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Original Article

Impact of Diffuse Traumatic Brain Injury on Survival and Quality of Life in Eastern India

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Abstract

Introduction: Diffuse axonal injury (DAI) is a brain injury characterized mainly as axonal injury of the white matter. In DAI, there is microscopic damage to the axons in the brain neural tracts, corpus callosum, and brainstem and is associated with significant mortality and morbidity. The occurrence of DAI depends on the mechanism of injury; it is more common in higher energy trauma, especially traffic accidents. DAI is clinically defined by coma lasting 6 h or more after traumatic brain injury (TBI), excluding cases of swelling or ischemic brain lesions.

Aims: The aim of the study was to study the impact of diffuse TBI on survival and quality of life (QOL): A prospective and observational study from a Level 1 trauma care center in Eastern India and to study the impact of associated injuries such as musculoskeletal/thoracoabdominal/spinal trauma on overall survival and outcome.

Materials and Methods: A non-randomized, prospective, and observational study was conducted in Department of Neurosurgery, Level 1 Trauma Care Centre IPGME and R and SSKM Hospital, Kolkata from April 2020 to August 2021. One hundred patients were taken in our study.

Results: Mean age of our study population was 37 years with a mortality rate of 66%. The majority of the patients 66 (66%) had extended Glasgow outcome scale (GOSE) score 1–2, 6 (6%) patients had GOSE score 3–4, 12 (12%) patients had GOSE score 5–6 while 16 (16%) patients had GOSE score 7–8. The mean QOL (Index score) and QOL (visual analog scale score) of our study was 0.541 ± 0.5212 and 69.15 ± 22.703, respectively.

Conclusion: Patients with Glasgow coma scale <8 and longer stay in intensive care unit expired having GOSE 1–2 while patients with FOUR score more than 12, Marshall score 1, no requirement of airway/ventilatory support and no complications had better QOL.

Key words: Diffuse axonal injury, Survival and outcome, Traumatic brain injury

INTRODUCTION

Diffuse axonal injury (DAI) is a brain injury characterized mainly as axonal injury of the white matter.[1] It often follows brain trauma, which causes wide-ranging denaturation of white matter, focal hemorrhage, emergence of axonal retraction balls, and microglia clusters. DAI is often accompanied by other brain injuries, and this has caused patients severe brain damage or even placed them in a persistent vegetative state. According to reports made in recent years, the mortality rate of DAI is 42–62%.[2]

In DAI, there is microscopic damage to the axons in the brain neural tracts, corpus callosum, and brainstem and is associated with significant mortality and morbidity. The occurrence of DAI depends on the mechanism of injury; it is more common in higher energy trauma, especially traffic accidents.[3,4] DAI is clinically defined by coma lasting 6 h or more after traumatic brain injury (TBI), excluding cases of swelling or ischemic brain lesions.[4]

DAI is considered the most important factor in determining morbidity and mortality in victims of TBI and is the most

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common cause of post-traumatic coma, disability, and a persistent neurovegetative state.[3,4]

DAI causes cognitive, physical, and behavioral changes that compromise social reintegration, return to productivity, and quality of life (QOL) of patients and their families.[3-6] These changes persist beyond the acute phase of treatment and continue for a long period after the traumatic event. Because the brain tissue is functionally impaired but not destroyed, the brain may gradually regain normal function as the clinical condition stabilizes and neural connections are remodeled due to plasticity.[5,6]

DAI, and more generally TBI, often results in physical, cognitive, and behavioral impairments that can be temporary or permanent.[3-6] Research on outcome after TBI, using scales of function and performance in activities of daily living, depicts the individual and social consequences of these changes suffered by patients after TBI.

The outcome of patients after DAI has been linked to the number of lesions identified through imaging. When damage is extensive as evidenced by a positive head computed tomography for intracranial hemorrhage, DAI can be identified. Most often, however, DAI is diagnosed by magnetic resonance imaging and represents a common radiographic diagnosis in up to 50% of traumatic brain injuries.[7] It is believed that DAI is present in nearly all of those who sustain loss of consciousness due to a motor vehicle crash,[7] and DAI appears associated with coma following TB.

