ORIGINAL ARTICLE

# Decompressive Craniotomy Verses Conservative Management in Severe Traumatic Brain Injuries

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## *ABSTRACT*

***Materials and Methods:*** *Study design; prospective study, department of neurosurgery SZH, Rahim Yar Khan.*

***Study Duration:*** *2 years and 1 month from 1st June 2011 to 31 July 2013.*

***Study Subject:*** *100 patients were divided into two groups i.e. I and II Group. Group I patients were managed conservatively and group II patients were managed surgically. Follow up was done at 3, 6, 9, 12 months after discharge and outcome in terms of improvement in GCS was compared between these two groups.*

***Results:*** *Improvement in GCS to 11 or above was achieved in 60% patients of group I and in 68% patients of group II who were discharged with GCS 12 or above.*

***Conclusion:*** *Our study suggests that operative measures for TBI gives better outcome as compared to conservative management.*

***Key Word:*** *Severe Traumatic Brain Injury, Decompressive Craniotomy, duraplasty, GCS.*

***Abbreviations:*** *GCS = Decompressive craniotomy, duraplasty. ICP = Intracranial hypertension. TBI = Traumatic brain injury. ICU = Intensive Care Unit.*

## INTRODUCTION

Head injury is taken as a major health problem, as it is a frequent cause of death and disability, placing immense demands on health services around the globe. In the developing countries, accidents resulting in traumatic brain injury are on a rise, besides other factors like industrialization, fall from height and ballistic trauma.[1]

Trauma presents with a variety of injuries and problems that demand early evaluation, intervention and monitoring, so as to save life and prevent permanent disability. Its management in recent times has revolutionized diagnosis with CT scan / MRI, ICU monitoring, serial intra cranial measurements and positive pressure ventilation. Previously conservative treatment was the only option available, which recently has included surgical management, with a significant differrence in the ultimate outcome of severe brain trauma.[2]

Decompressive Craniotomy with duraplasty, is now considered as a good option, in uncontrolled intracranial hypertension (ICP), after severe traumatic brain injury (TBI).[3] Lot of research is being done on it worldwide, but still there is controversy regarding the efficacy of the procedure in improving patients out come.

The concept of surgical decompression on post traumatic brain swelling was first put forward by Kocher in 1901.[4] According to him "if there is no CSF pressure, but brain pressure exists, then pressure relief must be achieved by opening the skull".[5]

Pathophysiologically changes in severe traumatic brain injury, results in brain edema and elevated intracranial pressure, which is the most common cause of death and disability. Unfortunately, no new medical treatment has come forward for quiet sometime. In raised ICP refractory to medical treatment, Decompressive Craniectomy / craniotomy may be an appropriate surgical option.[6] When performed correctly and timely, before the onset of irreversible ischemic changes and coupled with neurointensive care, this proce-

dure can reduce ICP immediately, improve oxygenation and prevent cerebral herniation and death.[7]

In our setup, we are receiving a huge bulk of road side accidents, the main cause of TBI. This study was to compare the outcome between conservative and operative management of traumatic brain injury. The procedure is surely time consuming and needs pre and post operative ICU care. Our experience though promising, may open a door to a new form of management of severe TBI in our setup.

## MATERIALS AND METHODS

This prospective study was conducted in Sheikh Zayed Hospital, Rahim Yar Khan from 1 June 2011 to 31 July 2013. The sample size comprised of 100 Patients, which were divided into two groups. Group I, placed on conservative treatment and Group II was surgical operated upon.

All adult patients from 15 – 55 years, with GCS 5 – 8, who were received within 24 hours of the trauma and showing diffuse axonal injury on the CT scan, were included in the study.

In contrast patients showing other pathologies in their CT scan, or having poly trauma or those who died during resuscitation in the emergency were not included in the study.

All the traumatic patients received in the emergency department, were clinically assessed (GCS, Pupils, Vitals, Neurological examination), resuscitated (Intubated, Elevation of head side, Mannitol, hyperventilation, sedation/antiepileptic / antipyretic) and put on ventilator. Later where required, serial CT scans were also performed.

Patients of Group I (conservative management) were similarly approached, and kept on conservative management, being monitored in neuro ICU followed by serial investigations and examinations. The elevated ICP was decreased by head elevation, Mannitol, Frusimide, ventilatory support (IPPV) with Fraction of inspired oxygen for ($FiO_2$) to 30 – 100%. The patients were also continuously monitored with one hourly GCS, pulse oximetry, CVP monitoring, ABGs assessments, vitals recordings, half hourly urine output and pupil size / light reaction.

