Three-Month Outcomes Comparison Among Wake-up and Non wake-up Ischemic Stroke in Phramongkutklao Hospital

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Abstract

Background and Objective: Stroke symptoms noticed upon waking, wake-up ischemic stroke, account for up to a quarter of all acute ischemic stroke. Patients with wake-up ischemic stroke, however, are often excluded from thrombolytic therapy due to stroke onset time is unknown, and these patients revealed worse outcomes. The objective was to investigate the 3-month favorable outcomes between wake-up and non wake-up ischemic stroke, as defined by modified Rankin scale 0-2 (mRS 0-2).

Materials and Methods: A prospective cohort study was conducted at Neurological division, Phramongkutklao Hospital. All patients of age group 18 years or more presenting with acute ischemic stroke during August 2016 to May 2017 were enrolled. Demographic data, clinical presentation, severity, treatment, and outcomes were collected. Three-month favorable outcomes (mRS 0-2) were compared between wake-up and non-wake up ischemic stroke by applying binary logistic regression analysis.

Results: A total of 264 patients diagnosed with acute ischemic stroke were included, of which 100 (37.9%) were wake-up ischemic stroke. Wake-up stroke patients were at a significantly lower percentage to receive thrombolytic therapy (6% vs 14.6%, p-value=0.044). The 3-month favorable outcomes were similar between wake-up and non wake-up ischemic stroke patients, however, wake-up ischemic stroke patients tend to have less 3-month favorable outcome (60% vs 65.2%, p-value=0.431).

Conclusion: In this study, approximately 38% of ischemic strokes were wake-up strokes. The 3-month favorable outcome of wake-up strokes were not significantly different from non-wake up strokes.

Keywords: ischemic stroke, non wake-up stroke, outcome, wake-up stroke (J Thai Stroke Soc. 2019;18(3):5-15)

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การศึกษาเปรียบเทียบผลการรักษาที่ 3 เดือนของผู้ป่วยโรคหลอดเลือดสมองขาดเลือดที่เกิดอาการขณะตื่นนอนกับผู้ป่วยโรคหลอดเลือดสมองขาดเลือดที่ไม่ได้เกิดอาการขณะตื่นนอนในโรงพยาบาลพระมงกุฎเกล้า

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บทคัดย่อ

ความเป็นมาและวัตถุประสงค์: อาการของโรคหลอดเลือดสมองขาดเลือดที่เกิดอาการขณะตื่นนอนหรือ wake-up ischemic stroke พบประมาณ 25% ของผู้ป่วยโรคหลอดเลือดสมองขาดเลือดทั้งหมด โดยผู้ป่วยกลุ่มนี้มักไม่ได้รับการรักษาด้วยยาละลายลิ่มเลือด เนื่องจากไม่ทราบระยะเวลาที่เกิดอาการแน่นอน และพบว่าผู้ป่วยกลุ่มนี้มีผลการรักษาที่แย่กว่า วัตถุประสงค์การวิจัย คือ เพื่อเปรียบเทียบผลการรักษาที่ดีที่ 3 เดือน (favorable outcome = mRS 0-2) ของผู้ป่วยโรคหลอดเลือดสมองขาดเลือดที่เกิดอาการขณะตื่นนอนกับผู้ป่วยโรคหลอดเลือดสมองขาดเลือดที่ไม่ได้เกิดอาการขณะตื่นนอน

วัสดุและวิธีการ: เป็นการศึกษาจากเหตุไปหาผลแบบไปข้างหน้า โดยทำการวิจัย ณ โรงพยาบาลพระมงกุฎเกล้า แผนกประสาทวิทยาในผู้ป่วยอายุตั้งแต่ 18 ปีขึ้นไปที่มาด้วยสมองขาดเลือดระหว่างเดือนสิงหาคม พ.ศ.2559 ถึงเดือนพฤษภาคม พ.ศ.2560 โดยเก็บรวบรวมข้อมูลพื้นฐานของผู้ป่วย อาการและอาการแสดง ความรุนแรง การรักษา และผลการรักษา ซึ่งผลการรักษาที่ดีที่ 3 เดือนระหว่างกลุ่มผู้ป่วยโรคหลอดเลือดสมองขาดเลือดที่เกิดอาการขณะตื่นนอนกับผู้ป่วยโรคหลอดเลือดสมองขาดเลือดที่ไม่ได้เกิดอาการขณะตื่นนอนจะถูกวิเคราะห์โดยใช้การวิเคราะห์การถดถอยโลจิสติค

