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Complications after spinal cord injury in a specialty hospital in Mexico

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Abstract

Introduction: there is a severe scarcity of data related to complications in people with spinal cord injury (SCI) in Latin America. Those complications are frequent causes of morbidity and mortality, leading to increased hospitalization rates, employability loss, and decreased quality of life. Objective: to describe the main complications that occur in people with SCI at the National Rehabilitation Institute (INR-LGII). **Material and methods:** an observational, cross-sectional, descriptive clinical study was carried out on patients attended at a tertiary-level hospital in Mexico City with SCI. **Results:** 1,284 individuals were studied, 54.51% of them had complications. The most common complications by frequency of occurrence were: pressure ulcers, spasticity, pain, respiratory complications, and infections. Regarding the degree of independence and life satisfaction, individuals with complications had a lower mean score in the following scales: the Spinal Cord Independence Measure version III (SCIM-III) and the Life Satisfaction Questionnaire-9 (LSAT-9). An association was found between having complications and traumatic etiology, a more severe injury and sex. **Conclusions:** this study is clinically relevant because complications after a SCI are frequent and impact individuals, their families, and the whole society. Moreover, knowledge about these complications may reinforce the security of the patient, diminish costs and design treatment strategies to avoid those complications.

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Abbreviations:
95%CI = 95% confidence interval
AIS = ASIA Impairment Scale
ASIA = American Spinal Injury Association
ISNCSCI = International Standards for Neurological Classification of SCI
LISAT-9 = Life Satisfaction Questionnaire-9
PU = pressure ulcers
SCI = spinal cord injury
SCIM-III = Spinal Cord Independence Measure version III

INTRODUCTION

Spinal cord injury (SCI) is a critical condition that has functional, psychological and socio-economic impacts;[1] and therefore, affects quality of life.[2] The medical complications may lead to frequent causes of morbidity and mortality which may generate a larger rate of re-hospitalization, loss of employment, and a poor quality of life.[1]

It is estimated that in the United States, the incidence of people with SCI from traumatic etiology is 54 per million people per year, approximately 282,000 survivors that may lead to complications and require medical attention and re-hospitalizations.[3] In the Spinal Cord Injury Systems Database Model, re-hospitalizations occurred in 55% of participants during the first year after SCI and

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continued at an approximate rate of 37% per year for the next 20 years. The main causes of hospitalization are: urinary complications, respiratory complications and pressure ulcers (PU).[4]

Although more than 80% of the world population lives in more than 100 developing countries, there is no study that has reviewed the global mortality nor the main complications that people with SCI in Latin America present.[5]

Investigations into demographic and clinical characteristics give a better understanding of risk factors, clinical consequences and complications originating from SCI, which leads to better preventive strategies.[6] Thus, this study aims to describe the main complications as well as their association with sociodemographic and clinical variables of people with SCI who attended a tertiary-level hospital from 2015 to 2021 (level 3 in Mexico is a Specialty Hospital and is the equivalent to the level 1 Trauma Centers, defined as somewhere able to provide «definitive care for every aspect of injury»).

SCI is evaluated by using the International Standards for Neurological Classification of SCI (ISNCSCI) Worksheet, which identifies: by completeness (ASIA Impairment Scale)

Complete (grade A): no sensory or motor function is preserved in the sacral segments (S4-S5).

Incomplete (grade B): sensory function is preserved below the neurological level, but motor function is not.

Incomplete (grade C): motor function is preserved below the neurological level, but more than half of the key muscles have a muscle grade of less than 3 (out of 5). This means the person cannot move their limbs against gravity.

Incomplete (grade D): motor function is preserved below the neurological level, and more than half of the key muscles have a muscle grade of 3 or greater. This means the person can move their limbs against gravity.

