Prevalence and Management of Poststroke Spasticity in Thai Stroke Patients: A Multicenter Study

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Objectives: *To study the prevalence, associated factors and management of poststroke spasticity in two muscle groups namely elbow flexor and knee flexor.*
Material and Method*: The Thai stroke rehabilitation registry (TSRR) was conducted among 9 rehabilitation centers. All subjects received the conventional rehabilitation program until they reached their rehabilitation goals or discharge criteria. The Brunnstrom motor recovery stage, Barthel Index, Thai Mental State Examination, Modified Ashworth Scale (MAS), and WHOQOL-BREF-Thai(26 items) questionnaires were used to assess the motor recovery, functional disability, cognition, spasticity and quality of life on admission respectively. The management of spasticity was also recorded.*
Results: *There were 327 patients with a mean age of 62.2 years old participating in the study. The prevalence of poststroke spasticity was 41.6%. Among these the prevalences of spasticity of both elbow and knee flexors was 31.2% and of either elbow or knee flexor were 4.9% and 5.5% respectively. Spasticity with MAS grade 1 was found in the majority. The patients with spasticity had a significantly longer time to rehabilitation admission interval after the stroke ($p = 0.049$), had the Brunnstrom motor recovery stages of arm ($p < 0.001$), hand ($p = 0.003$) and leg ($p < 0.001$) significantly lower than the no spasticity group. The factor associated with spasticity was Brunnstrom motor recovery stage 2 and 3 of the arm with the odds ratio being 6.1 (95% CI = 2.5-14.9) and 3.5 respectively (95% CI = 1.3-9.2). Management of spasticity was demonstrated in 83 patients (25.4%). Therapeutic exercise, oral antispastic medication and assistive device were the first three managements frequently prescribed respectively.*
Conclusion: *Spasticity was a common complication after stroke. Although the prevalence was quite high, spasticity with MAS grade 1 was found in the majority of cases. The associated factor was the Brunnstrom motor recovery stage of the arm. Therapeutic exercise was the mainstay of the management.*

Keywords: *Muscle spasticity, Prevalence, Risk factors, Stroke, Therapy*

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Spasticity is a motor disorder characterized by velocity-dependent increase in tonic stretch reflexes (muscle tone) with exaggerated tendon jerks, resulting from hyperexcitability of the stretch reflexes[1]. It is a well recognized complication after stroke as it can interfere with functional recovery, cause pain, and lead to secondary complications such as joint contracture and pressure ulcers. However, spasticity may be useful in some situations as in the lower limbs to facilitate standing and transferring[2]. Unfortunately, the disadvantages often outweigh the potential advantages[3]. Various treatments have been used to manage spasticity, including physical modalities such as heat and cold therapy, orthotic devices, therapeutic

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exercise, oral medication, focal injections with neurolytic agents, surgical intervention and intrathecal medications.

Prevalence of spasticity following stroke has been scarce of published studies. It has been reported that in the first-ever stroke patients, spasticity was presented in 19%[4] and 39%[5] at 3 and 12 months after stroke respectively. At 3 months, patients who were nonspastic had significantly better motor and activities score than spastic patients but the correlation between the spasticity and the disability was low[4]. In contrary, those with spasticity had a significantly lower Barthel Index score at 12 months[5]. It can be postulated that in the early stage after stroke, the spasticity was associated with motor impairments but, later in the disease process, it clearly had an impact on the disability.

In the general clinical settings in Thailand, there are limited inpatient rehabilitation facilities. Not all stroke patients were transferred directly from acute to rehabilitation facilities. Thus, stroke patients who were admitted for inpatient rehabilitation would have different duration of disease. Therefore, the study of prevalence of spasticity following stroke in consecutive patients would enable the rehabilitation professionals to appropriately design a plan of management. In addition, the study of factors associated with spasticity, the extent of spasticity, the need of treatment and the management approaches would alert us to the patients who were at risk and be basic information for the authors' clinical economics.

