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Original Article

A Comparison of Treatment Results between Decompressive Craniectomy with Blood Clot Removal and Craniotomy with Blood Clot Removal on Basal Ganglion Hemorrhage

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Background and Objective: **Basal ganglion is about 50% of Intracerebral hemorrhage which has high morbidity and mortality. The objective of the present study is to compare the results of treatment on basal ganglion hemorrhage between decompressive craniectomy and blood clot removal with craniotomy and blood clot removal by using the modified ranking scale (mRS) at discharge, 3 months, 6 months and death rate within 30 days.**

Methods: **A retrospective review of medical records of patients of Lampang Hospital who were diagnosed with basal ganglion hemorrhage and had surgery from 2010 to 2015 was performed. Information of patients includes sex, age, number of patients, Glasgow coma score of < 8 before surgery, midline shift > 0.5 cm. Intraventricular hemorrhage and death within 30 days were collected. Both groups were compared by using Fisher's Exact Test and student *t*-test. *P*-value < 0.05 was considered statistically significant.**

Results: **Of 256 patients, 117 cases were operated by decompressive craniectomy with clot removal while 139 cases were operated by craniotomy with clot removal. The sex and number of patients of midline shift were not statistically different. The age and number of patients of GCS < 8 before surgery and intraventricular hemorrhage were significantly different. Favorable outcome (MRS <3) of decompressive craniectomy group at discharge was not different from craniotomy group (8.6% vs. 6.5%, p = 0.634). But at 3 months and 6 months were significantly different (34.2% vs. 18.7%, p = 0.006 and 35.9% vs. 19.42%, p = 0.004). Death within 30 days was statistically different (19.7% vs. 34.5%, p = 0.011).**

Conclusion: **Decompressive craniectomy with blood clot removal is the alternative operation to treat basal ganglion hemorrhage to patients with midline shift of > 0.5 cm. or uncontrollable intracranial pressure due to better favorable outcome and has lower death rate than craniotomy with blood clot removal.**

Keywords: **Decompressive craniectomy with blood clot removal, craniotomy with blood clot removal, basal ganglion hemorrhage**

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Introduction

Intracerebral hemorrhage[1] is about 20% of stroke with high morbidity and mortality with 39% still under treatment in the hospital and the death rate in 30 days is 35.52%. Only 20% of patients who survived were independent at 6 months. Incidence of hemorrhagic stroke[2] has not changed since 1983 - 2006 which is 24.6 per 100,000 population base. Definite treatment of basal ganglion hemorrhage is uncertain although AHA Guidelines in 2015[3] suggested that decompressive craniectomy may improve outcome and decrease mortality in case of life-saving or uncontrolled increase of intracranial pressure.

Incidence of stroke at Lampang Hospital is 1,600-1,700 cases per year. The hospital uses decompressive craniectomy with blood clot removal or Craniotomy with blood clot removal for the patients with midline shift of > 0.5 cm uncontrollable increase of intracranial pressure.

The main objective of this study is to compare the favorable outcome Modified Ranking Scale (MRS < 3) decompressive craniectomy with blood clot removal to Craniotomy with blood clot removal. The second objective is to compare the incidence of death among patients within 30 days in both groups.

Methodology

Retrospective review from patients' medical records of Lampang Hospital who were diagnosed with basal ganglion hemorrhage and surgical treatment from 2010-2015 were analyzed. There was a total of 256 cases, 117 cases for decompressive craniectomy with blood clot removal, and 139 cases for craniotomy with blood clot removal. Information about their age, sex, number of patients of GCS < 8 before surgery, intraventricular hemorrhage, midline structure shift of > 0.5 cm, favorable outcome (MRS < 3) at discharge, 3 months, 6 months and death within 30 days were collected.

Operative Technique

Two neurosurgeons have done decompressive craniectomy with blood clot removal and one neurosurgeon by craniotomy with blood clot removal. The operation was done in case of midline structure shift of > 0.5 cm or uncontrolled increase of intracranial pressure.

Decompressive craniectomy with blood clot removal was done by large traumatic flap. Clot was removed by Transsylvain[4,5] Approach under microscope for minimal brain injury. Duraplasty was done by autograft or synthetic duragraft.

Craniotomy with blood clot removal was done by straight incision or traumatic flap. Corticotomy was done at the nearest blood clot. Clot was removed and stopped bleeding under microscope. Bone flap was replaced. Post operative case was done to control intracranial pressure (Lumbar puncture, ventriculostomy and 20% manitol etc.) and critical guideline.

Statistical Analysis

The patients' personal information, clinical presentation (GCS), CT characteristic, surgical technique and outcome were analyzed using descriptive statistics with number, mean, and standard deviation. Two groups were compared by Fisher's Exact Probability Test, student *t*-test Kaplan-Meier survival estimates and Cox Regression. The *p*-value < 0.05 was considered significantly different.

