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Comparison of Mortality and Glasgow Outcome Scale Extended (GOSE) between Craniotomy and Decompressive Craniectomy in Patients with Traumatic Acute Subdural Hematoma at Sanglah General Hospital, Bali

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ABSTRACT

Background: Craniotomy and decompressive craniectomy and are surgical modalities for the evacuation of acute subdural hematoma (SDH). These two techniques show different outcomes in various existing studies. The superiority between either techniques remains controversial. **Objective:** To determine the outcome comparison of mortality and Glasgow Outcome Scale Extended (GOSE) craniotomy with decompressive craniectomy in patients with traumatic acute SDH. **Methods:** This is a historical cohort study. Samples of the study were collected from January 2018 to March 2020 at Sanglah General Hospital. All patients with acute traumatic SDH who underwent SDH evacuation with craniotomy and decompressive craniectomy were assessed for mortality status at discharge and GOSE 3 months after surgery. Independent T-test will be carried out if the numerical variable were all normally distributed, while Mann-Whitney U test will be performed if otherwise. A Chi-square test will be performed on all unpaired categorical variables. Statistical analysis was performed with SPSS 25 with 95% confidence intervals. **Results:** As many as 40 subjects with traumatic acute SDH who underwent craniotomy and 40 subjects with traumatic acute SDH who underwent decompressive craniectomy were included in this study. There was no significant difference in mortality (RR: 1; 95% CI 0.67-1.87; p=0.651) and GOSE score (p=0.718) in traumatic acute SDH who underwent craniotomy or decompressive craniectomy. **Conclusion**: There was no difference in mortality and GOSE outcomes between a craniotomy and decompressive craniectomy for management of traumatic acute SDH.

Keywords: traumatic acute subdural hematoma, craniotomy, decompressive craniectomy.

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INTRODUCTION

Acute subdural hematoma (SDH) is a major problem in traumatic head injury.[1] Traumatic acute SDH lesion can increase intracranial pressure and is usually accompanied by diffuse injury, contusion, and edema. On Computed Tomography (CT) scan imaging, SDH can be seen as an extra-axial hyperdense lesion, crescents between brain parenchyma and the duramater.[2] Managements of traumatic acute SDH is divided into non-operative and operative care. Non-operative management alone is significantly correlated with a higher mortality rate compared to management with operative care.[3] Meanwhile, the operative management of traumatic acute

SDH can be evacuated either by craniotomy or decompressive craniectomy.[4]

Surgical management of traumatic acute SDH states that traumatic acute SDH greater than 10 mm in thickness or more than 5 mm in midline shift on computed tomographic (CT) scan have to be evacuated surgically, for any Glasgow Coma Scale (GCS) score. Patients with the GCS score <9 with an SDH thickness < 10 mm and midline shift < 5 mm should undergo surgical evacuation if there is a deterioration of patients' GCS score by 2 points or more between initial assessment right after the injury and hospital admission.[5] Craniotomy and decompressive craniectomy, both of which are commonly used for primary evacuation of traumatic acute SDH.[4]

No differences are shown between a craniotomy and decompressive craniectomy in regards to clinical and demographic data. The Decompressive craniectomy had a higher mortality rate compared to the craniotomy (23.3% vs 7.1%, p 0.04). There were no differences found in other outcomes and complications.[6] Although Decompressive craniectomy has efficacy in saving patients' life, however, it is accompanied by a myriad of fairly serious complications that have not been sufficiently highlighted in prospective clinical trials. The most common complications are bleeding, infection or inflammation, and disruption of the CSF compartment.[7] The objectives of this study are to compare the Glasgow Outcome Scale Extended (GOSE) and mortality outcomes of craniotomy and decompressive craniectomy management in traumatic acute SDH patients.

METHODS

This research is a historical cohort study conducted at the Sanglah General Hospital, Bali by collecting data from the subject's medical record. The sample inclusion criteria in this study were traumatic acute SDH patients who have done craniotomy surgery and decompressive craniectomy for SDH evacuation according to the Neurosurgery protocol at Sanglah General Hospital, Bali from January 2018 to March 2020. The exclusion criteria in this study were patients with incomplete medical records, traumatic acute SDH non-traumatic, patients who underwent secondary decompressive craniectomy due to increased intracranial pressure, and chronic subdural hematoma. The sampling technique in this study used a consecutive sampling technique.