ผลการศึกษา: มีผู้ป่วยโรคหลอดเลือดสมองขาดเลือดแบบเฉียบพลันที่เข้าเกณฑ์ของการวิจัยทั้งหมด 264 คน โดย 100 คน (37.9%) เป็นผู้ป่วยโรคหลอดเลือดสมองขาดเลือดที่เกิดอาการขณะตื่นนอน ผู้ป่วยกลุ่มนี้ได้รับการรักษาด้วยยาละลายลิ่มเลือดน้อยกว่าอย่างมีนัยสำคัญทางสถิติ (6% และ 14.6%, p-value=0.044) แต่ในส่วนของผลการรักษาที่ดีที่ 3 เดือนนั้นไม่แตกต่างกันระหว่างผู้ป่วยทั้ง 2 กลุ่ม อย่างไรก็ตามผู้ป่วยโรคหลอดเลือดสมองขาดเลือดที่เกิดอาการขณะตื่นนอนมีแนวโน้มที่จะมีผลการรักษาที่ดีที่ 3 เดือนน้อยกว่าอีกกลุ่ม (60% และ 65.2%, p-value = 0.431)

สรุป: จากการศึกษานี้พบผู้ป่วยโรคหลอดเลือดสมองขาดเลือดที่เกิดอาการขณะตื่นนอนประมาณ 38% ของผู้ป่วยโรคสมองขาดเลือดทั้งหมด โดยผลการรักษาที่ดีที่ 3 เดือนของผู้ป่วยกลุ่มนี้ไม่พบความแตกต่างอย่างมีนัยสำคัญทางสถิติจากกลุ่มผู้ป่วยโรคหลอดเลือดสมองขาดเลือดที่ไม่ได้เกิดอาการขณะตื่นนอน

คำสำคัญ: โรคหลอดเลือดสมองขาดเลือด, โรคหลอดเลือดสมองขาดเลือดที่เกิดอาการขณะตื่นนอน, โรคหลอดเลือดสมองขาดเลือดที่ไม่ได้เกิดอาการขณะตื่นนอน, ผลการรักษา (J Thai Stroke Soc. 2019;18(3): 5-15)

Introduction

Stroke is a major health burden in Thailand[1]. It is a leading cause of death and long term disability. The incidence of stroke in Thailand from Thai Epidemiological Stroke Study between 2004 to 2006 is estimated to be 1.88% among adults 45 to 80 years[2]. In 2005, stroke is the first most common cause of death among both women and men in Thailand[3].

Patients who wake up, having experienced a stroke while asleep (wake-up ischemic stroke) represent around 8-27% of acute ischemic stroke patients[4-8] but are often excluded from thrombolytic therapy, according to international guidelines for the management of acute ischemic stroke, because of unknown onset time[8, 9]. These patients have poorer functional outcomes compared to patients with known time of stroke (non wake-up stroke)[8, 10]. Studies show that many patients with wake-up ischemic stroke have clinical and radiological characteristics similar to patients with non wake-up ischemic stroke who receive thrombolytic treatments[4, 8, 9, 11, 12]. The primary hypothesis prior to data collection for this study was that wake-up ischemic stroke patients are often ineligible to receive thrombolytic therapy, and associated with worse outcomes. If these patients receive thrombolytic therapy, the outcome would be better.

Objective

The primary objective is to evaluate the 3-month favorable outcome between wake-up and non wake-up ischemic stroke, as defined by modified Rankin scale 0-2 (mRS 0-2). The secondary objectives are to assess rate of the 14-day symptomatic ICH, 90-day mortality and National institute of Health Stroke Scale (NIHSS).

Materials and Methods

Study design and patient

This is a prospective cohort study, conducted in neurological division, Phramongkutklao Hospital between August 2016 to May 2017. The inclusion criteria were 1) patients more than 18 years of age 2) diagnosed with acute ischemic stroke within 7 days, was defined according to the World Health Organization criteria: rapidly developed clinical signs of focal disturbance of cerebral function, lasting more than 24 hours, with no apparent cause other than vascular origin. The exclusion criteria include all case of transient ischemic attack, intracerebral hemorrhage, meningitis, primary and metastatic brain tumor, hypoglycemia, post-ictal phase seizure or post head injury infarction.

