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Article

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Traumatic spinal cord injuries – epidemiologic and medico-legal issues

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Abstract: Spinal cord injuries represent a special category of injuries in traumatic pathology, with high morbidity and mortality, which justify their analysis with the aim to identify useful aspects in order to prevent and treat them. We therefore performed a retrospective study on 426 cases in order to analyze epidemiology and medico-legal issues related to spinal cord injuries. The studied items regarded socio-demographic aspects (gender, age, home region), type of lesions (vertebral, spinal cord, association with other trauma), circumstances leading to trauma (cause of the injury, season), data regarding hospitalization (medical condition at the hospital admission, number of days of hospitalization, clinical diagnosis, imaging exploration level) and data resulting from autopsy (diagnosis, toxicological examination). Most of our results are consistent with literature data, except for some epidemiological items, which might be explained with cultural differences, life style and inhomogeneous population. Based on our results, the general conclusion is the need for prevention campaigns, focusing on road traffic accidents and falls (especially in elderly) as the main causes of spinal cord injuries.
Key words: spinal cord trauma, death, epidemiology, legal medicine

Introduction

Spinal cord injuries represent a special category in traumatic pathology, both regarding the high morbidity and mortality and dysfunctions leading to low quality of patient's life [4]. Mostly important is the cervical region, the most frequently affected [1], as it is associated with head trauma, difficulties in intubation and its major consequence, quadriplegia [5].

The incidence of spinal cord trauma varies largely among reported studies worldwide, mainly because of inclusion criteria, identification procedures and treatment possibilities, both before and after the admission to the hospital or owing to geographical and cultural factors [4]. Thus,

the lowest reported annual incidence was 2.3 per million in Canada and the highest 83 per million in Alaska [4]. Soopramanien in a study conducted in 1994 reported an annual incidence for Romania of at least 28.5 per million inhabitants [11].

Aim and objectives

The aim of our aim was to identify the epidemiological and medico-legal aspects which may be useful in preventing and treating spinal cord injuries. The main objectives are as follows: highlighting the causative and contributing factors in spinal cord trauma, identifying the most common injuries and the most frequent mechanisms of injury.

Material and methods

We performed a retrospective study using the data collected from the autopsy reports issued by the Institute of Legal Medicine of Iasi and the medical records during a 6 year time frame. Inclusion criteria of the cases were: the presence of spinal cord injury, alone or associated with injuries in other segments of the body and admission to the hospital prior to death, immediately after trauma.

The analyzed items were: socio-demographic factors (gender, age, home region), sustained injuries (spinal, spinal cord, association with other injuries), circumstances leading to trauma (cause of trauma, season), data mentioned in the medical files (medical condition at admission, number of days of hospitalization, clinical diagnosis, imaging exploration) and data acquired during autopsy (diagnosis, toxicological examination).

Results

Socio-demographic factors

We analyzed 426 cases of spinal cord trauma which fulfilled the inclusion criteria mentioned above.

Analysis of the gender revealed male predominance- 337 (79%) as opposed to female- 89 (21%), with male:female ratio 3.5:1.

Mean age was 55.3 years, most of the cases over 60 years (38% of the cases), while the least were under 20 years (5.1% of the cases).

Rural to urban ratio revealed almost twice higher the number of cases in rural area than in urban area, respectively 281:145.

Circumstances leading to trauma

Seasonal distribution showed a relatively equal distribution in summer (26.5%), autumn (28.6%) and winter (27.9%), the minimum number of cases recorded during spring (16.9%).

Circumstances leading to trauma correlated with the gender of the victim revealed the first place in women for road traffic accidents (52% versus 37% in male), while the falls hold the first place in male victims (49% versus 31% in female).

After 60 years of age the leading circumstances for spinal trauma are the falls (51.5% of these cases), followed by road traffic accidents (36.8% of these cases), while under 20 years of age, the leading circumstance is road traffic accidents (72.72% of these cases), followed by falls (18.18% of these cases).

For 55% of all the victims toxicological analysis revealed the presence of alcohol in the blood samples collected during the autopsy, 21% showing a blood alcohol concentration above 2g%o, this being the case for 15.38% of the road traffic victims and 7.32% of the fall victims.

