International Journal of Sciences

Research Article Volume 11 – March 2022 (03)

Epidemiological Characteristics of Traumatic Spinal Cord Injury in Guangzhou, China

Shaojie He[1], Zhenyu Zhao[1], Sheng Tang[1], Xiaofeng Lai[1], Xincheng Yu[1], Junlong Hou[1], Dingsheng Zha[1], Hao Wu[1]

[1]Department of Orthopaedics, the First Affiliated Hospital of Jinan University, Jinan University, Guangzhou 510630, China

Abstract: Objective: To study the epidemiological characteristics of traumatic spinal cord injury (TSCI) in Guangzhou, China, and identify high-risk population, so as to provide reference for prevention, diagnosis and treatment of SCI. **Methods**: The First Affiliated Hospital of Jinan University between January 2017 and December 2020 hospitalized patients with spinal cord injury were analyzed retrospectively, and observe the following relevant factors: age, gender, injury time, injury causes, segmental spinal cord injury, whether with spine fracture, whether to merge with other parts of the injury, whether complications. The above indicators were analyzed statistically. **Results**: There were 197 patients with spinal cord injury, the male to female ratio was 2.72:1. The average age was 47.83±13.70 years from 5 to 80 years old, and the patients aged from 41 to 50 years old were the most (28.0%). The main causes of injuries were falls (33.0%), falls (32.0%), traffic accidents (26.9%), and heavy injuries (7.1%). The incidence of lumbar spinal cord injury was the highest, followed by cervical spine injury. Complications occurred during hospitalization in 51.3% of TSCI patients, with pulmonary infection accounting for 34.8%, followed by urinary tract infection accounting for 25.6%. The higher the severity of spinal cord injury, the higher the probability of complications, the incidence of complications in ASIA grade A patients was 96%. Class B 73.3%; Grade C 59.1%, D 29.6%. **Conclusion**: Young and middle-aged men are the high risk group of TSCI, and the main causes of injury are fall injury, fall injury and car accident injury. The incidence of spinal cord injury was highest in lumbar vertebra L1 and L2, cervical vertebra C4 and C5, and thoracic vertebra T12 and T11. Complications occurred during hospitalization in 51.3% of TSCI patients, with pulmonary infection being the most common, followed by urinary tract infection. The higher the severity of spinal cord injury, the greater the probability of complications.

Keywords: Spinal Cord Injury, Epidemiology, Characteristic, The Correlation

Introduction

Traumatic spinal cord injury (TSCI) is a highly disabling condition. It places a heavy burden on individuals, families and society as a whole due to the loss of labor force, long-term rehabilitation, the occupation of large medical resources and the high cost of medical care [1,2]. According to literature reports, the annual incidence of TSCI worldwide is between 10.4 and 83.0 cases per 1 million people [3,4]. The incidence of TSCI varies globally, with 20.7-83.0 cases per million people in North America, 8.0-130.6 cases per million people in Europe [5,6]and 14.0 cases per million people in Australia [7]. A review of studies in developing countries found that the incidence of TSCI was 25.5 cases per 1 million people [8]. China had 45.1 and 66.5 cases per million population in 2009 and 2018, respectively[9]. So far, no obvious breakthrough has been made in the clinical treatment of TSCI, and the incidence and prevalence of TSCI have been on the rise, which highlights the role and importance of prevention of spinal cord injury. This study retrospectively studied the demographic and epidemiological characteristics of TSCI patients based on the hospital, so as to help clinical understanding of the characteristics of diseases in the hospital or even in the region, actively prevent the occurrence of diseases, and determine the optimal allocation of medical resources.

Materials and Methods

Research design and object

We included 197 TSCI patients admitted to the First Affiliated Hospital of Jinan University from 2017 to 2020. These patients came from all over the country and were transferred from our hospital, emergency department or other hospitals. Inclusion criteria :(1) clinical diagnosis of spinal cord injury; (2) there is a clear history of trauma; (3) causing spinal cord injury or cauda equina nerve injury; (4) Images and test data of patients from admission to discharge were complete. Exclusion criteria :(1) the diagnosis of spinal cord injury is not clear; (2) No clear history of trauma; (3) Lack of physical examination and imaging data.

Methods

Study indicators: With the informed consent of patients and their guardians, age, gender, injury time, injury cause, spinal cord injury level, whether there is spinal fracture, whether there is injury in other parts, and whether there is complication were retrospectively collected. Complications include respiratory infections, urinary tract infections, surgical site infections, pressure ulcers, electrolyte disorders, deep venous thrombosis of the lower extremities, urinary calculi, cardiovascular diseases, and digestive diseases.