Results

In Table 1, the personal information of patients in decompressive craniectomy group (DC group) was compared with the craniotomy group. There was not a significant difference in sex ($p = 1.000$) and number of patients midline structure shift of > 0.5 cm. ($p = 0.445$). They were statistically different in age (55.4 ±

Table 1 Comparison baseline characteristic and outcome between Craniotomy and Craniectomy (N = 256)

Factor	Craniectomy n=117	Craniotomy n=139	*p*-value
Age, mean ±SD	55.4 ± 11.8	58.7 ± 13.3	0.025
Gender, n (%)			1.000
Male	83 (70.9)	99 (71.2)	
Female	34 (29.1)	40 (28.8)	
GCS (%)			<0.001
≤ 8	78 (66.7)	57 (41.0)	
> 8	39 (33.3)	82 (59.0)	
Midline shift (%)			0.445
> 0.5 mm.	95 (81.2)	107 (76.77)	
≤ 0.5 mm.	22 (18.8)	32 (23.0)	
IVH, n (%)	44 (37.6)	28 (20.1)	0.002

Table 2 Favorable outcomes according to MRS at discharge, 3 and 6 months

Factor	Craniectomy n=117 (%)	Craniotomy n=139 (%)	*p*-value
MRS at D/C			
Favorable outcome	10 (8.6)	9 (6.5)	0.634
Non favorable outcome	107 (91.4)	130 (93.5)	
MRS at 3 months			
Favorable outcome	40 (34.3)	26 (18.7)	0.006
Non favorable outcome	77 (65.8)	113 (21.3)	
MRS at 6 months			0.004
Favorable outcome	42 (35.9)	27 (19.4)	
Non favorable outcome	75 (64.1)	112 (80.3)	
Death within 30 days	23 (19.7)	48 (34.5)	0.011

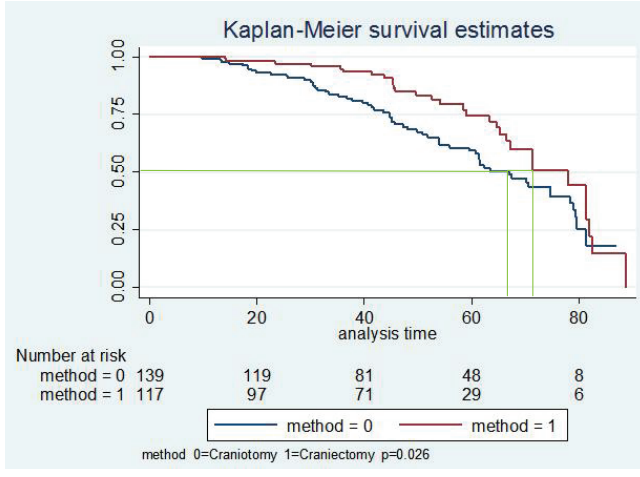

Figure 1 Kaplan-Meier estimates of survival probabilities

Table 3 Cox Regression

	Haz. Ratio	*P* > |z|	[95% Conf. Interval]	
Craniectomy	0.4879576	0.003	0.3043358	0.7823679
Sex	1.505334	0.084	0.9460162	2.395341
Age	1.018402	0.023	1.00252	1.034536
GCS ≤ 8	1.906662	0.005	1.219283	2.981557
IVH	1.256121	0.353	0.7760947	2.033052
midline shift ≤ 5 mm	0.8917878	0.701	0.4969301	1.600397

11.8 years VS 58.7 ± 13.3 years, $p = 0.025$), number of patient GCS < 8 before surgery (66.7% vs 41.0%, $p = 0.001$) and number of patients intraventicular hemorrhage (36.7% vs 20.1%, $p = 0.002$).

Table 2 shows the comparison between DC group and craniotomy group of favorable outcome. At discharge, it was not significantly different (8.6% vs 6.5%, $p = 0.630$). At 3 months and 6 months the difference were statistically significant (34.2% vs 18.7%, $p = 0.006$ and 35.9% VS 19.45%, $p = 0.004$).

Death within 30 days was statistically different (19.75% vs 34.5%, $p = 0.011$) between the groups of craniotomy with blood clot removal and was not crossed over with decompressive craniectomy with blood clot removal. Seven cases underwent recraniotomy due to rebleeding. Two cases underwent reoperation due to rebleeding.

Figure 1 represents Kaplan-Meier survival estimates at 50% survival time (month) comparing the DC group with craniotomy group. Its difference is statistically significant (78 months vs 67 months, $p = 0.026$).

