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EPIDEMIOLOGICAL STUDY ON SPINAL CORD INJURIES IN A HOSPITAL FROM NORTH-WEST OF ROMANIA

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ABSTRACT

Spinal cord injury mostly results in irreversible and permanent loss of spinal cord function, most commonly as a result of trauma. A spinal cord injury can cause deficits in sensation, movement, and autonomic regulation, as well as death. In both the acute and chronic phases of SCI, patients report high levels of gastrointestinal and cardiovascular. Our purpose was to analyze the effects of high spinal cord injuries. This is a retrospective cross-sectional epidemiological study. All patients were hospitalized with high spinal cord injuries in the Oradea Emergency County Clinical Hospital during 2017-2021. Our study included 40 patients, the type of injury shows an increased frequency (35%) of the central spinal cord injury syndrome at the level of the cervical spinal cord, closely followed by the anterior spinal cord injury syndrome (22.5%). Complete marrow injury was observed in only 12.5%. Lesions of the gill plexus or nerve roots were observed in only 5% of cases. The incidence and severity of high spinal cord injuries are higher among males. The incidence of cervical spinal cord injuries correlates positively with advancing age, the most affected being people over 65 years of age. The most common spinal cord injury was central spinal cord injury syndrome at the level of the cervical spinal cord.

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Introduction

Among the general population, the perceived impact of spinal cord injuries that people have is often limited to the visible effects of impaired mobility [1-3]. Less appreciated by the general population is the impact that spinal cord injuries have on pelvic function, resulting in bowel, bladder, and sexual dysfunction [4-6].

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Spinal cord injury (SCI) mostly results in irreversible and permanent loss of spinal cord function, most commonly as a result of trauma. Several treatment options, such as cell transplant methods, are being researched to overcome the disabilities that result from SCI. Most preclinical animal studies are performed in rodent models of SCI [4, 7-9].

The spinal cord is a vital part of the central nervous system and is housed in the spine. Its purpose is to send motor commands from the brain to the body and sensory information from the body to the brain and coordinate reflexes. The spinal cord is organized into thirty-one pairs of spinal nerves. A spinal cord injury disrupts this symbiosis between body and brain and can cause deficits in sensation, movement, and autonomic regulation, as well as death [10-12].

Control of the gastrointestinal system involves complex interactions between autonomic and somatic innervation ultimately acting on the intrinsic enteric nervous system. As a result of spinal cord injury, this fine control mechanism is disrupted to varying degrees, depending on the level and degree of spinal cord injury [13, 14].

To date, the effects of spinal cord injury on bowel function and management have been poorly understood [15]. A volume of published work has been devoted to the urological sequelae of spinal cord injury compared to the effects of the gastrointestinal system [16-18]. In recent years this has begun to be researched. This research has revealed that a considerable proportion of people with spinal cord injuries have shown that the rate of bowel dysfunction is a greater source of distress than bladder and sexual problems [9, 19-21]. In both the acute and chronic phases of SCI, patients report high levels of gastrointestinal morbidity [22]. Gastrointestinal problems are an important cause of hospitalization among people with spinal cord injuries, accounting for 11% of hospitalizations in a recent period according to an Australian study [23]. Subsequently, these patients develop mental health issues, frequently followed by depressive disorder [24]. This morbidity has significant implications for health system costs. In the setting of acute spinal cord injury, symptoms can affect any region of the gastrointestinal tract [25].

Gastrointestinal symptoms seen in people with spinal cord injury include poorly localized abdominal pain, bloating, and constipation, or upper gastrointestinal symptoms such as nausea and vomiting [22, 26]. This list of symptoms that is partially attributed to autonomic dysfunction exists alongside the potential for any other acute abdominal pathology. Diagnosis and treatment can often be complicated due to reduced visceral sensitivity. Symptoms of lower gastrointestinal tract dysfunction after spinal cord injury are more obvious to clinicians, presenting later with constipation and fecal incontinence [27-29].

