Print ISSN: 2321-6379
Online ISSN: 2321-595X

Original Article

Mortality in Cervical Spine Injury: A Study in a Tertiary Care Center in India

Arunesh Singh[1], Pranay Kumar Srivastava[2], S K Saraf[3]

[1]Associate Professor, Department of Orthopaedics, Chhattisgarh Institute of Medical Sciences, Bilaspur, Chhattisgarh, India, [2]Assistant Professor, Department of Orthopaedics, Pt. Jawahar Lal Nehru Memorial Medical College and Dr. Bhimrao Ambedkar Memorial Hospital, Raipur, Chhattisgarh, India, [3]Professor, Department of Orthopaedics, Institute of Medical Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, India

Abstract

Introduction: Cervical spine injury is a common injury worldwide. When cervical cord is also affected, it is the most devastating injuries due to poor recovery and disabling consequences. The management is still in the process of continuous evolution. However, even after so much ongoing research, there is no satisfactory treatment which can give complete restoration of the function.

Materials and Methods: The study was carried out as an observational study and had both prospective and retrospective components. The patient with cervical spine quadriplegia coming to the Department of Orthopedics as well as the bodies of the deceased with quadriplegia at the Department of Jurisprudence, Sir Sunderlal Hospital, Institute of Medical Sciences, Banaras Hindu University, over a period of 2 years from June 2005 to June 2007 were included in the study.

Results: A total of 92 patients of traumatic quadriplegia were admitted in orthopedics ward from May 2005 to June 2007. Of this, 44 patients expired either during the hospital stay or during follow-up period, a maximum of 6 months. The results are well depicted in tables.

Conclusion: There must be a training of primary health center staffs regarding the role of cervical immobilization during transportation to a hospital and also for rapid transportation of a cervical spine injury patient to a respective well-equipped hospital. The trained nursing staffs and a team approach along with well-equipped intensive care unit must be constituted for the management of traumatic quadriplegia patients.

Key words: Health, Injury, Spine

INTRODUCTION

Cervical spine injury is a common injury worldwide. When cervical cord is also affected, it is the most devastating injuries due to poor recovery and disabling consequences.

The management is still in the process of continuous evolution. However, even after so much ongoing research, there is no satisfactory treatment which can give complete restoration of the function.

Cervical spinal cord injury accounts for 2–3% of all traumatic injuries and 8.2% of all trauma-related deaths.[1-3] In cervical spine injury, mortality can be as high as 15-30%.[4]

Due to the absence of spinal cord injury registries in India, there are little data about the demography, social and economic burden, and mortality from these injuries in India.[5] Furthermore, there are a limited number of studies from India, where the demographics vary from the rest of the world due to varied population and their customs.

MATERIALS AND METHODS

The study was carried out as an observational study and had both prospective and retrospective components. The patient with cervical spine quadriplegia coming to the Department of Orthopedics as well as the bodies of the deceased with quadriplegia at the Department of Jurisprudence, Sir Sunderlal Hospital, Institute of Medical Sciences (IMS), Banaras Hindu University (BHU), over

Access this article online

www.ijss-sn.com

Month of Submission : 09-2019
Month of Peer Review : 10-2019
Month of Acceptance : 11-2019
Month of Publishing : 11-2019

Corresponding Author: Dr. Pranay Kumar Srivastava, Flat Number E-7, Ralas Enclave, Daganiya, Raipur, Chhattisgarh, India.

a period of 2 years from June 2005 to June 2007 were included in the study.

All the patients of traumatic quadriplegia were included and all dead quadriplegic patients coming from all hospitals for autopsy to the institute were included in the study.

All admitted patients were subjected to a detailed questionnaire and clinical examination as per pro forma. Details about family, social and economic background, contact details, and postal address were taken. Documentation regarding clinical photographs of the patients and X-rays of the patients was done. Detailed history about the mode of trauma, mode of transportation to hospital, details about spinal immobilization, methylprednisolone use, or any treatment carried out before visiting the hospital was noted. A thorough neurological evaluation of the sensory, motor, and autonomic affection of the patient by the injury was done.

Frankel's classification of neurological deficits in traumatic quadriplegia and classification of injury was done.

