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Original Research Article

Evaluation and Outcome of Traumatic Brain Injury in a Tertiary Care Hospital in North Bihar: A Prospective Study

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Abstract

Background: Traumatic Brain Injury (TBI) is a global epidemic causing significant morbidity and mortality. The outcome of TBI depends on quality of care. This study was ensued to evaluate the characteristics of TBIs in North Bihar and the outcomes.

Materials and Methods: This prospective study included details of TBI patients seen in the Surgery Department of Darbhanga Medical College and Hospital, Darbhanga, Bihar. All patients of any age with TBI were included in the study. Then inclusion and exclusion criteria were applied and the Study Population was obtained. The patients were clinically assessed and imaging was done and the data obtained were compared to find any correlation. The outcomes were also assessed.

Results: During the study period, 2,354 patients of TBI were seen. Out of this, after applying inclusion and exclusion criteria, 2,041 patients were included in Study Population. There were 70.4% males and 29.6% females. Most common culprit was Road Traffic Accidents (RTA) (56%), followed by Assaults (33%). Head injury was mostly mild (64%) and 16% had severe injury. Severe Head Injury patients had more incidence of intracranial bleed compared to Mild Head Injury. Thus Correlation exists between Clinical features and radiological findings. Mild head injury has best prognosis with complete recovery compared to severe head injury having 20% mortality. Prognosis also depends on the distance from where the patient is coming.

Conclusions: Traumatic Brain Injuries are mostly mild to moderate with low mortality rate.

Keywords: Traumatic Brain Injury, Road Traffic Accidents, Glasgow Coma Scale – Pupil Score.

Introduction

Traumatic Brain Injury (TBI) is defined as mechanical damage to the brain resulting in disruption of brain function. It may be mild, where the patient is conscious and oriented to time, place and person, moderate head injury causing concussion, or it may be severe enough to render the patient unconscious and even lead to death. It may cause a focal neurological deficit or may diffusely involve the brain resulting in cerebral edema or intracranial bleeding [1]. As per recent estimates, 69 million people sustain TBI annually. Road Traffic Accident (RTA) is a major cause of TBI in South East Asia (56%). Thus around 1.5% annual population is a victim of TBI secondary to RTA [2]. Other causes of TBI include – falls, assaults, trauma during sports or recreational activities.

TBI is a major cause of global morbidity and mortality in both children and adults, thus putting a burden on the health care infrastructure [3,4]. Outcome in TBI depends on clinical assessment and imaging studies. Basic predictors to prognosticate TBI clinically include – Patient's age and comorbidities, Glasgow Coma Scale (GCS) score, Pupil Reactivity and any other major life-threatening injuries. Non-contrast CT Scan of Brain is the investigation of choice in Emergency setting for evaluation of TBI. It helps to understand the severity and predict its outcome [5].

Outcome of TBI also depends on the quality of Emergency Care, which further depends on both human resources as well as health care infrastructure. Effective Emergency care significantly reduces morbidity and mortality . Quality of Emergency care in Low to Middle Income Countries (LMICs) is poor as compared High Income Countries (HICs) [6-8]. Appropriate and timely disposal of effective Emergency care plays pivotal role in preventing long term disabilities in TBI [9]. As per records, overall incidence as well as hospitalisation due to TBI has risen in HICs, but rate of mortality has not risen significantly, which indicates improved quality of patient care and timely intervention [10]. However, limited data is available from LMICs in this regard [11,12].

This study was ensued to evaluate the characteristics of TBI patients in North Bihar and their outcome in the Emergency Department.

Materials and Methods

Study Design: This prospective longitudinal study included patient for 16 Months- 1st September 2022 to 31st December 2023, from the Surgery Department of Darbhanga Medical College and Hospital, Darbhanga, Bihar. This study was conducted after approval from the Ethical Committee of the Institute. Patients' consents were taken before data collection and proper statistical analysis was done.

Inclusion Criteria:

- All TBI patients of any age and sex that were admitted via Surgery Out-patient and Emergency Department of the Institute and who gave consent for the study.

Exclusion Criteria:

- Patients not agreed to consent for the study.
- Patients who received primary care and did not prefer admission.
- Patients with other serious life-threatening injuries like Chest, Abdomen, Spine or Limb trauma which could affect outcomes.

Clinical Assessment:

Glasgow Coma Scale – Pupil (GCS-P) Score [13]

It is a combination of Glasgow Coma Scale (GCS) Score and Pupil reactivity. GCS Score gives an overall assessment of brain function (Table1). GCS Score is calculated as the sum total of best Eye response, best Vocal response and best Motor response. Pupil reactivity score (PRS) predicts worsening of outcome in for any value of GCS. There exists a correlation between combination of GCS Score with PRS and Severity of head injury (IMPACT and CRASH trials). It can be used to grade TBI into mild, moderate and severe.

Table 1: Glasgow Coma Scale (GCS) Score

Eye Opening	Verbal Response	Motor Response	Pupil Reactivity Score (PRS)
Spontaneously = 4	Well Oriented = 5	Obeys commands = 6	Both unreactive to light = 2
On Verbal Command = 3	Confused = 4	Localises Pain = 5	One unreactive to light = 1
To Painful Stimulus = 2	Inappropriate response = 3	Withdrawal to Painful Stimulus = 4	Nonunreactive to light = 0
No Eye Opening = 1	Incomprehensible sounds = 2	Abnormal Flexion (Decorticate posturing) = 3	
	No Verbal Response = 1	Abnormal Extension (Decerebrate posturing) = 2	
		No Motor Response = 1	

GCS Score = E- Score + V- Score + M- Score
GCS-P Score = GCS Score – PRS

Interpretation:

