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# Role of Compterized Tomography in Acute Traumatic Brain Injury

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**Abstract:** Head injury is a major health problem and common cause of disability and death. In developing countries like India the incidence of traumatic brain injury is increasing as traffic increases, besides other puzzling factors such as industrialization, falls and airborne trauma. CT facilitates a comprehensive diagnosis and targeted interventions. In this study the incidence of traumatic brain injuries is common among the 21-40 years (48.9%) of age group followed by 41-60 years age group (28.3%) and below 20 years age group (11.7%). The incidence among the above 61 years age group is 11.2%. In this study we found significant association between age group and outcome of the patient. Surprisingly no mortality was found in patients below 20 years age group. Out of 28 deaths high mortality rate found among older people >61 years of age, 15 deaths noted in these age group (60%). Mortality rate in 41-60 years age group is 12.7% (8 deaths out of 28).
**Keywords:** Computerized Tomography (CT). Sub-arachnoids hemorrhage (SAH), midline shift, subdural hemorrhage (SDH), Fractures.

## INTRODUCTION

Acute Traumatic brain injury (TBI) is a common and probability devastating problem. Developing country like India, road transportation is the most commonly used transport. Head injuries due to road traffic accidents have become a routine route to take the human lives. CT is the most useful and commonly used modality in the evaluation of patients with head injury as it is readily available and cost effective. Over the years, CT machines had become faster as the process of computers improved [1].

With the recent advanced technique of CT, neuro-radiological diagnosis has become easy with short scan time [2]. CT is also useful in finding bones abnormality and in detecting acute subarachnoid or acute parenchymal haemorrhage [3]. CT plays an important role in management of acute traumatic brain injury [4].

## AIM AND OBJECTIVES OF THE STUDY

1. To study the various clinic – radiological patterns of head injuries.
2. To correlate the CT features with clinical operative findings.
3. To identify Neuro imaging indicators of poor clinical outcome.
4. To highlights the importance of CT in early diagnosis of post traumatic lesions.
5. To compare the data with previous studies.

## MATERIALS ANDMETHODS

This is a hospital based cross sectional study carried out in patients of head injury referred to the Sree Balaji Medical College and Hospital, Chromepet, Chennai from March 2016 to February 2017. The present study includes 246 people with traumatic brain injury of both sexes, according to the inclusion and exclusion criteria, 23 patients are excluded from the study and 223 were included in this study.

**Inclusion Criteria**

All patients with head injuries and cranio-facial trauma who underwent CT scanning.

**Exclusion Criteria**

Patients on ventilators and with Glasgow coma scale <6. On the CT scans the location and extent of the lesions was identified. Search was made for the presence of blood within the ventricular system or in subarachnoid space or epidural space or subdural space.

Further bone windowing imaging was also done to locate the skull fractures.

## RESULTS

The present study was carried out to describe CT imaging characteristics of acute traumatic head injuries. CT scans were done in 223 patients with acute traumatic brain injury after fulfilling the inclusion and the exclusion criteria. Findings of the patients were studied and tabulated using Microsoft Excel. Two twenty three patients were evaluated for head trauma and each of them is evaluated for each type of lesions, location, associated fractures of skull bon, age incidence, and outcome. Most susceptible age group to head injuries with intracranial hematoma is 21-40yr and 41-60years. People above 60yr and below 20yr are less prone for head injuries. The mortality rate was at its peak in patients of the age group of more than 61 years.

**The incidence of intracranial traumatic pathologies**

In this study the incidence of normal scans was 59 (26.5%) cases and abnormal scans were 164 (73.5%). Among all intracranial traumatic lesions the incidence of multiple intracranial traumatic lesions are most common (35%), in which contusions associated with extra axial hematomas are most common, in their most common are CSA (contusions, subdural hemorrhage, subarachnoid hemorrhage) followed by CA (contusions, subarachnoid hemorrhage), SA (subdural hematoma, subarachnoid hemorrhage).

Next common intracranial traumatic lesions are contusions (13%) followed by epidural hematomas (9%) and subdural hematomas (6.7%).

Least common are subarachnoid hematomas (4.9%) and intra cerebral hematomas (4.9%). The incidence of fractures was 52.5%

**Table-1: Frequency Distribution of Various Intracranial Traumatic Lesions**

| | Normal scans | Abnormal scans | Contusions | SDH | EDH | SAH | MICTL | ICH | Fractures |
|---|---|---|---|---|---|---|---|---|---|
| | 59 | 164 | 29 | 15 | 20 | 11 | 78 | 11 | 123 |
| Percentage | 26.5% | 73.5% | 13% | 6.7% | 9% | 4.9% | 35% | 4.9% | 55.2% |

**Fig-1: Axial CT section shows cerebral contusions and epidural hematoma**

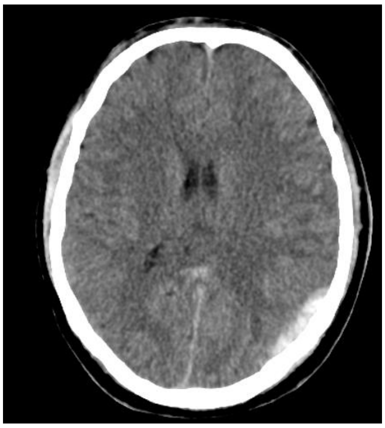

**Fig-2: shows epidural hematoma**

**Table-2: Sex Distribution of Head Injuries**

| | Frequency | Percent | Valid Percent | Cumulative percent |
|---|---|---|---|---|
| Female | 53 | 23.8 | 23.8 | 23.8 |
| Male | 170 | 76.2 | 76.2 | 100.0 |
| Total | 223 | 100.0 | 100.0 | |

**Table-3: Frequency Distribution of Location in Head Injuries**

| Location | Frequency percent | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|
| F | 23 | 10.3 | 10.3 | 10.3 |
| FP | 27 | 12.1 | 12.1 | 12.1 |
| FT | 14 | 6.3 | 6.3 | 28.7 |
| HC | 7 | 3.1 | 3.1 | 31.8 |
| O | 6 | 2.7 | 2.7 | 34.5 |
| P | 10 | 4.5 | 4.5 | 39.0 |
| T | 24 | 10.8 | 10.8 | 49.8 |
| TP | 14 | 6.3 | 6.3 | 56.1 |
| BF | 8 | 3.6 | 3.6 | 59.6 |
| BP | 1 | .4 | .4 | 60.1 |
| DIFFUSE | 2 | .9 | .9 | 61.0 |
| FTP | 4 | 1.8 | 1.8 | 62.8 |
| NIL | 79 | 35.4 | 35.4 | 98.2 |
| TOP | 4 | 1.8 | 1.8 | 100.0 |
| **Total** | **223** | **100.0** | **100.0** | |

**Table-4: Type of Fractures and Their Frequency Distribution**

| Fractures | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|
| CF | 11 | 4.9 | 4.9 | 4.9 |
| D | 10 | 4.5 | 4.5 | 9.4 |
| BP | 1 | .4 | .4 | 9.9 |
| C | 3 | 1.3 | 1.3 | 11.2 |
| F | 10 | 4.5 | 4.5 | 15.7 |
| FP | 2 | .9 | .9 | 16.6 |
| MUL | 22 | 9.9 | 9.9 | 26.5 |
| NIL | 100 | 44.8 | 44.8 | 71.3 |
| O | 15 | 6.7 | 6.7 | 78.0 |
| P | 11 | 4.9 | 4.9 | 83.0 |
| T | 34 | 15.2 | 15.2 | 98.2 |
| TP | 4 | 1.8 | 1.8 | 100.0 |
| **Total** | **223** | **100.0** | **100.0** | |