Every alternate patient was placed in Group II (Surgical management) as most of them were operated within 24 hours of admission. The patients underwent bilateral craniotomy / craniectomy with duraplasty and after surgery were shifted to neuro ICU for further management.

Every patient was followed up for one year with regular visits in OPD at 3, 6, 9 and 12 months interval.

## RESULTS

Our study comprised of 100 patients, divided in two equal groups. Group I were put on conservative treatment, whereas in Group II, patients were operated upon.

The conservatively managed group had about 2/3 males and 1/3 females, half of them being below 25 years of age. Similarly in other group, majority were males 35 while 15 were females as shown in Table 1.

In group I, out of the 50 patients, 15 died in ICU,

**Table 1:**

| Gender | Male | Percentage | Female | Percentage |
|---|---|---|---|---|
| Group I | 33 | 66% | 17 | 34% |
| Group II | 35 | 70% | 15 | 30% |

| Age | 13y to 25y | 26y to 45y | 46y to 55y |
|---|---|---|---|
| Group I | 23 | 16 | 11 |
| Group II | 25 | 16 | 9 |

Both the group of patients were initially received and treated in the ICU and later shifted to the neuro ward for further management.

In remaining 35 patients (who survived), 15 (43%) were shifted to the neuro ward at 10 GCS while 11

**Table 2:** *GCS at the time of Discharge from ICU.*

| Group I (35 Patients) | | | Group II (40 Patients) | | |
|---|---|---|---|---|---|
| GCS | No. of Patients | | GCS | No. of Patients | |
| 8 | 5 | 14.25% | 8 | 3 | 7.5% |
| 9 | 4 | 11.42% | 9 | 4 | 10% |
| 10 | 15 | 42.85% | 10 | 11 | 27.5% |
| 11 | 5 | 14.28% | 11 | 13 | 32.5% |
| 12 | 3 | 8.57% | 12 | 5 | 12.5% |
| 13 | 3 | 8.57% | 13 | 3 | 7.5% |
| 14 | – | – | 14 | 1 | 2.5% |
| 15 | – | – | 15 | – | |

(22%) at GCS between 11 – 13. Remaining 9 patients had GCS bellow 8 – 9. In the ward, 5 patients died, 30 patients showed an improvement and were discharged at a GCS above 11.

In group II, 10 patients died in the ICU, 40 patients were shifted to the ward with GCS ranging from 10 to 11. 6 patients died in ward and remaining 34 patients showed marked improvement. Majority of patients (32) were discharged from ward with GCS above 12.

**Table 3:** *GCS at the time of discharge from ward.*

| Group I (30 Patients) | | | Group II (34 Patients) | | |
|---|---|---|---|---|---|
| GCS | No of Patients | | GCS | No of Patients (34) | |
| 8 | – | | 8 | – | |
| 9 | – | | 9 | – | |
| 10 | – | | 10 | – | |
| 11 | 12 | 40% | 11 | 2 | 05.88% |
| 12 | 10 | 33.33% | 12 | 14 | 41.17% |
| 13 | 4 | 13.33% | 13 | 10 | 29.41% |
| 14 | 4 | 13.335 | 14 | 8 | 23.52% |
| 15 | – | | 15 | – | |

The Group I patients showed 30% death in ICU and 10% in ward, with a total of 20 deaths. Group II showed 20% deaths in ICU 12% deaths in ward with a total number of 16 deaths. Death rate was less in group II as depicted in Table 4.

**Table 4:** *Deaths.*

| | | | | |
|---|---|---|---|---|
| **Group I** | ICU | 15 | 30% | 40% |
| | Ward | 05 | 10% | |
| **Group II** | ICU | 10 | 20% | 32% |
| | Ward | 6 | 12% | |

The maximum stay of patients in ICU was 72 days for Group I, and 51 days in the surgical group II as shown in Table 5.

A one year follow up of the patients was planned after their discharge. Out of 30 patients discharged in Group I, a gradual improvement of GCS was noted with a maximum of 11 patients reaching to GCS 14

**Table 5:**

| Maximum stay in ICU | |
|---|---|
| Group I | 72 days |
| Group II | 51 days |

and 4 patients touching GCS 15, the rest of the 15 patients had their GCS between 11 to 13, at the one year follow up. Better outcome was observed in group II, where majority of patients 32 showed a remarkable clinical improvement having, a GCS of 13 and above, as shown in Table 6.

