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Research Article

DECOMPRESSIVE CRANIECTOMY IN ACUTE TRAUMATIC BRAIN INJURY: OUR OBSERVATION IN DMCH

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A B S T R A C T

Background: Acute traumatic brain injury (TBI) is common in all developing countries like Bangladesh. The reasons are motor vehicle accident, fall from height, assault and fall of heavy object on head due to unawareness, negligence and ignorance. Diffuse brain edema, acute subdural haematoma and multiple cerebral contusions are the most common cause of death in TBI. TBI can result in cerebral edema and vascular changes resulting in an increase in intracranial pressure (ICP), which can lead to further secondary damage. Decompressive craniectomy (DC) is a surgical option in the management of severe traumatic brain injury by reducing the ICP by giving particular attention to provide long time functional outcome among survival. DC initially considered as a second line treatment procedure where conservative treatment fail but recently DC considered more and more as an early procedure whenever it is indicated in clinical settings.

Objective: The aim of the current study was to observe functional outcomes of patients undergoing DC for raised ICP after severe traumatic brain injury and to assess possible predictive factors.

Method: All adult cases of severe TBI patient in which DC was performed between the period 1stJanuary 2015 to 31stDecember 2018 in Dhaka Medical College Hospital. 602 patients were included in this study.

Result: Six hundred and two patients underwent DC for raised and refractory ICP. Glasgow Outcome Scale (GOS) at 10th POD and 1-month follow‑up were reported. GOS at 1-month follow-up showed 169 patients (28.1%) had a good recovery, moderate disability was reported in 138 patients (22.9%), and severe disability in 108 patients (17.9%), persistent vegetative state was seen in 35 patients (5.9%). One hundred and fifty-two(152) patients had in-hospital mortality (25.2%).

Conclusion: DC is associated with an in-hospital mortality of 25.2%. Good outcomes (GOS 4-5) were seen in 51% patients. DC is effective in treating refractory intracranial hypertension following TBI and improve outcome in selected patients and play a definite role in the developing country like Bangladesh.

INTRODUCTION

Traumatic brain injury (TBI) remains a major public health problem across the globe [1]. Traumatic brain injury (TBI) is a major health problem usually complicated with intracerebral hemorrhage, contusion, brain swelling, extradural haematoma; subdural haematoma eventually leads to elevated intracranial pressure (ICP). Intracranial hypertension can lead to brain swelling, ischemia by reducing the cerebral perfusion pressure [2-4]. As demonstrated in most studies, intracranial hypertension (ICH) is correlated to the increased incidence of death and severe disability following TBI [5]. Thus, monitoring and reversing of ICP are essential in the management of TBI and routinely used in some trauma centers [6]. Though medical treatments including hyperosmolar therapy, sedation, barbiturate coma, therapeutic hypothermia and ventricular drainage prove to be effective, there do exist a set of patients resistant to these treatment modalities when brain swelling continues, and finally resulting in refractory ICH (RICH) [7, 8]. Decompressive craniectomy (DC) is a surgical procedure that has regained much interest in the management of RICH after TBI in recent years [9]. Recently some studies, including a large scale randomized controlled trial (RCTs, RESCUEicp trial), found that DC could reduce ICP and mortality, improve

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prognosis in comparison with medical therapies [10, 11].However, in some patients, maximal medical treatment fails to alleviate cerebral swelling, and in the absence of intracranial mass lesions, which can be evacuated, the management options of these patients are few. A last-tier therapy in these cases, used in many centers, is decompressive craniectomy [12]. Morbidity and mortality of patients with TBI is high. About 60% either die or survive with disability even though DC s recommended as a surgical intervention of choice being aimed at lowering ICP to reduce secondary brain damage.

MATERIALS AND METHODS

All adult cases of severe TBI patient in which DC was performed between the period of 1stJanuary 2015 to 31stDecember 2018. Total 602 patients were included in this study. The parameter evaluated includes the patient's demographic cause of head injury, GCS on admission, clinical and neurological deficit, CT findings, indication for surgery finally surgical outcome. Follow up done by post-operative Glasgow coma scale (GCS), Glasgow outcome Scale (GOS) for 10th POD and following 1 month.