Normal (grade E): motor and sensory function are normal for all parts of the body, though some reflexes may be abnormal.[7]

Moreover, we used the Life Satisfaction Questionnaire-9 (LISAT-9) is a standardized tool designed to assess an individual's overall life satisfaction and satisfaction within specific life domains. Its classification is associated with the score obtained: the higher scores indicate greater satisfaction. There is no total sum score; instead, each item is analyzed individually, and median or mean scores may be reported for group comparisons. This provides meaningful information on quality of life for clinical and research purposes in the field of SCI (for analytical purposes, responses are often dichotomized: Satisfied = scores 5-6 VS not satisfied = scores 1-4).[8,9]

Objective

To describe the main complications of individuals with SCI in a specialty hospital in Mexico City from 2015 to 2021 and to identify associations between complications and clinical and sociodemographic variables.

MATERIAL AND METHODS

Study design

An observational, cross-sectional, comparative and descriptive clinical study was carried out on people admitted with SCI from 2015 to 2021 at the SCI service in the National Rehabilitation Institute «Luis Guillermo Ibarra Ibarra» (INR-LGII), a specialty hospital in Mexico City. A database was elaborated to manage the information. The study was approved by an Investigative Committee.

Description of the participants

Persons with SCI, attended the SCI service. We based our measurements on the last note of the record; it was eliminated if the medical record was completed with less than 80% of the variables and excluded if SCI was rejected. We included all the adults with SCI from any etiology, severity and neurological level according to the International Standards of Neurological Classification of Spinal Cord Injury (ISNCSCI). ISNCSCI standardizes the physical examination that assesses the severity and impairment of motor and sensory function, and it is considered the gold standard for evaluating and documenting SCIs. It also identifies the Impairment Scale (AIS), based on the Frankel scale, which is a clinician-administered scale used to classify the severity (completeness) of injury in individuals with SCI.[10]

Outcomes

Complications were defined as «an unanticipated problem that arises following, and is a result of, the SCI». We specifically looked in the first note of the clinical record for pain, pressure ulcers, spasticity and spasms,

respiratory complications, infections, deep venous thrombosis, osteopenia, orthostatic hypotension and dysreflexia and urinary lithiasis.[2] Information about complications was directly asked during medical visits and recorded in the medical records.

To address potential biases, the information was collected exclusively by two trained SCI experts.

Proposed statistical analysis

Descriptive statistics were performed with measures of central tendency for the quantitative variables and frequencies and proportions for the qualitative variables. To estimate the relationship between the qualitative variables, χ^2 test of independence was used. To determine the relationship between qualitative and quantitative variables, means of groups defined by the qualitative variables were compared with Student t or ANOVA. We considered a confidentiality index of 95% and a significance level $p < 0.05$. The SPSS 21 program was used.

Also, a log-binomial regression analysis was conducted to derive prevalence ratios[11] estimating the presence of different complications according to demographic and clinical variables.

RESULTS

1,284 persons were included, most of them were men (66.2%, n = 1,940), with an average age of 42.23 years old (ranging from 18 to 88).

Table 1: Complications in patients attended at the INR-LGII 2015-2021.

Complication	n (%)
Pressure ulcers	429 (33.4)
Spasticity	108 (8.4)
Pain	98 (7.6)
Respiratory	48 (3.7)
Infection	39 (3.0)
Deep venous thrombosis	23 (1.8)
Spasms	14 (1.1)
Osteopenia	11 (0.9)
Orthostatic hypotension	6 (0.5)
Urinary lithiasis	5 (0.4)
Dysreflexia	4 (0.3)
Other	128 (10.0)

INR-LGII = National Rehabilitation Institute «Luis Guillermo Ibarra Ibarra».

Table 2: Comparison of means of quantitative variables.

Variables	Mean ± DS	p
Life satisfaction		< 0.001
With complications	37.2 ± 8.49	
Without complications	39.58 ± 7.69	
SCIM-III		< 0.001
With complications	71.4 ± 29.26	
Without complications	82.98 ± 26.95	
Age		0.54
With complications	41.94 ± 16.01	
Without complications	42.54 ± 16.57	

SCIM-III = spinal cord independence measure version III.
Statistics estimated from database of patients with SCI of INR-LGII.

