Epidemiological characteristics of thoracolumbar fractures from 2014 to 2019 in Shanxi, China

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Abstract

Background: We aimed to clarify the epidemiological characteristics of thoracolumbar fractures (TLFs) at Shanxi Bethune Hospital, Shanxi Academy of Medical Sciences, China.

Methods: A total of 1,096 patients with TLF between January 2014 and December 2019 were included in this retrospective study. Epidemiological characteristics (year, age, sex, marital status, occupation, injury level, etiology, fracture type, and American Spinal Injury Association ASIA impairment scale [AIS] grade) in medical records were extracted and analyzed.

Results: The number of TLF cases increased between 2014 and 2019. More than half of the patients were between 40 and 75 years old. The most common fracture level was L1, with compression as the most common injury type. A total of 137 patients (12.5%) experienced spinal cord injury. The primary cause of fracture was a “low fall”, and farmers were most vulnerable. Epidemiological characteristics (age, year, etiology, fracture type, occupation, and spinal cord injury) were quite different between males and females. In patients with spinal cord injury, the most frequent age group was 46–60 years old. Again, the primary fracture level was L1, and the most common occupation was farmer. However, with this group, the primary fracture type was burst, and the main etiology was “high fall”.

Conclusions: The number of patients with TLF increases with social development. The epidemiological profiles between sexes were quite different. Preventions and government regulations should be implemented to reduce the incidence of TLF, according to the epidemiological profiles of men and women.

Background

Spinal injury is a common traumatic disease with an increasing incidence rate [1, 2], often leading to severe consequences, such as pain, deformity, and spinal cord injury (SCI) [3-5]. Spinal injury also results in long-term convalescence, heavy economic burden, and psychological disorders in patients [6-8]. As the most common spinal fracture segment [9], the thoracolumbar spine has a unique alignment, which makes it more prone to fracture in trauma. Most thoracolumbar injuries occur at the thoracolumbar junction (T11-L2) [4].

According to early data from United States-based studies, the incidence of spinal fracture is approximately 64–117 per 100,000 people per year [10, 11]. In Tianjin, China, the incidence of thoracolumbar fracture (TLF) (T11-L2) was 2.4 per million in 2015 and is increasing annually [12]. Epidemiological characteristics, such as severity, injury levels, and spinal cord injury, vary among countries, ages, and sex [13, 14]. Additionally, TLFs often cause nerve damage. In a 2015 report from Tianjin, China, 20 of 132 patients with TLF developed SCI [12].

Clarifying the epidemiological characteristics of TLF is of great importance for developing effective prevention strategies, fast diagnostic procedures, and treatments. Over the past decades, many studies

have reported the epidemiological features of TLFs worldwide [10, 11, 13]. However, as the largest developing country comprising approximately 20% of the global population, there are few relevant studies on TLFs in China. In this study, we focused on the epidemiological characteristics of TLFs in Shanxi, China, through Shanxi Bethune Hospital, the largest hospital in Shanxi province. We collected and analyzed the medical records of patients with TLF from 2014 to 2019, which provided us the latest epidemiological data in Shanxi, China.

Methods

Patients

A total of 1,096 patients diagnosed with TLF at Shanxi Bethune Hospital between January 2014 and December 2019 were included in this study. Their medical records were collected, and epidemiological data, including year, age, sex, marital status, occupation, injury level, etiology, type of fracture, and American Spinal Injury Association (ASIA) impairment scale (AIS grade) [15], were extracted. Patients with serious injuries to other organs were excluded. This study was approved by the Shanxi Bethune Hospital (YXLL-KY-2021-014). Patients' names were anonymized to protect their privacy. This study was approved to exempt patients from informed consent. This study complied with the Declaration of Helsinki.

