International Surgery Journal
Joseph JJ et al. Int Surg J. 2020 Jul;7(7):2189-2194
http://www.ijsurgery.com
pISSN 2349-3305 | eISSN 2349-2902

DOI: http://dx.doi.org/10.18203/2349-2902.isj20202819

Original Research Article

Neurobehavioral sequelae of moderate traumatic brain injury

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Received: 02 March 2020
Revised: 09 May 2020
Accepted: 09 June 2020

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ABSTRACT

Background: The goal of providing neurobehavioural rehabilitation of traumatic brain injury (TBI) survivors still remains largely unachieved, as the problem is still neglected. This study analysed the change in behavioural sequelae in TBI patients over a period of twelve months, so that appropriate measures may be taken for their adequate rehabilitation.
Methods: All patients admitted with moderate TBI, aged between 15 and 60 years, during the study period of one year, or until the sample size (n=118) was reached, were included in the study. The initial details regarding the mechanism of injury and the initial Glasgow coma scale (GCS), number of days in intensive care unit (ICU), and so on were recorded. At follow up periods of six months and one year, the neuro behavioral rating scale was used in the review clinic to assess the change in neuro behavioral status. Data was analyzed using SPSS.
Results: Out of the 118 subjects included in the study, there was statistically significant improvement in inattention, disorientation, expressive deficit, memory deficit, inaccurate insight, depressive mood, hallucinatory behaviour, unusual thought content, comprehension deficit, speech articulation defect, and so on. There was worsening of anxiety, guilt, tension, etc. There was no much change in somatic concern, hostility and so on.
Conclusions: In view of significant worsening of behavioural components, this study has highlighted the need for individualized regimens for overall rehabilitation of the victims, thereby lessening burden on the patient, family and society.

Keywords: TBI, Neurobehavioural sequelae, Moderate TBI, Neuro rehabilitation

INTRODUCTION

According to Centres for Disease Control and Prevention, traumatic brain injury (TBI) may be defined as "disruption in the normal function of the brain that can be caused by a bump, blow, or jolt to the head, or penetrating head injury". The true incidence of TBI in the world population is difficult to be determined. Studies have shown that in the United States, around 1.5-2 million people sustain TBI per year.[1] Approximately 2.5 million emergency department deaths, visits and hospitalisations were associated with TBI.[2] Incidence of TBI in India was found to be higher than in Europe.[3] The global burden of disease study has estimated that the incidence of several categories of TBI were severe enough to warrant medical care or result in death. Equally significant is the prevalence of post-TBI syndromes and includes post-traumatic stress disorder (PTSD), depression, mania, aggression, delusions, auditory hallucinations and so on.

In the United States, TBI is a major public health problem, and contributes to about 30% of all injury deaths.[4] In a study conducted in 2010, around 2.5 million TBIs occurred either as an isolated injury or along with

other injuries.[5] TBI results in deaths, injuries and disabilities in all age groups, but more in young and productive persons, and is higher in males.[6] The most common cause of TBI reported in India are road traffic accidents accounting for 60%, followed by falls and assaults contributing to 25% and 10% of traumatic brain injuries respectively.[7]

TBI is largely a disorder affecting the younger population more.[8] Individuals younger than 30, mostly males, are affected most. People who are in the later stages of adolescent development or in early adulthood are usually affected. Therefore, TBI typically disrupts important periods of life involving educational and social development, emerging vocational productivity and adult independence, and beginning spousal relationships and family development. Problems related to aging include co-morbidities, slower and less complete recovery, and vulnerability to complications of injury and treatment.[9]

Integral to the treatment of persons with brain injury are psychological considerations. Most of the elements people use to define their self-worth, such as intelligence, physical prowess, financial status, etc., are vulnerable after brain injury. Moreover, coping skills may decline and behavioural disturbances may increase due to alterations in cognition. If treatment protocols are to succeed, psychological deliberations are to be incorporated.