Informed consents were done for all patients. Demographic data, clinical characteristic, onset-to-door time, time of onset, radiological characteristic (side and site of stroke, and The Alberta stroke program early CT score (ASPECTS)), Trial of Org 10172 in acute stroke treatment (TOAST) classification and thrombolytic therapy. Patient's functional and clinical status has been assessed according to modified Rankin scale (mRS) and NIHSS.

The patients have been classified in to 2 groups as non wake-up ischemic stroke group, with a known time of stroke onset, and wake-up ischemic stroke, patients waking from sleep with symptoms of stroke.

The primary outcome measure was the favorable outcome using modified Rankin Scale (mRS), defined as favorable (mRS 0-2) or unfavorable (mRS >2), and assessed at 90 days. The secondary outcomes are the 14-day symptomatic ICH, 90-day mortality and NIHSS.

This study was approved by the

Phramongkutklao Health Research Ethics Board. The Phramongkutklao Health Information Privacy Committee approved data access.

Statistics

The data were collected and analyzed by using SPSS version 22.0. Descriptive statistics were used in demographic data. Central tendency measurement was represented in the mean and standard deviation (mean±SD). The frequency and percentage were used for the group data. Comparisons of groups were done using Chi-square test. Binary logistic regression was used to assess outcomes. Statistical significance was set at p-value < 0.05.

Result

From the 264 included acute ischemic stroke patients during August 2016 to May 2017, 100 (37.9%) had wake-up stroke and 164 (62.7%) had non wake-up stroke.

The baseline characteristics of all patients are shown in table 1. The median age of the patients was 72 years, ranging from 31 to 95 years, and study population consisted of 152 (57.6%) males and 112 (42.4%) females. The median systolic blood pressure was 148 mmHg and diastolic blood pressure was 80 mmHg. Most common risk factor was hypertension (76.1%), followed by dyslipidemia (67%), diabetes mellitus (29.9%), previous stroke or TIA (23.1%), atrial fibrillation (13.6%), coronary artery disease (13.3%) and valvular heart disease (11.4%). Forty eigth percent of patients used antiplatelet drug and 9.1% used anticoagulant drug. Most common clinical presentation was hemiparesis (81.4%). The median onset-to-door time of patients was 420 minutes. Most common onset time was 6 am to 5.59 pm period. One hundred sixty-seven (96.6%) of patients had favorable baseline mRS (0-2). The median NIHSS at onset was 4, ranging from 1 to 36. The median ASPECTS was 9. The most common etiology of stroke was cardioembolism (31.4%). Thirty (11.4%) patients received thrombolytic therapy. The median admission duration was 2 days.

Table 1. *Baseline characteristics*

	N (%)
Sex	
Male	152 (57.6)
Female	112 (42.4)
Age (years) (mean ± SD)	69.6 ± 13.1
Blood pressure (mmHg) (mean ± SD)	
Systolic blood pressure	149.6 ± 27.0
Diastolic blood pressure	82.7 ± 16.7
Underlying disease	
History stroke/TIA	61 (23.1)
Atrial fibrillation	36 (13.6)
Valvular heart disease	30 (11.4)

	N (%)
Coronary artery disease	35 (13.3)
Diabetic mellitus	79 (29.9)
Hypertension	201 (76.1)
Dyslipidemia	177 (67.0)
Medication	
Antiplatelet	126 (47.7)
Anticoagulant	24 (9.1)
Clinical presentation	
Hemiparesis	215 (81.4)
Hemiparesthesia	77 (29.2)
Diplopia	9 (3.4)
Facial palsy	166 (62.9)
Dysarthria	160 (60.6)
Aphasia	35 (13.3)
Vertigo	21 (8.0)
Ataxia	15 (5.7)
Other	14 (5.3)
Onset-to-door time (minutes) (median [min-max])	420 [30 - 7200]
Onset time	
24.00-05.59	33 (12.5)
06.00-11.59	108 (40.9)
12.00-17.59	68 (25.8)
18.00-23.59	55 (20.8)
Baseline mRS	
0 - 2	255 (96.6)
> 2	9 (3.4)
NIHSS at presentation	
< 4	134 (50.8)
5 – 14	103 (39.0)
15 – 24	25 (9.5)
≥ 25	2 (0.8)
ASPECTS (mean ± SD)	8.7 ± 1.9
TOAST classification	
Large vessel	67 (25.4)
Cardioembolic	83 (31.4)