Grouping

The patients were diagnosed by three professional orthopedic surgeons based on their medical history, physical examination, and imaging reports. The patients were divided into age groups of ≤ 30 , 31–45, 46–60, 61–75, and >75 years. Marital status was categorized as married, unmarried, divorced, and widowed. Occupations were divided into farmer, retiree, worker, freelancer, staff, unemployed, technical staff, self-employed, student, teacher, and soldier. The etiology was divided into low fall (≤ 1 m), high fall (>1 m), traffic accident, crush, sprain, sports, heavy lifting, knife injury, bumps, coughing/sneezing, beating, and no inducing factor. Injury levels were classified as T11, T12, L1, L2, and multilevel injuries. AIS grades were divided into A, B, C, and D. Fractures were categorized as compression, burst, dislocation, chin, and open.

Statistical analysis

The data were recorded and analyzed using Microsoft Excel 2016 (Microsoft Corporation, Redmond, WA, USA) and GraphPad Prism version 6.0 for Windows (GraphPad Software, San Diego, California USA, www.graphpad.com). Continuous variables, such as "age", were reported as mean (standard deviation, SD). The categorical variables, such as "occupation", "etiology", and so on, were presented as numbers (percentages, %).

Results

Epidemiological and Clinical Features

A total of 1,096 patients with TLF between January 2014 and December 2019 were included in the study. The number of cases gradually increased from 2014 to 2019 (**Fig 1A**). The average age was 57.24 ± 17.51 years. The two age groups appearing most frequently overall were 46–60 and 61–75 years (**Fig 1 B**). Most patients were married (**Fig 1 C**). The most common fracture level was L1. Interestingly, multilevel injuries were the second largest group (**Fig 1 D**). Among these patients with multilevel fractures, the accumulated number of injured levels was calculated and is shown in **Fig 1 E**. Similar data shows that multilevel fractures occurred most commonly in L1, T12, L2, and T11. Compression was the most common fracture type, followed by burst, dislocation, chance, and open fractures (**Fig 1 F**). A total of 137 (12.5%) patients had SCI (**Fig 1 G**). Low fall, high fall, and traffic accidents were the top three etiologies (**Fig 1 H**). The three most vulnerable occupations were farmer, retiree, and worker (**Fig 1 I**).

Epidemiological and clinical features among TLF patients by sex

As shown in **Fig 2 A**, the age distribution was quite different between males and females. The most vulnerable ages were 46–60 and 61–75 years in men and women, respectively. The average age in males and females was 50.50 ± 17.44 and 64.86 ± 14.15 , respectively. In 2016–2019, the number of male patients increased and was larger than that of females (**Fig 2 B**). The distribution levels of males and females were similar (**Fig 2 C**). Most patients in either group were married. In the married, unmarried, and divorced groups, the number of male patients was higher. Interestingly, the number of females was higher than that of males in the widowed group (**Fig 2 D**). Low fall was the most common etiology in females, while high fall was the most common etiology in males. The number of males in the traffic accident and crush groups was greater than that of females (**Fig 2 E**). In both men and women, compression accounted for more than half of all patients. In the compression group, the number of females was larger than that of males. In contrast, the number of females in the burst, dislocation, chin, and open groups was less than that of males (**Fig 2 F**). In females, TLF patients were more likely to be retirees and farmers. Furthermore, retiree was the only occupation that had more cases among females than that among males. Among males, farmer, worker, and retiree were the top three occupations (**Fig 2 G**). The number of patients with SCI was larger among men than that among women (**Fig 2 H**).

The constituent ratio of TLF patients by fracture type

The age distribution and constituent ratio are shown in **Fig 3 A and B**. The age groups of 61–75 years and 46–60 years were the top groups with compression fractures, whereas with burst and dislocation, the

top two age groups were 31–45 years and 46–60 years. Of the chance fractures, 46–60 years was the primary age group, and in the open group, approximately 30 years was the only age group represented.

For compression fractures, retiree and farmer were the top two occupations. With burst and dislocation, the main occupations were farmers and workers. Workers were the primary occupation in chance fractures, and freelancer was the only occupation for open fractures (**Fig 3 C and D**).

