Head injury patients having Longitudinal Fracture of Temporal Bone associated with middle ear cavity injury and its clinical importance: A Prospective study

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Abstract:

Introduction: One of the most complex Head injury is involvement of the skull base fractures of different types with varying degree of severity. Vital structures in the temporal bone are bluntly ignored at the time of emergency trauma centre management. The Middle ear cavity, Facial cannel & Otic capsules are the vital structure to be counted & taken care of. Missing of diagnosis of the vital structure injury may lead to future complication like deaf, facial palsy & neurologogical symptoms.\textsuperscript{1}

Aim and objectives: To Study the Temporal bone fracture in Head injury patients associated with the common vital structures injuries of the Temporal bone directly or indirectly.

Study design: Observational study.

Material & Method: The Study includes 500 Head injury Patients attended in the Accident and Trauma Center, Jawaharlal Nehru Institute of Medical Sciences, Porompat, Imphal, and Manipur. The patients were accessed properly and were given the first line management. According to their stability and fitness for further investigation, the patients were subject to CT Scan Head and Neck at the earliest.

Conclusion: Temporal bone fracture, especially longitudinal fracture involving mastoid, Petrous & extending to the body of sphenoid usually involves the middle ear cavity with different degree of fracture & dislocation of the osicles. Thus a hidden fracture of middle ear cavity can be predicted by seeing the longitudinal fracture of the temporal bones involving the mastoid, petrous & body of sphenoid.

Key words: Temporal bone fracture, Middle ear cavity, longitudinal fracture.

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I. Introduction:

Head injury following any type of Trauma involving skull fracture is fairly common injury in the modern age. One of the most complex Head injury is involvement of the skull base fractures of different types with varying degree of severity.\textsuperscript{2} Vital structures in the temporal bone are bluntly ignored at the time of emergency trauma centre management. The Middle ear cavity, Facial cannel & Otic capsules are the vital structure to be counted & taken care of. Missing of diagnosis of the vital structure injury may lead to future complication like deaf, facial palsy & neurologogical symptoms.\textsuperscript{1}

Because of traffic congestion & fast life style in the modern world, Road traffic accident causing Head injury is increasing, so such type of study is required to evaluate the complication associated with any skull fracture.\textsuperscript{4} Compression of facial canal needs immediate decompression. Similarly injury to the middle ear cavity, Otic capsule needs prompt corrective measures.

Aim and object:

To Study the Temporal bone fracture in Head injury patients associated with the common vital structures injuries of the Temporal bone directly or indirectly.

Study design:

Observational study

Setting:

Jawaharlal Nehru Institute of Medical Sciences, Porompat, Imphal Manipur
II. Material & Method:

The Study includes 500 Head injury Patients attended in the Accident and Trauma Center, Jawaharlal Nehru Institute of Medical Sciences, Porompat, Imphal, Manipur. The patients were accessed properly and were given the first line management. According to their stability and fitness for further investigation, the patients were subject to CT Scan Head and Neck at the earliest.

CT Machine Allenger, 60 slices, Toshiba Company which is used for the study in the Department of Radio-diagnosis, Jawaharlal Nehru Institute of Medical Sciences, Porompat, Imphal, Manipur. CT scan of all head injury patient are examined carefully & findings are recorded in the Excel table for analysis.

Age of the patients is 5 to 80 years. Temporal bone fracture cases are further segregated for different parts involved in the fracture.

Duration:
Study is for a period of 2 years from 1st March 2015 to 28th Feb. 2017.

Inclusion criteria:
All head injury patients attended in the Accident and Trauma Center, Jawaharlal Nehru Institute of Medical Sciences, Porompat, Imphal, Manipur.

Exclusion criteria:
1. Skull fracture involving only the small appendage like, nasal bone, mandible & zygomatico arch.
2. Previously skull operated for other disease process or injuries.
3. Children below the age of 5 years.
4. Patients who are not fit/willing for the procedure.

Ethical Approval:
Ethical approval was taken.

Procedure:
CT scan findings of all head injury patients are precisely observed. Finding data are entered in the excel sheet. Total number of temporal bone fracture were segregated, scaled the type of fracture, frequency & associated injury of vital structures in the temporal bone are also well recorded specifically.

III. Results:

Out of 500 cases of skull fracture 119 cases of Temporal bone fracture were observed. Longitudinal temporal bone fracture is most common. These fractures are usually extends from the squamous part of temporal bone and ipsilateral to occipital bone or extended from contra lateral temporal bone fracture. Longitudinal fracture of mastoid portion of temporal bone extending to the petrous portion usually passes through the Middle Ear cavity. Those fractures with further extension to the body of sphenoid do not pass to the otic capsules.

LONGITUDINAL FRACTURE OF RIGHT TEMPORAL BONE INVOLVING MASTOID, PETROUS PORTION & EXTENDING TO THE BODY OF SPHENOID THROUGH MIDDLE EAR CAVITY
Head injury patients having Longitudinal Fracture of Temporal Bone associated with middle ear...

