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PREDICTORS OF FUNCTIONAL OUTCOMES IN TRAUMATIC BRAIN INJURY AT 4 MONTHS POST INJURY IN SOUTH INDIAN POPULATION

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ABSTRACT

Background: Goals of Rehabilitation after Traumatic Brain Injury (TBI) focus on preventing complications and improving the level of functional independence. The expectation of TBI survivors and family members following rehabilitation are focused on the quality of outcomes such as reintegration into the community, return to work, and maximal functional capacity. Multiple factors may affect recovery after TBI when interacting with the primary condition and predicting the degree of recovery helps in framing realistic goals. The purpose of this study was to analyze the factors influencing the functional outcome in TBI patients at four months post-injury.

Methodology: This observational study was carried out in the Neurosurgery outpatient department when TBI patients returned for review at four months post-injury. 50 TBI patients who were able to follow commands participated in this study. Factors like Admission Glasgow coma scale (GCS), Discharge GCS, Length of Hospitalization, Associated fractures of the upper and lower limb, Co-morbid conditions like Diabetes and Hypertension were obtained from the discharge summary of the patient. Caregiver literacy was obtained from the person who took care of the patient completely. Admission CT scan was graded using the Marshall CT classification. Finally, all these factors were compared to the functional status of the patient evaluated using the Barthel Index.

Results: Logistic regression was used to predict the factors affecting the functional outcome. Beta value of Caregiver literacy, Discharge GCS, and Co-morbid conditions was .561, .369 and .234, respectively which influences the functional outcome of TBI patients at four months post-injury.

Conclusion: The study concludes that caregiver literacy, Discharge GCS, and Co-morbid conditions influence the functional outcome of TBI patients, which emphasizes the need for awareness and education of the caregiver and along with post-discharge rehabilitation program specific exercises addressing the co-morbid conditions would enhance the recovery.

Keywords: Traumatic brain injury, Functional independence, Barthel Index, Glasgow coma scale, caregiver literacy.

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INTRODUCTION

Traumatic brain injury (TBI) is a non-degenerative, non-congenital insult to the brain from an external mechanical force, possibly leading to permanent or temporary impairment of cognitive, physical, and psychosocial functions, with an associated diminished or altered state of consciousness [1]. These impairments may be either temporary or permanent and cause partial or total functional disability or psychosocial maladjustment.

TBI prevalence is estimated to be 9.7 million in India, with 200,000 deaths and 1 million requiring rehabilitation services, and approximately 16% sustain severe TBI [2]. Head injury is increasing with urbanization and rising of motor vehicles and incidence of TBI in India is high in the age group of 21-40 years with 50.24% and the common mode of injury was road traffic accidents followed by falls and violence [3].

Primary injury following TBI occurs when brain tissue comes to contact with an object or rapid acceleration or deceleration of the brain. The secondary injury occurs due to a series of cellular events that follow tissue damage in addition to secondary effects of hypoxemia, hypotension, ischemia, edema, and elevated intracranial pressure (ICP) [4]. Acute Complications of TBI may include seizures, pulmonary problems, urinary tract infections, and derangement in electrolytes. A wide range of motor and sensory problems occur which include slowed motor responses, balance, coordination, Gait abnormalities and sensory perception issues. Hence, patients with TBI have a broad spectrum of impairments which include physical, cognitive, psychological, behavioral and emotional resulting in severe psychosocial and economic burden [5,6].