**Fig-3: SDH with midline shift**

**Fig-4: SAH**

**Table-5: Mortality Incidence of Head Injuries**

| Deaths | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|
| NO | 195 | 87.4 | 87.4 | 87.4 |
| YES | 28 | 12.6 | 12.6 | 100.0 |
| **Total** | **223** | **100.0** | **100.0** | |

**Table-6: Age Distribution of Various Hematomas**

| | Contusions | SDH | EDH | SAH | ICH |
|---|---|---|---|---|---|
| Up to 20 yr | 3 | 2 | 5 | 1 | 0 |
| 21-40 yrs | 15 | 3 | 11 | 5 | 5 |
| 41-60 yrs | 8 | 6 | 3 | 5 | 4 |
| Above 61 yr | 3 | 4 | 1 | 0 | 2 |
| Total | 29 | 15 | 20 | 11 | 11 |
| Percentage | 13% | 6.7% | 9% | 4.9% | 4.9% |
| P Value | 0.988 | 0.07 | 0.139 | 0.451 | 0.542 |

**Table-7: Age Distribution of Multiple Intracranial Traumatic Lesions**

| | MICTL | | | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| | **CA** | **CE** | **CEA** | **CS** | **CSA** | **CSE** | **NIL** | **SA** | **SEA** | |
| Age upto 20 | 0 | 0 | 0 | 1 | 2 | 0 | 23 | 0 | 0 | 26 |
| | 0.0% | 0.0% | 0.0% | 3.8% | 7.7% | 0.0% | 88.5% | 0.0% | 0.0% | 100.0% |
| Age upto 21-40 | 7 | 6 | 4 | 6 | 7 | 2 | 74 | 2 | 1 | 109 |
| | 6.4% | 5.5% | 3.7% | 5.5% | 6.4% | 1.8% | 67.9% | 1.8% | 0.9% | 100.0% |
| Age upto 41-60 | 7 | 0 | 1 | 2 | 9 | 2 | 37 | 4 | 1 | 63 |
| | 11.1% | 0.0% | 1.6% | 3.2% | 14.3% | 3.2% | 58.7% | 6.3% | 1.6% | 100.0% |
| Age upto 61 | 3 | 0 | 0 | 4 | 4 | 0 | 12 | 2 | 0 | 25 |
| | 12.0% | 0.0% | 0.0% | 16.0% | 16.0% | 0.0% | 48.0% | 8.0% | 0.0% | 100.0% |
| **Total** | **17** | **6** | **5** | **13** | **22** | **4** | **146** | **8** | **2** | **223** |
| | **7.6%** | **2.7%** | **2.2%** | **5.8%** | **9.9%** | **1.8%** | **65.5%** | **3.6%** | **0.9%** | **100.0%** |
| **P value** | **0.124** | | | | | | | | | |

**Fig-5: Axial CT section shows Subdural hematoma in left fronto-temporo-parietal region with mass effect on underlying brain parenchyma**

Most midline shifts are associated in the age groups of 21-60 and above 61 years. Only one case noted with midline shift <5mm in below 20 years age group. P 0.019 shows that relation is statistically significant.

**Table-8: Association between the Midline Shift and Age**

| | MS | | | | Total | P Value |
|---|---|---|---|---|---|---|
| | < 5MM | > 10MM | > 5MM | NIL | | |
| age upto 20 | 1 | 0 | 0 | 25 | 26 | 0.019 |
| | 3.8% | 0.0% | 0.0% | 96.2% | 100.0% | |
| age 21-40 | 1 | 3 | 3 | 102 | 109 | |
| | 0.9% | 2.8% | 2.8% | 93.6% | 100.0% | |
| age 41-60 | 5 | 1 | 2 | 55 | 63 | |
| | 7.9% | 1.6% | 3.2% | 87.3% | 100.0% | |
| age above 61 | 1 | 4 | 1 | 19 | 25 | |
| | 4.0% | 16.0% | 4.0% | 76.0% | 100.0% | |
| **Total** | **8** | **8** | **6** | **201** | **223** | |
| | **3.6%** | **3.6%** | **2.7%** | **90.1%** | **100.0%** | |

Temporal bone fractures are most commonly associated with all age groups followed by multiple bone fractures and occipital bone fracture. Except in below 20yr craniofacial bone fractures are most common followed by temporal bone fractures. P 0.049 shows that relationship is statistically significant.

**Table-9: Type of Fracture and Their Age Wish Distribution**

| | FRACTURE | | | | | | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | CF | D | B P | C | F | FP | MUL | NIL | O | P | T | TP | |
| age upto 20 | 4 | 1 | 1 | 0 | 1 | 0 | 3 | 10 | 0 | 2 | 3 | 1 | 26 |
| | 15.4% | 3.8% | 3.8% | 0.0% | 3.8% | 0.0% | 11.5% | 38.5% | 0.0% | 7.7% | 11.5% | 3.8% | 100.0% |
| age 21-40 | 4 | 7 | 0 | 2 | 6 | 0 | 13 | 44 | 9 | 7 | 14 | 3 | 109 |
| | 3.7% | 6.4% | 0.0% | 1.8% | 5.5% | 0.0% | 11.9% | 40.4% | 8.3% | 6.4% | 12.8% | 2.8% | 100.0% |
| age 41-60 | 2 | 2 | 0 | 0 | 1 | 2 | 6 | 35 | 5 | 2 | 8 | 0 | 63 |
| | 3.2% | 3.2% | 0.0% | 0.0% | 1.6% | 3.2% | 9.5% | 55.6% | 7.9% | 3.2% | 12.7% | 0.0% | 100.0% |
| age above 61 | 1 | 0 | 0 | 1 | 2 | 0 | 0 | 11 | 1 | 0 | 9 | 0 | 25 |
| | 4.0% | 0.0% | 0.0% | 4.0% | 8.0% | 0.0% | 0.0% | 44.0% | 4.0% | 0.0% | 36.0% | 0.0% | 100.0% |
| **Total** | **11** | **10** | **1** | **3** | **10** | **2** | **22** | **100** | **15** | **11** | **34** | **4** | **223** |
| | **4.9%** | **4.5%** | **0.4%** | **1.3%** | **4.5%** | **0.9%** | **9.9%** | **44.8%** | **6.7%** | **4.9%** | **15.2%** | **1.8%** | **100.0%** |
| **P Value** | **0.049** | | | | | | | | | | | | |

No mortality noted in the age group of below 20yrs. Mortality higher in the age group of above 61 years. 60% deaths are noted in the above 60 years age group. 12.7 % deaths are in the age group of 41 - 60 years age group. Highly significant P values are noted in relation to mortality associated with age groups.

**Table-10: Mortality Distribution in Different Ages**

| | No Deaths | No. of Deaths | Total | P Value |
|---|---|---|---|---|
| age upto 20 | 26 | 0 | 26 | 0.000 |
| | 100.0% | 0.0% | 100.0% | |
| age 21-40 | 104 | 5 | 109 | |
| | 95.4% | 4.6% | 100.0% | |
| age 41-60 | 55 | 8 | 63 | |
| | 87.3% | 12.7% | 100.0% | |
| age above 61 | 10 | 15 | 25 | |
| | 40.0% | 60.0% | 100.0% | |
| **Total** | **195** | **28** | **223** | |
| | **87.4%** | **12.6%** | **100.0%** | |

**Association of midline shift with variousintracranial traumatic lesions**

In this study midline shift is associated with SDH, MICTL, and ICH. Statistically significant midline shift is associated with cases of SDH. Out of 223 cases 15 have a SDH and in which 7 cases midline shift is noted. >10mm midline shift noted in total 8 cases in which 4 cases are due to SDH.

