Original Article

Clinical Profile and Predictors of Early Outcome in Patients with Traumatic Spinal Cord Injury in Jos, North-Central Nigeria

Abstract

Background/Objectives: Spinal cord injury is a devastating condition and has been recognised so since antiquity with evolving pattern of presentation and outcome. This study aimed to review the clinical profile and determinants of early outcome in patients with traumatic spinal cord injury (TSCI) in Jos, Nigeria. **Materials and Methods:** This retrospective cohort study, reviewed the health records of all patients with TSCI that were managed, based on the neurosurgical unit protocol for the management of TSCI in our institution from 2011 to 2021. Relevant data were retrieved into a preformed pro forma, analysis was done for determinants of outcome using SPSS and presented in tables and figure. **Results:** A total of 296 patients, aged 20–39 years, with male to female ratio of 5.2:1 were studied. The median time from injury to presentation was 96 h, and the cervical spine was the most (139, 47.0%) affected region. Most of the patients (183, 61.8%) had complete injury (ASIA A) at presentation, the average, first week mean arterial blood pressure (MAP) of 89.98 ± 8.86. Mortality was 73 (24.7%) at 6 weeks post injury and complete TSCI, cervical spinal cord segment and the average "first week" MAP were, independent predictors of mortality. The admission ASIA impairment scale (AIS) and injury to presentation interval were predictive of AIS improvement at 6 weeks and length of hospital stay (LOHs). **Conclusions:** We also found that AIS at admission, level of spinal cord affected and the average first week MAP were early predictors of mortality, while the injury to presentation interval and admission AIS, predicted improvement of AIS at 6 weeks. The LOHs was seen more in patients with severe AIS at admission and those who had delayed presentation.

Keywords: *ASIA, injury, outcome, predictors, spinal cord, traumatic*

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Introduction

The consequences and burden of care for patients with acute traumatic spinal cord injury (TSCI) can be quite enormous, and its attendant sequel have an untold hardship on the sufferers and care givers, especially when viewed from economic, psychological, and social perspectives.[1-6] Therefore, clinical predictors of these injuries, that can be improved upon to ensure a better neurological and functional outcome is highly desirable both to the patients and clinicians alike. Epidemiological data on TSCI initially researched into in the past 40 years, focused extensively on descriptive epidemiology (incidence rates, age, gender, race, cause of injury, level and completeness of injury).[7] In the year 2016, there were 0.93 million (0.78–1.16 million) new cases of TSCI, and age-standardised incidence rates of 13 (11–16) per 100,000, with the number of prevalent cases up to 27.04 million (24.98–30.15 million).[5] The global burden of acute TSCI, constitutes a considerable portion of the global injury burden as published by the 2019 Global Burden of Disease study group.[5,8] Although the study revealed that from 1990 to 2016, there was no significant change in the age standardised incidence or prevalence of TSCI, the population of people living with the consequences of TSCI is expected to rise, due to population growth in the near future, leading to an increase in the demand for specialised care of patients with this injury.[5] The prevalence and incidence of TSCI might not have changed much over time, however, there are marked variations in the incidence, prevalence and other clinical characteristics of this injury across, and within different countries and regions of the world.[1,9,10] This variation in the epidemiological profile of TSCI, can be partly explained by geographical and cultural conditions, as well as relevant

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infrastructural inequalities, but it also reflects the presence of diverse criteria used to identify and classify patients with spinal cord injury.[1,9,10] Understanding and recognizing these epidemiological profile or data help to provide information that forms the basis for appropriate allocation of limited resources in the prevention and management of this disease entity within and outside the region of practice.[1,11]

Outcome measurement in TSCI exist as a continuum, and is determined by a complex array of clinical, radiological, biomechanical and patho-physiological factors. In addition, the heterogeneous nature of this injury makes the determination of outcome a perplexing task for clinicians and researchers alike.[12] And there has been a pressing unmet need to accurately prognosticate early outcome after TSCI.[12,13] A number of individual clinical, radiographic and demographic factors have been shown to be of importance in predicting clinical outcome following TSCI.[12,13] In recent times, several of such factors; patient's demographic characteristics, mechanism of injury, segment of the cord involved and AIS grade conversion rates have been studied in order to determine their ability to predict neurological and functional outcome in patient with TSCI.[12-14] Some of these factors poorly predict future functional capacity.[15] However, factors such as; socio-economic characteristic, pre-hospital care and mode of transportation and injury to presentation interval have been poorly studied.