Cardiovascular function is altered in people with spinal cord injuries [30]. Impairment of autonomic function after SCI is a major contributing factor [31]. Particularly in high cervical and thoracic injuries, disruption of sympathetic outflow plays a key role in cardiovascular dysfunction [32]. Loss of supraspinal regulatory control of the sympathetic nervous system results in the reduced overall sympathetic activity below the level of injury and causes problems such as hypotension, bradycardia, and a diminished cardiovascular response to exercise [33-35].

Morphological changes occur in sympathetic preganglionic neurons distal to the lesion [36]. The occurrence of peripheral alpha-adrenergic hyperreactivity contributes to the excessive pressor response observed in autonomic dysreflexia [37]. In addition to autonomic abnormalities, there are indirect effects of reduced physical activity such as changes in metabolic function and other SCI-related conditions on cardiovascular function [38-41].

Our purpose was to analyze the effects of high spinal cord injuries.

Materials and Methods

Participants

This is a retrospective cross-sectional epidemiological study. All patients who were hospitalized with high spinal cord injuries in the Oradea Emergency County Clinical Hospital during 2017-2021 were included in this study.

The study involved adult patients, over 18 years of age, of both sexes, who were admitted for various high spinal cord injuries. In order to establish the diagnosis, patients with suspected spinal cord injury underwent chest MRIs. Patients whose diagnosis was not confirmed by MRI were excluded from this study.

The final database included a number of 40 patients with various high spinal cord injuries whose diagnosis was confirmed by imaging. The median age of the patients was 55 years, and the majority (90%) were male.

Instruments

Patient data were collected from the hospital's IT system. The search in the computer system was performed according to the ICD-10 diagnostic code. All patients with a diagnosis code from block S14 - Injury to the nerves and spinal cord at the level of the neck, were selected so that each patient was subsequently checked individually for imaging confirmation of the diagnosis.

Codes of diagnostic block S14:

- S14.0 Contusion and edema of cervical spinal cord
- S14.1 Other and unspecified injuries of cervical spinal cord
- S14.2 Injury of the nerve root of the 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 Injury to other neck nerves and unspecified
- S14.10 Injury of the cervical spinal cord, unspecified

- S14.11 Complete injury of cervical spinal cord
- S14.12 Central spinal cord injury syndrome at the level of the cervical spinal cord (incomplete spinal cord injury syndrome)
- S14.13 Other syndromes of incomplete medullary injury of the cervical spinal cord.

The data of patients who presented and imaging confirmation of the above-mentioned diagnoses were centralized in a common database. After applying the inclusion and exclusion criteria, the final database comprised 40 patients.

Results and Discussion

This retrospective cross-sectional epidemiological study included 40 patients, who presented a median age of 55 (38.25 – 73.75) years, with a minimum and maximum of 18 and 85 years, respectively.
Of the 40 patients, 90% (n=36) were male and only 10% (n=4) were female. The age of the male patients was 52 (38.25 – 73) years, and that of the female patients was 77 (39.5 – 83) years.
The graphic representation of the age of the patients can be seen in **Figure 1** Boxplot of age according to gender Although the age of patients with spinal cord injury was higher in the case of females, the differences were only marginally significant (p=0.071, Mann-Whitney test u).

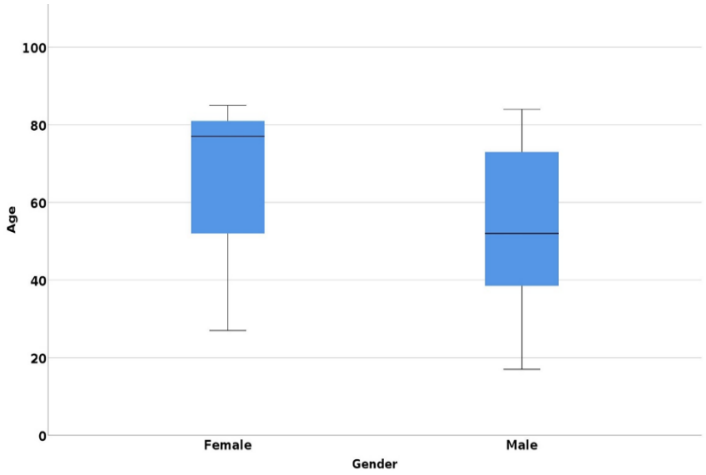

Figure 1. Boxplot of age by sex

The distribution of lesions according to age shows some equality of incidence in young people and adults, with a predominance of cervical spinal cord lesions at older ages **(Figure 2)**. The highest incidence of cervical spinal cord injuries is found in the age range of 65-80 years.

