RESEARCH ARTICLE

PROSPECTIVE STUDY OF OUTCOME OF DEPRESSED SKULL FRACTURE AND ITS MANAGEMENT

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ABSTRACT

Background: Many changes and improvements have taken place in the management of patients with head injury in the past 20 years. The introduction of the Advanced Trauma Life Support (ATLS) training program, which started in 1980, helped in better understanding of management of trauma patient. By preventing injury, limiting trauma, and treating early, we can achieve good outcome in patients with head injury.

Aims and Objectives: To study the various associated intracranial injury with depressed skull fracture (DSF) and to establish a plan of management of DSF.

Materials and Methods: This prospective study was undertaken on 50 patients with DFS visiting Department of Surgery at Sir Sayajirao General Hospital and Medical College, Baroda, from January 2010 to March 2012. The patients selected for this study belonged to all age groups and had clinically palpable DSF. The CT scan showed DFS. The principles of management were conservative as well as operative, depending on the type of fracture.

Results: Out of 50 patients, 32% were aged between 21 and 30 years; 94% were men and 6% were women. Vehicular accidents were the cause in 30 (60%) patients, whereas 8 (16%) patients witnessed assault. Extradural hematoma was reported in two (11.11%) patients. Of 42 cases of mild head injury, 29 were managed conservatively and 13 were operated. Six cases had severe head injury; three were operated; and three were treated conservatively.

Conclusion: Early definitive diagnosis and management of skull fracture decrease morbidity and mortality as well as help achieving maximal functional and aesthetic rehabilitation.

Key Words: Depressed Skull Fracture; Intracranial Injury; CT Scan; Extramural Hematoma

Introduction

With rapid urbanization and tremendous increase in high-speed traffic flow, incidence of trauma is increased both in developing and in developed countries. This makes it a universal health and social problem.[1] In majority of head injury cases, the incidence of depressed fracture of skull (DFS) is on the rise, requiring augmented care, trained personnel, and sophisticated equipment for saving the life of the patients.[2] DSF is a common neurotraumatic disorder. Skull fracture is said to be depressed when a fragment of skull bone is displaced inward a distance equal to or greater than the width of the calvarium.[1] Skull fracture results from large energy forces applied to the head. The extent and type of skull fracture is determined by the kinetic energy of the striking object, the geometry of the striking object, the direction of the impact force, and the anatomic site of the impact.[2] The findings of a DSF are classical to the patient who is otherwise relatively well and in whom the fracture may provide only definite evidence.[2] When DSF is associated with scalp laceration, it is called an open DSF and otherwise a simple DSF.[3] Compound depressed fractures are surgical emergencies, and unless treated promptly and properly, complications such as meningitis, cerebral abscess and osteomyelitis of skull after treatment, and epilepsy may supervene. The principles of management have undergone through a considerable evaluation in the past few decades. Both conservative and surgical managements depend on the type of fracture.[4] Early definitive diagnosis and management of skull fracture decrease morbidity and mortality as well as help achieving maximal functional and aesthetic rehabilitation.

The aim of this work was to study various intracranial injuries associated with DSF and to establish a plan of management for DSF.

Materials and Methods

This prospective study was undertaken on 50 patients with DFS visiting Department of Surgery at Sir Sayajirao General Hospital and Medical College, Baroda, from January 2010 to March 2012. The patients selected for this study belonged to all age group and had clinically palpable DSF. The CT scan showed the DFS. Patients excluded were female patient with pregnancy and head injury, patients having recurrent head injury, and patients with head injury associated with systemic

