ORIGINAL ARTICLE

Spinal cord injury in older population in Turkey

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Study design: Retrospective, comparative 4-year study.

Objectives: To identify the clinical characteristics unique to older patients with spinal cord injury (SCI).

Setting: Turkish Armed Forces Rehabilitation Center, Ankara, Turkey.

Methods: The study included 870 consecutive patients with SCI that were divided into two groups according to age. Patients aged ≥ 60 years at the time of injury constituted the study group, and randomly selected patients aged < 60 years that were matched for gender, week of admission and time since injury constituted the control group. Patients' demographic and clinical characteristics were recorded, compared and analyzed.

Results: The study group included 73 SCI patients (mean age: 66.98 ± 6.28 years) and the control group included 75 SCI patients (mean age: 33.93 ± 10.67 years). Among the 148 patients, 98 (66.2%) were male. The vast majority of lesions were at the thoracic level (47.3%). In the older group, falls were the most frequent etiology (32.9%), simple falls predominated (62.5%). 49.3% of the study group vs 18.6% of the control group had a non-traumatic cause of SCI. Older patients were found to be less likely to have complete injury (27.4 vs 44%, $P = 0.035$). The most common bladder management method was intermittent catheterization (69.6%) and the number of patients in each group treated with this method did not differ significantly ($P > 0.05$). More patients in the study group had neuropathic pain (50.7 vs 34.7%, $P = 0.049$) and abnormal urinary ultrasound findings (23.3 vs 9.3%, $P = 0.021$).

Conclusion: Results revealed that older patients with SCI may have different demographic and clinical features compared with younger patients.

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INTRODUCTION

Spinal cord injury (SCI) is associated with physical, emotional, psychological and economic sequelae that not only affect patients, but also their families and society.^{1,2} Older adults often have multiple health problems such as pulmonary, cardiovascular, liver and renal disease, musculoskeletal issues and mental impairment. Following SCI, an older patient with preexisting multiple comorbidities and limited physiological reserves is challenged by the new medical condition with which she/he must cope for the remainder of their life. Due to comorbid conditions and unique anatomical/physiological features, SCI in older patients might differ from that in younger patients.

Earlier studies reported that SCI exhibits bimodal distribution, with a peak age-specific incidence in young adults, and a second smaller peak in the older population.^{2–4} The older population worldwide is expected to almost double during the next four decades.⁵ Advances in rehabilitative care and treatment of SCI are increasing the number of SCI patients that survive to old age. As such, geriatric SCI is an important health issue that requires more attention than previously received.

Previously, studies have primarily focused on young or middle-aged SCI patients. Although the clinical features of older patients with SCI have been reported, the findings have been inconsistent.^{1,6} In Turkey, geriatric people (aged ≥ 65 years) currently account for only

8.5% of the total population. It is crucial that we identify the clinical characteristics of older SCI patients, including the mechanisms of injury, severity of injury and its management and complications, to improve prevention and treatment strategies. The aim of the present study was to identify the clinical and demographic characteristics of SCI patients aged ≥ 60 years, as compared with SCI patients aged 18–59 years.

MATERIALS AND METHODS

The medical records of all patients with SCI admitted to the Turkish Armed Forces (TAF) Rehabilitation Center, Ankara, Turkey, (the leading institution providing primary rehabilitation for patients with SCI in Turkey) were reviewed. The study included 870 consecutive patients with SCI that were admitted to the TAF Rehabilitation Center between January 2010 and December 2013.

Patients with SCI were divided into two groups according to age: patients aged ≥ 60 years constituted the study group, and randomly selected SCI patients aged < 60 years that were matched for gender, week of admission and time since injury constituted the control group. 60 years or older SCI patients with adult onset (age < 60 years) and patients less than 18 years of age were excluded from the study (Figure 1). The patients in this study aged ≥ 60 years and those aged 18–59 years are referred to as older and younger, respectively.