**Table-11: The Incidence of Midline Shift in SDH**

| MS | OTHER CASES | NO OFSDH CASES | Total | P value |
|---|---|---|---|---|
| <5MM | 6 | 2 | 8 | 0.000 |
| | 75.0% | 25.0% | 100.0% | |
| >10MM | 4 | 4 | 8 | |
| | 50.0% | 50.0% | 100.0% | |
| >5MM | 5 | 1 | 6 | |
| | 83.3% | 16.7% | 100.0% | |
| NIL | 193 | 8 | 201 | |
| | 96.0% | 4.0% | 100.0% | |
| **Total** | **208** | **15** | **223** | |
| | **93.0%** | **6.7%** | **100.0%** | |

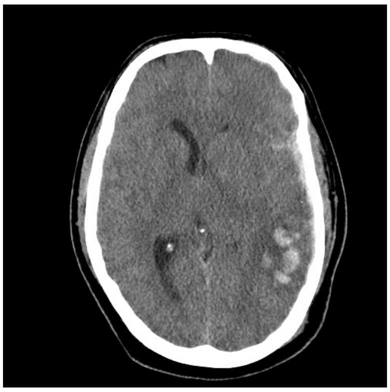

**Fig-6: Axial CT section shows Diffuse cerebral edema noted. Subarachnoid hemorrhage noted in bilateral fronto-parietal lobes and left sylvian fissure and Hemorrhagic contusion seen in left temporo-parietal lobes**

**Fig-7: Small hemorrhagic contusions seen in left posterior parietal lobe**

Midline shift detected in 13 cases of multiple intracranial traumatic lesions. In which <5mm midline shift cases are 5, >5mm cases are 3 and >10mm cases are 5.The P values (0.006) are found significant in relation to MICTL.

**Table-12: The Incidence of Midline Shift in MICTL**

| Midline shift | MICTL | | | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| | CA | CE | CEA | CS | CSA | CSE | NIL | SA | SEA | |
| <5MM | 0 | 0 | 1 | 0 | 3 | 0 | 3 | 0 | 1 | 8 |
| | 0.0% | 0.0% | 12.5% | 0.0% | 37.5% | 0.0% | 37.5% | 0.0% | 12.5% | 100.0% |
| >10MM | 0 | 0 | 0 | 1 | 1 | 0 | 5 | 1 | 0 | 8 |
| | 0.0% | 0.0% | 0.0% | 12.5% | 12.5% | 0.0% | 62.5% | 12.5% | 0.0% | 100.0% |
| >5MM | 1 | 0 | 0 | 1 | 3 | 0 | 1 | 0 | 0 | 6 |
| | 16.7% | 0.0% | 0.0% | 16.7% | 50.0% | 0.0% | 16.7% | 0.0% | 0.0% | 100.0% |
| NIL | 16 | 6 | 4 | 11 | 15 | 4 | 137 | 7 | 1 | 201 |
| | 8.0% | 3.0% | 2.0% | 5.5% | 7.5% | 2.0% | 68.2% | 3.5% | 0.5% | 100.0% |
| **Total** | **17** | **6** | **5** | **13** | **22** | **4** | **146** | **8** | **2** | **223** |
| | **7.6%** | **2.7%** | **2.2%** | **5.8%** | **9.9%** | **1.8%** | **65.5%** | **3.6%** | **0.9%** | **100.0%** |
| **P Value** | **0.006** | | | | | | | | | |

Highly significant P (0.000) values are obtained in relation to deaths associated with midline shift. The mortality was 87.5% in those with midline shift of more than 10mm, 66.7% in those with more than 5mm and 25% in less than 5mm midline shift.

**Table-13: Outcome in the Basis of Midline Shift**

| MS | Deaths | | Total | P Value |
|---|---|---|---|---|
| | No | Yes | | |
| <5mm | 6 | 2 | 8 | **0.000** |
| | 75.0% | 25.0% | 100.0% | |
| >10mm | 1 | 7 | 8 | |
| | 12.5% | 87.5% | 100.0% | |
| >5mm | 2 | 4 | 6 | |
| | 33.3% | 66.7% | 100.0% | |
| Nil | 186 | 15 | 201 | |
| | 92.5% | 7.5% | 100.0% | |
| **Total** | **195** | **28** | **223** | |
| | **87.4%** | **12.6%** | **100.0%** | |

**Table-14.1: Association of Contusions with Location**

| Location | Contusions | | Total | P Value |
|---|---|---|---|---|
| | No | Yes | | |
| F | 16 | 7 | 23 | 0.000 |
| | 69.6% | 30.4% | 100.0% | |
| Fp | 27 | 0 | 27 | |
| | 100.0% | 0.0% | 100.0% | |
| Ft | 10 | 4 | 14 | |
| | 71.4% | 28.6% | 100.0% | |
| Hc | 7 | 0 | 7 | |
| | 100.0% | 0.0% | 100.0% | |
| O | 5 | 1 | 6 | |
| | 83.3% | 16.7% | 100.0% | |
| P | 7 | 3 | 10 | |
| | 70.0% | 30.0% | 100.0% | |
| T | 19 | 5 | 24 | |
| | 79.2% | 20.8% | 100.0% | |
| TP | 13 | 1 | 14 | |
| | 92.9% | 7.1% | 100.0% | |
| B F | 3 | 5 | 8 | |
| | 37.5% | 62.5% | 100.0% | |
| B P | 1 | 0 | 1 | |
| | 100.0% | 0.0% | 100.0% | |
| Diffuse | 1 | 1 | 2 | |
| | 50.0% | 50.0% | 100.0% | |
| FIP | 4 | 0 | 4 | |
| | 100.0% | 0.0% | 100.0% | |
| Nil | 77 | 2 | 79 | |
| | 97.5% | 2.5% | 100.0% | |
| Top | 4 | 0 | 4 | |
| | 100.0% | 0.0% | 100.0% | |
| **Total** | **194** | **29** | **223** | |

Most common site of SDH is the fronto-temporo-parietal (50 %) region, followed by hemi-calvarial (42.9) and fronto-parietal (14.8%) regions in location.

**Table-14.2: Association of SDH with Location**

| LOCATION | SDH | | Total | P value |
|---|---|---|---|---|
| | NO | YES | | |
| F | 22 | 1 | 23 | 0.000 |
| | 95.7% | 4.3% | 100.0% | |
| FP | 23 | 4 | 27 | |
| | 85.2% | 14.8% | 100.0% | |
| FT | 14 | 0 | 14 | |
| | 100.0% | 0.0% | 100.0% | |
| HC | 4 | 3 | 7 | |
| | 57.1% | 42.9% | 100.0% | |
| O | 6 | 0 | 6 | |
| | 100.0% | 0.0% | 100.0% | |
| P | 10 | 0 | 10 | |
| | 100.0% | 0.0% | 100.0% | |
| T | 22 | 2 | 24 | |
| | 91.7% | 8.3% | 100.0% | |
| TP | 12 | 2 | 14 | |
| | 85.7% | 14.3% | 100.0% | |
| B F | 7 | 1 | 8 | |
| | 87.5% | 12.5% | 100.0% | |
| B P | 1 | 0 | 1 | |
| | 100.0% | 0.0% | 100.0% | |
| DIFFUSE | 2 | 0 | 2 | |
| | 100.0% | 0.0% | 100.0% | |
| FIP | 2 | 2 | 4 | |
| | 50.0% | 50.0% | 100.0% | |
| NIL | 79 | 0 | 79 | |
| | 100.0% | 0.0% | 100.0% | |
| TOP | 4 | 0 | 4 | |
| | 100.0% | 0.0% | 100.0% | |
| **Total** | **208** | **15** | **223** | |
| | **93.3%** | **6.7%** | **100.0%** | |

