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DEPRESSED SKULL FRACTURE;

INTERRELATIONSHIP BETWEEN CT EVALUATION OF & ITS CLINICAL FINDINGS;

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ABSTRACT...Purpose of the study: The purpose of study was to interrelate CT findings of depressed skull fracture with clinical findings. **Study design:** This was exploratory study. **Place of study:** The study was conducted at Mayo Hospital Lahore and Lahore General Hospital. **Duration of study:** From March 9, 2004 to October 2004. **Sample size:** Fifty patients irrespective of their age and sex were included. **Patients selection:** Only the newly admitted patients in the above mentioned hospitals were included in the study. Previously diagnosed depressed skull fracture or the patients having associated facial abdominal and thoracic injuries were excluded. **Methodology:** Patients having depressed skull fracture were clinically evaluated and thereafter subjected to 4th generation spiral CT scan at the radiology Department of the above mentioned hospitals. Both bone and brain window were taken for various intracranial structures. **Results:** Analysis of the data for association between the variables of clinical and CT findings revealed that patients with conscious level, with DSF and having mild head injury were less associated with scalp injury ($p=0.1156$) which is statistically insignificant. DSF with moderate and severe head injury had more probability of scalp injuries. Scalp laceration seen with DSF had association with scalp injury ($p<0.001$). **Conclusion:** It is a key for clinician and neurosurgeon to use GCS score in congestion with the CT findings for early management of DSF.

Key words: Head trauma, Depressed skull fracture (DSF), Cranial CT.

INTRODUCTION

Head injury is the leading cause of mortality and morbidity not only in the developed countries but also in developing countries[1]. The incidence is increasing day by day therefore it remains a universal health and socioeconomic problem. A skull fracture is considered depressed, when any portion of the outer table of the fracture line lies below the normal anatomical position of the inner table Depressed skull fractures typically occur when objects with a large amount of kinetic energy (e.g., baseball bat, hammer, rock) make contact with the skull over a fairly small area[2]. In radiological evaluation of depressed skull fracture, x-rays (AP & lateral views) are the mandatory standard investigation for these patients where CT is not available, though the advent of CT has revolutionized the diagnosis.

A positive CT scan of a patient with head trauma included the findings of epidural, subdural or parenchymal hematoma, subarachnoid hemorrhage, cerebral contusion or depressed skull fracture. The plain CT scan is a modality of choice and has replaced the conventional skull radiography because of its higher accuracy and ability to detect depressed skull fracture along with its intra cranial manifestations[3,4]. CT with bone window images of the skull displays the position, extent, number of fracture and depth of depression[5]. The aim of our study was to further investigate and to correlate CT findings of depressed skull fracture with clinical findings.

MATERIALS AND METHODS

This was the exploratory study performed in the Department of Radiology of Mayo Hospital Lahore and Lahore General Hospital. A consecutive sample of fifty patients with depressed skull fracture irrespective of their age group and sex was included.

Purpose of the study

The purpose of study was to further investigate and to interrelate CT findings of depressed skull fracture with clinical findings.

PATIENT SELECTION

Inclusion criteria

The newly admitted patients in the above mentioned hospitals having DSF were included.

Exclusion Criteria

Admitted patients previously diagnosed as having DSF were excluded. Patients having associated abdominal and thoracic injuries were also excluded.

METHODOLOGY

Patients with head injuries referred to Radiology department for CT scan were included. Consecutive fifty patients having DSF were included in the study. The study was conducted using spiral CT scan. No contrast was given, axial slices with thickness 05mm for basal area and 08–10mm thickness up to the vertex were taken.

STATISTICAL ANALYSIS

Variables of CT findings are scalp injury, brain contusion, extradural haematoma (EDH), subdural haematoma (SDH), Pneumocephalus and foreign body (FB). As we have taken all fifty patients with DSF and it is a common variable in all fifty patients so it was not included as a variable. No patient with diffuse axonal injury was observed so it was also not included as a variable in statistical analysis.

Regarding the variables of clinical findings we included conscious level, pupillary changes, localizing sign, seizure, vomiting, headache and scalp laceration. Conscious level was divided into three categories of head injuries according to the Glasgow comma scale score and described as mild (13-15), moderate (10-12) and severe (3-9). Glasgow comma scale ranges from 3 (absence of motor response, verbal response and eye opening) to 15 (normal motor response, verbal response and eye opening). Variable of CSF leak from the wound was not included, as no patient of otorrhea or rhinorrhea was present, likewise no patient with brain matter coming out was seen so this variable was also not included.

Chi square test was used to check the association between qualitative variables and Fisher's exact test is used to test the hypothesis that the Group (row) proportions are same by Statistical Analysis Software (SAS). P-value less than or equal to 0.05 consider significant.