Demographic and clinical data were analyzed, including age, gender, etiology, time since injury, degree and level of neurological impairment, length of stay (LOS), bladder management methods, complications and abnormal

Figure 1 Study methodology flow chart.

urinary tract ultrasound findings. The cause of injury was classified as traumatic or non-traumatic, and the level of injury was classified as cervical, thoracic or lumbosacral regions. Each patient's neurological level was determined according to the American Spinal Injury Association Impairment Scale.

This study protocol was approved by the Gülhane Military Medical Academy Ethics Committee.

Statistical analysis was performed using SPSS v.15.0 for Windows (SPSS, Chicago, IL, USA). Continuous variables are presented as mean $\pm$ s.d. (range) and categorical variables are shown as frequency and percentage. The χ^2 test was used to determine the level of significance of the difference in nominal variables between groups. The distribution of numeric variables was examined

using the Kolmogorov-Smirnov test for normality, and differences between the groups were determined via an independent samples *t*-test or the Mann-Whitney *U*-test. Logistic regression was used to quantify the correlation between some of the possible risk factors (age, gender, diabetes, level and severity of SCI), and neuropathic pain and LOS > 40 days. The level of statistical significance was defined as $P < 0.05$.

RESULTS

During the 4-year study period, 73 SCI patients aged ≥ 60 years, of which 48% were aged ≥ 65 years, were admitted to the TAF Rehabilitation Center. Mean age of these patients was 66.98 ± 6.28

Table 1 Etiology of spinal cord injuries

Etiology	Age 18–59 years (n = 75)	Age ≥60 years (n = 73)	P-value
	n (%)	n (%)	
Traumatic lesions	n = 61	n = 37	< 0.001
Fall	17 (22.7)	24 (32.9)	0.165
Simple fall	1 (1.3)	15 (20.6)	0.001
Fall from a height	16 (21.4)	9 (12.3)	0.324
Motor vehicle accident	31 (41.3)	11 (15.1)	< 0.001
Gunshot wound	8 (10.7)	1 (1.4)	0.018
Sports	5 (6.7)	1 (1.4)	0.102
Non-traumatic lesions	n = 14	n = 36	< 0.001
Degenerative	3 (4)	19 (26)	< 0.001
Neoplastic	3 (4)	8 (11)	0.107
Vascular	1 (1.3)	6 (8.2)	0.048
Others	7 (9.3)	3 (4.1)	0.206

Data in boldface indicate statistically significant differences.

years (range: 60–83 years). This group of patients (study group) accounted for 8.4% of all admissions during the study period. In addition, 75 of the patients aged 18–59 years admitted during the study period constituted the control group; mean age in the control group was 33.93 ± 10.67 years (range: 18–56 years). Among the 148 patients included in the study, 98 (66.2%) were male and 50 (33.8%) were female. Mean time since injury in all the patients was 17.28 ± 15.30 months.

In total, 66.2% of the 148 patients had a traumatic etiology. In the study group 51% of patients had SCI with traumatic etiology. The most common cause of SCI in the study group was falling (32.9%); of which 62.5% of the fall-related injuries occurred at ground level and 37.5% involved falling from a height. In this study, the results showed that the main cause of non-traumatic SCI in the study group was degenerative conditions (26%). In the control group, 81.3% of the injuries were traumatic; the leading cause of SCI was motor vehicle accident (41.3%), followed by falling (22.7%). There was a significant difference in the etiology of SCI between the study and control groups ($P < 0.05$) (Table 1).

Among all the patients, 68.2% were paraplegic (study group: 70.7%; control group: 65.8%). The most common site of injury was the thoracic level (47.3%), followed by cervical (31.8%) and lumbosacral (20.9%). The level of SCI was similar in both groups ($P > 0.05$). In the study group, the most common injury level according to traumatic and non-traumatic etiology were the cervical (37.8%) and thoracic (58.3%) level, respectively (Table 2).

The distribution of American Spinal Injury Association Impairment Scale grades was as follows: A: 35.8%; B: 18.2%; C: 21.6%; D: 24.3%. When compared with the younger patients, the older patients were less likely to have complete (27.4 vs 44%, $P = 0.035$) or severe neurological deficit (American Spinal Injury Association Impairment Scale grade A and B: 38.4 vs 65.3%, $P = 0.001$). In the study group, incomplete tetraplegia represented the most common neurological condition (31.5 vs 17.3%, $P = 0.045$).

