Bifrontal Contusions: What Is the Best Surgical Treatment?

Pragyan Sarma[1] Dhaval P. Shukla[1] Bhagavatula Indira Devi[1]

[1] Department of Neurosurgery, National Institute of Mental Health and Neurosciences (NIMHANS), Bangalore, Karnataka, India

Indian J Neurotrauma 2015;12:103–106.

Address for correspondence Dr. Dhaval P. Shukla, MCh, Department of Neurosurgery, National Institute of Mental Health and Neurosciences (NIMHANS), Hosur Road, Lakkasandra, Bangalore 560029, Karnataka, India (e-mail: neurodhaval@rediffmail.com).

Abstract

Problems Considered Bifrontal contusions are common and pose surgical dilemma regarding both indication as well as extent of surgery. There is no guideline available for optimal treatment of such lesions. The objective of this study was to determine the best modality of surgical treatment for such patients.

Methods This is a retrospective study of patients who were surgically treated for bifrontal contusions during the last 5 years. Clinical features, computed tomographic scan findings, surgical treatment modality, in-hospital mortality, and follow-up data were recorded.

Results A total of 98 patients (mean age 45 years) were operated for bifrontal contusions. Mean Glasgow coma score was 9 and motor response was M5. Contusions were of the same size on both sides in 22 cases and asymmetric in 76 cases. Patients underwent following surgical procedures: bifrontal decompressive craniectomy without evacuation of contusion (40 cases), bifrontal craniotomy and evacuation of bifrontal contusion (34 cases), and evacuation of unilateral contusion (24 cases). The overall mortality was 36.7%. The mortality was 55, 35.3, and 8.3%, respectively, with the above-mentioned surgical treatments. There was no difference in mortality between patients with symmetric and asymmetric contusions. The mean duration of follow-up was 23 months. Follow-up data were available for 42 (67.7%) survivors. Favorable outcome was seen in 80.9% of the survivors. Frontal lobe dysfunction was seen in 59.5% of the survivors.

Conclusion Patients who underwent bifrontal decompressive craniectomy without evacuation of contusion had worst outcome. Variable removal of contused brain tissue is required for reducing mortality.

Keywords
- bifrontal
- contusion
- traumatic parenchymal lesions
- decompressive craniectomy
- traumatic brain injury

Introduction

Intracerebral hemorrhage or contusion occurs in up to 15% of the patients with traumatic brain injury (TBI).[1] Among them, bifrontal contusions are common and frequently seen.[2] Patients with bifrontal contusions may have lucid intervals and remain conscious upon admission. Early computed tomography (CT) scans during the initial stages may only indicate moderate size frontal contusions and no obliteration of the ambient cistern. Therefore, these patients sometimes are not prioritized in casualty. It has been demonstrated that a proportion of patients with bifrontal contusions may develop enlarged intracranial hematomas and/or edema during later periods after injury, which could lead to rapid deterioration or even death as the result of cerebral herniation.[3] There is no consensus regarding indication for surgery, and extent of surgery for bifrontal contusions. In this study, we compared the results of

received
June 16, 2015
accepted
October 6, 2015
published online
December 17, 2015

DOI http://dx.doi.org/10.1055/s-0035-1570095.
ISSN 0973-0508.

different modalities of surgical treatment for such lesions and attempted to find out the optimum management of such lesions.

Materials and Methods

This is a retrospective study of patients of bifrontal contusions who were managed surgically over a 5-year period from June 2009 to June 2014. Cases with bifrontal contusions that also had other findings in CT scan (viz., epidural hematoma, acute subdural hematoma in frontotemporal region and contusion at other sites) were excluded from this study. Intracranial pressure monitoring was not done for any patient. The condition at follow-up was also noted.

Results

A total of 98 (75 males) patients with bifrontal contusions were operated with a median age of 47 years, ranging from 7 to 81 years. Most of these patients (67.7%) were older than 40 years of age. The causes of injury included traffic accidents (77 cases, 79%), fall (13 cases, 13%), and others (8 cases, 8%). The mean Glasgow coma score (GCS) was 9, and mean motor score was 5. The severity of injury according to admission GCS was severe TBI (GCS, 3–8) in 28 cases (29%), moderate TBI (GCS, 9–12) in 29 cases (30%), and mild TBI (GCS 13–15) in 42 cases (41%). Signs of brain herniation were present in 54% cases (53 cases) before surgery. A total of 39 cases of mild TBI, who were initially managed medically, had late deterioration characterized by either of the following: drop in GCS score by more than 2, deterioration in motor response, compression of cisterns, or worsening of pericontusion edema resulting in squashing of frontal horns of lateral ventricles. Mean volume of contusion (including both sides) was 28 mL. Contusions were of same size on both sides in 22 cases and asymmetric in 76 cases. Other CT scan findings were subarachnoid hemorrhage in 37% and occipital bone fracture in 31% patients. All patients received hyperosmolar agents for cerebral edema before surgery. The surgical procedures performed in these patients are summarized in ►**Table 1**. Overall bifrontal decompressive craniectomy without evacuation of contusion was done in 40 cases, bifrontal craniotomy and evacuation of bifrontal contusion was done in 34 cases, and evacuation of unilateral contusion was done in 24 cases. The preferred treatments for patients with symmetric contusions were bifrontal decompressive craniectomy or bifrontal craniotomy and evacuation of both side contusions. When patients underwent evacuation of both side contusions, only the hemorrhagic portion of contusion was evacuated. The preferred modality of treatment for patients with asymmetric contusion was also bifrontal decompressive craniectomy or bifrontal craniotomy and evacuation of both side contusions. In these patients, the larger contusion was completely evacuated, and the opposite contusion was conservatively removed. In patients with grossly asymmetric contusion, removal of only the larger side was done, opposite side was not touched.