RESULTS

The study lasted for the period of six months from December 2003 to May 2004. During the period, fifty patients with head injury and having DSF were registered from Mayo Hospital Lahore and Lahore General Hospital. A total of thirty-eight patients (76 %) of these were from Lahore City and twelve patients (24 %) from the other nearby Districts such as Kasur, Sheikhupura etc.

Age Incidence

Study of data revealed that DSF were more common in patients under 12-year age. According to different age group incidence is given as under and also shown in table-I.

Table-I. Distribution of DSF according to different age groups.

Group	Age (Years)	No. of Pts.	%age
Pre-School Children	Up to 4	03	03
Pre-Teens	5-12	22	44
Teen Age	13-19	4	08
Young Adults	20-40	16	32
Adults	41-60	05	10

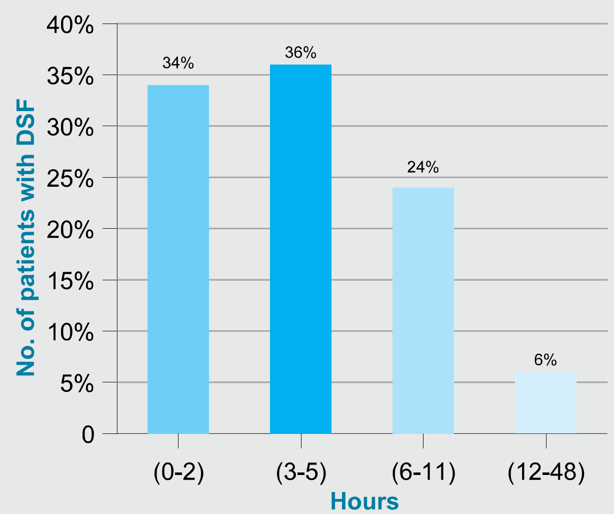
Data analysis revealed that DSF is more commonly seen in children under the age of 12-years and incidence is decreasing with age. Male patients were found to be more prone to the head injury and their number were thirty nine (78 %). Female patients were eleven (22 %).

Of the fifty patients with DSF, seventeen patient (34 %) reached hospital within first two hours after injury and eighteen patients (36 %) within three to five hours. Whereas twelve patients (24 %) in six to eleven hours and three patients (6 %) in twelve to forty eight hours mentioning their arrival from far places.

MODE OF INJURY

The patients were divided into following groups

Graph-I. Showing time elapsed since injury to reach hospital



according to etiological factors that leads to DSF:

1. Fall from height: In the study these were nineteen patients (38 %).
2. Road traffic accidents: include vehicle-to-vehicle and motorcycle that had seventeen patients (34 %).
3. Assault: Various means of assault seen like gun, axe, bricks, stones etc. Eleven patients (22 %) were in this group. Missile injury was one (2 %) also included in it.
4. Roadside accidents: Pedestrians hit by vehicle included two patients (4 %).
5. Sports Injury patient was one (2 %) with history of fall from horse riding.

Conscious level of the patients was categorized with Glasgow Comma Scale (GCS) score and divided in to mild, moderate and severe head injury. Twenty-six (52%) patients presented with mild head injury (GCS=13-14). Eleven patients (22%) presented with moderate head injury (GCS=9-12) and finally thirteen (26%) of DSF patients presented with severe head injury (GCS=3-8). The level of consciousness was inversely proportional to the severity of the injury. The most common clinical feature was vomiting observed in thirty eight patients followed by headache in twenty five patients. Localizing signs were seen in eight patients and Pupillary changes observed in six patients. Seizure was seen in three patients. Scalp laceration was noticed in forty-five patients (table-II).

Table-II. Clinical findings of patient with depressed skull fracture.

Clinical findings	No. of patients
Scalp laceration	45
Vomiting	38
Headache	25
Localized sign	08
Pupillary changes	06
Seizure	03

COMPUTERIZED TOMOGRAPHIC FINDINGS

Important radiological findings noted after CT Scanning of all fifty patients having DSF revealed; thirty-one patients presented with brain contusions (Fig-1a), whereas SDH and EDH were seen in four patients each. Fourteen patients had Pneumocephalus. DSF (Fig-1b) was seen in all the fifty patients with site of depression given as Parietal region in twelve patients, temporal region in one patient, frontal region in eighteen patients and occipital region in seven patients. Scalp injury was seen in 45 patients whereas foreign body in one patient.

ASSOCIATION BETWEEN CLINICAL FINDINGS AND CT FINDINGS

Variables of CT findings include, scalp injury, brain contusion, EDH, SDH, Pneumocephalus and FB. Where as variables of clinical findings were conscious level, pupillary changes, localizing sign, seizure, vomiting, headache and scalp lacerations. Conscious level was divided into three categories of head injuries according to the Glasgow comma scale score and described as mild, moderate and severe.