**Table 6:** *Group I (30 Patients) Follow-up.*

| GCS | 0 Month | 3 Month | 6 Month | 9 Month | 12 Month |
|---|---|---|---|---|---|
| 11 | 12 | 11 | 8 | 6 | 4 |
| 12 | 10 | 11 | 9 | 6 | 5 |
| 13 | 4 | 4 | 6 | 6 | 6 |
| 14 | 4 | 4 | 6 | 9 | 11 |
| 15 | 0 | 0 | 1 | 3 | 4 |

**Group II (34 Patients)**

| GCS | 0 Month | 3 Month | 6 Month | 9 Month | 12 Month |
|---|---|---|---|---|---|
| 11 | 2 | 2 | 2 | 2 | 1 |
| 12 | 14 | 12 | 7 | 3 | 1 |
| 13 | 10 | 12 | 14 | 12 | 10 |
| 14 | 8 | 7 | 9 | 11 | 12 |
| 15 | 0 | 1 | 2 | 6 | 10 |

## DISCUSSION

Severe traumatic brain injury (TBI) is one of the major causes of death in younger age group. In some countries of Europe, an intracranial pressure (ICP) targeted therapy protocol, the Lund concept, has been used in treatment of severe TBI since 1994.[8] Decompressive craniectomy / craniotomy is used as a protocol – guided treatment step.

Though the mainstay of treatment is medical therapy to reduce increased ICP associated with edema,

but in certain patients; for example, those with diffuse severe traumatic brain injury (TBI) and massive middle cerebral artery infarction; such treatment is not effective. In these patients, decompressive craniectomy / craniotomy with dural grafting to reduce ICP is another option.[9]

Although there is still controversy about the efficacy of the procedure in improving patient outcome, it is still widely used as a last resort in patients with uncontrollable intracranial pressure (ICP). Several retrospective and prospective studies have suggested the efficacy of decompressive craniectomy / craniotomy in decreasing ICP and improving prognosis in patients with refractory intracranial hypertension after TBI. Presently, the European Brain Injury Consortium and Brain Trauma Foundation guideline for severe TBIs refers to decompressive craniectomy / craniotomy as a second-tier therapy for refractory intracranial hypertension that does not respond to conventional therapeutic measures.[10]

**Josan et al,** study comprised of 12 Pts, half of them were operated similar to us with early decompressive craniectomy and rests of the 6 Pts were managed medically. Results showed operated patients improved to GOS 4 – 5, whereas those treated medically showed deaths in two, severe disability in one, and three patients improved to GOS 5 or GCS 14 – 15.[11]

**Bao et al**, included 37 patients with diffuse axonal injury and all underwent bilateral frontal decompressive craniectomy with dural grafting, 20 patients (54.1%) improved clinically to GOS 4 – 5 and 17 patients showed an unfavorable outcome, like death (07 Patients) vegetative state (04 Patients) and poor GOS 03 (06 Patients).[12]

In a study done by **Skoglund et al,** which comprised of 19 patients with traumatic brain injury; they showed a promising outcome after decompressive craniectomy. 84% of patients showed a clinical improvement of GOS 4 – 5, while 5% patients had vegetative state and 10% died.[13]

**On contrary, our study is a bigger study of surgically treated patients (50 Patients); our experience showed 32% death rate. 2% (01 patient) vegetative state and majority (66%) of patients showed a drastic improvement to GCS 13 and above (GOS 4 – 5), after one year of follow-up.**

**Jiang at el,** conservatively treated 846 patients of severe head injury in ICU setting. After One year follow-up results were: good recovery in 31.56%, moderate disability in 14.07% severe disability in 24.35%, vegetative state in 0.59% and death in 29.43%.[14]

**Maurtiz et al,** gathered information about 415 patients from 5 Austrian hospitals. Data showed 35.7% death rate, 33% had favorable outcome and in 51% showed unfavorable outcome while outcome was not known in 16% of patients.[15]

**Aarabi at el,** had a study of 50 patients who were treated conservatively; results showed 40% (20 Patients) death rate, good recovery with GOS 4-5 in 40% (20 Patients); 14% (07 Patients) had vegetative state and 06% (03 Patients) showed severe disability.[16]

**In our study of conservative treated patients 08% had excellent recovery (GCS 15), 34% had good recovery GCS 13 – 14, and 18% patients had moderate recovery (GCS 11 – 12). Death rate was 40% fortunately we had no vegetative patient after one year.**

## CONCLUSION

Analysis of the data from most of the case series has revealed a decrease in mortality and morbidity, improved functional outcome after decompressive craniectomy / craniectomy. Our study also gave us, an optimistic view regarding good output after surgery for severe traumatic brain injury. This may open a new gateway for treatment of severe brain injury in our setup.

