

Risk Factor Analyses for Spinal Cord Injury Related Complications

Spinal Kord Yaralanması ile İlişkili Komplikasyonlarda Risk Faktörü Analizi

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ABSTRACT

Objective: To analyze the risk factors of spinal cord injury related complications.

Methods: Medical records of 225 spinal cord injured patients who are rehabilitated in a tertiary rehabilitation center in Turkey between October 2012 and May 2014 were retrospectively analysed. Clinical and demographic characteristics of the patients and complications were recorded. The patients were selected using simple random sampling technique.

Results: The most common complications were neuropathic pain, spasticity, respiratory dysfunction and pressure ulcers. Cervical spinal cord injury is a risk factor for neuropathic pain, depression, sleep disorders, spasticity and respiratory dysfunction. Complete spinal cord injury is a risk factor for pressure ulcers and respiratory dysfunction. Males are (2,688 times) more prone to pressure ulcers than females and adults are (4,3 times) more prone to neuropathic pain than patients <18 years. Spasticity increases in time. Geriatric spinal cord injury patients are under greater risk (7,538 times) for osteoporosis compared to spinal cord injury patients < 18 years.

Conclusion: Patients with defined risk factors should be closely monitored in order to prevent complications associated with spinal cord injury.

Keywords: Spinal cord injury, complications, risk factors, rehabilitation

ÖZET

Amaç: Spinal kord yaralanması ile ilişkili komplikasyonların analizi.

Yöntemler: Ekim 2012 ve Mayıs 2014 tarihleri arasında Türkiye'deki bir tersiyer rehabilitasyon merkezinde yatarak tedavi gören 225 spinal kord yaralanmalı hastanın tıbbi verileri retrospektif olarak incelenmiştir. Hastaların klinik ve demografik özellikleri ile komplikasyonlar kaydedilmiştir. Hasta dosyaları basit randomizasyon yöntemi ile seçilmiştir.

Bulgular: En sık gözlenen komplikasyonlar nöropatik ağrı, spastisite, solunum disfonksiyonu ve bası yaralarıdır. Servikal spinal kord yaralanması; nöropatik ağrı, depresyon, uyku bozukluğu, spastisite ve solunum disfonksiyonu için risk faktörüdür. Komplet spinal kord yaralanması; bası yaraları ve solunum disfonksiyonu için risk faktörüdür. Erkek hastalar kadınlara kıyasla bası yaralarına (2,688 kat) daha yatkındır ve erişkin hastalar <18 yaş hastalara kıyasla nöropatik ağrıya (4,3 kat) daha yatkındır. Spastisite zaman içinde artış gösterir. Geriatrik spinal kord yaralanmalı hastalar <18 yaş hastalara göre osteoporoz için (7,538 kat) daha fazla risk altındadır.

Sonuçlar: Spinal kord yaralanması ile ilişkili komplikasyonların önlenmesi için tanımlanan risk faktörlerine sahip hastalar yakın takip edilmelidir.

Anahtar sözcükler: Spinal kord yaralanması, komplikasyonlar, risk faktörleri, rehabilitasyon

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Introduction

It is estimated that approximately 1 000 new spinal cord injuries (SCI) occur each year in Turkey (1). Besides significant impairments, patients with SCI also face with significant acute and chronic complications which have negative impact on survival, functional independence and quality of life. Therefore understanding the risk factors and prevention is of critical importance not only for patients but also for care givers, families and SCI specialists (2). So the aim of the present study, is to analyze the SCI related complications and risk factors in a rehabilitation center in Turkey.