Although, few studies from Nigeria and sub-Saharan Africa highlighted clinical factors that determine patients outcome at discharge, none of these studies evaluated the clinical predictors of early outcomes in patients with TSCI.[11,16,17] In addition, the paucity of local and regional data due to of lack of appropriate case registration at all levels of health care, remains an obstacle to the assessment of the global burden of TSCI and constitute a major impediment to the development of local and national frame work in the management of this injury. Particularly, injury prevention, training of a capable medical workforce, target resource allocation and the creation of effective medical care delivery systems.[18,19] Studies that evaluates the clinical profile and predictors of early outcome in patients with TSCI will contribute to the overall information database on TSCI in our region. This will be useful for policy formulation that may improve the neurological and functional outcomes in patients with this injury. This study, therefore, aims to review the clinical profile and predictors of early outcome in patients with acute TSCI.

Subjects and Methods

This retrospective, cohort study, involved all patients with TSCI managed from 2011 to 2021 in a neurosurgical unit of a tertiary health facility in Jos, North-Central, Nigeria. Ethical approval for this study was obtained from the Research and Ethics Committee of the institution (JUTH/DCS/ADM/127/XIX/6254), however individual consent was not required to conduct this retrospective study. The medical health records of all consecutive patients with acute TSCI who presented to Accident and Emergency Unit of the hospital, and where admitted and managed based on the neurosurgical unit protocol for the management of acute TSCI were retrieved.

The management protocol used for patients with TSCI in this facility consists majorly of; immediate stabilisation of the spine segment involved or suspected to be injured with external orthosis if not done from referring hospital or scene of injury. The patients were then evaluated clinically to establish the motor, sensory and neurological level of injury, using the ASIA impairment scale (AIS) form. Other management algorithm includes maintaining blood pressure above 90/60 mmHg in the first week of admission, and patients with high cervical spine injury or with respiratory insufficiency had endotracheal intubation and were ventilated. Adequate analgesia, early physiotherapy and rehabilitation, deep venous thrombosis prophylaxis and pressure ulcer prevention measures were instituted right from admission. Radiological imaging, X-rays or computer tomography scan and magnetic resonance imaging, were done as soon as possible and patients whose radiological images X-rays/magnetic resonance imaging or computer tomography/magnetic resonance imaging revealed cord compression or spinal instability, had surgical intervention, such as anterior cervical discectomy and fusion or lateral mass stabilisation for cervical spine and pedicle screw fixation for thoracic and lumbar spine. The patients were subsequently discharged to continue follow-up at the outpatient clinic at regular interval.

The medical health records of these patients were retrieved and reviewed, relevant clinical data, such as age, sex, aetiology, place of injury, mechanism of injury, injury presentation interval, spinal cord segment involved, etc. were entered into a structured, preformed pro forma. Patients whose medical records could not be traced, and those with less than 2/3 of relevant information were excluded from the study. Clinical parameters such as, age of the patients, aetiology, injury to presentation interval, the first week average mean arterial blood pressure (MAP), spinal cord segment involved and AIS at admission, where used as explanatory variable to predict clinical outcome. The outcome variables used were, length of hospital stay (LOHs), survival and neurological improvement at 6 weeks post injury.

Data analysis was done using the statistical software; IBM SPSS Statistics for Windows, Version 25.0 (IBM Corp., Armonk, NY). Demographic and baseline descriptive analysis were done and presented as frequencies and percentages on tables, bar charts, and pie charts, for categorical variables, while continuous variables were described using median or means and standard deviations. Chi square analysis was used to test for relationship between explanatory variables mentioned above and categorical outcome variables (survival and improvement in AIS at 6 months), whereas, Kruskal–Wallis *H* test was used to test for association between these predictor variables and length of hospital stay (LOHs was not normally distributed, because Kolmogorov–Smirnova; $P = 0.000$). Prediction of survival and AIS improvement at 6 weeks was done using simple and multivariate binary logistic regression analysis with the odd ratios (OR) and 95% confident interval (CI) computed, and the level of significance was set at a $P < 0.05$.