- 14-15 = Mild Head Injury
- 9-13 = Moderate Head Injury
- 3-8 = Severe Head Injury

Imaging Studies:

Following NCCT Brain findings were found –

- Normal CT scan with/without scalp edema
- Extradural Hematoma (EDH)
- Subdural Hematoma (SDH)
- Subarachnoid Hemorrhage (SAH)
- Cortical Hemorrhage / Hemorrhagic Contusion

Depressed Skull Fracture / Facial bone fracture / Hairline fracture of skull bone

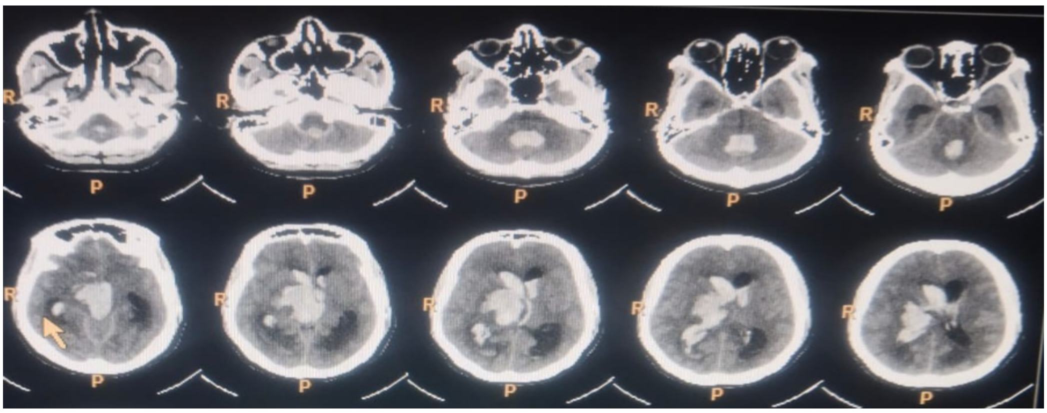

Figure 1: Intracerebral hemorrhage

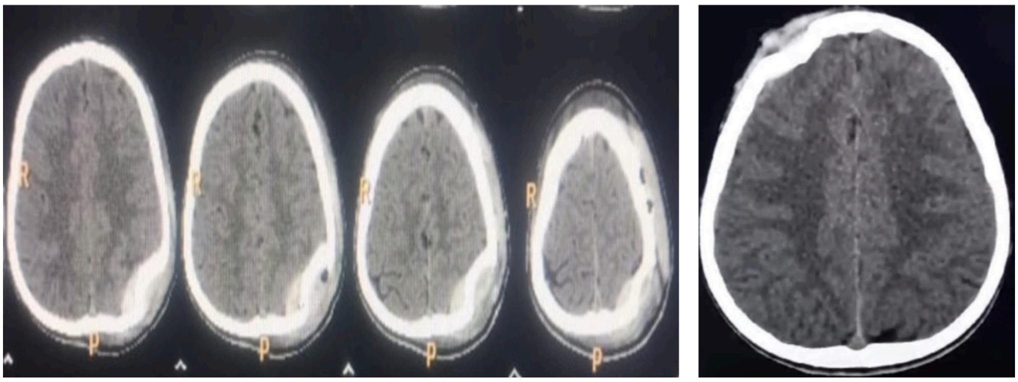

Figure 2: Depressed skull fracture

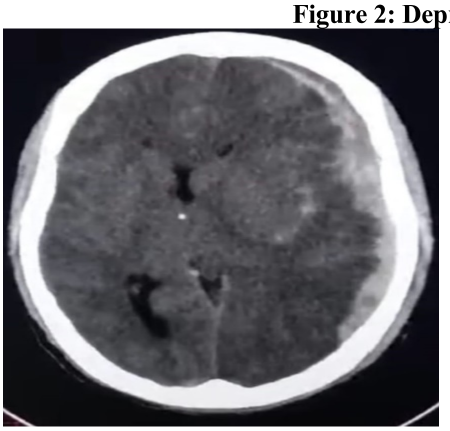

Figure 3: Subdural hematoma

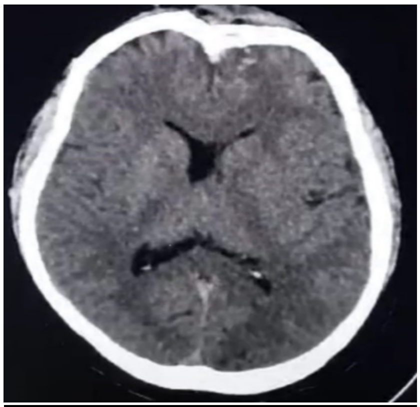

Figure 4: Hemorrhagic contusion

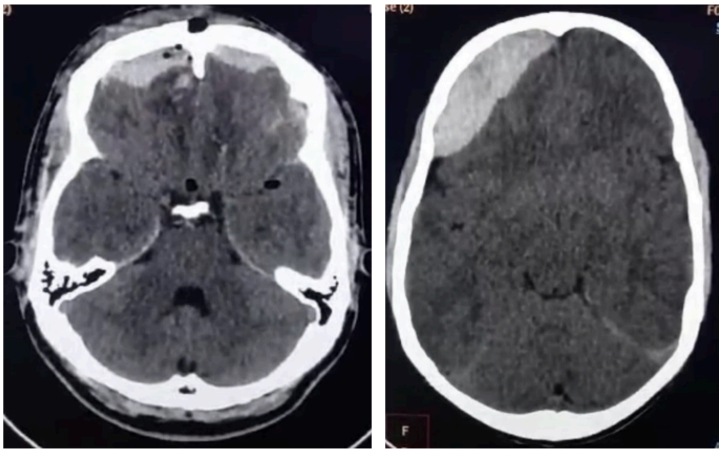

Figure 5: Extradural hematoma

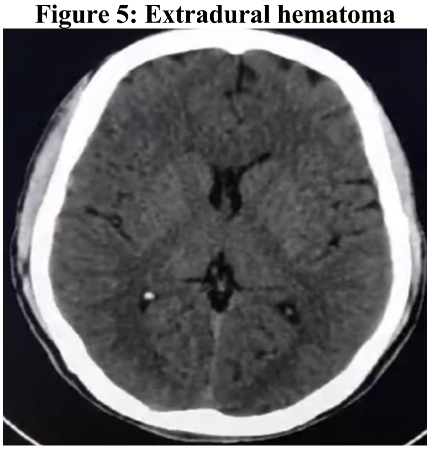

Figure 6: Normal NCCT Brain

Methodology:

The cause of trauma was classified as RTAs, Falls, Assaults, Gunshot Injury, Trauma during sports and recreational activities. The clinical parameter to assess severity used in this study is GCS-P score. The imaging assessment was on the basis of NCCT Brain findings.

The immediate outcome was classified as follows –

- Admission – those who required hospital admission.
- Disposed – Discharged from Emergency department after initial management.
- Detained and Disposed – who were kept under observation for 24 hours and then discharged
- Transferred – those who were referred to another hospital due to any reason.

NCCT Brain was performed in all patients and all the information was assembled on a structured proforma.

