Clinical Outcome of the Patients Treated Surgically for Spontaneous Intracerebral Hematoma at Sawanpracharak Hospital

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Objective: *To study the relationship of factors associated with clinical outcome in surgical groups of spontaneous intracerebral hematoma patients (SICH).*

Material and Method: *The data were retrospectively collected from surgically treated SICH patients who had surgery at Sawanpracharak Hospital between October 2006 and September 2009. Risk factors (heart disease, previous stroke, hypertension, diabetes mellitus (DM), hyperlipidemia, obesity, smoking, alcoholic consumption, and family history), Glasgow Coma Scale (GCS), hematoma volume, midline shift (MS), intraventricular bleeding (IVH), hydrocephalus, convulsion, tracheostomy, pneumonia, rebleeding, operating time, and intraoperative blood loss were studied.*

Results: *Throughout the study period, 380 patients with SICH underwent surgical treatment. Factors that were statistically significant related to outcome of SICH were age ($p<0.001$), diabetes mellitus ($p<0.001$), smoking ($p = 0.003$), alcoholic consumption ($p = 0.001$), Glasgow Coma Scale ($p<0.001$), hematoma volume ($p<0.001$), midline shift ($p<0.001$), intraventricular bleeding ($p<0.001$), hydrocephalus ($p<0.001$), pneumonia ($p<0.001$), rebleeding ($p = 0.006$), operating time ($p<0.001$), and intraoperative blood loss ($p = 0.008$). After logistic regression analysis was done, factors that were statistically significantly related were Glasgow Coma Scale 3 to 8 [OR 6.03 (3.09-11.75); $p<0.001$], Glasgow Coma Scale 9 to 12 [OR 3.29 (1.87-5.77); $p<0.001$], intraventricular bleeding [OR 2.33 (1.37-3.98); $p = 0.002$], pneumonia [OR 1.62 (1.00-4.23); $p = 0.049$], rebleeding [OR 2.30 (1.04-5.08); $p = 0.040$], operating time greater than two hours [OR 3.05 (1.11-8.34); $p = 0.030$], and midline shift greater than 10 mm [OR 2.07 (1.04-3.57); $p = 0.038$].*

Conclusion: *Outcome of surgical treatment of SICH in the present study were related to age, diabetes mellitus, smoking, alcoholic consumption, Glasgow Coma Scale 3 to 8 and 9 to 12, hematoma volume, midline shift greater than 10 mm, intraventricular bleeding, hydrocephalus, pneumonia, rebleeding, operating time greater than two hours, and intra operative blood loss.*

Keywords: *Spontaneous intracerebral hematoma, Glasgow coma scale, Hematoma volume, Intraventricular bleeding, Hydrocephalus, Glasgow outcome scale*

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Stroke remains a major cause of mortality and disability worldwide. Spontaneous intracerebral hemorrhage (SICH) accounts for 10 to 50% of all strokes, with an incidence of 10 to 20 per 100,000 and is more common in men. The incidence is twice as common as subarachnoid hemorrhage (SAH) and has a higher morbidity and mortality than cerebral infarction or SAH[1-4]. Approximately 35 to 50% of the patients with SICH die within the first month after bleeding[5,6]. Data from the Asian stroke Advisory Panel (ASAP) reveal an incidence of ICH ranging from 17 to 33% at all strokes, twice as high as in Western countries[7]. In Thailand, the incidence of SICH was 30% of all stroke[6].

Several prognostic models have been proposed and validated to help clinicians in predicting mortality and functional outcome. The most common risk factors in SICH patients are hypertension and advancing age. Other risk factors are cigarette smoking, alcoholic consumption, previous stroke, history of coronary heart disease, diabetes mellitus, hyperlipidemia, and family history. The well-known predictors for early death after SICH are low Glasgow Coma Scale on admission, hematoma volume, degree of intraventricular hemorrhage, midline shift presence, and degree of hydrocephalus.

