitted between January 2014 and March 2018 were screened. We included patients receiving PAC-CVD and age/sex/stroke severity/functional status-matched acute stroke patients (regular rehabilitation group). Baseline clinical characteristics and 3-months functional outcomes were analyzed. We defined 3-months mRS 0 to 2 as better, 3 to 4 as same, and 5 to 6 as worse functional recovery.

Results: One-hundred-and-seventy-three patients receiving PAC-CVD and 173 matched controls (68.2 ± 14.0-years-old, 68.5% ± 11.22% men) were recruited. All patients were with mRS 3 to 4 at discharge from our medical center. The distributions of 3-months functional recovery in two groups were as follows: better/same/worse 3-months functional outcomes, PAC-CVD = 40.4%/57.8%/1.8%; controls (regular rehabilitation) = 33.9%/50.3%/5.8%. Multivariate analyses adjusted for age, sex, NIHSS, and cardiovascular risk factors were performed to evaluate whether PAC-CVD predicted better or poor functional outcomes. The results showed that compared with controls, PAC-CVD group had similar frequency of better functional recovery (odds ratio [OR] = 0.97, 95% CI = 0.54-1.74, *p* = 0.924) but less frequency of worse functional outcomes (OR = 0.08, 95% CI = 0.08-0.84, *p* = 0.035).

Conclusion: About one-third of patients with mRS 3 to 4 recovered well in 3-months after stroke in both PAC-CVD and regular rehabilitation groups. Our results showed that PAC-CVD program can significantly decrease functional decline after acute stroke.

Keywords: Postacute care; Stroke; Taiwan

1. INTRODUCTION

Stroke is a main etiology of disable and mortality in the middle-aged and elderly people internationally.¹ In Taiwan, stroke affects approximately 40 000 people every year.² According to the 2016 statistics, stroke is the fourth leading cause of mortality and the major cause of disability;³ the prevalence of disable status at 1, 3, and 6-months after stroke is reported as 61.2%, 55.6%, and 51.7%, respectively.⁴ Conceivably, stroke-related medical and economic burden in Taiwan is no different from other countries.⁵ Therefore, promoting the functional independence of stroke survivors has become the priority in stroke care.

According to Taiwan National Health Insurance (NHI) data, in 2011, about 26 098 patients were hospitalized for acute stroke;

16.2% had prolonged hospital stay (PHS >30 days), usually in a tertiary hospital, which cost 56.4% of the NHI reimbursement for inpatient stroke care.⁶ In response to this issue, NHI initiated a nationwide postacute care (PAC) for stroke in 2013, mainly to overcome the financial burden from PHS in higher-level hospitals.³ This PAC-cerebral vascular disease (PAC-CVD) program has established a system of transferring patients from acute-care units (medical centers) to subacute rehabilitation or long-term care facilities (community hospitals) within 1-month after stroke. PAC-CVD program was formally launched in 2014 and our hospital, a Northern medical center, was one of the first participating institutions.

The current study aimed to evaluate the effect of PAC-CVD program on functional recovery after stroke. We compared functional recovery status at 3-months after stroke between patients receiving PAC-CVD program and regular rehabilitation from data retrospectively retrieved from stroke registry of our hospital.

2. METHODS

2.1. Stroke registry

Taipei Veterans General Hospital Stroke Registry has prospectively collected data of all patients of acute stroke consecutively admitted to emergency room and/or wards of

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Neurology Department since February 2009. We have two specialized nurses supervised by stroke-specialized physicians working on patients' data registry and further outcome follow-up. Recorded data are as follows: demographic and risk factors; stroke severity at admission; investigation results including brain, vascular, or cardiac checkup during hospitalization; and outcomes at discharge and 3-months (by phone call) follow-up. Data analyzed for the current study were retrospectively retrieved from the stroke registry. Institutional Review Board of Taipei Veterans General Hospital has approved the study.

2.2. Study population

The criteria of Taiwan PAC-CVD program are as follows: (1) acute stroke with symptoms onset ≤ 30 days; (2) stable vital signs and neurological functional status for ≥ 72 hours, with no or controlled complications (eg, infection or gastrointestinal bleeding); (3) a modified Rankin Scale (mRS) score of 2 to 4 (modified to 3 to 4 since 2017);³ and (4) able and willing to undergo rehabilitation. The basic length of stay in this program is between 3 and 6 weeks, but could be extended to 12 weeks if appropriate. The present study recruited patients who were admitted in our hospital for acute stroke between January 2014 and March 2018, received PAC-CVD, and with mRS 3 to 4 at discharge from our hospital as PAC group. Age, sex, and stroke severity-matched acute stroke patients admitted during the same period with mRS 3 to 4 at discharge and received rehabilitation at outpatient clinics were recruited as control group (regular-rehabilitation group).