Statistical Analysis: Statistical Analysis was done through IBM Statistical Package for the Social Sciences for Windows version 24.0. For continuous variables, the mean was calculated. For categorical variables, percentages were calculated.

Result

Enrolled Patients

All total of 2,354 TBI patients attended the Surgery Out-patient and Emergency departments of the Institute, making an estimated 5 patients per day. The month-wise distribution of the patients is as shown in table 2 and fig. 7.

Table 2: Month-wise distribution of TBI patients

Month & Year	TBI Patients Attending Surgery Department	%
September, 2022	141	6
October, 2022	187	8
November, 2022	213	9
December, 2022	117	5
January, 2023	70	3
February, 2023	72	3
March, 2023	142	6
April, 2023	141	6
May, 2023	164	7
June, 2023	166	7
July, 2023	143	6
August, 2023	140	6
September, 2023	164	7
October, 2023	210	9
November, 2023	189	8
December, 2023	95	4
Total	2354	100

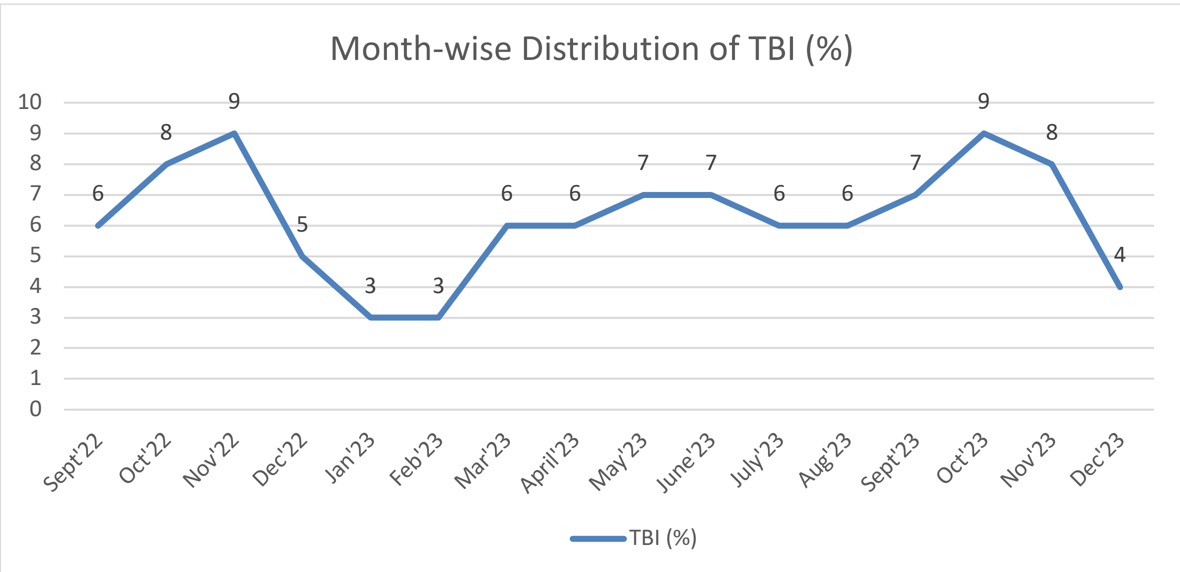

Figure 7: Month-wise distribution of TBI patients

Out of 2,354 patients, when the Inclusion and Exclusion criteria were applied, 313 patients were excluded from the study. Thus, our study population comprised of 2,041 patients of TBI. Of 2,041 patients, 1,538 patients belonged to low socio-economic status (75.4%), 351 patients belong to middle socio-economic status (17.2%) and 152 patients belong to high socio-economic status (7.4%) as per Revised Kuppuswamy Scale (Jan, 2021) (Fig. 8). There were 1436 male patients (70.4%) and 605 female patients (29.4%) in the study (Fig. 9).