Association between clinical findings and CT findings of patients with DSF are given in Table-III and results obtained revealed that:

Regarding conscious level, patients with DSF and having

Table-III. Association between clinical findings and CT findings of patients with DSF are given in Table-III and results obtained revealed that:

		CT Findings					
		Scalp Injury	Brain Contusion	Extradural Haematoma	Subdural Haematoma	Pneumocephalus	Foreign Body
		P-values	P-values	P-values	P-values	P-values	P-values
Clinical Findings	Conscious level	0.1156	0.0993	0.6514	0.4172	0.8386	1.0000
	Papillary changes	1.0000	1.0000	1.0000	<0.001	1.0000	0.1200
	Localizing sign	0.5774	0.6933	1.0000	0.0105	1.0000	0.1600
	Seizures	1.0000	0.2788	1.0000	1.0000	0.5500	1.0000
	Vomiting	0.5819	0.0050	1.0000	0.5604	1.0000	1.0000
	Headache	1.0000	0.0014	0.1099	1.0000	1.0000	1.0000
	Scalp Laceration	<0.001	0.0622	1.0000	1.0000	0.3041	1.0000

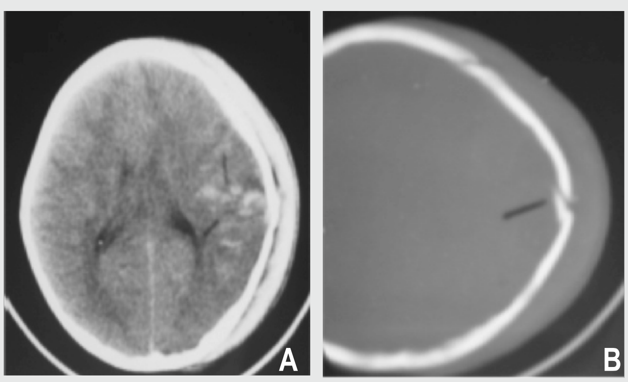


Fig-1. (a) Brain window showing contusions in left perietal region
Fig-1. (b) Bone Window showing depressed shull fracture

mild head injury were less associated with scalp injury (p=0.1156) which is statistically insignificant. DSF with moderate and severe head injury had more probability of scalp injuries (Shown in table-III).

Pupillary changes observed in patients of DSF were associated with subdural haematoma (p<0.001).

Localizing sign (Neurological deficits) observed in patients of DSF were associated with subdural haematoma (p=0.0105).where as no association with seizures was appreciated.

DSF patients with vomiting and headache were associated with brain contusions (p=0.005,0.0014) respectively.

Scalp laceration seen with DSF had association with scalp injury (p<0.001).

DISCUSSION

Incidence of trauma to the head is on the rise, both in developing as well as in developed countries. This makes it a universal health and social problem. Although skull is tough, resilient and provides excellent protection for the brain but its fracture may occur with head injuries. A severe impact or blow can result in fracture of the skull being accompanied by injury to the brain or without it. The brain can be affected directly by damage to the nervous system or by rupture of its vessels. It can be affected indirectly by blood clot, which forms under the skull but compresses the underlying brain tissue (subdural/or extradural haemotoma)[2,7].

The patient referral for the study includes the metropolitan city of Lahore and its nearby districts. A total of thirty eight (76%) patients from Lahore city and twelve (24%) patients from its nearby districts were documented and are consistent with the common notion that urbanization results in greater number of different injuries in general population due to increased mechanization of life.

Study reveals a relatively higher incidence (50%) of DSF in the children, especially in school going age group (4-12 years). The data collected reveals a remarkable increase in the incidence of DSF with decreasing age, one of the major factor attributed in this regards was the children playing in the street due to non-availability of play grounds, inadequate education and lack of general public awareness etc[8,10,11]. A higher prevalence of DSF was revealed among males as compared to females (3.5:1 ratio). It is due to the male who is bestowed the responsibility of earning while the women stay back as housewives[9].

In general, 70% of patients reached hospital within first five hours and 30% reached hospital within six to forty eight hours. Seventeen (34%) patients, reached hospital within first two hours followed by eighteen (36%) patients, took three to five hours from time of injury to reach hospital emergency. Patients who reached earlier were those from Lahore city or from nearby districts whereas patients that reached later were from the far off areas/districts. Time lapse since injury for 2nd group is inconsistent with the study of Babic M and Kovic ZM[11] where maximum time elapsed since injury is seven hours.

