Thai J Neurol Surg 2023;14(2):63-72.

Research Article

Factors Associated with Health-Related Quality of Life in Subarachnoid Hemorrhage in Southern Thailand

Natthanee Pisitthaworakul, M.N.S.
Suphawan Saetan, B.N.S.
Sompit Thongma, B.N.S.
Sukanya Kongchoo, B.N.S.
Jiamjit Kaewsuk, B.N.S.
Busakorn Puntachit, B.N.S.
Phaisit Tabtiang, B.N.S.
Thara Tunthanathip, MD, Ph.D.
Division of Neurosurgery, Department of Surgery, Faculty of Medicine, Prince of Songkla University, Songkhla, Thailand

Abstract

Background: Subarachnoid hemorrhage (SAH) leads patients to develop subsequent mortalities, disabilities, and poor health-related quality of life (HRQoL). The present study aimed to investigate factors associated with HRQoL in patients with spontaneous SAH following treatment.

Methods: The present study was a cross-sectional study to assess HRQoL in SAH patients after treatment by the visual analogue scale (VAS) scores. The correlation matrix with Pearson's correlation among various variables was used to screen a relationship between VAS scores and other variables. Moreover, linear regression analysis was performed in both univariate and multivariable analyses to explore factors associated with the VAS score.

Results: Ninety SAH patients consented and completed the questionnaire. The Hunt and Hess grade, World Federation of Neurological Surgeons grade, and Fisher grade all had negative correlations with VAS scores of -0.712, -0.551, and -0.377, respectively. Following the multiple linear regression with the backward stepwise procedure, the Hunt and Hess grade grade was the only factor in the final model that was linked to HRQoL of SAH patients after treatment

Conclusion: In summary, the present study demonstrated a negative linear correlation between the severity of SAH and patient-reported HRQoL. For general practice, the Hunt and Hess grade could be the most important predictor of HRQoL after treatment in SAH.

Keywords: Factors associated with quality of life following subarachnoid hemorrhage

Corresponding author: Thara Tunthanathip
Division of Neurosurgery, Department of Surgery, Faculty of Medicine, Prince of Songkla University, Songkhla, Thailand, 90110; Phone: 66-92-5495994; Email: tsus4@hotmail.com

วารสารประสาทศัลยศาสตร์ไทย
ปีที่ 14 ฉบับที่ 2 เมษายน - มิถุนายน 2566

บทคัดย่อ

ปัจจัยที่สัมพันธ์กับคุณภาพชีวิตด้านสุขภาพในภาวะเลือดออกในเยื่อหุ้มสมอง ภาคใต้ ประเทศไทย

ณัฐธนีย์ พิสิษฐวรกุล, พย.ม., ศุภวรรณ แซ่ตั้น, พย.บ., สมพิศ ทองมา, พย.บ., สุกัญญา คงชู, พย.บ., เจียมจิต แก้วสุข, พย.บ., บุษกร พันธชิต, พย.บ., ไพสิฐ ทับเที่ยง, พย.บ., ธาราณ์ ตันธนาธิป, พ.บ., ปร.ด.

ที่มาและความสำคัญ: ภาวะเลือดออกใต้เยื่อหุ้มสมอง (Subarachnoid hemorrhage: SAH) ทำให้ผู้ป่วยเสียชีวิต ทุพพลภาพ และคุณภาพชีวิตด้านสุขภาพแย่ลง (Health-related quality of life: HRQoL) การศึกษานี้มีวัตถุประสงค์เพื่อศึกษาปัจจัยที่เกี่ยวข้องกับ คุณภาพชีวิตด้านสุขภาพ ในผู้ป่วยเลือดออกใต้เยื่อหุ้มสมองที่เกิดขึ้นเอง ภายหลังการรักษา

