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# The Nature and Complications of Acute Traumatic Cervical Spinal Cord Injury in a University Hospital in Nigeria

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***Authors' contributions***

*This work was carried out in collaboration between all authors. Author ICE designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors WTY, JNK and BEE managed the analyses of the study. Authors CNA and DDM managed the literature searches. All authors read and approved the final manuscript.*

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## ABSTRACT

**Background:** Traumatic cervical spinal cord injury is one of the most devastating types of injuries. It results in varying degrees of disabilities that adversely affect patients' quality of life. This study aims to evaluate the nature and complications of traumatic cervical spinal cord injury in Benue State University Teaching Hospital, Makurdi, Nigeria (BSUTH).
**Methods:** A retrospective study of traumatic cervical spinal cord injury patients who presented to BSUTH from June 2012 to May 2017. Socio-demographic and clinical characteristics were extracted from hospital records and analyzed with SPSS version 21.0 (Armonk, NY: IBM Corp).
**Results:** A total of 47 patients with traumatic cervical spinal cord injury were studied. There were 42 males (89.4%) and 5 females (10.6%). Their ages ranged from 17 to 77 years with a mean of 35±16. The common causes were road traffic accidents (n=29, 61.7%), falls from height (n=8, 17.0%) and falling objects (n=5, 10.6%). Most patients were transported to the hospital in saloon

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cars (n=34, 72.3%). Of these patients, 3 (6.7%) had atlanto-axial (C1–C2) injuries while 44 (93.3%) had subaxial (C3–C7) injuries. Associated injuries were identified in 48.9% of patients with head injury being the most predominant. Four cases had established pressure sores on presentation. Twelve patients (19.7%) had skull traction while the rest had orthosis. Majority of the patients had ASIA class A (n=31, 66.0%) at the time of discharge. One patient (2.1%) had no neurological deficits (ASIA class E). Complications were observed in 63.8% of the patients, with skin pressure ulcers being the most frequent (36.6% of all complications). Other complications included urinary tract infections, respiratory tract infections, depression, neurogenic pain, spasms and contractures.
**Conclusion:** Traumatic cervical spinal cord injury predominantly affected young male patients and caused by road traffic accidents. It mostly involved the subaxial spine. Majority of patients had American Spinal Injury Association Class A injury. Pressure ulcers and urinary tract infections were the most common complications encountered.

*Keywords: Cervical spine; epidemiology; pattern; pressure ulcers; urinary tract infection; Nigeria.*

## 1. INTRODUCTION

Traumatic cervical spinal cord injury (TCSCI) accounts for 2–3% of all trauma injuries and 8.2% of trauma-related deaths [1]. Spinal cord injury (SCI) is one of the most devastating types of injuries resulting in varying degrees of paralysis, sensory loss, and bladder/bowel dysfunction [2]. A high index of suspicion, early diagnosis of injury, preservation of spinal cord function and maintenance or restoration of spinal alignment and stability are necessary for successful treatment of the acute injury [1]. The best outcomes in treating traumatic SCI are achieved by managing the acute injury, providing comprehensive rehabilitation and ensuring adequate support to allow community reintegration [3]. Despite great improvements in the management of acute traumatic SCI, resource-constrained settings have not benefitted from this progress to the same extent as have countries with vast resources [4].

Paucity of dedicated spine injury centers in most Sub-Saharan countries has hampered favourable outcomes. Lack of ventilators, pressure-relieving surfaces, wheel chairs, home-care teams are some of the problems militating against effective management. This has resulted in avoidable complications which then increase morbidity and mortality. In-hospital mortality rates after acute traumatic SCI are higher in resource-constrained settings mainly due to pressure ulcers (PU) and urinary tract infections (UTI), respiratory complications, delays in admissions and multiple hospital presentations [5].

The cervical spine is the most predominant segment of the spine involved in injury [5,6]. This is due to its greater mobility when compared to other segments thus rendering it more vulnerable to dangerous loading following sudden application of forces [7]. TCSCI is associated with significantly more morbidity and mortality than SCI involving other segments [8,9]. Possible involvement of respiration and all limbs is a major challenge to independent post-rehabilitation survival. Complications have a considerable impact on these patients and in order to optimize the individual rehabilitation process and outcome, it is important to predict and prevent complications in addition to managing them when they occur [10,11].

This study aims to study the pattern and associated complications in patients with acute TCSCI managed at Benue State University Teaching Hospital, Makurdi, Nigeria (BSUTH).

## 2. PATIENTS AND METHODS

This was a retrospective observational study of all patients with acute TCSCI seen from June 2012 to May 2017 at BSUTH. The hospital is a tertiary care center and teaching hospital for the Benue State University. It is a 350-bed hospital and serves as the major treatment center for trauma patients over an area with a population of about 240 000.

