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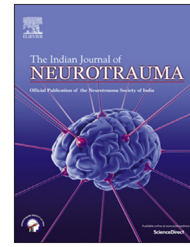

Original Article

Surgical outcome of brain contusions treated by decompressive craniotomy with or without lobectomy at high volume tertiary care trauma centre

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ABSTRACT

Aims and objective: To assess and compare surgical outcome of brain contusions treated by Decompressive craniotomy with or without lobectomy or contusectomy.

Methods: 156 patients of severe TBI, operated for brain contusions from January 2009 through December 2010 were reviewed. The patients with brain contusions >20 cm^3 in volume were included in study. In group A, decompressive craniotomy with lax duraplasty was done; in group B decompressive craniotomy with lax duraplasty along with excision of brain contusion or lobectomy was performed.

Results: There were 101 patients in group A and 55 in group B. Both groups were compared for demographic data, CT findings, GCS, time from injury to surgery, duration of surgery, blood loss, hospital stay, mortality and Glasgow outcome scale. Contusions were larger in group B ($p = 0.0001$). Pupillary reaction was worse in group B ($p = 0.037$). The time from injury to presentation to casualty ($p = 0.0033$) and time from injury to surgery ($p = 0.0008$) was longer in group B. Blood loss ($p = 0.0001$) and duration of surgery ($p = 0.0013$) were higher in group B. Rest other parameters were not significantly different. In group A, mortality rate was 63% and 50% in group B ($p = 0.131$). 28% patients in group A and 42% in group B had good outcome ($p = 0.073$).

Conclusions: Adequate contusectomy or lobectomy is useful in severe TBI with contusions. The results of present series suggest that one should be very aggressive in managing brain contusions to achieve better outcomes.

Abbreviations: CT, Computer tomography; GCS, Glasgow Coma Scale; NSRL, Normal Size Reacting to Light; NRL, Non-Reacting to light.

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1. Introduction

Brain contusions are common sequelae of traumatic brain injury (TBI). They occur in upto 8% of all TBI and 13–35% of severe TBI.[1–4] Most patients have small contusions for which surgical intervention is not required. Surgical intervention is indicated if patient develops neurological deterioration, refractory intracranial pressure or CT scan head show significant mass effect. The standard surgical approach is craniotomy with evacuation of brain contusion. The patients with TBI are surgically managed at our Center with either i) decompressive craniotomy with lax duraplasty only, or ii) decompressive craniotomy with lobectomy or contusectomy and lax duraplasty. The purpose of this study is to access the surgical outcome of patients with brain contusions and to compare two surgical approaches.

2. Material & methods

The clinical records of all operated patients with severe TBI, admitted to our Center, between January 2009 and December 2010, were retrospectively analyzed. Only those patients with cerebral contusions more than 20 cm^3 in volume were included in study. These patients were managed either with i) decompressive craniotomy with lax duraplasty only, or ii) decompressive craniotomy with lobectomy or contusectomy and lax duraplasty. The patients with penetrating injury, brainstem injury, hemodynamic instability, other associated injuries and history of prior neurologic disease or disability were excluded. The choice of surgical approach was non-randomized and at discretion of the attending neurosurgeon.

The following clinical parameters were recorded – demographic data, time of presentation to casualty since injury, time from injury to surgery, preoperative GCS, pupillary reaction and Glasgow outcome score at discharge. Preoperative Noncontrast CT scans were reviewed for contusion volume, subdural hemorrhage, subarachnoid hemorrhage, mass effect and midline shift. Postoperative CT scans were reviewed for any residual contusion, mass effect or midline shift. Intraoperative parameters reviewed were status of brain at opening/closure, duration of surgery, blood loss during surgery and the surgical procedure performed. Postoperative complications, duration of hospital stay and GCS at discharge were recorded.

Data analysis was done using SPSS 11.5 software.

2.1. *Surgical procedure*

The standard decompressive craniotomy procedure was performed by making a question mark skin incision and removal of fronto-temporo-parietal bone (size approximately 10 × 15 cm). Dura was opened by curvilinear incision across the Sylvian fissure within 1 cm of craniotomy window. The dural opening was enlarged by giving side cuts. Subdural hematoma was evacuated, if present. In group A, brain contusions were left untouched and only decompressive craniotomy was done. In group B, either lobectomy of the involved lobe or excision of contused brain was also done in addition to decompressive craniotomy. In both groups, lax duraplasty was done at the end of surgical procedure, using harvested pericranium graft or temporalis fascia graft. The bone flap was replaced in the abdominal subcutaneous tissue.