Materials and Methods

Medical records of 225 spinal cord injured patients who are rehabilitated in a rehabilitation center in Turkey between October 2012 and May 2014 were analysed retrospectively. The patients were selected using simple random sampling technique. Clinical and demographic characteristics of the patients including age, gender, SCI etiology, disease duration, level of injury (LI) and level of neurological impairment (LNI) were recorded. Complications when present or that had occurred since the day of SCI were registered on a standardized list. The occurrence of a complication was registered as follows: 0=no complication; 1=presence or history of this complication. The patients were divided into 3 age groups as 0-18 (pediatric SCI), 19-59 (adult SCI), ≥60 (geriatric SCI). Etiology of SCI was grouped as traumatic and non-traumatic. Disease duration was defined as follows; <1 month, 1-3 months, 3-6 months, 6-12 months and >12 months. LI was grouped as cervical, thoracal and lumbar. LNI was determined according to the American Spinal Injury Association (ASIA) Impairment Scale (AIS) as AIS A-B-C-D and E (3). The complications related to SCI were defined as follows; pressure ulcer, spasticity, contracture, autonomic dysreflexia, orthostatic hypotension, deep venous thrombosis, pulmonary embolism, urinary tract infection, respiratory dysfunction, neuropathic pain, depression, sleep disorders, heterotopic ossification, osteoporosis and complex regional pain syndrome. Patients with a LNI AIS E were excluded from the study.

The study protocol was approved by the hospital ethics committee.

Statistical Analysis

Statistical analyses were performed by using SPSS version 11.5 software. The Kolmogorov-Smirnov test was used to determine whether the continuous variable distribution was normal. Descriptive statistics were provided as mean±standard deviation or median

(minimum–maximum) for continuous variables while the number of cases and percentages were used for nominal variables. Variables that may have effect on complications were analysed with 2-state logistic regression models. For the models which are significant according to Omnibus test results, coefficients of the variables were analysed.

Results

Demographic and clinical characteristics of the patients are demonstrated on Table 1. Complication rates of the patients are shown in Figure 1 in decreasing order.

Table 1. Demographic and clinical characteristics of patients (n=225).

Characteristic	Value*
Gender	
Male	171 (76 %)
Female	54 (24 %)
Age	
mean±SD, median (min-max)	35,8±16,5, 32 (2-77)
0-18	30 (13,3 %)
19-59	173 (76,9 %)
≥60	22 (9,8 %)
Etiology	
Traumatic	206 (91,6 %)
Non-traumatic	12 (5,3 %)
Disease duration	
0-1 month	21 (9,3 %)
1-3 months	36 (16%)
3-6 months	29 (12,9%)
6-12 months	35 (15,5%)
>12 months	104 (46,2 %)
LI	
Cervical	66 (29,3 %)
Thoracal	104 (46,2 %)
Lumbar	55 (24,4 %)
LNI	
AIS A	107 (47,6%)
AIS B	36 (16 %)
AIS C	39 (17,3 %)
AIS D	43 (19,1 %)
Number of complications	
mean±SD, median (min-max)	3,3±1,8, 3 (0-9)

*Value defines number of the patients, percentage of the patients in round brackets and median and minimum-maximum values where indicated, **LI**: Level of injury, **LNI**: Level of neurological impairment, **AIS**: ASIA impairment scale