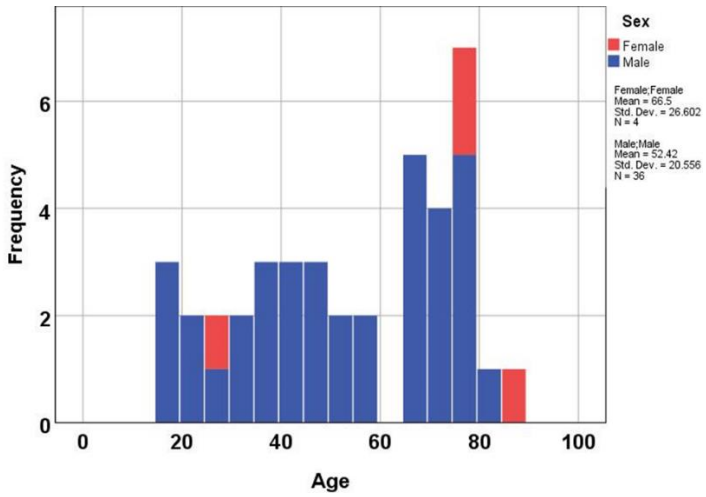

Figure 2. Histogram of cervical lesions by age and sex

Both in the case of males and females, cervical spinal cord injuries occur most frequently at ages over 65 years.
Regarding the distribution of spinal cord injury cases, we observe an approximately equal number each year, with an average of 8 cases per year **(Table 1)**.

Table 1. Distribution of cases by year

An	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	

In 2020, the most cases were registered, 11 in number, and in 2019 the fewest, only 5 cases.
The stratification of patients by diagnosis code shows us that the most frequent diagnosis code is S14.12, representing 35% of all diagnoses in block S14 **(Figure 3)**.

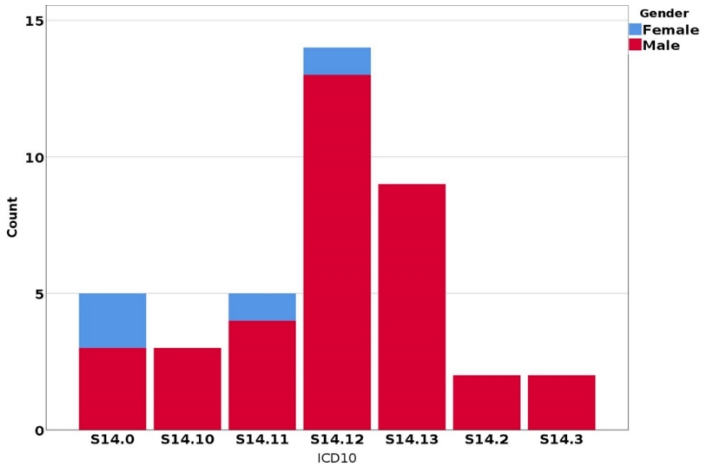

Figure 3. Distribution of diagnostic codes

The second most common diagnosis code was S14.13, accounting for 22.5% of the S14 block.
The least common diagnosis codes were S14.2 and S14.3, both of which were present in only 5% of cases.
Female patients had lesions that were assigned to diagnosis codes S14.0, S14.11, and S14.12. Male patients had lesions that were assigned to all S14 block diagnosis codes.
The distribution of cases according to the type of injury **(Figure 4)** shows an increased frequency (35%) of the central spinal cord injury syndrome at the level of the cervical spinal cord, closely followed by the anterior spinal cord injury syndrome (22.5%). Complete marrow injury was observed in only 12.5%. Lesions of the gill plexus or nerve roots were observed in only 5% of cases.

