The Correlation Between the Length of Stay in Post-Acute Care(PAC) and General and Improvements in Stroke Patients

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Abstract

Background Post-acute care (PAC) is a transitional care following acute medical stage for stroke patients and offering a more intensive rehabilitative program. According to National Health Insurance in Taiwan, only patients encountered acute stroke within one month, under relative stable medical condition and had potential for aggressive rehabilitation could transfer to PAC institution. Stroke patients receive physical, occupational and speech therapy in PAC. However, there's no research evaluating the effects of PAC for stroke patients ever since the PAC plan inaugurated in Taiwan. Thus, this study aims to investigate whether the duration of hospitalization in PAC correlates to the patients' improvements. **Methods** This is a retrospective and single- center study in Taiwan. We collected 193 stroke patients who received acute care at Chi Mei Medical Center, Taiwan during 2014~2017 and recorded their length of stay in PAC. Stroke patients' functional ability, such as activities of daily living (ADL) function, swallowing ability and so on, as well as their corresponding scales were assessed on the first and last day during PAC hospitalization. Statistical analysis was conducted via SPSS ver21.0. This study was listed on ClinicalTrials.gov(Identification number: NCT03778905). **Results** The average duration of hospitalization in PAC was 35.01 ± 16.373 days. The longer duration of hospitalization in PAC positively correlates to BI ($p=0.000^{***}$, $R=0.330$), BAL($p=0.000^{***}$, $R=0.461$), Gait Speed($p=0.002^{**}$, $R=0.218$), upper sensory function of FMA($p=0.000^{***}$, $R=0.263$) and upper motor function of FMA($p=0.000^{***}$, $R=0.276$) in stroke patients significantly. **Conclusion** Longer duration of hospitalization in PAC is conducive to enhancing ADL function, advancing balance and coordination, boosting walking speed and augmenting both dexterity and sensory function of upper limb in stroke patients.

Introduction

Post-acute care (PAC) is a transitional care following acute medical stage for stroke patients and offering a more intensive rehabilitative program. According to National Health Insurance in Taiwan, only patients encountered acute stroke within one month, under relative stable medical condition and had potential for better recovery could transfer to PAC institutions. Stroke patients receive physical, occupational and speech therapy in PAC. However, there's no research evaluating the effects of PAC inpatient stays for stroke sufferers ever since the PAC project inaugurated in Taiwan. Thus, this study aims to investigate: Whether the duration of hospitalization in PAC correlates to the stroke patients' improvements?

Methods

Design

This is a retrospective and single- center study in Taiwan. We collected 305 patients with stroke who received acute care at Chi-Mei Medical Center, Taiwan during 2014~2017 and recorded their length of stays in PAC after the patient discharged from our hospital. Patients' data and performance were collected by PAC case manager from PAC institutions. The study design was approved by the Institutional

Review Board of Chi Mei Medical Center and was listed on *ClinicalTrials.gov*(Identification number: NCT03778905).

Study Sample and Enrollment

Inclusion criteria of stroke Post-Acute Care(PAC) are modified Rankin scale(MRS) ranging 2~4, acute onset of stroke within 30 days and over 18-year-old. 305 stroke patients eligible for PAC admission were recruited. 3 stroke patients refused PAC admission while 6 stroke patients had second stroke during acute phase. 296 stroke patients successfully transferred to PAC institution but 8 patients ended PAC hospitalization earlier due to stroke or non-stroke disease progression. We scrutinized the rest of 288 stroke patients and excluded 95 stroke patients with incomplete records of functional ability during PAC hospitalization. 193 stroke patients, with completion of PAC hospitalization and intact data of functional ability, were enrolled in our study (Figure 1).

Functional Ability and Variables

Functional domains of stroke patients, including activities of daily living (ADL) function, swallowing ability, nutritional status, life quality, instrumental ADL function, balance and coordination, walking speed, cardiopulmonary capability, sensory function of upper extremities, motor function of upper extremities, cognitive function, occupational mobility¹ and language, were scrutinized at the beginning and the end of admission in PAC by the patients' physiatrists and therapists.

Measurements

ADL function was estimated through modified Rankin scale(MRS) and Barthel index(BI), swallowing ability by functional oral intake scale(FOIS), nutritional status via mini nutritional assessment(MNA), life quality through EuroQoL-5D(QoL), instrumental ADL function by Lawton-Brody IADL Scale(IADL), balance/coordination via Berg Balance Test(BAL), walking speed through Usual Gait Speed(Gait Speed), cardiopulmonary capability by Six-Minute Walk Test(6MWT), sensory and motor function of upper extremities via Fugl-Meyer Assessment(FMA), cognitive function through mini-mental state examination (MMSE), occupational mobility/occupational performance by Motor Activity Log(MAL) of amount use and quality and language via concise Chinese aphasia test(CCAT).

