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Dr. Sanjay S Vhora
MCh (Neurosurgery)
Professor & HOD
Neurosurgery, B. J. Medical College & Sasoon General Hospital Pune. Maharashtra

Dr. Ramesh Pandurang Sangle
MBBS MS, Mch Associate Professor

Dr. Charandeep
Senior Resident, Neurosurgery
G.B. Pant .Hospital. New Delhi

Dr. Mayur V Barhate
MBBS, MS (Gen.Sx)
Senior Resident

Dr. Madhur M Pardasani
JR-III M. S. General Surgery
B. J. Medical College & Sasoon General Hospital Pune. Maharashtra

Dr. Rohit Pandey
JR-II M. S. General Surgery
B. J. Medical College & Sasoon General Hospital Pune. Maharashtra

Parth Vhora
3 rd MBBS student
B. J. Medical College & Sasoon General Hospital Pune. Maharashtra.

Correspondence
Dr. Sanjay S Vhora
MCh (Neurosurgery)
Professor & HOD
Neurosurgery, B. J. Medical College & Sasoon General Hospital Pune. Maharashtra

CT scan as predictor of outcome in traumatic brain injury

Dr. Sanjay S Vhora, Dr. Ramesh Pandurang Sangle, Dr. Charandeep, Dr. Mayur V Barhate, Dr. Madhur M Pardasani, Dr. Rohit Pandey, Parth Vhora

Abstract
Introduction: The term "Traumatic Brain Injury" is synonymous with Head Injury. The main evidence of Head Injury is loss of consciousness or alteration in conscious state following injury. Brain function is temporarily or permanently impaired and structural damage may or may not be detectable with current technology.
TBI is an injury that often affects a younger population. The occurrence of TBI peaks with age groups below 5 years, between 15-24 years, about half of those with very severe TBI do not survive. Of those who die, 50% do so within the first couple of hours after the injury. Trauma is still the leading cause of death from people ages 1 to 44. As TBI mainly affects normal healthy individuals it is important to treat it in golden hour & Platinum minutes to reduce mortality & morbidity. Treatment should be aggressive & proactive. CT scan is easily available, Non invasive, less time consuming & help sin treatment decisions we studied cases of TBI with CT scan finding as predictor of outcome in TBI.
Aim & Objectives: To study the CT scan as one of the important Prognostic Factors in Cases of Traumatic Brain Injury (TBI).To Study other pre-injury parameters that must be considered in analyzing a patients prognosis
Material & Methods: We selected 45 patients admitted in Tertiary care hospital. These patients were diagnosed to have traumatic brain injury with surgery as the primary line of management. The study design was a prospective non randomized trial.
Data was analyzed by using SPSS (Statistical package for social sciences) version 17:0.
Observation: Traumatic Brain Injury is more common in the younger age group. In our study acute (Subdural Hematoma) SDH was the most common CT scan finding followed by depressed fractures and (Extradural Hematoma EDH. Chronic SDH and retro orbital hematoma were the least common.
Depressed fracture, chronic SDH & EDH have good prognosis whereas acute SDH has guarded prognosis.
Patients with acute SDH with midline shift with no other CT scan abnormality have better prognosis than patients with acute SDH with midline shift with severe SAH / contusions.
There is association between type of hematoma and survival at 1 year. EDH has good prognosis whereas acute SDH has guarded prognosis.
Conclusion: Traumatic brain injury is more common in the younger age group CT scan findings) is an independent predictors of survival in patients of Traumatic Brain Injury (TBI).