วิธีการ: การศึกษาครั้งนี้เป็นการศึกษาแบบภาคตัดขวางเพื่อประเมิน HRQoL ในผู้ป่วย SAH หลังการรักษาด้วยคะแนน Visual Analogue Scale (VAS) และมีการใช้เมทริกซ์สหสัมพันธ์ที่มีสหสัมพันธ์ของเพียร์สันระหว่างตัวแปรต่างๆ ถูกนำมาใช้เพื่อคัดกรองความสัมพันธ์ระหว่างคะแนน VAS กับตัวแปรอื่นๆ นอกจากนี้มีการวิเคราะห์การถดถอยเชิงเส้น เพื่อสำรวจปัจจัยที่เกี่ยวข้องกับคะแนน VAS โดยวิเคราะห์ทั้งแบบการวิเคราะห์ตัวแปรเดียวและหลายตัวแปร

ผลการศึกษา: ผู้ป่วย SAH 90 รายได้เข้าการศึกษา ผลการศึกษาพบว่าปัจจัย Hunt and Hess grade, World Federation of Neurological Surgeons grade และ Fisher grade มีความสัมพันธ์เชิงลบกับคะแนน VAS ที่ -0.712, -0.551 และ -0.377 ตามลำดับ ตามการถดถอยเชิงเส้นแบบพหุคูณด้วยขั้นตอนแบบย้อนกลับ ปัจจัย Hunt and Hess grade เป็นปัจจัยเดียวในแบบจำลองสุดท้าย (Final model) ที่สัมพันธ์กับ HRQoL ของผู้ป่วย SAH หลังการรักษา

สรุป: การศึกษานี้แสดงให้เห็นถึงความสัมพันธ์เชิงเส้นเชิงลบระหว่างความรุนแรงของ SAH และ HRQoL นอกจากนี้สำหรับนำผลการศึกษาไปใช้ในเวชปฏิบัติทั่วไป Hunt and Hess grade อาจเป็นตัวบ่งชี้ที่สำคัญที่สุดของ HRQoL หลังการรักษาใน SAH

คำสำคัญ: หลอดเลือดสมองโป่งพอง, คุณภาพชีวิตด้านสุขภาพ, โรคหลอดเลือดสมอง, ภาวะเลือดออกในเยื่อหุ้มสมอง

Introduction

Subarachnoid hemorrhage (SAH) is a serious condition that can cause mortality and disability. The common causes of spontaneous SAH are ruptured cerebral aneurysm, ruptured arteriovenous malformation, and other bleeding disorders.[1] SAH patients had an in-hospital mortality rate ranging from 10 to 21.5% based on a review of the literature, as well as functional disability and poor health-related quality of life (HRQoL).[2,3]

Lindberg et al. studied the prevalence of disability in SAH patients and found that 91% had independence in self-care, 80% had instrumental (80%) activities of daily living, and 23% reported the need for personal assistance.[4]

From previous studies of HRQoL, Greebe et al. reported HRQoL of 64 SAH patients using the visual analogue scale (VAS) scores and found that the

mean VAS scores after 4-month, 5-year, and 12.5-year follow-ups were 59, 72, and 76, respectively.[5] Meyer et al. investigated HRQoL at discharge in 113 patients with aneurysmal SAH and discovered that 92.2% of the patients had moderate or severe HRQoL problems. The mean VAS score at hospital discharge was 57.8 (SD 19.3), but it improved to 64.78 (SD 24.99) at the 12-month follow-up.[6] Additionally, Vogelsang et al. compared self-reported HRQoL in aneurysmal SAH patients after treatment to a general population sample. As a result, the mean VAS score of SAH patients was 70.7 (SD 22.1), while the general population's HRQoL was 77.6. (SD 18). The HRQoL of SAH patients was significantly lower than that of the general population.[7]

The data from previous studies on HRQoL in SAH patients are limited from a review of the literature, particularly the HROoL study from Thailand. Therefore, the present study aimed to investigate factors associated with HRQoL in patients with spontaneous SAH following treatment.