When the patient enters into the Rehabilitation phase after surviving from the acute phase and emerging from a coma, although patients receive individualized interventions, significant disabilities make rehabilitation challenging for the team members in setting realistic goals and integrating them functionally into the society. Predicting outcomes following TBI helps in knowing the rate of recovery and assisting in the healthcare decision making for individual patients while rehabilitating them. Literature shows that the commonly used predictors of outcome include age, GCS score, pupillary reaction, Hypotension, Computed Tomography (CT) findings, and Cognitive status. The global outcome at discharge is found to be well correlated with the motor component of the Glasgow Coma Scale (GCS) [7]. Patients with some minimal signs of recovery in consciousness at one month of injury have a better chance of recovery than patients than those who are still in a vegetative state (VS) which conveys that early the return of consciousness the better is the outcome [8]. Duration of Post Traumatic Amnesia (PTA) and Glasgow Coma Scale scores on admission to hospital were both strongly correlated with outcome and PTA is recognized as a predictor of functional recovery which is an indicator of cognitive dysfunction [9].

J Ponsford [10] identified the factors that contributed to the outcome of TBI and found to have a complex interrelationship between them. Marshall CT Scan classification provides accurate prediction regarding the likelihood of a fatal or non-fatal outcome [11]. Multiple motor systems are impaired up to 12 months post-injury, and GCS<11 have poor functional outcomes with a drop of employment rate from 86% before the injury to 29% after injury [12,13].

Studies on Community integration and return to work following TBI were found at different durations ranging from 1-5 years, which showed that 46.5% returned to either the same or similar jobs, and more than 50% were not working. 6% of TBI patients were in training for 1 year post-injury, and their outcomes were dynamic over the first five years [14-17]. The cognitive and emotional outcome was poor but showed good physical and functional results at 2-5 years post-injury [18].

Ability to perform normal activities of daily activities to meet basic needs and maintain well-being is dependent on the Functional status of an individual. Many studies have predicted the factors which influence the TBI patients in terms of return to community and work, but only a few studies have predicted their functional status but in a longer duration of more than a year. The severity of injury based on Marshall CT classification, length of hospital stay, the influence of co-morbid conditions, and associated limb fractures were not considered in many studies at an early age of 4 months of post-injury. This study intends to analyze various predictors of a functional status of a TBI patient in the south Indian population at four months post-injury which could help in decision making and planning of rehabilitation for TBI patients.

METHODOLOGY

This observational study involving subjects with TBI was approved by the Ethics committee (REF: CSP/16/SEP/51/277) Sri Ramachandra Institute of Higher Education and Research

Subjects were recruited from Sri Ramachandra Medical Centre Neurosurgery Outpatient department. Fifty patients of both genders and above the age of 20 years who were diagnosed as TBI and treated by Neurosurgeons were included when they returned for review at four months post-injury in the outpatient department.

INSTRUMENTATIONS:

BARTHEL INDEX (BI): It measures the extent to which a person can function independently and has mobility in their activities of daily living (ADL), i.e. feeding, bathing, grooming, dressing, bowel control, bladder control, toileting, chair transfer, ambulation, and stair climbing. Unable to perform is graded as 0 and independent is graded as 10 for every component and a total score of 100 is given.

Marshall computed tomography: The Marshall classification of TBI is a CT scan derived metric using certain features and has six categories (I to VI) of increasing severity based on the findings of a non-contrast CT scan of

the brain.

Glasgow coma scale: The GCS is used to describe the level of consciousness in a person with three components Eye-opening (E), Verbal Response (V), Motor Response (M). The score is determined by the sum of the score in each of the three categories, with a maximum score of 15 and a minimum score of 3.

PROCEDURE

Subjects were screened for their inclusion criteria to enter into the study when they return for review after four months after receiving permission from Neurosurgeon and informed consent from their caretakers. The functional status of the patient at four months post-injury was assessed with BI. Information about factors like Age, Gender, Admission GCS, Discharge GCS, Length of Hospitalization, Associated injuries UL/LL, Co-morbid conditions like Diabetes, and Hypertension were obtained from the discharge summary of the patient. Caregiver literacy was obtained from the person who took care of the patient entirely from the time of discharge. The literacy level was graded based on school or graduate level of education. CT scan taken at the time of admission was graded for the severity of injury using the Marshall CT classification of TBI with the help of Radiologists.

