Assessment of Intensive Inpatient Rehabilitation Program in Acquired Brain Injury Patients using UK FIM+FAM Scale: A Retrospective Study

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ABSTRACT

Introduction: Acquired Brain Injury (ABI) can lead to a combination of physical, cognitive, and behavioural impairments and requires comprehensive and structured inpatient rehabilitation program. A multidisciplinary rehabilitation program can deal comprehensively with all these issues together rather than focussing on a single aspect like motor function. Number of people suffering from Traumatic Brain Injury (TBI) in India has been documented to be between 1.5 million to two million per year whereas out of this approximately one million die due to TBI. The rationale of the present study was to document the outcome of multidisciplinary inpatient rehabilitation program objectively using a standard functional outcome measure.

Aim: To determine the change in functional outcomes of ABI patients being rehabilitated with a multidisciplinary inpatient neurorehabilitation program using UK version of Functional Independence Measure and Functional Assessment Measure (UK FIM+FAM).

Materials and Methods: The retrospective observational study was conducted in Medanta Hospital, Gurugram, Haryana, India, from September 2017 to June 2018. Retrospective analysis of previously maintained data was done from June 2018 to November 2018. Data was collected from the Department of Neurorehabilitation. Demographic data was collected including age, sex, type of injury, time from injury to admission and duration of stay in the neurorehabilitation unit. Functional outcome measure used in the study was the UK FIM+FAM. Data was collected in paper forms and collated in Microsoft Excel and transferred to IBM® Statistical Package for the Social Sciences (SPSS)® version 22.0 (IBM Corp., Armonk, NY) for analysis. The UK FIM+FAM data was analysed as aggregate total scores and motor and cognitive subscales. Non parametric tests were used as UK FIM+FAM is an ordinal scale. The test used to measure the change in score was Wilcoxon Test. The p-value <0.05 was considered statistically significant.

Results: Total number of patients who were analysed in the study were 45. Motor subset of scores showed significant improvement from admission (50) to discharge (72) (p-value=0.001). Similarly, the cognitive subset of scores also showed a significant improvement from admission (58) to discharge (68, p value=0.002). Apart from motor and cognitive subscales of UK FIM+FAM, change in score in sub divisions of self-care and transfers showed the maximum change with p-value=0.001. Other sub divisions of locomotion, sphincter, communication, psychological and cognition also showed a significant difference of p-value <0.05.

Conclusion: A physiatrist led intensive interdisciplinary inpatient rehabilitation program for patients with ABI may significantly reduce residual disability and improve functional independence. Such a program is not only effective in high income countries but also in Low Middle Income Countries (LMIC).

INTRODUCTION

Acquired Brain Injury (ABI) can be defined as an injury to the brain which cannot be attributed to hereditary, congenital or degenerative causes [1]. ABI can be categorised into Traumatic Brain Injury (TBI) and Non TBI (NTBI). TBI results from external mechanical forces, whereas NTBI is not caused by trauma, infact by a disease or illness [2]. Various causes of NTBI are tumour, infections, stroke and vascular malformations [3]. Stroke and TBI have been regarded as the two main causes of ABI [2]. The ABI can lead to a combination of physical, cognitive, and behavioural impairments and requires comprehensive, intensive and structured inpatient rehabilitation program [4,5]. A multidisciplinary rehabilitation program can deal comprehensively with all these issues together rather than focussing on a single aspect like motor function. To support this, we have a Canadian study [6], which concluded that such a comprehensive multidisciplinary rehabilitation program with extended length of stay did show significant improvement in functional outcomes on discharge. Similar results were also quoted by a British study [7], which claimed that comprehensive multidisciplinary rehabilitation was indeed beneficial for TBI patients. They found that an average length of stay of seven months in the inpatient rehabilitation ward was more effective than community based rehabilitation.

Number of people suffering from TBI in India has been documented to be between 1.5 million to 2 million per year whereas out of this approximately 1 million die due to TBI [8]. Functional Independence Measure (FIM) comprises of 18 functional activities on a seven-level scale (one implying total dependence and seven implying complete independence). This has been extensively used for medical rehabilitation, as an effective outcome measure. To this measure, were added a further 12 items pertaining to cognitive, behavioural and communicative measures, to formulate the Functional Assessment Measure (FAM) [9]. This addition was a necessity as it was useful to assess psychological and cognitive issues in ABI patients. Further, the scale was modified in 1990s to develop the UK FIM+FAM which responded to many of the limitations of previous version of FIM+FAM [10]. The UK FIM+FAM have 16 items pertaining to physical function and 14 items of cognitive and psychological function. Further six items of Extended Activities of Daily Living (EADL) were added which augmented its scoring accuracy and reliability [11]. Since, there is no Indian version of FIM+FAM, it was decided to apply UK FIM+FAM in the study. UK FIM+FAM measures disability and functional independence in neurorehabilitation patients [12].