Methods

Study Designs and Study Population

The present study was a cross-sectional study to assess HRQoL in SAH patients after treatment. The study population included SAH patients who were 18 years or older and admitted to a hospital in southern Thailand between January 2022 and December 2022. Patients were excluded for the following reasons: (1) patients were unable to complete the questionnaire on their own or had no caregiver to complete the questionnaire; (2) foreign patients who did not speak Thai or English; (3) patients who did not have a cranial computed tomography (CT) scan and cerebral angiogram; (4) patients who had hospital discharge with death. Therefore, data on clinical features and imaging findings, and treatment were collected. The clinical-based severity of SAH was estimated according to Hunt and Hess (HH) grading and the World Federation of Neurological Surgeons (WFNS) grading on the first visit to our hospital[8], while CT-based grading was performed by Fisher grading.[9]

Health-related Quality of Life assessment

Using VAS techniques, the HRQoL following treatment was evaluated. The VAS tool includes a scale range of 0-100 scores, and the patient is assigned the VAS score before hospital discharge.[10,11] In patients who were not fully conscious, family members or other caregivers assessed the VAS score using the proxy-patient perspective approach.[12]

In particular, the limitation of daily living activities was assessed using a 5-level Likert scale (1-5 levels). As a result, the 5-level responses were classified as follows: 1 denotes no problem, 2 denotes a mild problem, 3-4 denotes a moderate problem, and 5 denotes a severe problem.

Statistical analysis

The clinical features were derived from the descriptive data. While continuous variables were described using the mean and standard deviation (SD), categorical data was represented using percentages. A correlation matrix was used to screen Pearson's correlation among various variables, and a relationship between two variables is generally considered strong when their r value is greater than 0.7.[13]

A simple linear regression analysis was used

to determine the variables influencing the VAS score. Following a simple linear regression analysis, variables with a *p*-value of less than 0.1 were included as candidate variables in a comprehensive multivariable analysis model. Multiple linear regression analyses were also performed using the backward elimination method, and statistical significance was defined as a *p*-value less than 0.05. The variance inflation factor (VIF) and tolerance were used to estimate multicollinearity. A VIF greater than 10 and a tolerance less than 0.2 were used to define multicollinearity.[14,15]

Therefore, scatter plots were created to visualize the relationship between the significant variables and the VAS score from the final multiple linear regression model. Stata version 16 was used for statistical analysis. (StataCorp, Texas, United States, SN 401606310234).

Ethical considerations

The human research ethics committee approved the present study (REC.64-005-10-1). The patient's informed consent was performed, and patient identification numbers were encoded before analysis.

Results

Of the 93 SAH patients enrolled in the study, ninety patients consented and completed the questionnaire. Two patients were excluded because they were foreign patients who could not communicate in Thai or English languages. Additionally, One patient's cranial CT brain and cerebral angiogram were also unavailable. The baseline characteristics are demonstrated in Table 1. The average age of the present cohort was 58.07 (SD 13.99), with a range of 24 to 100 years, and more than two-thirds were female. Two-thirds of the current cohort had WFNS

Table 1 Baseline clinical characteristics (N=90)

Factor	N (%)
Gender	
Male	32 (25.6)
Female	58 (64.4)
Mean age-year (SD)	58.07 (13.99)
Type of aneurysm	
Anterior circulation	42 (46.7)
Posterior circulation	38 (42.2)
Negative finding of angiogram	10 (11.1)
Multiple aneurysm	22 (24.4)
Lateralization of aneurysm	
Left	29 (32.2)
Right	33 (36.7)
Midline	6 (6.7)
Bilateral	12 (13.3)
Negative finding of angiogram	10 (11.1)

Table 1 (cont.) Baseline clinical characteristics (N=90)

