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ORIGINAL ARTICLE

Demographic characteristics after traumatic and non-traumatic spinal cord injury: a retrospective comparison study

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Study design: Retrospective, 12-year case series.
Objective: To compare neurological and functional outcomes, and complications of patients with traumatic vs non-traumatic spinal cord injury (SCI) after in-patient rehabilitation.
Setting: In-patient rehabilitation unit of a tertiary research hospital.
Materials and Methods: The sample consisted of 165 newly injured patients with traumatic and non-traumatic spinal cord lesions whose medical records were retrospectively reviewed. Demographic characteristics, etiology, American Spinal Injury Association (ASIA) impairment scale, functional independence measurement (FIM) subgroup scores, length of stay and medical complications in both groups were compared.
Results: In all, 38 patients (23%) were non-traumatic and 127 patients (77%) were traumatic in etiology. Compared with patients with traumatic SCI (mean age 37.81 ± 13.65 years), patients with non-traumatic SCI (mean age 53.97 ± 14.48 years) were significantly older ($P<0.05$). Incomplete SCI was significantly higher in the non-traumatic group when compared with the traumatic group ($P<0.001$). In the non-traumatic group, admission motor FIM scores were significantly higher (28.29 ± 16.04) than scores from the traumatic group (36.60 ± 21.65; $P=0.029$); however, there was no significant difference in discharge motor FIM scores between the two groups ($P=0.140$). ASIA impairment scale scores were significantly higher in non-traumatic group both at admission and discharge ($P=0.000$ and $P=0.000$, respectively). The length of hospital stay was significantly shorter in the non-traumatic group ($P=0.002$).
Conclusion: According to the results of this study, although patients with non-traumatic SCI had shorter length of stay and higher ASIA scores, there was no significant difference in functional outcomes between traumatic and non-traumatic SCI patients.
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Keywords: complications; functional outcome; traumatic and non-traumatic spinal cord injury; rehabilitation

Introduction

Spinal cord lesions can lead to severe functional disorders and psychosocial problems.[1] Within the general population of spinal cord injury (SCI), traumatic SCI accounts for the largest portion, and there are many publications about individuals with traumatic SCI, their demographic data, type of injury, functional outcomes and disability. On the other hand, rehabilitation outcomes of non-traumatic SCI rehabilitation are published in a few studies.[2,3]

On the basis of the epidemiological data from US National Spinal Cord Injury Statistical Database, it is reported that the average age of individuals with spinal cord injury is 31 years. Of these individuals, 81% are males, 54% are singles and 62% are employed.[4] These results mainly belong to traumatic etiology and do not represent non-traumatic SCI. In studies comparing traumatic and non-traumatic SCI patients, it was shown that individuals with non-traumatic SCI were significantly older and were more likely married, female, retired, paraplegic and with incomplete injury.[2,5]

In the light of these data, our aim was to compare demographic data, complications arising during rehabilitation periods and neurological and functional outcomes of traumatic and non-traumatic SCI patients who were accepted into the rehabilitation program in our clinic.

Materials and methods

A retrospective comparison study was carried out, reviewing medical records of 169 patients who were diagnosed with SCI and accepted to an in-patient rehabilitation program at the

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rehabilitation unit of a tertiary research hospital between the years 1996 and 2008. Four patients whose length of hospital stay was <1 week were excluded from the study. Age, gender, marital status, demographic data including work status, SCI etiology, etiology of traumatic and non-traumatic subgroups, level of neurological injury, completeness/incompleteness of injury based on 'The American Spinal Injury Association' (ASIA) scale, length of time until admission to the rehabilitation center, length of stay in the hospital during rehabilitation period, complications arising during rehabilitation, functional state of patient at admission and at the end of rehabilitation right before discharge by using functional independence measurement (FIM) scores and FIM gain scores (measured as the difference between discharge and admission FIM scores) were recorded. Approval from the ethics committee of Baskent University was obtained for this study.

Statistical analysis

Statistical analyses were performed with SPSS software (Statistical Package for the Social Sciences, version 11.0, SSPS Inc, Chicago, IL, USA). Data were represented as average ± s.d., median and percentage. Independent samples *t*-test was used to compare parametric variables with normal distribution, Wilcoxon test was used to compare within-group parametric variables that do not have a normal distribution, Mann–Whitney test was used for between-group comparisons, χ^2 test was used to evaluate categorical variables and Spearman's test was used to analyze correlations. The *P*-value of <0.05 with 95% confidence level was considered to be significant.