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## REFRENCES

1. Charles M, Manjul J: The essential trauma care project-Relevance in South East Asia. Regional Health Form WHO South East Asia Region, 2004; 8 (1): 29-38.
2. Jaeger M[1], Soehle M, Meixensberger J. Effects of decompressive craniectomy on brain tissue oxygen in patients with intracranial hypertension. J Neurol Neurosurg Psychiatry, 2003 Apr; 74 (4): 513-5.
3. Manley GT. Introduction: decompressive craniectomy for trauma and cerebrovascular disease. Neurosurg Focus, 2009 Jun; 26 (6): E1.
4. Kocher T: Die Therapie des Hirndruckes, in HF6lder A (ed): HirnerschFCtterung, Hirndruck und chirurgische Eingriffe bei Hirnkrankheiten. Vienna: A HF6lder, 1901: pp 262-266.
5. Piek J. Decompressive surgery in the treatment of traumatic brain injury. *Curr Opin Crit Care*, 2000; 17: 451-

533.

6. Jaeger M[1], Soehle M, Meixensberger J. Improvement of brain tissue oxygen and intracranial pressure during and after surgical decompression for diffuse brain oedema and space occupying infarction. Acta Neurochir Suppl. 2005; 95: 117-8.
7. Figaji AA[1], Fieggen AG, Argent AC, Le Roux PD, Peter JC. Intracranial pressure and cerebral oxygenation changes after decompressive craniectomy in children with severe traumatic brain injury. Acta Neurochir Suppl. 2008; 102: 77-80.
8. Olivecrona M[1], Rodling – Wahlström M, Naredi S, Koskinen LO. Effective ICP reduction by decompressive craniectomy in patients with severe traumatic brain injury treated by an ICP – targeted therapy. J Neurotrauma, 2007 Jun; 24 (6): 927-35.
9. Hutchison P, Timofeev I, Kirkpatrick P. Surgery of Brain Edema. Neurosurg Focus, 2007; 22 (5): E14.
10. Huang X, Wen L. Technical Considerations in Decompressive Craniectomy in the Treatment of Traumatic Brain Injury. *Int J Med Sci.* 2010; 7 (6): 385-390.
11. Josan VA1, Sgouros S. Early decompressive craniectomy may be effective in the treatment of refractory intracranial hypertension after traumatic brain injury. Childs Nerv Syst. 2006 Oct; 22 (10): 1268-74. Epub 2006 Feb 22.
12. Bao YH1, Liang YM, Gao GY, Pan YH, Luo QZ, Jiang JY. Bilateral decompressive craniectomy for patients with malignant diffuse brain swelling after severe traumatic brain injury: a 37 – case study. J Neurotrauma, 2010 Feb; 27 (2): 341-7.
13. Skoglund TS[1], Eriksson – Ritzén C, Jensen C, Rydenhag B. Aspects on decompressive craniectomy in patients with traumatic head injuries. J Neurotrauma, 2006 Oct; 23 (10): 1502-9.
14. Ji – Yao Jiang, Guo – Yi Gao, Wei – Ping Li, Ming – Kun Yu, Early indicators of Prognosis in 846 cases of Sever Traumatic Brain injury, Journal of Neurotrauma. Jul 2002. Published in Volume: 19, Issue 7: July 8, 2004.
15. Maurtiz W1, Janciak I, Wilbacher I, Rusnak M; Severe traumatic brain injury in Austria IV: intensive care management, Wien Klin Wochenschr. 2007 Feb; 119 1-2: 46-55.
16. Aarabi B1, Hesdorffer DC, Ahn ES, Aresco C, Scalea TM, Eisenberg HM. Outcome following decompressive craniectomy for malignant swelling due to severe head injury. J Neurosurg. 2006 Apr; 104 (4): 469-79.

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