

Cranioplasty as a surrogate marker for excellent outcome in severe head injury

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Abstract: Outcome in severe head injury is difficult to assess due to lack of follow up. Operated patients who return for cranioplasty usually have the best outcome. The aim of this study was to assess outcome following severe head injury using cranioplasty as a surrogate marker. This was a retrospective study carried out from November 2008 to March 2010. All patients with severe head injury who underwent decompressive craniectomy (DC) or cranioplasty in the study period were included. Case records, imaging and follow up visit data from all patients were reviewed. Glasgow Coma Score on admission and Glasgow Outcome Score at discharge were assessed.

Of the 273 patients, 84.25% (n=230) were male and 15.75% (n=43) were female. The mean age was 34.3 years (range 2-81 years SD 16.817). The mean GCS on admission was 5.615 (range 3-8, SD 1.438). The in-hospital mortality was 54% (n=149). GOS of 4 or 5 at discharge was attained in 22% (n=60) patients. Sixty five patients returned for cranioplasty during follow up. The M:F ratio (6.2:1) matched with the study cohort. However, the difference in mean age (28.815 years SD 13.396) and mean GCS on first admission of 6.323 (SD 1.393) were statistical significant. Therefore, at the very minimum, 65 patients (24%) of the study cohort had excellent outcome. In operated severe head injury patients significant number of patients (24% in our study) have excellent outcome. Also, cranioplasty can serve as a useful marker to assess outcome of operated severe head injury patients in an institution.

Keywords: cranioplasty, outcome, severe head injury

INTRODUCTION

Traumatic brain injury is a leading cause of death and disability worldwide. Every year, about 1.5 million affected people die and several millions receive emergency treatment^{1,2}. Most of the burden (90%) is in low and middle income countries³. The incidence varies from 67 to 317 per 10000 in different continents and the mortality rates are in the range of near 1% for minor injury and 48% for severe head injury. It is the main cause of death and disability in people under 40 years of age⁴. The Glasgow Coma scale at the time of admission is the single most important predictor of outcome. Long term Outcome severe head injury is difficult to assess due to lack of follow up, especially in developing countries like India.

Most widely recognized indications for cranioplasty are aesthetic reconstruction and protection of brain

against external injuries; it is usually performed several months after the craniectomy. Patients who return for cranioplasty usually have a Glasgow outcome score of 5 and have reintegrated into society.

AIMS AND OBJECTIVES

To assess outcome of operated severe head injury patients using cranioplasty as a surrogate marker.

METHODS

This was a retrospective study carried out from November 2008 to March 2010 at the Jai Prakash Narain Apex Trauma center, All India Institute of Medical Sciences, New Delhi, India. All patients with severe head injury with a GCS 8 or less who underwent decompressive craniectomy (DC) and cranioplasty in the study period were included. Case records, imaging and follow up visit data from all patients were reviewed. Glasgow Coma Score on admission was assessed. Outcome at discharge was defined with the Glasgow outcome scale. The scale comprises five categories: death, vegetative state, severe disability, moderate disability and good recovery. For the purpose of this analysis, we dichotomised outcomes into favourable (moderate disability or good recovery) and unfavourable (dead,

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vegetative state, or severe disability) ⁵.

Category and definition on Glasgow outcome scale

- **Good recovery:** able to return to work or school
- **Moderate disability:** able to live independently; unable to return to work or school
- **Severe disability:** able to follow commands/unable to live independently
- **Persistent vegetative state:** unable to interact with environment; unresponsive
- **Dead**

Patients were given a date for cranioplasty ranging 2-3 months from discharge. On readmission patients were re-evaluated and the GCS calculated.

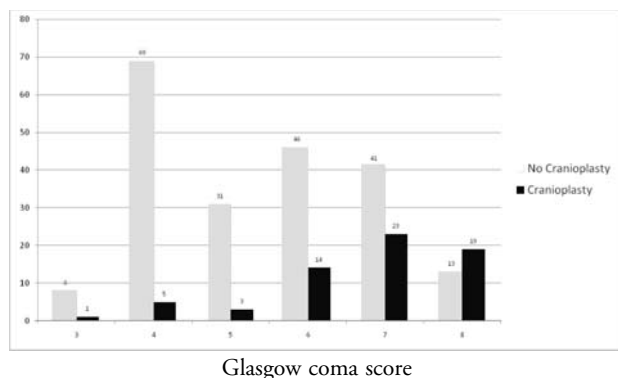
Those patients who underwent surgeries for other indications such as depressed fracture elevation and epidural hematoma evacuation were excluded from the study cohort. The data was analysed using Student's t-test, Chi-square test and the Wilcoxon Ranksum tests.

RESULTS

The study cohort comprised of the 273 patients of whom 84.25% (n = 230) were male and 15.75% (n = 43) were female. The mean age was 34.3 years (range 2-81 years SD 16.817). The mean GCS on admission was 5.615

Table 1: Glasgow coma score of patients in Cranioplasty and no Cranioplasty groups

GCS	No Cranioplasty	Cranioplasty	Total
3	8	1	9
4	69	11	80
5	31	3	33
6	46	14	60
7	41	23	64
8	13	13	26
Total	208	65	273



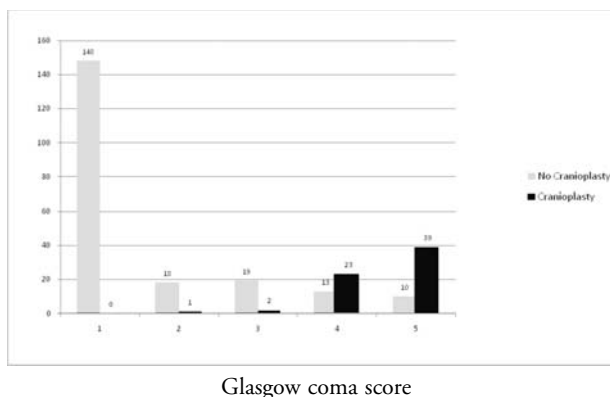
(range 3-8, SD 1.438) Table 1. The in-hospital mortality (GOS 1) was 54% (n = 149). Favourable outcome (GOS of 4 or 5) at discharge was attained in 22% (n = 61) patients (Table 2).