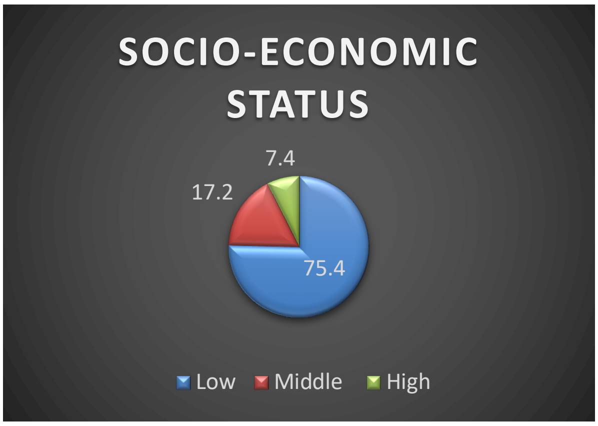

Figure 8: Socio-economic Distribution of TBI patients

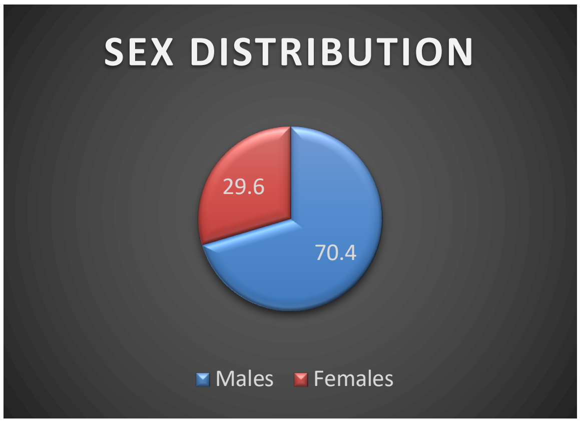

Figure 9: Sex Distribution of TBI patients

The patients are again classified based on the distance of occurrence of incident to our Institution. A thorough enquiry has been made whether the patient received primary treatment at lower health facilities or not (Table 3).

Table 3: Classification of TBI patients based on their distance of occurrence of incident

Distance (KM)	Received Treatment	Did Not Receive Treatment	Total
0-10	108	197	305
10-50	917	465	1382
>50	312	42	354
TOTAL	1337	704	2041

Age Distribution of the Patients: The mean age of the patients is 31years 10months and there is distribution is as given below. From the table given below, we find that the incidence of TBI is highest among 20-40 years age group (48.8%), followed by 0-20 years age group (24.9%) (Table 4 & Fig. 10)

Table 4: Age Distribution of TBI patients

Age Group (Years)	No. of TBI Patients	%
0-20	508	24.9
20-40	997	48.8
40-60	390	19.1
>60	146	7.2
TOTAL	2041	100

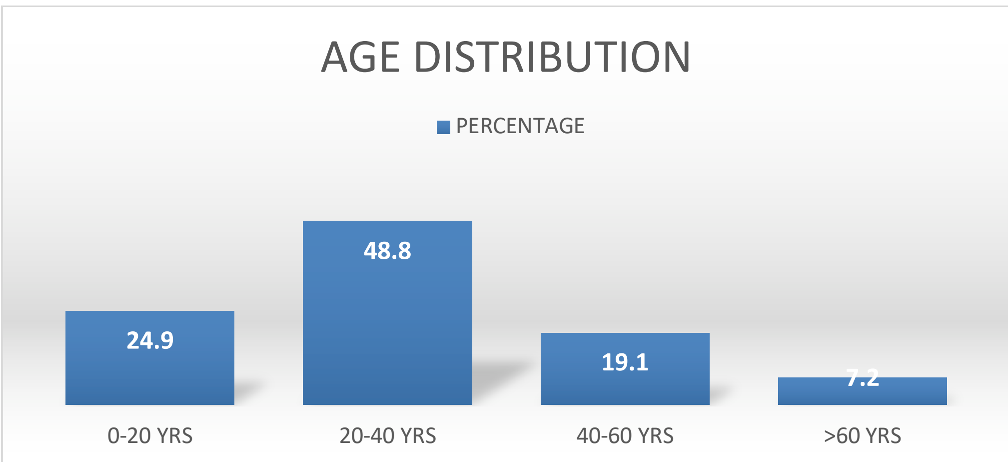

Figure 10: Age Distribution of TBI patients

Mode Of Injury	Male (%)	Female (%)	Total (%)
RTA	866 (75.7%)	278 (24.3%)	1144 (100%)
Assaults	413 (61.5%)	259 (38.5%)	672 (100%)
Fall	106 (64.6%)	58 (35.4%)	164 (100%)
Trauma During Sports	31 (75.6%)	10 (24.4%)	41 (100%)
Gunshot Injury	20 (100%)	0 (0%)	20 (100%)
Total	1436 (70.4%)	605 (29.6%)	2041 (100%)

Mode of trauma: Table 5. Different modes of Injury of TBI patients and their sex distribution
When the mode of trauma was assessed, RTAs were found to be the most prevalent cause of TBI. There were 1144 cases of RTA (56%) reported during the study, which accounted for approximately 2.3 cases per day. The second most common cause of TBI was Assaults with 672 cases (33%). An estimate of 1.4 cases of assaults were treated each day. Other minor causes include falls (8%), Trauma during sports (2%) and Gunshot injury (1%). The gender-wise distribution of mode of injury is as mentioned above (Table 5 & Fig. 11).