Bladder management methods were clean intermittent catheterization (CIC) in 103 (69.6%) of the patients, indwelling urethral catheter in 17 (11.5%) and normal voiding in 28 (18.9%). There was not a

Table 2 Injury level and severity according to etiology

	Traumatic lesions		P-value	Non-traumatic lesions		P-value
	Age 18–59 years	Age ≥60 years		Age 18–59 years	Age ≥60 years	
Injury level, n (%)			0.660			0.801
Cervical	19 (31.1)	14 (37.8)		3 (21.4)	11 (30.6)	
Thoracic	27 (44.3)	13 (35.1)		9 (64.3)	21 (58.3)	
Lumbosacral	15 (24.6)	10 (27)		2 (14.3)	4 (11.1)	
AIS, n (%)			0.202			0.089
Incomplete	35 (57.4)	26 (70.3)		7 (50)	27 (75)	
Complete	26 (42.6)	11 (29.7)		7 (50)	9 (25)	

Abbreviations: AIS, American Spinal Injury Association Impairment Scale.

significant difference in bladder management between the two groups ($P > 0.05$).

The demographic and clinical characteristics in the study and control groups are shown in Table 3.

Pressure sores occurred in 12.8% of the patients, contracture in 3.4%, deep vein thrombosis in 2.7%, heterotopic ossification in 2% and pulmonary embolism in 1.4%. There was a significant difference in these secondary complications between groups (study group: 31.1%; control group: 14.7%; $P = 0.024$). More of the patients in the study group had neuropathic pain (50.7 vs 34.7%, $P = 0.049$) and abnormal urinary tract ultrasound findings (hydronephrosis, renal and bladder calculi) (23.3 vs 9.3%, $P = 0.021$). The prevalence of diabetes was higher in the study group (24.7 vs 6.7%, $P = 0.003$). The only variable that strongly predicted the prevalence of neuropathic pain based on logistic regression analysis was age ≥ 60 years ($P = 0.029$) (Table 4).

Mean LOS among all the patients was 43.35 ± 20.46 days; LOS was longer in the study group than in the control group, but the difference was not significant (46.16 ± 20.99 days vs 40.61 ± 19.68 days, $P = 0.055$). The only variables that strongly predicted longer LOS via logistic regression analysis were age ≥ 60 (95% confidence interval 2.67 (1.31–5.42), $P = 0.029$) and completeness (95% confidence interval 2.25 (1.08–4.71), $P = 0.032$). There were no significant differences with regard to LOS, bladder management methods and complications in the older group with traumatic vs non-traumatic SCI ($P > 0.05$).

DISCUSSION

Although commonly young individuals are affected by SCI, mean age of patients with SCI has increased over the last few decades.⁴ The US National Spinal Cord Injury Database shows that the percentage of SCI patients aged > 60 years at the time of injury increased from 4.7% before 1980 to 10.9% after 2000, and that mean age at the time of injury increased from 27 years in the 1970s to 40 years after 2005.⁷ A similar trend has been observed at the TAF Rehabilitation Center. An earlier study performed at the TAF Rehabilitation Center showed that 6.4% of SCI patients were aged ≥ 60 years at admission between 2000 and 2007 and that the mean age was 33 years⁸ vs 8.4% and a mean age of 37 years in the present study (conducted between 2010 and 2013). These findings clearly show that the age of patients with SCI has increased.

