

Traumatic Spinal Cord Injuries in South Coastal Region of Andhra Pradesh

Kathi Aswani Kishore¹, Niranjan Kumar Gunjan²

How to cite this article:

Kathi Aswani Kishore, Niranjan Kumar Gunjan/Traumatic spinal cord injuries in South Coastal Region of Andhra Pradesh/ Indian J. Forensic Med Pathol. 2021;14(1): 17-26.

Abstract

Background: Traumatic Spinal Cord Injury (TSCI) is serious health problem among adults. It leads to significant morbidity, mortality, permanent disability and socio-economic effect. The present study was conducted in Narayana Medical College, Nellore State Andhra Pradesh.

Aims and Objectives: To know the common age group that is mostly prone to TSCI, sex difference of TSCI, the area of distribution of TSCI cases, mode of injury, various management modalities like Surgical, ICU stay etc and their role in the prognosis of patients with TSCI, the site of injury commonly involved and GCS of patients admitted due to TSC. To know the mortality rate among TSCI patients.

Type of study: This is a two years retrospective and one year prospective study.

Place of study: Spinal cord injuries admitted in Narayana Medical College & Hospital - Nellore, during the years 1st October 2010 to 30th September 2013.

Material and Methods: All patients admitted and managed for traumatic spinal cord injury were retrieved and data collected in a pre-designed proforma. Patient characteristics, details of etiology, mechanism of injury, level of injury, extent of neurological deficits, details of investigations, details of management and immediate outcome were recorded.

Observations and Discussion: The maximum cases 40 were in the age group of 41-50 (26.31%). The mean age is 38.45 + 14.56. SCI cases were more common among males 115 (75.66%), than in females 37 (24.34%) and also the most common age group was between 41-50 years 33 (21.71%) followed by 21-30 years 30 (19.73%). Male to female ratio was 4.18: 1. It was observed that maximum cases were in rural area 132 (86.80%), followed by urban area 20 (13.20%). It was observed that most common cause was fall from height 93 (61.20%), followed by road traffic accidents 52 (34.20%). It was observed that most common site of injury was cervical 67 (44.10%), followed by lumbar 54 (35.50%), thoracic 29 (19.10%), thoracolumbar 2 (1.30%).

Conclusion: Traumatic spinal cord injuries affect young population and can leave these persons with significant functional and physical morbidity. Male persons are more commonly injured than females.

Key words: Spinal cord injury; Spinal injuries; Spinal trauma.

Authors Affiliation: ¹Assistant Professor, Department of Forensic Medicine and Toxicology, Narayana Medical college, Chinthareddy Palem, Nellore, Andhra Pradesh 524003, India. ²Assistant Professor, Department of Forensic Medicine and Toxicology, Mata Gujri Memorial Medical College, Kishanganj, Bihar 855107, India.

Corresponding Author: Niranjan Kumar Gunjan, Assistant Professor, Department of Forensic Medicine and Toxicology, Mata Gujri Memorial Medical College, Kishanganj, Bihar 855107, India.

E-mail: niranjan.gunjan@gmail

Introduction

The cervical spine, being the most mobile portion of the spine, is the most common site of spinal injuries. An estimated 12000-14000 spinal cord injuries occur each year out of the total of 200000 traumatic spinal column injuries in the United States.¹⁻⁶ Nearly 10000 patients will die each year as a result of an injury to the spinal cord.^{5,7-10} The most frequent age group to suffer an injury to the spinal cord is 15-30 years, motor vehicle accidents, falls, and sports being the most common mechanisms

of injury^{2,5,11-13}. The cause of spinal injury varies with age, and particularly sex, with males being three to four times as likely to sustain an injury than females. Age is also a determinant of the type of spinal injury as children less than 4 years of age have fewer vertebral injuries than adults¹⁴. The injuries in young pediatric population tend to occur between the occiput and C2, representing 40% of all pediatric spine injuries, whereas only 20% of adult spinal injuries occur at this level.^{1,14-16} Anatomical differences of the pediatric spine includes ligaments laxity, incompletely ossified and wedge-shaped vertebral bodies, shallow and horizontal facet joints, and underdeveloped neck muscles.^{14,15} Subluxation injuries without fracture and spinal cord injuries without radiographic abnormality (SCIWORA) are very rare in adults and occur sometimes in young persons.^{14,15,17}