Based on the data collected from medical records, patients who met the inclusion criteria were included in the study. Outcomes assessed from this research are mortality and Glasgow Outcome Scale Extended (GOSE) score. GOSE is measured 3 months since the head injury patient receiving surgical procedures. Medical follow up on patients are conducted in addition to medical record tracing to obtain patient's mortality status (categorized into 2 groups, alive and dead) and GOSE scores. GOS Extended (GOSE) is an outcome measurement scale of the head injury that is used to state the prognosis. In this study, measurements will be assessed in the third post-traumatic month, which consists of 8 categories (**Table 1**).[8]

The data that has been collected will be processed in 2 stages, namely descriptively to determine the characteristics of the sample and bivariate analysis to compare mortality and GOSE scores between the two groups (craniotomy and decompressive craniectomy). The variables to be assessed are the type of surgery as the independent variable, mortality status, and GOSE score as the dependent variable. Other variables to be assessed are age, sex, GCS score, pupil size, SDH thickness and midline shift based on CT scan, trauma onset, duration of surgery, source of bleeding, extracranial injury, and other comorbid factors (diabetes mellitus, hypertension, and coagulopathy). Numerical data will be presented in terms of the mean and standard deviation, while Categorical data will be presented in terms of frequency and percentage.

Table 1. Glasgow Outcome Scale Extended (GOSE) score and Its Clinical Interpretation[8]

GOSE	Clinical Interpretation
1	Death: die
2	Persistent vegetative state: no response to external stimuli, unable to speak or do not follow orders, emotional behavior, spontaneous behavior that is not related to a particular event
3	Lower severe disability: need help from others almost all the time of the day
4	Upper severe disability: can be left at home alone for about 8 hours a day, but cannot travel far or go shopping without other people
5	Lower moderate disability: unable to work
6	Upper moderate disability: decreased working capacity
7	Lower good recovery: able to return to normal life, but has minor problems that affect daily activities
8	Upper good recovery: able to return to normal life without any problems related to head injury that affects daily activities

To compare mortality by type of surgery (craniotomy and decompressive craniectomy), a proportion comparison test was performed. The statistical test to be used is the Chi-Square Test or the Fischer Exact Test if the degrees of freedom is less than 5. Then, the relative risk will be calculated with a 95% confidence interval. To compare GOSE scores between craniotomy and craniectomy in alive traumatic acute SDH patients, a mean comparison test was performed. To assess the normal distribution of the data we, performed the Shapiro Wilk Test. We also performed Levene’s test to assess data homogeneity. An independent T-Test is performed for normally distributed and homogeneous data. If the distribution of data in both groups is not normally distributed or heterogeneous, the Mann-Whitney test will be used. The statistical analysis was performed using SPSS software (version 23.0). A p-value of less than 0.05 was considered statistically significant.

RESULTS

Eighty subjects with traumatic acute SDH who underwent surgery were included in the study. Subjects were divided into two groups, namely subjects who underwent craniotomy and decompressive craniectomy. In **Table 2**, the characteristics of the research sample are described. According to this data, based on age there was craniotomy with a mean of 46.2 years (SD: 20.38) and craniectomy with a mean of 44.5 (SD: 18.8). Based on gender, 26 respondents (51%) were male with craniotomy and 25 respondents (49%) had craniectomy, while 16 respondents (40%) were female with craniectomy, and 24 (60%) respondents had craniectomy.

Based on the source of bleeding, 33 respondents (66%) of the samples with bridging vein bleeding sources were performed and craniectomy was performed as many as 17 respondents (34%), while the source of contusion bleeding with craniotomy was 7 respondents (23.3%) and 23 (76.7%) craniectomy with p-value = 0.000 (< 0.05). It was concluded that there were differences in the surgical procedures for traumatic acute SDH patients between bridging vein bleeding sources and contusions.