Keywords: Traumatic brain injury (TBI), Sub dural Hematoma (SDH), Extra dural hematoma (EDH), Sub Arachnoid Hemorrhage (SAH)

Introduction
Traumatic brain injury (TBI), also known as intracranial injury, occurs when an external force traumatically injures the brain. TBI is a major cause of death and disability worldwide, especially in children and young adults. Prevention measures include use of technology to protect those people who can get involved in accidents, such as use of seat belts and motorcycle helmets, as well as efforts to reduce the number of accidents, such as safety education programs and enforcement of traffic laws.
Brain trauma causes secondary injury, a variety of events that take place in the minutes and days following the injury. These processes, which include alterations in cerebral blood flow and the pressure within the skull, contribute substantially to the damage from the initial injury.

TBI can cause a host of physical, cognitive, social, emotional, and behavioral effects and outcome can range from complete recovery to permanent disability or death. The 20th century saw critical developments in diagnosis and treatment which decreased death rates and improved outcome. These include imaging techniques such as computed tomography scan (CT scan) and magnetic resonance imaging (MRI). Depending on the injury, treatment required may be minimal or may include interventions such as medications and emergency surgery. Physical therapy, speech therapy, recreation therapy, and occupational therapy may be employed for rehabilitation.

All traumatic brain injuries are head injuries, but the latter term may also refer to injury to other parts of the head [1-3.]. However, the terms *head injury* and *brain injury* are often used interchangeably [4]. Similarly, brain injuries fall under the classification of central nervous system injuries [5]. And neuro-trauma [6]. In neuropsychology research literature, the term "traumatic brain injury" generally is used to refer to non-penetrating traumatic brain injuries.

Damage from TBI can be focal or diffuse, confined to specific areas or distributed in a more general manner, respectively [7]. However it is common for both types of injury to exist in a given case [7].

Types of injuries considered diffuse include edema (swelling) and diffuse axonal injury, which is widespread damage to axons including white matter tracts and projections to the cortex [8, 9].

Focal injuries often produce symptoms related to the functions of the damaged area [5]. Hematomas, also focal lesions, are collections of blood in or around the brain that can result from hemorrhage [10]. CT or MRI Scan Results - The cranial tomography (CT) scan is a procedure that provides the physician a picture of the brain that allows detection of disorders such as bruises, blood clots and swelling.

CT scan is a must in the following cases

A. All the patients with severe head injury.
B. All the patients with moderate head injury
C. In minor head injury cases when anyone of the following is present :

- History of convulsion
- History of CSF leak from nose or ear
- Compound head injury
- Severe headache or repeated vomiting or loss of consciousness
- Patients under influence of alcohol

In some cases, a magnetic resonance imaging (MRI) scan may also be performed. Eg: Cases of diffuse axonal injury in which CT scan imaging may be normal. Focal lesions have good prognosis if intervention is carried out timely.

We studied cases of TBI with special reference to CT scan findings, so that treatment can be carried out aggressively for the better outcome of patient.

Material & Methods

The study design was a prospective non randomized trial.

We selected 45 patients diagnosed to have traumatic brain injury with surgery as the primary line of management.

All patients records with respect to their name, age, sex, address, contact number, time & place of injury, CT Scan Photographic folder, psycho social background, history of alcohol abuse, prior brain injury, GCS scores at the time of admission pupillary status, Neuro deficits, time lag in shifting the patient to the hospital and all associated injuries were recorded.

Detailed clinical history of each patient was taken. This was followed by blood tests, chest x-ray, USG abd+ pelvis & CT scan. Only patients having positive CT scan findings which needed surgery as the primary line of management were included in the study. Some patients had positive CT scan findings but had a GCS score of 3/15 and pupils were fixed and dilated. Surgery was not advised to such patients due to poor prognosis. Thus, these patients were excluded from the study.

Post-op, patients were evaluated everyday till they were discharged from the hospital or death occurred. Patients once discharged were followed up every month for a period of one year.

All the collected data was tabulated and a master chart was prepared. Data was analyzed by using SPSS (Statistical package for social sciences) version 17:0. We have used chi-square test, fisher's exact test to find association between survival at one year and the various parameters.

P value of less than 0.05 is considered as significant association. After analysis of the data results were put forth.