In the present study, older patients had a more frequent non-traumatic etiology (49%) in comparison with the control group

Table 3 Demographic and baseline characteristics of patients with spinal cord injury

	Age 18–59 years (n = 75)	Age ≥ 60 years (n = 73)	P-value
Age (years) mean ± s.d.	33.93 ± 10.67 (18–56)	66.98 ± 6.28 (60–83)	
Gender M/F, n (%)	50 (66.7)/25 (3.3)	48 (65.8)/25 (34.2)	0.907
Mean time since injury (months) ± s.d.	18.28 ± 14.74 (1–52)	16.26 ± 15.89 (1–55)	0.103
Tetraplegia/paraplegia, n (%)	22 (29.3)/53 (70.7)	25 (34.2)/48 (65.8)	0.521
Length of stay (days) ± s.d.	40.61 ± 19.68 (17–101)	46.16 ± 20.99 (18–114)	0.055
AIS			0.002
A	33 (44)	20 (27.4)	0.035
B	19 (25.3)	8 (11)	0.024
C	11 (14.7)	21 (28.8)	0.037
D	12 (16)	24 (32.9)	0.017
Injury level, n (%)			0.774
Cervical	22 (29.3)	25 (34.2)	0.521
Thoracal	36 (48)	34 (46.6)	0.862
Lumbosacral	17 (22.7)	14 (19.2)	0.602
AIS and level, n (%)			0.054
Incomplete tetraplegia	13 (17.3)	23 (31.5)	0.045
Complete tetraplegia	9 (12)	2 (2.7)	0.032
Incomplete paraplegia	31 (41.3)	30 (41.1)	0.972
Complete paraplegia	22 (29.3)	18 (24.7)	0.522
Bladder management method, n (%)			0.394
Indwelling urethral catheter	7 (9.3)	10 (13.7)	0.405
Clean intermittent catheterization	56 (74.7)	47 (64.4)	0.174
Normal voiding	12 (16)	16 (21.9)	0.358

Abbreviations: AIS, American Spinal Injury Association Impairment Scale, S.d., Standard deviation.
Data in boldface indicate statistically significant differences.

Table 4 Logistic regression analysis of the predictors of neuropathic pain

Risk factor	RR (95% CI)	P-value
Age ≥ 60/ < 60 years	2.216 (1.083–4.536)	0.029
Male/female	1.083 (0.521–2.249)	0.831
Tetraplegia/paraplegia	1.983 (0.849–4.631)	0.114
Complete/incomplete	2.539 (0.578–11.143)	0.217
Diabetes mellitus	1.116 (0.438–2.845)	0.818
Traumatic/non-traumatic etiology	1.376 (0.639–2.961)	0.414

Abbreviations: CI, confidence interval; RR, relative risk.
Data in boldface indicate statistically significant differences.

(18.6%). This significant difference between two groups may be attributed to degenerative spine conditions occurring as a result of the natural aging process. The leading cause of SCI in older patients was falling differently from the control group in which motor vehicle accidents was the most common cause. These findings are consistent with earlier reports.^{2,4,6,9} Rahimi-Movaghar *et al.*¹⁰ reported that the relative frequency of fall-related SCI increased significantly during their study period from 1975–2009. It was reported that 33% of older adults fall each year and that 10% of these falls result in serious injury.¹¹ Simple falls in older people are increasing in developed countries with aging populations.¹² The increased risk of falling and subsequent SCI in older people might be due to a number of factors, including musculoskeletal fragility, decreased proprioception, cognitive impairment, visual impairment, polypharmacy and medical comorbidities.³ The present findings show that simple falls

accounted for >50% of fall-related SCIs in the study group, most of (66.7%) the simple fall-related SCIs were incomplete (cervical injuries predominated (46.7%)), and that fall-related SCIs occurred less frequently in the control group. It is not surprising that the mean age has been increasing in patients with SCI due to rising fall-related and non-traumatic SCI rates. So, the aging of population are directly associated with these rates.

It was reported that the most common site of traumatic SCI in older adults is the cervical region^{1,2,4} and that the level of SCI was similar in younger and older patients¹³, which is in agreement with the present findings; however, most non-traumatic lesions in the present study were at the thoracic level. Older patients are more likely to sustain incomplete SCI than complete SCI.^{1,3,4,14} In the present study, 72.6% of the study group had incomplete injury, which might have been due to the fact that SCI in older adults generally results from less severe mechanisms of injury, such as simple falls and non-traumatic causes, as compared with motor vehicle accidents or falling from a height in younger adults.