Backward logistic regression was used to find out the factors that influence functional outcomes.

RESULTS

All statistical analysis was performed using SPSS version 17.0. Backward logistic regression was used to find out the predictors for functional outcomes in TBI patients at four months post-injury.

Step: 1 Admission GCS was excluded. Beta= .585 and its 95% Confidence interval (Lower bound= -2.785 and Upper bound= -3.954)

Step: 2 Associated injuries were excluded. Beta -6.609 Lower bound=-21.978 and 8.760

Step: 3 Marshall CT scan was excluded Beta -2.259 Lower bound -1.789 and Upper bound =6.307

Step: 4 length of Hospitalization was excluded. Beta= -222 Lower bound= -586 and upper bound=-10

Step: 5 Discharge GCS Beta= -5.258 Upper bound = - 2.341 & Lower bound= -8.175

Care giver literacy -28.322. Beta Upper bound -18.121 & Lower bound = 38.524

Co-morbid conditions Beta= 14.763 Upper bound = 1.976 Lower bound= 27.55

GCS at discharge, care giver literacy, co-morbid conditions (DM, HTN) were highly significant and it determines the functional outcome at 4 months post injury. Length of hospitalization is found to have an influence but comparatively lesser than the previous three factors.

Table 1: Demographics of Study participants

Factors	Mean (SD)
Age	38.22(14.69)
Gender	Male- N=42, Female N=8
Barthel Index	78(30.58)
Admission GCS	6.92(3.70)
Discharge GCS	12.18(2.14)
Length of Hospitalization	25.68(21.59)
Associated Fractures UL/LL (%)	Present 22% Absent 78%
Co-morbid Conditions DM/HTN	Present 36% Absent 64%
Caregiver Literacy	No Education 12% School Level 62% College Level 26%
Marshall CT (Grade)	2.94 (1.74)

Table 2: Co-efficients

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
	B	Std. Error				Lower Bound	Upper Bound
(Constant)	-16.752	32.029		-.523	.604	-81.390	47.885
Admission GCS	.585	1.670	.071	.350	.728	-2.785	3.954
Discharge GCS	3.293	2.654	.231	1.241	.222	-2.063	8.649
Hospitalization stay	-.275	.184	-.194	-1.492	.143	-.646	.097
UL/LL Fractures	-6.141	7.815	-.084	-.786	.436	-21.912	9.630
DM, HTN	18.507	7.173	.293	2.580	.013	4.032	32.982
Care giver literacy	26.850	5.369	.532	5.001	.000	16.015	37.684
Marshall CT	2.592	2.084	.148	1.244	.220	-1.614	6.799
(Constant)	-42.541	22.010		-1.933	.059	-86.844	1.763
Discharge GCS	5.258	1.449	.369	3.629	.001	2.341	8.175
DM, HTN	14.763	6.353	.234	2.324	.025	1.976	27.551
Care giver literacy	28.322	5.068	.561	5.588	.000	18.121	38.524

DISCUSSION

Rehabilitation goals after TBI focus on attaining maximum level of functional independence, preventing complications, and providing an acceptable quality of life to the patient. Functional improvement is delayed due to the interaction of physical, cognitive, and neurobehavioral impairments during Rehabilitation. Recovery of brain function following TBI varies based on the individual and intensity of brain injury and is thought to occur by several mechanisms like Diaschisis, Redundancy and behavioral substitution which occurs maximum at the initial four months. Predicting

the degree of TBI recovery helps in framing goals that are realistic and attainable. This study intended to analyze the various factors predicting the functional outcome of TBI at four months post-injury.

Out of 50 TBI patients included in this study, 42 were males, and 8 were females, and the majority of the subjects were found in the age group of 21-30 years which shows that RTA is common in this group and found to be the primary cause of TBI. Population-based studies showed that selective age groups at risk of TBI include adolescents and young adults [19]. Association of age with outcome in TBI showed proportions of mortality and unfavorable outcomes increased with age, and older age is continuously associated with a worsening outcome after TBI [20, 21]. Return to employment was found to be more in females than males as per the meta-analysis done by Crepeay et al., (1993) [22].