Low fall was the most common etiology in compression fractures, while high fall was the most common etiology in burst, dislocation, and chance fractures. Knife injury was the only etiology for open fractures (**Fig 3 E and F**).

With compression fractures, L1, multilevel, and T12 were the three most common fracture levels. In burst fractures, L1 was the most common; T12 and L2 were equally common for dislocation fractures. In the open fracture group, L1 was the only level represented (**Fig 3 G and H**).

The epidemiological characters of SCI patients

In this study, there were 137 (12.5%) patients with SCI. Most patients were between 46 and 60 years of age (**Fig 4 A**), and the majority of patients with SCI were married (**Fig 4 B**). L1, T12, and L2 were the top three fracture levels accompanied by SCI (**Fig 4 C**). Nineteen SCI patients had multilevel fractures. In these patients, T12 and L1 were the most common fracture levels (**Fig 4 D**). Patients with SCI were more likely to be farmers and workers (**Fig 4 E**). Bursts and dislocations were the most common fracture types (**Fig 4 F**). High fall was the primary etiology, followed by crush and traffic accidents (**Fig 4 G**).

Discussion

To provide the latest TLF epidemiological data in Shanxi, China, we collected and analyzed the medical records of patients with TLF from 2014 to 2019. The epidemiological characteristics of TLF patients, categorized by sex and injury type, had many distinctions. In this study, 10.77% of TLF patients (n = 118) had SCI.

In this study, the number of cases of TLF increased between 2014 and 2019. The same increasing trend was reported from 2006 to 2015 in Tianjin, China [12]. Here, the average age of the TLF patients was 57.24 years. This was higher than the average age of all-spine fractures in Chongqing, China (45.7 years) [16]. Similarly, an epidemiological study based on a nationwide database in mainland China reported that adults over 60 years were more likely than younger adults to develop osteoporotic TLF [9]. Therefore, the average age of TLF patients is greater than that of patients with total spinal fractures. Many studies have shown that the thoracolumbar spine is the most common segment in spinal fractures [9, 12, 17]. This study further illustrates that L1 is the most common segment in TLF, whether in single-or multi-segment injuries. “Low fall”, “high fall”, and “traffic accident” were the top three etiologies of TLF in this study, which is supported by a systematic review that concluded that road traffic accidents and falls are the

main causes of traumatic spinal injury globally [13]. Fortunately, these major etiologies are preventable. This study summarizes the epidemiological characteristics of TLF patients and provides a basis for the formulation of targeted prevention policies.

There were many differences in epidemiological characteristics between men and women. In contrast to women, the average age of the male patients was much lower. This may be related to the fact that the etiologies in males were mainly high-energy injuries. The leading etiology among males, “high fall”, was in fact very low among females. In other words, men were more likely to be injured by high-energy causes at a younger age. Similar phenomena were also reported in a previous study [18]. Therefore, it is important to implement targeted preventive measures in specific populations.

There were also many distinctions between the different injury types. Consistent with a previous study [19], burst TLFs were mainly caused by high-energy damage. In this study, the vast majority of burst TLFs comes from “high fall”. It is worth noting that “high fall”, as a high-energy injury, is also the main cause of TLFs in patients with SCI. Previous studies have shown that spinal fractures caused by a fall from standing height tend to be mostly stable injuries [20].

In this study, 137 patients (12.5%) developed SCI after TLF. This ratio is similar to that reported in Tianjin, China (15.2%) [12] but lower than the ratio of SCI in spinal fractures in Canada (23.3%) [21] and Chongqing, China (44.30%) [16]. Unlike single fracture patients, patients with SCI were most likely to have a “burst” fracture, rather than the most common “compression” in TLF patients. In addition, as the most common cause of TLF, “low falls” only accounted for a small proportion of patients with SCI. This may be due to high-energy injuries such as “high fall”, “crush” and “traffic accidents” that are all more likely to cause SCI. In general, there are many differences in the causes and mechanisms of injury between patients with SCI and those with only one fracture. Similar differences were reported in a previous study [22]. These differences require doctors to provide more targeted and individualized treatments for patients with TLF. These epidemiological characteristics may provide recommendations for existing therapeutic guidelines for related diseases [23, 24].

