ORIGINAL REPORT

MAIN OUTCOMES OF STROKE REHABILITATION: A MULTI-CENTRE STUDY IN THAILAND

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Objective: To estimate the efficiency of inpatient rehabilitation for patients after stroke in Thailand.

Design: Multi-centre, prospective study.

Subjects: Patients after stroke, aged ≥18 years, with stable medical signs, able to follow 1-step commands and to sit for at least 30 min.

Methods: Main outcomes included Barthel Index (BI) scores, BI effectiveness, BI efficiency, length of stay, Thai Hospital Anxiety and Depression Scale (HADS) scores, and quality of life.

Results: Of a total of 327 patients, 285 completed the programmes, with a mean length of stay of 27.3 days. Mean age was 62.1 (standard deviation (SD) 12.1) years and 59% of patients were male. Mean BI scores on admission and at discharge were 7.48 (SD 3.96; range 0–19) and 13.27 (SD 4.86; range 0–20), respectively. The change score was 5.79 (SD 3.89) and the efficiency of functional score was 0.28 points/day. Using multivariate analysis, factors associated with change in BI score were age, previous stroke and length of stay. Sixty-four patients (25.5%) had anxiety and 95 (37.8%) had depression on admission. At discharge, the numbers of patients with anxiety and depression decreased to 17 (6.8%) and 41 (16.3%), respectively. The quality of life scores at discharge were significantly higher than those on admission.

Conclusion: Inpatient rehabilitation enabled stroke patients to reach optimal functional ability, and improved psychological status and quality of life.

Key words: stroke rehabilitation, outcomes, effectiveness, efficiency, emotion, quality of life.

J Rehabil Med 2009; 41: 54–58

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INTRODUCTION

The consequences of stroke are not only persisting neurological deficits but also physical impairments and long-term disability (1). According to a systematic review of the economic evaluation of stroke, rehabilitation is more efficient than other interventions (2) and a comprehensive interdisciplinary team approach is the key to successful rehabilitation outcomes. Stroke survivors admitted to stroke rehabilitation within 30 days experienced greater functional gains and shorter lengths of stay (LOS) than those whose admission to rehabilitation was delayed beyond 30 days after stroke (3).

Ideally, medical rehabilitation services should be available for most patients with neurological disorders, especially stroke (4). Physiotherapy was first introduced for orthopaedic patients in Thailand after World War II. A specialized training programme for doctors in rehabilitation medicine and a school of occupational therapy were established in 1985. Thereafter, medical rehabilitation services have gradually become available for neurological patients. At present approximately 14 public tertiary hospitals/centres have interdisciplinary teams that are able to provide inpatient rehabilitation programmes, mainly for neurological patients such as stroke and spinal cord injured patients. However, there has been no multi-centre study on the outcomes of stroke rehabilitation in Thailand. We therefore performed a national registry at 9 main tertiary hospitals/centres including 6 university hospitals, the Sirindhorn National Medical Rehabilitation Centre, the Thai Red Cross Rehabilitation Centre and the Neurological Institute, in order to estimate the efficiency of inpatient rehabilitation for stroke patients in Thailand.

METHODS

This study was a part of the Thai Stroke Rehabilitation Registry (TSRR), the first multi-centre, tertiary, hospital-based registry in 327 patients conducted prospectively during a 10-month period in 2006 (5). After all sites received ethical approval for human research, which complied with the Declaration of Helsinki, they started recruiting patients admitted for comprehensive stroke rehabilitation. The recruited stroke patients were more than 18 years old, with disability and stable medical signs for 48 h, who could follow at least 1-step commands, and who could sit without vertigo or dizziness for at least 30 min. Those with severe medical conditions, including dementia, uncontrolled heart disease, schizophrenia and multiple disabilities, were excluded. All patients signed the approved consent forms.