The objectives of the present study were to study the prevalence of poststroke spasticity in two muscle groups namely elbow flexor and knee flexor and the association between spasticity and various factors. Different management approaches among the clinical centers were surveyed.

Material and Method

The present study was a part of Thai Stroke Rehabilitation Registry (TSRR)[6] which was the first systematic hospital-based, multi-center national registry of in-patient post-acute stroke rehabilitation in Thailand. There were 376 patients screened for the present study, and 327 patients were enrolled into the present study. The physiatrists used the physical examination to screen for the spasticity in both elbow and knee flexors. The prevalence of spasticity was defined as the presence of spasticity at the time of admission and during hospitalization. The present study has focused on the spasticity of elbow flexor and knee flexor groups as they can interfere with activities of daily living and mobility respectively. The Modified Ashworth Scale (MAS)[7] was used to determine the tonal abnormalities of muscles because it was the most widely accepted clinical rating scales. This scale has been demonstrated to have good to very good inter- and intra-rater agreement for the measurement of tone in the elbow and knee flexor groups[8].

The association of spasticity and the following factors including the demographic data, the impairment related data and the quality of life at discharge were explored. The impairment related data were the Barthel index[9] score on admission and discharge and the Brunnstrom motor recovery stages[10] on admission. The Brunnstrom motor recovery stages is a test in which movement patterns are evaluated and motor function is rated according to the six stages of motor recovery in the arm, hand and leg after a stroke. The quality of life was measured by the WHOQOL-BREF-Thai (26 items) questionnaire[11] consisting of 4 broad domains of quality of life namely physical health, psychological well being, social relationships, and satisfaction with the environment. The overall QOL score is the summation of all four subscale scores plus another two global item scores. The QOL score is then used to classify the QOL as poor, fair, and good. In addition, the frequency of treatment and management approaches to spasticity were also reported.

Statistical analysis

The prevalence of spasticity was reported as percentage of presentation of spasticity on admission and during hospitalization among the total population in this study. Then, the total population was divided into two groups according to the presentation of spasticity. Patients who had spasticity in either elbow flexor or knee flexor muscles was defined as the spasticity group. The rest of total population was defined as the non-spasticity group. The comparison between these two groups with different factors was performed.

The Chi-Square Test was used to analyze the qualitative data which were categorized into 3 groups. Firstly, the demographic related group, which considered gender, marital status, educational levels, risk factors of stroke, pathology, and side of weakness respectively. Secondly, the impairment related group, which involved the Brunnstrom motor recovery stages of arm, hand and leg. The last group considered the

quality of life. The sum of the QOL score was divided into three levels as poor, fair and good.

The Independent Sample T-Test was used to analyze the quantitative data namely age, duration of stroke, Barthel Index score on admission and discharge.

Any variables significantly associated ($p < 0.05$) with the spasticity were used to calculate in multivariate analysis by logistic regression. The factors associated with spasticity were reported as the odd ratios with 95% confidence interval.

The management approaches to spasticity were reported as percentage of management frequency, different modes of management and management outcomes.

All analyses were performed using Statistical Package for Social Sciences (SPSS) version 11.5.

Results

There were 193 males and 134 females with mean age 62.2+12.1 years old (min 21, max 93) participating in the present study. A hundred and two patients had spasticity of both elbow and knee flexors. Thirty-four patients had spasticity of either elbow or knee flexors. Therefore, the total prevalence of poststroke spasticity was 41.6% (95% CI = 36.4-47.0). Focusing on the single joint, the prevalences of spasticity of elbow and knee flexors were 4.9% and 5.5% respectively. (Table 1). Among those who developed spasticity, it could be elicited on admission in most patients. The degree of spasticity according to the MAS score was grade 1 for the majority. The number of patients who had spasticity with MAS grade 1+ and 2 were quite close in value. Notably, significant spasticity which was defined as the muscle tone abnormalities with MAS grade 3 and 4, was very few. Only one patient had spasticity with MAS grade 3 and none reported spasticity with MAS grade 4 (Table 2).