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The aim of the present study was to find out the mortality rate and studied the effects of various prognostic factors on the outcome of the patient admitted with SICH. Knowing the prognostic factors at the time of admission will help predict the prognosis of the patient.

Material and Method

A retrospective analysis of patients who were admitted to the Department of Surgery at Sawanpracharak Hospital, Nakhonsawan province between October 2006 and September 2009 was conducted. The research proposal had been reviewed and approved by Sawanpracharak Hospital Ethic committee. In all patients suspected of stroke, computerized tomography (CT) scan of the brain were done on arrival at the hospital. All CT scan findings were evaluated by a neurosurgeon and a radiologist.

The inclusion criterion for SICH in this study is supratentorial hematoma (basal ganglia, thalamus, and subcortical region). Patients who had ICH from bleeding tumor, vascular malformations, aneurysm, brain stem hemorrhage, infarction, bleeding diathesis (thrombocytopenia, anticoagulation therapy), and hemorrhagic infarction (non-homogeneous high density areas confined to vascular territory) were excluded from the study.

Personal data including sex, age, major risk factors (e.g., heart disease, previous stroke, hypertension, diabetes mellitus), minor risk factors (e.g., hyperlipidemia, obesity, smoking, alcoholic consumption, hereditary), Glasgow Come Scale (GCS), hematoma volume, midline shift (MS), intraventricular bleeding(IVH), hydrocephalus, convulsion, tracheostomy, pneumonia, rebleeding, operating time, and intraoperative blood loss were collected.

Severity of neurological status was classified by Glasgow Coma Scale (GCS) into three groups (severe GCS ≤8, moderate 9 to 12, and mild GCS 13 to 15). Hematoma volume of ICH was classified into three groups (<30 cm^3, 31 to 60 cm^3, and >60 cm^3) by Kothari calculation and Broderick classification[8,9]. Midline shift (MS) was classified into three groups (MS 0-5 mm, MS 6 to 10 mm, and MS >10 mm). Day of tracheostomy was classified into two groups (early ≤7 days and late >7 days). Operating time was classified into three groups (0 to 60 minutes, 61 to 120 minutes, and >120 minutes) and intraoperative blood loss was classified into five groups (≤100 cm^3, 101 to 200 cm^3, 201 to 300 cm^3, 301 to 400 cm^3, and >400 cm^3). Outcome of the patients was classified by Glasgow Outcome Scale (GOS) in this study was grouped GOS into three groups, 1) GOS 4 and 5 had a good result of treatment called good prognosis, 2) GCS 2 and 3 had poor results of treatment called poor prognosis, and 3) GOS 1 the patients died.

All SICH patients were surgically treated. Furthermore. those with post-operative hydrocephalus and rebreeding were appropriately treated according to surgically.

The study was approved by the Ethics Committee, Sawanpracharak Hospital, Nakhonsawan.

Statistical analysis

STATA 10 SE was used for statistically analysis. The characteristics of the subjects were described in terms of frequency and percentage. Student,s t-test was used for comparison of continuous quantitative variables and Chi-square test were used for discrete data. The association between the groups was measured using the odds ratio with 95% confidence intervals for every prognostic factor. Only variables with a p-value <0.05 in the separate analysis were selected and studied in the logistic regression analysis. For all statistical tests, a value of $p<0.05$ was considered statistically significant.

