

Epidemiological Analysis of Spinal Cord Injuries in a North-Western Romanian Hospital

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ABSTRACT

Spinal cord injuries (SCI), especially those occurring at higher levels, frequently lead to lasting and often irreversible impairments in neurological function, often resulting from traumatic events. These injuries can compromise sensory and motor capabilities, disrupt autonomic regulation, and may even lead to death. The early and long-term stages of SCI are usually characterized by significant gastrointestinal and cardiovascular complications. Our study aimed to analyze the epidemiological and clinical characteristics of patients with high spinal cord injuries, focusing on both neurological and systemic effects. This study presents a retrospective cross-sectional epidemiological analysis of patients diagnosed with high-level spinal cord injuries and admitted to the Oradea Emergency County Clinical Hospital between 2017 and 2021. The study population consisted of 40 patients. Among them, the most common observed condition was central cervical spinal cord syndrome (35%), followed by anterior cord syndrome (22.5%). Complete spinal cord transection was relatively uncommon, recorded in 12.5% of cases. Injuries involving the brachial plexus or nerve roots were rare, occurring in only 5% of patients. The findings also showed that the prevalence and severity of these injuries were higher in male patients. Furthermore, cervical spinal cord injuries were more commonly found in older adults, especially those over 65 years of age. Central cervical cord syndrome emerged as the most common injury pattern in this cohort.

Keywords: Spinal cord injury, High cervical lesions, Autonomic dysfunction, Gastrointestinal complications, Complete Vs. incomplete injuries

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Introduction

In the general population, spinal cord injury (SCI) is often perceived primarily as a cause of motor impairment and reduced mobility. However, less recognized are the profound effects SCI has on pelvic organ function, including bowel, bladder, and sexual dysfunction [1–6].

SCI frequently results in permanent and irreversible loss of spinal cord function, most often following traumatic injury. While emerging therapies—such as cell transplantation—are under investigation, much of the preclinical work remains in the experimental stage, primarily conducted on rodent models [4, 7–9].

Anatomically, the spinal cord is a critical component of the central nervous system, responsible for transmitting motor commands from the brain to the body, relaying sensory input to the brain, and coordinating reflexes. It comprises 31 pairs of spinal nerves, organized segmentally. Damage to the spinal cord disrupts these pathways, leading to sensory deficits, motor dysfunction, autonomic dysregulation, and in severe cases, death [10–12].

Control of the gastrointestinal (GI) system relies on a delicate balance between autonomic and somatic innervation, acting through the intrinsic enteric nervous system. SCI disrupts this regulation to varying degrees depending on the location and severity of the lesion [13, 14]. Compared to the well-documented urological sequelae, the impact of SCI on bowel function has been historically under-researched [15–18]. However, more recent studies suggest that bowel dysfunction may be a greater source of distress for many SCI patients than urinary or sexual dysfunction [9, 19–21].

Gastrointestinal symptoms are common in both the acute and chronic stages of SCI, often leading to significant morbidity. One Australian study reported that GI complications accounted for approximately 11% of hospitalizations among SCI patients [22, 23]. These complications are also associated with increased rates of mental health disorders, including depression [24]. In acute SCI, symptoms may involve any part of the GI tract and can range from nausea, vomiting, and abdominal bloating to constipation and fecal incontinence [22, 25–29]. Diagnosing and managing these issues is often complicated by diminished visceral sensitivity and overlapping presentations with other abdominal conditions.

Cardiovascular dysfunction is another major consequence of SCI, especially in cases involving cervical and upper thoracic lesions. Disruption of supraspinal control over the sympathetic nervous system results in autonomic imbalance, leading to conditions such as orthostatic hypotension, bradycardia, and blunted cardiovascular responses to stress or exercise [30–35]. Morphological changes in sympathetic preganglionic neurons and increased peripheral adrenergic reactivity contribute to pathologies such as autonomic dysreflexia [36, 37]. Moreover, secondary effects of reduced mobility, such as altered metabolism and decreased physical fitness, further exacerbate cardiovascular dysfunction in this population [38–41].

