THE CRANIECTOMY PROCEDURE DECREASED MORTALITY RATE IN TRAUMATIC ACUTE SUBDURAL HEMATOMA (TASDH)

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ABSTRACT

The mortality rate after traumatic acute subdural hematoma (TASDH) is around 50 – 90%. There are many factors that affect the management of TASDH. Operative measures include decompressive craniectomy or craniotomy evacuation. This research compares both of these operative techniques in TASDH.

This research is an observational analysis with cross sectional design. Data was compiled retrospectively through patient medical records since January 2006 – December 2009 in Neurosurgery Department Hasan Sadikin Hospital Bandung. Statistical analysis was applied using chi square test, multiple regression logistic analysis and Pearson chi square test. Significance of test results will be determined based on the value of $p < 0.05$.

There were 148 ATSDH operations consisting of 117 males and 31 females with age range of 1 – 75 years (x; 33,7 ; SB=16,5). Eighty four patients underwent craniotomy while 64 under went craniectomy. Mortality rate corresponded significantly with age ($p<0,01$), GCS ($p<0,01$), neurological deficit ($p<0,01$), compressed cisterns ($p<0,01$), and also midline shift ($p=0,047$). There was no significant relationship between mortality rate and sex ($p=0,168$), and also with operation interval ($p=0,127$). From our research we found 110 patient with compressed cisterns, in which 55 patients underwent craniotomy with death in 42 of them (76%), whereas 55 patients underwent craniectomy in which there were 19 death (34%). Craniectomy relates significantly ($p<0,01$) in lowering mortality rate in ATSDH with compressed cisterns.

The craniectomy procedure decreased mortality rate in traumatic acute subdural hematoma , with an odd's ratio of 1.71 higher in patients undergoing craniotomy compared with craniectomy.

Keywords : **traumatic acute subdural hematoma** **compressed cisterns** **decompressive craniectomy** **craniotomy evacuation**

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INTRODUCTION

Raised intracranial pressure (ICP) in patients with head trauma relates with high mortality rate in these patients. The cause of death is due to herniated brain which deviates normal brain through a cavity in the skull causing compression of normal structure, in which the brainstem is the most important structure. Acute traumatic subdural hematoma (ATSDH) is one of type of intracranial bleeding with a very high mortality rate ranging between 50-90% .[1-3]

There are various factors affecting management of these cases such as, age, GCS during presentation and before operation, pupil diameter, time of operation interval. Presence of midline shift and basal cistern compression seen on CT Scan.

Basal cistern compression on CT Scan shows a reliable prognostic value . Patients with compressed basal cistern have a three times fold of worse prognosis compared to patients with normal basal cistern. [13-16]

Traumatic acute subdural hematoma (TASDH) with midline shift of more than 5 mm or witn a thickness more than 10 mm seen on CT Scan, is an indication of operative management consisting of craniotomy evacuation od decompressive craniectomy in order to lower down ICP with a better outcome compared to conservative measures. [3-5]

After operation patients need an intensive monitoring using an ICP monitor because cerebral edema is one of many causes of secondary brain injury in head trauma patients.

Two operative techniques are used in these cases, namingly: craniotomy evacuation and decompressive craniectomy. Craniotomy evacuation is performed if during operation the brain seems to pulsate normally and there is no swelling. Decompressive craniectomy is done when there is significant swelling and the duramater could not be sutured primarily. This procedure is still controversial as it is only recommended in situations where there is not other measures to be taken in order to lower down high ICP. The correct choice of what procedure to be undertaken sometimes only depends on intraoperative condition during each procedure.

During cerebral edema, there is significant rise in ICP, lowered cerebral blood flow and failure of brain metabolism after head trauma affecting the prognosis of patients eventhough hematoma evacuation has been performed. There are various methods to lower down post operative rise in ICP, such as, barbiturate induced coma, hiperventilation, hypothermia and decompressive craniectomy. Besides decompressive craniectomy, other methods are not available in our institution and also have a high price for these methods. Decompressive craniectomy is a simple procedure by opening up the skull and adding more volume foe the brain. This concept is the same with other compartments of the body due to high pressure in the compartments, such as fasciotomy in compartement syndrome . Decompressive craniectomy will reduce significant midline shift and open up the basal cisterns. [5-8]

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These facts mentioned above motivate the author to undergo this research in comparing decompressive craniectomy with craniotomy evacuation in lowering mortality rate in ATSDH patients.