Analysis

Statistical analysis was conducted via Statistical Product and Service Solution (SPSS) (version 21.0). Continuous variables such as length of stays in PAC were indicated as mean and standard deviation. Bivariate correlations, which were utilized for analyzing improvements of functional ability and the length of stay, were performed under Pearson product-moment correlation coefficient. Statistical significance is regarded as p-value less than 0.05.

Results

We recruited 193 stroke patients with mean age of 63.07 ± 14.135 and with the oldest one aged 91 while the youngest one aged 26. The average duration of hospitalization in PAC was 35.01 ± 16.373 days with longest stay of 84 days and shortest stay of 4 days. There are 76.7%(n=148) patient of ischemic stroke and 23.3%(n=45) of hemorrhagic stroke. 60.0%(n=117) of stroke patients were male and 39.4%(n=76) were female (Table 1). Among all stroke patients, only 51.8%(n=100) received speech therapy during PAC hospitalization.

As for improvements after PAC program, mean MRS decreased 0.554 ± 0.678 , mean BI increased 25.839 ± 18.585 , mean FOIS upgraded 0.495 ± 1.038 , mean MNA raised 1.832 ± 3.584 , mean QoL reduced 1.922 ± 2.167 , mean IADL grew 1.352 ± 1.350 , mean BAL rose 15.534 ± 11.972 , mean Gait Speed extended 4.726 ± 23.414 , mean 6MWT surged 91.443 ± 99.424 , mean sensory function of FMA advanced 9.358 ± 11.785 , mean motor function of FMA elevated 11.757 ± 11.718 , mean MMSE 3.156 ± 4.830 , mean occupational mobility (amount use) of MAL gained 0.679 ± 1.471 , mean occupational mobility(quality) of MAL expanded 0.278 ± 7.924 and mean CCAT improved 0.680 ± 1.067 (Table 2).

The longer duration of hospitalization in PAC positively correlates to BI ($p=0.000^{***}$, $R=0.330$), BAL($p=0.000^{***}$, $R=0.461$), Gait Speed($p=0.002^{**}$, $R=0.218$), upper sensory function of FMA($p=0.000^{***}$, $R=0.263$) and upper motor function of FMA($p=0.000^{***}$, $R=0.276$) in stroke patients significantly(Figure 2). However, no significant correlation between duration of hospitalization in PAC and MRS($p=0.071$, $R=-0.130$), FOIS($p=0.175$, $R=0.099$), MNA($p=0.408$, $R=0.060$), QoL($p=0.219$, $R=-0.089$), IADL($p=0.052$, $R=0.140$), 6MWT($p=0.208$, $R=0.091$), MMSE($p=0.066$, $R=0.133$), occupational mobility(amount use) of MAL ($p=0.714$, $R=-0.027$), occupational mobility(quality) of MAL ($p=0.859$, $R=-0.013$) or CCAT($p=0.060$, $R=0.189$)were found(Table 3).

Discussion

The PAC program revealed a more economic ^{2,3} and better recovery strategy ⁴ for stroke patient after acute phase. Current essay indicate benefits in ADL function, balance/coordination, walking speed, motor and sensory function of upper extremities after PAC hospitalization ^{1,5}, and in our study, we found all the

improvements of BI, BAL, Gait Speed as well as upper sensory and motor function of FMA correlate to longer stays in PAC for stroke patients.

However, though recent investigation implied advancements in MRS, FOIS, MNA, QoL, IADL, 6MWT, MMSE, occupational mobility(amount use) of MAL, occupational mobility(quality) of MAL and CCAT ⁵, our data didn't pointed out positive correlation between the duration in PAC and the above improvements. Interestingly, though not statistically significant, improvements in cognition and language, measuring in MMSE and CCAT, showed positive correlations with the duration in PAC to a certain degree, as p value reached 0.066 in MMSE and 0.060 in CCAT respectively.

The average length of stay in PAC in our study is 35.01 ± 16.373 days, which is a little longer than previous data of 25.21~34.11 days admitted in PAC for stroke patients in sub-acute phase³. Ischemic stroke accounted for 76.7%(n=148) stroke patients and hemorrhagic type accounted for 23.3%(n=45), which is quite compatible with previous essay indicated in 80% of ischemic stroke and 20% of hemorrhagic stroke in epidemiological prevalence⁶. In our study, stroke patients included 60.6%(n=117) male and 39.4%(n=76) female. Generally, male stroke incidence and prevalence surpassed 33% and 41% than the female⁷.