LONGITUDINAL FRACTURE OF RIGHT TEMPORAL BONE INVOLVING MASTOID, PETROUS & MIDDLE EAR CAVITY

DEPRESSED COMMINUTED FRACTURE LEFT FRONTAL BONE

BLOW OUT FRACTURE LEFT ORBIT INVOLVING THE MEDIAL WALL WITH HERNIATION OF THE MEDIAL RECTUS MUSCLE IN THE FRACTURE
Head injury patients having Longitudinal Fracture of Temporal Bone associated with middle ear...

Longitudinal temporal bone fracture extending to the body of sphenoid

TRANVERSE SKULL FRACTURE CROSSING THE FACIAL CANNAL & INJURY OF THE NERVE
Head injury patients having Longitudinal Fracture of Temporal Bone associated with middle ear..

Complete transverse skull fracture involving bilateral temporal bone longitudinal fracture.

Complete transverse skull fracture involving both temporal bones

Blow out fracture right orbit involving the medial wall with herniation of the
Table 1: Showing distribution of head injury patients according to age and sex (n=513, either sex)

<table>
<thead>
<tr>
<th>Age (in Yrs)</th>
<th>Male (%)</th>
<th>Female (%)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-15</td>
<td>40(9.7%)</td>
<td>23(25.6%)</td>
<td>63(12.6%)</td>
</tr>
<tr>
<td>15-30</td>
<td>170(41.3%)</td>
<td>17(19.3%)</td>
<td>187(37.4%)</td>
</tr>
<tr>
<td>30-45</td>
<td>129(31.3%)</td>
<td>21(23.9%)</td>
<td>150(30.0%)</td>
</tr>
<tr>
<td>45-60</td>
<td>54(13.1%)</td>
<td>22(25.0%)</td>
<td>76(15.2%)</td>
</tr>
<tr>
<td>&gt;60</td>
<td>19(4.6%)</td>
<td>5(5.7%)</td>
<td>24(4.8%)</td>
</tr>
<tr>
<td>Total</td>
<td>412</td>
<td>88</td>
<td>500</td>
</tr>
</tbody>
</table>

$\chi^2 = 31.377$ with 4d.f & $P$-value=0.000<0.05; Significant

Fig 1: Shows the Bar Chart among the age and sex Categories
Head injury patients having Longitudinal Fracture of Temporal Bone associated with middle ear ...

Table 2: Total No. Skull Fractures

<table>
<thead>
<tr>
<th>Fracture Type</th>
<th>Total No. Skull Fractures</th>
<th>Total No. Temporal Bone Fractures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parietal bone</td>
<td>60</td>
<td>118</td>
</tr>
<tr>
<td>Occipital bone</td>
<td>60</td>
<td>20</td>
</tr>
<tr>
<td>Temporal bone</td>
<td>6</td>
<td>36</td>
</tr>
<tr>
<td>Combined</td>
<td>20</td>
<td>36</td>
</tr>
<tr>
<td>Facial Fractures</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>Anterior Cranial Fissure</td>
<td>04</td>
<td></td>
</tr>
<tr>
<td>Middle Cranial Fissure</td>
<td>02</td>
<td></td>
</tr>
<tr>
<td>Posterior Cranial Fissure</td>
<td>02</td>
<td></td>
</tr>
<tr>
<td>Complete Cranial Fracture</td>
<td>02</td>
<td></td>
</tr>
</tbody>
</table>

PB-Parietal bone; OB-Occipital bone; TB-Temporal bone; ZYM-Zygomatico maxillary fracture; Le-Fo-lefort fracture type; NB-Nasal bone; ORB-Orbital fracture; ACF-Anterior cranial fossa; MCF-Middle cranial fossa; PCF-Posterior cranial fossa; COMPL-Complete cranial fracture; Sag-sagittal; Cor-coronal

Table 3: Total No. Of Temporal Bone Fractures

Table 4: Longitudinal Temporal Bone Fracture

Table 5: Pattern of skull Fracture (Vault) (Multiple Variable Counted):

<table>
<thead>
<tr>
<th>Vault</th>
<th>No. Of Cases</th>
<th>Percentages (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear</td>
<td>244</td>
<td>75.1%</td>
</tr>
<tr>
<td>Comminuted</td>
<td>16</td>
<td>4.9%</td>
</tr>
<tr>
<td>Depressed</td>
<td>50</td>
<td>15.4%</td>
</tr>
<tr>
<td>Diastatic</td>
<td>6</td>
<td>1.8%</td>
</tr>
<tr>
<td>Linear + Diastatic</td>
<td>4</td>
<td>1.2%</td>
</tr>
<tr>
<td>Linear + Comminuted</td>
<td>2</td>
<td>0.6%</td>
</tr>
<tr>
<td>Linear + Depressed</td>
<td>2</td>
<td>0.6%</td>
</tr>
<tr>
<td>Linear +Depressed+Diastatic</td>
<td>1</td>
<td>0.3%</td>
</tr>
<tr>
<td>Total</td>
<td>325</td>
<td>100%</td>
</tr>
</tbody>
</table>
Head injury patients having Longitudinal Fracture of Temporal Bone associated with middle ear...