METHODS

This research is an observational analysis with cross sectional design. Data was pertained retrospectively through patient medical records from 1 January 2006 until 31 December 2009. Subject of this research are all head injured patients with TASDH and performed either craniotomy evacuation or decompressive craniectomy within 72 hours after initial trauma. Patients with multiple trauma, age < 1 year, diagnosed with heart condition, coagulopathy and diabetes were excluded from this research.

Decompressive craniectomy is a procedure in which unilateral frontotemporoparietal bone flap is resected and a large fascia is used to suture the duramater, whereas craniotomy evacuation is a similar procedure but the bone flap is reinstalled and durameteris sutured primarily. [17]

The data is analysed statistically using SPSS 16. Various variables such as age, sex, GCS, neurological deficit, midline shift, basal cistern compression, and type of operative technique is compared with outcome using Chi Square test. A multiple regression logistic analysis is also used to calculate the relationship with each of these variables. Pearson chi square test is applied to test our hypothesis.

RESULTS

From our medical record between 1 January 2006 until 31 December 2009, there were 148 patients with ATSDH consisting of 117 males and 31 females with age range of 1 – 75 years From 148 patients, we performed 84 craniotomy evacuation and 64 decompressive craniectomy. (Table 1)

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Table 1. Patient characteristic between the two operative procedures

	Characteristic	Type Operation: Craniotomy (n=84)	Craniectomy (n=64)	Significance
1.	Age (year)			
	< 10	2	2	
	10-19	15	12	
	20-29	22	21	
	30-39	11	13	
	40-49	9	12	
	≥ 50	25	4	ZM-W=2,186
	x (SB)	35,8(17,7)	28,6(12,0)	P=0,029
	Median	32	27	
	Range	3-70	1-54	
2.	Sex			
	Male	68	49	X2=0,423
	Female	16	15	P=0,516
3.	GCS			
	≤ 8	27	32	X2=4,831
	>8	57	32	P=0,028
4.	Neurological deficit			
	Present	22	24	X2=2,169
	Not present	62	40	P=0,141
5.	Cisterns			
	Compressed	55	55	X2=7,969
	Not compressed	29	9	P=0,005
6.	Midline shift			
	< 5 mm	7	5	X2=0,013
	.> 5 mm	77	59	P=0,908
7.	Operation Interval (hour)			
	0-4	5	0	
	4-10	30	25	
	>10	49	39	
	x (SB)	18,5(17,20	19,5(16,6)	ZM-W=0,446

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Median	12	12,5	P=0,656
Range	3-72	5-72	

Note : x(SB) = average and standard deviation

x^2 = chi square test

Z_{M-W} = Mann-Whitney test

There is a significant relationship (p=0.01) between age and compressed basal cistern with type of operation and also between GCS (p=0.05) and operative technique. Meanwhile other variables such as sex, neurological deficit, midline shift and operation interval show no significant relationship with choice of operative technique in ATSDH patients (table 1).

Table 2. Correlation between various variables and outcome in ATSDH patients

	Characteristics	Outcome				Significance
		Survive	(n=83)	Death	(n=65)	
1.	Age (year)					
	< 10	3		1		
	10-19	13		14		
	20-29	33		10		
	30-39	14		10		
	40-49	12		9		
	≥ 50	8		21		
	x (SB)	28,8(13,3)		37,7(17,5)		ZM-W=2,809
	Median	26		35		P=0,005
	Range	1-70		4-70		
2.	Sex					
	Male	69		48		X2=1,898
	Female	14		17		P=0,168
3.	GCS					
	≤ 8	21		38		X2=16,720
	>8	62		27		P=<0,001
4.	Neurological deficit					
	Present	16		30		X2=12,293

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	Not present	67	35	P=<0,001
5.	Cisterns			
	Compressed	49	61	X2=23,146
	Not compressed	34	4	P=<0,001
6.	Midline shift			
	< 5 mm	10	2	X2=3,938
	.> 5 mm	73	63	P=0,047
7.	Operation Interval (hour)			
	0-4	3	2	
	4-10	24	31	
	>10	56	32	
	x (SB)	20,6(18,1)	16,9(15,0)	ZM-W=1,526
	Median	14	10	P=0,127
	Range	3-72	4-72	

Note : x(SB) = average and standard deviation

x^2 = chi square test

Z_{M-W} = Mann-Whitney test

There is a signifacnt relationship (p<0,01) between age, GCS, neurological deficit, and compressed cisterns with outcome. Meanwhile sex and operation interval show no such relationship.