In **Table 3**, a comparative analysis of mortality has been shown between the craniotomy and decompressive craniectomy using the chi-square test. After the craniotomy procedure, the number of patients who died was 18 respondents (45%) and 22 (55%) respondents were alive. After craniectomy, 16 (40%) patients died and 24 (60%) were alive with p-value = 0.651 and RR 1 (CI: 0.67-1.87). This result shows that there is no statistically significant difference in mortality in traumatic acute SDH patients between a craniotomy and decompressive craniectomy.

In **Table 4**, a comparison of GOSE scores is carried out between a craniotomy and a decompressive craniectomy. The Mann-Whitney U test was used to analyze the data because the data were not normally distributed. In patients who underwent craniotomy, the average GOSE score was 41.39 and in patients who underwent craniectomy, the average GOSE score was 39.61 with a p-value = 0.718, which means there is no difference in GOSE scores between a craniotomy and decompressive craniectomy of traumatic acute SDH patients.

Table 2. Characteristics of Research Samples Based on Types of Surgery

Variable	**Types of Surgery**		**p**
	Craniotomy	**Decompressive Craniectomy**	
Age	46.2±20.38	44.5± 18.8	0.727
Gender			
Male	26 (51%)	25 (49%)	0.816
Female	14 (48.3%)	25 (51.7%)	
Head injury			
Severe	16 (45.7%)	19 (54.3%)	
Moderate	14 (43.8%)	18 (56.3%)	0.104
Mild	10 (76.9%)	3 (23.1%)	
SDH thickness			
10	25 (45.5%)	30 (54.5%)	0.228
< 10	15 (60%)	10 (40%)	
Pupil reflex			
Non-isochor	11 (70.8%)	13 (29.2%)	0.626
Isochor	29 (30.4%)	27 (69.6%)	
Midline shift			
5 mm	21 (38.2%)	34 (61.8%)	0.002
< 5 mm	19 (76%)	6 (24%)	
Source of bleeding			
Bridging	33 (66%)	17 (34%)	0.000
Contusion	7 (23.3%)	23 (76.7%)	
Extracranial injury			
Yes	6 (28.6%)	15(71.4%)	0.022
No	34 (57.6%)	25(42.4%)	
Comorbid factors			
Yes	15(46.9%)	17 (53.1%)	0.648
No	25 (52.1%)	23 (57.5%)	
Onset of Trauma	25.3±18.9	23.5±17.4	0.661
Duration of Surgery	3.1±0.7	3.4±0.9	0.091

Table 3. Mortality comparison between craniotomy and decompressive craniectomy

Types of Surgery	**Mortality Status**		**RR**	**CI 95%**	**p**
	Died	**Alive**			
Craniotomy	18 (45%)	22 (55%)	1	0.67-1.87	0.651
Decompressive Craniectomy	16 (40%)	24 (60%)			

Table 4. GOSE score comparison between craniotomy and decompressive craniectomy

Surgery	**GOSE score**	**p***
Craniotomy	41.39	
Decompressive Craniectomy	39.61	0.718

***** The Mann-Whitney U test

DISCUSSION

Subdural hematoma is an accumulation of blood in the subdural cavity, which in its acute form, both blood and cerebrospinal fluid enter the space as a result of brain laceration or arachnoid tear, thereby increasing subdural pressure on direct injury to the brain.[9] Since the cerebrospinal fluid-covered brain can move, while the sinus venosus is fixed, the displacement of the brain that occurs in trauma can tear several soft veins at the site where they penetrate the duramater. Massive bleeding will cause acute symptoms resembling an epidural hematoma. Most subdural hemorrhages occur in the convexity of the brain in the parietal region. A small proportion is found in the posterior fossa, interhemispheric fissure, and tentorium or between the temporal lobe and the skull base. Acute subdural hemorrhage in the interhemispheric fissure has been reported, caused by rupture of the veins running between the medial and falx hemispheres, and has also been reported as a traumatic lesion of the pericallosal artery due to head injury. Interhemispheric subdural hemorrhage will give the classic symptom of monopharesis in the lower limbs. In children, subdural hemorrhages in the posterior interhemispheric fissure and tentorium are often found due to severe shaking of the child's body (shaken baby syndrome).[10]