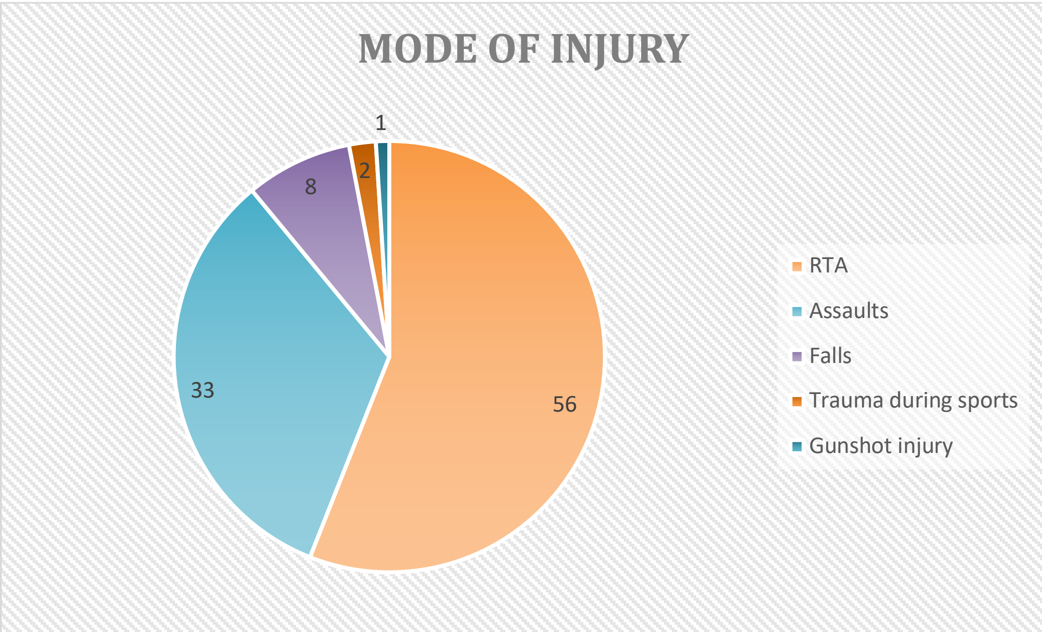

Figure 11: Different of Modes of Injury in TBI patients

Correlation of Socio-economic Status with Mode of Injury: When the Socio-economic statuses of the patients were compared with their Mode of Injury, the following results were obtained. The study shows RTAs and Assaults are more common among Low Socio-Economic groups, while Trauma during Sports and Gunshot injury are more common among High Socio-Economic groups (Table 6 & Fig. 12)

Table 6: Socio-Economic Distribution of Different modes of Injury of TBI patients

Mode of Injury	Low Income Group (%)	Middle Income Group (%)	High Income Group (%)	Total (%)
RTA	939 (82%)	136 (12%)	69 (6%)	1144 (100%)
Assaults	515 (76.6%)	137 (20.4%)	20 (3%)	672 (100%)
Fall	70 (42.6%)	57 (34.8%)	37 (22.6%)	164 (100%)
Trauma During Sports	11 (26.8%)	14 (34.2%)	16 (39%)	41 (100%)
Gunshot Injury	3 (15%)	7 (35%)	10 (50%)	20 (100%)
Total	1538 (75.4%)	351 (17.2%)	152 (7.4%)	2041 (100%)

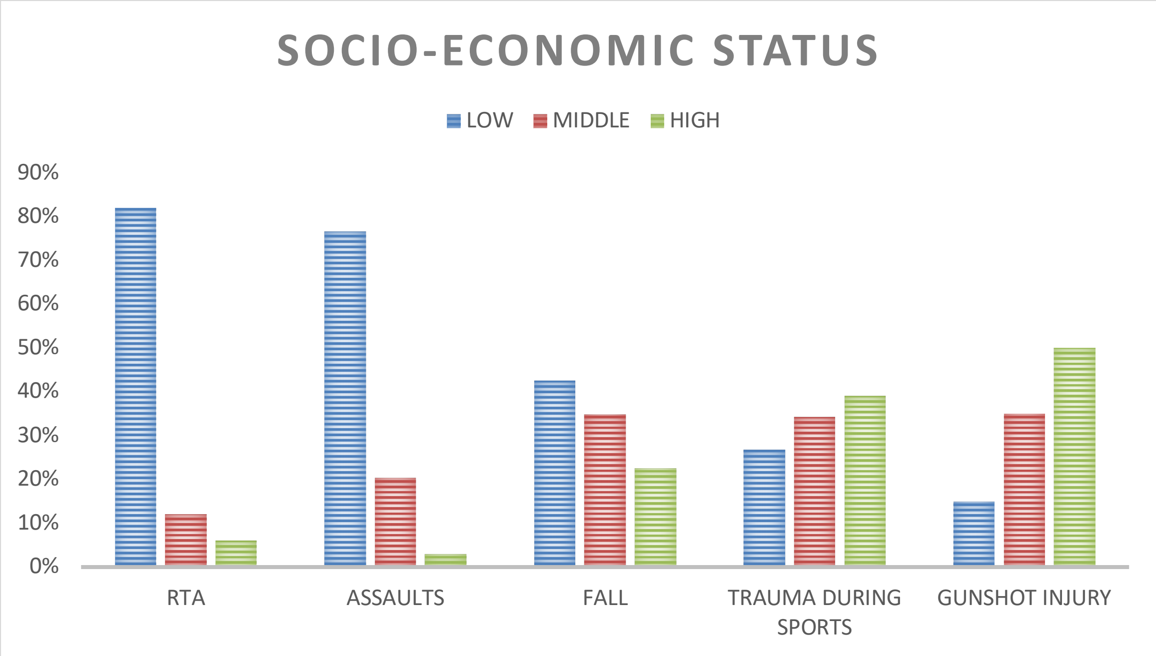

Figure 12: Socio-Economic Distribution of Different modes of Injury of TBI patients

Correlation of Age with Mode of Injury: When the mode of injury was compared with age group, it was found RTAs, Assaults, Trauma during Sports and Gunshot injuries were common among young population, while Falls are more prevalent among extremes of age (Table 7 & Fig. 13)