Level and type of injuries

The most affected was the cervical level, both in isolation (52%) and associated injuries in other segments of the spine, comprising 70%, in one case being affected the entire spine.

The most frequent recorded injuries were dislocations, caused by falls (31%) as well as by road traffic accidents (18.2%), followed by simple fractures, produced during road traffic accidents (14.2%) and fall (10.2%).

Data regarding hospital admission

27.81% of the road traffic accident victims and 43.97% of the fall victims have died in less than 24 hours after admission, while 5.32% of the road traffic accident cases and 26.7% of the fall cases have died after more than 30 days following admission in the hospital.

At admission, 17.37% of the victims were in coma (22.48% of the road traffic accident victims and 18.84% of the fall victims), 20.18% of the victims had an influenced state of consciousness (6.5% of the road traffic accident victims and 39.26% of the fall victims), while the remaining victims of the road traffic accidents and falls were conscious (16 cases, 2 of which sustained spinal trauma during road traffic accidents and 14 after a fall).

Discussions

The main objective of our study was to analyze the epidemiological factors in spinal cord trauma which have led to death, in order to identify the most common mechanisms and circumstances of injuries, the risk factors, causative and contributing factors, as well as the people most exposed to be the victims of this type of injuries, in order to prevent and effectively treat them.

During the time frame of our study, 426 cases have been identified, most of the victims being in the group over 60 years of age, which could be explained by the degenerative changes characteristic to elderly people [1], with a mean age of 55.3 years. On the contrary, Das et al. (2013) identified in their study conducted in India that the most affected age group, with more than 60%, people between 20-39 years of age- the productive age group of a society, highlighting the alteration of the productivity of that country due to spinal cord trauma [1]. Shingu et al. (1994) report the main affected age group in Japan- 55.8% as people between 40-69 years [10], so as Kamravan et al. (2014) who report the mean age being 37.2±15.9 years [5]. Hagen et al. (2012) identified in their review, after analyzing the cases with traumatic spinal cord injuries until 2011, the lowest mean age in Turkey- 26.8 years, and the highest in Oklahoma- 55.5 years, noting also an increase of the incidence for people over 60 years- from 5% to 13% [4]. Along with aging, the prognostic becomes poorer, recovery potential decreases and the risk for complications increases [4], specific anatomy

features concurring to a higher incidence of these injuries in elderly: calcification of the ligaments, decreased elasticity and increased bone demineralization [1].

Males are generally more affected than females, male to female ratio in our study being 3.7:1, alike with the results of Kamravan et al. 2014, who identified a 3:1 ratio [5] and with another Romanian study which identified a 3.35:1 ratio for the southern part of the country [11]. Instead, Das et al. (2013) identified a higher ratio, of 8.43:1, in a study regarding cervical spinal cord injury in eastern India, this difference being ascribed to the mainly household activity of the women [1]. An equal frequency was identified in studies conducted in Taiwan and Iran [4].

Regarding the circumstances of injury in spinal trauma, in our study prevail road traffic accidents (52% of the women and 37% of the men) and falls (49% of the men and 31% of the women). By comparison, a study made in the south of Romania more than 20 years ago revealed the falls from height as the major cause of spinal trauma, 59%- with 19% falls from horse-drawn carts, while 13% involved road traffic accidents [11]. Comparing these results with the findings of our study we note a marked increase of the road traffic accidents, most probably as a consequence of the general development of the country and road infrastructure and important increase of the road traffic. Another study published in the same period of time, i.e. 1994, in Japan, reveals the contrary- the predominance of the road traffic accidents in 44.6% of the cases followed by falls in 29.2% of the cases [10]. A different situation is observed in India, where it is seen a lower risk for women to be victims of road traffic accidents as their main activity involves the house [1]. Road traffic accidents represented the main cause of spinal injury in the study performed by Kamravan et al. (2014), while Fredo et al. (2012) identified 60% of the cases being the victims of falls and 21% the victims of road traffic accidents [3]. Hagen et al. (2012) identified the highest percent of road traffic accidents related to spinal cord injuries in the West Africa- 89%, and the lowest in Greenland- 4%, Pakistan and Nepal- both with 7% [4]. Regarding the spinal cord injuries produced after falls, data published by Hagen et al. (2012) showed the highest percent in Pakistan and Nepal- 82% and the lowest in South Africa- 3% [4]. These differences in reported number of cases might be explained by the geographical factors, disparity in defining the terms and methods for data collection [4], as well as differences in the level of development of the countries where the studies were performed [1].