**Table-14.3: Association of EDH with Location**

| LOCATION | EDH | | Total | P value |
|---|---|---|---|---|
| | NO | YES | | |
| F | 19 | 4 | 23 | 0.009 |
| | 82.6% | 17.4% | 100.0% | |
| FP | 26 | 1 | 27 | |
| | 96.3% | 3.7% | 100.0% | |
| FT | 14 | 0 | 14 | |
| | 100.0% | 0.0% | 100.0% | |
| HC | 7 | 0 | 7 | |
| | 100.0% | 0.0% | 100.0% | |
| O | 4 | 2 | 6 | |
| | 66.7% | 33.3% | 100.0% | |
| P | 8 | 2 | 10 | |
| | 80.0% | 20.0% | 100.0% | |
| T | 18 | 6 | 24 | |
| | 75.0% | 25.0% | 100.0% | |
| TP | 11 | 3 | 14 | |
| | 78.6% | 21.4% | 100.0% | |
| B F | 7 | 1 | 8 | |
| | 87.5% | 12.5% | 100.0% | |
| B P | 1 | 0 | 1 | |
| | 100.0% | 0.0% | 100.0% | |
| DIFFUSE | 2 | 0 | 2 | |
| | 100.0% | 0.0% | 100.0% | |
| FIP | 4 | 0 | 4 | |
| | 100.0% | 0.0% | 100.0% | |
| NIL | 78 | 1 | 79 | |
| | 98.7% | 1.3% | 100.0% | |
| TOP | 4 | 0 | 4 | |
| | 100.0% | 0.0% | 100.0% | |
| **Total** | **203** | **20** | **223** | |
| | **91.0%** | **9.0%** | **100.0%** | |

**Table-14.4: Association of SAH with Location**

| LOCATION | SAH | | Total | P value |
|---|---|---|---|---|
| | NO | YES | | |
| F | 21 | 2 | 23 | 0.007 |
| | 91.3% | 8.7% | 100.0% | |
| FP | 27 | 0 | 27 | |
| | 100.0% | 0.0% | 100.0% | |
| FT | 14 | 0 | 14 | |
| | 100.0% | 0.0% | 100.0% | |
| HC | 6 | 1 | 7 | |
| | 85.7% | 14.3% | 100.0% | |
| O | 6 | 0 | 6 | |
| | 100.0% | 0.0% | 100.0% | |
| P | 8 | 2 | 10 | |
| | 80.0% | 20.0% | 100.0% | |
| T | 22 | 2 | 10 | |
| | 91.7% | 8.3% | 100.0% | |
| TP | 14 | 0 | 14 | |
| | 100.0% | 0.0% | 100.0% | |
| B F | 8 | 0 | 8 | |
| | 100.0% | 0.0% | 100.0% | |
| B P | 1 | 0 | 1 | |
| | 100.0% | 0.0% | 100.0% | |
| DIFFUSE | 1 | 1 | 2 | |
| | 50.0% | 50.0% | 100.0% | |
| FIP | 3 | 1 | 4 | |
| | 75.0% | 25.0% | 100.0% | |
| NIL | 78 | 1 | 79 | |
| | 98.7% | 1.3% | 100.0% | |
| TOP | 3 | 1 | 4 | |
| | 75.0% | 25.0% | 100.0% | |
| **Total** | **212** | **11** | **223** | |
| | **95.1%** | **4.9%** | **100.0%** | |

**14.5: Association of ICH with Location**

| LOCATION | ICH | | Total | P value |
|---|---|---|---|---|
| | NO | YES | | |
| F | 0 | 23 | 23 | 0.000 |
| | 0.0% | 100.0% | 100.0% | |
| FP | 1 | 26 | 27 | |
| | 3.7% | 96.3% | 100.0% | |
| FT | 1 | 13 | 14 | |
| | 7.1% | 92.9% | 100.0% | |
| HC | 0 | 7 | 7 | |
| | 0.0% | 100.0% | 100.0% | |
| O | 0 | 6 | 6 | |
| | 0.0% | 100.0% | 100.0% | |
| P | 0 | 10 | 10 | |
| | 0.0% | 100.0% | 100.0% | |
| T | 1 | 23 | 24 | |
| | 4.2% | 95.8% | 100.0% | |
| TP | 1 | 13 | 14 | |
| | 7.1% | 92.9% | 100.0% | |
| B F | 1 | 7 | 8 | |
| | 12.5% | 87.5% | 100.0% | |
| B P | 1 | 0 | 1 | |
| | 100.0% | 0.0% | 100.0% | |
| DIFFUSE | 2 | 0 | 2 | |
| | 100.0% | 0.0% | 100.0% | |
| FIP | 0 | 4 | 4 | |
| | 0.0% | 100.0% | 100.0% | |
| NIL | 1 | 78 | 79 | |
| | 1.3% | 98.7% | 100.0% | |
| TOP | 2 | 2 | 4 | |
| | 50.0% | 50.0% | 100.0% | |
| **Total** | **11** | **212** | **223** | |
| | **4.9%** | **95.1%** | **100.0%** | |

Frequent regions involved in multiple intracranial traumatic lesions are fronto-parietal, temporal and frontal regions.