Frankel's Classification of Neurologic Deficits in Patients with Traumatic Quadriplegia

A. Absent motor and sensory function
B. Sensation present, motor function absent
C. Sensation present, motor function active but not useful (Grade 2–3/5)
D. Sensation present, motor function active and useful (Grade 4/5)
E. Normal motor and sensory function.

Classifications of Injury

All cervical spine injuries were classified on the basis of

- Level of injury
- Type of injury
- Stability of injury.

On the basis of neurological examination and local examination, the level of vertebral injury was clinically detected. For cervical spine injury, standard anteroposterior and lateral radiographs of the cervical spine were done. An anteroposterior open mouth view for suspected fracture C1–C2 and a lateral swimmers view for C6–C7 fracture were taken. For unilateral facet fracture or facet unlock, the left and the right oblique views were taken. In cases of doubtful subluxation, flexion extension views of the spine were taken till the point patient was comfortable.

In cases, where no bony injury was anticipated on X-rays and whenever a patient could afford, magnetic resonance imaging was done. All routine and baseline investigations, chest X–rays, and other relevant investigations concerned with the pre-existing disease of the patient were done at the time of admission. In suspected cases of head injury, computed tomography scan of head and brain was done and all investigations (ultrasound chest/abdomen, etc.) related to other associated injuries were undertaken.

Indoor Patients

For all indoor patients with a traumatic cervical spine injury except in those with a minor fracture or those with no neurological deficits, crutch field tongs (CFTs) were applied and traction given for 3–4 weeks.

Rest were given head halter traction. After 3–4 weeks of CFTs, the CFT was removed; patients were given head halter traction. For the patients managed on domiciliary basis, head halter traction was given.

The protocol for the management is given in Table 1.

Treatment

1. Minor fracture (all without neurological deficit)	Hard cervical collar for 2 months.
2. Stable fracture without neurological deficit	Four post collar for 2 months. Hard cervical collar for next 1 month.
3. Stable fracture with neurological deficit	Traction and bed rest for 3 months.
4. Unstable fracture without neurological deficit	Traction and bed rest for 3 months followed by ambulation with four post collar for next 3 months followed by hard cervical collar for next 3 months or surgical stabilization.
5. Fracture with neurological deficit	Traction and bed rest for 3 months or surgical stabilization.

General Care

Proper back care, bowel and bladder care, and quadriplegics care were explained and taught to the attendant.

General Examination

Regular neurological charting was done to look for neurological recovery. Daily clinical examination and auscultation of the chest were done to see for impending respiratory tract infections. In cases of respiratory tract infections, patient was started on oxygen, intravenous fluids, and antibiotics. Whenever required, the patient was shifted to intensive care unit (ICU). Daily clinical examination of the lower limb was done to look for deep vein thrombosis (DVT). In cases of suspected DVT, anticoagulant therapy was started. Daily examination for bedsores was done. Waterbed was given for those with bedsores or impending bedsores. In patients with bedsores, daily dressings/debridements were done.

Investigations

- In case of suspected DVT, color Doppler was done in the 1st and 3rd weeks after injury
- Urine routine microscopy and culture/sensitivity were

sent in every 1st and 3rd week after injury directly from the catheter
- Serum electrolytes and creatinine were done every fortnightly to look for electrolyte imbalance
- Whenever chest infection was suspected, portable X-ray chest was done
- In cases of deterioration, all routine investigations were sent and basic life-saving measures were employed and when required and when patients could afford, the patient shifted to ICU
- In cases of death.

In patients, in whom autopsy was possible, relevant clinical photographic documentation was done.

In cases, where autopsy was not possible, cause of death was determined on the basis of antemortem symptoms and signs presented by the patients and clinical investigations.

Follow-up

The patients were followed at an interval of 6 weeks for the first 6 months. During follow-up, patients were thoroughly examined clinically as well as neurologically and recovery in neurological status, and bowel and bladder function was noted. Patients were evaluated for any new complication.

In cases of mortality at home, all relevant information were acquired through telephonic conversation with relatives and if possible a visit to the site of death was made.

All the patients who had useful or normal motor power in lower limbs (Frankel Grade D or E) were allowed walking after 3 months with or without orthosis and/or crutches depending on the stability of the fracture and/or extent of neurologic deficit.

The patients who had absent or useless motor power in lower limbs (Frankel A, B, or C) were allowed walking after 3 months on wheelchair, orthosis.

After 6 months, these patients were trained to stand and walk independently with the help of high knee-ankle-foot orthosis with fixed pelvic belt and walker or axillary crutches.

Cases Directly Coming for Autopsy at the Department of Medical Jurisprudence, IMS, BHU

All relevant information were collected from the relative accompanying the dead body and the hospital where patient was being treated/admitted before his death. Photographic documentation was done of autopsy findings of cervical spine injury and any other related injuries contributing to the cause of death.

RESULTS

A total of 92 patients of traumatic quadriplegia were admitted in orthopedics ward from May 2005 to June 2007. Of this, 44 patients expired either during the hospital stay or during follow-up period, a maximum of 6 months.

There were 14 dead bodies of traumatic quadriplegia patients coming for autopsy at the department of medical jurisprudence.

A total of 58 deaths were considered for the final analysis.

Age Distribution

It is obvious from Table 1 that out of all deaths 65.6% were in the age group of 21–50 years.

Mode of Injury

Cases included in this study were further divided into seven groups according to different modes of injury [Table 2].

Fall from height was the most common mechanism of injury (48.3%). The most common type of falls was fall from roof (without parapet), trees, electric pole, and stairs.

Only patients coming directly to SS Hospital were included in this table.

Most of the patients were brought to our hospital without any cervical immobilization (95.7%).

Table 1: Description of patients in terms of age

Age	Number of cases	Percentage
0–9	0	0.0
10–19	7	12.1
20–29	12	20.7
30–39	11	19.0
40–49	15	25.9
50–59	4	6.9
60–69	7	12.1
≥ 70	2	3.4
Total	58	100

Table 2: Mode of injury

Mode of injury	Number of cases	Percentage
Fall from height	28	48.4
Road traffic accident	8	13.8
Railway accident	4	6.9
Assault	6	10.3
Firearm injury	4	6.9
Hit by animal	2	3.4
Others	6	10.3
Total	58	100

Time Interval between Injury and Reporting to Hospital

Only patients coming directly to SS Hospital were included in the table. Patients treated in other hospitals whose dead bodies came for autopsy in our hospital were not included in the table.

About 36.4% of patients reached hospital within 24 h of injury and 40.9% of patients reached hospital after 48 h–1 week of injury [Table 3].

Most of the deaths were recorded in lower cervical group as 67.3% [Table 4].

Patients hospitalized in our hospital were further classified into various groups on the basis of level of injury. Then, mortality in each group was assessed.

The most common injury in hospitalized patients was lower cervical vertebrae (68.5%). Percentage mortality of upper cervical injury was 53% as compared to lower cervical injury which was 46% [Table 5].

All the cases were further classified according to the type of injury into the following groups.

The most common type of injury was fracture dislocation/subluxation 52.3% followed by burst fracture 18.1% [Table 6].

All the hospital deaths were further classified, on the basis of Frankel's grading into five groups [Table 7].

Most of deaths were observed in Frankel's Group A (52.3%) followed by Frankel's Group B (47.7%). No deaths were observed in Frankel's Groups C, D, and E.

Associated Injuries [Table 8]

Sixteen of 58 cases had other associated injuries. Most common being head and facial injury, followed by skeletal injury, chest, and abdominal injury.

Hence, 27.2% of patients had associated injury. The most common injury was head and facial injury in 15.3% of cases. Skeletal injury occurred in 6.8% of cases.

Time Interval between Injury and Death [Table 9]

The 1st week after injury was the most crucial period for the survival of traumatic quadriplegia patients.

Most of the deaths were recorded in the 1st week after injury in 70.7% of cases.

Causes of Death [Table 10]

Causes of death were classified into pneumonia, acute respiratory failure (death within 3–4 days of injury without any other apparent cause), head injury with coma, bedsore, hemorrhagic shock, laryngospasm, medical causes (renal failure, etc.), DVT, and others (drowning, asphyxia, etc.).