281 of the total number of cases in our study came from rural areas and 145 from urban area, with a ratio of almost 2:1. Dryden et al. (2003) detected a 2.5 times higher risk for spinal cord injuries in people from villages in relation to people from urban areas [2]. Hence the risk for spinal trauma is higher in rural regions, where most of the people perform rough activities or farming [11] as opposed to intellectual activities in cities.

Analysis of seasonal repartition of cases revealed relatively equal frequencies in our study in summer, autumn and winter, with the fewest cases in spring. These results differ

from those reported by Karamehmetoglu et al. (1995), who found the highest frequency during spring- mainly as a result of falls, followed by summer- mainly road traffic accidents [7]. Sharif-Alhoseini and Rahimi-Movaghar (2014) reported the repartition of falls and road traffic accidents as follows: summer, spring, autumn and winter, assigning the road traffic accidents more frequently in spring, while the falls in winter [9] and Karacan et al. (2000) reported the highest frequency of road traffic accidents during summer [6]. Mondal et al. (2011) identified the predominance of road traffic accidents occurring during May-June [8]. The hypothesis of the present study take into account the fact that during winter and summer the spinal trauma might be attributed at least in part to extreme sports.

Given the fact that cervical injuries are the most frequent causes of death [1] it is justified the high incidence of the injuries in this segment- 52% isolated injuries and 70% associated with injuries in other segments. However, studies performed in China show only 5% cervical injuries, as opposed to Turkey, with 92% of the injuries, the difference being explained either as a consequence of different causal patterns or geographical and financial factors which may contribute to underreporting of spinal injuries [4]. Shingu et al. (1994) reported 74.3% of cases involving the cervical segment [10].

The most frequent recorded injury in our study was dislocation, comprising 31% in falls and 18.2% in road traffic accidents, followed by simple fracture in 14.2% of the road traffic accidents and 10.2% in falls. Das et al. (2013) reported the prevailing of fractures in combination with dislocation in 53.7% of cases, while simple fractures were recorded for 34.3% and isolated dislocation in 10.8% of cases [1]. Data regarding the frequency and level of injuries may contribute for the improvement of the work environment in spinal surgery, both by training the surgeons and adjustment of surgical instruments and techniques [1] and by training specialists from related fields: occupational therapists, physiotherapists and rehabilitation doctors [11].

Alcohol ingestion highly influences the occurrence of traumatic injuries. More than half of the victims were under the influence of alcohol at the moment of the trauma, for 21% blood alcohol concentration being more than 2‰, of which 26 were victims of road traffic accidents and 14 victims of falls. Shingu et al (1994) reported the presence of alcohol in 32.2% of bicyclists and 8.9% of car accidents victims [10]. Alcohol represented a main risk factor for the association of spinal cord injuries with head trauma, as reported by Hagen et al. (2012) [4].

Conclusions

The rate of spinal cord injuries varies largely in the identified studies, although the predominance of cervical segment was a general rule. Given the serious consequences of these injuries, it is therefore necessary to provide suitable medical and rehabilitation services, followed by supporting services and appropriate life style which might lead to minimization of the impact these injuries have on the victims and their families.

Differences detected across studies performed in this field regarding circumstances, age and gender may be explained by differences in culture, life style and inhomogeneous study population. However the results of our study as well as those of other similar studies emphasize the need for prevention campaigns especially regarding road traffic accidents and falls (mostly in elderly) and reducing alcohol ingestion. Regarding this last aspect, the high incidence of blood alcohol ingestion suggests the need for a moderate ingestion, alerting the people about the risks they expose especially before driving a car or bicycle, or when they need to perform highly risky activities.

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