The current study was conducted to determine the change in UK FIM+FAM scores in ABI patients, after a structured rehabilitation program. The study was planned as there was not much published literature, describing the effectiveness of a comprehensive multidisciplinary rehabilitation program for ABI patients, in LMIC, especially in Indian setting. The objective was to determine the change in functional outcomes of ABI patients being intensively rehabilitated in a comprehensive and multidisciplinary inpatient neurorehabilitation program in a tertiary care hospital in Haryana, India.

MATERIALS AND METHODS

This was a retrospective observational study conducted in Medanta Hospital, Gurugram, Haryana, India, from September 2017 to June 2018. Retrospective analysis of previously maintained data was done from June 2018 to November 2018. Hence the study duration was six months. Demographic data as well as change in functional outcome measures were assessed and analysed from medical records maintained in the Department of Neurorehabilitation. The study was in accordance with the ethical standards of the Institutional Review Board (IRB) and The Code of Ethics of the World Medical Association (Declaration of Helsinki) for experiments involving humans. The IRB approval was granted. There was a waiver of informed consent as analysis was conducted from medical records of the patients retrospectively.

Inclusion and Exclusion criteria: The ABI patients admitted for specialised neurorehabilitation program from September 2017 to June 2018 were incorporated in the study. Patients were identified from paper based medical records on the basis of inclusion and exclusion criteria. The age group included was 18-65 years of age. Patients suffering from moderate TBI, having Glasgow Coma Scale (GCS) of 9-12 were included in the study. Patients staying back for less than one week for neurorehabilitation were excluded as they would not meet even the lowest time threshold for repeat assessment. Patients who could not participate in the rehabilitation program due to co-morbidities, deterioration in clinical condition or poor comprehension were excluded from the study. As per the management protocol of the department, patients were discharged once patients, caregivers and family members realised maximal benefit with the rehabilitation program and were deemed appropriate to be discharged from the ward. The sample size calculated was 100, keeping 15% as relative error.

Sample size calculation: The total number of patients screened for the study was 120. Keeping in mind the inclusion and exclusion criteria, the number of patients who were recruited in the study were 50. Out of this 50, five patients had taken leave Against Medical Advice (AMA) in the middle of rehabilitation program and wanted to continue with home-based rehabilitation. Hence, the total number of patients was 45.

Study Procedure

Demographic data collected included age, sex, education, occupation, time from injury to admission and duration of stay in the neurorehabilitation unit. Functional outcome measure used in the study was the UK FIM+FAM [12]. As per the protocol of the department, all ABI patients were evaluated clinically and demographic data were recorded. Clinical examination included general examination, cranial nerve examination, higher mental function assessment, motor system examination, sensory system examination, GCS Scoring. Patients were subjected to a comprehensive interdisciplinary inpatient neurorehabilitation program comprising of goal setting, weekly multidisciplinary rounds and meetings headed by Physical Medicine and Rehabilitation (PM&R) physician and attended by all the members of rehabilitation team, that is, occupational therapist, physiotherapist, speech and language pathologist, neuropsychologist, and rehabilitation nurse. These were conducted to chart the progress of the patients. Further, care plan meetings, to discuss the plan of discharge with the caregivers of patients were conducted. These care plan meetings were headed by PM&R physician and attended by all the above mentioned members of the team aimed at dealing with apprehensions of caregivers with respect to discharge of their patients and further ensuring that they were safe to be discharged to the community.

The patients were subjected to a tailor made, impairment specific, rehabilitation program comprising of PM&R physician consultations, supervised physiotherapy and occupational therapy sessions. Patients were also subjected to speech and language therapy sessions and sessions by neuropsychologist wherever appropriate. The hours of therapy were usually around three hours of combined physiotherapy, occupational therapy, speech and language therapy and psychological intervention. It was done every day for six days in a week. As per the Department's protocol, UK FIM+FAM were scored within 48 hours of admission and then a day before the planned discharge. UK FIM+FAM scale was administered by the author of this paper, who has been trained to use it in United Kingdom. The reliability and validity of the rating scale, UK FIM+FAM has been well studied and published [12]. Permission was also sought from the author of the scale [10], regarding its usage in the current study for academic purposes. In UK FIM+FAM, nine items are for self-care including bladder and bowel management; seven items deal with transfers and mobility; five items address communication and nine items address cognitive and psychosocial function [10].