2.3. Functional recovery

We assessed functional recovery at 3-months after stroke using mRS score (3M mRS). We defined 3M mRS as the following: 0 to 2 as better, 3 to 4 as same, and 5 to 6 as worse functional recovery.

2.4. Statistical analyses

Analyses were performed with SAS software, version 9.1 (SAS Institute, Cary, NC, USA). All values were expressed as mean (SD) for continuous variables and number (percentages) for discrete variables. Group comparisons were performed using the nonparametric Wilcoxon rank sum test. The χ^2 test or Fisher's exact test was performed for categorical variables as appropriate. To test whether PAC-CVD program associated with better or worse functional recovery at 3-months after stroke, we used multivariate regression analyses and odds ratios with 95% CI were calculated. Variables such as age, sex, stroke severity at admission (NIH Stroke Scale), and vascular risk factors (hypertension, diabetes mellitus, hyperlipidemia, cigarette smoking, and alcohol consumption) were adjusted in multivariate analyses.

3. RESULTS

The current study recruited 173 patients as PAC group and 173 age, sex, and stroke severity-matched patients as regular-rehabilitation group. In each group, 148 (85.6%) and 25 (14.4%) patients were ischemic and had hemorrhagic stroke, respectively. Demographics of patients are presented in Table 1. The results showed that baseline characteristics were similar between two groups.

At 3-months after stroke, 40.4% of patients had better functional recovery and 1.8% had worse functional recovery in PAC group; 33.9% and 5.8% had better and worse functional recovery, respectively, in regular-rehabilitation group (Fig. 1).

Multivariate analyses showed that PAC group and regular-rehabilitation group had no difference regarding to better functional recovery at 3-months after stroke (Table 2). However, the results showed that PAC group was significantly associated with less functional worsening (mRS = 5 to 6) compared with regular-rehabilitation group (odds ratio = 0.08, 95% CI = 0.08-0.84, $p = 0.035$; Table 3).

4. DISCUSSION

Our main finding is that in a Northern medical center, acute stroke patients receiving PAC-CVD program had significantly less functional worsening (mRS 5 to 6) and similar functional recovery (mRS 0 to 2) at 3-months compared with age, sex, and stroke severity-matched patients without receiving PAC-CVD program.

Under the mandatory NHI program, mortality rate of acute stroke patients in Taiwan is lower than that of the other Organizations for Economic Cooperation and Development countries.⁷ However, with a population of 23 million, Taiwan has spent about US \$375 million for stroke-related medical expenditures every year.⁸ Much of the expense is contributed to PHS or frequent readmission in an acute-care unit, usually higher-leveled and high cost hospitals.⁶ Aiming to reduce this burden, Taiwan NHI launched PAC-CVD program in 2014 and reports did show that length of stay and readmission rate in acute-care units are both decreased after PAC-CVD program.^{9,10}

Internationally, PAC has become one of the most important elements of modern healthcare systems, covering a wide range of diseases and conditions. In addition to economic healthcare utilization, the other goal of PAC for stroke should also include a better functional recovery after stroke given a considerable prevalence of stroke-related disability.³ A previous systematic review reported that well-organized inpatient multidisciplinary postacute rehabilitation was essential to the functional recovery of stroke patients and was considered the benchmark for stroke care of other models.¹¹ Moreover, a recent study found that the stroke PAC may achieve similar functional gain for older patients with recurrent stroke compared with first-ever stroke

Table 1

Comparisons between postacute care and regular-rehabilitation groups

	Postacute care	Regular rehabilitation	<i>p</i>
Age, y, mean (SD)	68.22 (14.52)	68.51 (11.22)	0.237
Sex, female, n, %	54 (31.2)	54 (31.2)	1.000
NIH Stroke Scale scores			0.707
7-14, n, %	23 (13.3)	18 (10.4)	
15-38, n, %	5 (2.9)	5 (2.9)	
Hypertension, n, %	125 (72.3)	130 (75.1)	0.528
Diabetes mellitus, n, %	62 (35.8)	72 (41.6)	0.270
Previous stroke, n, %	31 (17.9)	39 (22.5)	0.284
HbA1c, %, mean (SD)	6.76 (1.67)	6.52 (1.256)	0.491
Dyslipidemia, n, %	104 (60.1)	92 (53.2)	0.193
Total cholesterol, mg/dL, mean (SD)	175.7 (34.97)	174.99 (36.82)	0.481
Alcohol consumption, n, %	35 (49.3)	36 (50.7)	1.000
Cigarette smoking, n, %	58 (33.5)	51 (29.5)	0.488