Factor	N (%)
Hunt and Hess grade	
I	24 (26.7)
II	42 (46.6)
III	11 (12.2)
IV	9 (10.0)
V	4 (4.4)
World Federation of Neurological Surgeons grade	
I	59 (65.6)
II	11 (12.2)
III	4 (4.4)
IV	12 (13.3)
V	4 (4.4)
Fisher grade	
I	2 (2.2)
II	23 (25.6)
III	30 (33.3)
IV	35 (38.9)
Pretreatment hydrocephalus	15 (16.7)
Treatment	
Clipping operation	32 (35.6)
Endovascular treatment	48 (53.3)
Schedule for follow-up angiogram	10 (11.1)
Health-related quality of life at hospital-discharge	
Mean visual analogue scale score after treatment (SD)	77.11 (19.84)
Status before discharge	
Neurological deficit	23 (25.5)
Self-care	
No problem	49 (54.4)
Mild problem	22 (22.4)
Moderate problem	19 (21.1)
Severe problem	10 (11.1)
Usual activities	
No problem	48 (53.3)
Mild problem	25 (27.8)
Moderate problem	7 (7.8)
Severe problem	10 (11.1)
Headache	
No problem	33 (36.7)
Mild problem	28 (31.1)
Moderate problem	25 (27.8)
Severe problem	4 (4.4)
Anxiety/depression	
No problem	39 (43.3)
Mild problem	26 (28.8)
Moderate problem	22 (24.4)
Severe problem	3 (3.3)

* included spontaneous SAH with negative finding on cerebral angiogram and ruptured AVM

† ncluded ruptured AVM

grade I, while 46.6% of all patients had HH grade II severity. On cranial CT, 35 individuals (38.9% of the population) had Fisher grade IV. Ten patients (11.1%) with SAH showed negative cerebral angiography findings, but aneurysm rupture was identified in 88.9% of all instances. In detail, anterior circulation ruptured aneurysms were detected in forty-two patients (46.7%), while posterior circulation ruptured aneurysms were found in 42.2% of instances. A total of 24.4% of the current cohort had multiple cerebral aneurysms. The current study found no mortality at hospital discharge, but three patients (3.3%) died at the 1-month follow-up. Furthermore, the current study's mean VAS score before hospital discharge was 77.11 (SD 19.84).

Moreover, the neurological deficit was observed in 25.5% of cases before hospital discharge, while SAH patients had self-care and usual activities problems in 45.6% and 46.7%, respectively. In the present study, 63.3% of SAH patients had headaches before being discharged from the hospital.