Most of the deaths occurred due to pneumonia (27.6%). Other important causes of death were acute respiratory failure (22.4%), head injury with coma (15.5%), and hemorrhagic shock (10.3%).

Most of the deaths occurred within the 1st week of injury which was further classified into the following groups.

Most of the deaths within the 1st week of injury occurred due to acute respiratory failure (36.1%). Other

Table 3: Description of patients in terms of time interval between injury and reporting to hospital (*n*=44)

Time interval between injury and reporting to hospital	Number of cases	Percentage
0 – 24 h	16	36.4
24 – 48 h	06	13.6
48 h–1 week	18	40.9
1–2 weeks	04	9.1
> 2 weeks	0	0.0
Total	44	100

Table 4: Level of injury in all deaths (*n*=58)

Level of injury	Number of deaths (*n*=58)	Percentage mortality
Upper cervical (C_1–C_4)	13	22.4
Lower cervical (C_5–C_7)	39	67.3
No bony injury	6	10.3
Total	58	100.0

Table 5: Level of injury in all deaths in hospitalized group (*n*=44)

Level of injury	Number of deaths	Number of cases (*n*=44)	Percentage mortality (%)
Upper cervical	9	17	53
Lower cervical	29	63	46
No bony injury	6	12	50
Total	44	92	47.8

Table 6: Type of injury (*n* = 44)

Diagnosis	Number of cases	Percentage
Fracture dislocation/subluxation	23	52.3
Burst fracture	8	18.1
Wedge compression	6	13.6
Fracture osteophytes	1	2.2
No obvious bony injury	6	13.6
Total	44	100

Table 7: Frankel's grading

Frankel's	Number of cases	Percentage
A	23	52.3
B	21	47.7
C	0	0
D	0	0
E	0	0
Total	44	100

Table 8: Associated injuries

Associated injuries	Number of cases	Percentage
Skeletal injury	4	6.8
Head and facial injury	9	15.3
Chest injury	2	3.4
Abdominal injury	1	1.7
Total	16 (58)	27.2 (100)

Table 9: Time interval between injury and death

Time interval between injury and death	Number of cases	Percentage
1 week	36	62.1
1–3 weeks	14	24.1
> 3 weeks	8	13.8
Total	58	100

Table 10: Causes of death

Cause of death	Number of cases	Percentage
Pneumonia	16	27.6
Acute respiratory failure	13	22.4
Head injury with coma	9	15.5
Bedsore	4	6.9
Hemorrhagic shock	6	10.3
Laryngospasm	3	5.2
Medical causes	1	1.7
Deep vein thrombosis	3	5.2
Others	3	5.2
Total	58	100

Table 11: Cause of death in cases of mortality within 1 week

Cause of death	Number of cases	Percentage
Pneumonia	3	8.3
Acute respiratory failure	13	36.1
Head injury with coma	9	25
Bedsore	0	0
Hemorrhagic shock	5	13.8
Laryngospasm	2	5.6
Medical causes	0	0
Deep vein thrombosis	2	5.6
Others	2	5.6
Total	36	100

important causes of deaths were head injury with coma (25%), hemorrhagic shock (13.8%), pneumonia (8.3%), laryngospasm (5.6%), DVT (5.6%), and others (5.6%) [Table 11].

Table 12: Use of cervical immobilization during transportation in hospitalized patients

Cervical immobilization	Number of cases	Percentage
Yes	4	4.3
No	88	95.7
Total	92	100

DISCUSSION

In this study, 65.6% of cases were from 20 to 49 years age group. This is the most physically active age group. Sundram[6] (1984) in his Madras series of 499 cases and Singh *et al.*[7] (2003) in his series of 483 cases, of which 164 were tetraplegics and 283 were paraplegics reported similar results.

In this study, 48.3% of patients sustained injury due to fall from height and only 13.8% of patients sustained injury due to road traffic accidents. There is a seasonal variance in incidences of traumatic quadriplegia since most of the people sleep on the roof (without parapet) at night, plucking of seasonal fruits from trees, leading to increased incidences of fall from height. Activities of daily living and living standard of the people living in this part of India (Eastern U.P., M.P., and Bihar) are entirely different from the people living in Metropolitan cities or Western countries which explain why fall from height is the main cause of traumatic quadriplegia in this part of India and not the road traffic vehicular accidents.