A standard procedure recommended in international literature was employed. In brief, in the operating room under general anesthesia, incisions were given as required (bi-coronal for bilateral or front temporal trauma flap for unilateral) and scalp flap was raised. After making burr holes, craniotomy was used to raise a bone flap, which was removed and stored in refrigerator. The dura was incised (durotomy) and then augmented using temporal fascia, pericranial fascia, or artificial fascia (duroplasty). Patients were ventilated for 24–48 h. All the patients were followed by principal investigator himself at both hospitals and at clinics after discharge for outcome. Good functional outcome was assessed using Glasgow outcome score (GOS).

RESULTS

Table 1 Socio-demographic characteristic of the study patients

Age (in years)	Number of patients	%
Mean ± SD	41.98 ± 20.24	
Range(min-max)	4.5- 85	
Sex		
Male	428	71.1
Female	174	28.9
Weight (kg)		
Mean ± SD	59.12±11.4	
Range(min-max)	15- 80	

A total 602 severely traumatic brain injury patients were enrolled in the study from January 2015 to December 2018. Table 1 shows the average age of the patient was 41.98 ± 20.24 years ranged from 4.5 to 85 years. Among them mostly are male 428 (71.1%) with mean weight was 59.12 ± 11.4 kg with ranged from 15 to 80 kg. Table 2 shows; in this present series, it was observed that road traffic accident was more frequent cause of injury 327(54.3%) followed by fall from height 169 (28.1%), assault 73 (12.1%) and fall of heavy object on head 33 (5.5%).

Table 2 Distribution of the study patients by cause of injury

Cause of Injury	Number of patients	%
Road traffic accident	327	54.3
Fall from height	169	28.1
Assault	73	12.1
Fall of heavy object on head	33	5.5

Table 3 Distribution of the study patients by Admission GCS Score

Admission GCS Score	Number of patients	%
3-5	191	31.7
6-8	126	20.9
9-12	166	27.6
13-15	119	19.8
Mean ± SD	9.62 ± 2.87	
Range(min-max)	5- 15	

In table 3; It was observed that frequent patients 191 (31.7%) belonged to on admission GCS Score 3-5, followed by 166 (27.6%) belonged to on admission GCS 9-12, 126 (20.9%) belonged to on admission GCS 6-8 and 119 (19.8%) belongs to on admission GCS 13-15 group. Mean on admission was 9.62 ±2.87with ranged from 5 to 15.

Table 4 Distribution of Traumatic brain injury (TBI)

Admission GCS Score	Number of patients	%
Extradural haematoma (EDH)	119	19.8
Subdural haematoma (SDH)	211	35.0
Subarachnoid haemorrhage (SAH)	121	20.1
Contusion	151	25.1

Table 4 reveals; subdural haematoma (SDH) was present in 211 (35.0%) patients followed by contusion in 151 (25.1%) patients, subarachnoid hemorrhage (SAH) in 121 (20.1%) patients and extradural haematoma (EDH) was present in 119 (19.8%) patients respectively

Table 5 Pre-op CT Head (Findings)

Thickness of Haematoma	Patients	%
<10 mm	224	37.2
10-25 mm	378	62.8
Ventricular Effacement	468	77.7
Condition of Basal Cisterns		
Normal	224	37.2
Compressed	344	57.1
Absent	34	5.7
Midline Shift (mm)		
<5	82	13.7
5-10	329	54.7
>10	189	31.4
Skull fracture	**513**	**85.2%**
Temporal	186	30.9
Parietal	163	27.1
Occipital	97	16.1
Sphenoid	67	11.1

In table 5; it presents overlying skull fracture was found in most patients 513 (85.2%). Among them temporal, parietal, occipital and sphenoid fracture found in 186 (30.9%), 163 (27.1%), 97 (16.1%) and 67 (11.1) respectively.

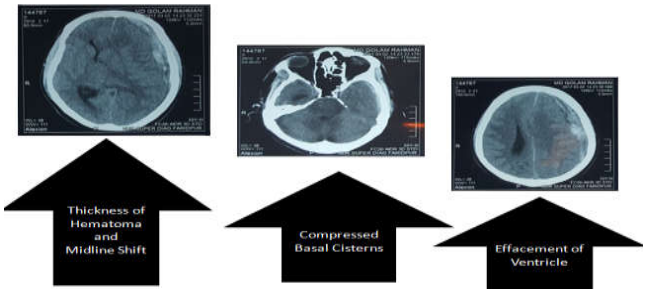

Figure 1 Different findings in CT scan of brain.