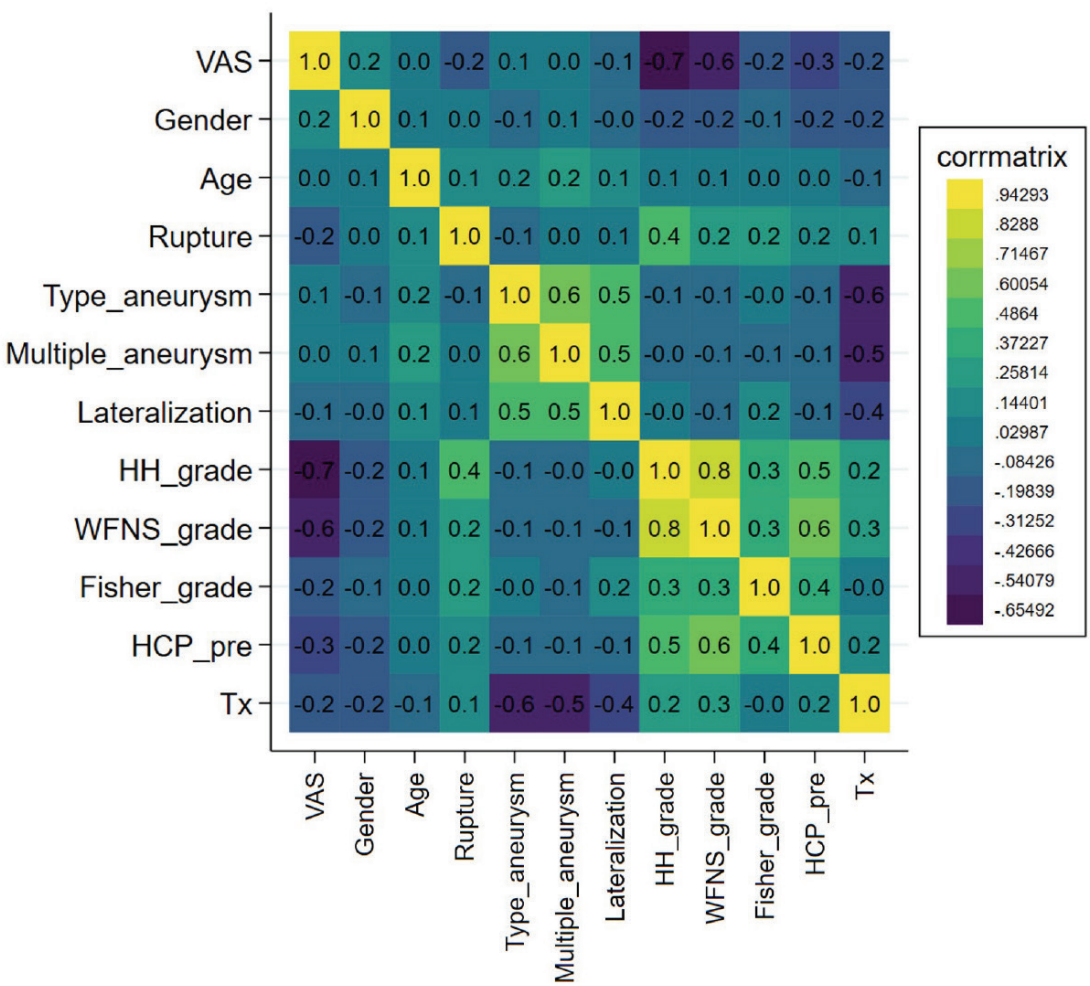

Figure 1 Correlation matrix among various clinical variables

The correlation matrix was performed to screen the relationship among various variables, as shown in Figure 1. The HH grade, WFNS grade, and Fisher grade all had negative correlations with VAS scores of -0.712, -0.551, and -0.377, respectively. As a result, simple linear regression analyses with various clinical and imaging variables were carried out, as shown in Table 2. Therefore, the multiple regression model included five candidate variables. Multicollinearity was checked for these candidate variables, and the VIFs for age, HH grade, WFNS grade, Fisher grade, and pre-treatment hydrocephalus were 1.30, 1.39, 1.25, 1.33, and 1.44, respectively. Furthermore, the age, HH grade, WFNS grade, Fisher grade, and pre-treatment hydrocephalus tolerances were 0.766, 0.719, 0.701, 0.712, and 0.694, respectively.

After the backward stepwise procedure, HH grade was the only factor in the final model that was linked to HRQoL of SAH patients after treatment, as shown in Table 3. From the final model, a scatter plot between the VAS score and HH grade was made with a linear fitting regression line, as shown in Figure 2.

Table 2 Simple linear regression analysis

Factor	Beta	95%CI	*p*-value
Gender	6.51	-2.11,15.13	0.13
Age	0.005	-0.29,0.30	0.04
Posterior circulation	2.50	-3.80,8.80	0.43
Multiple aneurysm	1.56	-5.61,8.75	0.66
Lateralization	-1.30	-4.92,2.32	0.47
HH grade	-13.08	-15.81,-10.34	< 0.001
WFNS grade	-8.62	-11.39,-5.85	< 0.001
Fisher grade	-6.04	-9.18,-2.89	< 0.001
Pre-treatment hydrocephalus	-15.74	-26.44,-5.03	0.004
Treatment	-5.30	-11.01,0.40	0.11