Indications for surgery in patients with traumatic acute SDH are an traumatic acute SDH with thickness > 10 mm or midline shift > 5 mm on CT scan and comatose patients (GCS < 9) with SDH thickness < 10 mm and midline shift < 5 mm who need to get surgical evacuation of the clot if the GCS score is reduced and/or the patient exhibits non-isochoric pupil and/or ICP greater than 20 mmHg.[11] Craniotomy is a means to achieve the goal of temporary intracranial surgery, while decompressive Craniectomy consists of sequentially removing pieces of skull bone to reduce intracranial pressure.[12,13]

Vilcinis, et al in their research stated that the decision to perform a craniectomy or craniotomy is better depending on the surgeon's preference. However, intra-operative brain swelling after ASDH evacuation is an indicator for performing a craniectomy as well.[14] In the study of Woertgen, et al, the craniectomy group tended to have worse injuries than the craniotomy group. Patients undergoing craniectomy tend to have pupillary mydriasis and brain herniation.[15] Li, et al in their study reported that the surgical technique was based on the preference of the surgeon. They reported that craniectomy tends to be performed in patients with cistern basal effacement and lower GCS scores.[16]

The results of the bivariate analysis showed that there are no significant differences between the mortality of traumatic acute SDH patients who underwent craniotomy and decompressive craniectomy. Although they are surgical procedures, such as craniotomy and decompressive craniectomy can be effective in the management of traumatic acute SDH, however, the preferred approach between the two is still controversial. Yilmas, et al showed that the mortality rate is higher among older patients and patients with a GCS score of less than 6 on arrival. The Midline shift of 10 mm or more in diameter and 15 mm in thickness of hematoma were significantly associated with a higher mortality rate. The study is also in line with the conclusion that stated decompressive craniectomy can help prevent further midline shift and is associated with a lower mortality rate in comparison with craniotomy.[17] Research conducted by Phan, et al also mention that craniectomy is associated with poorer post-operative outcomes compared to craniotomy.[18] In a meta-analysis conducted by Mahadewa, et al in 2020, comparing GCS score between craniectomy and craniotomy in patients with traumatic acute subdural hematoma, revealed craniectomy had poorer clinical outcomes with a pooled risk ratio of 1.41 (95% CI: 1.06-1.88; p=0.02).[19] The opposite conclusion was put forward by Leghani, et al in 2013. Research by Legnani, et al involving 152 patients demonstrated that performing a sub-occipital craniotomy has similar effectivity and safety compared to performing a craniectomy. both sub-occipital craniotomy and craniectomy showed similar results in maintaining dural integrity. However less post-operative complications were obtained when a sub-occipital craniotomy was performed compared to craniectomy.[20]

The results of this study showed that there was no difference in GOSE scores between craniotomy and decompression craniectomy (p>0.05). Mezue, et al found cranioplasty after decompressive craniectomy was associated with a higher complication rate, but good neurologic outcomes after surgery always outweighed the complications. Both GCS and GOSE mean scores showed significant improvement at 3 and 6 months after cranioplasty. Bone decompression is very useful in the management of head trauma. Careful selection of cases and appropriate radiological examination are utterly important and will help decide to perform craniotomy or craniectomy.[21]

Several limitations were found in this study. Firstly, this study did not involve multiple neurosurgery centers, so a larger sample could not be obtained. Secondly, the research is a historical cohort and fully involved the medical record system. A future study using a prospective design is expected to be carried out. Thirdly, due to incomplete medical record data, other necessary clinical data, such as the cause of death, volume of blood loss during surgery, and the mechanism of trauma patients cannot be included.

CONCLUSION

There was no difference in mortality and GOSE outcomes in traumatic acute SDH patients between those who underwent craniotomy and decompressive craniectomy. However, craniotomy should become the first choice in traumatic acute SDH management except in cases where brain edema was prominent, decompressive craniectomy should be considered.

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