Results

A total of 336 patients who had TSCI were managed within the study period, however, the health records of 40 patients with less than 2/3 of the information required or with missing health records were excluded from the analysis. The remaining 296 patients whose medical records meet the inclusion criteria for the study were reviewed and analysed.

The mean age of the patients was 35.96 ± 13.36 years, most of them (248, 83.3%) were males, with a male to female ratio of 5.2:1. More than half (174, 58.8%) of this injury occurred in young adults in their third and fourth decades of life. Trader/artisans (103, 34.8%) and farmers (87, 29.4%) account for more than half of the patient's population with TSCI in our environment [Table 1].

Road traffic accident (RTA) (156, 52.7%) was the common cause of injury, followed by falls from height (63, 21.3%) [Figure 1], local mining and occupational related injuries also resulted in significant amount of injury (57, 19.3%). More than half (166, 56%) of the patients sustained injury outside the state capital (*Jos* and *Bukuru* metropolis). None of the patients had a prehospital care at the scene of injury or while on transit to the first hospital of care. However, all the patients had their initial care in one or two hospitals or clinics before presenting to our facility, with most of the patients referred from a private hospital (86, 29.1%) and secondary health facility (66, 22.3%). Private cars (177, 59.8%) and public transportation (76, 25.7%) were the most common means of transportation for these patients. At presentation to our health facility majority (181, 61.1%) of the patient had no any form of spinal immobilization or external orthosis. Median time from injury to presentation was 96hours, and most (140, 47.3%) of the patients presented between 2 and 7 days (49–168 h) after injury. Of the 44 patients that had injury with Jos metropolis, more than half (31, 70.5%) presented within 48 h, while most of the patients who had injury outside Jos metropolis, and outside plateau state presented after 48 h of their injuries [Table 1].

Cervical spine was the most affected spine segment (139, 47.0%), followed by thoracolumbar junction injuries (58, 19.6%). Complete spinal cord injury (ASIA A) was the predominant type of injury at the time of presentation (183, 61.8%) while ASIA E injuries (13, 4.4%) were the least frequent [Table 1]. The average, mean arterial blood pressure (MAP) for the patients in the first week of admission was 89.98 ± 8.86. A total of 125 (42.2%) patients met indication for surgical intervention, however, 15 (5.1%) of the patients could not afford the cost of surgery and were managed with external orthosis. Of the patients operated, none had their surgery within 72 h of injury [Table 2].

At 6 weeks post injury, we had a mortality of 73 (24.7%) patients, the mortality was observed in most patients with complete (ASIA A) injury and in those with cervical spine injury [Table 2]. Simple logistic regression revealed that, the completeness of injury ($P = 0.000$, OR: 3.500, 95% CI: 1.954, 6.272), cervical spinal cord segment ($P = 0.000$, OR: 1.83, CI: 1.207, 1.814) and the average "first week" MAP of 80–89 ($P = 0.012$, OR: 1.044, CI: 1.010, 1.080) were, independent clinical predictors of mortality, although road traffic accident was significantly associated with mortality, it was not predictive of mortality ($P = 0.501$, OR: 1.093, CI: 0.844, 1.415). However, when a multiple regression analysis was done only the cervical spinal segment of injury and complete spinal cord injury were able to predict mortality [Table 4].

Improvement in neurology at 6 weeks was defined as, a minimum of one level improvement in ASIA score at admission. The 223 (75.3%) that were alive at 6 weeks post injury were evaluated for improvement in their admission ASIA score, majority 176 (78.9) of these patients had no improvement in their admission ASIA score. Although, 110 (37.2%) patients were operated, there was no significant association between surgical intervention and neurological improvement at 6 weeks ($P = 0.241$) [Table 3]. Simple logistic regression analysis shows that, ASIA A ($P = 0.013$, OR: 1.345, CI: 1.065, 1.699), and the mean injury to presentation interval were the independent predictors of improvement at 6 weeks ($P = 0.035$, OR: 1.001, CI: 1.000, 1.002) [Table 4].