**Table-14.6: Association of MICTL with Location**

| **Location** | **MICTL** | | | | | | | | | **Total** |
|---|---|---|---|---|---|---|---|---|---|---|
| | **CA** | **CE** | **CEA** | **CS** | **CSA** | **CSE** | **NIL** | **SA** | **SEA** | |
| F | 3 | 0 | 1 | 1 | 2 | 1 | 14 | 1 | 0 | 23 |
| | 13.0% | 0.0% | 4.3% | 4.3% | 8.7% | 4.3% | 60.9% | 4.3% | 0.0% | 100.0% |
| FP | 3 | 1 | 2 | 3 | 8 | 1 | 5 | 4 | 0 | 27 |
| | 11.1% | 3.7% | 7.4% | 11.1% | 29.6% | 3.7% | 18.5% | 14.8% | 0.0% | 100.0% |
| FT | 0 | 0 | 0 | 4 | 5 | 0 | 4 | 1 | 0 | 14 |
| | 0.0% | 0.0% | 0.0% | 28.6% | 35.7% | 0.0% | 28.6% | 7.1% | 0.0% | 100.0% |
| HC | 0 | 0 | 0 | 0 | 2 | 0 | 4 | 1 | 0 | 7 |
| | 0.0% | 0.0% | 0.0% | 0.0% | 28.6% | 0.0% | 57.1% | 14.3% | 0.0% | 100.0% |
| O | 0 | 3 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 6 |
| | 0.0% | 50.0% | 0.0% | 0.0% | 0.0% | 0.0% | 50.0% | 0.0% | 0.0% | 100.0% |
| P | 2 | 1 | 0 | 0 | 0 | 0 | 7 | 0 | 0 | 10 |
| | 20.0% | 10.0% | 0.0% | 0.0% | 0.0% | 0.0% | 70.0% | 0.0% | 0.0% | 100.0% |
| T | 4 | 1 | 1 | 2 | 0 | 0 | 15 | 1 | 0 | 24 |
| | 16.7% | 4.2% | 4.2% | 8.3% | 0.0% | 0.0% | 62.5% | 4.2% | 0.0% | 100.0% |
| TP | 2 | 0 | 0 | 1 | 2 | 2 | 6 | 0 | 1 | 14 |
| | 14.3% | 0.0% | 0.0% | 7.1% | 14.3% | 14.3% | 42.9% | 0.0% | 7.1% | 100.0% |
| B F | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 0 | 0 | 8 |
| | 0.0% | 0.0% | 12.5% | 0.0% | 0.0% | 0.0% | 87.5% | 0.0% | 0.0% | 100.0% |
| B P | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 100.0% | 0.0% | 0.0% | 100.0% |
| DIFFUSE | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 2 |
| | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 100.0% | 0.0% | 0.0% | 100.0% |
| FTP | 0 | 0 | 0 | 1 | 0 | 0 | 3 | 0 | 0 | 4 |
| | 0.0% | 0.0% | 0.0% | 25.0% | 0.0% | 0.0% | 75.0% | 0.0% | 0.0% | 100.0% |
| NIL | 3 | 0 | 0 | 1 | 1 | 0 | 74 | 0 | 0 | 79 |
| | 3.8% | 0.0% | 0.0% | 1.3% | 1.3% | 0.0% | 93.7% | 0.0% | 0.0%s | 100.0% |
| TOP | 0 | 0 | 0 | 0 | 2 | 0 | 1 | 0 | 1 | 4 |
| | 0.0% | 0.0% | 0.0% | 0.0% | 50.0% | 0.0% | 25.0% | 0.0% | 25.0% | 100.0% |
| **TOTAL** | **17** | **6** | **5** | **13** | **22** | **4** | **146** | **8** | **2** | **223** |
| | **7.6%** | **2.7%** | **2.2%** | **5.8%** | **9.9%** | **1.8%** | **65.5%** | **3.6%** | **0.9%** | **100.0%** |
| **P Value** | **0.000** | | | | | | | | | |

The association between the midline shift and location shows highly significance with P values corresponds to 0.000. The most common location in <5mm and >5mm midline shift cases are fronto-parietal region. In >10mm midline shift cases most common location involved is hemi-calvarial followed by fronto-temporal.

**Table-15: Association of Midline Shift with Location**

| Location | MS | | | | Total | P value |
|---|---|---|---|---|---|---|
| | <5MM | >10MM | >5MM | NIL | | |
| F | 0 | 0 | 0 | 23 | 23 | 0.000 |
| | 0.0% | 0.0% | 0.0% | 100.0% | 100.0% | |
| FP | 4 | 0 | 3 | 20 | 27 | |
| | 14.8% | 0.0% | 11.1% | 74.1% | 100.0% | |
| FT | 1 | 2 | 0 | 11 | 14 | |
| | 7.1% | 14.3% | 0.0% | 78.6% | 100.0% | |
| HC | 0 | 3 | 2 | 2 | 7 | |
| | 0.0% | 42.9% | 28.6% | 28.6% | 100.0% | |
| O | 0 | 0 | 0 | 6 | 6 | |
| | 0.0% | 0.0% | 0.0% | 100.0% | 100.0% | |
| P | 0 | 0 | 0 | 10 | 10 | |
| | 0.0% | 0.0% | 0.0% | 100.0% | 100.0% | |
| T | 0 | 0 | 0 | 24 | 24 | |
| | 0.0% | 0.0% | 0.0% | 100.0% | 100.0% | |
| TP | 3 | 1 | 1 | 9 | 14 | |
| | 21.4% | 7.1% | 7.1% | 64.3% | 100.0% | |
| B F | 0 | 1 | 0 | 7 | 8 | |
| | 0.0% | 12.5% | 0.0% | 87.5% | 100.0% | |
| B P | 0 | 0 | 0 | 1 | 1 | |
| | 0.0% | 0.0% | 0.0% | 100.0% | 100.0% | |
| DIFFUSE | 0 | 0 | 0 | 2 | 2 | |
| | 0.0% | 0.0% | 0.0% | 100.0% | 100.0% | |
| FTP | 0 | 1 | 0 | 3 | 4 | |
| | 0.0% | 25.0% | 0.0% | 75.0% | 100.0% | |
| NIL | 0 | 0 | 0 | 79 | 79 | |
| | 0.0% | 0.0% | 0.0% | 100.0% | 100.0% | |
| TOP | 0 | 0 | 0 | 4 | 4 | |
| | 0.0% | 0.0% | 0.0% | 100.0% | 100.0% | |
| **TOTAL** | **8** | **8** | **6** | **201** | **223** | |
| | **3.6%** | **3.6%** | **2.7%** | **90.1%** | **100.0%** | |

Supra-tentorial hematomas are associated with high mortality rate.

**Table-16: Association between the Location of Hematoma and Mortality**

| Location | DEATH | | Total | P value |
|---|---|---|---|---|
| | NO | YES | | |
| F | 21 | 2 | 23 | 0.000 |
| | 91.3% | 8.7% | 100.0% | |
| FP | 23 | 4 | 27 | |
| | 85.2% | 14.8% | 100.0% | |
| FT | 10 | 4 | 14 | |
| | 71.4% | 28.6% | 100.0% | |
| HC | 2 | 5 | 7 | |
| | 28.6% | 71.4% | 100.0% | |
| O | 6 | 0 | 6 | |
| | 100.0% | 0.0% | 100.0% | |
| P | 10 | 0 | 10 | |
| | 100.0% | 0.0% | 100.0% | |
| T | 22 | 2 | 24 | |
| | 91.7% | 8.3% | 100.0% | |
| TP | 11 | 3 | 14 | |
| | 78.6% | 21.4% | 100.0% | |
| B F | 7 | 1 | 8 | |
| | 87.5% | 12.5% | 100.0% | |
| B P | 0 | 1 | 1 | |
| | 0.0% | 100.0% | 100.0% | |
| DIFFUSE | 1 | 1 | 2 | |
| | 50.0% | 50.0% | 100.0% | |
| FIP | 3 | 1 | 4 | |
| | 75.0% | 25.0% | 100.0% | |
| NIL | 78 | 1 | 79 | |
| | 98.7% | 1.3% | 100.0% | |
| TOP | 1 | 3 | 4 | |
| | 25.0% | 75.0% | 100.0% | |
| **TOTAL** | **195** | **28** | **223** | |
| | **87.4%** | **12.6%** | **100.0%** | |

The only hematomas significantly associated with fractures were MICTL and SAH.