One essay has shown that speech disorder could be found in 82.37% of stroke patients⁸ but in our study only 51.8%(n=100) receiving speech therapy and no positive relations between longer stay in PAC and improvements in CCAT. Dysphagia, on the other hand, were verified in 23% to 50% stroke patients⁹ and 99% (N=191) of our stroke patients underwent swallowing training. FOIS was conducted to assess oral intake function and poor oral feeding may contribute to malnutrition in a certain way. Though FOIS and MNA do show benefits for stroke patient after PAC program⁵, both of them do not positively correlate to the duration of hospitalization in PAC in our study simultaneously.

Gait speed had positive correlation with the length of stay in PAC in our study while 6MWT didn't. Usual gait speed is executed with regular distance(5 meters of valid testing, 1 meter for acceleration and 1 meter for deceleration) and recorded the time of walking to acquire walking velocity¹⁰. On the contrary, 6MWT is executed with regular time of 6 minutes and recorded the distance of walking within the time¹¹. Gait speed is viewed as the sixth vital sign to assess general function and capacity of a person¹⁰ and Gait speed was found significantly and independently associated with 6- minute-walk distance in severe chronic lung disease¹². Both Gait Speed and 6MWT allow patients bring their walking devices during examination but are invalid if the patients need help from other person to accomplish the examination. Both tests mainly base on patients' ambulation by themselves, but 6MWT requires better cardiopulmonary capacity to achieve greater outcome. Thus, 6MWT may not show positive correlation to the length of stay in PAC as Gait speed does, since good cardiopulmonary capacity may not be easily established early in sub-acute phase of stroke.

ADL function is represented with MRS and BI in acute medical center and PAC setting. Relationship between MRS and BI in stroke patients was investigated in many essays, but there's no consensus for it.

Poor outcomes of stroke are viewed as MRS>3 and BI<60¹³. In our study, MRS doesn't reveal significant correlation with the duration of hospitalization in PAC while Barthel index does. This may be elucidated with different measuring categories in these two measurements. MRS basically focus on ambulation and ability to accomplish activity before stroke attack with 0~6 scale. On the other hand, Barthel index mainly aims on the capability to complete various aspects in daily life with 0~100 scale. Previous essay have also pointed out MRS are mainly for global disable assessment and doesn't account for limitation in normal activity of daily life¹⁴. That is to say, Barthel index is able to reflect small degree improvements of stroke patients and thus leading to significant correlation between its improvements and the length of stay in PAC.

Upper extremities function is evaluated by motor function of FMA and MAL(amount use/ quality) in our study. Current essay indicated more common use of FMA for post- stroke upper extremities function evaluation but international consensus of standard measurement is less established¹⁵. In our study, FMA showed significant correlation between its improvements and the length of stay in PAC but MAL didn't. It could be explained by the divergent way of examining upper extremities in the two measurements. Motor function of FMA examines joint movement, i.e. wrist extension, and coordination(finger-to-nose)¹⁶. Meanwhile, MAL focus on whether the patient could finish certain tasks by their upper extremities, i.e. use a key to open a door by self-reporting¹⁷. One essay revealed that FMA is more applicable for multiple impairment of upper extremity while MAL may be influenced by patient's recall and cognition¹⁸. It takes more coordination and enough muscle power to execute tasks in MAL and thus more rehabilitation is needed after joint movements training. In the sub-acute phase of stroke patients in PAC, the improvements in the motor function of FMA could be manifest easier than MAL and therefore significant correlation between improvements in motor function of FMA and the length of stay in PAC was noted in our study.

Limitation

There are some limitations in our study. This is a retrospective and a single center research, so the results may not virtually apply to nation-wide or even worldwide stroke patients. Subgroup analysis, such as stroke type, gender and age, should be further investigated to acquire more information. Different recorders in each PAC may derive bias and so does the training efficacy variant in each institution. Last but not least, the judging scale may not fully represent the patients' recovery and each measurement had its own restriction (i.e., 6MWT couldn't represent cardiopulmonary capacity in bed-ridden stroke patients). Therefore, more survey is needed to clarify the above questions.

Conclusions And Implications

Longer duration of hospitalization in PAC is conducive to enhancing ADL function, advancing balance and coordination, boosting walking speed and augmenting both dexterity and sensory function of upper limb in stroke patients. Physiatrists and medical team members could take this result into consideration while deciding discharge time and predicting further improvements for stroke patients in clinical setting.