The mean LOHs was 25 ± 19 days, Kruskal–Wallis *H* test for relationship between LOHs and clinical parameter showed that the admission ASIA score ($P = 0.02$) and injury to presentation interval ($P = 0.012$) were significantly associated with LOHs, while patient age ($P = 0.810$), aetiology ($P = 0.158$), first week average MAP ($P = 0.147$), and spinal cord segment ($P = 0.121$) were not.

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Table 1: Patients demographics and clinical profile of traumatic spinal cord injury

Clinical profile	Frequency (%)
Age group	
≤20	27 (9.1)
20–29	71 (24.0)
30–39	103 (34.8)
40–49	50 (16.9)
50–59	27 (9.1)
>60	18 (6.1)
Sex	
Male	248 (83.8)
Female	48 (16.2)
Occupation	
Farming	87 (29.4)
Civil/public service	59 (19.9)
Trading/artisan	103 (34.8)
Student	47 (15.9)
Mode of transportation	
Ambulance transportation	42 (14.2)
Public transportation	76 (25.7)
Private transportation	177 (59.8)
Police	1 (0.3)
Place of initial care	
Private hospital	86 (29.1)
Primary health care	34 (11.5)
Secondary health care	66 (22.3)
Tertiary health care	10 (3.4)
Missing data	100 (33.8)
Pre hospital use of spine orthosis	
Yes	18 (6.1)
No	181 (61.1)
Missing data	97 (32.8)
Spine segment involved	
Cervical	139 (47.0)
Cervico-thoracic (C7-T1)	20 (6.8)
Thoracic	46 (15.5)
Thoraco-Lumbar (T12-L1)	58 (19.6)
Lumbar	33 (11.1)
Total	296 (100.0)

AIS at admission	Frequency (%)	AIS at 6 weeks	Frequency (%)
A	185 (62.5)	A	109 (36.8)
B	54 (18.2)	B	34 (11.5)
C	21 (7.1)	C	29 (9.8)
D	24 (8.1)	D	33 (11.1)
E	12 (4.1)	E	18 (6.1)
		Death	73 (24.7)
Total	296 (100.0)	Total	296 (100.0)

Place of injury	Injury to presentation interval				Total	*P*-value
	<25 h (%)	25–48 h (%)	49–168 h (%)	>168 h (%)		
Within Jos	26 (59.1)	5 (11.4)	12 (27.3)	1 (2.3)	44 (100)	0.000**
Within plateau	47 (28.3)	16 (9.6)	94 (56.6)	9 (5.4)	166 (100)	
Outside plateau	18 (20.9)	10 (11.6)	34 (39.5)	24 (27.9)	86 (100)	
Total	91 (30.7)	31 (10.5)	140 (47.3)	34 (11.5)	296 (100.0)	

