

Prognosis Factors in Patients with Spinal Cord Trauma

Fatores de prognóstico em pacientes com trauma raquimedular

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Abstract

Objective Analyze the predictors of prognosis in patients with spinal cord trauma (SCT) in a tertiary hospital.

Method Study prospective with 321 patients. The analysis focused on patient-related data, cause of accident, anatomical distribution, neurologic status, associated injuries, length of hospital stay, and in-hospital complications/mortality.

Results The SCT was more common in men, but women older than 50 years presented a higher risk than men of the same age. Automobile accidents, motorcycle accidents, and gunshots resulted in more injuries associated. The cervical spine involvement was directly related to an increase in the number of associated injuries, complications, and mortality. Already, the neurologic status ASIA-A was associated with an increase in the number of complications, length of stay, and mortality.

Conclusion The predictive factors of prognosis in these patients included age, sex, cause of injury, anatomic distribution, and neurologic status.

Keywords

- traumatology
- complications
- mortality

Resumo

Objetivo Analisar os preditores de prognóstico em pacientes vítimas de trauma raquimedular (TRM) em um hospital terciário.

Método Estudo prospectivo com 321 pacientes. A análise foi direcionada aos dados relacionados aos pacientes, causa do acidente, distribuição anatômica, status neurológico, lesões associadas, tempo de permanência hospitalar e complicações e mortalidade no hospital.

Resultados O TRM foi mais comum em homens, mas mulheres com idade superior a 50 anos apresentaram mais risco que homens da mesma faixa etária. Ferimento por arma de fogo, acidentes automobilísticos e de motocicleta resultaram em maior número de lesões associadas. O trauma na coluna cervical foi diretamente relacionado

Palavras-chave

- traumatologia
- complicações
- mortalidade

a um aumento no número de lesões associadas, complicações e mortalidade. Além disso, o status neurológico ASIA-A foi associado com um aumento no número de complicações, tempo de permanência e mortalidade.

Conclusão Os fatores preditivos de prognóstico nesses pacientes foram: idade, sexo, causa da lesão, distribuição anatômica e status neurológico.

Introduction

Traumatic injuries are an important cause of death among young people, and although spinal cord traumas (SCTs) represent only a minority of injuries suffered by all trauma patients, their social, financial, and familial influences are extremely relevant and often more significant than those of other injuries.¹⁻³

The SCT is injury that results in the sequel sensory, motor, and autonomic functions.⁴ The diagnostic precision is very important to the success of the treatment.⁵ Additionally, the presence of associated lesion,⁶⁻⁸ neurologic severity of the injury, and spinal segment may contribute negatively to prognosis. Therefore, it becomes relevant to carry out a more thorough and comprehensive study in order to determine the factors that can really influence the prognosis of patients with SCT.

This study aims to analyze the prognostic factors in patients with SCT on a tertiary hospital.

Methods

A total of 321 patients with SCT were studied during the period from January 2008 to June 2012. All patients were admitted in the emergency department of the Hospital de Base, in São Jose do Rio Preto/Brazil. The data extracted from the original database for this study included general patients characteristics, mechanisms of trauma, level and regions of SCT, and final disposition/outcome, especially regarding death. The analysis focused on patient-related data (age at trauma incident, sex), cause of accident (fall, traffic accident involving car, motorcycle, bicycle, or pedestrian; sports; miscellaneous), anatomical distribution (C0-C2; C3-C7; T1-T10; T11-L2; L3-S1), neurologic status (American Spine Injury Association scale [ASIA]),⁹ associated injuries, length of hospital stay, and in-hospital complications/mortality.

The tests used for statistical analysis were Dunn's test for length of stay and chi-square test for assessing the association between variables and relative risk, being considered $p < 0.05$, as statistically significant.

The research was approved by the research ethics committee of the Faculty of Medicine from *São José do Rio Preto* (FAMERP), protocol 4823/2009. Subjects signed the informed consent form. When patient had the worst diagnosis or changes in level of consciousness, the written informed consent was given by a close relative. The study was conducted in compliance with the Declaration of Helsinki.