disease such as diabetes and hypertension. The initial assessment of the trauma patient included a primary survey, resuscitation, secondary survey, and definitive care. According to this, all patients who had head injury with DFS, neurosurgical evaluation began during the primary survey and the scores were determined according to the Glasgow Coma score (GCS). The GCS is determined by adding the scores of the best responses of the patient in each of the three categories. The motor score ranges from 1 to 6, verbal from 1 to 5, and eyes from 1 to 4. Therefore, the GCS ranges from 3 to 15. Mild head injury with GCS 13–15, moderate head injury with GCS 8–12, and severe head injury with GCS <8. A detail history including age, sex, occupation, address, mode of injury, time of injury, date of injury, history of unconscious, vomiting, convulsion, ENT bleeding, abdominal pain, abdominal distension, chest pain, breathlessness, moving all four limbs or not was recorded. If the patient had received any treatment at any hospital immediately following injury, details of the same were documented. In every case, general examination, including vital signs, shock, pallor, cyanosis, black eye, and conjunctival hemorrhage, and local examination, including wound, swelling locally, pelvic compression test, and chest compression test, were performed. In every case, central nervous system, abdomen, cardiovascular and respiratory organs were examined. In central nervous system, higher function, Glasgow Coma (GC) Scale, cranial nerve, pupil, reflexes, motor and sensory system, signs of irritation of the meninges, and back and spine were examined. In all cases, routine blood and urine examination were carried out. Blood group and cross-match were carried out, and CT scans were performed. All patients were examined every half hour for recording any changes in the vital parameters. Patients managed conservatively were the ones who had CT scan suggestive of DSF not more than 10 mm, not associated with underlying intracranial hematoma, mild head injury (GC Scale 13–15). Conservative modalities include intravenous antibiotics, analgesics, anticonvulsant, and mannitol or furosemide (diuretic). Those patients were managed operatively whose CT scan was suggestive of DFS more than 10 mm with severe head injury, associated intracranial hematomas such as epidural and subdural with mid line shift and sign of neurological deficit. Surgical modalities include simple elevation of closed as well as compound depressed fracture, durorraphy done for dural tear and drainage of extradural hematoma (EDH) or subdural hematoma (SDH) with elevation of depressed fragment of fracture skull. Patients having minor head injury were treated in hospital for 4–5 days, and those with moderate-to-severe head injury were treated in hospital for 10–30 days. The patients were discharged after 5–30 days, depending on the severity of head injury and GC Scale, with no complaint of unconsciousness, vomiting, and convulsion. On discharge, a dosage of T. phenytoin sodium (100 mg), three tablets in night for 1 month, was prescribed. Follow-up of all patients was carried out after 1 month to study the outcome of surgical management in terms of good recovery, morbidity, or mortality. Patients with good recovery means he/she has resumed most normal routine activities but may have minor residual problems, and patients with morbidity means the patient is independent but disabled or requires others for support.

Results

Of 50 patients, 26% were aged below 20 years. The peak incidence was observed in 32% patients belonging to 21–30 age group; 94% were men and 6% were women. Thus, the male/female ratio was 15.66:1. Table 1 shows age and sex distribution, various causes, and mode of presentation of DSF in this group. The most common cause of DSF was vehicular accidents, which were seen in 30 (60%) patients, whereas 8 (16%) patients had witnessed assault. Among patients, 28 (56%) presented with unconsciousness, 2 (4%) had vomiting, 13 (26%) presented with convulsion, and 17 (34%) had ENT bleeding. As shown in Table 2, the most common site of fracture is frontal region seen in 26 cases (52%). Compound fracture of skull was found in 32 cases (68%), whereas closed fracture was found in 18 cases (32%). Dura was found to be torn in 5 cases (10%) and intact in 45 cases (90%). Associated brain injuries were hematoma, involvement of venous sinus, and brain contusions. Intracranial hematoma like EDH was reported in two patients (11.11%) and SDH was reported in one patient (5.55%); no involvement of venous sinuses was found. Management of DFS consists of conservative and operative modalities (elevation of depressed fracture). Cases of mild, moderate, and severe head injuries were categorized according to GCS. As shown in Table 2, of 50 cases of DFS, 42 cases were of mild head injury, out of which 29 cases were conservatively managed and 13 cases were operated. Two cases had moderate head injury and they were operated. Six cases had severe head injury, of which three patients were operated and three patients were treated conservatively. As shown in Table 3, a total of 18 patients were operated upon, of which elevation of

depressed fracture was carried out in 3 patients, elevation with durroraphy was performed in 5 patients, elevation with drainage of EDH in 8 patients, and elevation with SDH drainage in 2 patients. Operative complication occurred in two patients, two patients (11.11%) had neurological deficit (hemiparesis), and three (16.66%) patients had wound infection. Forty-one patients had minor head injury and one patient had moderate head injury and had good recovery, and four patients with severe head injury had hemiplegia (morbidity). Three patients died, and out of three patients, one patient had isolated DSF, one patient had DSF associated with intracranial hematoma, and two patients had DSF associated with contusion. One patient had blunt chest injury, and eight patients had injury to extremities.