Treatment programs often focus on medical, physical, and cognitive factors maintaining balance, transferring between a bed and a chair, walking, or transfer into a vehicle; expressive language deficits; using upper extremities for activities of daily living; and medical stability.[10] Intervention is done by physicians when there is medical instability. In addition, the patients and their families assume that recovery of personality will accompany physical recover.[11] The term "medicalization" describes this process, where the patient becomes a set of symptoms.[12] The success of this process, partly, is based upon our society's expectation for health care, arising sometimes from media reporting of advances in research. After all, expectations are an important element in care.[13] However, fulfilling this expectation can leave persons with brain injury and their families dissatisfied. In the long term, factors associated with psychological variables and quality of life can have a greater impact on persons with brain injury and their families than other variables.[14] In addition, cognitive and behavioural concerns tend to be most burdensome.[15] To be more helpful, rehabilitation ought to address higher needs related to satisfaction with life.[16] Insurance system changes are leading to shorter hospital stays, and there is more pressure on families to provide care at home.[17] Majority of the families are not able to financially support the lengthy and costly rehabilitation programs.

Glasgow coma scale

The Glasgow Coma Scale (GCS) is a scale that is aimed at giving a reproducible and objective way of recording the consciousness level of a person for initial as well as serial evaluation. Teasdale et al professors of neurosurgery at the University of Glasgow's Institute of Neurological Sciences published the scale in 1974. The GCS was initially indicated for serial assessments of patients with traumatic brain injury.[18]

Levin's neurobehavioural rating scale

The neurobehavioural rating scale (NRS) of Levin et al is 27 items, multidimensional clinician-based assessment instrument designed to measure neurobehavioural disturbances.[19] Based on the brief psychiatric rating scale, the NRS included items which would be more specific to patients with neuropsychiatric symptomatology resulting from closed head injury.[20] The NRS is administered through a brief structured interview (typically requiring 15-20 minutes to complete) which includes a test of orientation and memory for recent events, questions regarding emotional state, post-concessional symptoms, focused attention, and concentration (performing serial sevens), explanation of proverbs, tasks of planning and mental flexibility, and delayed recall of three objects presented at the beginning of a session. Observations are also made regarding the patient's fatigability, visible signs of anxiety, disinhibition, agitation, hostility, difficulties in expressive and receptive communication, and disturbance of mood. About one third of the items are based solely on examiner observation which are graded according to a behaviourally anchored seven points rating scale. The balance of the items is rated according to the patient's performance on brief tasks and quality of answers to interview questions.

Objectives

To study the change in neurobehavioural sequelae in patients, aged between 15-60 years, admitted in Medical College Thiruvananthapuram, Kerala with moderate head injury (GCS between 9 and 13), between six months to one year after injury.

METHODS

Longitudinal design, review clinic, Government Medical College, Thiruvananthapuram. Patients admitted in Government Medical College, Thiruvananthapuram, Kerala with moderate traumatic brain injury (GCS 9-13), aged 15-60.

Exclusion criteria

Exclusion criteria were patients in vegetative state, patients with aphasia, patients with vision loss, patients with a documented history of psychiatric disorder or prior

brain injury, and patients unwilling for the study (blanket study).

Sample size $N=\frac{(Z_{1-\alpha/2}+Z_{1-\beta})^2}{\Delta^2}+\frac{Z^2_{1-\alpha/2}}{2}$

$\Delta=\frac{\mu_{2-}\mu_1}{\sigma}$ $\sigma=\frac{\sigma_2+\sigma_1}{2}$

Where,

μ1: mean six months score for speech articulation deficit=1.85.

μ2: mean one-year score for speech articulation deficit=1.51.
s1: Standard deviation of six months score=1.35.
s2: Standard deviation of one-year score=1.27.

Δ: effect size, α: significance level (5%), 1-β: power (80%). Sample size, n=118

According to the similar study neurobehavioural deficits after severe traumatic brain injury (TBI) Marcella Lippert-Gruner, Johannes Kuchta, Martin Hellmich and Norfrid Klug.

Study period

Average hospital admission rate for moderate head injuries were 20 per month. Therefore, study period was roughly one year (1st Jun 2018 to 31st May 2019), or till the sample size was met.

Study tools

GCS - scoring done at the time of admission for selecting eligible study subjects. Moderate head injury patients (GCS 9-13) are included in the study.

Levin's neurobehavioural rating scale - a seven points scale with 27 items. Used to assess the prognosis in neurobehavioural symptoms. It is a reliable and a valid instrument for quantifying behavioural disturbance and gross cognitive impairments in those with neurobehavioural symptoms including TBI.