AIS: ASIA impairment scale
**Pearson χ^2 test statistically significant

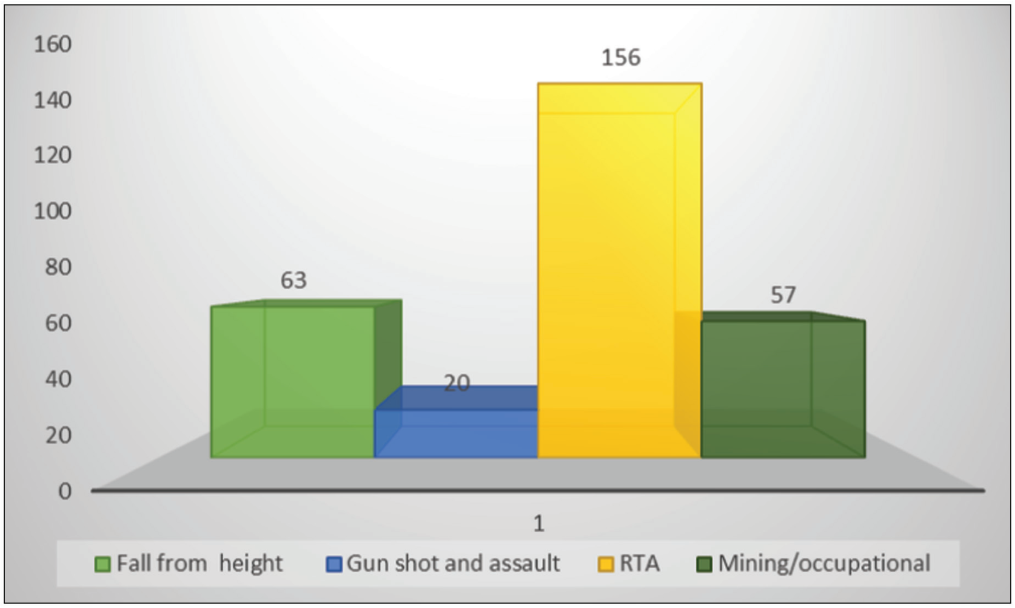

Figure 1: Bar chart showing distribution of the aetiology of TSCI

1.065, 1.699), and the mean injury to presentation interval were the independent predictors of was improvement at 6 weeks (*P* = 0.035, OR: 1.001, CI: 1.000, 1.002) [Table 4].

The mean LOHs was 25 ± 19 days, Kruskal–Wallis *H* test for relationship between LOHs and clinical parameter showed that the admission ASIA score (*P* = 0.02) and injury to presentation interval (*P* = 0.012) were significantly associated with LOHs, while patient age (*P* = 0.810), aetiology (*P* = 0.158), first week average MAP (*P* = 0.147), and spinal cord segment (*P* = 0.121) were not.

Discussion

Demographics, mechanism of injury and prehospital care

The demographics profile in our study showed that, majority of the patients in this study were young, physically active males, aged 21–39 years; these findings correspond to the local, regional and global trend in the demography of patients with TSCI.[3,6,16-20] As reported globally RTA, was also observed to be the most common cause of TSCI followed by falls from height in this study.[3,6,16] In addition, mining related injury, which is the third leading cause of TSCI in this study, is noticed to have been on the increase in our environment since it was reported by Irun *et al.*[20] and subsequently by Shilong *et al.*[21] from this institution. This is a unique finding that has been barely mentioned in previous studies and could be attributable to the traditional and unsafe conditions under which most mining activities take place in the environment of this study.

Nigeria lacks an organised prehospital care system in the management of trauma patients.[22-24] This is reflected in our study, as none of the patients had any form of coordinated or organised prehospital care at the scene of injury or while on transit to the first hospital of care. Although, all the patients had their initial care in one or two hospitals or clinics that do not have capacity for spine trauma care, before presenting to our facility, yet public transportation and the use of private cars were the most common means of transportation for these patients. And more than half of these patients had no any form of spinal immobilisation or external orthosis, with most of them presenting between 2 and 7 days (49–168 h) after injury. This finding is similar to publications on prehospital care and transportation in Nigeria by previous authors.[22-24] This constitutes a major gap in the management and care of these patients in our environment.

Clinical profile and injury characteristics

Cervical spine, is the most affected spinal level in patients with TSCI, globally, this is similar to the observation in this study.[1,4,18,25] Majority of the patients had complete (ASIA A) spinal cord injury, this is similar to other publications in the literature.[4,25] However, some studies that classify severity of disabilities caused by TSCI, as complete or incomplete, reported a lower percentage of complete injury than incomplete injury.[1,18] The average mean arterial blood pressure of the patients, during the first week of admission was 89.98 ± 8.86, this is in keeping with the American Association of Neurological Surgeons and Congress of Neurological Surgeons, and the Consortium for Spinal Cord Medicine recommendation and guidelines.[26,27] These recommendations, support the maintenance of MAP between 85 and 90 mmHg post-injury, based on class III clinical evidence derived from non-controlled case series in which MAP was aggressively maintained ≥85 mmHg for 5–7 days within the first week post injury.[26,27]

There exists, a strong rationale for early decompression in patients with acute TSCI, but the effect of timing of surgical