Neurological Injury

Up to 15% of patients sustaining spinal injury secondary to trauma show a neurological injury as a result.^{5,13} Injuries to the cervical spine, in particular, result in a much higher incidence of injury to the spinal cord than at any other spinal level. The incidence of spinal cord injury ranges from 2% to nearly 100% of cervical spine injuries, depending on the cervical level involved, with an incidence of 40%-60% overall.^{1,2,5,7-11,18,19} The incidence of spinal cord injury with cervical fracture is likely to be underestimated as some patients may die prior to medical attention. This is particularly true for atlanto-occipital dislocation, where 25% of patients may die as a result of respiratory arrest prior to evaluation.^{4,5,13}

In 2003 the worldwide incidence of spinal cord injury ranged from 9.2 to 50 persons per 1 million populations. Technological advances and improved medical care have increased both the physical survival and functional capabilities of persons with disabilities to a level that would have been unthinkable even a few years ago. The prevalence of Spinal Cord Injury worldwide is estimated to be around 500 per million populations. From the available literature, it is known that majority of the individuals will be in the age group of 20-30 years with a male preponderance (M: F ratio: 3-4:1). Traffic related injuries were the primary cause for 50-60% of Spinal Cord Injuries, followed by falls (20-30%), Sports and occupational injuries (5-10%). About 70% new cases of Spinal Cord Injury appear in less than 30 years of age. A review of literature from around the world reveals that the incidence of Traumatic spinal cord injury varies from 9- 53 per million per year.²⁰

One of the comprehensive study undertaken by the Shanta Memorial Rehabilitation centre at Bhubhaneshwar in Orissa, the annual incidence of spinal cord injuries was 20 per million population

per year for the period 1985- 1990. The male to female ratio was 3: 2. Nearly 50% of Spinal Cord Injury subjects were in between 20-40 years. Falls, Road traffic accident, and fall of objects were the major underlying causes in 53%, 26% & 12% respectively.²⁰

A careful epidemiological study and trends of traumatic spinal cord injuries can provide information regarding magnitude of the problem of spinal trauma and resultant demand on medical and social resources; and can help identify the risk factors involved and actual causes of spinal cord injury.

So, this study is taken up to help in formulating preventive measures which may modify or eliminate the risk factors and may decrease the incidence of spinal cord injuries.

Aims and Objectives

As stated earlier TSCI is serious condition resulting in loss of human life or survivor disability or issues related to sexuality and sexual functions resulting in family and social disharmony.

Advances in medical field in the management, investigative procedures, and patient care have drastically decreased the mortality and morbidity in TSCI.

To understand the magnitude, pattern, factors and other demographic profile of TSCI comprehensive studies are essential.

With this view in mind this study was carried out involving the 3 years data (two years retrospective and one year prospective) of 152 patients admitted to Narayana Medical College and Nellore from 1st October 2010 to 30th September 2013 with TSCI. The data is analysed with a view to achieve the following aims.

1. To know the common age group that is mostly prone to TSCI.
2. To know sex difference of TSCI.
3. To know the area of distribution of TSCI cases.
4. To know the mode of injury.
5. To know various management modalities like Surgical, ICU stay etc and their role in the prognosis of patients with TSCI.
6. To know the site of injury commonly involved and GCS of patients admitted due to TSCI.
7. To know the mortality rate among TSCI patients.

Materials and Methods

Source of Data

This is a two years retrospective and one year prospective study carried out involving 152 cases of

spinal cord injuries admitted in Narayana Medical College & Hospital – Nellore, during the years 1st October 2010 to 30th September 2013.

Inclusion Criteria

- All cases of spinal cord injuries admitted during the years 1st October 2010 to 30th September 2013.
- These cases include both direct admissions as well as referral cases.
- Suicidal and Accidental cases of spinal cord injuries are included.

Exclusive Criteria

- Cases of homicidal spinal cord injuries were not included, as no such case was reported during the study years.
- This study is a hospital based study and hence Postmortem findings were not considered.

