Comparison of Neurological versus Functional Recovery Observed during Rehabilitation, Among Paraplegics Following Traumatic Spinal Cord Injury

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Abstract: *Traumatic spinal cord injury occurs due to trauma to spinal column, which carries significant morbidity &mortality to affected individual. Spontaneous neurological injury may occur following injury, but functional activities of daily living & mobility is invariably affected. Rehabilitation is indicated to prevent complications and to achieve independence in self-care, mobility & sphincter control.* *Aims: To study the functional recovery using Modified Barthel Index (MBI) and neurological recovery using American Spinal Injury Association (ASIA) scale in paraplegics. To identify any correlation if exists between neurologic and functional recovery. Results: Neurological improvement was observed in 40 percent patients, which isstatistically significant. Functional improvement was observed in all patients irrespective of neurological recovery, and ishighly significant as per paired t-test results. There is no correlation between neurological recovery and functional recovery. Conclusion: Rehabilitation has huge impact on improving functional independence in self-care activities & mobility irrespective of neurological recovery.*

Keywords: Spinal cord injury; ASIA Scale; Modified Barthel Index; Functional recovery

1. Introduction

Health is basic human need, world health organization is focusing on universal health coverage for year 2019. Developing country like India although have better health facilities in 21st century, but we still lack universal access to medical facilities specially to underprivileged people.(1)Lack of facilities of rehabilitation after traumatic spinal cord injury is a worrisome situation in most partsof India. Rehabilitation centers dedicated to serving such patients are scarce in the community. Hence many of the patients are deprived of early access to rehabilitation, which adds to the morbidity of patients.

Traumatic spinal cord injury results from acute trauma to the neural elements in spinal cord, resulting in sensory and/or motor deficit. The incidence of spinal cord injury in India is estimated to be, 15 new cases per million per year. (2) This is causing huge impacthealthcare system in form of disease morbidity considering its chronic nature & India's current population of 1.3 billion. This study has been conducted in All India institute of Physical Medicine and Rehabilitation (AIIPMR) Mumbai. This institute has been dedicated to service of specially abled people since 1955, providing medical care and rehabilitation to patients suffering from various loco-motor disabilities. (3)Most of the studies suggest that, early rehabilitation has better outcome in functional improvement.(4)(5)(6) Hence weattempted to study the functional outcome in patients of spinal cord injury who had delayed accessto rehabilitation.

We have used Modified Barthel Index (MBI) shah version (7) (8) to document functional recovery . It is five point ordinal scale with maximum total score of hundred, it measure assistance required in ten different items of self-care and mobility. It is free to use and simple to administer scale for measurement of functional outcome. MN Hadley et al have concluded that combination two scales, each for neurological and functional outcome is the best approach for assessment in spinal cord injury. They also consider ASIA scale (American Spinal Injury Association Scale) to be the best for recording neurological recovery. (9) Elliot Roth et al found excellent correlation between Modified Barthel Index (MBI) and Functional Independence Measure (FIM) when used for functional assessment in spinal cord injury. (10) Hence we have used ASIA scale and MBI to document neurological and functional assessment respectively.

2. Objectives

- To access neurological & functional recovery in patients of traumatic spinal cord injury.
- To compare neurological and functional recovery scale to find out if any correlation exists between these two.

3. Methodology

Traumatic Spinal cord injury patients suffering fromparaplegia with neurological bowel and bladder between 16 to 60 years of either gender were included. Patients with quadriplegia, paraplegic with COPD, asthma,

amputation of extremity & paraplegia caused by non-traumatic etiology were excluded.

Patients were initially assessed at the time of admission, for neurological level/ impairment by using ASIA scale. Functional assessment was done using the Modified Barthel Index (MBI). Associated medical conditions were also noted and treated first such as bed sore, urinary tract infections. Simultaneously goal setting was done according to initial neurological level, multiple counseling were done for better understanding of injury by patient and to promote participation in rehabilitation program. Patients underwent rehabilitation program for, Activity of Daily Living (ADLs) training, prevention of pressure ulcer, bowel care & bladder management. Details of all training modules mentioned earlier are beyond the scope of this article but once patient achieved some improvement they were encourage in training to achieve maximum independence in ADLs, transfer activities, locomotion, bowel and bladder independence. Finally at the time of discharge patients were again assessed neurologically using ASIA scale and functionally using MBI.Scores were recorded for analysis.

4. Results

Total 30 patients were enrolled in study out of which 2 (7%) patients were female. Average age time of admission was 32.5 years with median age of 31 years. Average time duration of paraplegia was 16.8 months with median time duration of 11 months. Total length of stay in hospital for rehabilitation was 84 days. Eleven patients (37%) were suffering from upper dorsal injury with neurological level between D_1 -D_6, Fifteen (50%) patient were suffering from lower dorsal type of injury with neurological level between D_7 -D_{12} and four (13%) patients were having L_1 neurological level. The average ASIA score at admission was 184.5 which increased to 187.1 at the time of discharge. This change was analyzed using paired t-test and found to be statistically significant, t- value 3.742 with 29 degree of freedom (df).

