Motor, sensory and functional recovery in patients with spinal cord lesions

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The aim of this study is to evaluate the sensory, motor and functional improvement in patients with a Spinal Cord Lesion (SCL) by recording at admission, discharge and at 12 months after discharge. Fifty-five patients (29 with paraplegia and 26 with tetraplegia) admitted to our departments of Physical Medicine and Rehabilitation between December 1992–1995. Three patients were excluded as they did not give their consent. Each patient was evaluated at admission, before discharge and at 12 months after discharge. Motor status was evaluated by the motor score (MS), sensory status by the light touch score (LTS), and functional status by the Functional Independence Measure (FIM) score. Each patient was asked to complete a patient questionnaire which was developed according to the standards of the American Spinal Injury Association (ASIA) scale. Twelve patients (10 with paraplegia and two with tetraplegia) were evaluated at 12 months after discharge. Paired samples *t*-test was used for statistical analysis. The mean age of the patients group was 36.42 ± 17.70 years, the mean duration of inpatient rehabilitation was 93.87 ± 44.95 days. The SCL was due to trauma in 45 patients, 86.50% of the cases and was complete in nine patients (17.30%) and incomplete in 19 (36.53%) with paraplegia. Six tetraplegic patients (11.53%) had complete and 18 had (34.61%) incomplete lesions. The evaluation of MS, LTS and FIM scores at admission and discharge showed significant improvement in the MS and LTS in all of the patients with incomplete lesions ($P < 0.001$). FIM scores showed significant improvement only in those with complete or incomplete paraplegia ($P < 0.05$). At 12 months follow-up there was no significant change in the MS and the LTS whereas a significant change was noted in the FIM scores ($P < 0.05$) in 10 paraplegic patients. In summary, the results of this study indicate that rehabilitation was effective in our SCL series although the significant gain may also be attributed to the fact that 71.1% of the study group had incomplete neurological lesions.

Keywords: spinal cord injury; Functional Independence Measure, motor score, sensory score; neurological recovery

Introduction

In 1927 Harvey Cushing reported that 80% of spinal cord injured veterans died within several weeks after injury due to infection of the urinary tract and ischemic ulcers. Presently however 94% of these patients survive and lead functional useful lives owing to treatment in the rehabilitation and trauma centers.^{5,10,15} In the United States of America (USA) the reported prevalence of Spinal Cord Injury (SCI) is 200,000–250,000 and the annual incidence is 24–50 in a million.^{5,18,28,29} The incidence of SCI is lower than that of coronary disease and cancer but the financial burden of these patients in society is greater than both, and the treatment and rehabilitation needs are a socioeconomic challenge to society.^{18,25}

The functional loss in SCI is due to neurological defects and immobilization and a period of 2–6 weeks

of strict bed rest results in deterioration of the musculoskeletal and cardiovascular systems.⁴ The basic aim of rehabilitation in SCI is to minimize the negative effects of immobilization, and to prevent complications.^{4,12,14} Sudden disability resulting from SCI affects family members and their quality of life as well.²¹ Rehabilitation procedures aim to teach the patient independence in the activities of daily living, ambulation, and social integration depending on the degree of severity of the neurological defects.⁵

In this study our aim was to evaluate the effectiveness of rehabilitation in our SCL patients by recording MS, LTS and FIM score at admission, discharge and at 12 months after discharge.

Materials and methods

Fifty-five SCL patients (29 paraplegic and 26 tetraplegic) were admitted to our departments of Physical

Medicine and Rehabilitation during 1992–1995 for inpatient rehabilitation. Fifty-two gave their consent and were recruited for the study. Nine patients had complete and 19 incomplete paraplegia. Six tetraplegic patients had complete and 18 incomplete neurological lesions. All patients were evaluated on the first day of admission, at discharge and 10 with paraplegia were evaluated at 12 months follow-up by MS, LTS^{1,6,12,19} and FIM recordings.^{1,8,11,20,23} A patients' questionnaire developed in accordance with ASIA standards was completed by each patient and the degree of the lesion was determined by the same scale.^{1,6} Although each patient was recalled for reevaluation at 12 months, only 10 patients with paraplegia and two with tetraplegia attended for reevaluation. Paired samples *t*-test was used for statistical analysis.