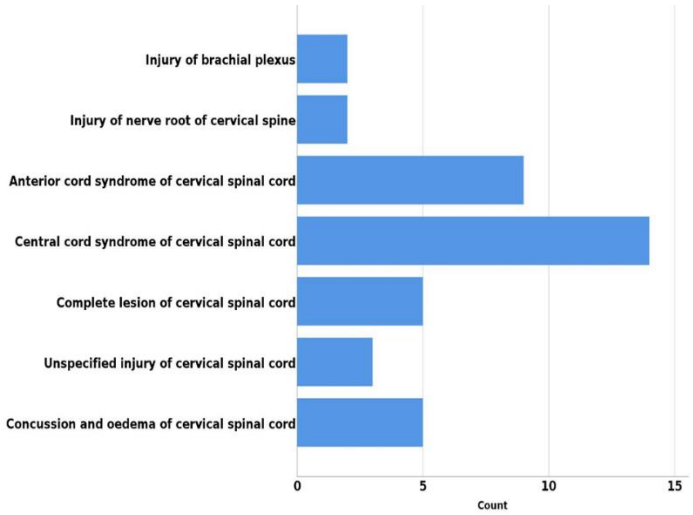

Figure 4. Distribution by type of injury

Regarding the severity of the spinal cord injuries, we note that most of the injuries are incomplete cord sections (65%), while

only 12.5% of the injuries were complete cord sections **(Table 2)**. Mild lesions, such as colitis or edema, were present in only 12.5% of cases, while root/nerve plexus lesions were the least common, only in 10% of cases.

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	

Gaussian distribution of injury severity can be seen, with moderate injuries being the most common, while mild and severe injuries were present in smaller numbers. Severe injuries were predominant in males.

Regarding the gender distribution in cervical spinal cord injuries, Lowery. in an epidemiological study that included more than 30,000 patients, reported a majority male distribution (70.9%) [42]. This is similar to the results presented in our study, which showed an increased incidence of cervical spinal cord injuries in males.

Lowery *et al*. reports a progressive increase in the incidence of cervical spinal cord injuries with age, the highest being in the 65-85 age group [42]. Both in our study and in the literature, we could observe a higher incidence of cervical spinal cord injuries among the adult population over 65 years of age. This pattern of increase in the incidence of cervical medullary fractures with increasing age was also observed by Hu R. in a study that included more than 2000 patients [43].

The NEXUS cohort presented by Lowery *et al*. represents the largest and most representative database on the epidemiology of cervical spinal cord injury. This provides evidence that cervical spine injuries occur more frequently among males. Although the total number of cervical spine injuries varies with age, a monotonous increase can be observed with increasing age, with the age groups 65-85 years being the ones that present an increased risk.

In our study, out of all cervical spinal cord injuries, only 12.5% of patients suffered a complete cord injury, most of the injuries being incomplete sections of the cord. This pattern of severity distribution was also reported by Hu R. [43] who showed an increased incidence of incomplete marrow lesions, and a reduced incidence of complete lesions.

The use of the hospital's administrative database makes it difficult to assess in detail information regarding the diagnosis of cervical spinal cord injury. Although we were able to identify the incidence of injuries in the entire researched population, detailed information is lacking in a system that is based on abstract coding of diagnoses. In our search, we were limited by the little information that ICD-10 medical coding provides. Due to these limitations, we could not accurately differentiate the location of the lesion.

Conclusion

The incidence and severity of high spinal cord injuries are higher among males. The incidence of cervical spinal cord injuries correlates positively with advancing age, the most affected being people over 65 years of age. The most common spinal cord injury was central spinal cord injury syndrome at the level of the cervical spinal cord (incomplete spinal cord injury syndrome). Moderate injuries were the most common, while minor injuries and complete injuries were the least common.

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Conflict of interest: None

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Ethics statement: Our study involves humans and we have the approval of ethics committee no. 26219/03.11.2021.

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