In the spasticity group, the demographically related variables were reported as the following: most of the patients were male with a mean age of 60.95 years old. The risk factors of stroke reported respectively were hypertension, dyslipidemia, smoking, previous stroke, diabetes mellitus and heart disease. Cerebral infarction with left side weakness was found in the majority. The median time to rehabilitation admission was 31 days. Among these variables, the duration of stroke ($p = 0.049$) was the demographic related factor found associated with the spasticity group. Regarding the impairment related variables, less motor recovery assessed by the Brunnstrom motor recovery stages of arm ($p < 0.001$), hand ($p = 0.003$) and leg ($p < 0.001$) was significantly associated with the spasticity group. There was no association between spasticity and the Barthel Index score on admission ($p = 0.93$) and at discharge ($p = 0.88$). Concerning the quality of life measurement, most of the patients with spasticity rated themselves as having fair quality of life at discharge. However, there was no association between this factor and the spasticity group (Table 3).

The logistic regression by multivariate analysis revealed only Brunnstrom motor recovery stages of the arm in stage 2 ($p < 0.001$) and 3 ($p = 0.01$) were related to spasticity (Table 4).

The management of spasticity was recorded in 83 patients (25.4%). Among these, 55 patients (16.8%) had elbow flexors and 63 patients (19.3%) had knee flexors spasticity. Modes of management reported respectively for these were therapeutic exercise, oral antispastic medication, assistive devices, Botulinum toxin injection, motor point block and physical modalities. After the spasticity management, only a few patients had resolved but most patients had it ongoing till the end of the program (Table 5).

Discussion

The prevalence of poststroke spasticity among the inpatient stroke rehabilitation patients in

Table 1. The prevalence of spasticity among the stroke patients

Prevalence of spasticity	Number (%)
Total	136 (41.6)
Elbow and knee flexors	102 (31.2)
Elbow flexor only	16 (4.9)
Knee flexor only	18 (5.5)

Table 2. Muscle tone abnormalities measured by the modified Ashworth scale (MAS) (n = 327)

Grading of tone abnormalities	Elbow flexor n (%)	Knee flexor n (%)
Grade 0	227 (69.4)	227 (69.4)
Grade 1	53 (16.2)	59 (18)
Grade 1+	26 (8.0)	18 (5.5)
Grade 2	20 (6.1)	22 (6.7)
Grade 3	1 (0.3)	1 (0.3)

Table 3. The comparison of various variables between the spasticity and no spasticity groups