Given these multifaceted complications, our study aimed to analyze the epidemiological and clinical characteristics of patients with high spinal cord injuries, focusing on both neurological and systemic impacts.

Materials and Methods

Participants

This research utilized a retrospective, cross-sectional approach to examine cases of high spinal cord injuries. The study population included all individuals admitted to the Oradea Emergency County Clinical Hospital between 2017 and 2021 with confirmed high-level spinal cord trauma.

Eligible participants were adults aged 18 years or older, regardless of sex, who had been diagnosed with upper spinal cord injuries. Diagnostic imaging using magnetic resonance imaging (MRI) of the chest and cervical spine was employed to verify each case. Individuals whose imaging results failed to confirm spinal cord injury were excluded from the final analysis.

A total of 40 patients met the inclusion criteria. Imaging confirmed their diagnoses, and all were treated within the hospital during the study period. The cohort had a median age of 55 years, with a significant male predominance—90% of the participants were men.

Instruments

Patient data were retrieved from the hospital's digital medical records system. The search was conducted using diagnostic codes from the International Classification of Diseases, 10th Revision (ICD-10). Specifically, patients were identified using codes from the S14 category, which pertains to injuries involving the nerves and spinal cord at the cervical level.

Each case flagged by this diagnostic filter was reviewed individually to confirm the presence of spinal cord injury through imaging, particularly MRI.

The ICD-10 S14 codes used for inclusion were:

- S14.0: Contusion and edema of the cervical spinal cord

- S14.1: Other and unspecified injuries of the cervical spinal cord
- S14.2: Injury of nerve root of cervical spine
- S14.3: Brachial plexus injury
- S14.4: Injury to the peripheral nerves of the neck
- S14.5: Injury of cervical sympathetic nerves
- S14.6: Other and unspecified injuries of neck nerves
- S14.10: Unspecified cervical spinal cord injury
- S14.11: Complete injury of the cervical spinal cord
- S14.12: Central spinal cord syndrome (incomplete) at cervical level
- S14.13: Other incomplete cervical spinal cord syndromes

Only those patients whose diagnosis was confirmed through imaging were included in the final dataset. After applying both inclusion and exclusion criteria, a total of 40 cases were selected for analysis.

Results and Discussion

This retrospective analysis included 40 patients with confirmed high cervical spinal cord injuries. The median age was 55 years, with an interquartile range (IQR) of 38.25 to 73.75 years. The youngest patient was 18 years old, while the oldest was 85 years old.

Of the total study population, 90% (n = 36) were male, and 10% (n = 4) were female. The median age for male patients was 52 years (IQR: 38.25–73), whereas for females it was higher, at 77 years (IQR: 39.5–83).

Figure 1 illustrates a boxplot showing the age distribution by gender. Although female patients tended to be older than their male counterparts, this age difference did not reach conventional statistical significance ($p = 0.071$), as determined by the Mann-Whitney U test.

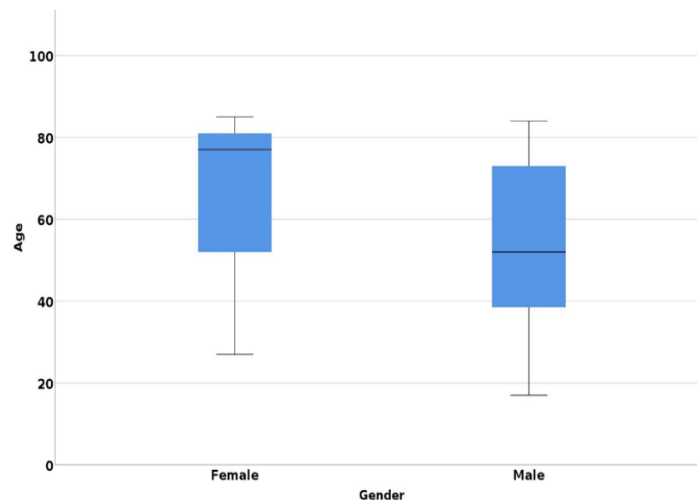


Figure 1. Boxplot of age by sex

The age distribution of spinal cord lesions reveals a relatively equal incidence between younger individuals and adults, with a noticeable increase in cervical spinal cord injuries in older age groups (**Figure 2**). The highest incidence of cervical injuries occurs in individuals aged 65 to 80 years (**Table 1**).