Before starting the rehabilitation programme, cognitive status was assessed with the Thai Mental State Examination (TMSE) (6). To assess symptoms of anxiety and depression, the Thai Hospital Anxiety and Depression Scale (HADS) was used (score 0–21) (7). A score of greater than or equal to 11 is indicative of clinical anxiety or depression. Activity limitations including self-care and mobility functions were assessed with the Barthel Index (BI), with a score range of 0–20 (8, 9). A higher BI score indicates better functioning. Regarding quality

of life (QoL) assessment, we used the Thai World Health Organiation Quality of Life, the brief version (WHOQOL-BREF) with a score range of 24–120 (10). The Thai WHOQOL-BREF is composed of 26 items divided into 4 dimensions, including physical, psychological, social and environment dimensions. A higher score indicates a better QoL. All of the questionnaires (TMSE, HADS and WHOQOL-BREF) had been tested previously for psychometric properties in a Thai population.

After the initial assessments with the above-mentioned tests/ questionnaires, the interdisciplinary teams, which were composed of rehabilitation specialists, nurses, physiotherapists, occupational therapists, social worker, etc., set rehabilitation goals. They provided the comprehensive rehabilitation programmes necessary for stroke patients using a mix technique between neurodevelopmental and task-oriented techniques set by a physiotherapist in each centre. The therapist provided a treatment programme once a day on weekdays. Physiatrists set appropriate goals for each patient. If the goals were reached or the BI scores were stable for 2 consecutive weeks, the programme was stopped and the patients were discharged. If a patient became ill or had a serious complication that required a transfer to another department or hospital, their outcome data was not collected and the study was counted as incomplete.

The main outcomes of stroke rehabilitation in this registry included admission and discharge' functional BI scores, BI effectiveness, BI efficiency, length of stay (LOS), the HADS scores, and the WHOQOL-BREF scores. Results at discharge were reported and compared with the baseline data on admission. Those patients who had communication difficulties and could not complete the questionnaires were excluded; thus the total numbers of patients completing each assessment questionnaire might be different.

Statistical methods

The main outcome of the rehabilitation programme was change from baseline in BI score at discharge. Anxiety, depression and QoL were classified into different categories and compared at 2 time points using the McNemar test. In order to identify factors that might be associated with the change in BI scores at discharge, Pearson's χ^2 test was employed for categorical data, e.g. gender, previous stroke and incontinence, whereas Pearson's correlation was used for quantitative data, e.g. age, duration of disease and LOS. Multiple linear regression was applied to test the effect of several independent variables simultaneously on change from baseline in BI score at discharge.

To compare the degree of anxiety and depression between admission and discharge, McNemar's test was performed. A paired *t*-test was used to test the difference in QoL score between admission and discharge.

RESULTS

The demographic data are presented in Table I. The mean age of patients was 62.2 (standard deviation (SD) 12.1) years and 59% were males. Most of the patients were married (73.1%), and living in urban areas (62.1%). The median duration from onset to admission interval (OAI) was 24 days (minimum=1, maximum=1456 days). Among these, 16 (4.89%) patients were admitted one year after their stroke. The major medical history was hypertension (74.9%), followed by dyslipidaemia (54.4%), diabetes mellitus (26.6%), and ischaemic heart disease (18.0%). Fifty-one (15.6%) patients had a history of previous stroke. Only 37 (11.3%) patients had had surgical treatment before admission for rehabilitation. Cerebral infarction was found in 71.9% of patients. The average LOS was 27 (SD 18) days. Of the 327 patients, 285 (87.2%) completed the programme. No patient died during inpatient rehabilitation.

Table I. *Demographic data of the 327 patients after stroke*

Demographic data	
Age, years, mean (SD) (min=21, max=93 years)	62.2 (12.1)
Sex : male, *n* (%)	193 (59.0)
Marital status: married, *n* (%)	239 (73.1)
Living place: urban, *n* (%)	203 (62.1)
Onset to adm. interval (median) (min=1, max=1456 days)	24
Known underlying diseases, *n* (%)	308 (94.2)
Hypertension	245 (74.9)
Dyslipidaemia	178 (54.4)
Diabetes mellitus	87 (26.6)
Ischaemic heart disease	59 (18.0)
History of stroke/TIA, *n* (%)	51 (15.6)
Surgical treatment before admission for rehabilitation, *n* (%)	37 (11.3)
Cerebral infarction, *n* (%)	235 (71.9)

TIA: transient ischaemic attack; adm: admission; SD: standard deviation..