Variables	Spasticity (n = 136)	No spasticity (n = 191)	p-value
Demographic related			
Gender			
Male	85 (44.0)	108 (56.0)	0.334
Female	51 (38.1)	83 (61.9)	
Age (yrs)**	60.95 ± 12.07	63.16 ± 12.12	0.104
Risk factors of stroke			
Hypertension	94 (38.4)	151 (61.6)	0.056
Diabetes mellitus	29 (33.3)	58 (66.7)	0.090
Dyslipidemia	71 (39.9)	107 (60.1)	0.569
Heart disease	21 (35.6)	38 (64.4)	0.375
Previous stroke	24 (50.0)	24 (50.0)	0.262
Smoking	49 (49.0)	51 (51.0)	0.092
Pathology			
Infarction	94 (40.2)	140 (59.8)	0.465
Hemorrhage	42 (45.7)	50 (54.3)	
Side of weakness			
Left	82 (46.6)	94 (53.4)	0.159
Right	51 (35.9)	91 (64.1)	
Bilateral	3 (42.9)	4 (57.1)	
Median time to rehabilitation admission (days)	31 (1-4,163)	19 (2-1,000)	0.049*
Impairment related			
Brunnstrom motor recovery stage of arm			
Stage 1	25 (18.4)	51 (26.7)	0.000*
Stage 2	62 (45.6)	41 (21.5)	
Stage 3	27 (19.9)	32 (16.8)	
Stage 4	8 (5.9)	21 (11.0)	
Stage 5	6 (4.4)	16 (8.4)	
Stage 6	8 (5.9)	30 (15.7)	
Brunnstrom motor recovery stage of hand			
Stage 1	55 (40.4)	69 (36.1)	0.003*
Stage 2	44 (32.4)	33 (17.3)	
Stage 3	11 (8.1)	20 (10.5)	
Stage 4	12 (8.8)	24 (12.6)	
Stage 5	8 (5.9)	21 (11.0)	
Stage 6	6 (4.4)	24 (12.6)	
Brunnstrom motor recovery stage of leg			
Stage 1	17 (12.5)	35 (18.3)	0.000*
Stage 2	62 (45.6)	47 (24.6)	
Stage 3	28 (20.6)	37 (19.4)	
Stage 4	22 (16.2)	33 (17.3)	
Stage 5	4 (2.9)	25 (13.1)	
Stage 6	3 (2.2)	14 (7.3)	
Barthel index score on admission**	7.50 ± 3.81	7.46 ± 4.07	0.930
Barthel index score at discharge**	13.32 ± 4.72	13.24 ± 4.96	0.880
Quality of life			
Quality of life at discharge			
Poor	1 (33.3)	2 (66.7)	0.55
Fair	95 (45.9)	112 (54.1)	
Good	28 (38.9)	44 (61.1)	

* Significant at p-value < 0.05, ** Mean ± SD, NS: no statistical significant

Table 4. The associated factor of spasticity by forward stepwise logistic regression analysis with duration adjusted

Variables	Odd ratios	95% confidence interval	p-value
Brunnstrom motor recovery stage of arm			
Stage 6	1.0		
Stage 5	1.5	0.4, 5.3	0.49
Stage 4	1.5	0.5, 5.0	0.43
Stage 3	3.5	1.3, 9.2	0.01*
Stage 2	6.1	3.5, 14.9	<0.001*
Stage 1	2.0	0.8, 5.2	0.15

* Significant at p-value < 0.05

Table 5. Management of spasticity

Management	Elbow flexor	Knee flexor
Frequency (n = 83)	55 (17.5)	63 (19.3)
Modes		
Therapeutic exercise	41 (74.5)	46 (73.0)
Oral medication	12 (21.8)	15 (23.8)
Assistive devices	6 (10.9)	11 (17.5)
Botulinum toxin	2 (3.6)	6 (9.5)
Motor point block	1 (1.8)	5 (7.9)
Physical modalities	0 (0)	3 (4.7)
Outcome		
Ongoing at the end of program	48 (87.3)	51 (80.9)
Resolved	7 (13.7)	12 (19.1)

the present study was 41.6%. The prevalence was rather high when compared to the cohort study of Sommerfeld[4] and Watkins[5]. Sommerfeld used the Modified Ashworth Scale to measure poststroke spasticity at several joints and reported prevalence of poststroke spasticity as 21% within 1 week and 19% at 3 months. Likewise, Watkins used the same scale to measure spasticity at the elbow joint at 12 months poststroke and reported the prevalence as 27%. The present study was a registry, some patients might enter rehabilitation after they had developed spasticity and that would result in the high prevalence of poststroke spasticity. Among the spasticity group, the prevalence of the patients with MAS score 1, 1+, 2, and 3 were found, respectively, and that was rather similar to the finding of Sommerfeld's study[4]. Regarding the risk factor of stroke, a previous stroke was not significantly associated with spasticity, which was similar to the study outcomes of others'[5, 12]. Therefore, the authors did not separately analyze the prevalence of spasticity in either the first and the recurrent stroke groups.

In the present study, the authors examined abnormal muscle tone on two groups of muscle, namely, elbow flexor and knee flexor. The number of patients who had spasticity in both muscle groups was higher than those affected in only a single joint. This manifestation showed that spasticity was the generalized process after upper motor neuron lesion.