Table 3 Multiple linear regression analysis

Model	Beta	95%CI	*p*-value
Full model			
Constant	100.34		
Age	0.052	-0.16,0.26	0.63
HH grade	-16.69	-22.51,-10.88	< 0.001
WFNS grade	2.34	-2.44,7.12	0.33
Fisher grade	0.65	-2.72,4.04	0.70
Pre-treatment hydrocephalus	0.59	-9.69,10.88	0.90
Final model			
Constant	105.75		
HH grade	-13.08	-15.81,-10.34	< 0.001

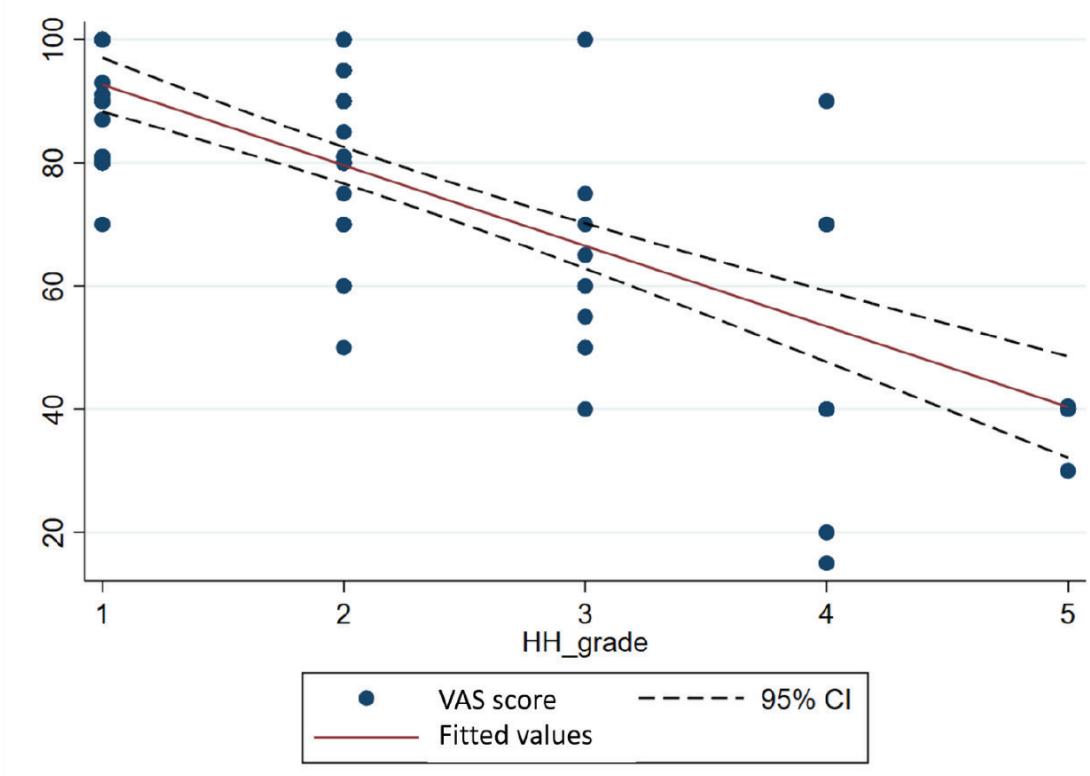

Figure 2 Scatter plot of visual analogue scale score and Hunt and Hess grade with linear fitting lines.

Discussion

SAH leads patients to develop subsequent disabilities as a result. There were noticeable difficulties with self-care and regular activities. Moreover, Patients' HRQoL was shown to be lower. In the current study, the mean VAS score before hospital discharge was 77.11 (SD 19.84). These results are in concordance with other research reports. Prior studies reported mean VAS score of SAH patients reduced to 57.8-76 after follow-ups.[5-7].