Generally, lobectomies were performed with regard to the possible consequences of the removal of brain substance. Frontal lobectomies were taken posteriorly no further than the coronal suture superiorly and 5 cm inferiorly. If the frontal lobectomy was performed on the dominant hemisphere, usually, the tissue removal was stopped 1 or 2 cm anterior to the coronal suture. Care was taken to avoid the Sylvian fissure

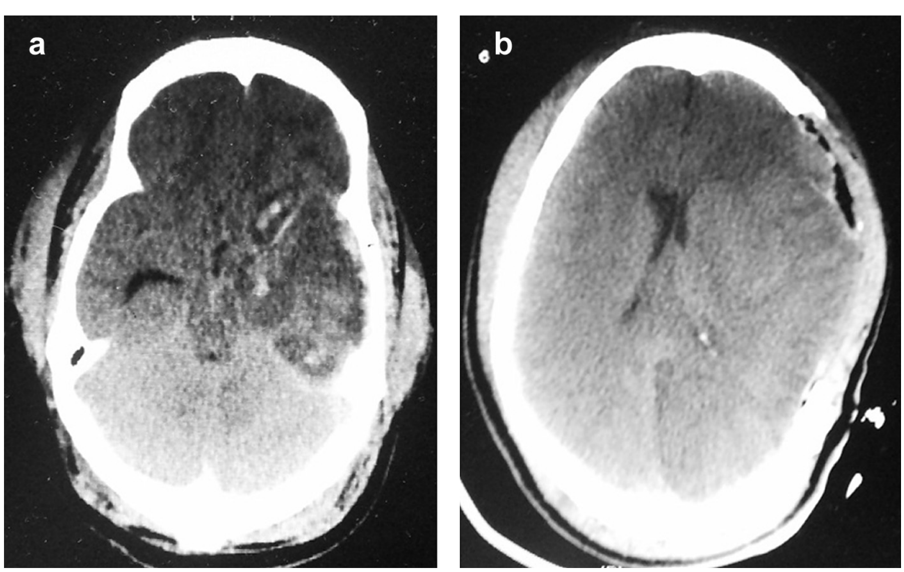

Fig. 1 – a) Preoperative NCCT Head of a patient showing left frontal and temporal contusions with mass effect. b) The patient underwent left frontotemporal decompressive craniectomy with lax duraplasty only. Postoperative NCCT head of the same patient showing decompressive craniectomy with resolving contusions and persisting mass effect.

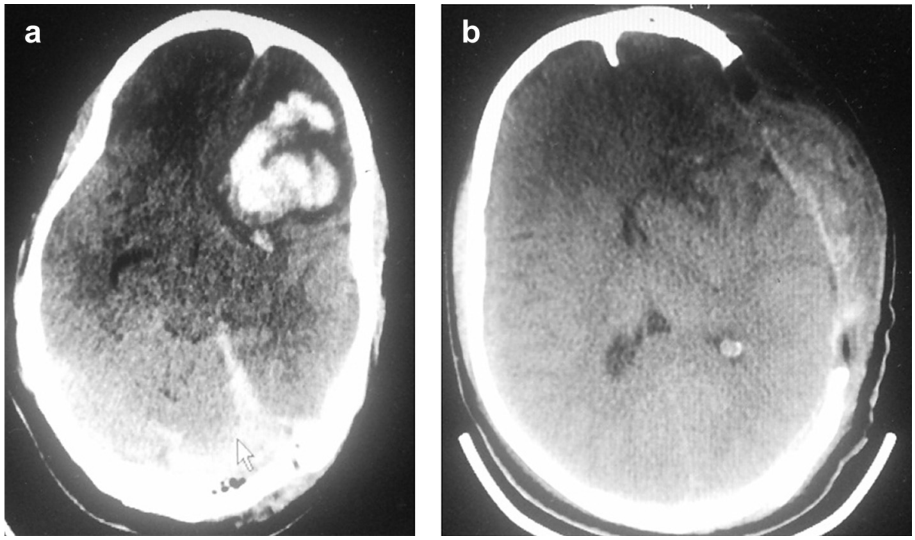

Fig. 2 – a) Preoperative NCCT Head of a patient showing large bilateral Basifrontal contusions, predominantly on the left side with gross midline shift and mass effect. b) the patient underwent left sided decompressive craniectomy with left frontal lobectomy and lax duraplasty. Postoperative NCCT Head showing resolution of the mass effect.