All patients with TCSCI admitted within 6 weeks of injury were included in this study. Patients with incomplete medical records and those who presented later than 6 weeks following their injuries were excluded from the study.

Patients' case notes were reviewed for demographic and clinical variables including age, gender, cause of trauma, associated injuries, neurological status, treatment given and clinical complications and length of hospital stay.

Neurological status was recorded and classified using the American Spinal Injury Association (ASIA) guidelines [12]. Motor and sensory examinations were performed routinely while on admission and at the time of discharge. TCSCIs were defined as complete when there was no motor or sensory function in the lowest sacral segment, whereas an incomplete injury is characterized by the presence of sacral sparing.

The conservative treatment for TCSCI involved measures employed to maintain alignment of the cervical spine employing cervical collar or skull traction using Gardner-Wells or Crutchfield calipers. Patients treated using skull traction lie supine in bed for 6 weeks then rehabilitated while keeping a cervical collar on.

Statistical analysis was carried out using the software IBM SPSS Statistics for Windows, Version 21.0. (Armonk, NY: IBM Corp.) Descriptive statistics were used to display single variable quantities using means and standard deviations (SD) for continuous variables or proportions for categorical variables unless otherwise stated.

## 3. RESULTS

Of the forty seven patients included in this study, 42 (89.4%) were male and 5 (10.6%) female making the ratio of men to women 8.4:1. Their ages ranged between 17 and 77 years with a mean of 35.15 ± 15.9 years. Students constituted the majority of patients (n=21, 44.7%). They were followed by farmers (n=10, 21.3%), civil servants (n=7, 14.9%), traders (n=4, 8.5%), artisans (n=3, 6.4%) and retirees (n=2, 4.3%). Fig. 1 shows the distribution of patients according to gender and age groups.

The commonest cause of traumatic cervical SCI was road traffic accidents (RTA) (n=29, 61.7%). The other causes were fall from height (n=8, 17.0%), falling objects (n=5, 10.6%), diving into shallow pools (n=3, 6.4%) and firearm injuries (n=2, 4.3%). Only 3 patients (6.4%) were transported to the hospital via ambulances; most patients were via saloon cars (n=34, 72.3%). Other modes of transport to hospital were via commuter buses (n=7, 14.9%) and motorcycle taxis (n=3, 6.4%). Of these patients, 3 (6.7%) had atlanto-axial (C1–C2) injuries while44 (93.3%) had subaxial (C3–C7) injuries. Associated injuries were identified in 48.9% of all patients, with head injury accounting for 69.2% of all associated injuries. Long bone fractures were the second most frequent (23.1% of all associated injuries). Other associated injuries included chest injury and facial trauma. Four cases had established pressure sores on presentation. Twelve patients (19.7%) had skull

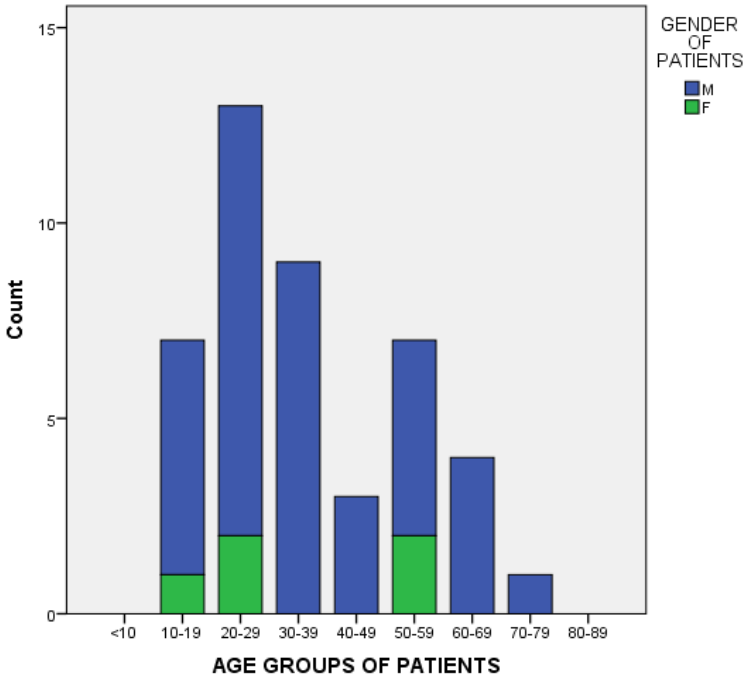


**Fig. 1. The distribution of patients according to gender and age groups**

traction while the rest had orthosis. Majority of the patients had ASIA class A (n=31, 66.0%) at the time of discharge. One patient (2.1%) had no neurological deficits (ASIA class E) Table 1 shows the demographic and clinical characteristics of patients. Complications were observed in 63.8% of the patients, with skin PU being the most frequent (36.6% of all complications). Other complications included UTI, respiratory tract infection, depression, neurogenic pain, spasms and contractures. Fig. 2 shows the distribution of complications among patients. The length of hospital stay ranged from 1 to 84 days with a mean of 33.8 days. Seven patients died giving a case fatality rate of 15.2%.