Results

There were 380 consecutive SICH patients admitted to the Department of Surgery at Sawanpracharak Hospital between October 2006 and September 2009 with the diagnosis of SICH. The age of the patients ranged from 21 to 89 years old (male 21 to 87, female 30 to 89). Two hundred seventeen patients were male (57.11%). Eighteen patients (4.74%) had history of heart disease, 29 (7.63%) had history of previous stroke, 259 (68.16%) had history of hypertension, 95 (25.00%) had a history of diabetes mellitus (DM), 181 (47.63%) had blood lipid level more than 200 mg/dl, 92 (24.21%) had obesity, 122 (32.11%) smokers, 153 (40.26%) alcohol consumption, and three (0.79%) had family history of stroke (Table 1). Regarding the GCS of the patients, 140 (36.84%) of the patients were GCS 3 to 8, 134 were GCS 9 to 12 (35.26%), and 106 were GCS 13 to 15 (27.89%). The CT characteristics of the patients were hemorrhagic volume <30 ml in 72 (18.95%), 31 to 60 ml in 201 (52.89%), and >60 ml in 107 (28.16%). The midline shift (MS) was 0 to 5 mm in 139 (36.58%), MS 6 to 10 mm in 171 (45.00%), and MS >10 mm in 70 (18.42%). One hundred seventy

Table 1. Demographic features, clinical characteristics, risk factors, and clinical outcomes of SICH patients (n = 380)

	Glasgow outcome scale			
	Good	Poor	Dead	p-value
Sex				
Male	72 (33.2)	84 (38.7)	61 (28.1)	
Female	40 (24.5)	80 (49.1)	43 (26.4)	0.092
Age (year)				
<50	41 (41.4)	25 (25.3)	33 (33.3)	
50-60	43 (38.1)	42 (37.2)	28 (24.8)	
60-70	19 (22.1)	47 (54.7)	20 (23.3)	
>70	9 (11.0)	50 (61.0)	23 (28.1)	<0.001
Mean (SD)	58.2 (13.9)	63.0 (12.1)	54.2 (10.1)	0.022
Major risk factor				
Heart disease				
No	110 (30.4)	156 (43.1)	96 (26.5)	
Yes	2 (11.1)	8 (44.4)	8 (44.4)	0.124
Previous stroke				
No	108 (30.8)	147 (41.9)	96 (27.4)	
Yes	4 (13.8)	17 (58.6)	8 (27.6)	0.113
Hypertension				
No	43 (35.5)	47 (58.6)	31 (25.6)	
Yes	69 (26.6)	177 (45.2)	73 (28.2)	0.204
Diabetes mellitus				
No	96 (33.7)	127 (44.6)	62 (21.8)	
Yes	16 (16.8)	37 (39.0)	42 (44.2)	<0.001
Minor risk factor				
Blood lipids (mg/dL)				
≤200	63 (31.7)	88 (44.2)	48 (24.1)	
>200	49 (27.1)	76 (42.0)	56 (30.9)	0.302
Obesity				
No	81 (28.1)	127 (44.1)	80 (27.8)	
Yes	31 (33.7)	37 (40.2)	24 (26.1)	0.592
Smoking				
No	62 (24.0)	122 (47.3)	74 (28.7)	
Yes	50 (41.0)	42 (34.4)	30 (24.6)	0.003
Alcohol				
No	51 (22.5)	112 (49.3)	64 (28.2)	
Yes	61 (39.9)	52 (34.0)	40 (26.1)	0.001
Family history of stroke				
No	111 (29.4)	163 (43.2)	103 (27.3)	
Yes	1 (33.3)	1 (33.3)	1 (33.3)	0.941

three (45.53%) patients had intraventricular bleeding and 73 (19.21%) had hydrocephalus (Table 2). Thirty-eight (10.00%) had episode of convulsion. In 117 (78.00%) patients, early tracheostomy was done (≤7 days). One hundred seventeen (30.79%) patients had pneumonia and 33 (8.68%) had rebleeding post-operatively. Regarding operating time of the patients, 106 had 0 to 60 minutes (27.89%), 239 had 61 to 120 minutes (62.89), and 35 had greater than 120 minutes (9.21%). Intraoperative blood loss of ≤100 ml was recorded in 44 (11.52%) patients, 101 to 200 ml in 130 (34.2%) patients, 201 to 300 ml in 113 (29.74%) patients, 301to 400 ml in 73 (19.21%) patients, and >400 ml in 20 (5.26%) patients (Table 3).