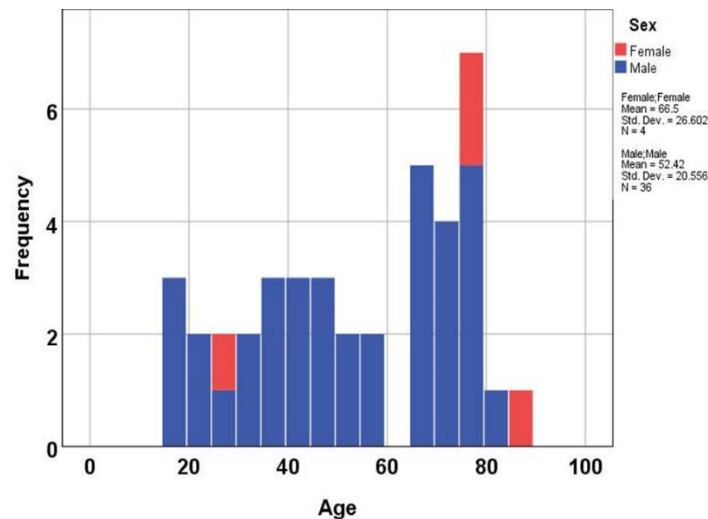


Figure 2. Histogram of cervical lesions by age and sex

Table 1. Distribution of cases by year

Year	Absolute frequency	Relative frequency	Cumulative percentage
2017	8	20.0	20.0
2018	9	22.5	42.5
2019	5	12.5	55.0
2020	11	27.5	82.5
2021	7	17.5	100.0
Total	40	100.0	

The year 2020 saw the highest number of cases, with a total of 11, while 2019 had the fewest, recording only 5 cases. Stratifying patients according to their diagnosis codes reveals that the most common code was S14.12, accounting for 35% of all diagnoses within the S14 category (**Figure 3**).

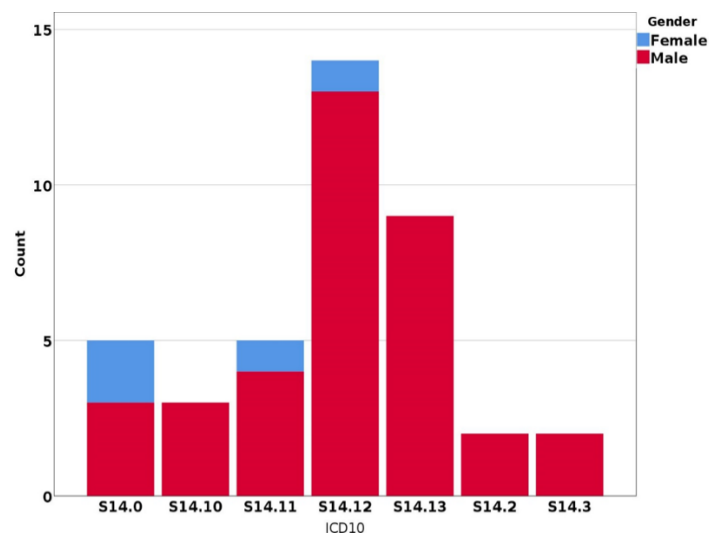


Figure 3. Distribution of diagnostic codes

The diagnosis code S14.13 ranked second in frequency, contributing to 22.5% of the total cases within the S14 block. In contrast, the least frequent diagnoses were S14.2 and S14.3, each accounting for only 5% of cases. For female patients, lesions were most commonly linked to the diagnosis codes S14.0, S14.11, and S14.12. Male patients, on the other hand, exhibited a broader range of diagnoses, encompassing all codes within the S14 block.