Sixty five patients returned for cranioplasty during follow up. However the difference in mean age 28.815 years (SD 13.396) and mean GCS on first admission of 6.323 (SD 1.393) were statistical significant (p<0.005).

Of the 273 patients recruited in this study 65(24%) returned for Cranioplasty. The M:F ratio (6.2:1) matched with the study cohort. The age and presenting GCS of these two groups were compared using an independent sample 2-tailed t test and the Mann-Whitney U test respectively. There was a statistically significant difference in age, but not a biologically significant difference. The cranioplasty patients were younger than those who did not return for cranioplasty (mean age of 28 years compared to 36 years with a p value of 0.0024) which was statistical significant. The Glasgow coma score of both groups were clinically comparable 6 compared to 5 in the cranioplasty and no cranioplasty groups respectively, even though there was a statistical significant difference noted. The mean Glasgow Outcome Score at discharge was 3.907 (SD 1.283) in the cranioplasty group as compared to 1.649 (SD 1.170) in the no cranioplasty group which was statistical significant.

Table 2: Glasgow outcome score of patients in Cranioplasty and no Cranioplasty groups

GOS	No Cranioplasty	Cranioplasty	Total
1	148	0	148
2	18	4	22
3	19	23	42
4	13	20	33
5	10	18	28
TOTAL	208	65	273



DISCUSSION

Older age, low Glasgow coma score, absent pupil reactivity and the presence of major extracranial injury predict poor prognosis. All of these variables have been previously identified as prognostic factors for poor outcome in traumatic brain injury⁶. The long term outcome of operated severe head injury patients in developing countries cannot be assessed due to the lack of follow up. Hence this understates the need for a more simpler prognostic indicator of good outcome. This study examined whether cranioplasty could serve as a marker for outcome of operated severe head injury.

Glasgow coma score showed a clear linear relation with mortality. Increasing age was associated with worse outcomes. Similar findings have been found in other studies^{7,8}. Plausible explanations for this include extracranial comorbidities, changes in brain plasticity, or differences in clinical management associated with increasing age.

Most patients included were in their middle age, severe head injury being the major cause of death and disability in this age group⁴.

We had a better outcome in patients undergoing decompressive craniectomy for severe head injury compared to the earlier published data⁹. In this study, 48% died during their initial hospital stay and 21% were discharged in a vegetative state (GOS 2), 24% were discharged with severe disability, while 7% had moderate disability at discharge¹⁰. Our data was comparable with Marshal et al who had a favourable outcome in 25% of patients¹¹. The percent of patients who returned for Cranioplasty with a Glasgow outcome score of 5 were 24% (n = 65) which is comparable to the favourable outcome mentioned in these studies. Therefore, at the very minimum, 65 patients (24%) of the study cohort had excellent outcome.

CONCLUSIONS

In operated severe head injury patients significant number of patients (24% in our study) have excellent outcome. Also, cranioplasty can serve as a useful marker to assess outcome of operated severe head injury patients in an institution.

REFERENCES

1. Bruns J Jr, Hauser WA. The epidemiology of traumatic brain injury: a review. *Epilepsia* 2003; 44(suppl 10):2-10.
3. Fleminger S, Ponsford J. Long term outcome after traumatic brain injury. *BMJ* 2005; 331:1419-20.
4. Hoffman K, Primack A, Keusch G, Hrynkow S. Addressing the growing burden of trauma and injury in low- and middle-income countries. *Am J Public Health* 2005; 95:13-7.
5. Basso A, Previgilino I, Durate JM, Ferrari N. Advances in management of Neurological trauma in different continents. *World J Surg* 2001; 25:1174-8.
6. Jennett B, Bond M. Assessment of outcome after severe brain damage. *Lancet* 1975; i:480-4.
7. Brain Trauma Foundation (US) AANS. Management and prognosis of severe traumatic brain injury. New York: 2000.
8. Hukkelhoven CW, Steyerberg EW, Rampen AJ, et al Patient age and outcome following severe traumatic brain injury: an analysis of 5600 patients. *J Neurosurg* 2003; 99:666-73.
9. J Lemcke, S Ahmadi and U Meier. Outcome of Patients with Severe Head Injury After Decompressive Craniectomy. In, Zbigniew Czernicki (Ed) Brain Edema XIV. *Acta Neurochirurgica Supplementum* 2010; 106:231-233.
10. Signorini DF, Andrews PJD, Jones PA, Wardlaw JM, Miller JD. Predicting survival using simple clinical variables: a case study in traumatic brain injury. *J Neurol Neurosurg Psychiatry* 1999; 66:20-5.
11. Marshall LF, Gattille T, Klauber, et al. The outcome of severe closed head injury. *J Neurosurg* 1991; 75:S28-S36.