Comparing Glasgow Outcome Scale (good, poor and dead) to demographic data and risk factors, the mean age ± SD was 58.2±13.9 years in the good group, 63.0±12.1 years in the poor group, and 54.2±10.1 years in the dead group. There was statistically significant association between GOS

Table 2. Clinical profiles, CT characteristics and clinical outcomes of SICH patients

	Glasgow outcome scale			
	Good	Poor	Dead	p-value
Glasgow coma scale				
3-8	8 (5.7)	71 (50.7)	61 (43.6)	
9-12	38 (28.4)	67 (50.0)	29 (21.6)	
13-15	66 (62.3)	26 (24.5)	14 (13.2)	<0.001
Hematoma volume (ml^3)				
0-30	21 (29.2)	32 (44.4)	19 (26.4)	
31-60	82 (40.8)	72 (35.8)	47 (23.4)	
>60	9 (8.4)	60 (56.1)	38 (35.5)	<0.001
Midline shift (mm)				
0-5	49 (35.3)	60 (43.2)	30 (21.6)	
5-10	58 (33.9)	73 (42.7)	40 (23.4)	
>10	5 (7.1)	31 (44.3)	34 (48.6)	<0.001
IVH				
No	86 (41.6)	90 (43.5)	31 (15.0)	
Yes	26 (15.0)	74 (42.8)	73 (42.3)	<0.001
Hydrocephalus				
No	104 (33.9)	127 (41.4)	76 (24.8)	
Yes	8 (11.0)	37 (50.7)	28 (38.4)	<0.001
Convulsion				
No	107 (31.3)	144 (42.1)	91 (26.6)	
Yes	5 (13.2)	20 (52.6)	13 (34.2)	0.067
Tracheotomy (day)				
<7	5 (4.3)	83 (70.9)	29 (24.8)	
≥7	1 (3.0)	27 (81.8)	5 (15.2)	0.456
Pneumonia				
No	109 (41.4)	84 (31.9)	70 (26.6)	
Yes	3 (2.6)	80 (68.4)	34 (29.1)	<0.001

Table 3. Treatment and progression on clinical outcomes of SICH patients (n = 380)

	Glasgow outcome scale			
	Good	Poor	Dead	p-value
Re-bleeding				
No	110 (31.7)	147 (42.4)	90 (25.9)	
Yes	2 (6.1)	17 (51.5)	14 (42.4)	0.006
Operating time (min)				
0-60	35 (33.0)	48 (45.3)	23 (21.7)	
60-120	74 (31.0)	104 (43.5)	61 (25.5)	
>120	3 (8.6)	12 (34.3)	20 (57.1)	<0.001
Blood loss (ml)				
<100	18 (40.9)	18 (40.9)	8 (18.2)	
100-200	45 (34.6)	52 (40.0)	33 (25.4)	
200-300	34 (30.1)	55 (48.7)	24 (21.2)	
300-400	13 (17.8)	30 (41.1)	30 (41.1)	
>400	2 (10.0)	9 (45.0)	9 (45.0)	0.008

Table 4. Logistic regession analysis on clinical outcomes of SICH patients

	OR	95% CI	p-value
GCS 3-8	6.03	3.09-11.75	<0.001
GCS 9-12	3.29	1.87-5.77	<0.001
DM	1.63	0.96-2.77	0.069
IVH	2.33	1.37-3.98	0.002
Convulsion	2.04	0.99-4.23	0.054
Pneumonia	1.62	1.00-4.23	0.049
Rebleeding	2.30	1.04-5.08	0.040
OR >2 hr	3.05	1.11-8.34	0.030
MS >10 mm	2.07	1.04-3.57	0.038

and age group ($p<0.001$), history of diabetes mellitus ($p<0.001$), smoking ($p = 0.003$), and alcoholic consumption ($p = 0.001$) (Table 1).