	N (%)
Small vessel	80 (30.3)
Other determined	8 (3.0)
Undetermined	26 (9.8)
Thrombolytic therapy	30 (11.4)
Duration of admission (days) (median [min-max])	2 [1 - 178]

Abbreviations: TIA, transient ischemic attack; mRS, modified Rankin scale; NIHSS, National Institutes of Health Stroke Scale; ASPECTS, The Alberta stroke program early CT score; TOAST classification, Trial of Org 10172 in acute stroke treatment classification

A comparison of the baseline characteristics of wake-up stroke patients with non wake-up stroke patients are described in table 2. There were female patients in wake-up stroke more than non wake-up stroke (53% vs. 36%, p-value=0.007). Wake-up stroke patients were older (72 years vs. 68 years, p-value=0.008). The diastolic blood pressure was 78 mmHg in wake-up stroke, 86 mmHg in non wake-up stroke (p-value<0.001). There was more valvular heart disease in those with wake-up stoke (22% vs. 4.9%, p-value<0.001). Hemiparesthesia was more found in non wake-up stroke (35.4% vs. 19%, p-value=0.005) but facial palsy was more found in wake-up stroke (71% vs. 57.9%, p-value=0.036). There was no statistically significant difference in systolic blood pressure, underlying disease (except valvular heart disease), medication and clinical presentation (except hemiparesthesia and facial palsy). As unexpected, the stroke onset was significant longer among non wake-up stroke patients (p-value=0.028). Wake-up stroke occurred more often from 12pm-05.59am (p-value<0.001). Non wake-up stroke occurred more often from 12am-05.59pm and 6pm-11.59pm (p-value=0.006 and 0.019). Wake-up stroke showed significantly lower ASPECT score when compare with non wake-up stroke (p-value=0.019). Wake-up stroke patients were at a significantly lower percentage to receive thrombolytic therapy (6% vs. 14.6%, p-value=0.044). There was no statistically significant difference in baseline mRS, NIHSS at presentation, TOAST classification, and duration of admission.

Table 2. *Comparison of baseline characteristics between wake-up and non wake-up stroke group*

	Wake up N (%) (n=100)	Non wake up N (%) (n=164)	p-value
Sex			
Male	47 (47.0)	105 (64.0)	0.007
Female	53 (53.0)	59 (36.0)	0.007
Age (years) (mean ± SD)	72.3 ± 11.5	67.9 ± 13.8	0.008
Blood pressure (mmHg) (mean ± SD)			
Systolic blood pressure	145.7 ± 25.7	151.9 ± 27.6	0.068
Diastolic blood pressure	77.7 ± 15.2	85.7 ± 16.9	< 0.001

	Wake up N (%) (n=100)	Non wake up N (%) (n=164)	p-value
Underlying disease			
History stroke/TIA	22 (22.0)	39 (23.8)	0.766
Atrial fibrillation	10 (10.0)	26 (15.9)	0.200
Valvular heart disease	22 (22.0)	8 (4.9)	< 0.001
Coronary artery disease	11 (11.0)	24 (14.6)	0.458
Diabetic mellitus	34 (34.0)	45 (27.4)	0.271
Hypertension	70 (70.0)	131 (79.9)	0.075
Dyslipidemia	64 (64.0)	113 (68.9)	0.421
Medication			
Antiplatelet	49 (49.0)	77 (47.0)	0.800
Anticoagulant	6 (6.0)	18 (11.0)	0.193
Clinical presentation			
Hemiparesis	83 (83.0)	132 (80.5)	0.744
Hemiparesthesia	19 (19.0)	58 (35.4)	0.005
Diplopia	6 (6.0)	3 (1.8)	0.087
Facial palsy	71 (71.0)	95 (57.9)	0.036
Dysarthria	53 (53.0)	107 (65.2)	0.052
Aphasia	12 (12.0)	23 (14)	0.711
Vertigo	6 (6.0)	15 (9.1)	0.483
Ataxia	3 (3.0)	12 (7.3)	0.177
Other	4 (4.0)	10 (6.1)	0.578
Onset-to-door time (minutes) (median [min-max])	420 [60 - 2880]	480 [30 - 7200]	0.028
Onset time			
24.00 - 05.59	29 (29.0)	4 (2.4)	< 0.001
06.00 - 11.59	42 (42.0)	66 (40.2)	0.797
12.00 - 17.59	16 (16.0)	52 (31.7)	0.006
18.00 - 23.59	13 (13.0)	42 (25.6)	0.019
Baseline mRS			
0 - 2	94 (94.0)	161 (98.2)	0.087
> 2	6 (6.0)	3 (1.8)	0.087
NIHSS at presentation			
< 4	53 (53.0)	81 (49.4)	0.613
5 - 14	40 (40.0)	63 (38.4)	0.797
15 - 24	5 (5.0)	20 (12.2)	0.081
≥ 25	2 (2.0)	0 (0)	0.143