The module of EADL was excluded while conducting the study as these activities was not very much India specific. Due to cultural and social reasons, in India, EADL like meal preparation, laundry, shopping etc., are conducted with the help of care givers, helpers or other family members except in a few cases.

STATISTICAL ANALYSIS

Data was collected in paper forms and collated in Microsoft Excel and transferred to IBM® SPSS version 22.0 (IBM Corp., Armonk, NY) for analysis. The UK FIM+FAM data was analysed as aggregate total scores and motor and cognitive subscales [9]. Non parametric tests were used as UK FIM+FAM is an ordinal scale. The test used to measure the change in score was Wilcoxon Test. The p-value <0.05 was considered statistically significant.

RESULTS

The total number of patients screened were 45. Number of patients suffering from TBI was 10 whereas 35 patients had NTBI. There were almost three times as many men as women, recruited in the study. The total number of men recruited was 33 and women recruited were 12. In the TBI group, 80% were men and 20% women. In the NTBI group 71.4% were men and 28.5% women. The mean age at admission for TBI group was 31 with a range from 20-55. As expected, this was lesser than NTBI group having mean age of 50 with a range from 35-64. The mean duration from injury was 53 weeks in TBI group whereas it was 60 weeks in NTBI group. The mean of duration since injury for both the groups combined was 55 weeks, with a range from 35-110. The mean duration of stay in the neurorehabilitation unit for undergoing rehabilitation was 56 days i.e., eight weeks, while that for NTBI group was 49 days or seven weeks. The number of patients requiring ICU care was eight and 31 amongst TBI and NTBI group, respectively. The demographic data, grouped into TBI and NTBI, has been depicted in [Table/Fig-1].

The percentage of patients having stroke was around 55.5% (n=25), while of those suffering from TBI was 22.2% (n=10). Other causes of NTBI comprised of around 22.2% (n=10). Various causes of NTBI have been depicted in [Table/Fig-2]. The UK FIM+FAM scores at admission and on discharge were analysed and compared. The UK FIM+FAM scores were available for 45 patients, i.e., 10 suffering from TBI while 35 having NTBI. It has been well defined that UK FIM+FAM change is the absolute difference between discharge and admission scores. Motor subset of scores showed significant improvement from admission to discharge (50 vs 72, p-value <0.001). Similarly, the

Variable	Total No. of patients	Percentage
Education		
Primary	22	48.8
Secondary	9	20
High school	33	15.3
Graduate and above	7	15.5
Marital status		
Single	15	33.3
Married	30	66.6
	TBI	**NTBI**
No. of patients	10	35
Male n (%)	8 (80%)	25 (71.5%)
Female n (%)	2 (20%)	10 (28.5%)
Median age at admission (years)	31 (20-55)	50 (35-64)
Duration of stay in neurorehabilitation unit (days)	56 (42- 84)	49 (39-70)
Duration from injury (Median) (weeks)	53 (35-98)	60 (40-110)
Number of patients requiring ICU care	8	31

[Table/Fig-1]: Demographic data.
ICU: Intensive care unit

cognitive subset of scores also showed a significant improvement from admission to discharge (58 vs 68, p-value <0.05). This change was more evident in the motor subscale. The significant difference in both the subsets has been given in [Table/Fig-3].

Causes of NTBI	Number of patients
Stroke	25
Postcardiac arrest	2
Sub arachnoid haemorrhage	2
Encephalitis/Meningitis	3
Brain Tumour	3

[Table/Fig-2]: Various causes of NTBI.

UK FIM+FAM scores	Admission median	Discharge median	Median difference	p-value
Motor	50	72	22	0.001
Cognitive	58	68	10	0.002
Total (FIM+FAM)	108	140	32	0.001

[Table/Fig-3]: Change in UK FIM+FAM Scores in motor and cognitive subsets. (Wilcoxon Test used to measure change).

Apart from motor and cognitive subscales of UK FIM+FAM, change in score in further sub divisions of self-care (26 vs 34, p-value <0.001) and transfers (11 vs 18, p-value <0.001) showed the maximum change with p-value <0.001. Other sub divisions of locomotion (7 vs 11, p-value <0.05), sphincter (6 vs 10, p-value 0.05), communication (21 vs 25, p-value <0.05) psychological (15 vs 20, p-value <0.05) and cognition (20 vs 23, p-value <0.05) also showed a significant difference. The change in UK FIM+FAM score for patients in various sub-divisions has been shown in [Table/Fig-4].