Table 2: Showing relationship between clinical profile and survival

Clinical parameters	Survival outcome		Total *n* (%)	χ^2 or Fisher's exact	*P*-value
	Alive *n* (%)	Death *n* (%)			
Mean arterial pressure					
<80	16 (76.2)	5 (23.8)	21 (100)	10.886	0.012*
80–89	58 (67.4)	28 (32.6)	86 (100)		
90–100	118 (75.2)	39 (24.8)	157 (100)		
>100	31 (96.9)	1 (3.1)	32 (100)		
Age group					
<20	23 (85.2)	4 (14.8)	27 (100)	6.475	0.263
20–29	54 (76.1)	17 (23.9)	71 (100)		
30–39	72 (69.9)	31 (30.1)	103 (103)		
40–49	38 (76.0)	12 (24.0)	50 (100)		
50–59	24 (88.9)	3 (11.1)	27 (100)		
>60	12 (66.7)	6 (33.3)	18 (100)		
Aetiology					
Falls	48 (76.2)	15 (23.8)	63 (100)	15.499	0.002*
Gun shot and assault	18 (90.)	2 (10.0)	20 (100)		
RTA	105 (67.3)	51 (32.7)	156 (100)		
Mining/occupational	52 (91.2)	5 (8.8)	57 (100)		
Admission AIS					
A	119 (64.3)	66 (35.7)	185 (100)	32.803	0.000*
B	49 (90.7)	5 (4.8)	54 (100)		
C	20 (95.2)	1 (4.8)	21 (100)		
D	23 (95.8)	1 (4.2)	24 (100)		
E	12 (100)	0 (0.0)	12 (100)		
Spinal segment injured					
Cervical	90 (64.7)	49 (35.3)	139 (100)	19.183	0.001*
Cervico-thoracic	14 (70.0%)	6 (30.0)	20 (100)		
Thoracic	40 (87.0)	6 (13.0)	46 (100)		
Thoraco-Lumbar	52 (89.7)	6 (10.3)	58 (100)		
Lumbar	27 (81.8)	6 (18.2)	33 (100)		
Time lapse to presentation					
<25 h	73 (80.2)	18 (19.8)	91 (100)	2.644	0.450
25–48 h	23 (74.2)	8 (25.8)	31 (100)		
49–168 h	100 (71.4)	40 (28.6)	140 (100)		
>168 h	27 (79.4)	7 (20.6)	34 (100)		
Total	223 (75.3)	73 (24.7)	296 (100)		
Treatment option					
Operative	83 (75.5)	27 (24.5)	110 (100)	0.740†	0.740
Operative, but not done	13 (86.7)	2 (13.3)	15 (100)		
Non operative	68 (76.4)	21 (23.6)	89 (100)		
Total (missing data 82 [27.7%])**	164 (76.6)	50 (23.4)	214 (100)		

RTA; road traffic accident, AIS; ASIA impairment scale
* Pearson χ^2 test statistically significant
** Missing data
† Fisher's exact test

decompression still remains a controversy, with significant variability in timing in clinical practice.[28-30] However, a pooled analysis by Badhiwala *et al.*, concluded that surgical decompression within 24 h of acute TSCI is associated with improved sensorimotor recovery, with the first 24–36 h window after injury being the most crucial time to achieve optimal neurological recovery with decompressive surgery after injury.[30] In our study, majority of the patients met the indication for surgical decompression, however, some of these patients could not afford the cost of surgery and were managed with external orthosis. Of those operated, none was operated within 72 h of injury, it was surprising that surgical intervention was not associated with neurological improvement (P = 0.241). The use of "out of pocket" payment to finance health care service in our environment, remains a major challenge to health care delivery, as seen in some of our patients who could not afford cost of initial care. This was also published by Yusuf *et al.*[25], where

Table 3: Showing relationship between clinical profile and AIS improvement of 223 patients at 6 weeks

