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.


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.

INTRODUCTION

Head injury is the leading cause of mortality and morbidity not only in the developed countries but also in developing countries. 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. 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. CT with bone window images of the skull displays the position, extent, number of fracture and depth of depression. 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 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 %).

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

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

Data analysis revealed that DSF is more commonly seen in children under the age of 12-year age. According to different age group incidence is given as under and also shown in table-I.

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.

MODE OF INJURY
The patients were divided into following groups...
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).

**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
Depressed skull fracture (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 ($p<0.001$).

The 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 and contusion 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/extradural haematoma).

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 no association with seizures was appreciated.

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. 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.

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 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. 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 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. 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.

Vomiting was seen in thirty-eight (76%) patients. Vomiting was observed most frequently in children compared to adults. 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. 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. 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.
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. SDH presented with loss of
consciousness, pupillary changes, localizing sign,
headache and vomiting. Our study revealed four (8%)
patients with acute SDH. Pneumocephalus is a seri
ous 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
fifteen (28%) patients with Pneumocephalus. 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%. 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. 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.

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.

CONCLUSIONS
Several factors are involving in improving the mortality
rate. In the last 35 years, 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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DEPRESSED SKULL FRACTURE


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