Various factors associated with HRQoL were discovered through a review of the literature. Vogelsang et al. studied 217 aneurysmal SAH patients and discovered that Glasgow coma score was significantly related to HRQoL, whereas treatment type (clipping and coiling) was not significantly related to HRQoL.[7] Taufique et al. investigated 1-year HRQoL in 1,181 SAH patients and discovered that nonwhite ethnicity, high school education or less, depression history, poor clinical grade (HH grade 3), and delayed infarction were predictors of poor HRQoL.[16] Kronvall et al. conducted a prospective study to estimate reduced HRQoL in SAH patients and found that age, gender, HH grade, and pituitary dysfunction were predictors of HRQoL.[17] Furthermore, according to Passier et al., female gender and older age are significantly related to poorer HRQoL after aneurysmal SAH.[18]

In the present study, the multivariable analysis demonstrated a negative correlation between high HH grade and VAS score. The HRQoL of SAH patients

decreased as a result of neurological deficits and headaches. Blood extravasation into the subarachnoid space between the pial and arachnoid membranes obstructs cerebrospinal fluid flow, which may result in increased intracranial pressure and decreased HRQoL due to pain symptoms.[19] Also, having both an intracranial hematoma and a cerebral infarction at the same time can cause neurological problems that make SAH patients' HRQoL even worse.[16,19]

According to the World Health Organisation paradigm, HRQoL has lately been proposed as a supplement to standard neurological outcome indicators from the patient's perspective. For implication, the findings of this study may be used for future research such as economic evaluation, or health interventions and technologies.[20] Additionally, the factors associated with poor HROoL from the present study may be used to establish a treatment plan and predict their prognosis in the real-world context. However, the current study's limitations should be noted. We did not compare HRQoL between SAH patients and the general population; however, we assumed the general population's well-being score was close to 100 using the VAS method.[21]

Furthermore, because this study had a small sample size, a larger, multicenter trial would be preferable in the future to improve results and confirm the relationship between HRQoL and HH grade.[22,23]

Conclusion

In summary, the present study demonstrated a negative linear correlation between the severity of SAH and patient-reported HRQoL. For general practice, the HH grade could be the most important predictor of HRQoL after treatment in SAH.

Funding

None

Conflict of Interest

The authors declare that there were no conflicts of interest concerning the work contained herein.

References

1. Sobey CG, Faraci FM. Subarachnoid haemorrhage: what happens to the cerebral arteries?. Clin Exp Pharmacol Physiol 1998;25(11):867-76.
2. Chan V, Lindsay P, McQuiggan J, Zagorski B, Hill MD, O'Kelly C. Declining Admission and Mortality Rates for Subarachnoid Hemorrhage in Canada Between 2004 and 2015. Stroke 2019;50(1):181-4.
3. Park SW, Lee JY, Heo NH, Han JJ, Lee EC, Hong DY, et al. Short- and long-term mortality of subarachnoid hemorrhage according to hospital volume and severity using a nationwide multicenter registry study. Front Neurol. 2022;13:952794.
4. Lindberg M, Angquist KA, Fodstad H, Fugl-Meyer AR. Self-reported prevalence of disability after subarachnoid haemorrhage, with special emphasis on return to leisure and work. Br J Neurosurg 1992;6(4):297-304.
5. Greebe P, Rinkel GJ, Hop JW, Visser-Meily JMA, Algra A. Functional outcome and quality of life 5 and 12.5 years after aneurysmal subarachnoid haemorrhage. J Neurol 2010;257(12):2059-64.
6. Meyer B, Ringel F, Winter Y, Spottke A, Gharevi N, Dams J, et al. Health-related quality of life in patients with subarachnoid haemorrhage. Cerebrovasc Dis 2010;30(4):423-31.
7. von Vogelsang AC, Burström K, Wengström Y, Svensson M, Forsberg C. Health-related quality of life 10 years after intracranial aneurysm rupture: a retrospective cohort study using EQ-5D. Neurosurgery 2013;72(3):397-406.
8. Sungkaro K, Tunthanathip T, Taweesomboonyat C,

Kaewborisutsakul A. Surgical outcomes of patients after treatment of ruptured anterior communicating artery aneurysms: "real-world" evidence from southern Thailand. Chin Neurosurg J. 2021;7(1):42.