Regarding the clinical characteristics of SCI, most individuals had a complete injury classified with the ISNCSCI using the ASIA Impairment Scale (AIS). Its distribution in this study was: AIS A in 42.7% of patients, followed by D (28.9%), C (14.5%), B (11.1%), and E (2.8%).

The most frequent neurological level was low thoracic (T7-T12) (29.8%), followed by high thoracic (T1-T6 (26.9%), low cervical (C5-C8) (16.9%), high cervical (C1-C4) (15.8%), lumbar (10.3%) and sacral (0.2%). The most common etiology was traumatic injury (64.8%).

Most participants presented complications, 54.51% (n = 699), of which the most frequent, in descending order, were: pressure ulcers in 33.4% (n = 429), spasticity in 8.4% (108) and pain in 7.6% (n = 98), see *Table 1*.

The means' comparison of the quantitative variables between groups defined by the presence of complications were examined, as shown in *Table 2* below.

The table shows that the group of participants with complications had a lower Life Satisfaction Questionnaire-9 (LISAT-9) score compared to the group without complications, and this difference was statistically significant ($p < 0.001$). Also, subjects with complications had a SCIM-III score significantly lower than the group of subjects without complications. No significant differences were observed in terms of age.

Complications were more frequent in men than in women. 502 men had complications (39%) in comparison to 198 women who developed complications (15.42%) (χ^2 test $p > 0.001$). Complications were more frequent in individuals with traumatic injury etiology

than with non-traumatic injury (784 subjects [61%] vs 500 [38.94%]; χ^2 test $p < 0.001$). Distribution according to IISNCSCI is presented in *Figure 1*.

A logistic regression analysis was performed to determine the effects of age, sex, satisfaction with life, independence, AIS, and neurologic level on the likelihood that participants presented complications.

The logistic regression model was statistically significant, p = 0.037. The model had a Nagelkerke R2 = 0.164 and correctly classified 66.2% of cases *(Table 3)*.

Men were 1.51 times more likely to present complications than women; people with motor complete SCI (AIS A and B) were 2.403 times more likely to have complications than those with motor incomplete SCI; people with tetraplegia (C1-C8) were 1.08 times more likely to have complications than those with paraplegia (≤ T1); and people with traumatic SCI were 1.87 times more likely to have complications than those with non-traumatic SCI. Increasing age and independence were associated with a higher likelihood of complications. Satisfaction with life and neurologic level did not show a statistically significant effect on the presence of complications.

For particular complications, a logistic regression analysis was performed to determine the effects of age, sex, satisfaction with life, independence, AIS, and neurologic level on the likelihood that participants presented the complications.

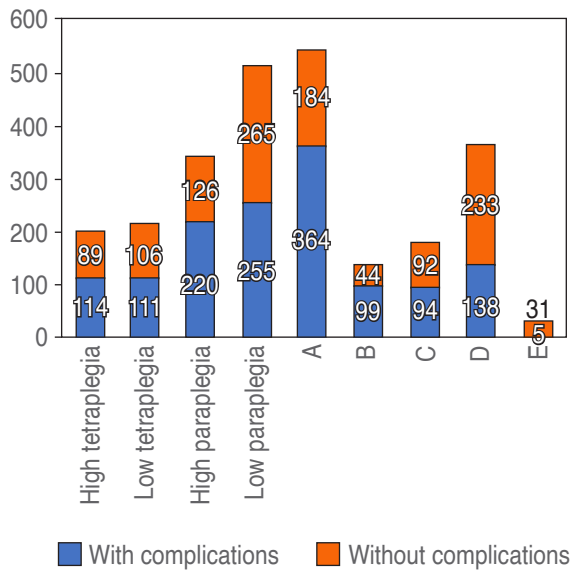

Figure 1: Complications according to spinal cord injury severity.

Pressure ulcers

The logistic regression model was statistically significant, p = 0.047. The model had a Nagelkerke R2 = 0.263 and correctly classified 70.9% of cases.