Time to rehabilitation admission interval in the spasticity group was significantly longer than the non- spasticity group. Hence, it could be postulated that the stroke patients in the non- spasticity group might have entered the rehabilitation program earlier than those in the spasticity group. Early onset of rehabilitation interventions after stroke is strongly associated with improved functional outcome[13] by facilitating motor movement[14]. In the present study, the stroke patients in the non-spasticity group had better motor recovery. Most of them had Brunnstrom motor recovery stages of arm, hand and leg in stage 5 and 6 which represented almost full to full recovery. On the contrary, the number of patients with spasticity who had Brunnstrom staging of arm, hand and leg in stage 2 and 3 was significantly higher than those without spasticity. According to the Brunnstrom motor recovery stage, the spasticity has emerged from stage 2 and is escalating to the synergy stage or stage 3. Welmer had also found that all stroke patients whose movements were restricted to the synergies stage exhibited spasticity[15].

The association between spasticity and Barthel index score was not found in the present study. The reason might be most patients had spasticity of elbow flexor and knee flexor with MAS grade I. Spasticity in the affected arm might not hamper the self care function as the patients can learn the compensation technique to perform those tasks. For mobility function, the presence of spasticity in the knee flexors was not as great to contribute to the disability.

After applying logistic regression analysis, only the Brunnstrom motor recovery of arm in stage 2 and 3 had more relation with spasticity than other stages. However, the Brunnstrom motor recovery stages of hand and leg were not related with spasticity. In the spasticity group, most patients had better motor recovery (stage 4-6) of their legs than their arms and hands. Meanwhile, the motor recovery of the hand was the poorest, the spasticity had not yet emerged. Therefore, in the present study the motor recovery of the arm which was mostly at the Brunnstrom stage 2 and 3 had more association with spasticity. This pattern of motor recovery had been studied by Twitchell. He reported the arm and hand were more involved at the onset of stroke and eventual motor recovery in the arm and hand were less than the leg[16].

According to the survey of management frequency among nine centers, knee flexor spasticity was managed more often as it may have an impact on ambulation. The management delivered in the present study was divided into two types. Management for preventing complication from spasticity such as joint stiffness and pressure ulcer. Therapeutic exercise was the mainstay of management since it was parallel with the degree of spasticity found in the present study. Thus, the range of motion exercise was most frequently provided to the patients. Management for reducing the muscle tone such as intramuscular neurolysis and motor point block was rarely performed, because very few patients had spasticity with MAS grade 3 or 4. Therefore, after management most patients still had spasticity ongoing til the end of the program.

Conclusion

The prevalence of spasticity in consecutive stroke patients was 41.6%. It usually affected multiple joints and occurred on admission rather than during hospitalization. The factors related with spasticity were the Brunnstrom motor recovery of arm in stage 2-3. The spasticity with MAS grade 1 was found in the majority; therefore the therapeutic exercise was the mainstay of management in the present study.

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ความชุกและการรักษาภาวะกล้ามเนื้อหดเกร็งในผู้ป่วยโรคหลอดเลือดสมองไทย: การศึกษาสหสถาบัน

ปิยะภัทร เดชพระธรรม, วิไล คุปต์นิรัติศัยกุล, อภิชนา โฆวินทะ, พัชรวิมล คุปต์นิรัติศัยกุล, กัลยา เดชนันทรัตน์

วัตถุประสงค์*: เพื่อศึกษาความชุก การรักษาและปัจจัยที่สัมพันธ์กับการเกิดภาวะกล้ามเนื้อหดเกร็งภายหลังการเกิดโรคหลอดเลือดสมองที่กล้ามเนื้อ 2 กลุ่ม คือ กล้ามเนื้องอศอกและกล้ามเนื้องอเข่า*