Linear regression was used to analyze the impact of factors on functional outcomes at four months post-injury in TBI patients. Caregiver literacy, discharge GCS, and co-morbid conditions (DM, HTN) had more significant with the functional outcome at four months. Previous studies focussed on the impact of Admission GCS on recovery following TBI and found to have an impact on recovery patterns and significant predictor of functional outcome. Ritchie et al., (2000) [23] found that elderly patients with presenting GCS less than 11 have a poor functional outcome but Leitgeb et al., (2013) [24] showed that discharge GCS is a good predictor as found with the association at the one-year outcome of patients with TBI. GCS < 10 at ICU discharge has a poor chance of outcome which is consistent with the present study which also shows a decreased outcome in BI at four months post-injury when the Discharge GCS was low.

The severity of brain injury, as graded with the Marshall CT classification, did not influence the functional outcome. Brazinova et al. (2010) [25] correlated the outcome of TBI with a CT scan and found that poor prognosis was found when the midline shift was more than 15mm. Poor prediction in this study could be because an equal number of subjects were not present in all the six grades. Fractures of upper and lower limbs were taken as associated injuries in this study and found they do not influence the functional outcome. Schonberger et al. (2011) [26] found that the presence of limb injuries had a direct influence on the initial recovery, but showed that they were not significantly associated at five years post-injury as patient revert back to normal or compensatory strategies help them to return to near normal. Out of 50 subjects taken up in this study, only 11 subjects had either upper or lower limb fractures, which could be the reason for the present result.

The mean length of hospitalization stay was 25.68 days, which shows a moderate relationship with the functional outcomes, which conveys that length of stay predicts functional outcome at four months post-injury. Cifu et al. did a study., (1997) [27] shows that rehabilitation stay of employed persons was 26 days compared to 48 days in the

unemployed at one-year post-injury. Out of 50 subjects, 18 had common lifestyle disorder, DM, and HTN, which was taken up as co-morbid conditions and found to have good prediction. TBI is associated with a stress response that includes hyperglycemia and hypertension which could worsen the neurological outcome. Management of associated diseases such as DM, HTN, cardiac problems and renal problems reduces the chance of recovery. The use of analgesic and sedative are to be administered carefully as an effect of the medicines may have unpredictable results and they might be contraindicated for surgical procedures which might hamper the recovery [28]. Brink et al. (1980) [29] found that complications of prolonged hypertension significantly decrease the probability of achieving physical independence.

Many studies have explored the depression, burden of a caregiver in the rehabilitation of TBI patients. The literacy level of the TBI patients was found to have a direct relationship with the functional outcome at ten years post-injury [30], but the literacy of the caretaker was not considered. Turner et al. (2010) [31] found that the rate of depression of caregivers for people with TBI was higher and insisted on the need for specific caregiver support before the patient is discharged from hospital. An increase in the rate of depression will have a negative impact on the recovery of TBI patients. Though acute injury can traumatize the family members who need to take care of the patient who is not time-bound, literacy can improve the awareness, acceptability of the caregivers and thereby improve rehabilitation of the TBI patients. The impact of caregiver literacy on the functional outcome of TBI patients shows a strong relationship that insists that education helps the caregiver to be aware of the condition and strategies to manage symptoms without much depression, thereby contribute to the positive outcome of the patient.

CONCLUSION

The study concludes that caregiver literacy, Discharge GCS, and Co-morbid conditions followed by Length of hospitalization influence the functional outcome of a TBI patient at four months post-injury. The result emphasizes the need for awareness and education of the caregiver, and along with the routine post-discharge rehabilitation program, specific exercises addressing the co-morbid conditions would enhance the recovery.

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