Study variables

Socio-demographic variables like age, sex, occupation etc. Neurobehavioural sequelae - neurobehavioural consequences of moderate TBl, assessed after 6 months and 1 year for the 27 variables included in the NBRS. Neurobehavioural sequelae are said to be improved or deteriorated if the change is significant statistically.

Data collection

Details of patients are collected at the time of admission and neurobehavioural symptoms will be assessed at follow up visits at 6 months and one year (by the same investigator).

Data analysis

Data will be entered in excel sheets and analysed using SPSS software. All qualitative variables will be expressed as proportion and quantitative variables in mean and SD. The NRS ratings were summarized using mean and standard deviation and appropriate tests of significance will be used to state the change.

Ethical considerations

Institutional Ethical Committee clearance will be obtained, informed consent will be obtained from the participants, and confidentiality will be ensured and maintained throughout the study.

RESULTS

Out of total number of subjects 118, 68.6% were males and 31.4% were females. Of these, 45.8% were aged less than 30 years, 36.4% were between 30 and 45 years and 17.8% were above 45 years. 42.4% were school drop outs, 38.1% were educated upto pre-degree, 9.3% were educated upto degree, and 10.2% were professionals. 11.9% were skilled workers, 32.2% were manual labourers, 27.1% were students, 7.6% were self-employed, and 21.2% were unemployed. 2.5% had a positive family history of psychiatric illness. 33.1% were habituated to intake of tobacco and 37.3% to alcohol. Out of all subjects habituated to alcohol, 34.09% had alcohol intake prior to sustaining Traumatic Brain Injury. Based on the mechanism of injury, 58.5% had road traffic accident (RTA), 9.3% had history of fall, 20.3% had history of assault, 11.9% had unknown mechanism. 37.3% of the subjects had subdural haemorrhage, 22.9% patients had extradural haemorrhage, 22.9% had haemorrhagic contusions, 5.9% had subarachnoid haemorrhage, and 11% had depressed fracture. Of all subjects, 56.8% were operated and the remaining were managed conservatively.

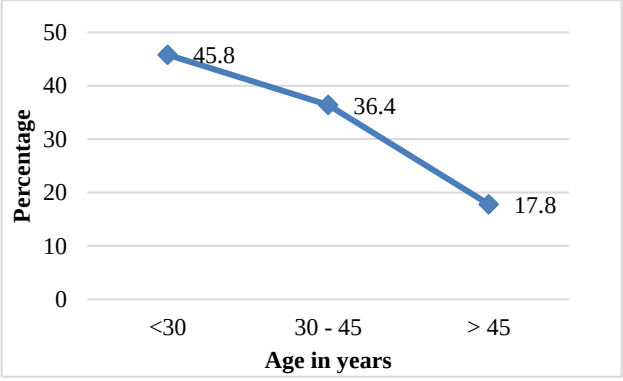

Figure 1: Percentage of study subjects according to age.

Of all patients that were operated, 52.3% underwent decompressive craniectomy, 37.3% underwent craniotomy and evacuation of haematoma, and 10.4% underwent elevation of depressed fracture. Out of all study subjects, 12.7% had undergone tracheostomy. Out of all study subjects, 3.4% had undergone revision surgery. Out of all patients, 40.7% had stay in ICU ranging from 10 to 15 days and 31.4% stayed for more than 15 days. Traits such as anxiety, guilt, lability of mood, tension, etc worsened, whereas inattention, memory deficit, speech articulation defect and so on improved changes in neurobehavioural sequelae.

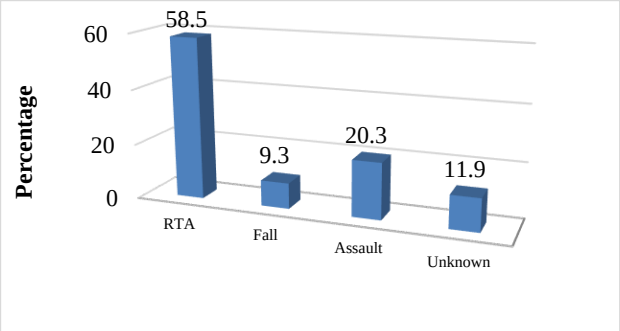

Figure 2: Percentage of subjects with their mechanisms of injury.