Table 6 Distribution of the study patients by timing of surgery

Timing of Surgery	Number of patients	%
Within 06 hrs of trauma	19	3.2
Within 24 hrs of trauma	308	51.2
Within 48 hrs of trauma	163	27.0
Within 72 hrs of trauma	112	18.6

In table 6; it was observed that 308 (51.2%) patients had surgery within 24 hours of trauma, followed by 163 (27.0%) within 48 hours of trauma, 112 (18.6%) within 72 hours of trauma and 19 (3.2%) within 06 hours of trauma.

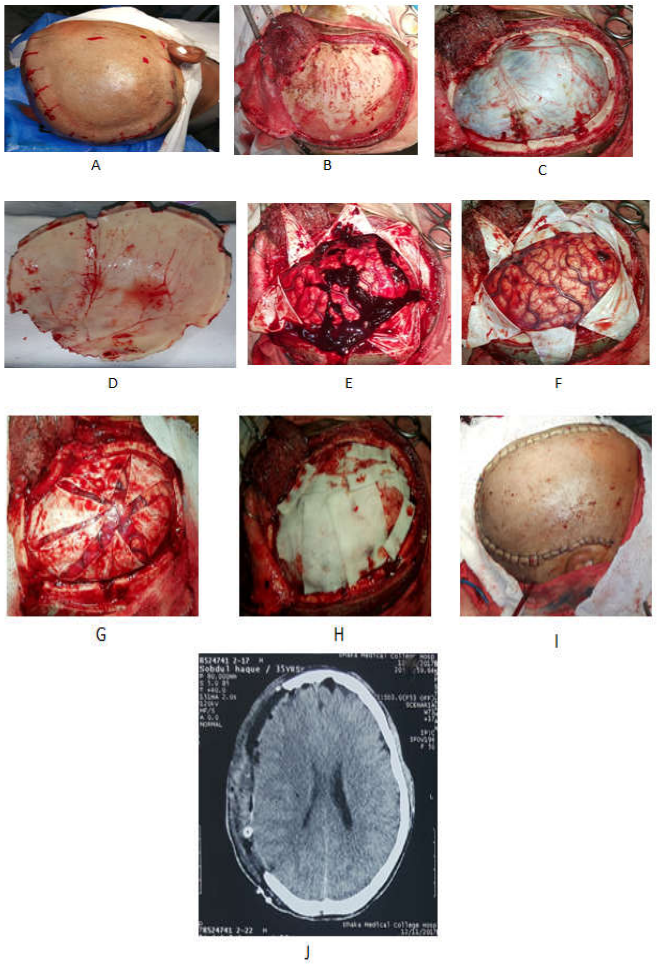

Figure 2 Different steps of Decompressive craniectomy surgery; (A) Positioning and skin marking, (B) After elevation of skin flap skull bone exposed, (C) After removal of skull bone, (D) Removed skull bone fragment, (E) After durotomy, blood clot visualized, (F) After durotomy blood clot removed, (G) Dural repositioning, (H) Placement of haemostatic agent (Gelfoam), (I) After skin closure, (J) Post-operative CT scan of brain

Table 7 Post op GCS Score

	Number of patients	%
On 1st POD (n= 600)	**Death: 2**	
3-5	198	32.9
6-8	148	24.6
9-12	129	21.4
13-15	125	20.8
Mean ± SD	7.38 ± 2.76	
Range (Min-Max)	3-15	
On 10th POD (n= 468)	**Death: 132**	
3-5	84	14.0
6-8	156	25.9
9-12	102	16.9
13-15	126	20.9
Mean ± SD	8.76 ± 5.2	
Range (Min-Max)	3-15	
Following 1 Month (n= 450)	**Death: 18**	
3-5	36	6.0
6-8	108	17.9
9-12	136	22.6
13-15	170	29.2
Mean ± SD	10.13 ± 4.39	
Range (Min-Max)	3-15	

All these patients underwent surgery and some of them were kept in ICU or HDU level and majority were in post-operative ward. GCS of 1st POD, 10th POD and following 1 month were shown in table 7. With duration GCS was increasing as only 6% of the patients in GCS 3-5 and 29.2% of patients in GCS 13-15 with mean 10.13 ± 4.39 ranging from 3 to 15.