Table 3 shows the Cox Regression Test by adjusting age, sex, GCS < 8, intraventricular hemorrhage and midline structure shift. DC group has lessen death rate 51% compared with craniotomy group (HR = 0.49, 95% Conf. Interval, 0.30 - 0.78, $p = 0.003$).

Discussion

Treatment of basal ganglion hemorrhage is still controversial but several studies on decompressive craniectomy to treat basal ganglion hemorrhage had good outcome.

Li Ma, et al.[6] studied on spontaneous basal ganglion hemorrhage on 84 cases with 38 cases for decompressive craniectomy with blood clot removal and 46 cases for craniotomy with blood clot removal. Decompressive craniectomy group was associated with improved 30-day mortality 0.11, 95%, confidence interval 0.02 - 0.60, $p = 0.01$ and 6 months functional survival 26.97%, 95% confidence interval 2.20 - 317.62 $p = 0.01$. It is concluded that decompressive craniectomy with blood clot removal might lessen mortality of

deteriorating patients with spontaneous basal ganglion hemorrhage.

Q. Li, et al.[7] studied on surgical treatment for large spontaneous basal ganglia hemorrhage: retrospective analysis of 253 cases. The result showed that the mean postoperative ICP was 28.8 ± 6.7 mmHg for patients without DC, and only 17.5 ± 8.6 mmHg for patients with DC. Twenty five patients (9.9%) died within 30 days of operation, and 88 patients (34.8%, GOS > 4) had good outcome 3 months after surgery. ICH volume > 50 mL, preoperative GCS score < 8, and ICH score > 3 are risk factors for unfavorable outcomes. It is concluded that DC can be used for patients with low preoperative GCS score, and effectively reduces ICP and 30-day mortality. Hematoma volume, preoperative GCS score, and ICH score are of predictive value for surgical outcome of large basal ganglia hemorrhage.

R. Ramnarayan, et al.[8] studied on decompressive hemicarniectomy in large putaminal hematomas of 23 patients. The result showed that all patients underwent hemicraniectomy on the side of the lesion and dura was left open. At 3 months, 13 patients had a good outcome and 10 had a poor outcome (including 3 deaths). The conclusion is that decompressive hemicraniectomy can be a useful alternative surgical procedure in moderate to large putaminal hematomas. Satoru Takeuchi, et al.[9] studied on decompressive craniectomy with hematoma evacuation for large hemispheric hypertensive intracerebral hemorrhage of 21 patients. The result showed that 6 patients had favorable outcomes and 15 had poor outcomes. The mortality rate was 10%. A statistical analysis showed that the GCS score at admission was significantly higher in the favorable outcome group than that in the poor outcome group ($p = 0.029$). The conclusion suggested that DC with hematoma evacuation might be a useful surgical procedure for selected patients with large hemispheric hypertensive ICH.

AHA guideline of 2007 and STITCH[3,10] trial recommended for conservative medical treatment achieved similar result with early surgery with blood clot removal but decompressive craniectomy is recommended as class IIb, level of evidence C. The STITCH trial found that 26% of medical treatment group was crossed over with surgical treatment and 85% of surgical treatment used craniotomy procedure. This trial includes supratentorial intracerebral hemorrhage dose which is not specific to basal ganglion hemorrhage. This study investigated the basal ganglion patients who have midline structure shift of > 0.5 cm. or uncontrollable increase in intracranial pressure. The outcome was compared between decompressive craniectomy with blood clot removal (DC group) and craniotomy with blood clot removal (craniotomy group). The medical data of DC group are more severe than the craniotomy group. The result of craniotomy group shows similar results of Charlotte JJ van Asch, et al.[2] study in Incidence, a fatal case, and functional outcome of intracerebral haemorrhage over time, basing upon age, sex, and ethnic origin. The death within 30 days in the DC group compared to their study is 34.5% vs 40.6% and favorable outcome at 6 months is 19.4% vs 12-39%.

The DC group has better favorable outcome at 3 months, 6 months and death within 30 days than craniotomy group which is statistically significant. It might be that craniotomy with blood clot removal is not adequate to decrease intracranial pressure by only blood clot removal because intracranial pressure may be aggravated by peri-hemorrhagic edema. It is explained in intracerebral hemorrhage pathophysiology, a medical review written by Guohau Xi, et al.[11], that secondary and late phase of brain edema may be extended to three weeks. The procedure using decompressive craniectomy with blood clot removal decreases intracranial pressure,[12,13] increases cerebral blood flow, and cerebral perfusion pressure and decreases midline structure compression by removing mass effect (blood clot) and increases space for brain expansion.