Observation

1. Distribution of patients with respect to age (years).

Table 1

Age group	Number of patients	Percentage (%)
≤ 50	36	80.0
> 50	9	20.0
Total	45	100.0

This table explains that 36 patients out of 45 patients are ≤ 50 years of age i.e. 80% of the sample size. 9 patients out of 45 patients are > 50 years of age i.e. 20 % of the sample size.

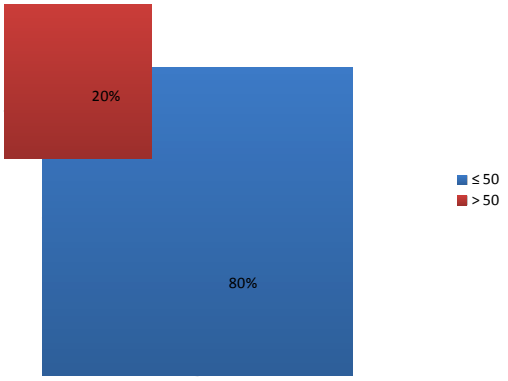

Fig 1

2. Distribution of patients with respect to GCS score.

Table 2

GCS score	Number of patients	Percentage (%)
3 - 5	7	15.6
6 – 9	12	26.7
> 9	26	57.8
Total	45	100.0

Table 2 explains that in our study 15.6% of the patients belong to the GCS score of 3-5. 26.7% of the patients belong to the GCS score of 6-9 & 57.8 % of the patients belong to

the GCS score of 10-15.

In our study only those patients requiring surgery as the primary line of treatment are included. Patients with a poor GCS score of 3/15, pupils fixed and dilated are usually not operated due to poor prognosis & hence excluded from our study. As a result GCS score group of 3-5 has decreased in our study. Hence no conclusion can be made.

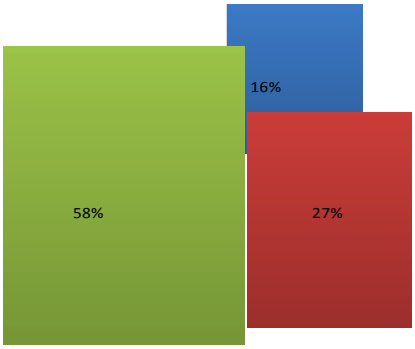

Fig 2

3. Distribution of patients with respect to pupil findings.

Table 3

Pupil	Number of patients	Percentage (%)
Pupils equal reactive to light	14	31.1
Pupils equal sluggishly reactive to light	13	28.9
pupils unequal reacting to light	7	15.6
pupils unequal not reacting to light	7	15.6
Pupils fixed dilated	2	4.4
Pupils cannot be Assessed	2	4.4
Total	45	100.0

Table 3 explains that in our study 60% of the pupils are equal & fully or sluggishly reactive to light. 15.6% of the pupils are unequal but reacting to light. 20% of the pupils are either not reacting to light or fixed and dilated. In our study only those patients requiring surgery as the primary line of treatment are included. Patients with a poor GCS score of 3/15, pupils fixed and dilated are usually not operated due to poor prognosis & hence excluded from our study. As a result pupil fixed & dilated group has decreased in our study. Hence no conclusion can be made.

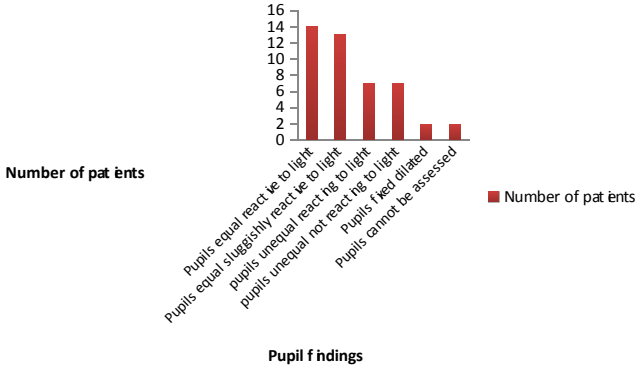

Fig 3

4. Distribution of patients with respect to CT scan findings.

Table 4

CT scan findings	Number of patients	Percentage (%)
Depressed fracture	11	24.44
Chronic SDH	3	6.67
EDH	10	22.22
Hemorrhagic contusions	9	20.00
Acute SDH	15	33.33
Retro orbital hematoma	1	2.22