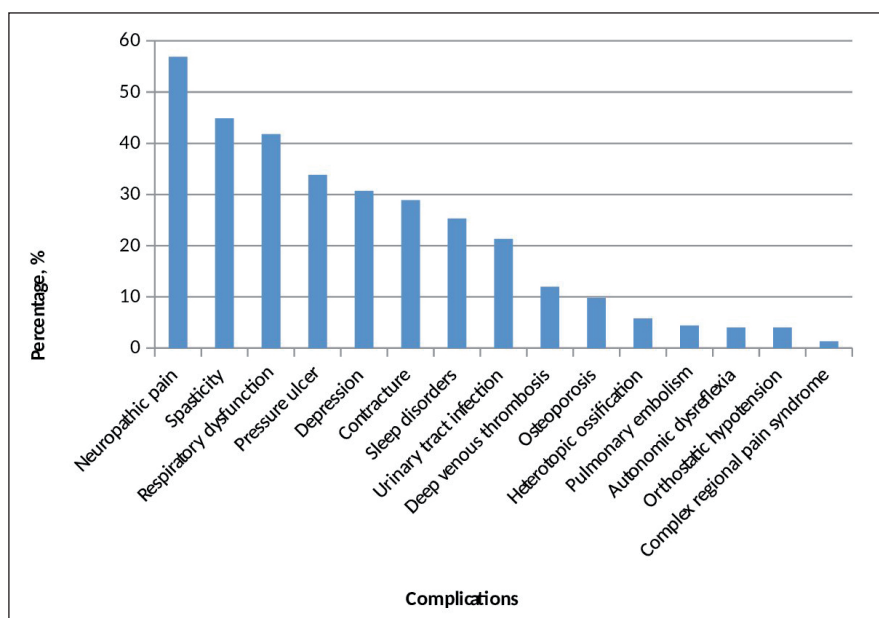


Figure 1: Percentage of complications seen in 225 SCI patients.

Pressure ulcers, neuropathic pain, depression, sleep disorders, spasticity, osteoporosis and respiratory dysfunction are found to be related to different variables evaluated (Table 2).

Pressure ulcers: Pressure ulcers are 2,688 (1/0,372) times more common in males than females. Patients with AIS A are 3,058 (1/0,327) times more prone to pressure ulcers than patients with AIS C and 3,267 (1/0,306) times more prone than patients with AIS D. Pressure ulcer development is found independent from age, disease duration, LI and etiology.

Neuropathic pain: Patients with a cervical lesion have 3,690 (1/0,271) times greater risk for neuropathic pain development than patients with a thoracic lesion and 2,808 (1/0,356) times greater risk than patients with a lumbar lesion. Spinal cord injured adults are 4,3 times more prone to neuropathic pain development than spinal cord injured pediatric patients. Neuropathic pain is found independent from gender, disease duration, LNI and etiology.

Depression: Patients with a cervical SCI are 3,412 (1/0,293) times more prone to depression than patients with a thoracic SCI and 2,816 (1/0,355) times more prone than patients with a lumbar SCI. Depression is found independent from age, gender, disease duration, LNI and etiology.

Sleep disorders: Sleep disorders in patients with a cervical SCI are found 2,631 (1/0,380) times more common than in patients with a thoracic SCI and 3,058

(1/0,327) times more common than in patients with a lumbar SCI. Sleep disorders are found independent from age, gender, disease duration, LNI and etiology.

Spasticity: Spasticity is found 7,042 (1/0,142) times more common in the cervical SCI compared to lumbar SCI. Moreover spasticity is 4,545 (1/0,220) times more common in the pediatric SCI population compared to geriatric SCI population. Besides compared to patients with a disease duration <1 month, patients with a disease duration 1-3, 3-6, 6-12 and >12 months have 7,229, 17,511, 9,338 and 15,884 times greater risk for spasticity respectively. On the other hand spasticity is found independent from gender, LNI and etiology.

Osteoporosis: Osteoporosis is found 7,538 times more common in the geriatric SCI group than pediatric SCI group. On the other hand osteoporosis is found independent from gender, disease duration, LI, LNI and etiology.

Respiratory dysfunction: Respiratory dysfunction in cervical SCI patients are found 2,717 (1/0,368) times more common than thoracic SCI patients and 8,547 (1/0,117) times more common than lumbar SCI patients. Moreover patients with AIS A have 5,291 (1/0,189) times greater risk for respiratory dysfunction than patients with AIS D. Breathing disorders are found independent from age, gender, disease duration and etiology.

Deep venous thrombosis, urinary tract infections and contractures are found not to be related to the variables evaluated. ($p > 0,05$)

Table 2. Independent variables effecting complications (all complications represented in one table).