	Wake up N (%) (n=100)	Non wake up N (%) (n=164)	p-value
ASPECTS (mean ± SD)	8.3 ± 2.1	8.9 ± 1.8	0.019
TOAST classification			
Large vessel	26 (26.0)	41 (25.0)	0.885
Cardioembolic	27 (27.0)	56 (34.1)	0.274
Small vessel	33 (33.0)	47 (28.7)	0.491
Other determine	3 (3.0)	5 (3.0)	1.000
Undetermine	11 (11.0)	15 (9.1)	0.673
Thrombolytic therapy	6 (6)	24 (14.6)	0.044
Duration of admission (days) (mean ± SD)	8.3 ± 13.3	8.7 ± 22.5	0.863

Abbreviations: TIA, transient ischemic attack; mRS, modified Rankin scale; NIHSS, National Institutes of Health Stroke Scale; ASPECTS; The Alberta stroke program early CT score; TOAST classification, Trial of Org 10172 in acute stroke treatment classification.

Table 3 shows the outcomes of wake-up and non wake-up stroke groups at 14 and 90 days. In primary outcome measure, there is not statistically significant difference in 90-day favorable outcome between wake-up and non wake-up stroke (p-value=0.431). However, wake-up stroke patients tended to had a lower percentage of favorable outcome at 90 days (60% vs. 65.2%). In secondary outcomes measure, there were not significant differences in 90-day mortality rate, 90-day NIHSS, and 14-day symptomatic ICH (p-value=1, 0.426, and 0.714). The other outcomes; recurrent rate at 14 and 90 days, and NIHSS at 14 days, did not differ significantly between wake-up and non wake-up stroke.

Table 3. *Outcomes of wake-up and non wake-up stroke groups at 14 and 90 days*

Outcomes	Wake up N (%) (n=100)	Non wake up N (%) (n=164)	p-value
mRS at 90 days (mean ± SD)	2.2 ± 1.9	2.0 ± 1.9	0.459
0 – 2	60 (60.0)	107 (65.2)	0.431
> 2	40 (40.0)	57 (34.8)	0.431
mRS at 14 days (mean ± SD)	2.6 ± 1.8	2.5 ± 1.8	0.767
0 – 2	49 (49.0)	88 (53.7)	0.526
> 2	51 (51.0)	76 (46.3)	0.526
Recurrent stroke at 14 days	2 (2.0)	5 (3.0)	0.713
Symptomatic ICH at 14 days	2 (2.0)	6 (3.7)	0.714
NIHSS at 14 days (mean ± SD)	6.1 ± 7.1	5.5 ± 6.1	0.509
< 4	53 (53.0)	81 (49.4)	0.613
5 – 14	40 (40.0)	63 (38.4)	0.797

Outcomes	Wake up N (%) (n=100)	Non wake up N (%) (n=164)	p-value
15 – 24	5 (5.0)	20 (12.2)	0.081
≥ 25	2 (2.0)	0 (0)	0.143
Mortality at 90 days	2 (2.0)	4 (2.4)	1.000
Recurrent stroke at 90 days	0 (0)	3 (1.8)	0.291
NIHSS at 90 days (mean ± SD)	4.5 ± 5.8	4.00 ± 5.6	0.426
< 4	66 (66.0)	117 (71.3)	0.410
5 – 14	27 (27.0)	33 (20.1)	0.226
15 – 24	5 (5.0)	8 (4.9)	1.000
> 25	0 (0)	2 (1.2)	0.528

Abbreviations: mRS, modified Rankin scale; ICH, intracerebral hemorrhage; NIHSS, National Institutes of Health Stroke Scale.

In subgroup analysis (table 4), there was no statistically significant difference in 90-day favorable outcome between thrombolysed and non- thrombolysed wake-up stroke patients (p-value=1), but thrombolysis in wake-up stroke patients tended to had a higher percentage of favorable outcome at 90 days (66.7 % vs. 59.6%). There is no statistically significant difference in symptomatic ICH at 14 days (p-value=0.651 and 0.571).