Table-1: Age and sex distribution, cause and mode of presentation

Characteristics		Frequency	Percentage
Age (years)	0–10	3	6
	11–20	10	20
	21–30	16	32
	31–40	9	18
	41–50	8	16
	51–60	2	4
	61 and above	2	4
Sex	Male	47	94
	Female	3	6
Causes	Assault	8	16
	Fall from height	6	12
	Fall of object on patient	6	12
	Vehicular accident	30	60
Mode of Presentation	Unconscious	28	56
	Vomiting	2	4
	Convulsion	13	26
	ENT bleeding	17	34

Table-2: Sites of fracture, type of fracture, associated intracranial injury, and severity of head injury

Characteristics			Frequency	Percentage
Sites of Fracture	Frontal		26	52
	Temporal		5	10
	Frontoparietal		3	6
	Parietal		6	12
	Temporal-parietal		4	8
	Occipital		6	12
Type of Fractures	Compound	Dural tear +	3	6
		Dural intact	15	30
		Total	18	36
	Closed	Dural tear +	2	4
		Dural intact	30	60
		Total	32	64
Associated Brain Injury	Intracranial hematoma: EDH		2	4
	SDH		1	2
	Brain HC		3	6
Severity of head injury			Operated	Conservative
Mild GCS (13–15) 42			13	29
Moderate GCS (8–12) 2			2	0
Severe GCS (<8/15) 6			3	3
Total			18	32

HC, hemorrhage contusion; SDH, subdural hematoma; EDH, extradural hematoma; GCS, Glasgow Coma Scale

Table-3: Operative management, postoperative complication, recovery, and residual-associated morbidity and mortality

Characteristics		Frequency	Percentage
Operative Management	Elevation	3	16.66
	Elevation with durroraphy	5	27.77
	Elevation with EDH drainage	8	44.44
	Elevation with SDH drainage	2	11.11
	Total operated cases	18	
Postoperative Complication	Neurological deficit (hemiplegia, hemiparesis, paraplegia, quadriplegia)	2	11.11
	Wound infection	3	16.66

SDH, subdural hematoma; EDH, extradural hematoma

Discussion

Trauma is a huge problem seen in the developed countries as well as developing countries. The head injury is a major factor responsible for mortality in young population.[4] DSF s are common injuries, majority of them are sustained in road accidents. This study analyzed 50 cases of DFS treated in SSG Hospital, Baroda, between January 2010 and March 2012 in context of causes and factors relating to head injury and management of patients. Various aspects were compared with similar work and studies carried out in the past.[1,6–10] In our study, most of the patients (32%) were belonged to 21–30 years age group; 94% patients were men and 6% were women. Thus, the male/female ratio was 15.66:1. This higher prevalence of DSF found among men was because majority of men are the breadwinners whereas majority of women are housewives.

In studies conducted by Madurai (1996) and Ali *et al*. (2003), higher prevalence of head injury with DSF has been reported in 11–20 years age group. In a study by AI-Haddad and Kirollos (2002), higher prevalence of head injury was seen in 16–29 years age group. Vehicular accident was the main cause of injury (60%) in the present study, whereas in the study by Ali *et al*. fall from height was the main cause of injury (51.94%). In a study by Braakman (1972), 51% of the patients had vehicular accident followed by fall from height, seen in 26% patients. Fall from height was the most common mode of injury reported in studies by Madurai (1996), Mehdi *et al.* (2010), and Ali *et al*. (2003). Assault was the most commonly cause found in studies by Hossain *et al*. (2008) and AI-Haddad and Kirollos (2002). The findings of the present study is consistent with that of Braakman (1972), but not with the other studies, as the present study was conducted in Baroda city and nearby districts, which are densely populated areas and also due to urbanization. In our study, the most common cause of presentation was unconsciousness (56%) followed by ENT bleeding (34%), whereas that in Ali *et al*. (2003) and

Hossain *et al*. (2008) studies it was unconsciousness in 40% and 25% cases, respectively.

Frontal region was the most common site of injury in 52% patients. In the study conducted by Ali's *et al.* (2003), parietal was the first and temporal was the second most common sites of injury. In studies by Braakman (1972) and Mehdi *et al.* (2010), frontal region was the most common site of fracture in accident. This finding is consistent with that of other studies. In the present study, 68% of the fractures were compound fractures whereas in studies by Ali *et al.* (2003), Braakman (1972), , Madurai (1996), M Hossain *et al*. (2008) they were found in 73.5%, 86%, 95%, and 43.64% patients, respectively. Of 50 patients, 18 were operated; dural tear was seen in five of the operated cases. In a study by Mehdi *et al.*(2010), of 50 patients, 45 (90%) patients were operated and 5 (10%) patients were managed conservatively. In Hossain *et al*. study (2008), of 93 patients, 67 patients were operated with 17 patients having dura tear (i.e., 25% of the patients with DSF). In Braakman study (1972) of 225 patients, 44% had dura tear. In the current study, 11.11% patients had intracranial hematoma like EDH and 8% had neurological deficit like hemiparesis whereas in a study by Madurai (1996), 19.7% patients had intracranial hemorrhage (ICH) and 5.3% had involvement of venous sinus. In Mehdi *et al.* (2010) study, 31 patients had brain contusion and 4 had SDH. In Hossain *et al*. (2008) study, 22% patients had EDH and 31% had brain contusion. In Ali *et al.* (2003) study, 10.78% patients had ICH and3.9% had involvement of venous sinus. Thus, the above findings suggest that patients of head injury with DSF most commonly present with ICH or brain contusion on CT scan.