Variables	Admission median	Discharge median	Median difference	p-value
Self-care	26	34	8	0.001
Sphincter	6	10	4	0.044
Transfers	11	18	7	0.001
Locomotion	7	11	4	0.045
Communication	21	25	4	0.045
Psychosocial	15	20	5	0.04
Cognition	20	23	3	0.049

[Table/Fig-4]: Change in UK FIM+FAM Scores in various sub divisions. (Wilcoxon Test used to measure change).
p-value <0.05 was considered statistically significant

DISCUSSION

To the best of my knowledge, this is one of the few limited studies available to evaluate the effectiveness of multidisciplinary, comprehensive, specialised, inpatient rehabilitation program using UK FIM+FAM tool in an Indian setup. The study inferred that the program did produce a statistically significant change in both motor and cognitive sub scales in a diverse group of patients suffering from ABI, who attended the comprehensive inpatient rehabilitation program. All the patients at time of transfer to neurosciences ward had significant motor and cognitive disability. There is well established research demonstrating effectiveness of multidisciplinary rehabilitation program on ABI patients [12-14].

Similar to results of study published by Gray DS and Burnham RS, patient's age at admission was higher in the NTBI group as older patients are more prone to causes like stroke and vascular malformations [15]. The mean age of patients suffering from stroke has been documented as varying from around 60-75 years for men and between around 65-80 years for women, which is quite similar to study by Appelros P et al., [16]. Since stroke comprises of a major cause amongst those suffering from NTBI, the findings in present study of relatively older population in NTBI group can be well justified.

Similar to findings in other studies, the ratio of men:women were much higher in both TBI and NTBI group [15,17]. This can be well justified as more men suffer from TBI due to being involved in outdoor activities as well as due to their job profile, which comprises of more risk taking activities. In a Swedish Systematic Review article, it has been clearly indicated that male stroke incidence rate was 33% higher and stroke prevalence was 41% higher than the females [16]. However, as age progresses beyond 65 years, the ratio reverses [16]. Since our study has been limited to 18-65 years, the findings of the study can be well justified.

Willer B et al., stated that the functional improvement in terms of motor, ADL, sensory and communication, behaviour, emotional and cognitive domains of functional abilities were significantly greater than the gains of matched sample of individuals who did not receive residential based rehabilitation [6]. They conducted a case control study, on the contrary to this study, which is a reterospective analysis of previously maintained data. However, the results obtained are on similar lines. In their study, three Health and Activity Limitation Survey (HALS) Scales that is, Motor (8 items), ADL (8 items), Sensory and Communication (6 items) were used. Behaviour (8 items), Emotional (4 items) and Cognitive (8 items) scales were also added to HALS, to make it more appropriate for the TBI population.

In another study by Gray DS and Burnham RS, it was noted that motor subset scores as well as cognitive subset scores showed a significant change at the time of discharge as compared to admission values [15]. This was again similar to the results of the current study.

British study conducted by Semelyn JK et al., has further reiterated the contention that multidisciplinary comprehensive in-patient rehabilitation services are more effective than community based rehabilitation and add to the process of natural recovery [7].

Limitation(s)

Limitations of the study are that since there was no Indian version, the components of UK FIM+FAM scale were not pretty much India specific. The components of EADL are not of much relevance in the Indian context and had to be excluded from our study as in India, activities like meal preparation, doing laundry and doing shopping are mostly done with the help of helpers or care givers due to social and cultural factors in the family.

The sample size on which the study was done was small. More such studies, preferably multicentric in origin should be undertaken in future. The lack of controls in the study further raises a question that

whether the change in scores achieved is a result of spontaneous recovery or as a result of comprehensive rehabilitation. Similar issue of lack of control group has also plagued previous studies measuring the outcome of rehabilitation interventions [15].

The group of patients with ABI, who are discharged from other hospitals where a formal Department of PMR is not established and patients are not subjected to a comprehensive rehabilitation program, might be used as a control group in future studies of similar approach. The suggestion of multicentric studies being conducted in future can serve as a solution to this limitation. Further, since the time of admission of most patients was around one year after injury, the period of spontaneous recovery was over and this change can be considered as a result of the rehabilitation program.

CONCLUSION(S)

A physiatrist led intensive interdisciplinary inpatient rehabilitation program for patients with acute brain injury may significantly reduce residual disability and improve functional independence. The study also highlights the fact that such kind of rehabilitation program was not only effective in high income countries, but also in LMIC. A tailor made rehabilitation program can prove to be of immense help to improve the functionality of ABI patients, even in sub-acute phase.

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