Fig. 1 Functional recovery at 3-mo after stroke in patients with postacute care and regular rehabilitation, respectively.

patients.¹² A longitudinal study showed that long-term outcomes of hospital-based PAC services were superior to other healthcare facilities.¹³ Nevertheless, the national postacute stroke care audit in the United Kingdom disclosed that stroke PAC programs were not well-standardized and the PAC healthcare workers were in need of more organized training.¹⁴ Previous studies evaluating the outcomes of Taiwan PAC-CVD program utilized NIH-claimed database.^{9,10} Original data of acute stroke, particularly patients without receiving PAC-CVD program such as stroke severity at admission or discharged mRS could not be obtained in those studies. Since stroke severity and functional status are two main factors determining functional recovery after stroke,¹⁵ the effect of functional recovery after PAC-CVD program is hard to be validated when there is lack of stroke severity or functional status-matched control group. The present hospital-based study utilized comprehensive clinical data from stroke registry and case-control study setting matched for age, sex, and stroke severity to show the independent effect of PAC-CVD program on functional recovery after stroke.

Our results showed that about half of the stroke patients improved their functional status at 3-months after stroke no matter receiving PAC-CVD program or not and about 40% of patients receiving PAC-CVD program had intended functional status at 3-months. Although there was no difference in the prevalence of better functional recovery (mRS 0 to 2) between PAC and regular-rehabilitation groups, PAC-CVD program was

significantly associated with less functional worsening (mRS 5 to 6) at 3-months after stroke in our study population. PAC-CVD program in Taiwan is a hospital-based PAC service; the basic length of stay in this program is between 3 and 6 weeks, but could be extended to 12 weeks if appropriate.¹ In addition to intensive rehabilitation program every day, PAC-CVD program involves medical doctors, physical therapists, occupational therapists, nurses, pharmacists, and nutritionists.³ Intensive management of comorbidity in hospitals and multidisciplinary approach might be the reasons of less functional worsening at 3-months after stroke in patients receiving PAC-CVD program.

There are limitations in the present study. Since this is data from one medical center, the study sample is relatively low. And whether our results apply to the other hospitals' patients warrants future studies with multicenters' participation. In addition, we did not record the magnitude and frequency of rehabilitation in control group, which might affect functional recovery after stroke. The current study used functional recovery at 3 months, and whether functional status at longer period such as at 6-months or 1 year was different between two groups warrants further studies. Lastly, though we adjusted cardiovascular risk factors in our analyses, medications for stroke recurrence or other comorbidity diseases were not taken into analyses in the present study. Whether these medical factors involved in functional recovery after stroke in our population was unknown.

Table 2
Multivariate analysis for good functional recovery (modified Rankin Scale 0-2)

	Odds ratio	95% CI	p
Age	0.96	0.94-0.99	0.002
Sex, male	0.84	0.54-2.15	1.076
NIH Stroke Scale	0.68	0.59-0.79	<0.001
Hypertension	1.06	0.54-2.11	0.861
HbA1c	1.08	0.89-1.31	0.448
Total cholesterol	1.00	0.990-1.00	0.601
Alcohol consumption	0.62	0.29-1.35	0.226
Cigarette smoking	0.92	0.45-1.88	0.809
Postacute care program	0.97	0.54-1.74	0.924

Table 3
Multivariate analysis for worse functional recovery (modified Rankin Scale 5-6)

	Odds ratio	95% CI	p
Age	1.03	0.95-1.12	0.497
Sex, male	2.15	0.31-15.04	0.441
NIH Stroke Scale	1.28	1.07-1.54	0.008
Hypertension	0.66	0.12-3.58	0.630
HbA1c	0.77	0.34-1.75	0.530
Total cholesterol	0.99	0.96-1.02	0.386
Alcohol consumption	1.50	0.24-9.58	0.667
Cigarette smoking	2.20	0.32-15.19	0.423
Postacute care program	0.08	0.08-0.84	0.035

In conclusion, from data of a Northern medical center, PAC-CVD program in Taiwan could successfully improve functional status and significantly decrease functional worsening at 3-months after stroke. In addition to its financial missions, we prove that Taiwan PAC program is beneficial to stroke patients' functional recovery.

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