Table 4. *Subgroup analysis of thrombolysed wake-up and non wake-up stroke patients*

Outcomes	Wake up N (%) (n=100)	Non wake up N (%) (n=164)	p-value
mRS at 90 days			0.651
0 – 2	4 (66.7)	11 (45.8)	
> 2	2 (33.3)	13 (54.2)	
Symptomatic ICH at 14 days	2 (33.3)	4 (16.7)	0.571

Abbreviations: mRS, modified Rankin scale; ICH, intracerebral hemorrhage

The predictors of 90-day favorable outcome in multivariate logistic regression analysis (table 5) were lower age (adjusted OR=0.94, 95%CI 0.91-0.97), lower diastolic blood pressure (adjusted OR=0.98, 95%CI 0.96-1), higher ASPECTS (adjusted OR=1.67, 95%CI 1.36-2.05) and thrombolytic therapy (adjusted OR=14.42, 95%CI 1.62-128.41). Wake-up and non wake-up stroke were not a predictor of 90-day favorable outcome (95% CI 0.44-1.91)

Table 5. Predictors of 90-day favorable outcome in multivariate logistic regression analysis

Variables	Adjusted OR (95%CI)	p-value
Female	0.86 (0.43 - 1.71)	0.661
Age	0.94 (0.91 - 0.97)	< 0.001
Diagnostic blood pressure	0.98 (0.96 - 1)	0.036
Valvular heart disease	1.66 (0.58 - 4.71)	0.342
ASPECTS	1.67 (1.36 - 2.05)	< 0.001
Thrombolytic therapy	14.42 (1.62 - 128.41)	0.017
Wake up stroke	0.91 (0.44 - 1.91)	0.806

Values presented as Odds ratio (95% Confident interval). P-value corresponds to Binary logistic regression.

Discussion

In this prospective cohort study, wake-up strokes comprised approximately 38% of ischemic stroke cases that presented in Phramongkutklao Hospital. This rate is higher than that published in the previous studies (8-27%)[4-8]. Timing of wake-up stroke varied widely with the majority occurring from 12 am to 05.59 pm. This finding is not different from the report of a meta-analysis of 31 publications[13]. The gender-specific risk was similar in our study. In concordance with the results of other published studies, we found females having higher incidence of wake-up stroke. We found atrial fibrillation to be more frequent among non wake-up stroke. This data was supported by the observation of higher frequency of cardioembolic etiology.

Many wake-up stroke patients are not eligible for thrombolytic treatment in routine clinical practice because the time of onset is not known[8, 9]. The outcome of wake-up stroke may be worse compared with patients with non wake-up stroke[8, 10].This study did not show a difference in the primary outcome of mRS 0 to 2 at 90 days between wake-up and non wake-up stroke (60% vs. 65.2%, p-value=0.431), although non wake-up stroke patients were at a significantly higher percentage to receive thrombolytic therapy (14.6% vs. 6%, p-value=0.044). This may be because non wake-up stroke patients tended to had higher rate of recurrent stroke at 14 and 90 days, symptomatic ICH after thrombolysis at 14 days, that caused mRS at 90 days of non wake-up stroke were not better than wake-up stroke as previous studies.

From multivariate analysis, the predictors of 90-day favorable outcome were younger age, lower diastolic blood pressure, higher ASPECTS and thrombolytic therapy, were not wake-up or non wake-up stroke. Especially, thrombolysed patients had 14-times of 90-day favorable outcome. This suggests that thrombolytic treatment in selected wake-up stroke patients is feasible and may be associated with better outcomes.

The strength of this study lies with the comparison of wake-up and non wake-up stroke, which is possibly the first study on wake-up stroke in Thailand. The major limitation of our study is being a single-center study. Secondly, we only measure functional outcome by mRS score.

Conclusion

The 3-month favorable outcome of wake-up strokes were not significantly different from non-wake up strokes. Wake-up stroke patients

were at a significantly lower percentage to receive thrombolytic therapy.

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Body of knowledge

Nowadays, there are more patients who wake up having experienced a stroke while asleep (wakeup stroke), but there are few studies about these patients. This study shows the information of wakeup stroke patients in Phramongkutklao hospital and the importance of treatment in these patients for better outcomes.

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