Materials

Case sheets pertaining to this study were obtained from Medical Records Section with permission from the competent authorities. The case sheets thus obtained were studied for the following details.

Patient Characteristics

1. Name
2. Age/Gender
3. IP.NO
4. Occupation
5. Contact Information and Contact Number
6. Locality

Pre-Hospital Details

1. Cause of Injury
2. Date of Injury
3. Time of Injury
4. Mechanism of Injury
5. Pre-Hospital Care

ER Care

1. Neurological Status At Er Arrival
2. Level Of Injury
3. Blood Pressure
4. Respiration
5. Respiratory Rate
6. Pulse
7. SPO2
8. Intubation
9. GCS
10. Fluid Management
11. X-Rays

12. MRI
13. CT Scan Brain

Management

1. Icu Care
2. Ventilation
3. Chest Care
4. Medical Management (Conservative)
5. Surgical Management
6. Duration of Hospital Stay

Outcome

1. Neurologically Improved
2. Remained The Same
3. Died

Follow Up Complications

All these details were documented in a proforma and are analyzed by Using Microsoft Excel – 2007

This study has the approval of Institutional Ethics Committee. (IEC)

Observations and Results

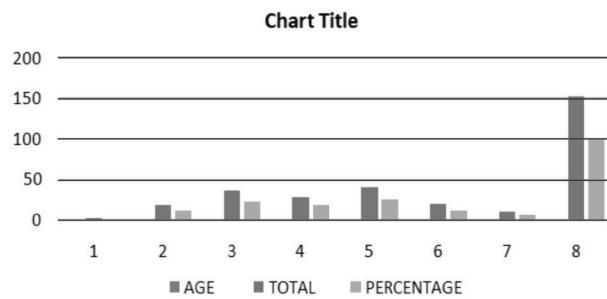
This study is a two years retrospective and one year prospective study carried out involving 152 cases of spinal cord injuries admitted in Narayana Medical College & Hospital – Nellore, during the years 1st October 2010 to 30th September 2013. Details of the patient like name, age, gender, IP No, occupation, contact information and contact number , locality, cause of injury, date of injury, time of injury, mechanism of injury, pre-hospital care, neurological status, level of injury, blood pressure, respiration, respiratory rate, pulse, Spo2, intubation, GCS, fluid management, X-rays, MRI, CT scan brain, ICU care, ventilation, chest care, medical management (conservative), surgical management, duration of hospital stay and outcome are noted. The above details are statistically analyzed.

Table 1: Table No. 1 and Bar Diagram 1 shows Age wise distribution of SCI admitted in Narayana Medical College, Hospital between 1st October 2010 to 30th September 2013.

Age Wise Distribution		
Age	Total	Percentage
0-10	2	1.31
11-20	18	11.84
21-30	35	23.02
31-40	28	18.42
41-50	40	26.31
51-60	19	12.50
> 61	10	6.57
	152	100

Table No.1 reveals the maximum cases 40 were in

Bar Diagram - 1



the age group of 41-50(26.31%), followed by 21-30(23.02%) and least number of cases were in the age group of less than 10 years (1.31%) followed by more than 61 years(6.57%). The mean age was 38.45 + 14.56.