Variables	Exp (B)	Std. Error	p
Pressure Ulcer			
Gender			
Male			
Female	0,372	0,429	0,021*
LNI			
AIS A			0,008**
AIS B	1,222	0,393	0,610
AIS C	0,327	0,467	0,017*
AIS D	0,306	0,494	0,017*
Neuropathic pain			
Age			
0-18			0,002**
19-59	4,300	0,447	0,001**
≥60	1,598	0,618	0,448
LI			
Cervical			0,002**
Thoracal	0,271	0,377	0,001**
Lumbar	0,356	0,422	0,014*
Depression			
LI			
Cervical			0,001**
Thoracal	0,293	0,347	0,000***
Lumbar	0,355	0,406	0,011*
Sleep Disorders			
LI			
Cervical			0,008**
Thoracal	0,380	0,358	0,007**
Lumbar	0,327	0,447	0,012*
Spasticity			
Age			
0-18			0,030*
19-59	1,121	0,459	0,804
≥60	0,220	0,726	0,037*
Disease duration			
<1 month			0,005**
1-3 months	7,229	0,843	0,019*
3-6 months	17,511	0,871	0,001**
6-12 months	9,338	0,843	0,008**
>12 months	15,884	0,795	0,001**
LI			
Cervical			0,000***
Thoracal	0,733	0,359	0,388
Lumbar	0,142	0,452	0,000***
Osteoporosis			
Age			
0-18			0,002**
19-59	1,077	0,791	0,925
≥60	7,538	0,869	0,020*
Respiratory disorders			
LI			
Cervical			0,000***
Thoracal	0,368	0,370	0,007**
Lumbar	0,117	0,505	0,000***
LNI			
AIS A			0,005*
AIS B	0,545	0,425	0,154
AIS C	0,467	0,457	0,096
AIS D	0,189	0,490	0,001*

*: $p < 0,05$ **: $p < 0,01$ ***: $p < 0,001$, LI: Level of injury, LNI: Level of neurological impairment, AIS: ASIA impairment scale.

Because of the relatively low number of patients with pulmonary embolism, heterotopic ossification, autonomic dysreflexia, orthostatic hypotension and complex regional pain syndrome, the effect of different variables on these complications cannot be studied.

Discussion

Neuropathic pain, spasticity, respiratory dysfunction and pressure ulcers are the 4 most common complications in our study (Figure 1), in accordance with the literature. In a study published in 1993, Knutsdottir (4) evaluated

the most common complications and their rates in SCIs occurred between 1973 and 1989 in Iceland. According to his study the most common complications were pain (64.4%), urinary tract infections (62.2%), spasticity (60%) and pressure sores (58%). In their long term study, Mc Kinley et al (5) reported pressure ulcers, autonomic dysreflexia and respiratory disorders as the most common long term complications. In another study by Haisma et al (6); pain, spasticity, urinary tract infections and pressure sores were again the most common complications following SCI as in Knutsdottir's study. Recently a long term study reported neuropathic pain, musculoskeletal

pain and urinary tract infections as the most common complications after SCI (7). The above mentioned studies represent the most common complications in SCI from the past to the present. Although the reported complications in our study are similar, the complication rates in percentages are lower. This may be due to the developing preventive and therapeutic strategies in time. The findings of our study, that do not coincide with the previous reports may also be attributed to the variation of the design and patient population too. The low socioeconomic status for example may have influenced the rates of some complications such as autonomic dysreflexia, because of lack of education and awareness. Just like this, the decreased complication rates may also be related to inadequate records in patient files.

According to our results, pressure ulcers are 2,688 times more common in males than in females. Moreover patients with AIS A lesions have approximately 3 times greater risk for pressure ulcers than patients with AIS C and D lesions. After SCI the well-known risk factors for pressure ulcers are; immobility, lack of sensation, moisture due to urinary/fecal incontinence, muscular atrophy, prolonged time since injury, depression, smoking, malnutrition, low household income and fewer years of education (8,9). Patients with neurologically complete injury (AIS A) and males were also found to be more prone to pressure ulcer development in some other papers in the literature, compatible with our results (5,7). Also in a study from South Africa, motor completeness of injury (AIS A and B) was found as an independent predictor of pressure ulcer development (10). Moreover in some studies, violent SCI etiology, being admitted with an existing pressure ulcer and a low functional independence measure score also found to be risk factors for pressure ulcer development (5,10,11) but as we could not evaluate these variables, we could not find such relationships. Anyway our results are important for emphasizing the increased risk for male gender and complete SCIs.