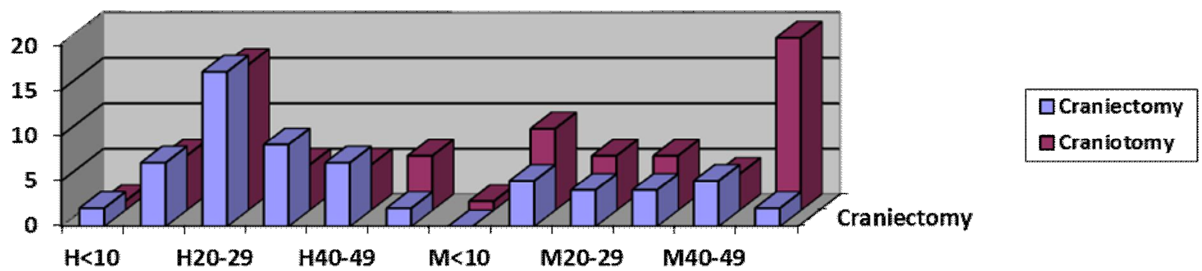

Chart 1. Relationship between age group and outcome

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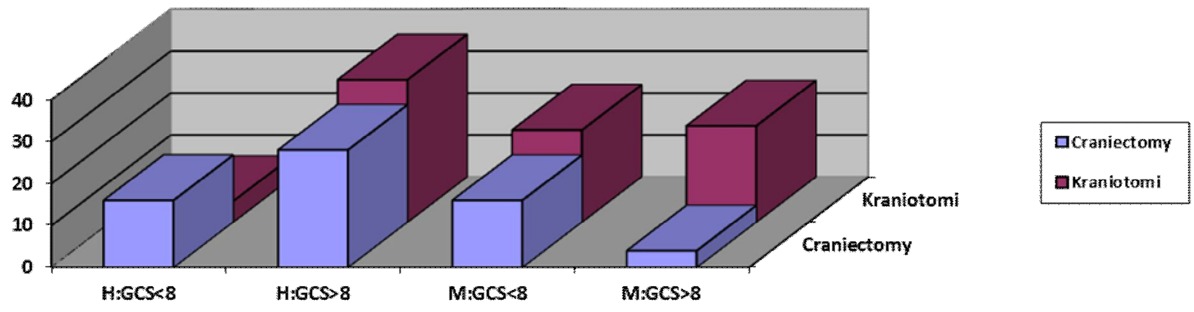
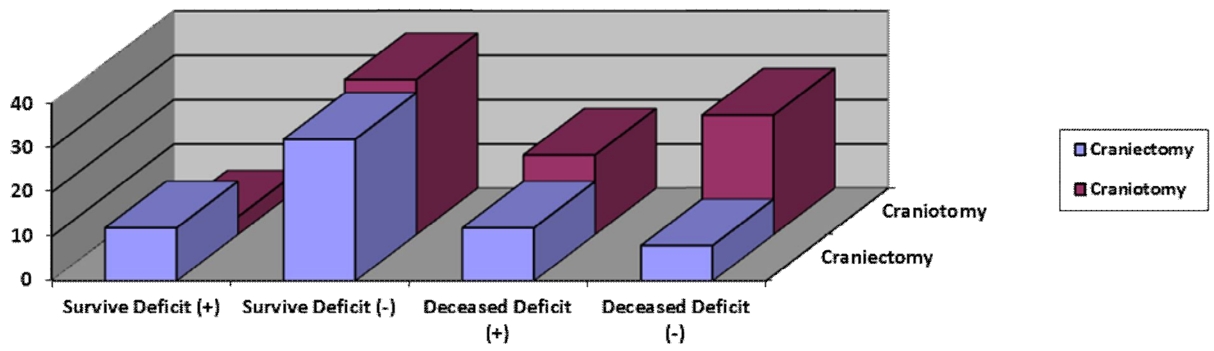
The relationship between age group and outcome shows a high significancy. Increasingv age is an independent factor in determining the prognosis of these patients (p<0,01). This is true especially in patients above 60 years of age (brain Trauma Foundation,2000)

According to type of operation, there is a significant relationship between age group and outcome. Besides that there is clear data showing high mortality rate in age group above 50 years old (Graph 1).