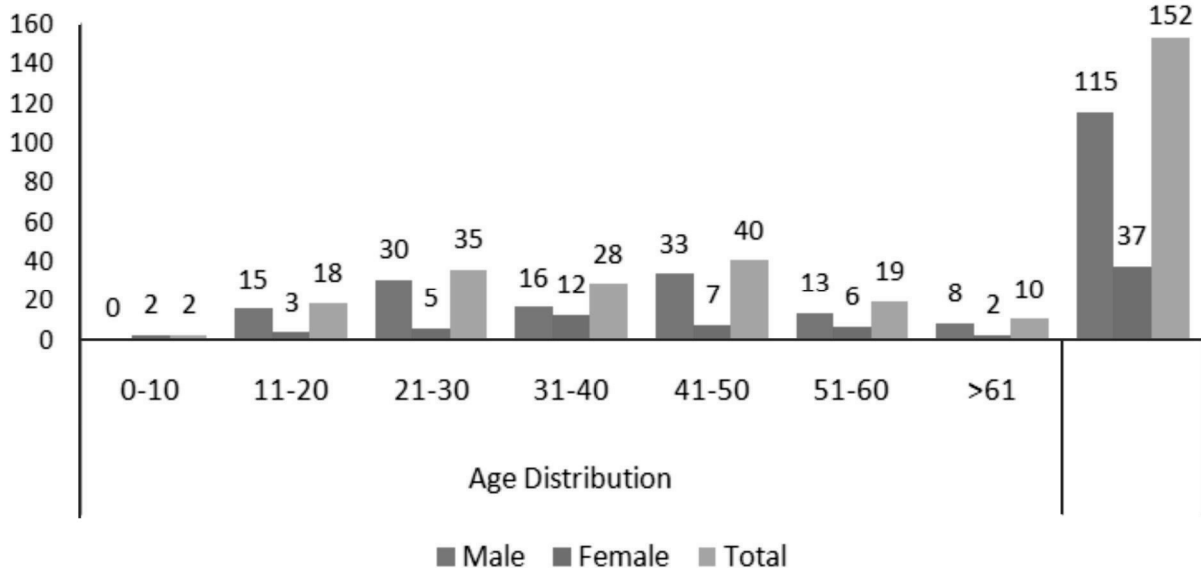
Table No. 1 and Bar Diagram 1 shows Age wise distribution of SCI admitted in Narayana Medical College, Hospital between 1st October 2010 to 30th September 2013.

Table 2: Table no. 2 and Bar Diagram 2 shows Sex wise distribution of SCI .

Age Distribution	Male	%	Female	%	Total	%
0-10	0	0	2	1.31	2	1.31
11-20	15	9.86	3	1.97	18	11.84
21-30	30	19.73	5	3.28	35	23.02
31-40	16	10.52	12	7.89	28	18.42
41-50	33	21.71	7	4.60	40	26.31
51-60	13	8.55	6	3.94	19	12.50
> 61	8	5.26	2	1.31	10	6.57
Total	115	75.66	37	24.34	152	100

Bar Diagram - 2

Table No. 2 reveals SCI cases were more



common among males 115(75.66%), than in females 37(24.34%) and also that in males the age group involved was between 41- 50 years(21.71%) followed by 21-30 years(19.73%).Where as in females the common age group involved between 31-40 years followed by 41-50 years. The least age group involved in males was 0-10 i.e. no cases found, in females 0-10 years (1.31%) and more than 61 years (1.31%). Male to female ratio was 4.18: 1

Table 3: Table No. 3 and Bar Diagram 3 shows Area wise distribution of SCI cases.

Area	Frequency	Percentage
Rural	132	86.8
Urban	20	13.2
Total	152	100

Bar Diagram - 3

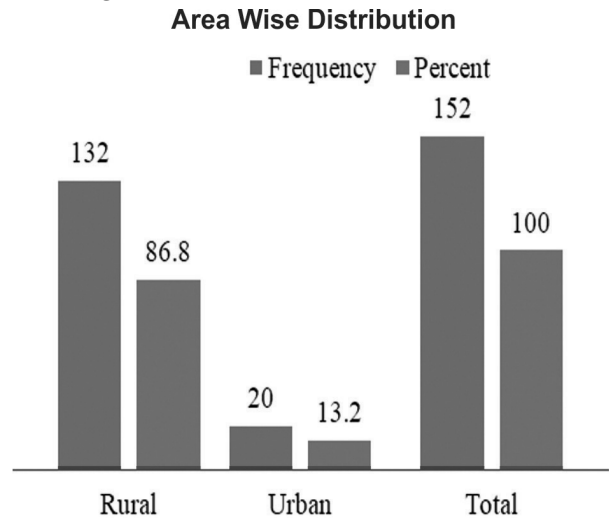


Table no.3 reveals that maximum cases noted in

rural area 132(86.80%), followed by urban area 20(13.20%).

Table 4: Table no. 4 and Bar Diagram 4 shows Mode of injury.