Our results revealed a 4 times greater neuropathic pain risk for adult SCI patients compared to pediatric SCI patients. Moreover patients with cervical lesions are found to be approximately 3-3,5 times more prone to neuropathic pain than patients with thoracic and lumbar lesions. Similar to our results Haisma (6) et al also found increasing age and LI as risk factors for neuropathic pain. Besides Adriaansen (7) et al claimed patients with tetraplegia were significantly more susceptible for neuropathic pain compared with paraplegic patients and an increase in age was associated with an increase in neuropathic pain severity similar to our results. On the other hand, in another study researchers could not find a relationship between neuropathic pain and the demographic and injury related characteristics of the

patients (12). Nonetheless there seems to be a relation between age/ LI and neuropathic pain and our results support this too.

The results of the present study revealed that patients with a cervical SCI have approximately 2,5-3,5 times greater risk for depression and sleep disorders compared with the patients with a thoracic or lumbar SCI. It is now known that the prevalence of depression (mean prevalence 22.2%) after SCI is substantially greater than that of general medical and healthy population (13,14). Factors predictive of psychological disorders in SCI included female gender, increasing years of education, premorbid psychiatric/psychological treatment, cognitive impairment, higher scores on ASIA motor index, secondary complications, indwelling catheter use, smoking, resilience, and anxiety (15-17) Sleep disorders are also common among SCI patients compared to healthy individuals. White race, being a current smoker, alcohol abuse, asthma, chronic obstructive pulmonary disease and problematic weight gain are found to be independent predictors of sleep dysfunction in SCI (17). Our results, although predictable with higher depression and sleep dysfunction rates in higher LI, are the first revealing the relation of LI with depression and sleep disorders to our knowledge.

According to our results, spasticity is 7 times more common in cervical lesions than in lumbar lesions and gets more common as time passes since injury. Also pediatric patients are 4,5 times more prone to spasticity compared with geriatric patients. In the literature, there are some contradictory results about the factors affecting spasticity in SCI. In one study; male gender, traumatic etiology, incomplete lesion and tetraplegia were found to be related with a higher degree of spasticity (6). Tetraplegia was defined as a risk factor for spasticity in another study too (7). Spasticity-time passed since injury relation is also challenging, with some studies giving lower spasticity rates in time (7) whereas others not (6). Among these results, tetraplegia as a risk factor is in accordance with our results, but the other factors are not.

Osteoporosis is found 7,5 times more common in elderly SCI patients than in SCI patients \leq 18 years old. In a similar manner Mc Kinley (5) et al also found greater risk for long bone fractures in lower extremities for patients $>$ 60 years at annual follow up year 15. In the literature factors influencing bone mass in SCI were defined as LI, level of functional impairment, duration of injury, age and completeness of injury (1). The present results of our study seem as if osteoporosis is independent from LI, completeness of injury and time since injury is probably because of the relatively small number of osteoporotic patients in our study population.

Finally respiratory dysfunction in cervical SCI is 2,7 times more common than thoracic SCI and 8,5 times more common than lumbar SCI. Also patients with AIS A are 5,3 times more prone to respiratory dysfunction than patients with AIS D. According to the literature, the extent of respiratory complications depend on the LI and motor impairment as in our results (18-20).

Conclusions

In conclusion, patients with cervical SCI are found to be under greater risk for neuropathic pain, depression, sleep disorders, spasticity and respiratory dysfunction while patients with AIS A lesions are under greater risk for pressure ulcers and respiratory dysfunction. Moreover interestingly males are more prone to pressure ulcers than females and adults are more prone to neuropathic pain than children and teenagers. Spasticity risk seems to increase in time and geriatric SCI patients have greater risk for osteoporosis as expected.

Recognizing and taking precautions at the right time for the complications not only decreases morbidity and mortality rates but also improves patients' and caregivers' quality of lives.

Limitations

The most important limitation is the retrospective data collection method making it difficult to analyze the relation of time and complications. Moreover data was based on medical records instead of face to face interview and physical examination restricting detailed information. Besides study population is relatively inadequate for statistical analyses of some rare complications.

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