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A demographic profile of cervical injury: an Indonesian single tertiary hospital study with 6 months to 1-year follow-up

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Abstract

Background: Spinal cord injury (SCI) can cause considerable morbidity and mortality. Until now there is no spinal cord injury profile in Indonesia. Therefore, this study aims to provide an overview of the spinal cord injury profile as well as to analyze the functional outcome at the sixth month and the first year.

Results: Most spinal cord injury cases were traumatic SCI (67.5%). Meanwhile, non-traumatic SCI was 32.5%. The mean age of patients who had traumatic SCI was 41.9 ± 17.4 years while non-traumatic SCI patients was 48.4 ± 13.7 with a significant difference ($p < 0.05$). Most cases occurred in men rather than women with significant differences based on the type of injury ($p < 0.05$). Traffic accidents were the most common cause of cervical injuries (47.1%). Surgery was the most common treatment modality in cervical injury cases (60.4%) with the posterior approach being the preferred approach in most operative measures (72.4%). Respiratory failure was the leading cause of death (48.9%). The mean LOS of patients with traumatic SCI was 28.8 ± 14.3 days while the mean LOS of non-traumatic SCI patients was 44.7 ± 28.7 with a significant difference ($p < 0.05$). There was significance difference between the initial outcome and after the sixth month to first year follow-up ($p < 0.05$).

Conclusions: This study demonstrated the epidemiology and characteristics of spinal cord injury which mostly had a good neurological outcome.

Keywords: Cervical Injury, Frankel, Spinal Cord Injury

Background

Spinal cord injury (SCI) can cause considerable morbidity and mortality. Spinal cord injury (SCI) can be non-traumatic or traumatic. In non-traumatic cases, generally in the form of degenerative diseases, infections and neoplasms [1]. The most common causes of traumatic SCI are traffic accidents, falls, diving and vigorous sports. There is a tendency for spinal cord injuries to occur more in men, this result may be due to men consuming more alcohol, have a habit of driving at high speeds and participating in sports with a high risk of injury [2, 3].

There are no data that clearly explains the profile of spinal cord injuries, whether caused by trauma or non-trauma, starting from demographic data to outcomes obtained by patients in Indonesia, especially at Dr. Soetomo Hospital, Surabaya. Spinal cord injury profile data is very important, because it can be used as educational information and evaluation of spinal cord injury management. Therefore, this study aims to provide an overview of the spinal cord injury profile in patients at Dr. Soetomo General Hospital in Surabaya for the period 2017–2019.

Methods

This research was conducted at Dr. Soetomo General Hospital in Surabaya, Indonesia. This is a retrospective study which was conducted with a descriptive and

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analytical design. The analysis focused on patient-related data including age, sex, mechanism of injury, type & level of injury, type of therapy, length of stay, and patient outcome (live, died and neurological status).

This study used secondary data obtained from the patient's medical records in the Medical Records Section and the Outpatient Installation of Dr. Soetomo General Hospital. Ethical approval for this study was obtained from Health Research Ethics Committee—Dr. Soetomo General Hospital (1802/KEPK/I/2020). This study using total sampling. The collected data were then analyzed descriptively. The age, sex, and the outcome data were also analyzed analytically using SPSS.

Results

Based on the data obtained, the number of samples that should be used is 144 based on the index data of the Spine Division of the Orthopedics & Traumatology Department, with 142 samples available in the data collection time period. Among the available samples, 126 data (88.7%) were valid based on predetermined inclusion and exclusion criteria. Based on the data found, traumatic SCI was the most common type of cervical injury, with a total of 85 cases (67.5%), while non-traumatic SCI had a total of 41 cases (32.5%).

According to the data shown in Table 1, spinal cord injury cases occurred most frequently in the 35–54 years age group with a total of 55 cases (43.7%). The mean age of patients with traumatic SCI was 41.9 ± 17.4 years, while the mean age of non-traumatic SCI patients was 48.4 ± 13.7. According to *t* test, it had a significant difference ($p = 0.025$).

Spinal cord injury cases were more common in male patients with 100 cases (79.4%) mostly traumatic SCI, while for female gender, 26 cases (20.6%) were found with details of each of the 13 patients in both types of cervical injury. From this data, a Chi Square test was performed and the p value was obtained = 0.033 ($p < 0.05$), which means that there were significant differences in the number of male and female groups based on the type of injury.