9. Taweesomboonyat C, Tunthanathip T, Kaewborisutsakul A, Saeheng S, Oearsakul T, Riabroi K, et al. Outcome of Ruptured Posterior Communicating Artery Aneurysm Treatment Comparing Between Clipping and Coiling Techniques. World Neurosurg. 2019;125:e183-8.
10. Hauser K, Walsh D. Visual analogue scales and assessment of quality of life in cancer. J Support Oncol 2008;6(6):277-82.
11. Hilari K, Boreham LD. Visual analogue scales in stroke: what can they tell us about health-related quality of life?. BMJ Open 2013;3(9):e003309.
12. Pickard AS, Knight SJ. Proxy evaluation of health-related quality of life: a conceptual framework for understanding multiple proxy perspectives. Med Care 2005;43(5):493-9
13. Tunthanathip T, Oearsakul T, Tanvejsilp P, Sae-Heng S, Kaewborisutsakul A,et al. Predicting the Health-related Quality of Life in Patients Following Traumatic Brain Injury. Surg J (N Y) 2021;7(2):e100-10
14. Kim JH. Multicollinearity and misleading statistical results. Korean J Anesthesiol 2019;72(06):558-69
15. Yoo W, Mayberry R, Bae S, Singh K, Peter He Q, Lillard JW Jr. A study of effects of multicollinearity in the multivariable analysis. Int J Appl Sci Technol 2014;4(5):9-19
16. Taufique Z, May T, Meyers E, Falo C, Mayer SA, Agarwal S, et al. Predictors of Poor Quality of Life 1 Year After Subarachnoid Hemorrhage. Neurosurgery 2016;78(2):256-64.
17. Kronvall E, Sonesson B, Valdemarsson S, Siemund R, Säveland H, Nilsson OG. Reduced Quality of Life in Patients with Pituitary Dysfunction After Aneurysmal Subarachnoid Hemorrhage: A Prospective Longitudinal Study. World Neurosurg 2016;88:83-91.
18. Passier PE, Visser-Meily JM, Rinkel GJ, Lindeman E, Post MW.. Determinants of health-related quality of life after aneurysmal subarachnoid hemorrhage: a systematic review. Qual Life Res 2013;22(5):1027-43.
19. Golanov EV, Bovshik EI, Wong KK, Pautler RG, Foster CH, Federley RG, et al. Subarachnoid hemorrhage - Induced block of cerebrospinal fluid flow: Role of brain coagulation factor III (tissue factor). J Cereb Blood Flow Metab. 2018;38(5):793-808.
20. Tunthanathip T. Health Economic Evaluation in Neurosurgery. In: Tunthanathip T. ed. Translational Medicine in Neurosurgery. Bangkok: Sahamit Pattana printing; 2022: 239-72.
21. Shmueli A. The Visual Analog rating Scale of health-related quality of life: an examination of end-digit preferences. Health Qual Life Outcomes 2005;3:71.
22. Tunthanathip T, Sae-Heng S, Oearsakul T, Kaewborisutsakul A, Taweesomboonyat C. Economic impact of a machine learning-based strategy for preparation of blood products in brain tumor surgery. PLoS One 2022;17(7):e0270916.
23. Tunthanathip T, Duangsuwan J, Wattanakitrungroj N, Tongman S, Phuenpathom N. Comparison of intracranial injury predictability between machine learning algorithms and the nomogram in pediatric traumatic brain injury. Neurosurg Focus 2021;51(5):E7.