Intensive Management and Prognosis of 127 Cases with Traumatic Bilateral Frontal Contusions

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Key words
- Bifrontal contusions
- Intracranial pressure
- Traumatic brain injury

Abbreviations and Acronyms
CPP: Cerebral perfusion pressure
CSF: Cerebrospinal fluid
CT: Computed tomography
GCS: Glasgow Coma Scale
GOS: Glasgow Outcome Scale
ICP: Intracranial pressure

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BACKGROUND: **With the development of edema and the possible enlargement of the hemorrhagic contusion, patients with a bifrontal contusion may deteriorate rapidly or even die as the result of central brain herniation. Therefore, close monitoring and in time treatment may be important to these patients.**

METHODS: **A 127 patients with bifrontal contusions were reviewed retrospectively. Among them, 63 patients accepted operations, 39 cases underwent intracranial pressure (ICP) monitoring, and 24 cases did not. We compared the Glasgow Outcome Scale (GOS) for prognosis, length of osmolar therapy, and length in intensive care unit (ICU) and hospital stay between ICP and non-ICP groups.**

RESULTS: **Compared with the non-ICP operation group, there was no significant difference in Glasgow Coma Scale score in the ICP group, both at admission (average 8.62 vs. 8.91, $P = 0.711$) and at discharge (average 11.32 vs. 10.45, $P = 0.427$). However, the length of stay in the ICU was much shorter in the ICP operation group than that of the non-ICP group (15.67 $\pm$ 8.72 days vs. 25.32 $\pm$ 18.78 days, $P = 0.013$). Hospital stay was also shortened significantly in the ICP operation group compared with the non-ICP operation group (18.94 $\pm$ 8.92 days vs. 34.29 $\pm$ 22.64 days, $P = 0.001$). The length of osmolar therapy with mannitol was also decreased in the ICP operation group compared with the non-ICP group (14.11 $\pm$ 6.65 days vs. 21.84 $\pm$ 12.02, $P = 0.008$). However, there was no difference in mortality between two groups (5/39 vs. 4/24). We followed up 29 ICP operation patients and nineteen non-ICP operation patients using GOS 6 months later. The average GOS was 4.21 and 3.32 for the ICP and non-ICP groups respectively ($P = 0.025$).**

CONCLUSION: **ICP is one of the most important intensive types of monitoring for patients with moderate-to-severe bifrontal contusions and may be beneficial in creating a better prognosis. Intensive care and proper management are necessary to reduce stays in ICU, hospitalization, and mannitol osmolar therapy, and to improve GOS.**

INTRODUCTION

Bifrontal contusions often are observed in contrecoup head injuries such as traffic accidents and falling (2). Patients with bifrontal contusions may have lucid intervals and remain conscious upon admission. Computed tomography (CT) scans during the first few hours after injury may only indicate nonsevere frontal contusions and no obliteration of the ambient cistern. Therefore, these patients sometimes do not receive sufficient attention from emergency doctors at either the site of injury or in even the emergency room. It has been demonstrated that a proportion of patients with bifrontal contusions may develop enlarged intracranial hematomas and/or encephalademas during later periods after injury, which could lead to rapid deterioration or even death as the result of cerebral herniation (5). To date, a guideline for treating bifrontal contusions has not been developed. In this study, we reviewed 127 patients with bifrontal contusions who were admitted to our clinical institution retrospectively from January 2003 to October 2009. We mainly focused on the intensive management, which comprised the monitoring of intracranial pressure (ICP) and cerebral perfusion pressure (CPP). We also summarize our own management strategies for such patients.

MATERIALS AND METHODS

Patient Population

From January 2003 to August 2009, we enrolled consecutively a total of 127 patients with traumatic brain injury who suffered from bifrontal contusions, as determined by CT scans. Any patients with epidural hematoma greater than 30 cm^3, acute subdural hematoma with thickness greater than 10 mm, a midline shift greater than 5 mm, or any parenchymal mass lesion except frontal contusions greater than 20 cm^3 in volume were excluded. Of these 127 patients, there were 102 men and 25 women with an average age of 47 years, ranging from 7 to 81 years of age (Table 1). Most of these patients (67.7%) of involved patients were older than 40 years of age. The causes of injury included traffic accidents (76 cases,

Table 1. Patient Demographics

	Mild TBI (53 Cases)*	Moderate TBI (38 Cases)†	Severe TBI (36 Cases)‡	Total (%)	GOS Score (Mean ± SD)
Male:female	43:10	25:13	34:2	102:25	
Age, years, mean ± SD					
<20	1	1	0	2 (1.6%)	5.00 ± 0.00
20–39	10	15	14	39 (30.7%)	4.00 ± 1.49
40–49	15	6	4	25 (19.7%)	4.32 ± 1.25
50–59	15	7	7	29 (22.8%)	4.07 ± 1.46
60–69	7	7	6	20 (15.7%)	3.90 ± 0.91
>70	5	2	5	12 (9.4%)	3.17 ± 1.59

TBI, traumatic brain injury; GOS, Glasgow Outcome Scale.
*Mild TBI: GCS score 13–15.
†Moderate TBI: GCS score 9–12.
‡Severe TBI: GCS score 3–8.