laterally and the anterior cerebral arteries medially. When a temporal lobectomy was performed, the anterior 5 cm of the temporal lobe were removed, including the mesial structures, in order to clearly identify the incisura. The superior temporal gyrus was preserved in dominant lobectomies, and a layer of cortex was left along the Sylvian fissure to avoid disruption of major vascular structures.

3. Results

There were 156 patients of brain contusions who were managed surgically. Group A (decompressive craniotomy with lax duraplasty) had 101 patients (Fig. 1); while in group B (Decompressive craniotomy with lobectomy/contusectomy with lax duraplasty), there were 55 patients (Fig. 2).

Both the groups were homogenous with regard to the patient demographic variables and presenting neurological status (GCS). The median age of patients in group A was 35 years and 40 years in group B. Male to female ratio in both the groups was 5.7:1. The modes of injury in both groups were similar. 73% patients had history of road traffic accident, 19% had history of fall from height and 8% were due to assault. The median GCS of patients in both groups was 6 (Table 1).

In group B, time from injury to presentation in casualty and time from injury to surgery was significantly longer ($p = 0.0033$ and 0.0008 respectively). Blood loss during surgery was more in group B and duration of hospitalization was also significantly longer ($p = 0.0001$ and 0.0013 respectively). All other parameters were statistically non significant (Table 1).

Pupillary reactivity was significantly worse in patients in group B, with more number of patients in group B having ipsilateral or bilateral non-reacting and dilated pupils ($p = 0.037$) (Table 2).

The volume of the contusion was significantly larger in group B ($p = 0.0001$), while other CT findings were statistically not significantly different in both groups (Table 3). In group A, mean contusion volume was 34.7 ± 3.6 cm^3 while in group B mean contusion volume was 39 ± 5 cm^3. This was not statistically significant.

Table 1 – Patient variables.

Patient variables		Group A Median (range)	Group B Median (range)	*p* Value
Age		35 years (12–90 years)	40 years (6–82 years)	0.2949
Sex	Male	86	47	0.959
	Female	15	8	
Mode of injury	Road traffic accident	74	40	0.967
	Fall from height	19	10	
	Others (Assault, gunshot)	8	5	
GCS		6 (3–8)	6 (4–8)	0.8355
Time from injury to presentation in casualty		5 h (0.5–72 h)	7.5 h (1–120 h)	0.0033
Time from injury to surgery		8 h (1–220 h)	14 h (3–216 h)	0.0008
Blood loss		600 ml (100–1700 ml)	800 ml (100–2500 ml)	0.0001
Duration of surgery		4 h (2–10 h)	5 h (3–8 h)	0.0013
Duration of hospitalization		11 days (2–67 days)	10 days (1–46 days)	0.5476

Table 2 – Pupillary reactivity.

Pupils	Group A	Group B	Total	p Value
B/L NSRL	44 (43%)	31 (56%)	75 (48%)	0.037
Ipsilateral dilated NRL	23 (23%)	16 (29%)	39 (25%)	
B/L NRL	34 (34%)	8 (15%)	42 (27%)	

Table 3 – CT findings.

CT findings		Group A n (%)	Group B n (%)	p Value (paired t test)
Contusion volume	20–40 cm^3	97 (96%)	41 (75%)	0.0001
	>40 cm^3	4 (4%)	14 (25%)	
SDH		85 (84%)	38 (69%)	>0.05
SAH		30 (30%)	22 (40%)	
MLS >5 mm		92 (92%)	51 (93%)	

SDH – Subdural hemorrhage, SAH – Subarachnoid hemorrhage, MLS – midline shift.