Table 4 explains that depressed fracture as a CT scan finding was seen in 24.44 % of the patients, chronic SDH was seen in 6.67%, EDH in 22.22%, hemorrhagic contusions in 20%, acute SDH in 33.33% & retro orbital hematoma in 2.22% of the patients.

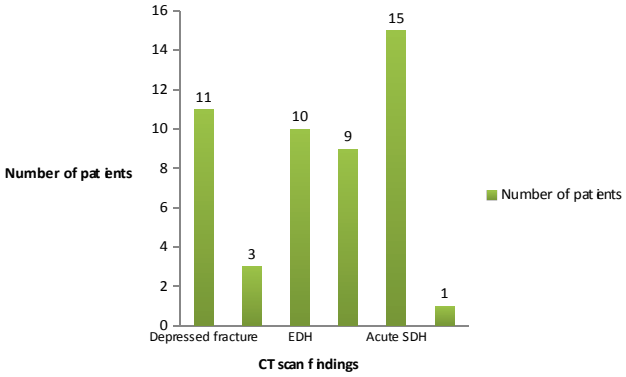

Fig 4

5. Distribution of patients with respect to survival at 1 year.

Table 5

Survival at 1 year	Number of patients	Percentage (%)
Yes	32	71.1
No	13	28.9
Total	45	100.0

Table 5 explains that in our study 71.1 % of the patients were alive at the end of 1 year and 28.9 % of the patients died by the end of 1 year.

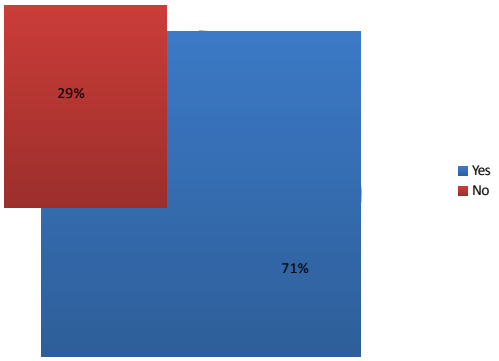

Fig 5

6. Distribution of patients with respect to CT scan findings and survival at 1 year.

Table 9

	Survival at 1 yr		Total
	Yes	No	
Depressed fracture	10	1	11
Chronic SDH	3	0	3
EDH	9	1	10
Hemorrhagic contusions	6	3	9
Acute SDH	5	10	15
Retro orbital hematoma	1	0	1

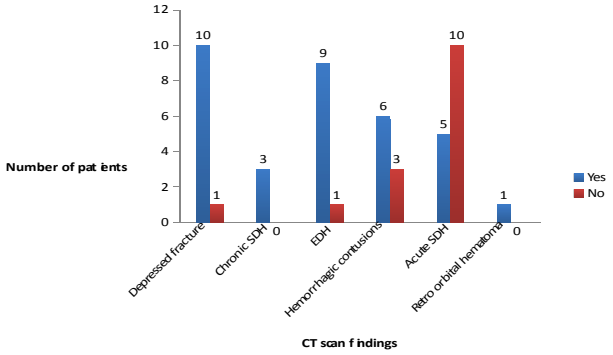

Fig 9

7. Distribution of patients with respect to CT scan findings for SDH and survival at 1 year.

Table 10

	Survival at 1 yr	
	Yes	No
SDH with midline shift	5	4
SDH with SAH/contusion	0	6

Table 10 explains that out of the 9 patients who had acute SDH with midline shift with no other CT scan abnormality, 5 patients survived at 1 year. On the other hand patients who had acute SDH with midline shift with severe SAH / contusions, none survived at one year.