On the analysis of clinical finding and CT characteristics, there was statistically significant association between Glasgow Outcome Scale and Glasgow Coma Scale ($p<0.001$), volume of hematoma ($p<0.001$), midline shift ($p<0.001$), intraventricular bleeding ($p<0.001$), hydrocephalus ($p<0.001$), pneumonia ($p<0.001$), and operating time ($p<0.001$) (Table 2, 3).

After logistic regression analysis was done, the present study found that factors affecting clinical outcome of the patients were Glasgow Coma Scale 3 to 8 [OR 6.03 (3.09-11.75); $p<0.001$], Glasgow Coma Scale 9 to 12 [OR 3.29 (1.87-5.77); $p<0.001$], intraventricular bleeding [OR 2.33 (1.37-3.98); $p = 0.002$], pneumonia [OR 1.62 (1.00-4.23); $p = 0.049$], rebleeding [OR 2.30 (1.04-5.08); $p = 0.040$], operating time greater than two hours [OR 3.05 (1.11-8.34); $p = 0.030$], midline shift greater than 10 mm [OR 2.07 (1.04-3.57); $p = 0.038$], diabetes mellitus [OR 1.63 (0.96-2.77); $p = 0.069$], convulsion [OR 2.04 (0.99-4.23); $p = 0.054$], and intraoperative blood loss greater than 400 ml [OR 2.61 (0.81-8.41); $p = 0.019$] (Table 4).

Discussion

SICH had a high reported mortality rate of 35 to 52%, out of which one-half of deaths occurred within the first two days[9-12]. In the present study, the overall mortality rate was 27.37%, which is similar to the figures reported by the previous two Malaysian studies[13,14]. The mean age of the present study was 59.2 years and this figure is comparable to previous Malaysian study[13,14]. Western studies had reported an older mean age[15].

There have been numerous attempts to identify outcome predictors for ICH. Several prognostic models had been proposed and validated to help clinicians in predicting mortality and functional outcome[5,16,17]. The following independent factors were significantly associated with outcome: age, diabetes mellitus, smoking, alcoholic consumption, hematoma volume, midline shift, intraventricular bleeding, hydrocephalus, pneumonia, rebleeding, operating time, and intraoperative blood loss were statistical significant association with outcome. Whereas the following factors were not associated with outcome, sex, heart disease, previous stroke, hypertension, hyperlipidemia, obesity, family history, convulsion, and pneumonia.

The advancing age and hypertension were the most important risk factor for SICH[18,19]. In the present study there was statistical significant association between age and outcome ($p<0.001$). The present study shows poor outcome in old age patients. Similar to results reported in other studies[20-29]. There was statistical significant association between hypertension and outcomes in the other[20,27,34-37]; however, hypertension was not significantly associated in studies. Hyperglycemia on admission had been reported as the indicator of a poor prognosis in patients with SICH[33]. The hyperglycemia was probably not directly harmful to the brain but reflects stress relating to stroke severity[33]. In the present study there was statistical significant association between diabetes mellitus and outcome ($p<0.001$), also similar to that reported by others[20,27,34-37]. The study of Gill JS et al[38] found that low levels of alcohol consumption might have same protective effect upon the cerebral vasculature, whereas heavy consumption predisposes to both hemorrhagic and non-hemorrhagic stroke. Many studies also showed heavy consumption of alcohol as one of the risk factors for hemorrhagic stroke[21,30,35,39,40]. In this study there was statistical significant association between alcohol consumption and outcome ($p<0.001$). As with smoking, there was statistical significant association between smoking and outcome ($p = 0.003$), same as reported by other studies[20,21,30,40].

The admission GCS was a well-known predictor of outcome in ICH[41,42]. The GCS score was a standard neurological assessment tool that because of its reproducibility and reliability[43], it had been associated with ICH outcome in other prediction

models[44]. This was also shown in this present study where survival increased progressively with the GCS, 43.6% dead in GCS 3 to 8 while 13.2% dead in GCS 13 to 15.