## 4. DISCUSSION

TCSCI remains an important public health problem associated with significant morbidity and mortality [7,8]. In this study, the majority of patients were predominantly young adult males. This is in keeping with findings from other studies [8,13]. The high proportion of this group of patients may be due to the fact that young males are more mobile and participate in high risk-taking activities. Involvement of the economically productive age-group places a huge toll on national productivity. The multiplier effect on the society is evident considering the fact that the affected population, in a country with no social security, are usually breadwinners for their families. The adverse effects of SCI are not limited to the individual and family alone but the entire society [14]. There ought to be an urgent public policy response to address the causes of SCI in Nigeria.

RTA were the most common cause of TCSCI in this study. This is similar to findings in other studies [7,13]. RTA are said to be the leading cause of injury-related mortality in both developed and developing countries with developing countries bearing a disproportionately high share of the burden [15]. Some of the reasons RTA abound in developing countries are growth in motor vehicle numbers and poor enforcement of traffic safety regulations [16].

**Table 1. Demographic and clinical characteristics of patients**

| Variable | Frequency | Percentage |
|---|---|---|
| **Occupation of patients, n=47** | | |
| Student | 21 | 44.7 |
| Farming | 10 | 21.3 |
| Civil service | 7 | 14.9 |
| Business | 4 | 8.5 |
| Artisanship | 3 | 6.4 |
| Retirees | 2 | 4.3 |
| **Aetiology of TCSCI*, n=47** | | |
| RTA** | 29 | 61.7 |
| Fall from height | 8 | 17.0 |
| Falling objects | 5 | 10.6 |
| Diving into shallow pools | 3 | 6.4 |
| Firearm injuries | 2 | 4.3 |
| **Means of transport of patients to A&E, n=47** | | |
| Saloon cars | 34 | 72.3 |
| Commuter buses | 7 | 14.9 |
| Ambulance | 3 | 6.4 |
| Motorcycle taxis | 3 | 6.4 |
| **Type of TCSCI, n=47** | | |
| Atlanto-axial injuries | 3 | 6.7 |
| Subaxial injuries | 44 | 93.3 |
| **Severity of injury (ASIA#)** | | |
| Grade A | 31 | 66.0 |
| Grade B | 5 | 10.6 |
| Grade C | 7 | 14.9 |
| Grade D | 3 | 4.9 |
| Grade E | 1 | 2.1 |

**Traumatic cervical spinal cord injury, **Road traffic accidents,*
*#American Spinal Injury Association*

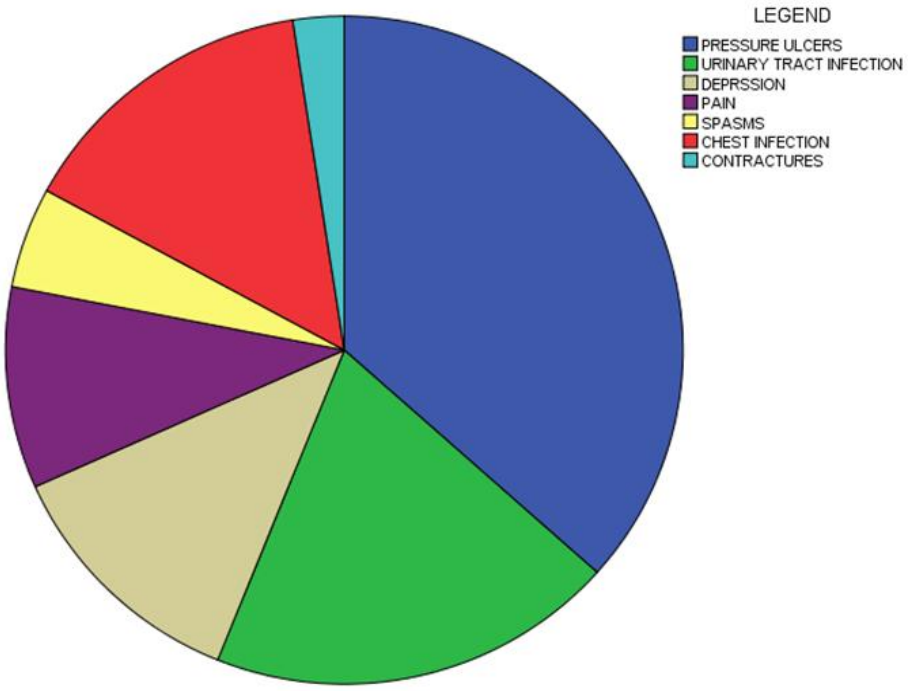


**Fig. 2. The distribution of complications among patients**

The absence of a formal pre-hospital trauma care in the study area means urgent airway management and protection of the injured spine to prevent aggravation of injury cannot be guaranteed. This is likely to be a major contributing factor to the morbidity and mortality of TCSCI.