Men were 2.1 times more likely to present pressure ulcers than women. People with motor complete SCI (AIS A and B) were 4.55 times more likely to have pressure ulcers than those with motor incomplete SCI. Increasing age and independence were associated with an increased likelihood of presenting pressure ulcers, but increasing satisfaction with life was associated with a reduction in the probability of exhibiting pressure ulcers. Etiology and neurologic level did not show a statistically significant effect on the presence of pressure ulcers.

Table 3: Regression analysis components.

Variable	B	SE	Wald	Sig	Exp(B)	95%CI for Exp(B)	
						Lower	Upper
Etiology (traumatic)	0.626	0.147		0.000	1.869	1.4	2.496
Sex (men)	0.411	0.134		0.002	1.508	1.160	1.960
SCIM-III	0.010	0.003	14.953	0.000	1.010	1.005	1.016
LISAT-9	0.013	0.008	2.358	0.125	1.013	0.996	1.030
Age	−0.012	0.004	8.032	0.005	0.988	0.980	0.996
AIS (motor complete)	0.877	0.143	37.368	0.000	2.403	1.814	3.182
Neurological level (tetraplegia)	0.081	0.140	0.336	0.562	1.084	0.824	1.427
Constant	−1.761	0.377	21.825	0.000	0.172		

95%CI = 95% confidence interval. AIS = ASIA Impairment Scale. LISAT-9 = Life Satisfaction Questionnaire-9. SCIM-III = Spinal Cord Independence Measure version III. SE = standard error. Sig = significance.

Pain

The logistic regression model was statistically significant, p = 0.012. The model had a Nagelkerke R2 = 0.10 and correctly classified 92.4% of cases.

Females were 1.7 times more likely to present pain than males, and people with traumatic SCI were 1.76 times more likely to present pain than those with non-traumatic etiology. Increasing age and more independence were associated with an increased likelihood of exhibiting pain, but increasing satisfaction with life was associated with a reduction in the probability of exhibiting pain. AIS and neurologic level did not show a statistically significant effect on the presence of pain.

Respiratory complications

The logistic regression model was statistically significant, p = 0.032. The model had a Nagelkerke R2 = 0.105 and correctly classified 96.2% of cases.

Subjects with traumatic SCI were 2.92 times more likely to present respiratory complications than persons with non-traumatic SCI. Individuals with motor complete SCI were 1.69 times more likely to present respiratory complications than individuals with motor incomplete SCI. Persons with tetraplegia had 1.75 times more probability of having respiratory complications than people with paraplegia. Increasing independence was associated with a reduction in the likelihood of presenting respiratory complications. Age and satisfaction with life did not show a statistically significant effect on the presence of pressure ulcers.

DISCUSSION

In the present study, SCI complications were described, along with the association between these complications and the clinical and sociodemographic variables in a single hospital in Mexico City.

Most of the participants were male (66.2%), with complete paraplegia, and the majority presented complications (54.5%). The reported frequency varies worldwide, with the highest prevalence of up to 56% reported in Europe, while as low as 11% in the United States. In the meta-analysis by Shiferaw et al.,[12] they referred to 32.36%, being more common in those with SCI AIS A, with upper thoracic injury, and males.

We found a statistically significant association between people with complications and a lower satisfaction with life than those without complications. This is similar to other authors,[13] who mentioned that a reduction in life satisfaction is observed more frequently in those patients with intestinal-related issues and those who present moderate or severe nociceptive pain. Another study reported that 73.5% of people had at least one episode of a urinary tract infection, and their overall quality of life worsened.[14]