Table 7: Age Distribution of Different modes of Injury of TBI patients

Mode of injury	0-20 Years	20-40 Years	40-60 Years	>60 Years	Total (%)
RTA	297 (26%)	639 (55.9%)	162 (14.1%)	46 (4%)	1144 (100%)
Assaults	118 (17.5%)	326 (48.5%)	196 (29.2%)	32 (4.8%)	672 (100%)
Falls	75 (45.7%)	5 (3.1%)	19 (11.6%)	65 (39.6%)	164 (100%)
Trauma during sports	17 (41.5%)	15 (36.5%)	7 (17.1%)	2 (4.9%)	41 (100%)
Gunshot injury	1 (5%)	12 (60%)	6 (30%)	1 (5%)	20 (100%)
Total	508 (24.9%)	997 (48.8%)	390 (19.1%)	146 (7.2%)	2041 (100%)

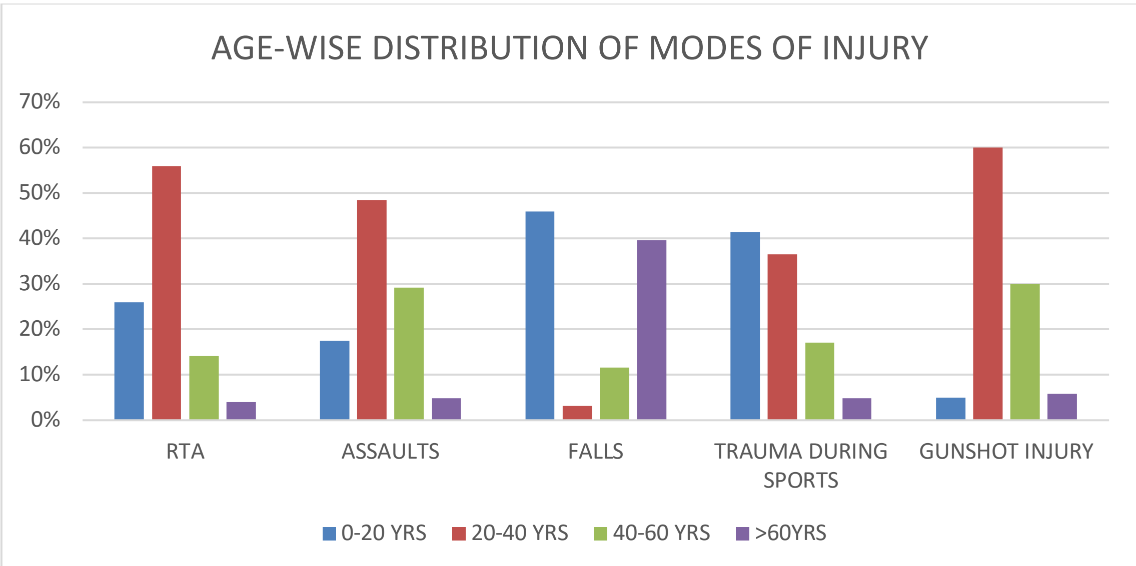

Figure 13: Age Distribution of Different modes of Injury of TBI patients

Types of TBI: There were 1269 patients (62.17%) who had suffered polytrauma. Lacerations and limb fractures were common. However, polytrauma patients with other life-threatening injuries than TBI were already excluded from the study, as mentioned in the Exclusion criteria. Most polytrauma patients were injured in RTA. Head lacerations were present in 93% patients. NCCT Brain findings were present in 795 patients and its gender-wise distribution is summarised in table 8 below.

Table 8: Different NCCT Brain Findings in TBI

NCCT Brain Findings	Male (%)	Female (%)	Total (%)
Extradural Hematoma	200 (13.9%)	135 (22.3%)	335 (16.4%)
Subdural Hematoma	138 (9.6%)	52 (8.6%)	190 (9.3%)
Subarachnoid Hematoma	117 (8.1%)	81 (13.4%)	198 (9.7%)
Intracranial Hemorrhage / Contusion	279 (19.4%)	163 (26.9%)	442 (21.7%)
Skull bone/ Facial bone fracture	328 (22.8%)	102 (16.9%)	430 (21.1%)
No finding	875 (60.9%)	371 (61.3%)	1246 (61%)
Total	1436 (100%)	605 (100%)	2041 (100%)

Clinical Severity of TBI: Based on GCS-P Score, the patients were classified into mild, moderate and severe TBI. In our study, there were 1307 mild cases, 406 moderate cases and 328 severe cases (Fig. 14 & Table 9)

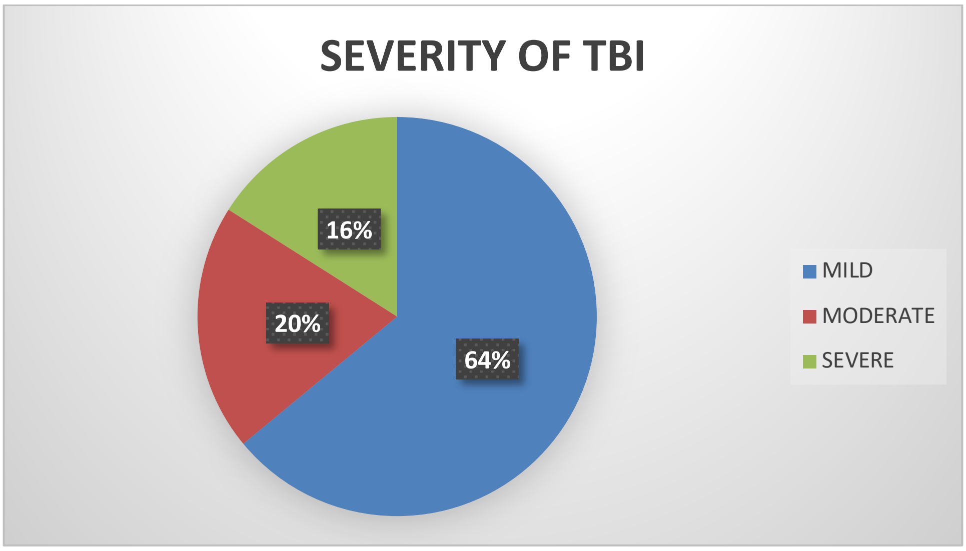

Figure 14: Clinical Severity wise Distribution of TBI patients

Table 9: Clinical Severity wise Distribution of TBI patients with Sex distribution