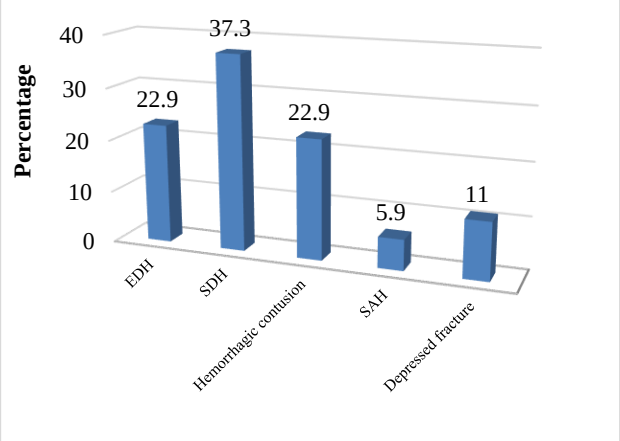

Figure 3: Percentage of subjects with their CT brain findings.

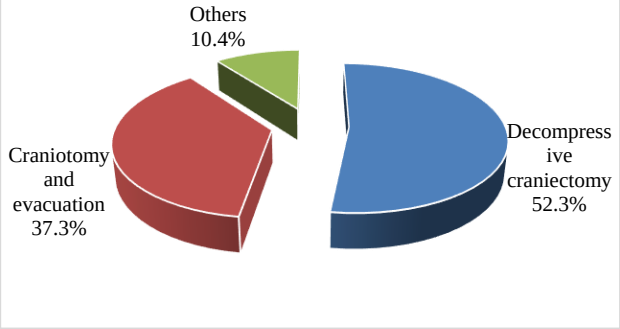

Figure 4: Proportion of patients that underwent various surgical procedures.

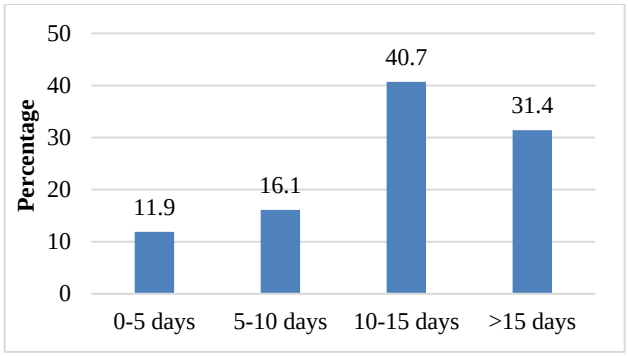

Figure 5: Figure showing the number of days of ICU stay of the subjects.

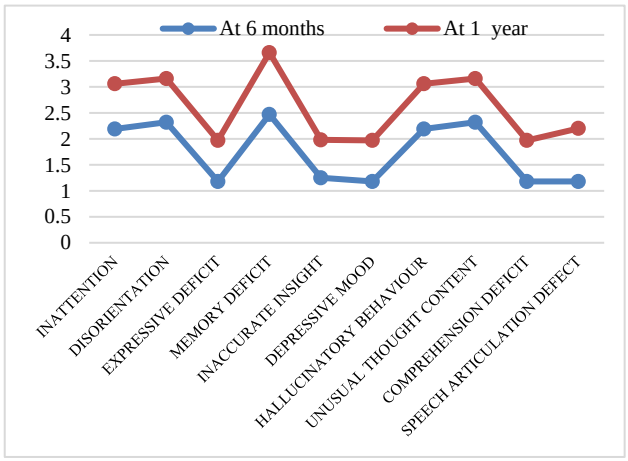

Figure 6: Illustration of components of neurobehavioural scale showing improvement at one year of follow up.

Table 1: Results of analysis of neurobehavioural change.

Significantly worsened	Significantly improved	Not significant (p>0.05)
Anxiety	Inattention	Somatic concern
Conceptual disorganisation	Disorientation	Emotional withdrawal
	Expressive deficit	Disinhibition
Guilt	Memory deficit	Agitation
Blunted affect	Inaccurate insight	Hostility
Excitement	Depressive mood	Decreased motivation
Lability of mood	Hallucinatory behaviour	Suspiciousness
Tension	Unusual thought content	Fatiguability
	Comprehension deficit	Motor retardation
	Speech articulation defect	Poor planning

Table 2: Analysis of components of the neurobehavioural rating scale.