Mode of Injury		
Mode	Frequency	Percentage
MVA	52	34.2
Fall From Height	93	61.2
Other Causes	7	4.6
Total	152	100

Bar Diagram - 4

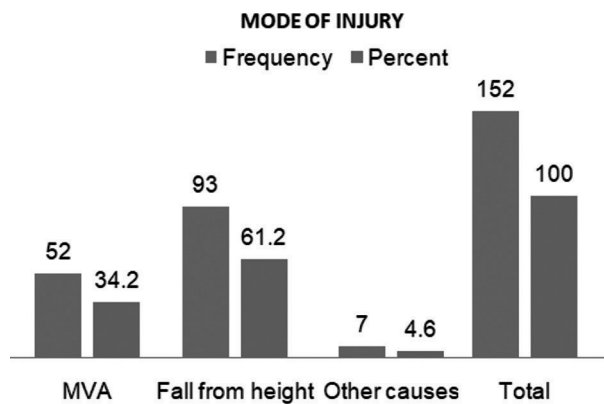


Table no.4 reveals that most common cause was fall from height 93(61.20%), followed by MVA 52(34.20%).

Table 5: Reveals that most common site of injury was cervical 67(44.10%), followed by lumbar 54(35.50%), thoracic 29(19.10%), thoracolumbar 2(1.30%).

Level of Injury		
Level	Frequency	Percentage
Cervical	67	44.1
Thoracic	29	19.1
Thoracolumbar	2	1.3
Lumbar	54	35.5
Total	152	100

Bar Diagram - 5

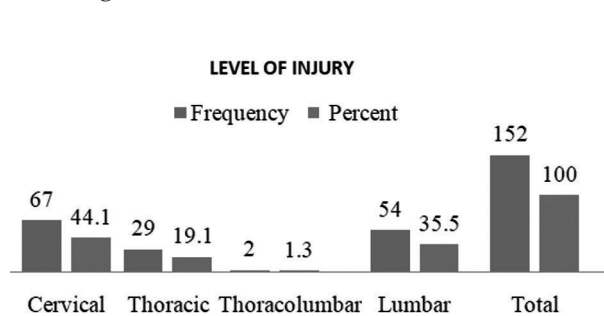


Table no. 5 reveals that most common site of injury

was cervical 67(44.10%), followed by lumbar 54(35.50%), thoracic 29(19.10%), thoracolumbar 2(1.30%).

Table 6: Table no.6 and Bar Diagram 6 shows CT scan brain requirement.

CT Scan Brain		
	Frequency	Percentage
Yes	26	17.1
No	126	82.9
Total	152	100

Bar Diagram - 6

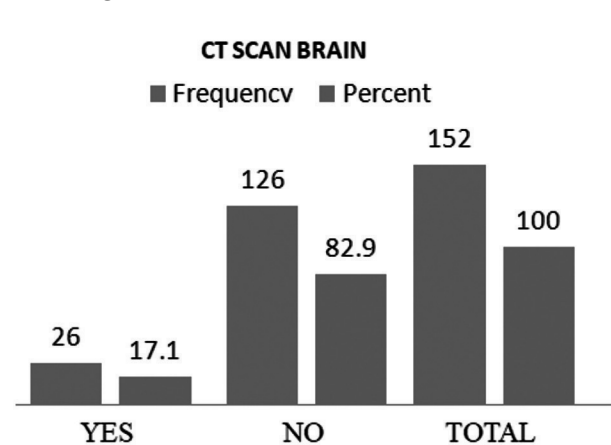


Table no. 6 reveals the 26(17.10%) patients required CT scan brain to rule out brain injury.

Table 7: Table no. 7 and Bar Diagram 7 shows ICU stay requirement.