Clinical predictors of outcome should be easy to use if they were to gain wide acceptance. CT scanners had the capability to outline and measure areas of hemorrhage. Helping the physician to make quick and critical decisions about a patient with ICH. The ideal method was the one that gave a reasonable estimation of actual hemorrhage volume as quickly as possible because of volume of the hematoma is a powerful predictor of outcome in ICH[41,45,46]. The simple ellipsoid method could easily estimate hemorrhage volume within one to two minutes. According to Broderick JP, Broth T, patients in whom the hematoma volume was 60 ml^3 or greater and GCS score was 8 or less, the predicted 30-day mortality rate was 91% compared with only 19% in those in whom the volume was less than 30 ml^3 and the GCS score was 9 or more(46). The hematoma volume was also related to mortality in this study, 24.17% dead in hematoma volume smaller than 60 ml^3 while 35.5% dead in hematoma volume greater than 60 ml^3. In this study volume of hematoma had remained an important predictor of mortality, in agreement with Bhattathiri PS et al[47] and Davis SM et al[48]. With regard to radiological variables based on CT imaging, a significant association between midline shift and functional outcome and survival time were observed[23,28]. The present study found that midline shift as the significant predictor of functional outcome [OR 2.07 (1.04-3.57); p = 0.038], which was consistent with other studies[23,28]. Intraventricular bleeding seems to be a very powerful predictor of outcome, both in this study and other[49], in the present study IVH was the strong risk factor for outcome [OR 2.33 (1.37-3.98); p = 0.002]. The pathophysiologic mechanism by which intraventricular blood increased morbidity in ICH is still unascertained. A large prospective observation study from the Stroke Data Bank demonstrated that frequency of neurologic deterioration was greatest on the first hospital day and most of the patients had a large hematoma volume on initial CT scan[50]. However, the powerful association between IVH and hematoma volume in the present study suggested that the volume of hematoma was underestimated due to extension of blood into the ventricles and subarachnoid spaces, thus making IVH the strongest predictor of poor outcome. The incidence of hydrocephalus was higher in patients with deep hemorrhage, and over half of the patients with hydrocephalus died compared with 2% of those without hydrocephalus[51]. Hydrocephalus was associated with a considerably higher mortality. In this study hydrocephalus was an independent predictor of outcome ($p<0.001$), demonstrated the impact of hydrocephalus on outcome from ICH.

Seizures were well known to occur at the onset of ICH. In the present study, there was no significant association between convulsions with functional outcome. After ICH, progressive brain edema was a well-documented phenomenon[52,53] and occurs in 25 to 61% of patients[54,57]. Brain edema was most often manifested as midline shift. In this study, there was statistically significant association between midline shift with functional outcome especially in MS >10 mm.

Most common complications of surgical ICH patients were ventilator-acquired pneumonia and rebleeding. According to Saribekian AS et al there were 29% deaths from pneumonia and 19.5% deaths from rebleeding[58]. Similarly to this study, there was statistically significant association between ventilator-acquired pneumonia and rebleeding with functional outcome.

In addition, the present study showed that operating time greater than two hours was the strong risk factors for outcome [OR 3.05 (1.11-8.34); p = 0.030].

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Potential conflicts of interest

None.