**Table 6:**

<table>
<thead>
<tr>
<th>S. L. N. O.</th>
<th>TOTAL NO. OF TEMP. BONE #</th>
<th>TOTAL NO. OF SQ.PA RT # Only</th>
<th>TOTAL LONG. TEMP. BONE #</th>
<th>TOTAL NO. OF TRANSVERSE #</th>
<th>TOTAL NO. COMPL. B/L TEMP. BONE #</th>
<th>P-value of MEC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>118</td>
<td>11</td>
<td>08</td>
<td>02</td>
<td>78</td>
<td>09 01 01 02 02 04</td>
</tr>
</tbody>
</table>

\[ \chi^2 = 14.510 \text{ with } 1 \text{d.f}; \text{ P-Value } = 0.000<0.05 \text{ Which is Significant by Linear by Linear Association.} \]

Body of Sphenoid which is not affecting the Middle Ear Cavity is 04 cases, 3 cases involves Otic capsule & 1 involves facial canal. 2 cases of longitudinal fracture were minor which do not pass through middle ear cavity.

4 cases of transverse temporal bone fractures are recorded, three were passing through mastoid portion & other three cross petrous portion through the facial canal. Another 4 cases of complete transverse fracture of temporal bone were seen, involving both the temporal bones through their longitudinal axis, treated as longitudinal fracture.

Out of the 119 cases of Temporal bone fractures, the total no. of longitudinal fracture of Temporal bone is 99 cases. Out of 102 cases of longitudinal temporal bone fracture total number of fracture passing through Mastoid, Petrous portion through Middle Ear Cavity only were 65 cases. Total no. of longitudinal fracture of Temporal bone involving Mastoid, Petrous portion and body of Sphenoid bone through middle ear cavity are 21 cases, Mastoid only is 10 cases, No. of longitudinal fracture of Temporal bone involving Mastoid, Petrous, & Otic Capsule is 3 cases, Mastoid, Petrous without middle ear cavity is 2 cases & Mastoid, Petrous & Facial canal is 1.

Bilateral Mastoid, Petrous through body of Sphenoid & Middle ear cavities is 2 cases and Unilateral Mastoid, Bilateral Petrous & Middle Air cavities through the body of Sphenoid is 2 cases.

**IV. Discussion:**

CT scan findings of all 500 (five hundred) head injury patients are precisely observed. Finding data are entered in the excel sheet. Total number of skull fractures are recorded in the three categories viz. Cranial vault.
fracture; Base of the skull fracture & Facial fracture etc. Cranial vault fracture are further categorized as linear, comminuted & de press fracture with involvement of one, more than one bones. 


Only mandible fracture cases are not counted.

In facial fracture most common fracture is the Zygomatico maxillary fracture followed by frontal & nasal bone fracture.

Similarly fracture base of the skull is also recorded as anterior cranial, Middle cranial fossa & Posterior cranial fossa fracture with further categorization in the type of the individual bone fracture. Bone fracture were further segregated, scaled the type of fracture, frequency & associated injury of vital structures in the temporal bone are well recorded specifically. In the middle cranial fossa fracture most important bone is Temporal bone.

Out of the 119 cases of Temporal bone fractures, the total no. of longitudinal fracture of Temporal bone is 99 cases. Out of 99 cases of longitudinal temporal bone fracture total number of fracture passing through Mastoid, Petrous portion through Middle Ear Cavity only were 65 cases. Total no. of longitudinal fracture of Temporal bone involving Mastoid, Petrous portion and body of Sphenoid bone through middle ear cavity are 21 cases. No. of longitudinal fracture of Temporal bone involving Mastoid, Petrous, Body of Sphenoid which is not affecting the Middle Ear Cavity is 04 cases, three (3) cases involves Otic capsule & one (1) involves facial canal. Two (2) cases of longitudinal fracture were minor which do not pass through middle ear cavity.

Besides, six (6) cases of transverse fracture temporal bone were seen. Out of these six (6) cases 3 (Three) fracture passing through the petrous portion crosses facial canal with facial palsy. Complete transverse bilateral temporal bone fracture cases are also found with involvement of the Middle ear cavity. The longitudinal fracture line passing through the mastoid, petrous portion & body of sphenoid does not involve the otic capsule.

V. Conclusion:

1. Temporal bone fracture, especially longitudinal fracture involving mastoid, Petrous & extending to the body of sphenoid usually involves the middle ear cavity with different degree of fracture & dislocation of the osicles. Thus a hidden fracture of middle ear cavity can be predicted by seeing the longitudinal fracture of the temporal bones involving the mastoid, petrous & body of sphenoid.
2. Fracture extending to the body of sphenoid usually does not involve otic capsule
3. Longitudinal fracture of temporal bone usually does not cross the facial canal.
4. Transverse fracture of temporal passing through the petrous portion usually passes through the facial canal.

References: