ORIGINAL ARTICLE

Nonoperative treatment of acute traumatic spinal injuries: A prospective study

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Abstract

Background: Traumatic spinal injury is a major cause of morbidity and mortality worldwide. There is no agreed method of care. Neurological recovery in complete injury has been dismal.

Aims and Objectives: The aim of this study is to determine the neurological recovery at discharge in traumatic spinal injury patients managed nonoperatively in our center.

Materials and Methods: This was a prospective descriptive study carried out on traumatic spinal injury patients managed by neurosurgical unit in our center from August 2010 to July 2013. The unit started in July 2010 with virtually no available facilities for surgical care for these patients. All patients were managed nonoperatively. The unit recorded data of the patients in accident and emergency, intensive care unit, and wards using structured proforma. Data were analyzed using Epi Info 7 software.

Results: There were 76 patients studied of which 57 were males and 25 were females. Fifty three were caused by road traffic accident. Nineteen were complete injury. Patients with incomplete injuries did well at discharge. Completeness of injury significantly affected the outcome.

Conclusion: The neurological recovery in incomplete spinal injuries in our study was good, but poor in complete injury. Conservative treatment should be adopted in developing countries in patients with poor resources and in centers where facilities are not available for adequate imaging and surgical care. Trauma system is imperative in our country.

Key words: Nonoperative, spinal injuries, traumatic, treatment

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Introduction

Spinal injury is a devastating neurosurgical condition not only to the patients, their relatives and caregivers, but to the society in general. It affects 200,000 people yearly in USA with nearly 10,000 new cases annually.[1] It has worldwide incidence of 15-40 cases/million people.[2] The clinical effects are from primary injury as well as secondary injury that results from disruption of microvasculature leading to edema and release of vasoactive amines and free radicals.[3,4] Operative and nonoperative managements, and their effects on neurological recovery are controversial. The outcome in complete spinal cord injury (SCI) is at best frustrating.[5]

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Materials and Methods

This is a prospective cross-sectional study of the outcome of patients with traumatic spinal injuries managed by our neurosurgical center from August 2010 to July 2013. The neurosurgical unit started in July 2010 with no facilities for surgical care of spinal injury patients and no functional intensive care unit (ICU) in the hospital. No magnetic resonance imaging (MRI) or computerized tomography scan in the hospital or within the city. We managed all the patients nonoperatively.

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Spinal injuries managed by the unit from August 2010 to July 2013 were included in the study. Whiplash injuries, those referred to centers with better facilities, and those discharged against medical advice were excluded from the study.

Protocol

We used Philadelphia collar to splint the neck in cervical spine injuries and corsets for thoracic and lumbar spine injuries. We resuscitated patients in accident and emergency with normal saline ensuring they were normotensive and euvolemic. They were given intramuscular (im) paracetamol 1 g 8 hourly and im diclofenac 75 mg 12 hourly. Those with open wounds were given intravenous (IV) ceftriaxone 1 g daily for 2 days or more if there was infection. Those with high cervical injury or associated chest injuries with respiratory distress were given oxygen through nasal catheter or face mask. We started ventilating patients in 2012 when ventilators were provided in ICU. Other organ injuries were treated as needed. Size 14 Foley's catheter was passed in accident and emergency. X-rays of the sites involved were obtained in accident and emergency. They were kept on bed rest for 6-10 weeks. They were nursed on water/air mattresses. For those who could not afford water/air mattresses we used air ring (designed from foam) to protect pressure areas: Buttocks, heels, and the occiput. We used bisacodyl suppository from 3rd day if they fail to open bowel. One was inserted into the anus on alternate days. We commenced oral feeding once they started to open bowel, and they were given high energy and high protein diets 5-6 times daily. IV fluids and parenteral drugs were then discontinued. They were given vitamin C one tablet 3 times daily, vitamin E 1000 IU twice daily, and vitamin B complex one tablet 3 times daily. Aspirin 75 mg once daily and heparin (clexane) 40 mg once daily (for those who could afford it) were given to them. Two hourly turning, psycho- and physio-therapy were commenced once diagnosis was made and the site splinted. Check X-ray was taken 6 weeks postinjury. They were mobilized on seeing union on X-ray at site of lesion, on wheelchair or on feet when power in lower limbs were minimum of four, and subsequently discharged to outpatient clinic for follow-up. We referred some to occupational therapist on discharge as our center does not have occupational therapist.

We used structured proforma, which was part of our prospective data bank that was approved by our hospital Ethics and Research Committee to collect data. Biodata; history of the injury and clinical findings were filled in accident and emergency, and the progress of the patients filled in ICU and wards. Patients' American Spinal Injury Association (ASIA) impairment grades were recorded in accident and emergency and at discharge. Patients are graded from A to E. (A) Is complete spinal injury. (B) Is incomplete spinal injury with sensory, but no motor below the level of injury. (C) Is incomplete injury with more than 50% of key muscles below injury level having power below three. (D) Is incomplete injury with more than 50% of key muscles below the injury level having power more than 3. (E) Is normal sensory and motor. Center for Disease Control and Prevention, Atlanta, Georgia, USA. Epi Info 7 version 7.0.8.0 Oct 2011.(http://wwwn.cdc.gov/epiinfo/7/index.htm.).

Results

There were 76 patients studied. Males were 57 (75%) while females were 19 (25%). The age range was 17-74 years with mean age of 38.42 years. Patients aged 30-40 years had highest frequency of 26 patients [Table 1], but age did not play a significant role in the outcome $P = 0.168$. The hospital stay ranged from 14 to 97 days with average of 54.84 days. The most common region involved was cervical with 55 patients [Table 2]. Central cord syndrome was the most common lesion [Table 3]. Patients with complete SCI fared worst at discharge, while patients with central cord syndrome and Brown-Sequard syndrome (BSS) had best outcome. Type of injury significantly affected outcome, $P = 0$ [Table 4]. Complications associated with the lesion were significant factors in determining outcome, $P = 0.0001$ [Table 5]. The most common etiology was road traffic accident (RTA) and etiological factors played a significant role in outcome $P = 0.045$ [Table 6]. Patients who presented with Grade D had full recovery (Grade E). Four patients with ASIA Grade C improved to E before discharge, making a total of 29 (38.2%) with Grade E. ASIA grades at presentation significantly affected the outcome $P = 0$ [Table 7].

Discussion

There were 76 patients in the study with 75% males and 25% females. Obalum *et al.*[6] in Lagos, Nigeria, in 468 patients studied found males 70.1% and females 29.9%. Solagberu[7] in Ilorin, Nigeria, found 36 males and 3 females in 39 patients he studied. Draulans *et al.*[8] in their review of etiologies of spinal injuries in Sub-Sahara Africa found predominant male involvement. In our environment, males mainly provide for the families and are thus involved in occupations that predispose them to injuries such as driving commercial motorcycles and vehicles. Wine tapping and carpentry are almost exclusive of males and many of our patients fell from palm trees and roof tops. This was corroborated by the fact that RTA and fall were the most common etiologies. Obalum *et al.*,[6] Solagberu,[7] and Draulans *et al.*,[8] all found RTA and fall as most common etiologies. In western world, RTA was the most common etiology, followed by fall.[2,9,10] The most common region involved was the cervical region. Solagberu[7] found cervical region while Obalum *et al.*[6] found lumbar region the most involved areas. These are the most mobile areas of the spine and hence more vulnerable to injury.

American Spinal Injury Association grade at presentation, type of injury, etiology and complications significantly affected the outcome in our study. Pollard and Apple[11] discovered that central cord syndrome and BSS fared very well in their study. They found that age significantly affected their outcome. They concluded that most important variable relating to neurological recovery was completeness of the lesion. Other authors found that severity of injury determine the outcome.[12] Our result showed worst outcome in ASIA Grade A patients, corroborating their findings, but age did not affect outcome significantly in our study. This may be due to the fact that only one teenager was affected in our study.

One surprising thing about our study was effects of tissue hypoxia in those patients that needed ventilatory support and only got oxygen from nasal catheter or face mask. The expected secondary injury effect did not manifest in the result. Thus, the study showed that in the absence of ventilators for patients in respiratory distress, oxygen by face mask or nasal prongs may take longer time to stabilize the patient, but neurological outcome might be the same. It also showed that mild hypoxia might have affected neurological recovery positively. Recent finding by Hayes *et al.*[13] that daily intermittent hypoxia enhances walking after chronic spinal injury may also apply to acute spinal injury and needs to be studied.

Controversies in management of spinal injuries

Reduction of subluxation

Some authors in case reports and case series[14-17] argue that focal traumatic disc herniation which is often associated with spinal injuries leads to worsening neurological condition if reduction is attempted. In their study Doran *et al.*[16] found that closed reduction of facet dislocation associated with disc rupture might result in increased spinal cord compression and neurological deficit. Rizzolo *et al.*[18] found disc herniation in 80% of patients with bilateral facet dislocations and 100% of patients with anterior cord syndrome. However, Lee *et al.*[14] found that early reduction in patients with neurological deficits gave the best chances of neurological recovery. Waters *et al.*[19] found that motor recovery among tetraplegic individuals did not depend on whether unilateral and bilateral facet dislocations were reduced, and in patients with incomplete lesions, those with reductions actually had a poorer outcome than those who were left in a dislocated position. We did not attempt reduction in our patients due to lack of imaging modalities to establish the extent of injuries, and lack of ICU and surgical facilities in case of deterioration of patients during reduction.

Table 1: Age group frequency

Age (years)	Frequency	Percentage
10–<20	1	1.32
20–<30	16	21.05
30–<40	26	34.21
40–<50	16	21.05
50–<60	14	18.42
60–<70	2	2.63
70–<80	1	1.32
Total	76	100

Table 2: Regional frequency

Region	Frequency	Percentage
Cervical	55	72.37
Thoracic	10	13.16
Lumbar	11	14.47
Total	76	100

Surgery

Surgical management of spinal injuries is itself enmeshed in[20] reports indicated the potential neurological benefit associated with early spinal decompression[21-23] while others did not.[14,18,19,24] A Toronto group of investigators reviewed data that included all human SCI trials conducted from 1966 to 1998 and from 2000 to 2005 and found there was no clear census on the appropriate timing of surgical intervention and that there was no compelling evidence that early surgical decompression influences outcome[25-27] Pollard and Apple[11] discovered that neurosurgical recovery was not related to early surgery. Preliminary data from the recent surgical treatment for acute SCI studies trial showed that early surgery has the potential to offer improved neurological function.[28]

Conservative

Katoh *et al.*,[9] conservatively managed 63 patients with incomplete spinal injuries and found good

Table 3: Injury versus ASIA grades at presentation

Type of injury	ASIA grades at presentation				
	A	B	C	D	Total
Anterior cord syndrome	0	7	7	14	28
Brown-Sequard syndrome	0	1	1	1	3
Cauda equina syndrome	1	1	3	0	5
Central cord syndrome	0	2	9	10	29
Complete	19	0	0	0	19
Total	20	11	20	25	76

ASIA=American Spinal Injury Association

Table 4: Injury versus ASIA grades at discharge

Type of injury	ASIA grades at discharge						
	A	B	C	D	Died	E	Total
Anterior cord syndrome	0	1	4	7	1	15	28
Brown-sequard syndrome	0	0	0	2	0	1	3
Cauda equina syndrome	1	0	0	3	0	1	5
Central cord syndrome	0	0	0	9	0	12	21
Complete	13	1	0	0	5	0	19
Total	14	2	4	21	6	29	76

P=0. ASIA=American Spinal Injury Association

neurological improvement. They noted that the inherent nature of the injury and the lack of sensitive scales for measuring small changes in neurological progress are probably two of the many reasons why an assessment of the influence of treatment on recovery is difficult. Many other authors reported conservative management of spinal injuries.[29,30] Rahimi-Movaghar *et al.*[31] compared surgical and nonoperative treatment with respect to motor recovery and found better recovery among nonoperative group. The sample size was small; hence, it cannot be said to be significant.

No superiority

In their study Donovan *et al.*[30] found that the extent of neurological recovery did not depend on surgical versus nonsurgical management. Tator *et al.*[32] in their comparison of surgical and conservative management of 208 patients with acute SCI found that there was no difference between operated and nonoperated patients in length of stay or neurological recovery. Waters *et al.*[19] discovered that motor recovery did not significantly differ between patients categorized in various surgical subgroups (early and late) or between those having surgery and those treated nonoperatively.

Table 5: Complications versus ASIA grades at discharge

Complications	ASIA grades at discharge						
	A	B	C	D	Died	E	Total
Depression	1	0	1	0	0	0	2
Fecal impaction	0	0	0	3	0	1	4
Multiple	5	0	0	4	2	0	11
None	2	0	2	9	2	28	43
Others	0	0	0	0	1	0	1
Pneumonia	0	0	0	1	0	0	1
Pressure sores	4	1	1	3	1	0	10
Urine retention	2	1	0	1	0	0	4
Total	14	2	4	21	6	29	76

P=0.0001. ASIA=American Spinal Injury Association

Table 6: Etiology versus ASIA grades at discharge

Etiology	ASIA grade on discharge						
	A	B	C	D	Died	E	Total
Assault	1	0	0	0	1	3	5
Fall	5	0	0	5	0	2	12
Gunshot	0	0	0	1	0	0	1
Others	0	0	0	3	0	1	4
RTA	8	2	3	12	5	23	53
Sports	0	0	1	0	0	0	1
Total	14	2	4	21	6	29	76

P=0.045. ASIA=American Spinal Injury Association; RTA=Road traffic accident

Challenges and consolations

The aim of this study and its limit to when patients were discharged to avoid home environment effects on patients, was to use the "expected" poor result from secondary injuries from lack of facilities to put pressure on the management of the hospital to provide more facilities; but, we were somehow "disappointed" after the analysis and comparing it with other studies.

The nearest center where MRI and surgical care are available is about 400 km from our center with the connecting roads laden with pot holes. There is no linking flight. The first patient that went by road had severe respiratory distress on reaching the center. MRI showed cord edema reaching the medulla. It took them about 2 weeks to stabilize him before he had surgery. He developed gluteal pressure sores in the process and succumbed to sepsis. Most of our patients did not receive any prehospital care and many were brought to hospital with private cars, commercial vehicles, police vans or worse still, on motorcycles. Trauma system with air and road ambulances, and adequate insurance cover, could have helped these patients, but no trauma system in Nigeria. Majority of our patients were poor and could not afford private helicopters for their transfer to centers with adequate facilities.

Our consolation was that there was good outcome in these patients with nonsurgical protocols we used. Tears of joy during mobilization of these patients were soothing to our mental trauma. One of the patients who had anterior cord syndrome and was already concluded to be on wheelchair for life by villagers told us that there were wailing and rolling on the ground by villagers with songs of praise to God on seeing him walking to his house. Tears were rolling down his cheeks as he was narrating the story and my staff got "infected." A nurse who watched us mobilize one of our patients approached us and said "if you were here 3 years ago, my brother would not have died." There

Table 7: ASIA grades at presentation versus ASIA grades at discharge

Grade at presentation	ASIA grade at discharge (%)						
	A	B	C	D	Died	E	Total
A	14 (70)	1 (5)	0 (0)	0 (0)	5 (25)	0 (0)	20 (100)
B	0 (0)	1 (9.1)	4 (36.4)	5 (45.4)	1 (9.1)	0 (0)	11 (100)
C	0 (0)	0 (0)	0 (0)	16 (80)	0 (0)	4 (20)	20 (100)
D	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	25 (100)	25 (100)
Total	14 (18.4)	2 (2.6)	4 (5.3)	21 (27.6)	6 (7.9)	29 (38.2)	76 (100)

P=0. ASIA=American Spinal Injury Association

were many heart-warming actions and stories from many of our patients that encourage us to keep working in the challenging environment we found ourselves. We believe that we can make a difference with our knowledge no matter the situation.

Conclusion

Patients with incomplete spinal injuries did well under nonoperative care in our study, but the outcome of complete injury was poor. The result of our study showed that nonoperative care could be adopted for traumatic spinal injuries in poor resource centers while surgery should be done in careful selected cases to relieve pressure effect on cord or nerve roots. In developing countries where poverty is very high, patients' resources should be channeled into preventing secondary injuries and complications while surgery should take secondary position except those who can afford both. Study is needed on effects of low hypoxia on acute spinal injuries as intermittent hypoxia has been shown to be beneficial in chronic spinal injury patients. Trauma system with air and land ambulances coupled with good insurance coverage cannot be overemphasized in our country in this 21st century. This will enable patients have proper prehospital care before they are transferred to trauma centers.

Our result should encourage young neurosurgeons to go to rural areas and use their knowledge to serve the most economic vulnerable group in the society.

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