Regarding the injury types (**Figure 4**), the most common was central spinal cord injury syndrome at the cervical level, representing 35% of the cases. This was followed by anterior spinal cord injury syndrome at 22.5%. Complete spinal cord injuries were observed in 12.5% of the patients, while lesions involving the brachial plexus or nerve roots were the least frequent, found in only 5% of cases.

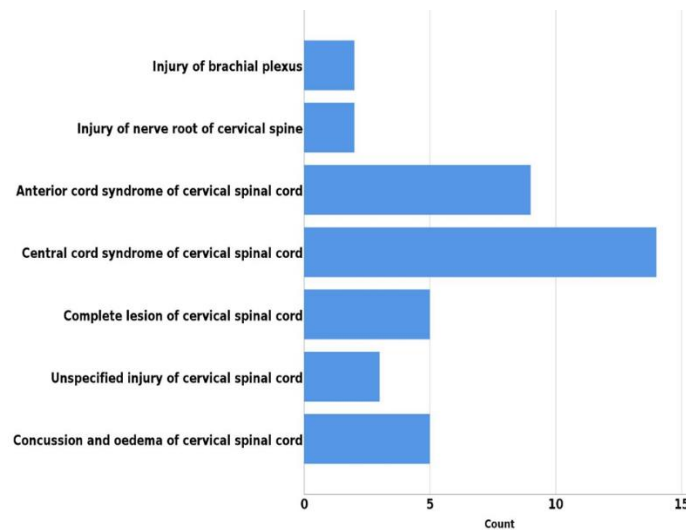


Figure 4. Distribution by type of injury

In terms of injury severity, the majority of spinal cord injuries were incomplete (65%), with only 12.5% classified as complete cord injuries (**Table 2**). Mild lesions, such as edema or colitis, were observed in just 12.5% of the cases, while lesions involving the nerve roots or plexus were the least frequent, occurring in only 10% of patients.

Table 2. Severity of spinal cord injuries

Type of injury	Absolute frequency	Relative frequency	Cumulative percentage
Concussion/edema	5	12.5	12.5
Nerve root/plexus	4	10.0	22.5
Incomplete	26	65.0	87.5
Complete	5	12.5	100.0
Total	40	100.0	

In this study, the distribution of injury severity followed a Gaussian pattern, with moderate injuries being the most prevalent. Severe injuries were more commonly observed in male patients, while mild injuries were comparatively rare.

Our findings align with those of Lowery *et al.* [42], who reported a male predominance (70.9%) in cervical spinal cord injuries in a study of over 30,000 patients. This gender disparity is also evident in our cohort, where a higher incidence of cervical spinal cord injuries was found in males. Furthermore, Lowery *et al.* [42] documented an increase in the incidence of these injuries with age, particularly in those aged 65-85 years. Similarly, our study and other literature sources confirm a rise in cervical spinal cord injuries among individuals over 65 years.

The Nexus cohort, a comprehensive epidemiological database, supports the observation that cervical spinal cord injuries occur more frequently in males and that their incidence increases progressively with age, especially in the 65-85 years age group.

In terms of injury severity, our study found that 12.5% of patients had complete spinal cord injuries, while the majority had incomplete injuries. This pattern of incomplete injuries being more common has been corroborated by Hu *et al.* [43] in a study with over 2,000 patients, reinforcing the trend of incomplete spinal cord lesions being predominant.

A limitation of this study is the reliance on the hospital's administrative database, which uses ICD-10 coding. This system lacks detailed information on the exact location of the injuries, making it difficult to categorize the

lesions accurately. While we were able to identify trends in the overall incidence of spinal cord injuries, finer details about lesion specifics were not available.

Conclusion

Our study reveals that high cervical spinal cord injuries are more frequent in males and show a significant increase with age, especially in individuals aged 65 and older. The most common type of injury observed was central spinal cord injury syndrome at the cervical level (an incomplete spinal cord injury), with moderate injuries being the most frequent. Minor and complete injuries were less common.

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