In group A, 63% patients expired while in group B 51% patients expired ($p = 0.131$) (Table 4). Glasgow outcome score at the time of discharge is given in Table 5. In group A 28% patient had good outcome while in group B good outcome was observed in 42% patients (p value 0.073).

4. Discussion

Traumatic brain contusions comprise approximately 20% of intracranial lesions.[2–6] Most of the brain contusions are of small size and do not require surgery. Larger contusions with mass effect may cause secondary brain injury leading to neurological deterioration.[1,7] It is recommended that patients with GCS 8 or less, contusion greater than 20 cm^3, midline shift of 5 mm or more, cisternal compression on CT scan and any lesion greater than 50 cm^3 must be treated surgically.[1,7]

The standard surgical treatment for hemorrhagic contusion is craniotomy with evacuation of contusions. But this procedure is less effective when brain injury is diffuse and with severely raised intracranial pressure resulting from brain edema.[2,3,5,8,9] The decompressive craniotomy is a better option in comparison to limited craniotomy with lesion evacuation to reduce raised intracranial pressure in these patients.[10–13]

Brain swelling in a contused area is commonly seen and is often a common cause of neurological deterioration leading to death. There are three phases of brain swelling due to contusion. The ultra early phase occurs within first 24 h and is often the cause of clinical deterioration. The second phase occurs after 24–72 h.[14] Decompressive craniotomy alone is sometimes insufficient to ameliorate the raised intracranial pressure in large brain contusions because of the delayed development of edema in contused brain (Fig. 1a and b). Results of recent randomized trial have shown that long-term outcome is worse for decompressive craniotomy.[15] The benefits of removing the contused brain include the removal of edema producing osmotic load and abolition of necrotic and apoptotic cascades triggered off by blood degradation products[16] (Fig. 2a and b). Brain lobectomies may benefit patients of severe head injury with contusion and intractable intracranial hypertension.[17] The survival and functional outcome after this procedure are acceptable. This is also observed in the present series. The profile of patients in group B was worse in terms of pupillary reaction ($p = 0.037$), time delay from injury to presentation in casualty ($p = 0.0033$), time from injury to surgery ($p = 0.0008$) and size of contusions ($p = 0.0001$). But even after being the worst group as compared to group A, the overall mortality was less and surgical outcome of patients was better in this group, although not statistically significant (p 0.073). This suggests that one should be very aggressive in managing patients with brain contusions.

According to the literature, the mortality rate for patients with surgical intraparenchymal hemorrhagic lesions is 32–56%, which is comparable to our results (Table 4).[1,2,5]

This study had several limitations. One limitation was patient selection. It was non-randomized selection based on the attending neurosurgeon's decision. Secondly, the study

Table 4 – Patient outcome.

Outcome	Group A n (%)	Group B n (%)	Total n (%)	Odds ratio (95% confidence interval) Unadjusted	Odds ratio (95% confidence interval) Adjusted	p Value
Improved	37 (37%)	27 (49%)	64 (41%)	1.7 (0.86, 3.2)	1.6 (0.71, 3.6)	0.131
Expired	64 (63%)	28 (51%)	92 (59%)			(not significant)

Table 5 – Glasgow outcome score.

Glasgow outcome score[a]	Group A	Group B	Odds ratio (95% confidence interval) Unadjusted	Odds ratio (95% confidence interval) Adjusted[a]	p Value
Poor outcome	73 (72%)	32 (58%)	1.52 (0.67, 3.5)	1.87 (0.94, 3.73)	0.073 (not significant)
Good outcome	28 (28%)	23 (42%)			

[a] Adjusted for pupillary reactivity, time from injury to presentation in casualty, time from injury to surgery, blood loss, duration of surgery, duration of hospitalization.

had inherent drawbacks of retrospective study. Finally, the patients were assessed at the time of discharge from the hospital and there was no follow-up data. However, in future, more such trials can be designed with a large number of patients and with a longer follow-up for outcome assessment after decompressive craniectomy with brain lobectomy.

5. Conclusion

Despite of being a retrospective study, our study has brought out several findings of significance. Brain lobectomy or contusectomy along with decompressive craniotomy is a useful adjuvant in the management of severe head injury with contusion larger than 20 cm^3. Aggressive management of brain contusion can lead to better outcome.

Conflicts of interest

All authors have none to declare.

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