Results

Patient-Related Data

The study group (total of 321 patients) consisted of 231 males (72%) and 90 females (28%) patients. The overall male-to-female ratio was 2.6:1. The mean age of patients with spinal fractures was 42.7 years, ranging from 5 to 93 years. The highest rate of SCT was observed in the patients aged 21 to 30 years; however, women older than 50 years had a risk of 1.43 ($p = 0.04$, chi-square test) more often than men in the same age group. The distribution of SCT according to patient age and sex is shown in ►Fig. 1.

Etiology of Injury

The etiology of SCT and their frequencies along with the neurologic status, clinical complications, associated lesions, and anatomical distribution are summarized in ►Table 1. Automobile accidents were the most common etiology of trauma with 133 patients (41%), followed by accidental falls with 89 (28%) patients. Automobile accidents were also involved most frequently with neurologic deficits revealing 23 patients (7%) ASIA-A on admission and 25 (8%) patients ASIA-B/C/D; accidental falls were second most frequent with 14 (4%) patients ASIA-A on admission and 21 (7%) patients ASIA-B/C/D; and motorcyclists were the third with 13 (4%) patients ASIA-A and 13 (4%) patients ASIA-B/C/D.

Only the etiologies, automobile accidents, motorcycle accidents, and gunshots were significantly associated with a greater number of associated lesions (chi-square test, $p < 0.001$, with 95% of total dependence). No other significant association was found.

Anatomical Distribution

The 321 patients in our study population sustained 559 injuries. These injuries were categorized into five anatomical regions: high cervical (C0-C2), low cervical (C3-C7), thoracic (T1-T10), thoracolumbar transition (T11-L2), and lumbar-sacral (L3-S1). The low cervical region was the most common segment of spinal fracture with 121 patients (38%), followed by thoracolumbar transition with 80 patients (25%), thoracic with 41 patients (13%), high cervical with 28 patients (7.2%), and lumbar-sacral with 16 patients (5%). Of the 321 patients with SCT, 35 (11%) had multiple injuries involving different areas of the spine (►Table 2).

An interesting relation between the etiology of trauma and the fracture region was found in the patients who suffered spinal fractures. Traffic accidents, motorcycle

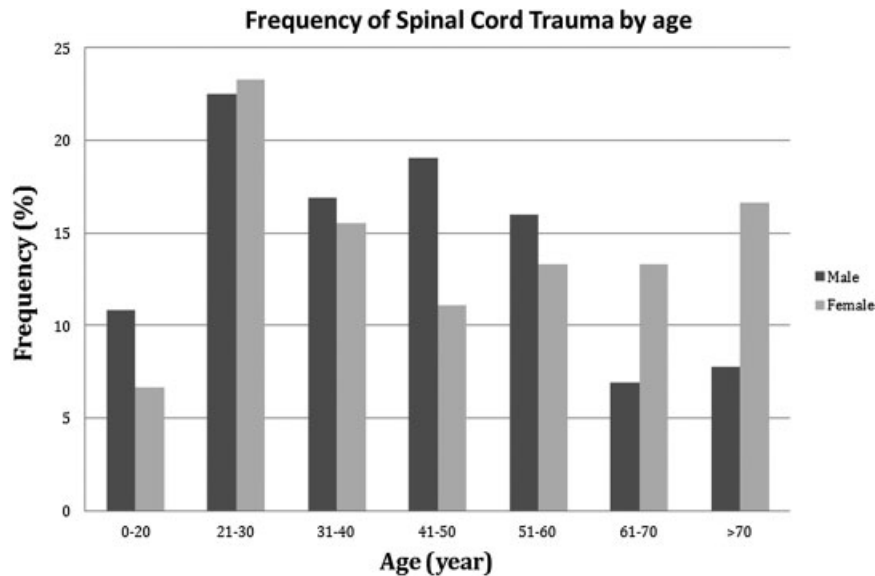


Fig. 1 Age and sex distribution.

accidents, and sports injuries resulted more often in low cervical spine injuries. On the other hand, accidental falls resulted in thoracolumbar transitional region fractures more often than in other segments of the spine (►Table 1). The most common level of observed spinal fracture was C6 (14.3%), followed by C5 (12.9%) and L1 (9.3%).