Regarding functional ability, the average BI scores on admission and at discharge were 7.48 (SD 3.96; range 0–19) and 13.27 (SD 4.86; range 0–20), respectively. The score at discharge was significantly higher than the score on admission ($p<0.001$). The change score of BI (discharge score – admission score) was 5.79 (SD 3.89) and the efficiency of functional score was 0.28 points/day (Table II). Table III demonstrates the factors (several personal and baseline characteristics at admission) associated with the change in BI score or effectiveness. Using univariate analysis, only a few factors were found to be significantly associated with the change in BI score, including older age, having previous stroke, infarct pathology and LOS. However, after using multivariate analysis, only age, having previous stroke and LOS appeared to be associated with change in BI score.

Concerning the impairments in emotional functions after stroke, 64 patients (25.5%) had anxiety and 95 (37.8%) had depression on admission. At discharge the numbers of patients with anxiety and depression were decreased to 17 (6.8%) and 41 (16.3%), respectively. In addition, the status of patients at discharge compared with on admission was also tabulated and it was found that the number of patients who were improving at discharge was 94 (37.5%) for anxiety and 98 (39.0%) for depression (Table IV). Relating to QoL, the mean (SD) of scores on admission and at discharge were 69.74 (SD 11.75) and 77.72 (SD 10.69), respectively, with statistical significance $p<0.001$. The change score was 7.98 (SD 11.56).

Table II. *Effectiveness and efficiency of stroke functional outcome (Barthel Index score)*

Functional outcome	Mean (SD) *n*=327
Admission score	7.48 (3.96)
Discharge score	13.27 (4.86)
Effectiveness*	5.79 (3.89)
Efficiency†	0.28 (0.30)

*Discharge score – admission score.
†Change score/length of stay.
SD: standard deviation.

Table III. *Factors correlation to change in Barthel Index (BI) scores: univariate and multiple linear regression analysis*

	n	Univariate analysis Change in BI score (dis–adm) Mean (SD)	p	Multiple linear regression b	SE (b)	p
Age (years)	327	r=–0.161	0.003	–0.042	0.017	0.017
Sex						
Male (0)	193	5.96 (4.17)	0.322	–	–	–
Female (1)	194	5.54 (3.44)				
Previous stroke / TIA						
No (0)	279	6.00 (3.98)	0.022	–1.528	0.585	0.009
Yes (1)	48	4.60 (3.08)				
Incontinence						
No (0)	237	5.80 (3.59)	0.948	–	–	–
Yes (1)	90	5.77 (4.59)				
Pathology						
Haemorrhage (0)	92	6.54 (4.40)	0.032	–0.291	0.475	0.540
Infarction (1)	234	5.52 (3.78)				
Medical diseases*	327	r=–0.040	0.475	–	–	–
Onset to admission interval (days)	310	r=–0.047	0.408	–	–	–
Depression score at admission	271	r=–0.047	0.441	–	–	–
Anxiety score at admission	271	r=0.013	0.827	–	–	–
WHOQOL-BREF at admission	290	r=–0.027	0.649	–	–	–
Length of stay (days)	327	r=0.280	<0.001	0.061	0.012	<0.001

*Including diabetes mellitus, hypertension, hypercholesterolemia and cardiac disease.

SD: standard deviation; TIA: transient ischaemic attack; WHOQOL-BREF: World Health Organisation Quality of Life, the brief version; SE: standard error; b: regression coefficient; dis: discharge; adm: admission.

DISCUSSION

After being admitted for one month of stroke rehabilitation, nearly 90% of stroke patients reached their optimal rehabilitation goals set on admission. Although on admission half of the patients had impaired cognitive functions, the results at discharge showed better outcomes in all dimensions of body functions as well as neurological and emotional functions. This is true also of activity and participation as well as QoL. These outcomes reflect the success of our inpatient interdisciplinary stroke rehabilitation services.