Results

The mean age of the patients group was 36.42 ± 17.70 years and the mean duration of inpatient rehabilitation was 93.87 ± 44.95 days. The educational level of the group was low, uneducated and primary school graduated being 67.3% of the total cases (Table 1). SCL was due to trauma in 21 people with paraplegia and 21 with tetraplegia (80.7%), tumor in four patients (three paraplegic and one tetraplegic) (7.7%), infection in three patients (two paraplegic and one tetraplegic) (5.8%) and degenerative lesions in three patients (two paraplegic and one tetraplegic) (5.8%). Falls, traffic accidents and head-on diving were the three main causes of traumatic SCL in this series. (Table 2). Nine with paraplegia (17.30%) had incomplete, and 19 paraplegic patients (36.53%) had complete lesions. Six with tetraplegia (11.53%) had complete, 18 (34.61%) had incomplete lesions. The evaluation of

MS, LTS and FIM score at admission and discharge showed significant improvement in MS and LTS in all patients with incomplete lesions ($P < 0.001$) whereas FIM scores were significant only in those with paraplegia with complete or incomplete lesions ($P < 0.05$) (Table 3). The reevaluation of 10 paraplegic patients at 12 months follow-up showed no significant difference in MS and LTS scores whereas significant progress was noted in FIM scores ($P < 0.05$). (Table 4). The results of follow-up evaluation of those with tetraplegia are not included in the study since only two such patients attended.

Discussion

Several studies have reported that the mean age of spinal cord injured (SCI) patients is in the third decade.^{2,3,5,12,17,22,27} Some other studies however report a range from the second to fourth decades.^{9,15,16,26,29–31} In our study the mean age of the group was on the third decade. SCI is more common in the male sex^{2,7,9,17} and epidemiological studies report a percentage of 80%.^{3,5,29,30} In our study the male/female ratio was 32/20.

The mean duration of inpatient rehabilitation was 93.87 ± 44.95 days in our study. De Vivo *et al.* have shown this duration to be 97.9 days during 1973–1977 and this period shortened to 76.6 days in 1986–1987. Several studies from our country have shown the mean inpatient rehabilitation duration to be 54.4,²² 55.9³¹ and 139 days.² Studies from USA show that the hospital stay for tetraplegic patients was 149 days in 1974⁵ and has been shortened to 92 days in 1989.

The most common etiological factor in SCI is trauma.^{2,3,5,7,9,14,16–18,22} In our study a traumatic etiology was noted in 80.7% of the cases. Traumatic factors were falls from high places in 36.5%, traffic accidents in 19.2%, diving in 9.6%.

In the USA the most common factors responsible for SCI are motor vehicle accidents in 45%, falls in 22%, fights in 16% and sports accidents in 13%.^{3,5} In our study there was a low educational level. Living in suburban areas which may account for the fact that falls have a higher percentage than motor vehicle accidents among the etiological factors for SCI.

Table 1 Demographic features of the subjects

	Number	%
Gender		
Female	20	38.5
Male	32	61.5
Education		
No education	13	25
Primary school	22	42.3
High School	12	23
College	5	9.6
Marital status		
Married	32	61.5
Single	15	28.8
Widow	5	9.6
ASIA impairment scale		
Complete	15	28.9
Incomplete	37	71.1
	Medium $\pm$ SD	
Age (5–75 years)	36.42 ± 17.70	
Duration of rehabilitation (14–258 days)	93.87 ± 44.95	

Table 2 Etiological factors in patients with a Spinal Cord Lesion

	Number	%
Trauma	42	80.7
Falls	19	36.5
Traffic accidents	10	19.2
Diving	5	9.6
Iatrogenic	4	7.6
Gunshot wounds	4	7.6
Tumor	4	7.7
Degenerative	3	5.8
Infection	3	5.8