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ผลการรักษาของผู้ป่วยเลือดคั่งในสมองที่เกิดขึ้นเองที่ได้รับการผ่าตัดรักษาที่โรงพยาบาลสวรรค์ประชารักษ์

ณรงค์พงศ์ โล้วพฤกมณี

วัตถุประสงค์: *เพื่อศึกษาความสัมพันธ์ของปัจจัยที่มีผลต่อการรักษาของผู้ป่วยเลือดคั่งในสมองที่เกิดขึ้นเอง*

วัสดุและวิธีการ: *เก็บข้อมูลย้อนหลังของผู้ป่วยที่ได้รับการผ่าตัด ณ โรงพยาบาลสวรรค์ประชารักษ์ ระหว่าง ตุลาคม พ.ศ. 2549 ถึง กันยายน พ.ศ. 2552 ข้อมูลเก็บวิเคราะห์ได้แก่ โรคหัวใจ ประวัติโรคหลอดเลือดสมอง ความดันโลหิตสูง เบาหวาน ไขมันในเลือดสูง อ้วน สูบบุหรี่ ดื่มสุรา ประวัติครอบครัว ระดับความรู้สึกตัว (GCS) ปริมาตรของก้อนเลือด ระยะการเคลื่อนที่ของสมองผ่านแนวกลาง เลือดคั่งในช่องน้ำสมอง ภาวะช่องน้ำสมองโต การเกิดเลือดออกซ้ำ ระยะเวลาการผ่าตัด และการเสียเลือดระหว่างผ่าตัด*

ผลการศึกษา: *ผู้ป่วยจำนวน 380 ราย ที่มีเลือดคั่งในสมองและได้รับการผ่าตัดรักษาจากการศึกษานี้พบว่า ปัจจัยที่มีความสัมพันธ์กับผลการรักษาประกอบคือ อายุ ($p<0.001$) เบาหวาน ($p<0.001$) การสูบบุหรี่ ($p = 0.003$) การดื่มสุรา ($p = 0.001$) ระดับความรู้สึกตัว ($p<0.001$) ปริมาตรของก้อนเลือด ($p<0.001$) ระยะการเคลื่อนที่ของสมองผ่านแนวกลาง ($p<0.001$) เลือดคั่งในช่องน้ำสมอง ($p<0.001$) ภาวะช่องน้ำสมองโต ($p<0.001$) ปอดติดเชื้อ ($p<0.001$) การเกิดเลือดออกซ้ำ ($p = 0.006$) ระยะเวลาการผ่าตัด ($p<0.001$) และการเสียเลือดระหว่างผ่าตัด ($p = 0.008$) หลังจากวิเคราะห์ด้วย (logistic regression analysis) พบว่าปัจจัยที่มีความสัมพันธ์กับผลการรักษาประกอบด้วย GCS 3-8 [OR 6.03 (3.09-11.75); $p<0.001$], GCS 9-12 [OR 3.29 (1.87-5.77); $p<0.001$], เลือดคั่งในช่องน้ำสมอง [OR 2.33 (1.37-3.98); $p = 0.002$], ปอดติดเชื้อ [OR 1.62 (1.00-4.23); $p = 0.049$], การเกิดเลือดออกซ้ำ [OR 2.30 (1.04-5.08); $p = 0.040$], ระยะเวลาการผ่าตัดมากกว่า 2 ชั่วโมง [OR 3.05 (1.11-8.34); $p = 0.030$] และระยะการเคลื่อนที่ของสมองผ่านแนวกลางมากกว่า 10 มิลลิเมตร [OR 2.07 (1.04-3.57); $p = 0.038$]*

สรุป: *การรักษาด้วยวิธีการผ่าตัด จากการศึกษานี้พบว่าผลการรักษามีความสัมพันธ์กับอายุ เบาหวาน การสูบบุหรี่ การดื่มสุรา GCS 3-8 และ 9-12 ปริมาตรของก้อนเลือดระยะการเคลื่อนที่ของสมองผ่านแนวกลางมากกว่า 10 มิลลิเมตร เลือดคั่งในช่องน้ำสมอง ภาวะช่องน้ำสมองโต ปอดติดเชื้อ การเกิดเลือดออกซ้ำ เวลาการผ่าตัดที่มากกว่า 2 ชั่วโมง และการเสียเลือดระหว่างการผ่าตัด*