**Table-17: Type of Fracture and Their Association with SAH**

| Type of fracture | SAH | | Total | P value |
|---|---|---|---|---|
| | NO | YES | | |
| CF | 11 | 0 | 11 | 0.023 |
| | 100.0% | 0.0% | 100.0% | |
| D | 10 | 0 | 10 | |
| | 100.0% | 0.0% | 100.0% | |
| B P | 1 | 0 | 1 | |
| | 100.0% | 0.0% | 100.0% | |
| C | 3 | 0 | 3 | |
| | 100.0% | 0.0% | 100.0% | |
| F | 10 | 0 | 10 | |
| | 100.0% | 0.0% | 100.0% | |
| FP | 2 | 0 | 2 | |
| | 100.0% | 0.0% | 100.0% | |
| MUL | 19 | 3 | 22 | |
| | 86.4% | 13.6% | 100.0% | |
| NIL | 97 | 3 | 100 | |
| | 97.0% | 3.0% | 100.0% | |
| O | 13 | 2 | 15 | |
| | 86.7% | 13.3% | 100.0% | |
| PARIETAL | 8 | 3 | 11 | |
| | 72.7% | 27.3% | 100.0% | |
| TEMPORAL | 34 | 0 | 34 | |
| | 100.0% | 0.0% | 100.0% | |
| TP | 4 | 0 | 4 | |
| | 100.0% | 0.0% | 100.0% | |
| **TOTAL** | **212** | **11** | **223** | |
| | **95.1%** | **4.9%** | **100.0%** | |

**17.1: Type of Fracture and Their Association with MICTL**

| Fractures | MICTL | | | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| | CA | CE | CEA | CS | CSA | CSE | NIL | SA | SEA | |
| CF | 3 | 0 | 0 | 0 | 1 | 0 | 7 | 0 | 0 | 11 |
| | 27.3% | 0.0% | 0.0% | 0.0% | 9.1% | 0.0% | 63.6% | 0.0% | 0.0% | 100.0% |
| D | 0 | 1 | 2 | 0 | 0 | 0 | 6 | 0 | 1 | 10 |
| | 0.0% | 10.0% | 20.0% | 0.0% | 0.0% | 0.0% | 60.0% | 0.0% | 10.0% | 100.0% |
| B P | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| | 0.0% | 0.0% | 0.0% | 100.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 100.0% |
| C | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 3 |
| | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 100.0% | 0.0% | 0.0% | 100.0% |
| F | 1 | 0 | 2 | 0 | 0 | 1 | 6 | 0 | 0 | 10 |
| | 10.0% | 0.0% | 20.0% | 0.0% | 0.0% | 10.0% | 60.0% | 0.0% | 0.0% | 100.0% |
| FP | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 2 |
| | 0.0% | 0.0% | 0.0% | 0.0% | 50.0% | 0.0% | 50.0% | 0.0% | 0.0% | 100.0% |
| MUL | 0 | 1 | 0 | 2 | 2 | 0 | 16 | 1 | 0 | 22 |
| | 0.0% | 4.5% | 0.0% | 9.1% | 9.1% | 0.0% | 72.7% | 4.5% | 0.0% | 100.0% |
| NIL | 4 | 1 | 0 | 6 | 7 | 2 | 74 | 5 | 1 | 100 |
| | 4.0% | 1.0% | 0.0% | 6.0% | 7.0% | 2.0% | 74.0% | 5.0% | 1.0% | 100.0% |
| O | 2 | 2 | 0 | 0 | 4 | 1 | 5 | 1 | 0 | 15 |
| | 13.3% | 13.3% | 0.0% | 0.0% | 26.7% | 6.7% | 33.3% | 6.7% | 0.0% | 100.0% |
| P | 3 | 0 | 0 | 1 | 0 | 0 | 7 | 0 | 0 | 11 |
| | 27.3% | 0.0% | 0.0% | 9.1% | 0.0% | 0.0% | 63.6% | 0.0% | 0.0% | 100.0% |
| T | 3 | 1 | 1 | 3 | 7 | 0 | 18 | 1 | 0 | 34 |
| | 8.8% | 2.9% | 2.9% | 8.8% | 20.6% | 0.0% | 52.9% | 2.9% | 0.0% | 100.0% |
| TP | 1 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 4 |
| | 25.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 75.0% | 0.0% | 0.0% | 100.0% |
| Total | 17 | 6 | 5 | 13 | 22 | 4 | 146 | 8 | 2 | 223 |
| | 7.6% | 2.7% | 2.2% | 5.8% | 9.9% | 1.8% | 65.5% | 3.6% | 0.9% | 100.0% |
| **P Value** | **0.008** | | | | | | | | | |

**Mortality Rate in Various Hematomas**

Second most common mortality among the head injury cases are due to SDH. The incidence of SDH low compared to EDH but mortality rate is high.

**Table-18.1: Mortlity Rate Associated With SDH**

| | Other Cases | Deaths in SDH | Total | P value |
|---|---|---|---|---|
| NO DEATHS | 187 | 8 | 195 | 0.000 |
| | 95.9% | 4.1% | 100.0% | |
| NO. OF DEATHS | 21 | 7 | 28 | |
| | 75.0% | 25.0% | 100.0% | |
| Total | **208** | **15** | **223** | |
| | **93.3%** | **6.7%** | **100.0%** | |

**Mortality associated with edh**

Only 3 cases are died due to EDH even though incidence of EDH high than SDH.

**Mortality associated with sah**

**Mortality associated with ich**

Third most common cause of death is ICH. The mortality rate due to ICH was 21.4%.

**Table-18.2: Mortlity Rate Associated With SDH**

| | Deaths in ICH | Other Cases | Total | P value |
|---|---|---|---|---|
| NO DEATHS | 5 | 190 | 195 | 0.000 |
| | 2.6% | 97.4% | 100.0% | |
| NO. OF DEATHS | 6 | 22 | 28 | |
| | 21.4% | 78.6% | 100.0% | |
| Total | **11** | **212** | **223** | |
| | **4.9%** | **95.1%** | **100.0%** | |

**DISCUSSION**

The present study consists of 246 people with traumatic brain injury were admitted to Sree Balaji Medical College and Hospital, between March 2016 to February 2017. After exclusion criteria applied 223 patients out of 246 were included in this study. Head injury is a major health problem and common cause of disability and death. In developing countries like India the incidence of traumatic brain injury is increasing as traffic increases. CT plays an important role in diagnosis and treatment. An earlier study by Asaleye C. M. [5], in 2005, from Nigeria, in patients with moderate to severe head injury showed that 87 % of the patients had abnormal CT findings. In this study, 73.5% had abnormal findings due to head injuries.

In this study the incidence of traumatic brain injuries is common among the 21-40 years (48.9%) of age group followed by 41-60 years age group (28.3%) and below 20 years age group (11.7%). The incidence among the above 61 years age group is 11.2%. This is similar to a study done by Zimmerman and Bilaniuk [6] and Satish Prasad B. S., Sharma M. Shetty [7] in which they found maximum injuries in the age group of 19-50 years (79%), people above 50 were 21%. These are in contrast to the study by K. J. Van Dongen, *et al*.[8] in which the maximum incidence was noted in the age group below 20 years (40 %) followed by 21 - 40 years and 40 - 60 years. The increased incidence in this study among the age group of 21-40 years can be explained by the fact that these are the people who are active in life and who ride motorized two wheelers and four wheelers and are hit by the heavy vehicles in the road traffic accidents. In this study we found significant association between age group and outcome of the patient. Surprisingly no mortality was found in patients below 20 years age group. Out of 28 deaths high mortality rate found among older people >61 years of age, 15 deaths noted in these age group (60%). Mortality rate in 41-60 years age group is 12.7% (8 deaths out of 28).The study shows highly significant 'P values (0.000)' in association between age group and outcome of the patient. This can be explained by the time elapse between the injury and medical care and associated systemic insult that are more likely to result in poor out come. Similarly a study done by Seelig J. M. and Becker [9] found patients under 21 years have better outcomes than older people. Narayan R. K. *et al*. [10] showed that study age is important determining in outcome.

