ORIGINAL ARTICLE

# Role of Emergency Decompressive Craniectomy in Patients of Traumatic Brain Injury

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***ABSTRACT***

***Objective:*** *To study the role of emergency decompressive craniectomy in patients of traumatic brain injury.*

***Methodology:*** *This observational study was performed in the department of Neurosurgery, MTI, LRH, Peshawar, from 1st February, 2016 to 31st January, 2017. A total of 28 patients of traumatic brain injury, who underwent emergency decompressive craniectomy within 24 hours of their admission were included in the study after applying the inclusion and exclusion criteria. A questionnaire was used to document the data. Data analysis was performed with the help of SPSS version 20.*

***Results:*** *The total no. of patients were 28, out of which 21 (75%) were male and 7 (25%) were female. The mean age of all the patients was 31 ± 19.84, with a range of 10 – 80 years. The preoperative diagnosis was acute subdural hematoma (ASDH) in 15 (53.6%), large contusion in 6 (21.4%), post-traumatic intracerebral bleed in 3 (10.7%), and ASDH plus small multiple contusions in 4 (14.3%) patients. Dura was left open in all the cases. The preoperative mean GCS was 8.39 ± 3.01. A total of 8 (28.6%) patients expired during the first postoperative week. The mean GCS of the remaining 20 patients at discharge was 10.55 ± 4.05. At 3 months follow-up, 7 (25%) patients were in vegetative state (GOS2), 3 (10.7%) were having major disability (GOS3) and 10 (35.7%) had good (GOS 4 and 5) clinical outcome.*

***Conclusion:*** *The decompressive craniectomy can be very helpful in patients of traumatic brain injury because it can lower the ICP and improve the survival rate in TBI patients.*

***Abbreviations:*** *GCS (Glasgow Coma Scale), GOS (Glasgow Outcome Scale), ICP (Intracranial Pressure).*

***Keywords:*** *Decompressive craniectomy, Traumatic brain injury, Acute subdural hematoma, Contusion, Intracerebral bleed.*

## INTRODUCTION

Severe traumatic brain injury is a leading cause of morbidity and mortality across the world.[1-3] It is also one of the main indications responsible for admissions to intensive care unit(ICU).[4] The chain of events in traumatic brain injury patients are brain edema leading to increase in intracranial pressure (ICP) and reduction in oxygen and blood supply which causes exhaustion of energy resources and cell death.[1] The objective of treatment in TBI patients is to control ICP, in order to ensure adequate cerebral perfusion pressure (CPP) and prevent cell death.[5] The raised ICP can initially be managed medically by using various options like head elevation, Mannitol infusion, and hyperventilation etc. Decompressive craniectomy (DC) becomes an option when these measures are ineffective.[6]

The concept of surgical decompression was first put forward by Kocher in 1901, and since then it has been used for more than a century for the treatment of raised intracranial hypertension which fails to respond to medications.[1,2,3,7] The mechanism of action of decompressive craniectomy is that it converts the cranial cavity which is like a closed box, into an open system and allows the brain to expand ,thus preventing brain herniation and death, as a result.[8,9]

Though decompressive craniectomy is performed



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in all neurosurgical settings around the globe, but the controversies regarding whether to perform or not and when to perform the procedure, continues.[1]various studies are showing the improved clinical outcome with the procedure.[2,3,5,10] On the other hand, there are several concerns about the efficacy and safety of the procedure. Various drastic complications likebrain herniation through the craniectomy defect, CSF leak, subdural hematoma etc. have also been reported.[1]

This study was conducted in order to evaluate the efficacy of decompressive craniectomy in TBI patients with refractory ICH in terms of improvement in Glasgow outcome scale (GOS).

## MATERIALS AND METHODS

This observational study was performed in the department of Neurosurgery, Lady Reading Hospital (MTI), Peshawar. The duration of study was one year from 1st February, 2016 to 31st January, 2017. The following inclusion and exclusion criteria were used for the selection of the patients.

### Inclusion Criteria

Those patients who underwent decompressive craniectomy within 24 Hours of their admission for the following indications were included.

- Age 10 – 80 years.
- Both genders.
- TBI with midline shift more than 5mm on CT scan.
- TBI with effacement of ventricles and cisterns on CT scan.
- TBI cases in which the surgeon was not able to close the Dura primarily.

### Exclusion Criteria

- DC for extradural hematoma (EDH).
- DC for middle cerebral artery infarct (MCA).
- DC performed after 24 hrs.

Anapproval from the ethical committee of the hospital was acquired before the start of the study and informed consent was taken from the patient's relatives at the time of procedure. A questionnaire was used to document the preoperative GCS, CT scan findings, intra-operative findings, postoperative complications and GCS at discharge. The patients were re-evaluated at 3 months follow up and Glasgow outcome scale (GOW) was recorded at follow up visit. Any morbidity or mortality during the follow up period was also recorded. The data was analyzed in SPSS version 20.

### Operative Steps for Decompressive Craniectomy

After intubation, the patient is put in supine position. A rolled towel is placed beneath the ipsilateral shoulder and the head is rotated towards the opposite side. Reversed question mark incision is given, starting 0.5 cm in front of the tragus, moving up and extended 15 cm posterior to the key burr hole, then moving up and anteriorly parallel to the sagittal sinus. Five burr holes are made in the following areas 1.in temporal bone superior to the root of zygomatic process 2. In keyhole area behind the zygomatic arch 3. Along the superior temporal line posterior inferiorly. 4 in the parietal and 5. Frontal parasagittal area. The bone flap is removed and placed in the abdomen. The Dura is opened with a cruciate incision. Duraplasty is done using periosteal patch or fascia lata or the Dura is left open if not possible. All the layers are closed in reverse order.