The overall in-hospital mortality was 36.7%. The mortality data are summarized in ►**Table 2**. The mortality was similar in patients with symmetric and asymmetric contusions. Patients with symmetric contusion who underwent only decompressive craniectomy without evacuation of contusion had highest mortality (75%). The mortality was least (0–10.5%) in patients who underwent only unilateral contusion evacuation. The cause of mortality was brain herniation leading to infarcts in 80% cases. Other causes of mortality were infection, systemic injuries, cardiac arrhythmia, and diabetes.

Detailed follow-up data were available for 42 of 62 (67.7%) survived patients. The mean duration of follow-up was 23 months. Unfavorable outcome (Glasgow outcome scale [GOS] vegetative state or severe disability) was seen in 8 out of 42 (19.1%) cases, and favorable outcome (GOS moderate disability or good recovery) was seen in 34 out of 42 (80.9%) cases. Behavioral disturbance suggestive of frontal lobe syndrome was seen in 25 out of 42 (59.5%) cases.

Discussion

Bifrontal contusions are complex. Patients with such injury may rapidly deteriorate as the result of progressive hemorrhage, enlargement of intracranial contusion, edema, and cerebral herniation.[3] Bifrontal contusions commonly occur in coup or contrecoup injuries. In elderly patients, such injuries are more likely accompanied by occipital fractures.[4] In our study, 67.7% patients were older than 40 years of age, and occipital fracture was seen in 31% cases. Though analgesia, sedation, hyperosmolar therapy, and correction of coagulation dysfunction are very important measures to prevent patients with bifrontal contusion from deterioration, patients with bifrontal contusion who are not

Table 1 Surgical treatment modality depending on symmetry of contusions

Type of contusion	Bifrontal decompressive craniectomy without evacuation of contusion	Bifrontal craniotomy and evacuation of bifrontal contusion	Evacuation of unilateral contusion
Bilateral symmetrical contusions (22 cases)	8	9	5
Asymmetric contusions (76 cases)	32	25	19
Total (98 cases)	40	34	24

Table 2 Mortality depending on symmetry of contusions and surgical modality

No of deaths	Bifrontal decompressive craniectomy without evacuation of contusion	Bifrontal craniotomy and evacuation of bifrontal contusion	Evacuation of unilateral contusion
Symmetrical contusion 8 out of 22 cases (36.4%)	6 out of 8 cases (75%)	2 out of 9 cases (22.2%)	0 out of 5 cases (0%)
Asymmetric contusions 28 out of 76 cases (36.8%)	16 out of 32 cases (50%)	10 out of 25 cases (40%)	2 out of 19 cases (10.5%)
Total mortality 36 out of 98 cases (36.7%)	22 out of 40 cases (55%)	12 out of 34 cases (35.3%)	2 out of 24 cases (8.3%)

comatose on arrival to casualty can rapidly deteriorate.[3] In our study, 39 out of 42 (92.8%) cases with clinically mild TBI deteriorated. The predictors of deterioration are not clear in these patients; hence, close vigilance is required for such patients. We found that the commonest cause of deterioration was worsening of cerebral edema surrounding the contusion. Once deterioration occurs, craniotomy is the only useful method to control intracranial pressure. However, what extent of craniotomy should be done is not known. As frontal lobe plays an important role in working memory and executive functions, there is apprehension about development of severe behavioral disturbance if frontal lobe contusions are evacuated. Hence, decompressive craniectomy without removal of contused brain is often performed. It has been more than 30 years since the first bifrontal decompressive craniectomy was performed to control refractory increased intracranial pressure (ICP).[5] Bifrontal craniotomy can effectively control the elevation of ICP.[6,7] Brain trauma foundation guidelines[8] have recommended bifrontal decompressive craniectomy as a treatment option for patients with diffuse, intractable posttraumatic cerebral edema with resultant intracranial hypertension and GCS of 6 to 8. Whether decompressive craniectomy is sufficient treatment for bifrontal contusion is not known. In our study, the mortality was highest (55%) in patients who underwent only decompressive craniectomy without evacuation of contusion. Besides craniotomy removal of hematoma and contused tissue can offer more space for compensation, so that the impact of brain edema and bifrontal contusions on the thalamus and brain stem can be minimized. Guideline on surgical management of traumatic parenchymal lesions mention craniotomy with evacuation of mass lesion in patients with signs of progressive neurological deterioration referable to the lesion, medically refractory intracranial hypertension, or signs of mass effect on CT scan.[9] Though this guideline mention about volume of contusion and extent of midline shift as indications for surgery, there is no literature available on the extent of removal of bilateral frontal contused brain tissue to reduce brain stem compression at the same time to preserve function of frontal lobes. When we performed evacuation of contusion (more aggressive on larger side, and conservative on smaller side), the mortality was 35.5%. The mortality in our study was least for the patients who underwent only unilateral contusion removal (0–10.5%).