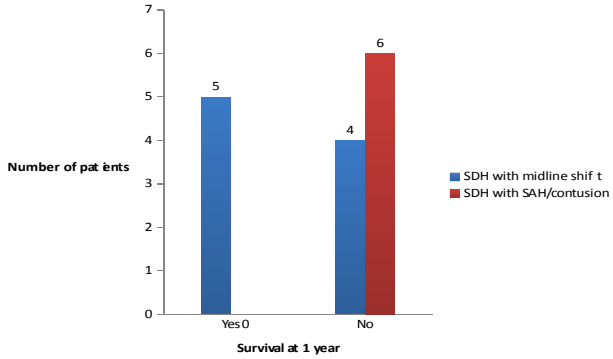

Fig 10

8. Distribution of patients with respect to type of hematoma and survival at 1 year.

Table 11

Type of hematoma	Survival at 1 yr		Total	p-value
	Yes	No		
EDH	9	1	10	0.04
SDH	8	10	18	

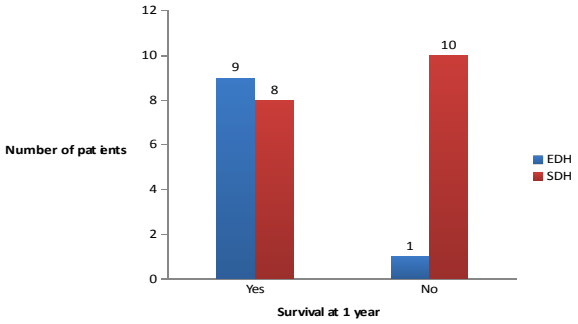

Fig 11

Observation

Traumatic Brain Injury is more common in the younger age group.

In our study acute SDH was the most common CT scan finding followed by depressed fractures and EDH. Chronic SDH and retro orbital hematoma were the least common.

Depressed fracture, chronic SDH & EDH have good prognosis whereas acute SDH has guarded prognosis.

Patients with acute SDH with midline shift with no other CT scan abnormality have better prognosis than patients with acute SDH with midline shift with severe SAH / contusions.

By using Fisher's exact test p-value < 0.05 therefore there is association between type of hematoma and survival at 1 year. EDH has good prognosis whereas acute SDH has guarded prognosis.

Discussion

In our study we took a sample size of 45 patients. Out of these 45 patients, 36 were under the age of 50 years and 9 were above the age of 50 yrs. Out of the 36 patients that were under the age of 50 years, 29 patients survived at one year and 7 patients did not survive at one year. That means 80 % of the patients <50 years who came to the casualty and were diagnosed as having traumatic brain injury that needed surgery survived at one year. 20 % of patients < 50 years did not survive at one year.

CT scan findings were divided into 6 groups. Some patients had multiple findings on CT scan. Such patients were included in both the groups. For example: if a patient had SDH with hemorrhagic contusions then he/she was included in both the groups i.e, the 'SDH' group and the 'hemorrhagic contusions' group.

11 patients out of 45 had depressed skull vault fractures.10 patients out of these 11 patients survived at one year. 3 patients out of 45 patients had chronic SDH. All 3 patients survived at one year. 10 patients out of 45 patients had EDH. 9 patients out of these 10 patients survived at one year. 9 patients out of 45 patients had hemorrhagic contusions. 6 patients out of these 9 patients survived at one year. 15 patients out of 45 patients had acute SDH. Only 5 patients out of these 15 patients survived at one year. One patient had retro-orbital hematoma and he survived at the end of one year.

From these findings it is obvious that depressed fractures, chronic SDH and EDH have good prognosis (provided that the patients under these groups have a good GCS score) while acute SDH has guarded prognosis.