Table 1 Demographic and injury characteristics

	N	*Traumatic* (n = *127*)	*Non-traumatic* (n = *38*)	P-*value*
Age (years) (mean ± s.d.)		37.81 ± 13.6	53.97 ± 14.4	0.000*
Sex				0.158
Female	41/17	32.3%	44.7%	
Male	86/21	67.7%	55.3%	
LOS (days)		85.56 ± 73.6	57.89 ± 55.9	0.002*
Paraplegia/tetraplegia	122/53	67.9/32.1%	74.1/25.9%	0.221
Incomplete/complete		26/74%	68.4/31.6%	0.000*

Abbreviation: LOS, length of stay.
*$P<0.005$.

Table 2 Etiology of traumatic and non-traumatic SCI

Diagnosis	N	*(%)*
Traumatic SCI		
Motor vehicle accidents	70	55.1
Falls	43	33.9
Gunshot wounding	10	7.9
Diving	3	2.4
Sports injury	1	0.6
Non-traumatic SCI		
Spinal tumors	11	28.9
Spinal stenosis	11	28.9
Vascular origin	6	15.8
Transverse myelitis	7	18.4
Spinal arachnoiditis	2	5.3
Syringomyelia	1	2.6

Abbreviation: SCI, spinal cord injury.

Results

Medical records from 165 patients were reviewed; they consisted of 127 (77%) traumatic SCI patients and 38 (23%) non-traumatic SCI patients. Demographic characteristics observed for patients with traumatic and non-traumatic SCI are presented in Table 1. The average age and median of traumatic and non-traumatic SCI patients were 37.81 ± 13.65 (median 35) years and 53.97 ± 14.48 (median 56) years, respectively. Patients with a non-traumatic injury were significantly older than patients with a traumatic injury ($P=0.000$). In the traumatic SCI group, 41 (32.3%) of the patients were females and 86 (67.7%) were males. In the non-traumatic group 17 (44.7%) of the patients were females and 21 (55.3%) of them were males. No statistically significant difference was observed between the two groups based on gender ($P=0.158$). Cause of injury in traumatic SCI patients consisted of 70 (55.1%) motor vehicle accidents, 43 (33.9%) falls, 10 (7.9%) gunshot wounding, 3 (2.4%) diving and 1 (0.6%) sports injury. Cause of injury in non-traumatic SCI patients consisted of 6 (15.8%) vascular origins, 2 (5.3%) infections, 11 (28.9%) tumors, 11 (28.9%) spinal stenosis, 7 (18.4%) transverse myelitis and 1 (2.6%) syringomyelia (Table 2). Most of the patients with neoplasms had primary tumors (81.8%, $n=9$) whereas 18.2% ($n=2$) of the patients had metastatic tumors. Overall, 63.6% ($n=7$) of the tumors were benign and 36.4% ($n=4$) were malignant tumors.

Length of time until patients were admitted to our rehabilitation center was similar in both the traumatic and non-traumatic groups (6.56 ± 17.13 and 6.77 ± 14.37 months, respectively; $P=0.169$). In the traumatic group, 97 (76.4%) patients were married and 30 (23.6%) were single; in the non-traumatic group 34 (89.5%) patients were married and 4 (10.5%) were single. The percentage of married patients was higher in non-traumatic group but the difference found between the two groups was not statistically significant ($P=0.080$).

When the patients were evaluated on the basis of occupation/profession, the patients in the traumatic group consisted of 78 working individuals, 13 retired individuals, 13 students and 23 housewives, whereas the patients in the non-traumatic group consisted of 10 working individuals, 11 retired individuals, 3 students and 14 housewives. When the two groups were compared, the percentage of patients who were retired were significantly higher in the non-traumatic group (52.4 versus 14.3%; $\chi^2=14.707$, $P=0.000$).