59.84%), falling down (45 cases, 35.43%), and others (6 cases, 4.73%). According to CT scans, subarachnoid hemorrhage was observed in 42.5% patients, and 23.6% patients had occipital bone fractures. Upon admission, Glasgow Coma Score (GCS) demonstrated 36 cases (28.3%) had severe brain injuries (GCS 3–5), 38 cases (29.9%) had moderate injuries (GCS 9–12), and 53 cases (41.7%) had mild injuries (GCS 13–15). Almost one third of patients (36 cases, 28.3%) developed brain herniation either upon admission or during close observation. In these conditions, pupils showed enlargement and herniation could be confirmed by CT scan.

Clinical Measurements, ICP Monitoring, and Surgical Management

GCS was documented upon admission or at the earliest possible occasion for each patient. Blood routine, arterial blood gas analysis, serum electrolyte, plasma osmotic pressure, liver and renal function, blood coagulation function, and pro b-type natriuretic peptide were measured for all patients after admission. All patients underwent at least two CT scans within the first 24 hours after injury. The first CT scans were performed on the earliest occasion after admission, followed by the secondary scans at 2 hours later or upon signs of patient deterioration. All patients underwent osmolar treatment to achieve proper regulations of the osmotic pressure, regardless of later surgical operation. Among these patients, 63 experienced surgical operation. Of these 63 patients, 39 underwent ICP monitoring (Table 2).

The ICP group of patients, that is, those with GCS less than 8, GCS between 9 and 12 with agitation in need of sedative therapy, and those with CT scans showing progressively enlarged bilateral frontal contusions and GCS deterioration of more than two scores, were monitored first with ICP in the lateral ventricle. If initial ICP was more than 25 mmHg when the patient was in a state of general anesthesia, craniotomy was performed to evacuate the hematoma and contusion immediately (Figure 1). If initial ICP was less than 25 mmHg, craniotomy was not considered at that time (Figure 2). For patients who did not undergo craniotomy, if GCS score decreased more than 2 and ICP increased past 20 mmHg despite aggressive comprehensive management, including osmotic therapy and proper cerebrospinal fluid (CSF) external drainage, CT scans were repeated to evaluate whether the contusions and hematomas enlarged. If CT imaging confirmed that the cisterna ambiens disappeared and edematous bifrontal tissue compressed the shrinking bilateral frontal lateral angle seriously, craniotomy was considered again (Figure 3). Dynamic monitoring of ICP, CT imaging, and GCS level determined whether craniotomy was performed. During craniotomy, we removed broken frontal contusion tissue from the obvious side while attempting to keep the contralateral frontal lobe intact to protect cognitive function as much as possible. Bilateral frontal bone flap was discarded to lessen intracranial pressure.

For the non-ICP group, ICP was not considered upon admission. According to the CT imaging and GCS level, we determined whether patients would have craniotomies. Craniotomy would be performed to the patients under the following conditions: GCS less than 8, CT imaging showing disappearance of the cisterna ambiens, and edematous bifrontal tissue

Table 2. Operation for TBI Patients

Group	Operation	Mild TBI	Moderate TBI	Severe TBI	Total
Non-ICP group (24 cases)	Craniotomy*	2	2	5	9
	Decompressive craniotomy†	1	8	6	15
ICP group (39 cases)	ICP‡	2	1	4	7
	ICP Craniotomy§	1	2	3	6
	ICP decompressive craniotomy‖	1	14	11	26
Total		7	27	29	63
Percentage		13.20% (7/53)	71.10% (27/38)	80.56% (29/36)	

TBI, traumatic brain injury; ICP, intracranial pressure.
*Craniotomy: removing frontal contusions and hematoma with returning bone flap.
†Decompressive craniotomy: discarding bone flap after removing broken contusion brain and hematoma.
‡ICP: ICP monitoring without craniotomy.
§ICP Craniotomy: ICP monitoring after removing frontal contusions and hematoma with returning bone flap.
‖ICP decompressive craniotomy: ICP monitoring, duraplasty and discarding bone flap after removing broken contusion brain and hematoma.