Severity of TBI	Male (%)	Female (%)	Total (%)
Mild	973 (74.4%)	334 (25.6%)	1307 (100%)
Moderate	285 (70.2%)	121 (29.8%)	406 (100%)
Severe	178 (54.3%)	150 (45.7%)	328 (100%)
Total	1436 (70.4%)	605 (29.6%)	2041 (100%)

Correlation of Clinical Severity with Radiological Findings: Out of 328 cases of Severe TBI in our study, we had 221 cases of EDH (67.4%), 184 cases of Intracerebral hemorrhage (56%), 143 cases of Skull bone fractures (43.6%), 77 cases of SAH (23.4%) and 49 cases of SDH (14.9%) (Table 10 & Fig. 15).

In case of Moderate TBI, out of 406 cases, there were 172 cases of normal NCCT brain (42.4%), 114 cases of EDH (28%), 104 cases of Intracerebral hemorrhage (25.6%), 99 cases of Skull bone fracture (24.4%), 86 cases of SAH (21.2%) and 48 cases of SDH (11.8%) (Table 10 & Fig. 15).

In case of Mild TBI, out of 1307 cases, 1074 patients have a normal NCCT Brain (82.2%), 187 patients have facial bone fracture or a hairline skull bone fracture (14.3%), 154 patients have multiple tiny hemorrhagic contusions (11.8%) and 93 cases of SDH (7.1%). There were no cases of EDH and SAH among Minor TBI group (Table 10 & Fig. 15).

Table 10: Clinical Severity wise Distribution of TBI patients with their NCCT Brain findings

NCCT Brain	Mild TBI	Moderate TBI	Severe TBI	Total
Normal	1074 (82.2%)	172 (42.4%)	0 (0%)	1246 (61%)
Skull Bone/ Facial Bone Fracture	187 (14.3%)	99 (24.4%)	143 (43.6%)	430 (21.1%)
Intracerebral Hemorrhage / Contusion	154 (11.8%)	104 (25.6%)	184 (56%)	442 (21.7%)
SAH	34 (2.6%)	86 (21.2%)	77 (23.4%)	198 (9.7%)
SDH	93 (7.1%)	48 (11.8%)	49 (14.9%)	190 (9.3%)
EDH	0 (0%)	114 (28%)	221 (67.4%)	335 (16.4%)
Total	1307 (100%)	406 (100%)	328 (100%)	2041 (100%)

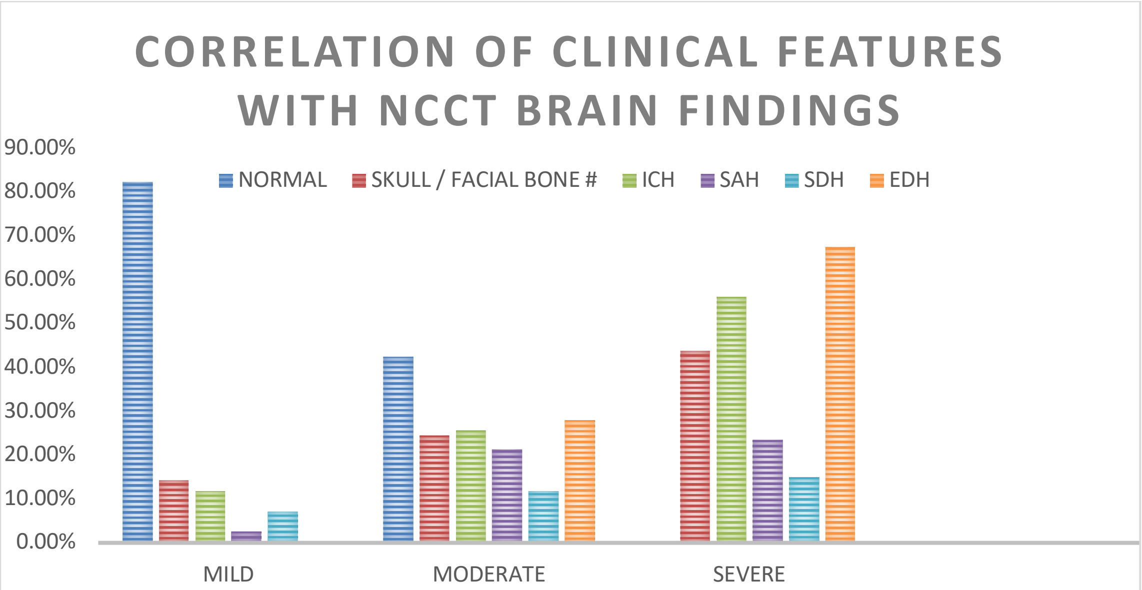

Figure 15: Correlation of Clinical Features with NCCT Brain findings in TBI patients

Thus, from the above finding, we can conclude that the probability of getting intracranial bleeding (EDH/SDH/SAH/Intracerebral bleed) is more among the Severe TBI as compared to mild and moderate ones. Hence Clinical Severity matches with Radiological Findings.