Evaluating the association between the anatomical distribution of the SCT and the number of associated injuries with the chi-square test, our study demonstrated that with higher level of the fracture along the spine, the number of associated injuries increases ($p = 0.001$), as shown ►Fig. 2A, with 80% of the total dependence explained. Using the same study, we found an association ($p = 0.0004$, chi-square test) with the anatomical distribution of the lesion with the number of complications. The dependence diagram with 97% of the explanation of the total dependence showed that 60% of the dependence comes from a higher number of complications as higher level of SCT (►Fig. 2B).

Patients with cervical spine injury had significantly increased neurologic deficit, clinical complications, and injuries associated with a risk of death 2.4 times more compared with other segments of the spine ($p < 0.05$, chi-square test).

Neurologic Status

Using the ASIA classification system, these spinal cord injuries were divided into three groups of patients: ASIA-A (patients exhibiting complete motor and sensitive deficit), ASIA-B/C/D (patients exhibiting incomplete motor or sensitive deficit), and ASIA-E (patients exhibiting no motor or sensitive deficit).

The total of 143 patients suffered SCT with neurologic deficit (►Table 3). The most frequent fractured anatomical region associated with complete and incomplete motor and sensorial deficit (ASIA-A and ASIA-B/C/D) was the low cervical region.

Using the chi-square test, the present study founded a significant association between the neurologic status and the

number of complications (dependence diagram with 97% of resolution). We demonstrated that the number of clinical complications rises progressively while the neurologic status of patients with spinal injuries gets worst ($p < 0.001$) (►Fig. 3).

Patients with ASIA-A showed 57% of clinical complications, 4.24 higher risk of mortality ($p = 0.0001$), and length of stay (21.9 ± 23.5 days) significantly higher than the other, through of chi-square test.

Associated Injuries

One hundred nineteen patients (37%) sustained a cumulative of 187 associated injuries. Of the patients with associated injuries, 48 (40%) sustained a head injury, 20 (17%) suffered a thoracic injury, 15 (13%) suffered facial injury, 11 (9%) suffered abdominal injury, 14 (12%) suffered superior limb fracture, 12 (10%) suffered inferior limb fracture, and 67 (36%) suffered others associated lesions. The two most common etiologies of trauma underlying the SCT accompanying these injuries were automobile accidents (61 [51%] patients), motorcycle accidents (23 [19%] patients), and accidental falls (16 [13%] patients) (►Table 1).

Length of Hospital Stay/In-Hospital Complications/ Mortality

The mean duration of hospital stay for all patients who were admitted in our hospital presenting SCT was 11.2 ± 15.9 days. Patients who sustained injuries due to gunshot had the longest hospital stay of 31.5 ± 39.8 days, compared with other etiologies of trauma (►Table 1). Patients presenting with SCT on the cervical region had the longest hospital stay of 14.3 ± 20.1 days, compared with other anatomical regions (►Table 2). Patients presenting with complete motor and sensitive neurologic deficits (ASIA-A) had the longest hospital stay of 21.9 ± 23.5 days (►Table 3).

The per-patient in-hospital complication rate was 22% (72 patients), with 37 patients (51%) presenting with one complication, 25 (35%) with two complications, and 10 (14%)

Table 1 Etiology of trauma and neurologic status/anatomical distribution

Etiology	Total	A	ASIA		Complic. (n = 117)			Injury associate (n = 187)		
			B, C, D	E	01	02	03	01	02	03
Cars	133	23	25	85	12	09	01	31	19	11
Motorcycle	49	13	13	23	9	03	01	10	07	06
Fall	89	14	21	54	11	09	03	12	03	01
Sports	21	04	07	10	03	01	01	04	01	0
Diving	13	06	05	02	0	03	02	05	0	0
Gunshot	08	06	01	01	01	0	01	05	02	0
Miscellaneous	08	02	03	03	01	0	01	02	0	0
Total of patients	321	68	75	178	37	25	10	69	32	18
Total	321	68	75	178	37	50	30	69	64	54

Cervical high	Cervical lower	Segments					
		Thoracic	Thoracolumbar	Lumbosacral	Two segments	MORT	TI (days)
20	58	15	28	03	09	13	9.8 (± 12.5)
01	16	12	12	03	05	0	11.8 (± 13,9)
03	22	07	36	08	13	10	9.3 (± 10,2)
03	13	0	03	01	01	02	17.3 (± 31.6)
0	10	0	0	0	03	0	15.5 (± 22.6)
01	01	04	0	0	02	0	31.5 (± 39,8)
0	01	03	01	01	02	0	7.7 (± 5.2)
28	121	41	80	16	35	25	11.2 (± 15.91)
28	121	41	80	16	35	25	11.2 (± 15.91)