Table 8 Post Op GOS Score on 10th POD

Sl. No.	GOS		On 10th POD		Following 1 Month	
			No of patients (N)	%	No of patients (N)	%
1	Good outcome	**5:** Good recovery: Resumption of normal life despite minor deficits	126	20.9	169	28.1
2		**4:** Moderate disability: Disabled but independent; can work in sheltered setting	139	23.1	138	22.9
3	Poor outcome	**3:** Severe disability: Conscious but disabled; dependent on other for daily support	137	22.8	108	17.9
4		**2:** Persistent vegetable state: Minimal responsiveness	66	10.9	35	5.9
5	Expired	**1:** Death	134	22.3	152	25.2

In this study it was observed that 44% patients had favorable surgical outcome among them GOS score 5 in 126 (20.9%) and GOS score 4 in 139(23.1%) respectively in 10th POD. Poor surgical outcome in 33.7% patients; among them GOS score 3 in 137 (22.8%) and GOS score 2 in 66 (10.9%). 134 (22.3%) patients died in 10th POD (GOS score 1). In 1 month follow up was good outcome in 51% patients. Among them GOS score 5 in 169 (28.1%) and GOS score 4 in 138(22.9%) respectively in 1 month follow up. Poor surgical outcome in 23.8% patients; among them GOS score 3 in 108 (17.9%) and GOS score 2 in 35 (5.9%). Death was in 152 (25.2%) patients died in 1 month (GOS score 1).Patients died (GOS score 1) in 1st POD 2 patients, in 10th POD 132 patients and 1 month 18 patients, total: 152.

DISCUSSION

In this study, we evaluated the outcome of DC in the 10th POD and one month follow up with TBI. DC was quite effective in reducing the ICP, and it was also associated with good outcome in 51% of the patients and poor outcome in 23.8% of the patients after 1 month follow up. As a developing country, we do not have the facility of ICP monitoring to objectively document the reduction in postoperative ICP. Decompressive craniectomy in diffuse traumatic brain injury (DECRA) investigators reported results from a multi-centered, randomized clinical trial comparing DC and standard care in the management of diffuse severe TBI [13]. The results suggested that though DC lowers refractory ICP, therapeutic intensity levels and intensive care unit days, it does not improve mortality and may even worsen functional outcome at 6 months in patients with diffuse severe TBI. DECRA deals with those who have diffuse injury but most of our patients had an intracranial haematoma as well. So, after evacuation of haematoma; brain become relaxed and gets some space along with augmented duroplasty.

A study by *Jagannathan et al*. reported similar outcomes [14]. It was a retrospective review of prospectively acquired data of children who underwent DC at the authors' institution between January 1995 and April 2006. Although the mortality rate for children with severe TBI remains high, DC was effective in reducing ICP and is associated with good outcomes. Another study revealed that DC was associated with a better than expected functional outcome in patients with medically uncontrollable ICP and brain herniation, compared with outcome in other control cohorts reported on in the literature [15].

We observed better outcomes in younger patients. GCS score of 9 and above is associated with favorable outcome, while mortality rates and the incidence of residual disabilities are much higher in patients with admission GCS of 5 and below, which is comparable to other studies [16-18]. GCS had statistically significant association. ICP monitoring is considered as standard care in TBI but we have no scope of ICP monitoring which is important parameter in management of TBI and post DC monitoring. Few limitations of this study were observed. There was no comparison, polytrauma patients are not considered here, no definite selection criteria, ICU support not sufficient, scope of ICP monitoring lacking, finally post DC status of the patient with cranioplasty andinfection cannotanalyzed and only done in a single centerlike Dhaka Medical College Hospital.

CONCLUSION

DC is associated with an in-hospital mortality of 25.2%. Good outcome (GOS 4-5) were seen in 51% patients. DC is effective in treating refractory intracranial hypertension following TBI and improve outcome in selected patients and play a definite role in the developing country like Bangladesh.

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