On the basis of neurological levels, in the traumatic group, 36 (28.3%) of the patients were tetraplegic (C4-T1), 76 (59.8%) were paraplegic (T2–T12) and 15 (11.8%) had conus–cauda equina (L1–S4) injury. In the non-traumatic group, 7 (18.4%) patients were tetraplegic (C4-T1), 20 (52.6%) were paraplegic (T2–T12) and 11 (28.9%) had conus–cauda equina (L1–S4) injury. Distribution of paraplegic/tetraplegic patients

Table 3 ASIA impairment scale comparison between the traumatic and non-traumatic SCI groups at admission

	A	*B*	*C*	*D*	*E*
Traumatic SCI (*n*)	94	18	8	7	0
Non-traumatic SCI (*n*)	12	9	10	6	1

Abbreviations: ASIA, American Spinal Injury Association; SCI, spinal cord injury.

Table 4 ASIA impairment scale comparison between the traumatic and non-traumatic SCI groups at discharge

	Traumatic SCI (n)	*Non-traumatic SCI* (n)
A	89	12
B	20	8
C	6	7
D	12	10
E	0	1

Abbreviations: ASIA, American Spinal Injury Association; SCI, spinal cord injury.

Table 5 Medical complications in traumatic and non-traumatic SCI

	Traumatic SCI (%)	*Non-traumatic SCI (%)*
Urinary tract infection	65	50
Pressure ulcers	27.6	7.9
Neuropathic pain	19.6	26.3
Spasticity	17.3	7.9
Deep venous thrombosis	6.3	5.3

Abbreviation: SCI, spinal cord injury.

Table 6 Functional outcome comparisons between traumatic and non-traumatic SCI

	Traumatic SCI (mean ± s.d.)	*Non-traumatic SCI (mean ± s.d.)*	P-*value*
FIM motor admission	28.29 ± 16.04	36.60 ± 21.65	0.029*
FIM motor discharge	46.75 ± 20.69	52.91 ± 22.65	0.140
FIM gain	18.98 ± 16.72	16.66 ± 16.41	0.353

Abbreviations: FIM, functional independence measurement; SCI, spinal cord injury. *$P<0.05$.

was similar in both the groups; 67.9/32.1% in the traumatic group and 74.1/25.9% in the non-traumatic group ($P=0.221$; Table 1).

The proportion of patients with an incomplete injury was 26.0% in the traumatic group and 68.4% in the non-traumatic group, and the difference between the two groups was significant ($P=0.000$). The proportion of patients with a complete injury was 74.0% in the traumatic group and 31.6% in the non-traumatic group, and there was a statistically significant difference between the two groups ($P=0.000$; Table 1).

ASIA scale was used for assessment of impairment in all the patients in both the traumatic and non-traumatic groups. ASIA scores were recorded at the time of admission and at discharge (Tables 3 and 4). When compared between groups, it was found that ASIA scores were significantly higher in the non-traumatic group at admission ($P=0.000$) and at discharge ($P=0.000$).

During the rehabilitation period, at least one complication was observed in 113 (89.0%) of the patients in the traumatic group and 30 (78.9%) of the patients in the non-traumatic group. In both the traumatic and non-traumatic groups, the most frequent complication was urinary tract infection (65 and 50%, respectively). Only symptomatic urinary tract infections with clinical signs such as fever or spasticity were included in our study. Other complications in the traumatic group were, in order of frequency, pressure ulcers (27.6%), neuropathic pain (19.6%), spasticity (17.3%) and deep venous thrombosis (6.3%). On the other hand, in the non-traumatic group neuropathic pain (26.3%), pressure ulcers (7.9%), spasticity (7.9%) and deep venous thrombosis (5.3%) were the other most frequently observed complications (Table 5). No statistically significant difference was found between groups on the basis of recorded complications ($P>0.05$).

When the two groups were compared with regard to pressure ulcers, in order of frequency, in the traumatic group 57.1% of pressure ulcers were found in the sacrum, 14.3% in heels, 5.7% in the trochanter major region, 2.9% in the ischium, 14.3% in both the trochanter major and sacral region and 5.7% in both the sacrum and heels; in the non-traumatic group, 66.7% of the pressure ulcers were found in the sacral region and 33.3% in the trochanter major region. All of the pressure ulcers were present on admission.