Regarding functional ability, our study revealed that age, previous stroke and LOS were found to be significantly associated with change in BI score. Compared with the study of Hankey et al. (11), they found that the most important predictors of disability after stroke were increasing age, baseline BI score, severity of hemiparesis and recurrent stroke. A study from Thailand revealed that the total Functional Independence Measure *(*FIM*)* score at the time of discharge and the total FIM scores gain are highly correlated with the total FIM scores at the time of admission and age (12). Many studies reported

the predictor factors for stroke outcomes. However, the BI score on admission was the strongest predictor for long-term outcome (13, 14). Our results appear to support those of the study of Pan et al. (15), showing that the BI effectiveness had significant effects on long-time survival while initial BI was not a significant predictor. In addition, older age (11, 16, 17) as well as LOS (18) were also found to be predictors of outcome. Ng et al. (18) reported that factors associated with better functional outcomes were: higher admission motor and cognitive FIM scores, male gender, a longer rehabilitation LOS, and the use of acupuncture; whereas the factors associated with poorer functional outcomes were: older age, clinical deconditioning, ischaemic heart disease, depression, pressure sores, and the presence of a domestic worker as a caregiver. Bohannon et al. (19) also reported the post-admission BI score to be the best predictor of the LOS. However, further recovery may be possible, as the average LOS of our study was approximately 4 weeks. A follow-up study has been conducted and will be reported.

Abnormal mood is an important consequence of stroke and may affect recovery and outcomes. Among these, depression

Table IV. *Number (%) of patients who had anxiety and depression in stroke rehabilitation*

Admission (n=251)	Discharge Anxiety Normal (0–7)	Suspected (8–10)	Cases (11–21)	p-value*	Depression Normal (0–7)	Suspected (8–10)	Cases (11–21)	p-value*
Normal (0–7)	111 (87.4)	12 (9.5)	4 (3.1)	<0.001	79 (84.0)	13 (13.9)	2 (2.1)	<0.001
Suspected (8–10)	41 (68.3)	17 (28.3)	2 (3.3)		34 (54.8)	20 (32.3)	8 (12.9)	
Cases (11–21)	32 (50.0)	21 (32.8)	11 (17.2)		25 (26.3)	39 (41.1)	31 (32.6)	

*p-value compare level of anxiety/depression between admission and discharge, McNemar Test.

and anxiety are common emotional disturbances after stroke (20). The prevalence of depression after stroke varied from 20% up to 40% of patients (21–23). However, emotional disturbances are often undiagnosed or inadequately treated. Our results revealed that at discharge the number of patients with anxiety and/or depression was decreased. According to a systematic review in 2005, physical disability, stroke severity and cognitive impairment were consistently associated with depression (24). In addition there was evidence that post-stroke depression (PSD) had a negative impact on the functional recovery process, especially after discharge (25). Rehabilitation should focus more strongly on interventions that promote emotional coping and reduce depressive symptoms (26).

Concerning QoL, a previous study revealed that variables positively associated with stroke survivors' QoL were: independence in activities of daily living, increased functional ability, social support, and healthcare resources (27). Our patients had higher QoL scores at discharge than on admission. However, the dimension that the patients rated lowest was the social dimension (data not presented). This may be because our rehabilitation programmes placed more stress on physical and functional outcomes than on social ones. In the future we should therefore pay more attention to social issues when planning a discharge.

In this study the average LOS, of 27 days or approximately 4 weeks, is comparable with that in other studies, such as the Texan study with an average LOS for inpatient medical rehabilitation of 21.9 days (28), and the Irish study with an average LOS of 31.3 days at a regional hospital (29). Bagg et al. (30) reported in 2006 that the mean LOS of stroke patients in Canadian rehabilitation facilities was 49.2 days, which was longer than in our study. This may be related to differences in the healthcare and family support systems between countries. A short LOS may be due to high medical expenses, well-organized rehabilitation programmes, or a well-organized home-healthcare system, while a long LOS is usually associated with complications (31).

There are several limitations of our study. The data were gathered from tertiary rehabilitation centres, so they might not be applicable to other secondary or primary hospitals. Since this was a registry study, no intervention was applied. In addition, only patients after stroke with good potential for rehabilitation were recruited, therefore the data may not represent the outcomes for all types of patients after stroke.

In conclusion, this registry study showed that the inpatient stroke rehabilitation programme was of benefit for post-acute stroke patients with disability, in terms of physical, psychological and QoL aspects. A 3-week LOS may be enough to gain optimal physical and functional outcomes. However, social issues following discharge should be of greater concern in order to improve QoL of stroke survivors in the community.

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