Abbreviations

Activities of daily living , ADL; Barthel index, BI; Berg Balance Test, BAL; Concise Chinese aphasia test, CCAT; EuroQoL-5D, QoL; Fugl-Meyer Assessment, FMA; Functional oral intake scale, FOIS; Lawton-Brody instrumental activity of daily life Scale, IADL; Mini-mental state examination , MMSE; Mini nutritional assessment, MNA; Modified Rankin scale, MRS; Motor Activity Log, MAL; Post-acute care, PAC; Six-Minute Walk Test, 6MWT; Usual Gait Speed, Gait Speed

Declarations

Ethics approval and consent to participate

Not applicable

Consent for publication

Not applicable

Availability of data and material

The datasets used and analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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There's no funding regarding this study.

Authors' contributions

Study concept and design: Hsin-Han Cheng, Willy Chou

Acquisition of data: list names: Yu-Ju Tung

Analysis and interpretation of data: list names: Yu-Ju Tung, Hsin-Han Cheng, Willy Chou

Drafting of the manuscript: Yu-Ju Tung

Critical revision of the manuscript for important intellectual content: Willy Chou

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Tables

Table 1. Demographics of stroke patients, mean length of stay in PAC and mean age

Variables	Patients (n=196)
Gender	
Male	117(59.7%)
Female	76(40.3)
Age	63.07±14.135 years old
Length of stay in PAC	35.01±16.373 days
Stroke types	
Hemorrhagic	45(23.3%)
Ischemic	148(76.7%)

Table 2. Functional ability before and after Post-acute care(PAC) training program

Variables	Before PAC program	After PAC program	Improvements
MRS	3.69±0.574	3.13±0.874	-0.554±0.678
BI	42.64±22.873	68.48±25.441	25.839±18.585
FOIS	6.03±1.532	6.53±1.022	0.495±1.038
MNA	19.65±5.308	21.48±4.885	1.832±3.584
QoL	10.47±2.255	8.55±2.250	-1.922±2.167
IADL	1.59±1.498	2.94±1.863	1.352±1.350
BAL	20.26±16.659	35.80±17.317	15.534±11.972
Gait Speed	7.28±17.924	12.00±16.921	4.726±23.414
6MWT	55.30±106.361	146.74±153.328	91.443±99.424
FMA sensory	28.08±15.515	37.44±12.616	9.358±11.785
FMA motor	27.56±22.293	39.32±22.714	11.757±11.718
MMSE	18.78±8.669	21.92±7.704	3.156±4.830
MAL(amount use)	0.87±1.255	1.55±1.926	0.679±1.471
MAL(quality)	1.51±7.499	1.79±3.173	0.278±7.924
CCAT	9.84±2.387	10.42±2.028	0.680±1.067

Abbreviation: MRS, modified Rankin scale; BI, Barthel index; FOIS, functional oral intake scale; MNA, mini nutritional assessment; QoL, EuroQoL-5D; IADL, Lawton-Brody IADL Scale; BAL, Berg Balance Test; Gait Speed, Usual Gait Speed; 6MWT, Six-Minute Walk Test; FMA, Fugl-Meyer Assessment; MMSE, mini-mental state examination; MAL, Motor Activity Log; CCAT, concise Chinese aphasia test

Table 3. Improvements of the functional domains after PAC program and the correlations with the length of stay in PAC

	p	R
ΔMRS	0.071	-0.130
ΔBI	0.000***	0.330
ΔFOIS	0.175	0.099
ΔMNA	0.408	0.060
ΔQoL	0.219	-0.089
ΔIADL	0.052	0.140
ΔBAL	0.000***	0.461
ΔGait Speed	0.002**	0.218
Δ6MWT	0.208	0.091
ΔFMA sensory	0.000***	0.263
ΔFMA motor	0.000***	0.276
ΔMMSE	0.066	0.133
ΔMAL (amount use)	0.714	-0.027
ΔMAL (quality)	0.859	-0.013
ΔCCAT	0.060	0.189

Abbreviation: SD, standard deviation; MRS, modified Rankin scale; BI, Barthel index; FOIS, functional oral intake scale; MNA, mini nutritional assessment; QoL, EuroQoL-5D; IADL, Lawton-Brody IADL Scale; BAL, Berg Balance

Test; Gait Speed, Usual Gait Speed; 6MWT, Six-Minute Walk Test; FMA, Fugl-Meyer Assessment; MMSE, mini-mental state examination; MAL, Motor Activity Log; CCAT, concise Chinese aphasia test

Figures

Figure 1

Enrollment diagram of the study.

Figure 2

Correlation between Δ Barthel index, Δ Berg Balance test, Δ Usual Gait Speed, Δ Fugl-Meyer Assessment of sensory and motor function and the length of stay in PAC

Supplementary Files

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