Abbreviations: Complic., complications; HT, hospital time; MORT, mortality.

with three complications. The three most commons complications included pneumonia in 30 patients (42%), urinary tract infection in 18 patients (25%), and atelectasis in 6 patients (8%). Bedsores were notified in three patients (4%). The etiology of injury most common with complications was automobile accident (► **Table 1**).

The in-hospital mortality rate was 8% (25 patients). Low cervical region presented the highest risk of in-hospital mortality registering 13 deaths (11%) between all anatomical distributions of spinal fractures (► **Table 2**). The complete motor and sensitive deficit (ASIA-A) registered 13 deaths (19%).

Discussion

SCTs are common occurrences in neurosurgical practice. They account for an important proportion of care, disability, and ethical issues. They can be present in association with other conditions, and its early recognition may be difficult in these cases. The number of patients with spinal trauma has been found to range from 900 to 1,200 per million persons per year.¹⁰⁻¹² The high rate of complications observed in patients with SCT is due to forces involved in trauma or to the

neurologic status of these patients.¹³ The rate of complications have been found to vary between studies.¹⁴⁻¹⁷

The present study evaluated the presence of associated lesions and the in-hospital clinical complications of patients admitted with SCT treated at a single tertiary institute between January 2008 and June 2012. Our series prospectively evaluated 321 patients suffering from SF, including only those who required specialized investigation and treatment while excluding patients who did not survive the trauma at the time of accident. Thus, our series represents only patients with a real need for posttrauma treatment.

The average age of our patients was 42.68 years, with the majority aged between 20 and 40 years (► **Fig. 1**). In agreement with most published series, we found a high male: female ratio 2.6:1.¹⁸⁻²¹ The three main etiologies of spine injury found included automobile accidents, accidental falls, and motorcycle accidents. The most affected anatomical region was the low cervical, being C6 the most injury vertebra. The fractures in the cervical are potentially more severe and can result in devastating consequences if treatment is not appropriate.²²

Twenty-two percent of patients with SCT had some type of clinical complication, the most common being pneumonia,

Table 2 Anatomical distribution and neurologic status

Segments	Total	HT (days)	ASIA			Complications			Injury associated			Mortality
			A	B, C, D	E	01	02	03	01	02	03	
Cervical high (C0–C2)	28	14.3 (± 22.7)	01	02	25	03	03	01	11	02	04	05
Cervical lower (C3–C7)	121	14.3 (± 20.1)	36	38	47	14	13	06	24	17	06	13
Thoracic (T1–T10)	41	11.5 (± 11.5)	17	10	14	07	06	0	08	06	04	03
Thoracolumbar (T11–L2)	80	6.7 (± 7.3)	05	14	61	11	02	01	14	03	04	02
Lumbosacral (L3–S1)	16	3.8 (± 3.2)	0	03	13	01	0	0	01	02	0	0
Two segments injury	35	10.9 (± 12.3)	09	08	18	01	01	02	11	02	0	02
Total DE patients	321	11.2 (± 15.9)	68	75	178	37	25	10	69	32	18	25
Accurate Total	356	11.2 (± 15.9)	68	75	178	37	50	30	69	64	54	25

Abbreviations: HT, hospital time.