Diagnosis basis of spinal cord injury : The diagnosis of spinal cord injury is mainly based on X-ray, CT, MRI and other imaging data, referring to clinical symptoms. All fractures and dislocations were included in the statistics, excluding spinal cord injuries without fractures and/or dislocations. The degree of spinal cord injury was graded according to the American Spinal Cord Injury Association (ASIA) : A -complete injury, without any sensory-motor function retention in the

Published at: http://www.ijsciences.com/pub/issue/2022-03/
DOI: 10.18483/ijSci.2557; Online ISSN: 2305-3925; Print ISSN: 2410-4477

Dingsheng Zha, Hao Wu (Correspondence)
+

sacral segment; B - Incomplete lesion, with sensory function but no motor function below the nerve plane, including the sacral segment (S4 ~ S5); C - Incomplete injury, with motor function below the nerve plane, and muscle strength of most key muscles less than grade 3; D -Incomplete injury, with motor function below the nerve plane and muscle strength greater than or equal to grade 3 in most key muscles; E -Normal, normal sensory and motor functions.

Statistical methods

Microsoft Excel 2019 was used to describe the statistical data.

Results

Basic information

A total of 197 patients with traumatic spinal cord injury admitted to the First Affiliated Hospital of Jinan University from 2017 to 2020 were included in this study. There were 144 male patients (73.1%) and 53 female patients (26.9%). The mean age of the patients was 47.83±13.70 years old, including 47.61±14.01 years old for male patients and 48.45±12.94 years old for female patients. Among them, patients aged 41 to 50 years were the most, with 55 cases accounting for 28.0% of the total number of patients, followed by patients aged 51 to 60 years, with 54 cases accounting for 27.4% of the total number of patients (see Figure.1a for the number of patients in each age group).

Etiology

In the etiological statistics, the incidence of fall injury was the highest (65 cases), accounting for 33.0% of the total number of patients. The second place was high fall injury (63 cases), accounting for 32.0% of the total number of patients. 53 cases of traffic accidents accounted for 26.9% of the total, and 14 cases of heavy injuries accounted for 7.1% of the total. Other etiology 2 cases accounted for 1% of the total (Table 1) .

Damage level and degree

The incidence of L1 injury was 26.4%, followed by C4 spinal cord injury (11.7%). The incidence of C4 spinal cord injury was the highest in cervical spinal cord (11.7%), followed by C5 (7.6%). T12 injury was the most common in thoracic spinal cord injury (8.6%), followed by T112.5%. The incidence of L1 injury was the highest in lumbar spinal cord injury (26.4%), followed by L210.7% (Figure.1b). Among the injured sites, 67 cases of cervical spinal cord injury accounted for 34.0%. There were 34 cases of thoracic spinal cord injury (17.3%). 96 cases of lumbar spinal cord injury accounted for 48.7%. Patients with ASIA grade A were the least, with 25 cases, accounting for 12.7% of the total number of patients. There were 30 grade B patients, accounting for 15.3% of the total. 44 grade C patients, accounting for 22.3% of the total number of patients; The 98 cases of grade D patients accounted for the largest proportion of patients with spinal cord injury, accounting for 49.7% of the total number of patients. In patients with cervical spinal cord injury, there were up to 22 cases (32.8%) of ASIA GRADE B patients, and there was no significant difference in the proportions of the four injury grades. Patients with thoracic spinal cord injury had the most GRADE D ASIA (34 cases (55.9%)), and patients with lumbar spinal cord injury had the most GRADE D ASIA (63 cases (65.6%)). (Table 2)

Combined injury

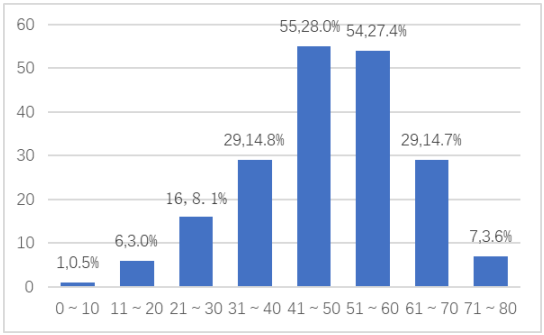
Of these patients, 163 (82.8%) had spinal fracture or dislocation, 34 (17.2%) had no fracture or dislocation, 101 (51.3%) had other injuries, and 96 (48.7%) had no other injuries (Table 1).