Chacko *et al.*[8] (1985) reported fall from height in 55.2% of cases and road traffic accident in 12.8% of cases, Sundram[6] (1987) reported 66% of cases in fall from height and 14% in road traffic accident, Dave *et al.*[9] (1994) reported fall from height in 49.4% of patients and road traffic accident in 36.5% of patients, Singh *et al.*[7] (2003) reported fall from height in 44.5% of cases and road traffic accident in 34.8% of cases. Karacan *et al.*[10] (Turkey) (2000) reported fall from height in 36.5% of cases and road traffic accident in 48.8% of cases; Lan *et al.*[11] (Taiwan) (1993) reported fall from height in 23.3% of cases and road traffic accident in 61.6% of cases; Powell *et al.*[12] (Australia) (1999) reported fall from height in 31% of cases and road traffic accident in 43% of cases; and spinal cord facts and figures as a Glance – June 2006, USA, reported road traffic accident in 46.9% of cases and fall from height was the second most common cause of injury. Thus, from above data, one can conclude that fall from height is the most common cause in Indian scenario and

road traffic accident is the most common cause in western countries and metropolitan cities in India.

Most of the patients were transported to our hospital without any prior cervical immobilization (95.7%) [Table 12]. Due to repeated movements of the unsupported neck in cases of unstable type of cervical spine injury, there are repeated episodes of secondary insult to cervical spinal cord. This leads to ascending edema of cord which further compromises the respiration, leading to increased mortality due to acute respiratory failure.

Only 36.4% of patients reached hospital with 24 h of injury. Most of the patients reached hospital after 48 h of injury 40.9%, 9.1% reached after 1 week of injury. We have also observed in the study that the maximum number of deaths occurs in the 1st week of injury and that sooner the patient reaches the hospital the chances of his/her survival greatly increase. This is the gray area where we have scope for intervention and improvement. If we could provide cervical immobilization during transportation and provide for early transport of patient to the medical center with improved ambulance facilities, we can definitely reduce the mortality associated with cervical spine injury.

In this study, a total of 92 cases of traumatic quadriplegia patients were admitted in SS Hospital, of this 17 were upper cervical injury, 63 were lower cervical injury, and in 12 cases, no bony injury could be determined. Of this, 9 (53%) cases having upper cervical spine injury expired, number of expiry in lower cervical spine injury group was 29 (46%), and in 6 cases (50%), mortality was recorded in no obvious bony injury group. One can easily argue that upper cervical spine injury is more dangerous than the lower cervical spine injury due to involvement of the diaphragm (C3–C5). Hence, percentage mortality in upper cervical injury is more than the lower cervical spine injury group. However, one should note that the level of bony injury never always corresponds to the level of radiological diagnosis. Cord contusion and necrosis may extend higher up in the cord. Lower cervical spine injuries are further complicated with ascending edema of cord, which may further complicate respiration, leading to increased mortality.

About 52.3% of deaths were observed in complete type of injury (Frankel's A) and 47.7% were in incomplete type of injury (Frankel's B). No mortality was observed in Frankel's Groups C, D, and E.

The number of patients having associated injuries is also very high. The type of the associated injuries greatly modifies the ultimate management of the patients. In cervical cord injury with head and facial injuries and other musculoskeletal trauma, the management is very difficult. Mortality is high in all these associated injuries individual since cervical cord injury itself is a very critical condition as far as handling of the patients is concerned which is further compounded by associated injury. In our study, the most common associated injuries were head and facial injuries (15.3%) followed by skeletal injury (6.8%). Karamehmetoğlu *et al.*,[13] 1997, and Nwadinigwe *et al.*,[14] 2004, reported head and facial injury to be most commonly associated with cervical spine injury.

The causes of death following spinal cord injury have changed. In the past, urinary tract disease and renal failure were leading causes of mortality. At present, renal failure in those with spinal cord injury is unusual. The leading cause of death at present is pneumonia.