In the traumatic and non-traumatic SCI patient groups, the average and median length of stay at the hospital were 85.56 ± 73.68 (median 72) and 57.89 ± 55.93 (median 44) days, respectively. The length of hospital stay was significantly longer in traumatic SCI patients ($P=0.002$; Table 1). A positive correlation was found between length of hospital stay and pressure ulcers ($r=-0.235$, $P=0.008$) and spasticity ($r=-0.215$, $P=0.015$) in the traumatic group, and between length of hospital stay and spasticity ($r=-0.414$, $P=0.010$) in the non-traumatic group. Length of stay was significantly longer in patients with spasticity in both the traumatic and non-traumatic groups ($P=0.016$ and $P=0.012$, respectively).

In the traumatic group, the average and median FIM motor scores was 28.29 ± 16.04 (median 25) at admission and 46.75 ± 20.69 at discharge ($P=0.000$). In the non-traumatic group, average and median motor FIM was 36.60 ± 21.65 (median 28) at admission and 52.91 ± 22.65 at discharge ($P=0.000$). The comparison of the admission FIM scores between the two groups revealed that the traumatic SCI group had significantly lower scores than the non-traumatic SCI group ($P=0.029$). However, the difference between the two groups with regard to discharge motor FIM scores and FIM gain scores was not statistically significant ($P=0.140$ and $P=0.353$, respectively, Table 6).

Use of orthosis providing therapeutic and/or functional ambulation was compared between the two groups at discharge. In the traumatic group, 64 (50.4%), patients required lower extremity orthosis, whereas in the non-traumatic group, 11 (29.7%) patients required lower extremity orthosis. Requirement of orthosis was significantly higher

in the traumatic group ($P<0.05$). Similarly, 98 (77.2%) patients in the traumatic group, and 21 (55.3%) patients in the non-traumatic group were using wheelchairs and the difference between the two groups was statistically significant ($P=0.008$).

Discussion

In this retrospective study, demographic features, etiological factors, complications, neurological and functional outcomes of traumatic and non-traumatic SCI patients who were admitted to the in-patient rehabilitation program were evaluated and compared. In our study, only 23% of the patients were non-traumatic SCI patients. In previous studies, this ratio varied between 25 and 60%.[5–7] In the literature, it was reported that traumatic SCI is observed more frequently in young adults and[8] the age range varies between 31 and 50 years,[9,10] whereas in non-traumatic SCI patients the average age is higher.[2,5] Similar to the literature, in our study, the average age of the traumatic group was 37.8 and it was significantly lower than the average age of the non-traumatic group.

In our study, the male-to-female patient ratio was almost equal in the non-traumatic group, whereas in the traumatic group the number of male patients was twice as many. As might be expected, women incur fewer injuries in sporting activities, from motor vehicle accidents and from acts of violence. Previous epidemiologic data also indicate results parallel to ours in which traumatic SCI is more frequent in males,[4] and in non-traumatic groups the ratio of females to males is quite similar[5] or even higher in some studies.[2,7]

Consistent with the previous data,[2,6,11] motor vehicle accidents (55.1%) and falls (33.9%) were the most frequent etiological factors of traumatic SCI, and spinal stenosis and tumor compression were the most frequently reported causes of non-traumatic SCI in our study group. However, some of the previous studies have reported act of violence as the most frequent cause followed by motor vehicle accidents.[12,13] Vascular reasons (15.8%) and transverse myelitis (13.2%) were other frequent causes of non-traumatic SCI in our study group.

In various studies based on occupation analysis, it was found that most of the patients in the traumatic group were in a job, whereas in the non-traumatic group there was a higher number of retired patients.[2,5] Similar results from our study showed that the rate of non-working and retired patients (52.4%) was significantly higher in the non-traumatic group ($P=0.00$).

It has been reported in the literature that non-traumatic spinal cord lesions tends to be associated with more incomplete injuries.[6,14] Similarly, the number/ratio of incomplete cases in non-traumatic SCI patients was higher than the traumatic group in our study population. Furthermore, consistent with previous studies, ASIA scale scores were significantly higher in the non-traumatic group both at admission and at discharge, meaning that patients in the traumatic group had more impairment both at the time of admission and discharge from rehabilitation.[7,15] The number of paraplegic patients was higher than tetraplegic patients in both groups. In our study, 52.6% of the non-traumatic patients had injury to the thoracic region. This can be explained by the fact that spinal cord tumors are typically observed in the thoracic region and are a frequent etiologic factor, which is consistent with literature.[6,14]