In this study males had higher incidence (76.2%) of head trauma compared to females (23.8%), Consistent with Clifton GL *et al.*, [11] in their study found male to female ratio 5:1. And also Satish Prasad B. S. and Shama M. Shetty, *et al.*, [7] in their study reported a male to female ratio of 9:1.Mortality rate among the males are higher than females. Kraus JF, Peek ASA *et al.*, [12] found no significant difference between the outcome and gender. It was found that more males suffered from head trauma as compared to females because of the exposure of males to traffic and outdoor activities than females in India. The male to female ratio was 3:1. Our findings were consistent with

Bharti, *et al*., [13] who reported that males were predominantly involved with head injuries (85 %). This study reveals that 35% of patients had more than one finding on CT. Among the various CT findings the incidence of multiple intracranial traumatic lesions is 35%. Multiple hematomas are the most common intra-cranial traumatic lesions in this study. This can be explained by more number of cases brought to the hospital are associated with heavy motor vehicle accidents not a simple accidents because the hospital situated near the national hive so heavy vehicular traffic is more.

Among all MICTL contusions associated with extra axial hematomas forming majority of lesions, most common are CSA (contusions, subdural hematoma, and subarachnoid hemorrhage) followed by CA (contusions and subarachnoid hemorrhage) and CS (contusions and subdural hematoma) CEA (contusions, epidural hematoma, subarachnoid hemorrhage) CE (contusions, epidural hematoma). Less common are CSE (contusions, subdural hematoma, epidural hematoma), SEA (subdural hematoma, epidural hematoma, subarachnoid hemorrhage). Ashok Nayak, *et al*., [14] showed contusions are the common intra-cranial traumatic lesions.

MCTL were more frequent in 21-40 years age group, but morality rate was high only above 61 years age group.This study showed highest proportion of skull fractures in the temporal region followed by multiple regions and parietal region. Common location of MICTL in the fronto- parietal region followed by temporal. The highest mortality rate was seen in the fronto-parietal location of hematomas. Significant P values are obtained in my study with MTICL associated with location, fractures, midline shift and mortality.

According to Mac Pherson and Jennet [15], the occurrence of cerebral contusions varied from 30 % to 40 %. The mechanism of contusion production was complex, with lesions occurring at the site of impact (coup) as well as sites remote from the impact (countercoup).Contusions are second most common intra cranial hematomas (13%) after MICTL in this study. More frequent in 21-40 years age group, but mortality rate was high only above 61 years age group. The overall mortality due to contusions is 7.1%.

Common location of contusions were in the bilateral frontal lobe (30.4%) followed by frontal-temporal (28.6%). Common fractures associated with contusions are frontal-parietal (50%) and comminuted fractures (33%).

Ashok Nayak's study [14] showed an incidence of 66 % with a mortality rate of 36 % with contusions. The early detection of extra-axial hematomas, as made possible by CT scan, results in early surgical intervention with marked improvement in morbidity and mortality in head trauma patients. Regrettably, some patients with extra-axial bleeds present for imaging investigation and management after long delays, thus greatly impacting the final outcome. Reasons for this include delays on conservative management in non-specialized hospitals.

Second most common mortality in head injury patients are due to SDH (25%) after multiple intracranial traumatic lesions (32.2%).This study Showed 15 cases of SDH out of 223 cases. Majority of the patients are in the age group of 41-60 years and above 61 years. Sub-dural hematoma occurred in approximately 5 % to 22 % of patients with severe head injuries as reported by Seeling, *et al*., [16] and was the most lethal of all head injuries as it was commonly associated with concomitant parenchymal brain injuries. In the present study, it was found in 19.37% of the patients. SDH are more common in the frontal-parietal-temporal (50%) region followed by hemi-calvarial location (42%).Most common fractures associated with SDH are temporal bone fracture followed by frontal and parietal bones. Statistically significant midline shift associated with SDH. 50% association noted with midline shift greater than 10mm, 25% and 17% in $<$5mm and $>$5mm midline shift.

Acute subdural haematoma (ASDH) is still a condition with a high mortality and morbidity. The reported incidence of ASDH is as high as 5% in patients with head trauma and some retrospective studies report increased incidence with age [17].

In spite of advances in neuro-traumatology and aggressive neuro-surgical interventions, the mortality rate of traumatic ASDH is still high in majority of the series ranging between 39 % and 75 % [18]. Wilberger, *et al*., [19] reported that the overall mortality from traumatic ASDH is 66 % and functional recovery 19 %. In our series, the overall mortality was 20.1% and functional recovery 45.6%.This incidence of EDH is higher than the SDH in this study, is third commonest hematoma found next to MICTL and contusions. 20 (9%) cases out of 223 were EDH. EDH are most frequent than SDH because in most age group prone for accidents are young people, correlated with age incidence of EDH. Occipital region (33.3%) is most frequently affected followed by temporal (25%) region and parietal (20%) region. Common fractures associated with EDH are temporal-parietal bone fractures and comminuted fractures. Zimmerman stated that epidural hematoma was most common (65%) in temporo-parietal region [18].

Samuddrala, *et al*. stated that epidural hematomas are associated with skull fractures in more than 90 % of patients [20]. The epidural hematomas are frequently associated with linear fractures according to Phonprasert [21].There is no significant association found between the EDH and midline shift. Only 12%

association is noted in <5mm midline shift cases. Mortality rate in this study due to EDH is 10.7% (3 out of 20 are died). The incidence was high as compared to SDH but mortality is low. The incidence of traumatic subarachnoid hemorrhage, reported by different authors, ranged from 12% to 44% [22]. In the present study, it was found in 11 (4.9%) cases out of 223 patients. More frequent in 21-60 years age group. By location, diffuse involvement is most common followed by frontal-parietal region. Parietal bone fractures followed by multiple fractures associated with SAH. The study shows 11 (4.9%) cases out of 223 were intra cerebral hematomas. According to Hirsh, intra-cerebral hematomas of frontal and temporal lobes were commonest in head injuries [44]. In the present study, the intracerebral hematoma was found in 11 patients (4.5%) in the fronto-parietal location followed by diffuse involvement. Ashok – Nayak *et al.*, [14] revealed maximum incidence in temporal 26%, parietal 22% and then frontal 18% occipital 2%. Mortality rate in relation to the site of ICH was relevant; it is found that it was high in sites like basal ganglia and thalamus, cerebellum. This is similar to Nayak Ashok *et al*., [14] most common fractures associated with ICH are temporal followed by temporal-parietal fractures. Out of 11 cases (4.9%), 6 cases (21.4%) were died; highly significant P values are obtained in relation to deaths associated with intra cerebral hematomas. In my study ICH found to be third most common cause of death after multiple intracranial traumatic pathologies and SDH.The incidence of ICH (4.9%) in this study does not correlate with the incidence of Nayak – Ashok *et al*., [14] in which incidence of ICH is 54% but my study showed similarity peak age incidence in 21-40 years age group. The study showed similarly with Jamison's study as far as the mortality rate was considered. This study showed that older people with ICH showed poor outcome. This is similar to the Gutman *et al*., [23].

**Table-19: Comparison of Incidence of Various Hematomas with Previous Studies**

| | B Lee 54 2005 | Sc Ohaeg Bulam 99 [24]2011 | Satish Prasad B.S, Shama M Shetty [7] 2014 | Presentstudy |
|---|---|---|---|---|
| Peak incidenceof age | - | $2^{ND}$ decade | 18-30 years | 21-40 years |
| Incidence of MICTL | - | 13% | - | 35% |
| Incidence of contusions | 43% | 30% | 57% | 13% |
| SDH | 10-20% | 27% | 28% | 6.7% |
| EDH | | 8% | 16% | 9% |
| SAH | 11% | - | - | 4.9% |
| ICH | - | - | 8% | 4.9% |
| FRACTURES | - | 23.4% | 81% | 55.2% |
| High Mortality In | SDH<br>50-85% | - | ICH<br>62.5% | MICTL<br>32.2% |

In the present study, skull fracture was maximally present in the temporal region. Next most common are multiple fractures. Among the type of fractures linear fracture was the most frequent type followed by depressed and comminuted fractures.