Variables	At 6 months		At 1 year		t value	P value
	Mean	SD	Mean	SD		
Inattention	2.19	0.78	3.06	0.67	-10.838	<0.001
Somatic concern	2.20	0.67	2.24	0.68	-0.533	0.595
Disorientation	2.32	0.63	3.16	0.60	-11.026	<0.001
Anxiety	1.97	0.90	1.18	0.81	7.114	<0.001
Expressive deficit	1.18	0.81	1.97	0.90	-7.114	<0.001
Emotional withdrawal	2.20	0.67	2.19	0.78	0.083	0.934
Conceptual disorganisation	3.16	0.60	1.97	0.90	13.179	<0.001
Disinhibition	2.24	0.68	2.32	0.63	-0.980	0.329
Guilt	1.98	0.88	1.25	0.82	6.589	<0.001
Memory deficit	2.47	0.86	3.66	0.85	-10.508	<0.001
Agitation	2.15	0.70	2.15	0.70	0.000	1.000
Inaccurate insight	1.25	0.82	1.98	0.88	-6.589	<0.001
Depressive mood	1.18	0.81	1.97	0.90	-7.114	<0.001
Hostility	2.20	0.67	2.24	0.68	-0.533	0.596
Decreased motivation	2.15	0.70	2.15	0.70	0.000	1.000
Suspiciousness	2.20	0.67	2.24	0.68	-0.533	0.589
Fatiguability	2.15	0.70	2.15	0.70	0.000	1.000
Hallucinatory behaviour	2.19	0.78	3.06	0.67	-10.838	<0.001
Motor retardation	2.20	0.67	2.24	0.68	-0.533	0.595
Unusual thought content	2.32	0.63	3.16	0.60	-11.026	<0.001
Blunted affect	3.27	0.68	2.51	0.66	10.189	<0.001
Excitement	3.16	0.60	1.97	0.90	13.179	<0.001
Poor planning	2.24	0.68	2.32	0.63	-0.980	0.329
Lability of mood	1.97	0.90	1.18	0.81	7.114	<0.001
Tension	2.20	0.67	1.18	0.81	10.695	<0.001
Comprehension deficit	1.18	0.81	1.97	0.90	-7.114	<0.001
Speech articulation defect	1.18	0.81	2.20	0.67	-10.695	<0.001

DISCUSSION

Sample size was 118, compared to 59 in the reference study (neurobehavioural deficits after severe traumatic brain injury (TBI) Marcella Lippert-Gruner, Johannes Kuchta, Martin Hellmich, and Norfrid Klug). The age distribution was between 15-60 years, compared to 15-64 years in the reference study. Male to female ratio was 2:1, while it was 4:1 previously. In this study, 37.3% of the subjects had subdural haemorrhage, 22.9% patients had extradural haemorrhage, 22.9% had haemorrhagic contusions, 5.9% had subarachnoid haemorrhage, and 11% had depressed fracture, while it was 42%, 22%, 80%, 29% and 22% respectively in the earlier study. In the present study, components like anxiety, conceptual disorganisation, guilt, blunted affect, excitement, lability of mood and tension showed significant worsening, Those that improved significantly were inattention, disorientation, expressive deficit, memory deficit, depressive mood, inaccurate insight, hallucinatory behaviour, unusual thought content, comprehension deficit, and speech articulation defect. The remaining components of the neurobehavioural rating scale showed no significant change. In the reference study, components that improved were Inattention, reduced alertness and disorientation. Those that worsened were conceptual disorganization, agitation, inaccurate insight, emotional withdrawal, disinhibition, memory deficit, decreased initiative, unusual thought content, blunted affect, excitement, tension and poor planning.

CONCLUSION

Though there have been great advances in neurocritical care over the years, the neurobehavioural aspect of the victims is still largely ignored. In view of significant worsening of behavioral components, this study has highlighted the need for individualized regimens for overall rehabilitation of the victims, thereby lessening burden on patient, family and society.

ACKNOWLEDGEMENTS

I thank all patients whose cooperation made this study a success. The support given by my co-workers and members of faculty were invaluable.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Joseph JJ, Asher P, Pendro VS, Peethambaran A, Prabhakar RB. Neurobehavioral sequelae of moderate traumatic brain injury. Int Surg J 2020;7:2189-94.