Table 3 Motor, sensory and functional recovery at admission and on discharge

	Number	Medium $\pm$ SD	P
*M.S.A.-M.S.D.			
Paraplegia incomplete admission	19	63.22 $\pm$ 19.28	$P < 0.001$
Paraplegia incomplete discharge	19	71.93 $\pm$ 17/88	
Paraplegia complete admission	9	50.33 $\pm$ 1.87	**N.S.
Paraplegia complete discharge	9	52.00 $\pm$ 3.77	
Tetraplegia incomplete admission	18	40.22 $\pm$ 24.27	$P < 0.001$
Tetraplegia incomplete discharge	18	57.05 $\pm$ 26.47	
Tetraplegia complete admission	6	11.50 $\pm$ 10.50	N.S.
Tetraplegia complete discharge	6	20.66 $\pm$ 11.97	
L.T.S.A.-L.T.S.D.			
Paraplegia incomplete admission	19	98.10 $\pm$ 15.62	$P < 0.001$
Paraplegia incomplete discharge	19	101.26 $\pm$ 14.14	
Paraplegia complete admission	9	66.33 $\pm$ 15.18	N.S.
Paraplegia complete discharge	9	68.33 $\pm$ 12.28	
Tetraplegia incomplete admission	18	83.22 $\pm$ 31.68	$P < 0.001$
Tetraplegia incomplete discharge	18	90.61 $\pm$ 28.34	
Tetraplegia complete admission	6	25.66 $\pm$ 12.80	N.S.
Tetraplegia complete discharge	6	36.50 $\pm$ 9.79	
F.I.M.A.-F.I.M.D.			
Paraplegia incomplete admission	19	72.50 $\pm$ 20.84	$P < 0.05$
Paraplegia incomplete discharge	19	97.00 $\pm$ 19.58	
Paraplegia complete admission	9	61.00 $\pm$ 12.18	$P < 0.05$
Paraplegia complete discharge	9	74.44 $\pm$ 17.72	
Tetraplegia incomplete admission	18	51.00 $\pm$ 15.26	$P < 0.05$
Tetraplegia incomplete discharge	18	79.94 $\pm$ 27.47	
Tetraplegia complete admission	6	49.83 $\pm$ 9.43	N.S.
Tetraplegia complete discharge	6	59.50 $\pm$ 14.36	

*M.S.A.-D.: Motor Score Admission-Discharge; L.T.S.A.-D.: Slight Touch Score Admission-Discharge; F.I.M.A.-D.: Functional Independence Measure Admission-Discharge; **N.S.: Not Significant

Table 4 Motor, sensory and functional recovery at discharge and 12 months after discharge

	<i>Number</i>	<i>Medium ± SD</i>	<i>P</i>
Motor Score			
Paraplegia discharge	10	71.71 ± 16.83	*N.S.
Paraplegia 12 months after discharge	10	72.14 ± 15.62	
Light Touch Score			
Paraplegia discharge	10	88.28 ± 24.77	N.S.
Paraplegia 12 months after discharge	10	91.57 ± 25.74	
Functional Independence Measure			
Paraplegia discharge	10	94.80 ± 15.95	<i>P</i> < 0.05
Paraplegia 12 months after discharge	10	103.90 ± 90	

*N.S.: Not Significant

The results of the epidemiological study by Murray *et al*¹⁴ indicate that trauma is the most common etiological factor in those below 40 years of age (69%). In those over 40, neoplasms (53%), spondylosis (25%) and trauma (13%) are the responsible factors.

Since 71.1% of patients in our series had incomplete lesions, our patients had the chance of spontaneous neural recovery which may be reflected by the

significant change from admission and discharge. There was a significant progress in MS, LTS and FIM scores in all incomplete cases, independent of the level of lesion (MS and LTS $P < 0.001$, FIM $P < 0.05$) in our study. No significant change in MS, LTS and FIM scores were noted ($P < 0.05$) in incomplete lesions. Although no significant difference was noted in MS and LTS scores in cases with complete lesions, significant progress noted in FIM scores at discharge and 12 months follow-up may account for the effectiveness of rehabilitation and former studies on this subject also support this point.³²⁻³⁴

This significant improvement in FIM scores both at discharge and at 12 months follow-up points to the effectiveness of rehabilitation and emphasizes the need for objective evaluation and recording criteria for the long-term follow-up of SCI patients.

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