Complications

Of the 197 patients, 101 (51.3%) developed complications during hospitalization, of which pulmonary infection accounted for 34.8%, followed by urinary tract infection (25.6%). Details of other complications are shown in the table. We found that the incidence of complications in ASIA grade A patients was 96%; The incidence of complications in grade B patients was 73.3%; The incidence of complications was 59.1% in grade C patients and 29.6% in Grade D patients (Table 3).

Variables	2017	2018	2019	2020	Total
Cases	54	51	55	37	197
Age (mean ± SD)	46.33±12.22	48.67±14.52	48.09±14.66	46.93±12.79	47.83±13.70
Gender					
Male	39	38	39	28	144
Female	15	13	16	9	53
Etiology					
Traffic accidents	15	12	17	9	53
High fall	12	19	17	15	63
Low fall	23	18	19	5	65
Hit injury	4	2	2	6	14
Other	0	0	0	2	2
With spinal fracture					
Yes	52	39	43	29	163
No	2	12	12	8	34
Associated Injury					
Yes	30	29	24	18	101
No	24	22	31	19	96

Table.1 Basic information of included patients



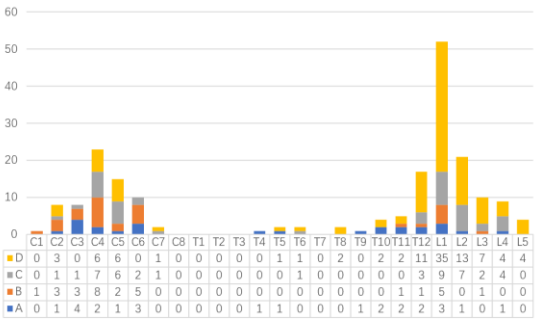


Figure.1a Number and proportion of TSCI patients at different ages; b The number of patients with each degree of injury corresponding to each TSCI injury segment.

	A	B	C	D	Total
Pulmonary infection	10 (28.6%)	8 (22.9%)	6 (17.1%)	11 (31.4%)	35 (34.8%)
Urinary tract infection	5 (19.2%)	7 (26.9%)	6 (23.1%)	8 (30.8%)	26 (25.6%)
Surgical site infection	1 (9.1%)	3 (27.3%)	4 (36.4%)	3 (27.3%)	11 (10.9%)
Bedsore	1 (25.0%)	0 (0.0%)	2 (50.0%)	1 (25.0%)	4 (4.0%)
Electrolyte disturbance	2 (22.2%)	2 (22.2%)	0 (0.0%)	5 (55.6%)	9 (8.9%)
Deep venous thrombosis	2 (33.3%)	1 (16.7%)	3 (50.0%)	0 (0.0%)	6 (5.9%)
Urinary calculus	0 (0.0%)	1 (50.0%)	1 (50.0%)	0 (0.0%)	2 (2.0%)
Cardiovascular diseases	1 (50.0%)	0 (0.0%)	0 (0.0%)	1 (50.0%)	2 (2.0%)
Digestive system disease	2 (33.3%)	0 (0.0%)	4 (66.7%)	0 (0.0%)	6 (5.9%)
Total	24 (23.8%)	22 (21.8%)	26 (25.7%)	29 (28.7%)	101

Table.2 Corresponding relationship between various complications and different degrees of injury in TSCI patients

	A	B	C	D	Total
Cervical	11(16.4%)	22(32.8%)	18(26.9%)	16(23.9%)	67 (34.0%)
Thoracic	9(26.4%)	2(5.9%)	4(11.8%)	19(55.9%)	34 (17.3%)
Lumbosacral	5(5.2%)	6(6.3%)	22(22.9%)	63(65.6%)	96 (48.7%)
With complication	24 (96%)	22 (73.3%)	26 (59.1%)	29 (29.6%)	101 (51.3%)
Without complication	1 (4%)	8 (26.7%)	18 (40.9%)	69 (70.4%)	96(48.7%)
Total	25 (12.7%)	30 (15.3%)	44 (22.3%)	98 (49.7%)	197

Table .3 The corresponding relationship between TSCI injury levels, complications and injury degree

Discussion

In traumatic spinal cord injury, the primary injury damages nerve cells and triggers a complex cascade of secondary injuries leading to neuronal and glial cell death, ischemia, and inflammation. This is followed by changes in the tissue and structure of the spinal cord, including glial scarring and the formation of cystic cavities. Glial scarring and lumen, combined with poor endogenous myelin regeneration and axon regeneration, mean that the spinal cord has a poor intrinsic recovery potential, so spinal cord injury can lead to permanent neurological dysfunction and is a high disability rate.