Out of the 15 patients that on CT scan had acute SDH, 9 patients had acute SDH with midline shift with no added findings on CT scan imaging. Out of these 9 patients, 5 patients survived at the end of one year. The remaining 6 patients had acute SDH with midline shift with severe SAH/

hemorrhagic contusions. None of these 6 patients survived at one year. This shows that patients having acute SDH have guarded prognosis. In this acute SDH group, the prognosis is better if the patient has only acute SDH with midline shift and no other CT scan finding. Patients with acute SDH with midline shift with severe SAH/ hemorrhagic contusions have dismal prognosis.

10 patients out of 45 patients had EDH out of which 9 patients survived. 18 patients out of 45 patients had acute/ acute on chronic/ chronic SDH out of which 8 patients survived.

By using Fisher's exact test, p value < 0.05 there is a significant association between Type of hematoma and survival at one year, EDH having better prognosis than acute SDH.

CT Scan Findings and Outcomes of Head Injury Patients: A Cross-Sectional Study [11] - RESULTS OF THIS STUDY ARE AS FOLLOWS : The common age group was between 20-50 years (70.9%), and less than 13% were elderly (> 60years) patients. Males had higher incidence of head trauma than females (306 vs. 76). History of altered sensorium (68.3%) was the most common clinical presentation, followed by vomiting (47.6%), headache (34.2%), nasal/aural discharge (28%), convulsions (9.8%), shock (4.9%), respiratory distress (3.7%), and abdominal distension (2.4%). Long bone or pelvic bone fractures were the most commonly associated injury (13.4%), followed by maxillary or mandibular fracture (11%), chest injury (4.9%), abdominal visceral injury (3.7%), and spinal injury (2.4%). Cerebral edema was detected in 63.4% of the cases, followed by skull fracture (62%), hemorrhagic contusion (46.3%), and epidural hematoma (30.4%). Acute subdural hematoma was present in 19.4% and subarachnoid hemorrhage was seen in 28.8% patients, midline shift in 24.3% patients, pneumocranium in 12% and intra-ventricular hemorrhage in 10.7% of the patients. The highest proportion of skull fractures was found in the frontal region (49%), followed by temporal or temporo-parietal region (33.3%), followed by parieto-occipital region (17.6%). The proportion of pneumocranium in frontal, temporal or temporo-parietal and parieto-occipital regions was 60%, 30% and 10%, respectively. Epidural hematoma was present in temporo-parietal region in 48.0% patients, 32% in frontal region, and 20% in parieto-occipital region. In about half of the patients, intracerebral hematoma was present in the frontal region. Overall, coup injuries were greater than counter coup injuries at all sites. Intra-cerebral hematoma was present in frontal regions in majority of the cases (52.5%), followed by temporo-parietal (26%), and parieto-occipital region (21.5%). Samudrala *et al* stated that epidural hematomas are associated with skull fracture in more than 90% of patients.

Summary

Traumatic brain injury is more common in the younger age group. Acute SDH was the most common CT scan finding followed by depressed fractures and EDH. Chronic SDH and retro orbital hematoma were the least common. Survival at one year was 71.1%. Due to advances in anesthetic and neuro-surgical techniques, survival at one year is on the rise. There is significant association between age in years and survival at 1 year. Traumatic brain injury in older patients has poorer survival. There is significant association between CT scan finding and survival at 1 year. Depressed fractures, chronic SDH and EDH have good prognosis whereas acute SDH has guarded prognosis. Patients with acute SDH with midline shift with no other CT scan abnormality have better prognosis than patients with acute SDH with midline shift with severe SAH/ hemorrhagic contusions. There is significant association between type of hematoma on CT scan and survival at 1 year. EDH having better prognosis than acute SDH.

Conclusion

Thus we conclude that CT scan findings is an independent predictor of survival in patients of Traumatic Brain Injury (TBI).

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