In some studies evaluating the length of hospital stay, traumatic and non-traumatic SCI patients showed variable results.[5,16] In our study, the average length of hospital stay of traumatic SCI patients was significantly longer (85.6 days) than non-traumatic SCI patients (57.9 days; $P=0.002$). Consistent with our findings, Mckinley *et al*.[3] also found longer length of hospital stay in the traumatic group. They believed that this was because of coexisting problems arising from the trauma itself (concomitant abdominal injuries, multiple fractures and so on) and other medical complications. In our study, higher proportion of complete injury and further functional loss and higher frequency of pressure ulcers might have prolonged the length of hospital stay in the traumatic group.

When admission and discharge motor FIM scores between groups were compared, in the non-traumatic group, the average scores at admission were significantly higher. Although neurological and functional status was better at the time of the hospitalization in the non-traumatic SCI patients, functional outcome was similar with the traumatic group. As reported in previous studies,[2,3,6] this situation may be explained by the higher age average of non-traumatic SCI patients, underlying etiological reasons and short hospital stays.

Need of orthosis to provide therapeutic and/or functional ambulation was significantly lower in the non-traumatic SCI patients ($P<0.05$). In addition, the usage of wheel chairs in the traumatic SCI patients was significantly higher ($P=0.007$).

New *et al*.[11] reported that the incidence of medical complications was lower in the non-traumatic group compared with the traumatic group. Similarly, in our study incidence of medical complications during the rehabilitation period was lower in the non-traumatic group compared with the traumatic group. Consistent with the previous studies, the most frequent complication observed in both groups was urinary tract infection.[11,17]

Pressure ulcer was the second most common complication in the traumatic SCI patients (27.6%), whereas in the non-traumatic group this ratio was quite low (7.9%). This discrepancy may be because of the small sample size of the non-traumatic group that consisted of patients who were medically stable and with better neurological and functional status. On the other hand, the most frequent location of pressure ulcer was the sacrum (57.1 and 66.7%, respectively) in both the traumatic and non-traumatic groups. In other studies, pressure ulcer rates vary between 15.4 and 31.3% in non-traumatic groups,[6,7,11,18] and between 23.7 and 41.8% in traumatic groups.[6,17,19]

Deep venous thrombosis was another complication observed in 5.3% of the non-traumatic SCI patients and in 6.3% of the traumatic SCI patients. Reported rate of deep

venous thrombosis was a little higher in previous studies in both non-traumatic group and traumatic SCI patients.[6,11,17] In our clinic, patients with clinical suspicion of deep vein thrombosis are evaluated using Doppler ultrasonography to verify the diagnosis. In addition, our routine prophylactic approaches, such as using low-molecular-weight heparin, wearing low-medium compression stockings and early mobilization, might explain the lower deep venous thrombosis incidences in our study group.

Although neuropathic pain was the second most frequently observed complication in the non-traumatic group, in our study, when compared with previous studies,[6,7,11,17,20] the incidences of spasticity and neuropathic pain were quite low in both the traumatic and non-traumatic group.

The reason that complications were more frequent in the traumatic SCI group could be because of the higher percentage of patients with complete and tetraplegic injuries in this group, whereas most patients in the non-traumatic group had paraplegic and incomplete injuries. In addition, functional status of non-traumatic SCI patients was better than traumatic SCI patients both at the time of hospitalization and discharge. For reasons such as these the incidences of medical complications in the non-traumatic SCI group were lower.

Retrospective design is the major limitation of this study. Small sample size, especially in the non-traumatic group, the study sample consisting of patients only from a single center who were medically stable, and finally the lack of referral of non-traumatic SCI patients to rehabilitation units may also present limitations to the study.

Conclusion

Non-traumatic SCI rehabilitation patients have a different demographic profile and length of stay compared with traumatic SCI patients. The findings in our study indicate that there are differences in terms of age and incomplete versus complete injury ratio among non-traumatic SCI and traumatic SCI patients. This study has shown that in spite of more impairment in patients with traumatic SCI according to the ASIA scale scores, there was no significant difference in functional gain between patients with traumatic and non-traumatic SCI.

Conflict of interest

The authors declare no conflict of interest.

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