Accidental falls were the next most important cause of cervical spine injury in this study. Falls play an important role in the causation of cervical SCI [8,17]. While falls from height are responsible for most cases of fall-related SCI, low-level falls are of importance in populations with a lot of elderly patients [18]. Most falls in this study were from heights among palm wine tappers, electricians and carpenters. Some of the workers use inefficient locally-fabricated safety equipment. Establishment and enforcement of complete fall protection protocol for people at risk of falling while working at heights may help reduce fall-related cervical SCI in Nigeria. The program should include training users, selecting, fitting, and inspecting equipment.

Firearm injuries were the least common cause of cervical SCI in this study. This may be because the neck presents a small surface area compared to other parts of the spine and that the injuries may be so severe that the patients do not make it to the hospital. The cavitation effect of high-velocity injuries explain some cases of complete cord injuries seen with no vertebral fractures.

The mean duration between injury and presentation to hospital was 4.6 days. Late presentation has been reported in similar studies done in developing countries [19,20]. Patients remain in peripheral hospitals in sub-optimal conditions that may lead to the development of complications resulting in increased morbidity and mortality. Financial constraints have been cited as important impediment to effective management of cervical SCI in Nigeria [21]. Almost all patients cater for their hospital bills. The National Health Insurance Scheme at the moment is not comprehensive with regards to SCI. Extending comprehensive insurance coverage to the entire population may help curb the menace of delayed presentation among these patients.

Majority of patients (93.7%) showed involvement of the subaxial region of the cervical spine with C 5 being the most commonly involved. Involvement of the atlanto-axial region may reflect poor initial survival precluding them from presenting to hospitals. There was no neurological deficit in 3 cases, 13 were motor

and sensory incomplete and 31 were motor and sensory complete.

PU were the most common complication noted in this study. They are a frequent cause of morbidity among spinal cord-injured patients [6, 10,19] The causation of PU is multifactorial. While direct pressure or shear over bony prominences is necessary, there are multiple systemic, internal, and external factors that contribute to the development of PU, including but not limited to such divergent factors as skin moisture level, nutritional factors, psychosocial, and cognitive issues [22]. They are costly to manage and result in prolonged hospitalizations, delayed community reintegration, reduced quality of life, and loss of self-esteem [22,23]. Prevention of these ulcers is one of the cornerstone principles of management. This involves education, involvement and education of family, increased nurse-to-patient ratio, optimized nutrition, maintaining good skin hygiene, having pressure relief surfaces and finally having 'turning teams' or other ways of regular pressure relief [24]. Treatment of the ulcers when they occur is paramount. However insufficient human and material resources are an impediment to efficient implementation of these measures.

A SCI may interrupt the communication between the pontine micturition center and the spinal cord in cervical SCI causing neurogenic lower urinary tract dysfunction [25]. This may result in incontinence and bladder-emptying difficulties which then predispose to, among others, UTI. UTI is a major cause of morbidity and mortality among SCI patients. It was the second most prevalent complication in this study. The neurogenic bladder in SCI patients `is predisposed to an increased risk of infection because of incomplete voiding, elevated intra-vesical pressure and catheter use [26]. All the patients in the study had indwelling urethral catheters as the method of urinary drainage during the spinal shock and rehabilitation periods. The use of an indwelling urethral catheter (IUC) is an important risk factor for UTI. Clean intermittent catheterization (CIC) is said to be the method of choice of bladder management in SCI patients during the rehabilitation phase. CIC (that is, self-catheterization) decreases complication rates compared with IUC and is recommended for the management of neurogenic bladder dysfunction [27]. However, IUC are used to a large extent in resource-constrained settings because of a lack of catheters and staff to assist with catheterization, and a resistance among patients to self-catheterize [26].

## 5. CONCLUSIONS

TCSCI predominantly affects young male patients and caused by RTA. It mostly involved the subaxial spine. Majority of patients had ASIA Class A injuries. Pressure ulcers and urinary tract infections were the most common complications encountered.

## CONSENT

It is not applicable.

## ETHICAL APPROVAL

It is not applicable.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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