วัสดุและวิธีการ*: ทำการศึกษาทะเบียนโรคหลอดเลือดสมองแบบสหสถาบัน ณ 9 โรงพยาบาลในประเทศไทย ผู้ป่วยทุกรายได้รับโปรแกรมการฟื้นฟูสมรรถภาพตามมาตรฐานจนกระทั่งถึงเป้าหมายของการฟื้นฟูสมรรถภาพหรือเกณฑ์จำหน่ายตามที่กำหนดไว้ เมื่อแรกรับทำการวัดการฟื้นตัวของระบบประสาทด้วย Brunnstrom motor recovery stage ความพร่องสมรรถภาพวัดด้วยแบบประเมิน Barthel Index สมรรถภาพสมองวัดด้วยแบบประเมิน Thai Mental State Examination (TMSE) ภาวะกล้ามเนื้อหดเกร็งวัดด้วยแบบประเมิน Modified Ashworth Scale (MAS) และคุณภาพชีวิตประเมินด้วยแบบสอบถาม WHOQOL-BREF ฉบับภาษาไทย นอกจากนี้ได้ทำการบันทึกเกี่ยวกับการรักษาภาวะกล้ามเนื้อหดเกร็งทุกชนิดที่ผู้ป่วยได้รับ*

ผลการศึกษา*: ผู้ป่วยโรคหลอดเลือดสมอง 327 คนอายุเฉลี่ย 62.2 ปีที่เข้าร่วมการศึกษา มีค่าความชุกของภาวะกล้ามเนื้อหดเกร็งภายหลังการเกิดโรคหลอดเลือดสมองเท่ากับร้อยละ 41.6 โดยความชุกของกล้ามเนื้อกลุ่มงอศอกและกล้ามเนื้องอเข่าหดเกร็งเท่ากับร้อยละ 31.2 ส่วนความชุกของกล้ามเนื้อกลุ่มงอศอกและงอเข่าหดเกร็งเพียงข้อเดียวเท่ากับ 4.9 และ 5.5 ตามลำดับ ส่วนมากพบภาวะกล้ามเนื้อหดเกร็งที่ระดับ MAS grade 1 ผู้ที่มีภาวะกล้ามเนื้อหดเกร็งมีระยะเวลาของการเกิดโรคหลอดเลือดสมองนานกว่า ($p = 0.049$) มีระดับ Brunnstrom motor recovery stage ของแขน ($p < 0.001$) มือ ($p = 0.003$) และขา ($p < 0.001$) ต่ำกว่าผู้ที่ไม่มี กล้ามเนื้อหดเกร็งอย่างมีนัยสำคัญทางสถิติ ปัจจัยที่มีความสัมพันธ์กับภาวะกล้ามเนื้อหดเกร็ง คือ Brunnstrom motor recovery stage 2 และ 3 ของแขนด้วยค่า odds ratio เท่ากับ 6.1 (95% CI = 2.5-14.9) และ 3.5 (95% CI = 1.3-9.2) ตามลำดับ มีผู้ป่วยโรคหลอดเลือดสมอง 83 ราย (ร้อยละ 25.4) ที่ได้รับการรักษาภาวะกล้ามเนื้อ หดเกร็ง โดยการออกกำลังกาย รับประทานยาลดเกร็ง และใช้อุปกรณ์เสริมเป็นการรักษา 3 ลำดับแรกที่ผู้ป่วยได้รับ บ่อยที่สุดตามลำดับ*

สรุป*: ภาวะกล้ามเนื้อหดเกร็งเป็นภาวะแทรกซ้อนที่พบได้บ่อยภายหลังการเกิดโรคหลอดเลือดสมอง แม้ความชุกจะสูง แต่ส่วนมากพบภาวะกล้ามเนื้อหดเกร็งที่ระดับ MAS grade 1 โดย Brunnstrom motor recovery stage ของแขนมีความสัมพันธ์กับภาวะกล้ามเนื้อหดเกร็ง และการออกกำลังกายเป็นการรักษาที่ผู้ป่วยส่วนใหญ่ได้รับ*