In Table 2, it can be seen that the most common injury mechanisms causing traumatic SCI were traffic accidents in 40 cases (47.1%), followed by falls from a height of 32 cases (37.6%), and heavy objects hit by 7 cases (8.2%) and simple fall as many as 6 cases (7.1%). traumatic SCI were more common in the lower cervical as many as 71 cases (83.5%) compared to upper cervical as many as 14 cases (16.5%) with a ratio of 5: 1. The cause of non-traumatic SCI was mostly caused by degenerative diseases in 25 cases (62%), followed by neoplasms in 9 cases (22%), infection in 6 cases (14.6%) and congenital disease in 1 case (2.4%).

A total of 83 patients (65.9%) were alive after undergoing treatment at Dr. Soetomo General Hospital, with details of 22 patients undergoing conservative therapy and 61 patients undergoing operative therapy. Meanwhile, there were 43 patients (34.1%) who died after undergoing treatment at the Dr. Soetomo General Hospital with details as followed; 3 patients had conservative therapy, 15 patients underwent operative therapy, and 25 patients had not undergone surgery.

Based on Table 3, there were 25 patients who had not had surgery (19.8%), because the patient died before surgery, 25 patients (19.8%) received conservative therapy with details of 22 traumatic SCI patients and 3 patients with non-traumatic SCI. Meanwhile, of the 76 patients who received operative therapy, 21 cases (27.6%) had an anterior approach in surgery with details as followed; 7 patients with traumatic SCI and 14 non-traumatic SCI patients. The remaining 55 cases (72.4%) had a posterior

Table 1 Distribution of data by age and sex

Variable	Total (*n*)		Total	(%)
	Traumatic SCI	Non traumatic SCI		
Age				
0–14	3	1	4	3.2
15–34	27	4	31	24.6
35–54	33	22	55	43.7
55–74	21	13	34	26.9
≥ 75	1	1	2	1.6
Sex				
Men	72	28	100	79.4
Women	13	13	26	20.6

Table 2 Distribution of data based on mechanism of injury

Variable	Total (*n*)	(%)
Mechanism of injury traumatic SCI		
Trivial Injury	6	7.1
Fall from Height	32	37.6
Traffic Accident	40	47.1
Heavy objects hit	7	8.2
Level of injury traumatic SCI		
Lower Cervical	71	83.5
Upper Cervical	14	16.5
Causes of non traumatic SCI		
Degenerative	25	62
Infection	6	14.6
Neoplasms	9	22
Congenital disease	1	2.4

Table 3 Distribution of data based on treatment modalities, surgical approach and causes of death

Variable	Total (*n*)		Total	%
	Traumatic SCI	Non traumatic SCI		
Treatment modalities				
Surgery not done	21	4	25	19.8
Conservative	22	3	25	19.8
Operative	42	34	76	60.4
Surgical approach				
Anterior	7	14	21	27.6
Posterior	35	20	55	72.4
Causes of death				
Respiratory failure	18	3	21	48.9
Cardiovascular	0	1	1	2.3
Sepsis	19	1	20	46.5
Neurogenic shock	1	0	1	2.3

approach to surgery with details as followed; 35 traumatic SCI patients and 20 non-traumatic SCI patients. From the total 43 patients who died, the leading cause of death for cervical injuries was respiratory failure (21 cases, 48.9%).

Table 4 shows the difference between the degree of injury at the initial measurement, which is at the time of completion of hospitalization with the degree of injury at follow-up 6 months to 1 year after discharged. From the statistical analysis of the Chi square test, it was found that there was a significant difference between the initial injury degree group and the 6 months to 1-year follow-up injury degree group after discharged with a value of $p = 0.000$ ($p < 0.05$). This could be seen from the number of patients. From 6 patients in the Frankel A group, who were followed up after discharged, 2 patients improved to Frankel D, 2 patients improved to Frankel C and 2 patients improved to Frankel B. From 9 patients in Frankel B group, 2 patients improved to Frankel E, 2 patients improved to Frankel D, 3 patients improved to Frankel C, and 2 patients were still in Frankel B. From 16 patients in Frankel C group, 5 patients improved to Frankel E, 5 patients improved to Frankel D, and 6 patients were still in Frankel C. From 22 patients in Frankel D group,13 patients improved to Frankel E, 8 were still in Frankel D. However, there was 1 patient who deteriorated to Frankel C after followed up.