In our series, pneumonia is the leading cause of death (27.6%), followed by acute respiratory failure (22.6%), head injury with coma (15.5%), hemorrhagic shock (10.3%), and bedsores (6.9%).

Acute respiratory failure was the most common cause of death within the 1st week (36.1%).

Since the patients in our setup reached to hospital after 48 h after injury in most of the cases, this led to loss of precious time in instituting early emergency life-saving measures. Cervical immobilization was rarely used during transportation of these patients, leading to secondary insult to already damaged cervical spinal cord, causing ascending edema and thus respiratory failure.

CONCLUSION

To reduce the incidence of traumatic quadriplegia patients and deaths due to it, awareness among the patients regarding hazards of rooftop without parapet, and road safety measures should be increased. There must be a training of primary health center staffs regarding the role of cervical immobilization during transportation to a hospital and also for rapid transportation of a cervical spine injury patient to a respective well-equipped hospital. The trained nursing staffs and a team approach along with well-equipped ICU must be constituted for the management of traumatic quadriplegia patients.

REFERENCES

1. Harrop JS, Sharan AD, Scheid EH Jr., Vaccaro AR, Przybylski GJ. Tracheostomy placement in patients with complete cervical spinal cord injuries: American spinal injury association grade A. J Neurosurg 2004;100:20-3.

2. Kang SW, Shin JC, Park CI, Moon JH, Rha DW, Cho DH, *et al*. Relationship between inspiratory muscle strength and cough capacity in cervical spinal cord injured patients. Spinal Cord 2006;44:242-8.
3. Shackford SR, Mackersie RC, Holbrook TL, Davis JW, Hollingsworth-Fridlund P, Hoyt DB, *et al.* The epidemiology of traumatic death. A population-based analysis. Arch Surg 1993;128:571-5.
4. Lee KS, Doh JW, Bae HG, Yun IG. Causes of death and cardiopulmonary function in cervical spine injury. J Korean Neurosurg Soc 1994;23:1055-62.
5. Sharma BK, Pal SS, Chaudhary D. Epidemiological study of cervical spine injury. Int Surg J 2016;3:1431-6.
6. Sundram TK. Final Report of Madras. Madras: Paraplegia Project; 1987.
7. Singh R, Sharma SC, Mittal R, Sharma A. Traumatic spinal cord injuries in Haryana: An epidemiological study. Indian J Community Med 2003;28:184-6.
8. Chacko V, Joseph B, Mohanty SP, Jacob T. Management of spinal cord injury in a general hospital in rural India. Paraplegia 1986;24:330-5.
9. Dave PK, Jayaswal A, Kotwal PP. Spinal cord injuries a clinico-epidemiological study. Ind J Orthop 1994;28:39-45.
10. Karacan I, Koyuncu H, Pekel O, Sümbüloglu G, Kirnap M, Dursun H, *et al.* Traumatic spinal cord injuries in Turkey: A nation-wide epidemiological study. Spinal Cord 2000;38:697-701.
11. Lan C, Lai JS, Chang KH, Jean YC, Lien IN. Traumatic spinal cord injuries in the rural region of Taiwan: An epidemiological study in Hualien county, 1986-1990. Paraplegia 1993;31:398-403.
12. Powell M, Kirshblum S, O'Connor KC. Duplex ultrasound screening for deep vein thrombosis in spinal cord injured patients at rehabilitation admission. Arch Phys Med Rehabil 1999;80:1044-6.
13. Karamehmetoğlu SS, Nas K, Karacan I, Sarac AJ, Koyuncu H, Ataoğlu S, *et al.* Traumatic spinal cord injuries in Southeast Turkey: An epidemiological study. Spinal Cord 1997;35:531-3.
14. Nwadinigwe CU, Iloabuchi TC, Nwabude IA. Traumatic spinal cord injuries (SCI): A study of 104 cases. Niger J Med 2004;13:161-5.

How to cite this article: Singh A, Srivastava P, Saraf SK. Mortality in Cervical Spine Injury: A Study in a Tertiary Care Center in India. Int J Sci Stud 2019;7(8):54-60.

Source of Support: Nil, **Conflict of Interest:** None declared.