Other injuries associated with DSF were blunt chest injury, abdominal injury, injury to extremities, spinal injury, or pelvis injury. In our study, we encountered one patient with blunt chest injury and eight patients with injury to extremities whereas in Ali *et al.* (2003) study six patients had blunt chest injury and five had injury to extremities. In the study by Madurai (1996), 35 patients had blunt chest injuries, 38 patients had abdominal injury, and 5 patients had injury to extremities. In the current study, majority of the patients were managed conservatively. The indications were CT scan suggestive of DSF not more than 10 mm, not associated with underlying intracranial hematoma, and mild head injury (GC Scale 13–15). Conservative modality includes intravenous antibiotics, analgesics, anticonvulsant, and mannitol or furosemide (diuretic). Of 50 cases, 32 were managed conservatively. According to the study carried out by Bullock *et al*. in 2006, for surgical management of DSF suggestive of following: (1) patient with open (compound) skull fracture depressed greater than the thickness of the skull should undergo operative intervention to prevent infection. (2) Patient with compound DSF may be treated nonoperatively if there is no clinical or radiographic evidence of dural penetration, significant ICH, depression >1 cm, frontal sinus involvement, gross cosmetic deformity, wound infection, pneumocephalus, or gross wound contamination. Nonoperative management is suggested for closed and simple DSFs.[5] It was suggested in cases where CT scan was suggestive of DFS >10 mm with severe head injury, associated intracranial hematomas, such as epidural and subdural, with mid line shift, and sign of hemiplegia. Operation was performed in the form of craniotomy followed by simple elevation of closed as well as compound depressed fractures or elevation with durroraphy, EDH drainage, or drainage of SDH. Simultaneously antibiotics, mannitol, anticonvulsant, and steroid were given. Drain was removed after 5 days. In the present study, 42 patients had mild head injury GCS (13–15), 13 of them were operated and 29 were conservatively managed without any morbidity. Two patients had moderate head injury GCS (8–12) and were operated without any morbidity. Severe head injury (GCS <8–15) was seen in six patients, out of which three were operated and three were conservatively managed. Among them, one patient died, four patients had morbidity, and one had good recovery. In a study by Mehdi *et al.* (2010), 52% of patients had mild head injury, 22% patients had moderate head injury, and 26% patients had severe head injury; two patients died. In AI-Haddad and Kirollos (2002) study, 72% patients had mild head injury, 15% patients had moderate head injury, and 13% severe head injury, with 68.5% patients reporting good recovery, 9.6% moderate disability, and 2.7% severe disability. Death of one patient is also reported. Thus, the findings are consistent with those of the studies conducted in the past (i.e., those patients with mild head injury and conservative management had good recovery). Postoperative wound infection; epilepsy; and neurological deficit such as dysphagia, hemiparesis, and loss of vision; are most commonly seen in operated patients. In the present study, postoperative infection was found in 16.66% cases, 8% patients had neurological deficit like hemiparesis whereas in the study by AI-Haddad and Kirollos, 12.3% patient had episodes of postoperative epilepsy.

Limitation of the Study

A large study sample is ideally required to ascertain the statistical significance of the results, their implications, and their validity. The current study had a small study sample. Thus, it was difficult to apply the statistical significance of the result in large population. This study involved only a short-term follow-up; hence, results cannot be used for prognostic purpose.

Conclusion

Head injury with DSF is common in frontal region and often presented with EDH. This is because many adult men were injured in road accidents. Patients with mild head injury should be managed conservatively and those with moderate-to-severe head injury should be managed operatively. Early definitive diagnosis and management of skull fracture decrease morbidity and mortality as well as help achieving maximal functional and aesthetic rehabilitation. Use of GCS in conjunction with the CT findings is most helpful in early management of DSF.

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