Aims and Objectives

The objectives of the study are as follows:

- To study the impact of diffuse TBI on survival and QOL: A prospective and observational study from a Level 1 trauma care center in Eastern India
- To study the mode of injury and clinicoradiological severity of the injury as per Glasgow coma scale (GCS) Score and FOUR Score at presentation, along with application of established Radiological Severity Scoring Systems (Marshall/Rotterdam) and to correlate the same with 30 days survival, short-term (180 days) functional status (as per extended Glasgow outcome scale [GOS-E]) and short-term (180 days) QOL (as per EQ5D)
- To study the impact of associated injuries such as musculoskeletal/thoracoabdominal/spinal trauma on overall survival and outcome.

MATERIALS AND METHODS

Study Design

This was a non-randomized, prospective, and observational study.

Study Setting

This study was conducted at Department of Neurosurgery, Level 1 Trauma Care Centre IPGME and R and SSKM Hospital, Kolkata.

Study Timelines

The duration of the study was April 2020–August 2021.

Period of Study

The study period was 18 months.

Study Population

All patients admitted to trauma care centre during the study period with diffuse TBI.

Sample Size

The sample size was 100 cases.

Inclusion Criteria

- All patients admitted to Trauma Care Centre with diffuse TBI were included in the study.

Exclusion Criteria

The following criteria were excluded from the study:

- Individuals/Legal guardian not willing to participate in the study
- Patients lost to follow-up.

Data Collection

All patients admitted to trauma care center with diffuse TBI between April 2020 and August 2021 will be included in this study while those not willing to participate in the study or lost to follow-up will be excluded from this study.

RESULTS AND DISCUSSION

Age

- Mean age of our study population was 37 years
- Similarly, in other studies, the mean age was <40 years – Humble *et al*.[8] the mean was 40 years, Moen *et al*.[9] it was 34 years and Moen *et al*.[10] it was 33 years
- Unlike our study, the study done by Matsukawa *et al*. had a higher mean age of 47 years.

Sex

- Male comprised 86% of our study population
- Similar male preponderance was also seen in other studies likes Matsukawa *et al*.[11] 85%, Chelly *et al*.[12] 81%, and Adams *et al*.[13] 79%.

Mode of Injury

- Out of 100 cases in our study, 88 cases (88%) were due to road traffic accidents (RTA) while 12 patients (12%) were due to fall from height

- Mortality from RTA was 64.8 % while that from fall from height was 75%
- Similar to our study, RTA was the main mechanism of injury reported in other studies likes Adams *et al*.[13] (RTA [69%], Fall [18%]), Skandsen *et al*.[14] (RTA [60%], Fall [27%]), and Hilario *et al*.[15] (RTA [89%], Fall [11%])
- Unlike our study, fall (54%) was the main mechanism of injury in the study of Matsukawa *et al*.[11]

GCS

- There was statistically significant association between GCS with mortality and GOSE in the present study. About 90.3% of patients with GCS <8 having GOSE 1–2, expired. All patients with GCS 13–15 survived. Seven out of eight patients with GCS 13–15 had GOSE 7–8 while one had GOSE 6
- In our study, the majority of the patients presented with severe GCS (62%) followed by moderate (30%) and mild GCS (8%). The findings were comparable to the results of other studies Plata *et al*.[16] Mild GCS 3%, moderate GCS 14%, severe GCS 83%, and Chelly *et al*.[12] Mild GCS 3.5%, moderate GCS 12.9%, severe GCS 83.6% indicating that severity of head injury plays an important role in the mortality of head injury patients
- Patients with GCS <8 had poor QOL.

Four Score

- There was statistically significant association between FOUR score with mortality and GOSE score. Most of the patients with FOUR score more than 12 survived while majority of the patients with FOUR score <12 had GOSE score 1–2
- Patients with FOUR score more than 12 had better QOL.

Need for Airway/Ventilatory Support

- Mechanical ventilation was required for 63 (63%) patients in our study out of which 56 (88.9%) died indicating that patients requiring airway/ventilator support had poor prognosis
- Patients not requiring airway/ventilator support had better QOL
- Similarly, a higher rate of ventilatory support was required for 77 patients (98.7%) in the study of Chelly *et al*.[12]

Marshall Score

- In our study, 78% patients had Marshall score 1, 18% had Marshall score 2, and 4% had Marshall score 3
- With increasing Marshall score, GOSE score decreased and vice versa
- Marshall score 1 had higher QOL than Marshall score 2–3
- Unlike our study, other studies had majority of the patients with Marshall score 2- Skandsen *et al*.[14] had 45% patients with Marshall score 2 while Matsukawa *et al*.[11] had 35% with Marshall score 2.