Considering the frequency of specific complications, the results of this study were similar to international data,[15] according to which PU is the most common complication. Shiferaw et al in 2020 in «The global burden of pressure ulcers among patients with spinal cord injury: a systematic review and meta-analysis» revealed that about one in three patients as the global pooled magnitude of pressure ulcers among patients with SCI; and on the subgroup analysis, the highest magnitude in Africa 41.19%. Therefore, policy makers and other concerned bodies should design country context-specific preventive strategies to reduce the burden of pressure ulcers in patients with spinal cord injury.[12] Chen et al in 2020 study findings «Incidence of pressure injury in individuals with spinal cord injury: a systematic review and meta-analysis» indicate that more than one in five individuals with SCI will develop a pressure injury and its high risk of developing them, especially in community settings or low- and middle-income developing countries.[16] Moreover, Lessing et al in 2020 in «Pressure ulcers after traumatic spinal injury in East Africa: risk factors, illustrative case, and low-cost protocol for prevention and treatment» report high-risk patients were those with delayed presentation, complete neurologic injuries, and thoracic injuries.[17] Pérez et al in «Frequency of ulcers for pressure in the patient with spinal cord injury, its correlation with the neurologic level and scale of ASIA» also found that the ulcers for pressure are the most frequent chronic complication that is presented in the patient with spinal cord injury being observed for up of 60%, considering more than 87% with a low socioeconomic level in Mexico. However, no association was found between having PU and sociodemographic variables.[18]

In the literature, urinary tract infection is the second most frequent complication. Golestani et al.[19] compared the results of developing and developed countries, showing that pressure ulcers and urinary tract infections are major secondary complications in all regions. In our study, infections were the fifth most frequent complication. The cross-sectional nature of the study might be the reason for that finding, since patients might not report complications that were treated successfully in the past.

Spasticity and pain were reported in 70 and 80% respectively by Gatti et al.[20] However, we found a lower rate of these complications. Furthermore, we encountered an association of pain with the female sex, also reported by Werhagen et al.[21] We did not find an association between pain and SCI severity (AIS, nor neurologic level). Conversely, Jorgensen et. al.[13] showed that veterans with AIS D reported more pain, less vitality, and lower overall health compared with those with a different SCI type. There are several plausible explanations for these findings, such as fatigue related to walking, the frustration of being slow to multitask and feeling misunderstood due to less visible deficits (such as pain, sexual problems, and those related to the bowel and bladder). Margot-Duclot A et al[22] report that cervical and thoracic SCI levels, as well as cauda equina injuries, seem to have a greater association with neuropathic pain.

Spasticity was the second most frequent complication in this study. DeForest et al reported spasms in muscles innervated at or below the injury level close to 80%.[23] Also, we observed that spasms are more frequently reported by male individuals.

We found respiratory complications in 3.7% and a higher frequency of them was observed in persons with SCI AIS A and B, as well as in those whose neurological level was a cervical level (tetraplegia). According to the study reported by Vieri Failli et al.,[24] their data are similar to ours in terms of severity of the injury; they also observed high rates of pneumonia in individuals with AIS A and B. Regarding the neurological level, in our study a higher risk was found in those persons with SCI at the cervical level, which is not surprising because of the weakness of respiratory muscles at those levels.[1]

Due to people with SCI's life expectancy increasing, more research worldwide is required to improve information related to long-term complications in this group of people.

This study is clinically relevant because the high rates of complications should alarm the authorities to establish political statements. In our Specialty Hospital, the SCI medical specialist takes care of complex SCI inpatients and outpatients with or without medical complications. So, from the very start, it is a challenge to care for this type of individual and we face different scenarios to whom we adapt in the best way, since in Mexico we don't have long-term acute care hospitals or skilled nursing facilities. Medical doctors should emphasize the awareness and prevention of these complications from the first meeting with the patient. This would improve preventive management, diminish costs, and help design strategies to manage complications in people with SCI.

Limitations

Since this was a cross-sectional study, it was not possible to retrieve data that had not been previously documented in the medical record. In addition, this study investigated medical complications, while SCI also has psychosocial complications beyond the scope of this investigation and these may influence the patient's prognosis as much as medical complications.

At the time of data collection, it was not possible to find specific information that could have been important. It was not possible to collect data on the recurrence of complications and then to describe if these lead to more hospital admissions and consequently a greater propensity to suffer more complications.

The results should be interpreted with caution, as they only reflect the reality of a high-complexity hospital in Mexico. Therefore, the conclusions derived should be exclusively for public health policies or resource allocation in that region.

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Data available on request due to privacy/ethical restrictions.

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Patient anonymity has been protected.
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