## RESULTS

### Gender Distribution

The total no. of patients was 28. Male patients were 21 (75%), and female were 7 (25%), with a male to female ratio of 3:1.

### Age Distribution

The mean age of the patients was 31and SD ± 19.84, with a range of 10 – 80 years.

### Preoperative GCS

The mean preoperative GCS was8.39 and SD ± 3.01. The preoperative GCS of all the patients in the study was as shown in Table 1.

**Table 1:** *Preoperative GCS.*

| Preoperative GCS | No. of Patients | Percentage |
|---|---|---|
| 3 – 8 | 15 | 53.57% |
| 9 – 12 | 10 | 35.71% |
| 13 – 15 | 3 | 10.71% |

## Preoperative Diagnosis

The preoperative diagnosis in the study group was as shown in Table 2.

**Table 2:** *Preoperative Diagnosis.*

| Preoperative Diagnosis | No. of Patients | Percentage |
|---|---|---|
| ASDH | 15 | 53.6% |
| Single large Contusion | 6 | 21.4% |
| ICB | 3 | 10.7% |
| ASDH plus small contusions | 4 | 14.3% |

## Intra-operative Findings

Unilateral temporofrontoparietal decompressive craniectomy was performed on the side of the pathology. Dura was left open in all the cases. The bone flap was placed in the subcutaneous pocket of the abdomen.

## Mortality

During the first postoperative week, 8 (28.6%) patients expired. The mean preoperative GCS of the patients who died during the first postoperative week was 5.63 and SD ± 1.68.

## Postoperative GCS at Discharge

The mean postoperative GCS at discharge of the remaining 20 patients was 10.55 ± 4.05.

## GOS at Follow-up

At 3 months follow-up the GOS of all the patients was as shown in table 3.

**Table 3:** *GOS Follow-up.*

| GOS | No. of Patients | Percentage |
|---|---|---|
| GOS 1 | 8 | 28.57% |
| GOS 2 | 7 | 25% |
| GOS 3 | 3 | 10.72% |
| GOS 4 | 2 | 7.14% |
| GOS 5 | 8 | 28.57% |

## Morbidity and Mortality

During the first postoperative week, 8 patients expired. No expiry reported during the follow up period. The complications were as shown in table 4.

**Table 4:** *Morbidity and Mortality.*

| S. No. | Complications | No. |
|---|---|---|
| 1. | Wound infections | 2 |
| 2. | CSF leak | 1 |
| 3. | Cerebral herniation | 2 |
| 4. | Contusion expansion | 3 |
| 5. | Subdural hematoma | 1 |

## DISCUSSION

Traumatic brain injury is responsible for a huge number of morbidity and mortality worldwide and as a result, one of the main indications for ICU admissions. The main concern in patients of traumatic brain injury is the raised intracranial pressure. Raised intracranial pressure can initially be controlled with medical therapies like Mannitol or hyperventilation, but when these therapies are ineffective, decompressive craniectomy become an option. We conducted this study in order to evaluate the role of decompressive craniectomy in patients of traumatic brain injury.

The mechanism of action of decompressive craniectomy is that it converts the cranial cavity into an open box and allowing the brain to expand and prevents the dire consequences of raised intracranial pressure, but on the other hand it exposes the patient to so many post-operative complications like, subdural hematoma, brain herniation through craniotomy defect and CSF leak etc. Therefore, the role of decompressive craniectomy is always questioned in terms of whether or not and when to do it?[8,9]

In our study, 75% were males. The same was found in Grille P et al.[4] study, in which 79% were males, while in Gouello G et al.[6] study 77% were males. The highest proportion of male was probably because of increased exposure of males to the trauma in day to day life.

In our study the preoperative diagnosis was ASDH (53.6%), ASDH plus small multiple contusions (14.3%), Single large contusion(21.4%), and post-traumatic ICB (10.7%), while in Khalili H et al. study[11], the preoperative diagnosis was ASDH (66.2%), Large contusion (33.8%), Tense brain (19%), and EDH in 15.5% cases. Similarly in Saade N et al. study,[12] the

preoperative diagnosis was ASDH (78.6%), brain contusion (28.6%), and EDH in 17.9%. so, all these studies showing that acute subdural hematoma is one of the main indication for decompressive craniectomy.

In our study, the clinical outcome was reported as GOS 4&5 in (35.7%), GOS 3 in (10.7% ),and GOS 2 (25% ). 28.6% patients expired during the first post-operative week, while no mortality was reported in the follow-up period. In Hutchinson PJ et al. study[13], the clinical outcome was GOS 4&5 in (27.4%), GOS 3 in (37.3%), and GOS 2 in (8.5%) of patients. The mortality was reported to be 26.9%. In Ban SP et al. study,[14] the clinical outcome was GOS 4&5 in (47.2%), GOS 3 in (22.5%), and GOS 2 in (6.7%) of patients. The mortality was reported to be 23.6% in their study.

In our study, all the cases were operated within 24 hours of their admission to the hospital in comparison to other studies where most of the patients were operated after 24 hours.[13] In our study decompressive craniectomy was performed only on one side, in comparison to a few other studies where bilateral decompressive craniectomy was performed.[14]

The limitations of our study were a small sample size, lack of availability of ICP monitor and follow up for a short duration of time. Further studies are recommended, in which the patients could be followed up for longer duration of time to see the long-term outcome.

## CONCLUSION

The decompressive craniectomy can be very helpful in patients of traumatic brain injury because it can lower the ICP and improve the survival rate in TBI patients.

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