Data reported in literature from foreign countries suggests that common causes of head injury are motor vehicle accident followed by vehicle pedestrian's accidents, falls and assault Babic M and Kovic ZM[11]. In our study, among the various causes of DSF, the most common cause was falls from the height constituting 38% of the total number of patients followed by the road traffic accidents 34%, assault 11%. These results are consistent with the local study[9] giving falls from height 53%, RTA 31% and assault 7%. This apparent difference from most of the international data can be understood easily if we consider that most of these studies take into account of head injuries as a whole, including DSF and all other types of injuries suffered at the head. Whereas in our study, falls is the most common cause. However, some specific factors can also be identified that may contribute to a high incidence of this mode of injury i.e., DSF incurred commonly in falls. Our climatic conditions, cultural set up and traditional life style along with the general socioeconomic situation have led to many specific behavioral pattern of the general population. Examples are sleeping on the rooftop in summer season that mostly do not have boundary walls, where the children are at great risk. Similarly pigeon and kite flying are other examples of indigenous use of rooftops. Falls from trees while climbing also contribute especially in rural population.

In our study conscious level of the patient is categorized with the Glasgow comma scale (GCS). Study revealed twenty-six (52%) patients with mild head injury, eleven (22%) patients with moderate head injury and thirteen (26%) patients with severe head injury[11]. Their study revealed mild head injury 50%, moderate head injury 24% whereas severe head injury 26%. Majority of the patients were conscious at the time of admission and most of the head injuries were of mild degree in nature[9,11,15].

Vomiting was seen in thirty-eight (76%) patients. Vomiting was observed most frequently in children compared to adults[11]. Headache recorded in twenty-five (50%) patients and pupillary changes were seen in six (12%) patients. Seizure was seen in three (6 %) patients that are quite close to 7.8% observed by Ali et al[8]. Seizure was more common with patients having intracranial haematoma. Scalp injury was seen in forty-five (90%) patients that included bogginess, abrasion and laceration where as five (10%) patients were without remarkable scalp injury but having DSF beneath it. These patients were having no intracranial manifestations on CT except that of DSF. Hence, DSF can occur without intracranial manifestation[14]. Regarding the prevalence of contusions, these are most common in frontal and temporal regions but can occur anywhere. They may be a result of counter coup mechanism of injuries i.e., contusion occurring at a site of brain opposite to the direct blow on skull. Thirty-one (62%) patients in our study had brain contusions that are in conformity with, Zee CS and Khan AH[3,14].

Extradural haematoma is seen in 2% of head injuries. In our study, four (8%) patients were having EDH. These patients presented with deterioration in the conscious level, localizing sign, pupillary changes, headache, vomiting and bradycardia. Temporoparietal region is the most common site of clot[7]. SDH presented with loss of consciousness, pupillary changes, localizing sign, headache and vomiting. Our study revealed four (8%) patients with acute SDH[8,14,15,17]. Pneumocephalus is a serious complication, usually results form fracture involving paranasal sinuses or mastoid air cells and full thickness skull fracture. Air may be seen in extra dural, subdural or subarachnoid spaces or within brain parenchyma or ventricular system. Our results revealed fourteen (28%) patients with Pneumocephalus[14]. Forty-five patients (90%) were operated upon and five patients (10%) were conservatively managed. Two (4%) patients died because of severe head injury. Death rate is low in our study, as we have not included patients with thoraco abdominal injuries. However, reported death rate is 13%[18,19,10,12,16].

In order to observe association between clinical and CT findings of our study, and observations interpreted as patients with mild head injury experienced less scalp laceration compared with the patients of moderate and severe head injuries. As the level of severity of head injury increases, scalp lacerations and skull fracture especially those of compound type and associated brain findings proportionately increases[17,20]. Pupillary changes and localizing signs are associated with SDH, vomiting and headache is associated with brain contusion. Scalp laceration is associated with scalp injury. These findings are consistent with Khan AH[14].

We have observed that CT scan can detect DSF with its associated intracranial lesions earlier before they produce clinical changes. Early CT scan of such patients, rather than neurological deterioration reduces the delay in the detection and treatment of acute traumatic intracranial injuries specially DSF[8,12,13].

CONCLUSIONS

Several factors are involving in improving the mortality rate. In the last 35years, we have seen significant changes in the provision of care to trauma patients. New 4th generation CT scan have become easily accessible even in the government district hospitals and these are no longer restricted in costly centres. This means inappropriate transfer of critically ill patients to tertiary centres can be reduced and patients with depressed skull fractures can be managed promptly and efficiently in district level, since depressed skull fracture is predictive of Ct evidence of contusions & / or presence of intra and extra axial haematoma. It is a key for clinician and neurosurgeon to use GCS score in congestion with the CT findings for early management of DSF.

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