Clinical parameters	AIS improvement at 6 weeks		Total	χ^2 or Fisher's exact	*P*-value
	No	Yes	*n* (%)		
	n (%)	*n* (%)			
Mean arterial pressure					
<80	13 (81.3)	3 (18.8)	16 (100)	7.493	0.058
80–89	51 (87.9)	7 (12.1)	58 (100)		
90–100	85 (72.0)	33 (28.0)	118 (100)		
>100	27 (87.1)	4 (12.9)	31 (100)		
Age group					
<20	22 (81.5)	5 (18.5)	27 (100)	4.298	0.507
20–29	56 (78.9)	15 (21.1)	71 (100)		
30–39	85 (82.5)	18 (17.5)	103 (103)		
40–49	43 (86.0)	7 (14.0)	50 (100)		
50–59	25 (92.6)	2 (7.4)	27 (100)		
>60	13 (72.2)	5 (27.8)	18 (100)		
Aetiology					
Falls	35 (72.9)	13 (27.1)	48 (100)	4.099	0.251
Gun shot and assault	14 (77.8)	4 (22.2)	18 (100)		
RTA	81 (77.1)	24 (22.9)	105 (100)		
Mining/occupational	46 (88.5)	6 (11.5)	52 (100)		
Admission AIS					
A	108 (90.8)	11 (9.2)	119 (100)	40.183	0.000*
B	27 (55.1)	22 (44.9)	49 (100)		
C	10 (50.0)	10 (50.0)	20 (100)		
D	19 (82.6)	4 (17.4)	23 (100)		
E	12 (100)	0 (0.0)	12 (100)		
Spinal segment injured					
Cervical	70 (77.8)	20 (22.2)	90 (100)	4.761	0.313
Cervico-thoracic	9 (64.3)	5 (35.7)	14 (100)		
Thoracic	35 (87.5)	5 (12.5)	40 (100)		
Thoraco-lumbar	39 (75.0)	13 (25.0)	52 (100)		
Lumbar	23 (85.2)	4 (14.8)	27 (100)		
Time lapse to presentation					
<25 h	67 (91.8)	6 (8.2)	73 (100)	14.449	0.02*
25–48 h	20 (87.0)	3 (13.0)	23 (100)		
49–168 h	69 (69.0)	31 (31.0)	100 (100)		
>168 h	20 (74.1)	7 (25.9)	27 (100)		
Total (missing data 73[24.7%])**	176 (78.9)	47 (21.1)	223 (100)		
Treatment option					
Operative	98 (89.1)	12 (10.9)	110 (100)	2.874†	0.241
Operative, but not done	15 (100.0)	0 (0.0)	15 (100.00)		
Non operative	75 (84.3)	14 (15.7)	89 (100)		
Total (missing data 82 [27.7%])**	188 (87.9)	26 (12.1)	214 (100)		

RTA: road traffic accident, AIS; ASIA impairment scale
* Pearson χ^2 test statistically significant
** Missing data
† Fisher's exact test

ineffective or near absence of health insurance coverage, constitute a major challenge to health care delivery in the management of acute TSCI in our environment.

Clinical predictors of early mortality

Studies on predictors of early or in-hospital mortality in patients with TSCI are few, most studies focused mainly on causes of long-term mortality.[31] In this study we had an early of mortality of 24.7%, this is similar to mortality rate reported in the literature for patients with TSCI in sub-Saharan African (17–29%), which is higher than that seen in developed countries of the world.[11,22,31,32] The predictors of mortality observed in this study were; the AIS on admission, level of spinal cord injury and the average first week MAP. With the mortality seen more in patients with complete (ASIA A) spinal cord injury,

Table 4: Showing simple and multiple logistic regression analysis for predictor of survival and AIS improvement at 6 weeks

Variables	*B*	SE	Wald	*P*-value	Odd ratio	95% CI	
						Lower	Upper
Simple logistic regression for predictors of survival at 6 week post injury							
Aetiology	–0.089	0.132	0.454	0.501	1.093	0.844	1.415
Admission AIS	–1.253	0.298	17.727	0.000**	3.500	1.954	6.272
Spinal cord segment injured	–0.392	0.104	14.191	0.000**	1.480	1.207	1.814
Mean arterial pressure	0.043	0.017	6.373	0.012**	1.044	1.010	1.080
Multiple logistic regression for predictors of survival at 6 week post injury							
Mean arterial pressure	0.034	0.018	3.509	0.061	1.035	0.998	1.073
Aetiology	0.095	0.151	0.397	0.529	1.100	0.818	1.477
Admission AIS	1.246	0.306	16.575	0.000**	3.477	1.908	6.335
Spinal cord segment injured	0.428	0.112	14.488	0.000**	1.534	1.231	1.912
Simple logistic regression for predictors of improvement in AIS at 6 week post injury							
Injury to presentation interval	0.001	0.001	4.451	0.035**	1.001	1.000	1.002
Admission AIS	0.296	0.119	6.193	0.013**	1.345	1.065	1.699
Multiple logistic regression for predictors of improvement in AIS at 6 week post injury							
Admission AIS	0.260	0.123	4.443	0.035**	1.297	1.018	1.651
Injury to presentation interval	0.001	0.001	2.814	0.093	1.001	1.000	1.002