Graph 2. Relationship between GCS and outcome

Based on type of operation, it is shown on graph 2 that there is a significant relationship between GCS and outcome. Fifty nine patients with GCS ≤ 8 have mortality in 38 patients (64%), inspite of 89 patients with GCS > 8 have 27 deaths (30%).



Graph 3. Relationship between neurological deficit and outcome

Based on type of operation, there is a significant relationship between neurological deficit (anisochor of pupils and hemiparesis) with outcome. From 83 patients who survived, neurological deficit was negative in 67 patients (81%) but from 46 patients with neurological deficit there were 30 patients who died (65%).

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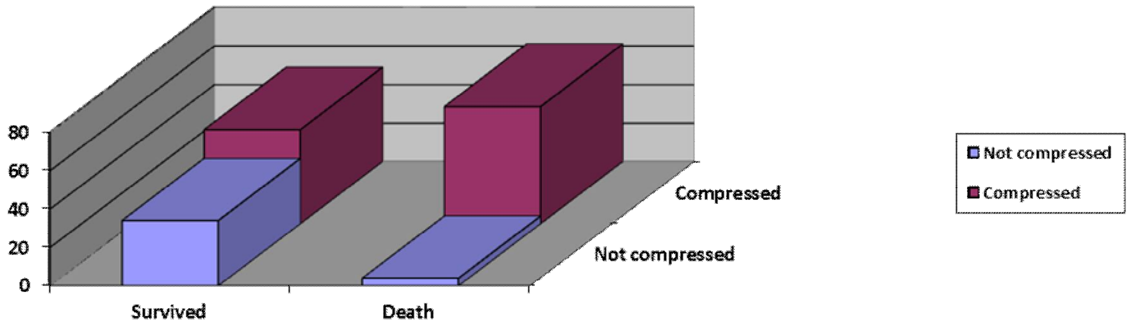
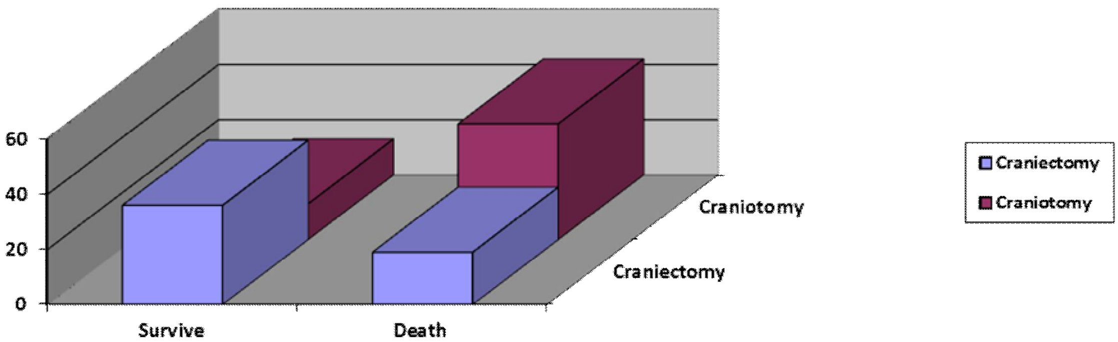


Graph 4. Relationship between compressed cistern and outcome

There is a highly significant relationship between the basal sisterna compression and outcome in which surgery was performed. Of the 110 ATSDH patients with compressed cisterns, there were 61 patients (56%) who died. While of 65 patients who died, 61 patients (94%) had a compressed sisterna as seen on CT scan, while the other 4 patients did not have such feature. These results show that compressed basal cistern as shown on CT scan is of a very strong prgonostic value.



Graph 5. Relationship between type of operation and compressed cistern

From our research we found 110 patient with compressed cisterns, in which 55 patients underwent craniotomy with death in 42 of them (76%), whereas 55 patients underwent craniectomy in which there were 19 death (34%). With $p<0.001$, showing a strong correlation between type of procedure and compressed cistern.

Table 3 shows a strong correlation between these various variables that correlate significantly using multiple logistic regression analysis.