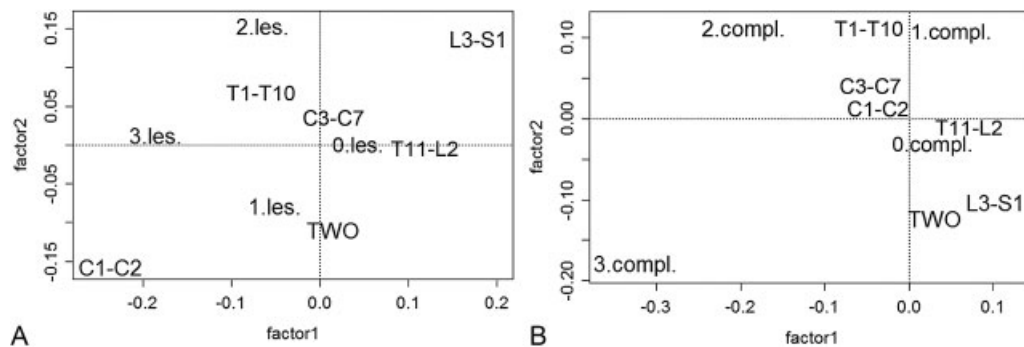


Fig. 2 (A) Anatomical distribution of the spinal cord injury and the number of associated injuries (chi-square test, $p = 0.001$). (B) Anatomical distribution of the associated lesions and number of complications (chi-square test, $p < 0.001$).

observed in 42% of patients with complications. Of patients with complete motor and sensitive deficit (ASIA-A), 54% presented with any clinical complication during hospital stay (►Table 3). These results suggest that those who lose the ability to walk were at higher risk for developing any clinical complication. According to Santos et al,¹⁵ this is particularly true to infections of the respiratory tract. Our study showed a statistically significant association between the neurologic status of patients with SCT and the number of complications, demonstrating that those with worst injuries usually present with a higher number of clinical complications.

The study of anatomical segment of SCT also revealed a higher occurrence of clinical complications, worst neurologic

status, and death between patients with low cervical spine injury (►Table 2). Twenty-seven percent of patients with low cervical spine injury had some clinical complication, 30% presented on admission as ASIA-A, and 11% died. According to Kawu et al,¹⁶ the risk factors associated with mortality following spine cord injury were age, Glasgow Coma Scale inferior of nine, cervical spine injury, and complete neurologic injury and those for clinical complications were cervical spine injury and ASIA-A. Our study showed statistically that patients with higher levels of SCT along the spine present with more associated lesions and clinical complications during in-hospital care.

Associated lesions were identified in 37% of patients sustaining a cumulative of 187 associated injuries. The

Table 3 Neurologic status and associated lesions/complications

ASIA	Total	Average length of hospitalization (days)	Complications			Injury associated			Mortality
			1	2	3	1	2	3	
A	68	21.9 (± 23.5) ^a	15	14	8	18	7	3	13
B, C, D	75	9.8 (± 12) ^b	7	7	0	14	8	2	6
E	178	7.6 (± 11.5) ^c	15	4	2	37	17	13	6
Total	321	11.2 (± 15.9)	37	25	10	69	32	18	25

^{a,b,c}Statistical difference of $p < 0.05$ by Dunn test.

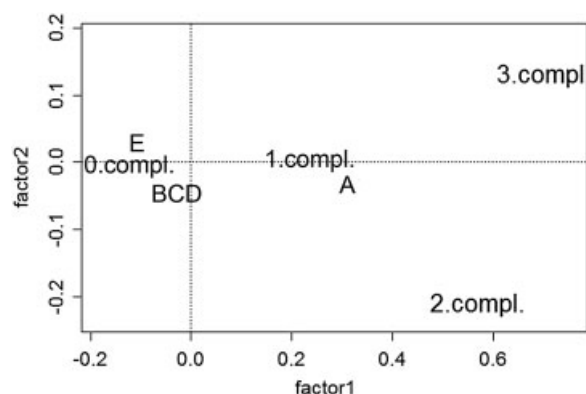


Fig. 3 Neurologic status and clinical complications (chi-square test, $p < 0.001$).

most common was head trauma, which represented 40% of all associated injuries. According to Holly et al⁷ and Lourenco et al,²³ because of the etiology and mechanisms of trauma in the cervical region, the head and the chest are at great risk of associated injuries.

Conclusion

The SCT was more common in men, but women older than 50 years presented with a higher risk than men of the same age. Automobile accidents, motorcycle accidents, and gunshots resulted in more injuries associated. The cervical spine involvement was directly related to an increase in the number of associated injuries, complications, and mortality. Already, the neurologic status ASIA-A was associated with an increase in the number of complications, length of stay, and mortality. We conclude that the predictive factors of prognosis in these patients included age, sex, cause of injury, anatomic distribution, and neurologic status.

Note

This study is part of the dissertation Morais DF carried out at FAMERP, São José do Rio Preto, São Paulo, Brazil.

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