In this study, we conducted a retrospective study on 197 patients with traumatic spinal cord injury. We found 144 male patients and 53 female patients, the ratio of male to female was 2.72:1, the average age of patients was 47.83±13.70 years old, the age of patients from 41 to 50 years old accounted for 28.0% of the total number of patients, followed by 51 to 60 years old. A total of 54 cases accounted for 27.4%. In an epidemiological study of TSCI in Shanghai, China, published in 2018, Change[10] found that the male to female ratio was 2.1 to 1. Yang[11] counted TSCI patients in Guangdong province from 2003 to 2011 and found that the male to female ratio was about 3.5:1, with an average age of 41.6±14.7 years. In an epidemiological study of spinal cord injury in Xi 'an, China, published by Du in 2020[12], it was found that the average age was 50.1± 14.8, and the male to female ratio was 2.91:1. It can be seen that there are certain differences in the demographic characteristics of spinal cord injury in different regions of China. The probability of disease in males is much higher than that in females. Males undertake more physical and risky work activities in society and are more likely to be exposed to the risk of injury[4,7]. People aged between 41 and 50 are the main output age of the labor force and often play a pillar role in the work, so the probability of spinal cord injury is the highest.

In the etiological statistics, the incidence of fall injury was the highest at 33.0%, followed by high fall injury, and traffic accident 26.9%. Yang [11] studied the etiology of spinal cord injury in Guangdong province from 2003 to 2011 and found that high falls (41.0%), traffic accidents (37.8%), falling objects (8.8%) and violence (8.7%). With a total ban on motorcycles in Guangzhou in 2007, the number of spinal cord injuries caused by traffic accidents dropped sharply. The increase in spinal cord injury caused by falls and low falls may be due to the aging of the population and changes in lifestyle leading to spinal degeneration, which often leads to spinal cord injury in falls.

The incidence of lumbar spinal cord injury was the highest, followed by cervical spine injury. The incidence of L1 (54.2%) and L2 (21.9%) was higher in lumbar vertebrae. The incidence of C4 (34.3%) and C5 (22.4%) was higher in cervical spine. T12 (50%) and T11 (14.7%) were more common in thoracic vertebrae. Ning, Taşoğlu, and Fredo[13-15] found that the incidence of cervical spinal cord injury was the highest, and C4-C6 and T11-L1 were the most common sites of injury.

In TSCI patients, fewer patients had complete spinal cord injury (12.7%), and most patients had incomplete injury (87.3%). Most patients suffered spinal fracture or dislocation (82.8%), and more than half (51.3%) suffered other injuries. Complications occurred during hospitalization in 51.3% of TSCI patients, with pulmonary infection accounting for 34.8%, followed by urinary tract infection accounting for 25.6%. Wang [16]showed that 36.5% of patients developed complications, among which respiratory diseases were the most common (30.7%). Respiratory problems are associated with bed-ridden, smoking-induced lung

problems and broken ribs. SCI in the neck may affect the function of the diaphragm or intercostal muscles, impair breathing, cause coughing and make it difficult to cough up phlegm. We also found that the higher the severity of spinal cord injury, the greater the probability of complications, ASIA grade A patients had A incidence of complications 96%; Class B 73.3%; Grade C 59.1%, D 29.6%. ASIA A patients face long periods in bed, with no use of their limbs and incontinence, making them more prone to complications.

Conclusion

Through the investigation and analysis of the epidemiological characteristics of spinal cord injury in Guangzhou, it is necessary to further study the epidemiology of spinal cord injury in this area. In addition, education on the safety and protection of high-risk groups should be strengthened to reduce the incidence of TSCI. In addition, our study shows that respiratory complications are the main complication after spinal cord injury, and the more serious the injury, the more likely the patient will have complications.

Advantages and disadvantages

First of all, this was a retrospective study, and epidemiological data such as education level, race, length of hospital stay, and rehabilitation were missing from the study. Secondly, this study was a single-center study, which could not accurately describe the epidemiological characteristics of TSCI in Guangzhou. Third, due to the lack of access to the number of deaths of TCSCI patients before admission, some patients refused treatment and were discharged home, so this paper failed to conduct further research on mortality.