CIC is an effective long-term urinary management strategy that maintains continence and reduces urinary tract complications¹⁵, and as such is currently the most preferred method for the management of neurogenic bladder in patients with SCI. Cameron *et al.*¹⁶ reported that use of CIC increased from about 13% in 1972 to 56% in 1991. An earlier study by Roth *et al.*¹⁷ reported that there were significant differences between older and younger patients with respect to bladder management, and that older patients used indwelling urethral catheter nearly twice. In the present study, there were not any differences in bladder management between the two groups and patients were more likely to be discharged with CIC in both age

groups. These data indicate that although CIC is a troublesome process, the older patients were willing and capable of using it.

Krassioukov *et al.*¹³ noted that the prevalence of preexisting comorbidities is significantly higher in older patients, and that secondary complications after SCI are more common in patients with preexisting comorbidity. A number of complications occurred more frequently in the present study's older patients. One of the most important secondary complications of SCI that negatively affects patient quality of life is neuropathic pain.⁹ Werhagen *et al.*¹⁴ reported that SCI patients aged >50 years had the highest prevalence of neuropathic pain (58%). In the present study, 50.7% of the older patients and 34.7% of the younger patients reported neuropathic pain. Logistic regression analysis in the present study showed that age ≥ 60 years was a significant risk factor for neuropathic pain, but that the level of injury, completeness of injury, gender and diabetes were not, as previously reported.^{9,14} We think additional research on the factors that predispose older SCI patients to neuropathic pain is necessary.

Patients with SCI have a high risk of developing urological complications that can be life threatening. Drake *et al.*¹⁸ reported that as age and duration of injury increase, so does the urological complication rate. In the present study, the older SCI patients had urological abnormalities based on ultrasound examination, including upper and lower urinary tract stones and hydronephrosis, at a rate more than double that in the younger SCI patients. Although the duration of injury was short, the presence of urological abnormalities in nearly 25% of the older patients following SCI suggests that aging has an important role in urological abnormalities. As such, we strongly recommend close monitoring via ultrasound examination every 6 months in older SCI patients.

The literature includes inconsistent findings concerning the effect of age on LOS. A study reported that older patients are more likely to have longer LOS⁴, whereas another reported the opposite.⁶ This discrepancy might be due to the studies' differences in patient characteristics, including injury level and severity, complications, comorbidities and time since injury, as well as in targets in rehabilitation management. The present findings show that the older SCI patients had longer LOS than the younger patients, but the difference was not significant. In addition, logistic regression analysis showed that age ≥ 60 years and completeness negatively affected LOS. Although age was a significant risk factor for prolonged LOS, the lack of significance in the difference in LOS between the two groups might have been due to the higher number of incomplete SCI in the older patients.

The present study has some limitations. First, the sample size was small to detect the possible difference between the groups. Historically, geriatric patients have been considered to be age ≥ 65 years, but in the present study age, ≥ 60 years was considered older. Older patients might have already had some abnormal urinary tract ultrasound findings before SCI, yet we did not have any information about it. Due to the study's retrospective design, some data may be missing. Finally, the functional status of the patients at discharge was not evaluated. Studies that include larger samples followed up for a longer time period, and that assess functional status might improve our understanding of the differences between geriatric and non-geriatric SCI patients.

The present findings show that older patients (aged ≥ 60 years) with SCI differed from SCI younger patients (aged 18–59 years) in

etiology, severity and complications. Among the older patients, SCI was primarily due to falling, especially simple falls, and was incomplete, and the complication rate was much higher, as compared with the younger patients. As such, we think that SCI should be considered separately in the elderly. In older patients with injury, even due to unintentional falls, SCI should be kept in mind and establishing public policies aimed at preventing SCI should focus on falls. Knowledge of the clinical characteristics of older SCI patients might help improve primary prevention strategies, rehabilitation and healthcare planning. As the number of SCI patients aged ≥ 60 years is increasing, new studies must focus on this important patient population.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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