The average Modified Barthel Index score at admission was 29.33 which increased to average score of 81.7 at the time of discharge, this was very significant improvement. Statistically t-value was found to be 22.74 with 29 degree of freedom on paired t-test *(table 1).*

The MBI score of 18 (60%) patients was increased between 51- 75 points at time of discharge compared to admission. The 11 (33%) patients had gained MBI score between 26- 50 points & one patient had gained the score by 19 points at the time of discharge. Pearson correlation was calculated between gain of ASIA score and gain in MBI score. The correlation coefficient (r) was found to be 0.126 with P value being 0.504, indicating poor correlation between change in ASIA score and change in MBI score.

Table 1: Comparison score of ASIA scale and Modified Barthel Index n=30

|	ASIA Admission	ASIA Discharge	MBI Admission	MBI discharge
Average	184.5	187.1	29.33	81.7
Median	200	202	24	81
Standard Deviation	35.15	36.01	13.6	12.12
Paired t- test pre and post	t-value	3.742	t-value	22.74
	p-value	0.008	p-value	<0.0001

5. Discussion

Result showed that mean age of enrolled patients were 32.5 years at the time of admission.This is consistent with study done by Chhabra & Arora on demographic profile in India.(11)(12) The fall from height was most common cause of spinal cord injury 43 percent followed by road traffic accident 37 percent in study. Woman enrollment was only seven percent in our study as compared to global statistics of 20 percent, this may be because of less number of woman engage in high risk activities and driving job in India. The median length of stay in hospital for inpatient rehabilitation was around 90 days this more than United state data but less than that ofwith studies publish from Netherlands &Japan**. (table 2)**

| *Table :2* Name of studies & country of origin	Length of stay in for rehabilitation
NSCISC, Fact and Figure 2019, United States (13)	31 days
Tooth L,et al, Australia(14)	88 days
Marcel Post, et al, Netherlands(15)	240 days
Sumida M et al, Japan(5)	267 days
Present study	90 days

Neurological improvement was observed in patients, the average gain in ASIA score between admission and discharge was found statistically significant on paired t-test (p=0.008), but actual gain was observed in only 12 (40%) patients while in others (60%) there was no change in ASIA score. Out of 12 patient only 5 (16%) patients had, neurological improvement which was evident clinically in form of gain in motor power of key muscles & significant sensory gain, other patients only had minimal change in sensory score during period of stay in hospital for rehabilitation. Sumida et al, found neurological recovery in early less than six month of spinal cord injury.(5) Two patients had delayed neurological recovery after one year this may be because of activity dependent plasticity. (16)

The functional recovery was observed in all patients, irrespective neurological recovery which was not seen 60 percent patients. On paired t-test evaluation p -value (<0.0001) was very significant for change of MBI score with mean difference of 52.4 points. Mobility subscale score were severely affected at admission, as most of patients were bedbound before admission. The area covered by MBI are self-care, sphincter-control & mobility, we had observed significant improvement in all items of MBI at the time of discharge. (*graph1*)
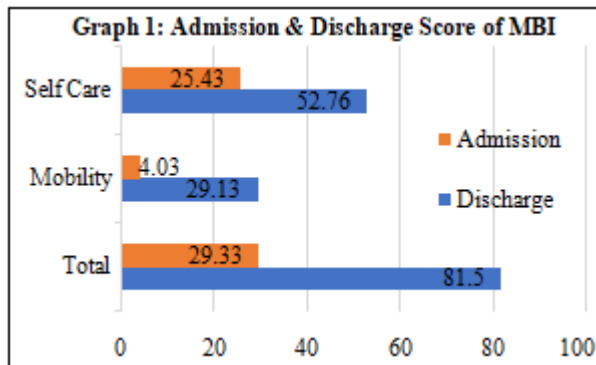
Graph 1

On analysis of gain in ASIA and MBI score at the time of discharge, we found Pearson's correlation coefficient 0.126,suggesting poor correlation between neurological and functional recovery. We found functional recovery despite of no neurological recovery in 60% patients. So we can attribute the functional recovery to inpatient rehabilitation of patients.(*graph 2*) .
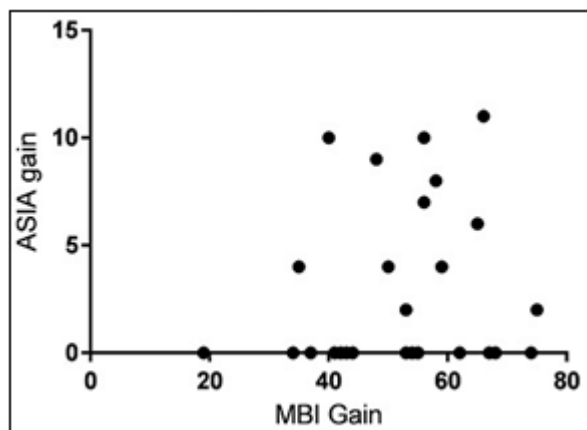
Graph 2: Correlation ASIA & MBI

Our study contrary to Scivoletto et al. found that early rehabilitation is relevant prognostic factor for functional recovery. (17)Our finding are consistent Sumida et al, who reported good functional recovery as effort of rehabilitation with or without neurological recovery.(5)(18)

6. Conclusion

Poor correlation observed between neurological and functional recovery in paraplegics affected with traumatic spinal cord injury. Functional recovery is independent of neurological recovery, rehabilitation helps in gaining functional independence in self care & mobility. It should be initiated as early possible to reduce morbidity despite of lack of neurological recovery in such patients.

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