Acknowledgements

The authors thank the other investigators and partcipants of the study for their valuable contributions.

References

1. Chamberlain J D, Deriaz O, Hund-Georgiadis M, et al. Epidemiology and contemporary risk profile of traumatic spinal cord injury in Switzerland[J]. Inj Epidemiol, 2015, 2(1): 28. DOI: 10.1186/s40621-015-0061-4
2. Singh A, Tetreault L, Kalsi-Ryan S, et al. Global prevalence and incidence of traumatic spinal cord injury[J]. Clin Epidemiol, 2014, 6: 309-31. DOI: 10.2147/CLEP.S68889
3. Jackson A B, Dijkers M, Devivo M J, et al. A demographic profile of new traumatic spinal cord injuries: change and stability over 30 years[J]. Arch Phys Med Rehabil, 2004, 85(11): 1740-8. DOI: 10.1016/j.apmr.2004.04.035
4. Jazayeri S B, Beygi S, Shokraneh F, et al. Incidence of traumatic spinal cord injury worldwide: a systematic review[J]. Eur Spine J, 2015, 24(5): 905-18. DOI: 10.1007/s00586-014-3424-6
5. Cripps R A, Lee B B, Wing P, et al. A global map for traumatic spinal cord injury epidemiology: towards a living data repository for injury prevention[J]. Spinal Cord, 2011, 49(4): 493-501. DOI: 10.1038/sc.2010.146
6. Wyndaele M, Wyndaele J J. Incidence, prevalence and epidemiology of spinal cord injury: what learns a worldwide literature survey?[J]. Spinal Cord, 2006, 44(9): 523-9. DOI: 10.1038/sj.sc.3101893
7. Majdan M, Brazinova A, Mauritz W. Epidemiology of traumatic spinal cord injuries in Austria 2002-2012[J]. Eur Spine J, 2016, 25(1): 62-73. DOI: 10.1007/s00586-015-3985-z
8. Rahimi-Movaghar V, Sayyah M K, Akbari H, et al. Epidemiology of traumatic spinal cord injury in developing countries: a systematic review[J]. Neuroepidemiology, 2013, 41(2): 65-85. DOI: 10.1159/000350710
9. Hao D, Du J, Yan L, et al. Trends of epidemiological characteristics of traumatic spinal cord injury in China, 2009-2018[J]. Eur Spine J, 2021, 30(10): 3115-3127. DOI: 10.1007/s00586-021-06957-3
10. Chang F S, Zhang Q, Sun M, et al. Epidemiological study of Spinal Cord Injury individuals from halfway houses in Shanghai, China[J]. J Spinal Cord Med, 2018, 41(4): 450-458. DOI: 10.1080/10790268.2017.1367357
11. Yang R, Guo L, Huang L, et al. Epidemiological Characteristics of Traumatic Spinal Cord Injury in Guangdong, China[J]. Spine (Phila Pa 1976), 2017, 42(9): E555-E561. DOI: 10.1097/BRS.0000000000001896
12. Du J, Hao D, He B, et al. Epidemiological characteristics of traumatic spinal cord injury in Xi'an, China[J]. Spinal Cord, 2021, 59(7): 804-813. DOI: 10.1038/s41393-020-00592-3
13. Sun D, Zhang Z. Epidemiological characteristics of traumatic cervical spinal cord injury in Chongqing, China, from 2009 to 2018[J]. Spinal Cord Ser Cases, 2021, 7(1): 70. DOI: 10.1038/s41394-021-00434-1
14. Tasoglu O, Koyuncu E, Daylak R, et al. Demographic and clinical characteristics of persons with spinal cord injury in Turkey: One-year experience of a primary referral rehabilitation center[J]. J Spinal Cord Med, 2018, 41(2): 157-164. DOI: 10.1080/10790268.2016.1224215
15. Fredø Hege Linnerud,Rizvi Syed Ali Mujtaba,Lied Bjarne et al. The epidemiology of traumatic cervical spine fractures: a prospective population study from Norway.[J] .Scand J Trauma Resusc Emerg Med, 2012, 20: 85. DOI: 10.1186/1757-7241-20-85
16. Wang Z M, Zou P, Yang J S, et al. Epidemiological characteristics of spinal cord injury in Northwest China: a single hospital-based study[J]. J Orthop Surg Res, 2020, 15(1): 214. DOI: 10.1186/s13018-020-01729-z