The overall mortality in our study was 36.7%. We found only one study dealing with surgical treatment of bifrontal contusions. In this study, a total of 55 patients underwent surgery, 41 decompressive craniectomy, and 14 craniotomy with removal of frontal contusion.[10] The overall mortality was 14.3%, which is much lower than our study. The authors have not mentioned about mortality in relationship to symmetry of contusions, and type of surgical procedure. In a literature review on traumatic parenchymal lesions, mortality in patients with bilateral contusions was 40%, which is similar to ours.[9]

We could follow-up only 67.7% of our patients, and majority (80.9%) of survivors had favorable outcome, though frontal lobe dysfunction was seen in 59.5% of these cases. In the previous mentioned study of bifrontal contusion, follow-up was available for 76%, and the mean GOS was 3.94 at 6 months. The authors did not mention about frontal lobe dysfunction in survivors.

One limitation of our study was the lack of ICP monitoring. In a recent study of ICP monitoring in patients with bifrontal contusions, the author concluded that ICP is one of the most important intensive types of monitoring for patients with bifrontal contusions.[10] The patients who underwent ICP monitoring had shorter length of stay and shorter length of therapy with mannitol. Though there was no difference in mortality between groups, the average GOS was better in patients who underwent ICP monitoring.[10]

Conclusion

Though firm conclusions cannot be drawn from a retrospective study, we do not recommend decompressive craniectomy without removal of contusion as a treatment for patients with bifrontal contusion. These patients require variable extent of removal of contused brain to preserve life. The patients who undergo only unilateral contusion removal fare best; hence unless there is compelling indication, patients with bifrontal contusion should be treated with removal of only larger side contusion. Though frontal lobe dysfunction is of concern in patients who undergo removal of contused brain, the patients still have favorable outcome. The frontal lobe dysfunction in survivors may be due to inherent injury, and not due to removal of contused brain.

Highlights

- Bifrontal decompressive craniectomy without evacuation of contusion has worst outcomes.
- Variable removal of contused brain tissue is required for reducing mortality.
- Outcome is favorable in survivors even with frontal lobe dysfunction.

References

1 McCormick WF. Pathology of closed head injury. In: Wilkins RH, Rengachary SS, eds. Neurosurgery. 2nd ed. Vol. 2. New York, NY: McGraw-Hill; 1996:2639–2666

2 Hung KS, Liang CL, Wang CH, Chang HW, Park N, Juo SH. Outcome after traumatic frontal intracerebral haemorrhage: a comparison of unilateral and bilateral haematomas. J Clin Neurosci 2004; 11(8):849–853

3 Rehman T, Ali R, Tawil I, Yonas H. Rapid progression of traumatic bifrontal contusions to transtentorial herniation: A case report. Cases J 2008;1(1):203

4 Pittella JE, Gusmão SS. Cerebral contusion in victims of fatal traffic accidents. Frequency and association with other craniocerebral lesions [in Portuguese]. Arq Neuropsiquiatr 1999;57(3B):848–852

5 Venes JL, Collins WF. Bifrontal decompressive craniectomy in the management of head trauma. J Neurosurg 1975;42(4):429–433

6 Whitfield PC, Patel H, Hutchinson PJ, et al. Bifrontal decompressive craniectomy in the management of posttraumatic intracranial hypertension. Br J Neurosurg 2001; 15(6):500–507

7 Jagannathan J, Okonkwo DO, Dumont AS, et al. Outcome following decompressive craniectomy in children with severe traumatic brain injury: a 10-year single-center experience with long-term follow up. J Neurosurg 2007;106 (4, Suppl):268–275

8 Brain Trauma Foundation; American Association of Neurological Surgeons; Congress of Neurological Surgeons. Guidelines for the management of severe Traumatic Brain Injury. J Neurotrauma 2007;24(1):S1–S106

9 Bullock MR, Chesnut R, Ghajar J, et al; Surgical Management of Traumatic Brain Injury Author Group. Surgical management of traumatic parenchymal lesions. Neurosurgery 2006;58(3, Suppl): S25–S46, discussion Si-iv

10 Gao L, Wu X, Hu J, et al. Intensive management and prognosis of 127 cases with traumatic bilateral frontal contusions. World Neurosurg 2013;80(6):879–888