The highest mortality rare present in the hematomas associated with depressed and comminuted fractures. Depending on the location, size, and type of fracture, fractures may need to be surgically repaired to relieve or prevent CSF leakage, infection, hemorrhage, or vascular compromise.

Although plain films of the skull may detect fractures, CT is the imaging modality of choice. Fractures involving para-nasal sinuses, mastoid air cells, or the entire thickness of the calvarium can allow air to enter the intracranial space. Such pneumocephalus is often absorbed over time, but when persistent, raises suspicion of a CSF lead. Patients with basilar skull fractures should receive follow-up CT scan to exclude pneumocephalus

**Table-20: Studies Comparison of Midline Shift with Previous Studies**

| | Chiewvit p [27] | Present study |
|---|---|---|
| Total no of cases | 216 | 223 |
| Total Cases with MS | 96 | 13 |
| <5mm MS | 6 | 5 |
| >5mm MS | 53 | 5 |
| >10mm MS | 37 | 3 |
| mortality | High in > 10mm shift | High in >10mm shift |

Comparison of midline shift with study done by chiewvit *et al*.

**Table-21: Comparison of Mortality among Various Hematomas with Previous Stidies**

| CT findings | Gupta Prashant K.,Krishna Atul [25]Oct - Dec 2011 | | Present study | |
|---|---|---|---|---|
| | No. of cases | Mortality | No. of cases | Mortality |
| CONTUSIONS | 242 | 121 (50%) | 29(13%) | 2(7.1%) |
| EDH | 116 | 28(24%) | 20(9%) | 3(10.7%) |
| SAH | 110 | 87(79%) | 11(4.9%) | 1(3.6%) |
| ICH | 177 | 88(49%) | 11(4.9%) | 6(21.4%) |
| MICTL | - | - | 78(35%) | 9(32.2%) |

In this study the most frequent mode of accidents was road traffic accidents comprising 78% of all head injuries. Heavy motor vehicles, two wheeler, four wheelers, autos were responsible majority.

The second most frequent mode of accidents was falls. Least common are assault cases coming from the adjacent village using sticks, iron road and hatchets. These figures re comparable with Gutman *et al*., [23] in whose series RTA was the most common mode of head injury followed by falls. Gutman *et al*., series showed that majority involved in RTA that the motor vehicle occupants. This can be explained by the fact the Gutman *et al*., series the commonest mode of transport are cars and other four wheelers in their country, where as in our city commonest mode of transport is two wheelers and autos.

When age incidence is taken 21-40 years age group was the most prone for the head injuries. This is similar to Gutman *et al*., [23]series. Above 61 years age group suffered the highest mortality in our series and also in Gutman *et al*., series. This can be explained by the fact that in elderly patients the cerebral atrophy causes increased propensity for the bridging veins to tear and also because of the increased fragility of intracranial vessels secondary to atherosclerotic damage.

There is a significant need for objective measures to predict the clinical course of TBI patients. Clinical variables, including GCS scores, extent of amnesia, duration of ventilator support, and duration of intensive care unit stay, have weak relationships with subsequent neuropsychiatric testing.

Although some anatomic imaging findings such as the presence of blood or subarachnoid hemorrhage, intra-ventricular hemorrhage, edema, mid-line shift, effacement of the basal cisterns, and location of lesions have been found to be predictive of overall survival, they are not adequately predictive of functional outcome, even when clinical data are added.

Ultimately, functional outcome depends on how many neurons are preserved after injury. However, the location of damage and the ability of existing neurons to reorganize their connections to recover function are also critical. Neuronal injury is caused by direct injury, compression, ischemia, and diffuse axonal injury (DAI).

DAI, which occurs in up to 48 % of patients with closed head injuries, is caused by the shear force generated by the rapid deceleration in motor vehicle accidents. The force may either tear the axons or alter axoplasmic membranes, which subsequently impairs axoplasmic transport and results in delayed damage to axons.

DAI usually is diffuse and bilateral, frequently involves the lobar white matter at the gray-white matter interface and may be reversible. Although DAI is rarely fatal, it can result in significant neurological impairment. The number of lesions correlates with poorer outcomes, and lesions in the supra-tentorial white matter, corpus callosum, and corona radiata correlate with a greater likelihood that the patient will remain in a persistent vegetative state. Whereas hemorrhagic axonal injury can be seen on CT as multiple foci of high attenuation, non-hemorrhagic injury can be missed. In fact, CT is abnormal in less than half of all patients with DAI.

Wei *et al*., stated that the coronal reformations improve the detection of intracranial hemorrhage over axial images alone, especially for lesions which lie in the axial plane immediately adjacent to bony surfaces and should be considered in the routine interpretation of head CT examination for evaluation of head injury victims [26].

Limitations of the study due to Beam-hardening effects, displacement of the CT signal near metal objects, bone, calcifications, and high concentrations of contrast, can degrade the image quality and prevent accurate assessment. CT can miss small amounts of blood that occupy widths less than a slice because of volume averaging. CT findings may lag behind actual intracranial damage, so that examinations performed within 3 h of trauma may underestimate injury. In the absence of changes in neurological status, it is still under debate whether CT scans should be repeated after a normal admission CT.

## CONCLUSION

CT scan helps in identification of majority of intracranial hematomas. CT scan has precisely localized the parenchymal damage of the brain of head trauma victims rapidly and non-invasively, for prompt and effective management as patients with head injury deteriorate suddenly. Evidence of parenchymal damage on CT is predictive of poor outcome. The common age groups affected in head injuries are 21-40 years (48.9%), followed by 41-60 years (28.3%) age group.The incidence of mortality rate is more in the age group above 61 years. Incidence of head injuries is more common among the males (76.2%) as compared to females of all intracranial hematomas, multiple intracranial traumatic lesions (MICTL) are most frequent type (35.5%) in which contusions associated with other hematomas are common, followed by contusions (13%) and EDH (9%), SDH (6.7%), SAH (4.9%), ICH (4.9%).In EDH occipital region was most commonly affected followed by temporal and parietal. 21-40 years age group were most commonly affected, mortality rate 10.7%.In SDH fronto-temporo-parietal regions (50 %) followed by hemi-calvarial regions (42.6 %) were the most common locations affected. The most frequent age group affected in SDH was 41-60 years age group. The mortality rate was 25%. In contusions bilateral frontal lobe involvement (62.5%) is most frequent. The age group commonly affected is 21-40 years. Mortality rate due to contusions 7.1%.In ICH most common location is temporal-occipital-parietal (50%) followed by bilateral frontal. Most common age group affected is 21 - 40 years. Third highest mortality rate noted in cases with ICH, the mortality rate was 21.4%.Of all skull fractures temporal bone fractures was most common followed by multiple bony fractures. Skull fractures are most common when associated with MICTL. Road traffic accidents were most common mode of head injury and 21-40 years ago group was the most frequent group involved. Shift of mid line structures and type of intracranial traumatic pathology were the most power full prognostic indicator determining the outcome of head injury patients. Shift of midline structures more than 10mm has a worst prognosis; the mortality rate is highest in these cases. CT scan head and brain helps in assessing the extent of damage to the intracranial structures and there by helps in assessing the prognosis by accurate evaluation of type of hematoma, site, size and extent and mid line shift and mass effect, the age of the patient also helps in determining the prognosis.C.T scan helps in the modifying the line of management of patients and review.

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