Rotterdam Score

- In our study, 96% patients has score 1–2, 4% patients had score 3–4 while there were no patients with score 5–6
- Unlike our study, the study of Moen *et al*.[10] had 38% patients with score of 1–2, 53% patients with score of 3–4 while 8% patients had score 5–6.

GOSE

- In our study, the majority of the patients 66 (66%) had GOSE score 1–2, 6 (6%) patients had GOSE score 3–4, 12 (12%) patients had GOSE score 5–6 while 16 (16%) patients had GOSE score 7–8.
- In contrary to our study, other studies had minimum patients with GOSE 1-2 - Plata *et al*.[16] ([13.6%] GOSE 1–2, [36.3%] GOSE 3–4, [22.7%] GOSE 5–6, [27.2%] GOSE 7–8), Hilario *et al*.[15] ([12%] GOSE 1–2, [40%] GOSE 3–4, [22%] GOSE 5–6, [26%] GOSE 7–8) and Moen *et al*.[9] ([2%] GOSE 1–2, [15%] GOSE 3–4, [30%] GOSE 5–6, [50%] GOSE 7–8).

Length of Stay in Intensive Care Unit (ICU) and Hospital

- In both ICU and in hospital, mean length of stay was more for those who survived and for patients with GOSE 3–4
- Mean ICU stay of our study was 6.5 days while mean hospital stay of our study was 10.3 days
- Similarly, the study of Humble *et al*.[8] had a mean ICU stay of 6 days and a mean hospital stay of 11 days
- Unlike our study, the study of Chelly *et al*.[12] had a longer ICU stay of 19.6 ± 13.8 days while the study of Plata *et al*.[16] had a longer hospital stay of 20 ± 8 days
- Patients with longer stay in ICU had poor QOL (Index score).

Body Regions

- Head was the most common region involved in all cases of our study (100%) resulting in the death of 66 patients (66%) followed by extremities in 23 patients (23%) resulting in the death of 16 subjects (69.6%). Nine patients (9%) presented with spine injuries and 2 patients (2%) presented with abdominal injuries, both of which had 100% mortality. Eight patients (8%) presented with chest injuries out of which 6 died (75%).

Complications

- In our study, 14 patients were complicated with sepsis while decubitus ulcer and seizure occurred in six and four patients, respectively

- QOL (Index score) was better in patients with no complication.

QOL and Mortality

- The mean QOL (Index score) and QOL (visual analog scale score) of our study was 0.541 ± 0.5212 and 69.15 ± 22.703, respectively
- Total mortality rate of present study was 66%.

CONCLUSION

- Total mortality rate of present study was 66%
- All patients were managed conservatively
- RTA accounted for 88 cases (88%) resulting in the death of 57 patients (64.8%) while fall from height accounted for 12 cases (12%) resulting in the death of 9 patients (75%)
- About 90.3% of patients with GCS <8 having GOSE 1–2, expired. All patients with GCS 13–15 survived. Seven out of eight patients with GCS 13–15 had GOSE 7–8
- Patients with GCS <8 had poor QOL
- Most of the patients with FOUR score more than 12 survived and had better QOL while majority of the patients with FOUR score <12 had GOSE score 1–2
- 56 out of 63 patients (88.9%) requiring airway/ventilator support expired having GOSE score 1–2
- Patients not requiring airway/ventilator support had better QOL
- With increasing Marshall score, GOSE score decreased and vice versa
- Marshall score 1 had higher QOL than Marshall score 2–3.
- In both ICU and in hospital, mean length of stay was more for those who survived and for patients with GOSE 3–4
- Patients with GOSE 1–2 had stayed more days in ICU (6.65 ± 2.64) out of the total days spent in hospital (7.56 ± 3.6)
- Patients with longer stay in ICU had poor QOL (Index score)
- QOL (Index score) was better in patients with no complication
- Mean QOL (Index score) of the study population was 0.541 ± 0.521.

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