This study had several limitations. Although Shanxi Bethune Hospital is the largest hospital in the Shanxi province, a single-center retrospective study could not represent the entire profile of the Shanxi province. As a retrospective study, causality was not available; thus, we could not assess the prognosis and determinants of TLF. In the future, we will explore the more representative epidemiology of TLFs and try to evaluate the prognosis and determinants of TLFs.

In conclusion, this study provided the latest TLF epidemiological data from 2014 to 2019 in Shanxi, China. The epidemiological characteristics observed in this study differed from those in other cities and countries. The increased number of TLF patients indicates that it is crucial to enact the policy and law of security and prevention to reduce the incidence of TLF in China. This study may help the government and relevant departments formulate effective regulations and take corresponding preventive measures to reduce the occurrence of TLF.

Conclusion

This study provided the latest TLF epidemiological data from 2014 to 2019 in Shanxi, China. The number of patients with TLF increases with social development. The epidemiological profiles between sexes and fracture types were quite different. This study may help the government and relevant departments formulate effective regulations and take corresponding preventive measures to reduce the occurrence of TLF.

Abbreviations

TLF: thoracolumbar fracture; AIS: American Spinal Injury Association (ASIA) impairment scale; SCI: spinal cord injury; SD: standard deviation.

Declarations

Ethics approval and consent to participate

This study was approved by the Shanxi Bethune Hospital (YXLL-KY-2021-014).

Consent for publication

Not applicable.

Availability of data and materials

The data contributing to this study may be made available upon request by sending an e-mail to the corresponding authors.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

Qiang Li designed the study, collected and analyzed the data, wrote and edited the manuscript. Yi Kang designed the study, collected and analyzed the data, wrote and edited the manuscript. Zhao Gao designed the study, collected and analyzed the data, wrote and edited the manuscript. Chao-Yu Wang designed the study, collected and analyzed the data, wrote and edited the manuscript. Chen Chen collected and analyzed the data. Hong-Yi Zhang collected and analyzed the data. Ming Zhang collected and analyzed the data. Jing Zhao collected and analyzed the data. Heng-Xing Zhou designed the study, analyzed and interpreted the data, revised and approved the manuscript. Shi-Qing Feng designed the study, analyzed and interpreted the data, revised and approved the manuscript. Hao-Yu Feng designed the study, analyzed and interpreted the data, revised and approved the manuscript. Qiang Li, Yi Kang, Zhao Gao, and Chao-Yu Wang contributed equally and were considered as co-first authors. Hao-Yu Feng, Shi-Qing Feng, and Heng-Xing Zhou contributed equally and were considered as co-corresponding authors. All authors read and approved the final manuscript.

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Figures

Figure 1

The case number analysis

(A) The number of cases of thoracolumbar fractures (TLF) from 2014 to 2019. (B) Age distribution. (C) Marital status distribution. (D) Distribution of single level fracture and (E) multilevel fracture. (F) Distribution of fracture type. (G) Spinal cord injury distribution. (H) Etiology distribution. (I) Occupation distribution.

Figure 2

Differences between sexes

(A) Age distribution. (B) Year distribution, (C) Fracture level distribution, (D) Marital status distribution, (E) Etiology distribution, (F) Fracture type distribution, (G) Occupation distribution, (H) Spinal cord injury distribution.

Figure 3

The constituent ratio of patients with thoracolumbar fractures

(A, B) Age constituent ratio, (C, D) Occupation constituent ratio, (E, F) Etiology constituent ratio, (G, H) Fracture level constituent ratio for different fracture types.

Figure 4

The epidemiological characteristics of spinal cord injury patients

(A) Age distribution. (B) Marital status distribution. (C, D) Fracture level distribution of single level (C) and multilevel (D) fractures. (E) Occupation distribution. (F) Fracture type distribution. (G) Etiology distribution.