Outcome

After a full assessment and all first aid measures, the immediate outcome of TBI patients was categorised into four classes – admission, disposed, detained and transferred. Disposed patients were not included in the study, as they were lost to follow up. Admitted and Detained patients received treatment as per their clinical grading and radiological findings and followed up till 6 months of injury. Transferred patients were traced and followed up accordingly.

Patients with minor head injury had a good prognosis. Patients were managed as per their injuries like Facial bone fracture or Intracranial hemorrhagic contusions. Average length of Hospital stay for Minor Head Injury was 3 days, almost 85% patients being discharged by 48hrs. 6 month follow up showed no residual neuro-deficit (Table 11).

Most of the patients with Moderate TBI were managed conservatively, while a few required interventions. There was no mortality among this group. Average length of Hospital Stay for patients in this group was 10 days, though 70% patients were discharged by 7th day. Till 6 months follow up all patients were doing well having no disability or residual neuro-deficit (Table 11).

Severe TBI patients did not have a good outcome. They were provided life support and definitive intervention as per need. Out of 328 patients, 32 patients died within 24 hours of admission (9.7%), 296 patients did survive. However, only 196 of them had a complete recovery by 6 months (59.7%), while rest 100 patients still had residual paralysis (30.5%).

Table 11: Outcomes as per Clinical Severity in TBI

Severity of TBI	Complete Recovery	Residual Neuro-Deficit Till 6 Months	Mortality	Total
Mild	1307 (100%)	0 (0%)	0 (0%)	1307 (100%)
Moderate	406 (100%)	0 (0%)	0 (0%)	406 (100%)
Severe	196 (59.8%)	100 (30.5%)	32 (9.7%)	328 (100%)
Total	1909 (93.5%)	100 (4.9%)	32 (1.6%)	2041 (100%)

Correlation of Outcome with Place of Occurrence of Incident: Outcome also depends on the Place of Occurrence of the incident and whether or not primary treatment has been provided. Patients coming from >50km far without receiving any treatment has high mortality (20%) and poor recovery (30% residual neuro-deficit), while patients coming from <10km has a favourable outcome (99% complete recovery) irrespective of receiving any primary treatment (Table 12).

Table 12: Outcomes as per the distance of occurrence of incident

Distance (KM)	Received Primary Treatment	Complete Recovery	Residual Neuro-Deficit	Mortality	Total
0-10	Yes	107 (99.1%)	1 (0.9%)	0 (0%)	108 (100%)
0-10	No	195 (99%)	2 (1%)	0 (0%)	197 (100%)
10-50	Yes	909 (99.1%)	7 (0.8%)	1 (0.1%)	917 (100%)
10-50	No	419 (90.1%)	34 (7.3%)	12 (2.6%)	465 (100%)
>50	Yes	259 (83%)	43 (13.8%)	10 (3.2%)	312 (100%)
>50	No	20 (47.6%)	13 (31%)	9 (21.4%)	42 (100%)
Total		1909 (93.5%)	100 (4.9%)	32 (1.6%)	2041 (100%)

Discussion

Due to the evolving trend of socio-economic factors, TBI has become a major epidemic in the 21st century especially in developing countries like India. In this Prospective Longitudinal Study of TBI, from a Tertiary Hospital in North Bihar, Road Traffic Accidents were identified to be the most common cause (56%). This finding is coherent with our National data [8]. The second most common cause of TBI was found to be Assaults (33%) in this study, which differs from the National data. Falls have been attributed as the second most common cause of TBI in India [8]. The reason for this variation can be many like – poor literacy rates, poor enforcement of laws, etc.

In the present study it was observed that mostly young (21-40 years) and productive population is getting affected by Intracranial injury and majority of patients were males (70.4%) which is close to the IMPACT study (2007), according to which TBI case are dependent on age [14] . Study of M.K. Goyal, et al. (2010) also concluded that most affecting age group to be 21-40 years and 66% were males [15]. Road traffic accidents (60%) was found to be major common mode of injury which is close to the similar finding i.e. 65.73% in the study of A. Pathak, et al. (2008) [16]. In the study of KU Tobi et al in 2016 Patients aged between 31 and 40 years accounted for the majority (24.2%), followed by patients between 21and 30 years old (19.8%) [17].

From this study, we found that most of the TBIs are mild in nature (64%), which have a very good prognosis, with no mortality or residual disabilities till 6 months of follow up. However, severe cases (16%) had poor prognosis – around 80% survived and 20% expired. Among the severe TBI patients that survived, 30% had residual neuro-deficit even after 6 months. Poor prognosis among severe cases can be attributed to lack of timely ambulance service, lack of trained medical personal and equipments at Primary and Secondary levels of Health Care, and lack of sufficient ventilators and ICU beds at Tertiary levels.

A correlation does exist between the Clinical Severity and Radiological findings in TBI patients , as evident from higher incidence of intracranial hemorrhage in Severe cases compared to moderate and mild cases. This is helpful particularly in predicting outcome and initiation of treatment. Low Glasgow coma score at admission was associated with poor outcome at the time of discharge. Mortality rate was 1.6% was in our Study which is close to study of Ram et al in 2014. Prognosis also depends on the distance of place of injury to health care facility. Nearest to the health care facility, better is the outcome. Thus overall prognosis is good.

Conclusion

The trends of TBI have been shown in this study. Major culprits include RTAs and Assaults in North Bihar. Most cases are mild with a favourable outcome. Mortality in TBI is generally low. However, due to lack of resources, and travel distance outcome is poor for severe cases. There exists a positive correlation between clinical assessment and imaging studies, which is helpful in predicting outcome and thereby necessary actions can be taken.

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