In the variable length of stay (LOS), using Mann Whitney test, Cervical patients who survived for 35.7 ± 23.0 days and who died for 19.3 ± 16.7 days with a significant difference ($p = 0.000$).

Table 5 showed the mean Length of Stay (LOS) of cervical injury patients who survived for 35.7 ± 23.0 days

Table 5 Differences between mean length of stay (LOS) in cervical injury patients

LOS	Mean LOS ± SD (day)	Min. (day)	Max (day)	
Survived	35.7 ± 23.0	6	123	$p = 0.000$
Dead	19.3 ± 16.7	1	65	
Traumatic SCI	28.8 ± 14.3	7	66	$p = 0.004$
Non traumatic SCI	44.7 ± 28.7	6	123	

Table 4 Differences between degrees of injury according to Frankel scale

	Frankel 6 months–1 year after discharge				Total	
	B	C	D	E		
Initial Frankel						
A	2	2	2	0	6	$p = 0.000$
	2.4%	2.4%	2.4%	0%	7.2%	
B	2	3	2	2	9	
	2.4%	3.6%	2.4%	2.4%	10.8%	
C	0	6	5	5	16	
	0%	7.2%	6.0%	6.0%	19.3%	
D	0	1	8	13	22	
	0%	1.2%	9.6%	15.7%	26.5%	
E	0	0	0	30	30	
	0%	0%	0%	36.1%	36.1%	
Total	4	12	17	50	83	

and who died for 19.3 ± 16.7 days with a significant difference ($p = 0.000$). Meanwhile, the mean LOS of patients with traumatic SCI was 28.8 ± 14.3 and the mean LOS of non-traumatic SCI patients was 44.7 ± 28.7 with a significant difference ($p = 0.004$).

Discussions

In this study, out of 126 total spinal cord injury patients that we could evaluate, it was found that the number of traumatic SCI cases was higher than that of non-traumatic SCI, namely, 67.5%. This was in line with research conducted by Ones et al. [4] and Cosar et al. [5]. However, this result was different from research conducted by Ge et al. where the total number of non-traumatic SCI cases from 2003 to 2014 was greater than SCI caused by trauma in Rochester, United States [6].

According to the results obtained, the mean age of patients with traumatic SCI was younger than the mean age of non-traumatic SCI patients, namely, 41.9 years and 48.4 years. This result was in line with a study conducted by Cosar et al. [5]. Where the mean age of traumatic SCI patients was 37 years and was significantly younger than the average age of non-traumatic SCI patients. In a study conducted by van den Berg et al. in 2010, it showed a bimodal age distribution. The first peak was found in young adults between 15 and 29 years, mostly caused by traffic accidents. The second peak in older adults, aged more than 65 years, mostly caused by falls. Meanwhile, non-traumatic SCI was more common in elderly patients, because non-traumatic SCI was more often caused by age-related pathologies, such as tumors, degenerative diseases and vascular disorders [7].

In this study, men were more likely to experience cervical injuries than women with a ratio of 4: 1. In both traumatic SCI and non-traumatic SCI, men were found to be more at risk of developing SCI. The data found by Igho et al. shows the same thing, where men had a higher risk and number of fracture events due to their high participation in physical activities, such as construction work, motorbike riding, and others [8].

Traffic accidents were the main cause of traumatic SCI incidence in this study. There were 47.1% of traumatic SCI caused by traffic accidents while falling from a height was the next most common cause of fracture at 37.6%. These results were in line with a meta-analysis study conducted in the Middle East and North Africa, where in almost all countries the main cause of traumatic SCI events was traffic accidents [9]. According to Nantulya, the causes of the high number of traffic accidents in developing countries were the increasing number of motor vehicles, poor enforcement of traffic safety regulations, and poor road infrastructure [10].