Table 3. Multiple logistic regression analysis of various factors that influence the type of operation

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Variable	Coef B	SE (B)	p value	OR (95%CI)
Age Group	0,2534	0,1469	0,090	1,29(0,96-1,73)
GCS	-1,4809	0,5229	0,005	0,23(0,08-0,63)
Neurological Deficit	-0,7982	0,5103	0,118	0,45(0,17-1,22)
Cisterns	-2,7478	0,6385	<0,001	0,06(0,02-0,22)
Operation	-2,2153	0,5193	<0,001	0,11(0,04-0,30
Constant	8,940			

Note : Accuracy =73,65

Table 4. Relationship between type of procedure and outcome

Type of Procedure	Outcome	
	Survive	Death
Craniotomy	39(46,4%)	45(53,6%)
Craniectomy	44(68,8%)	20(31,3%)

Note : X2= 7,348; p=0,007

Based on table 4, the probability rate is p=0,007 and if p is less than 0,05, H0 is rejected.

$$\text{Ratio rate}_{death} = \frac{\text{craniotomy}}{\text{craniektomy}} = 1{,}71$$

Based on our calculation on the odd's ratio of mortality rate in this research between craniotomy and craniectomy procedure, the mortality rate in the craniotomy group is higher 1.71 times compared to the craniectomy group. This shows that the mortality rate in the craniectomy group is lower in patients with ATSDH.

DISCUSSION

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Head trauma is more common in male than female patients. This correlates with high mobility in males than females. The age group 20-29 years is the highest as this is one of the most productive age group with high mobility. This is the same with a similar work in England. [1-3]

Our results differs from the of research for acute traumatic SDH which presents with the "four hour rule" , that shows lower mortality rate of 30% in patients with acute traumatic SDH in which surgery was performed less than 4 hours. But when the surgery was performed over 4 hours the mortality rate reached 90%. No significant association is noted between the operation time interval in our results. This is allegedly due to the small number of patients operated less than 4 hours. Only 5 patients during the 5 year range.[4-6]

There is no difference between male and female in terms of type of operation and outcome as there is no significant difference in brain anatomy.

This is consistent with research stating that increasing age is an independent factor in determining the prognosis of patients with severe head injury, with the significantly worse prognosis in patients above 60 years old. For patients with acute traumatic SDH, there is a tendency of worse prognosis in the elderly particularly those arriving with lower GCS score. [7-9]

GCS score has a strong correlation with outcome in acute traumatic SDH patients. The lower the GCS score the higher the mortality rate. This is similar with a research by Marshall (1996) of 746 patients, in which the mortality rate was 36% (271 patients), 16 patients had a GCS> 8, while the other 255 patients had a GCS ≤ 8. The lower GCS the higher is the mortality rate as explained by by Wilberger et al (1991), that patients with GCS 3 have a mortality of up to 90%, GCS 4 with 76% mortality rate, GCS 5 62 %, mortality rate while the GCS 6 and 7 have a mortality of 51%. [10-15]

Clinical presentation such as GCS score, pupil reactivity and motoric deficit correlate with size and progression of ATSDH and severity of trauma. Patient with acute onset of loss of consciousness and decerebration after trayma are assumed to have difuse injury of the brain parenchym with worse prognosis. [12-16]

Anisochoria pupil was present in 51% patients ATSDH, whereas motoric deficit/hemiparesis was present in 49%. [12-16]. Eventhough the presence of neurologic deficit is not a specific sign for ATSDH but it shows valueble information regarding the progression of intracranial mass. These two signs show the ongoing process of brain herniation which would cause irreversible damage and worst outcome. The high mortality rate in patients with neurological deficit is due to this herniation process of brainstem compression. [14]

The basal cistern presentation on CT scan is also a valueble prognostic factor. In patients with compressed basal cistern, the outcome will be grave. [13-17] This high mortality rateof 76% in craniotomy patients with compressed basal cistern is caused by :

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1. Presence of cerebral edema after head injury causing worst outcome. [13]
2. Anesthesia procedure during surgery causing brain relaxation. This may warrant the surgeon to only perform craniotomy evacuation procedure.
3. No ICP monitor present in our institution in which all severly head injured patients should undergo ICP monitoring to measure the exact intracranial pressure. [11]

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