SE: standard error, CI: confidence interval, AIS: ASIA impairment scale
**Pearson χ^2 test statistically significant

cervical spine injury and those with the average first week MAP of 80–89. A host of clinical factors, such as, age, level of spinal cord involvement, clinical severity of neurological injury, pressure ulcers, infection, delays in admissions, etc, have been reported in the literature to contribute to the high mortality in these patients.[31-33] Our findings, are similar to previous publications on predictors of mortality in TSCI, which found that the most important predictors are; age, level of spinal cord involvement, and severity of neurological injury. Although, age was not predictive of mortality in this study, but the average first week MAP was observed to be an important predictor of early mortality.

Clinical predictors of early improvement in AIS

Our ability to predict the extent of neurological improvement or recovery, after acute TSCI, should be considered as an integral part of the care and guidance giving to patients and their families during the illness by the physicians.[34] In our study, we define improvement in AIS at 6 weeks as; improvement in at least one or more level of the admission AIS, weather this improvement is clinically meaningful or significant remains a subject of debate in the literature.[35] The initial AIS after TSCI has been shown to be one of the most consistent predictor of neurological outcome, where patients with complete TSCI (ASIA A) have less neurological recovery than patients with an incomplete injury (ASIA B–E).[34,35] In this study the simple regression analysis model used shows that the AIS at admission and injury to presentation interval were independent predictors of AIS at 6 weeks after injury. Most studies in the literature on neurological improvement, looked at the effect of timing of surgical intervention on neurological improvement. The findings in these studies may not be clinically applicable in sub-Saharan Africa where there is limited or lack of organised pre-hospital care and transportation system, resulting in delay presentation to facilities with capacity for spine care. This was reflected in our study where majority of the patients presented after 48 h of injury. This delay in presentation was associated with poor neurological improvement at 6 weeks after injury, which resulted in prolong hospital stay. These are an important factor that can be improved upon in the care of patients with acute TSCI in our environment.

Predictors of length of hospital stay

The mean LOHs in patient with TSCI varies considerably in the literature. In our study the LOHs was 25 ± 19 days, this is similar to publication in developed countries of the world, but varies considerably from studies in our region and in publications from other developing countries.[35-37] This could be due to our use of early and aggressive mobilisation and discharge of the patients to outpatient rehabilitation or a reflection of improved efficiency in our health care services. The severity of AIS at admission and delay in the injury to presentation interval were the two clinical parameters associated with increased LOHs, this finding is consistent with systematic review by Parent *et al.* and several other publications in the literature.[37]

Limitations

This study has some inherent limitations that are common to retrospective cohort studies, where data analysis is restricted by the available information. As reflected in this review, where we recognise that a third of the patients were not included in most of the analysis due to inadequate data from their health record. As a result, the likelihood of information and ascertainment bias cannot be completely ruled out. Overall, this observational study has provided valuable information for future prospective study in Nigeria with regard to the clinical predictors of early outcome in patients with TSCI.

Conclusion

In this study, we have further reaffirmed the fact that TSCI affect young, males in their third and fourth decade of life, with road traffic accident being the most common cause. And this injury most frequently affects the cervical spinal cord than any other spinal segment. Lack of prehospital care, multiple hospital visit and delay presentation are among major findings in this study. Severe AIS at admission was predictive of mortality, with less likelihood of improvement in AIS at 6 weeks and prolong LOHs. Whereas, the level of spinal cord injured, and the average first week MAP were significant factors, that predicted mortality at 6 weeks post injury. Multiple hospital visit with delay in presentation was predictive of less likelihood of improvement in AIS at 6 weeks and prolong LOHs.

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Conflicts of interest

There are no conflicts of interest.

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