In this study, it was found that traumatic SCI were more common in the lower cervical, namely, C3–C7 as many as 71 patients (83.5%) while the upper cervical or C1 and C2 were 14 patients (16.5%). These results were in line with research conducted by Wang, in China. From 2001 to 2010, 656 patients (70.9%) had lower cervical fractures and 269 (29.1%) upper cervical fractures [11]. The large number of fractures of the lower cervical spine was due to the biomechanical weakness of the cervical spine and a lot of movement in this region [12].

Non-traumatic SCI was caused by various conditions including degenerative diseases, neoplasms, infections, congenital diseases and vascular diseases. A research in the United States stated that the most common cause of non-traumatic SCI was degenerative disease [6]. The results of this study also showed a similar result in which 62% of non-traumatic SCI patients were caused by a degenerative disease. However, in other studies it was also mentioned that neoplasms were the most common cause [13].

The total number of cervical injury patients at Dr Soetomo General Hospital from 2017 to 2019 was 126 patients. Of the total 126 patients, 83 patients survived either after conservative or operative treatment, and 43 patients who died, either those who had definitive therapy or those who had not. The most common causes of death in this study were respiratory failure and sepsis. The results of this study were in line with research conducted by Savic et al. where 29.3% of 2170 patients from 1943 to 2010 in England died from respiratory failure [14], while according to Thietie et al. The most common cause of death in SCI patients in their study was sepsis [15]. Respiratory failure in SCI was caused by several mechanisms including weakness of the respiratory muscles, impaired cardiovascular function and autonomic nerves, pulmonary edema, prolonged bed rest, and impaired cough function [16]. While sepsis in cervical injury patients could be caused by several pathologies, including urinary tract infection due to repeated insertion of Foley catheters or impairment of bladder emptying, skin and soft tissue infection, such as pressure ulcer, surgical osteomyelitis, and pneumonia due to sputum retention [17].

In this study there were 76 patients (60.4%) who underwent surgery, 25 patients (19.8%) underwent conservative therapy, and 25 patients (19.8%) died before surgery. Of the 76 patients who underwent surgery 55 patients (72.4%) via the posterior approach and 21 patients (27.6%) via the anterior approach. Either an anterior or a posterior approach can be chosen for stabilization of an unstable cervical injury based on the preference of the surgeon, indication and condition of the patient [18].

The mean length of stay (LOS) of traumatic SCI in this study was 28.8 ± 14.3 days. The mean length of stay (LOS) of non-traumatic SCI was 44.7 ± 28.7 days. There was a significant difference between the mean LOS of traumatic SCI and non-traumatic SCI patients ($p = 0.004$). This result was different from a study, conducted by Celani et al. where LOS in traumatic SCI was significantly longer than LOS in non-traumatic SCI. This might be because traumatic SCI was usually accompanied by other accompanying injuries, such as abdominal trauma, thoracic trauma, and multiple fractures [13]. Different results were shown in this study, because the majority of non-traumatic SCI patients had other comorbidities, such as neurological or metabolic disease.

In this study also found a significant improvement in neurological scores at 6 months to 1-year follow-up after discharged. The restoration of normal motor function depended on the re-organization of the remaining spinal circuit ring. This ability to reorganize, commonly referred to as plasticity, was thought to have a profound effect on recovery of function after injury, as well as learning and memory in the undamaged central nervous system. In undamaged nerves, there were changes in synaptic function and the pattern of connections between synapses within the nerve circuit ring. In addition, there was growth or sprouting of undamaged axons as compensation for injured axons [19].

Conclusions

This study was able to detect some interesting correlations that will be able to guide, especially primary care physicians in their initial diagnostic work up. However, this study also had limitations, the most obvious being the dependence upon the quality of the data recorded in the medical records.

Abbreviations

SCI: Spinal cord injury; LOS: Length of stay.

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Authors' contributions

LW conceived the ideas of the study, provide grammatical revisions to manuscript. AJ performed the data collection, analysis, interpretation and research funding. KDH provided revisions to scientific content of manuscript & access to crucial research components. All authors read and approved the manuscript.

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Availability of data and materials

All data generated or analysed during this study are included in this published article.

Declarations

Ethics approval and consent to participate

Ethical approval for this study was obtained from Health Research Ethics Committee–Dr. Soetomo General Hospital (1802/KEPK/I/2020)

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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