However, this study is a retrospective study with single center study and many patients are lost to follow-up. The effect of treatment may be biased. Controlled prospective study with multiple centers is needed to clarify the effects of decompressive craniectomy with blood clot removal.

Conclusion

Decompressive craniectomy with blood clot removal is the alternative operation to treat basal ganglion hemorrhage with midline shift of > 0.5 cm. or uncontrollable intracranial pressure because the favorable outcome is better and has lower death rate than craniotomy with blood clot removal.

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บทคัดย่อ **เปรียบเทียบผลการรักษา Basal ganglion hemorrhage ระหว่าง decompressive craniectomy and blood clot removal กับ craniotomy and blood clot removal**

อตินาท ศรีรัตน์ (พ.บ., วว.ประสาทศัลยศาสตร์)

ความสำคัญ: โรคหลอดเลือดสมองเป็นสาเหตุการตายอันดับต้น ๆ ของประเทศไทย โดย Intracerebral hemorrhage เป็นโรคที่พบเป็นอันดับสองของโรคหลอดเลือดสมอง โดยประมาณ 50% เป็น Basal ganglion hemorrhage ซึ่งมี mortality และ morbidity สูง จึงเป็นโรคที่มีความสำคัญของสาธารณสุขไทย

วัตถุประสงค์: เพื่อเปรียบเทียบผลการรักษา Basal ganglion hemorrhage ระหว่าง decompressive craniectomy and blood clot removalกับcraniotomy and blood clot removalโดยดูจาก modify ranking scale ที่ขณะจำหน่าย, 3 เดือน และ 6 เดือน กับอัตราตายใน 30 วัน

รูปแบบ สถานที่ และผู้ป่วย: เป็นการศึกษาเชิงพรรณนา จากฐานข้อมูลกระทรวงสาธารณสุข และเวชระเบียน โรงพยาบาลลำปาง ของผู้ป่วย Basal ganglion hemorrhage ที่ทำการรักษาโดยการผ่าตัดตั้งแต่ปี 2553 - 2558

การวัดผลและวิธีการ: วิเคราะห์ข้อมูลทั่วไป โดยใช้สถิติเชิงพรรณนา รายงานผลเป็น จำนวน ร้อยละ ค่าเฉลี่ย และส่วนเบี่ยงเบนมาตรฐาน เปรียบเทียบผลลัพธ์ของการผ่าตัดทั้ง 2 แบบ โดยใช้สถิติ Fisher's exact probability test, student t-test, Kaplan-Meier survival estimates และ Cox regression ขึ้นกับลักษณะของข้อมูล กำหนดนัยสำคัญที่ค่า $p < 0.05$

ผลการศึกษา: จำนวนผู้ป่วย Basal ganglion hemorrhage ทั้งหมด 256 ราย แบ่งเป็น decompressive craniectomy and blood clot removal 117 ราย Craniotomy and blood clot removal 139 ราย กลุ่ม decompressive craniectomy and blood clot removal เทียบกับ Craniotomy and blood clot removal ไม่มีความแตกต่างอย่างมีนัยสำคัญในเรื่องเพศและจำนวนผู้ป่วยที่มี midline shift แต่มีความแตกต่างอย่างมีนัยสำคัญในเรื่องของอายุ, จำนวนผู้ป่วย Glasgow Coma Score < 8 ก่อนผ่าตัดและจำนวนผู้ป่วย intraventicular hemorrhage โดยที่ favorable outcome (MRS < 3) ขณะจำหน่ายไม่ต่างกัน $p = 0.634$ (8.6% VS 6.5%) ที่ 3 เดือนและ 6 เดือนมีความแตกต่างกันอย่างมีนัยสำคัญ $p = 0.006$ (34.2% VS 18.7%) และ $p = 0.004$ (35.9% VS 19.42%) ตามลำดับ อัตราตายใน 30 วัน $p = 0.011$ (19.7% VS 34.5%)

ข้อยุติและการนำไปใช้: การรักษาผู้ป่วย Basal ganglion hemorrhage โดยการผ่าตัดแบบ ระหว่าง decompressive craniectomy and blood clot removal น่าจะเป็นวิธีหนึ่งในการรักษาผู้ป่วยที่มีภาวะสมองถูกกดทับ (midline shift > 0.5 cm) หรือภาวะ Increase intracranial pressure ที่ไม่ตอบสนองต่อการรักษาด้วยยา เนื่องจากมี mRS ที่ดี เมื่อติดตามผลการรักษา และอัตราการตายภายใน 30 วันที่น้อยกว่าการผ่าตัด Craniotomy and blood clot removal อีกทั้งเป็นการผ่าตัดที่ง่าย รวดเร็ว และสามารถดูแลผู้ป่วยหลังผ่าตัดได้ง่าย