ICU Stay		
ICU Stay Required	Frequency	Percentage
Yes	64	42.1
No	88	57.9
Total	152	100

Bar Diagram-7

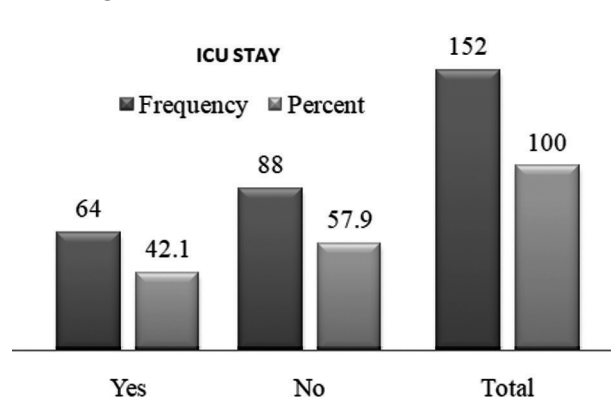


Table No. 7 reveals the 64(42.10%) patients

required ICU stay indicating that they had more complications.

Table 8: Table no. 8 and Bar Diagram 8 shows surgical management.

Surgical Management		
	Frequency	Percentage
Spinal Fusion	118	77.6
Laminectomy	12	7.9
Conservative	22	14.5
Total	152	100

Bar Diagram - 8

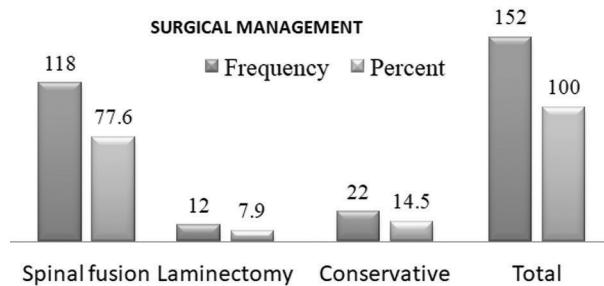


Table no. 8 reveals that 130 patients (85.52%) required surgical management out of 118 patients (77.60%) spinal fusion, 12 patients (7.90%) laminectomy and 22 patients(14.50%) managed conservatively.

Table 9: Table No. 9 and Bar Diagram 9 shows Prognosis and Mortality.

Prognosis and Mortality		
Prognosis	Frequency	Percentage
Alive	141	92.8
Dead	5	3.3
Referral	6	3.9
Total	152	100

Bar Diagram-9

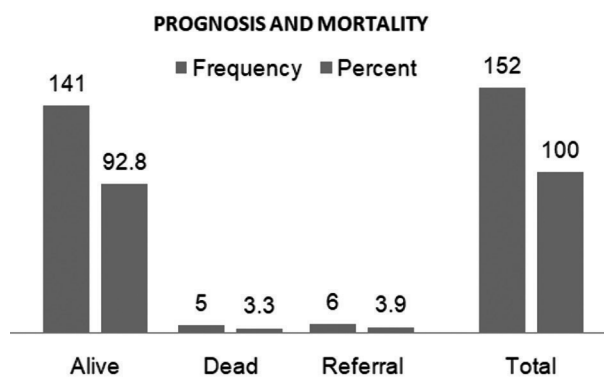


Table no. 9 reveals 5 cases (3.30%) died and 147 cases (96.71%) were alive. However of which 6 cases (3.90%) were referred and went to other centers and

their prognosis is not known.

Table 10: Table no.10 and Bar Diagram 10 shows GCS.

GCS		
Score	Frequency	Percentage
3	3	1.94
4	3	1.94
10	3	1.94
11	3	1.94
12	12	7.90
13	3	1.94
14	10	6.6
15	115	75.7
Total	152	100

Bar Diagram - 10

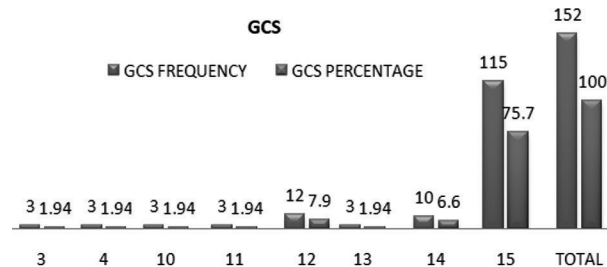


Table no. 10 reveals GCS score 15 was seen in 115 patients (75.70%), score 12 in 12 patients (7.90%) and score 14 in 10 patients (6.60%) indicating good prognosis and remaining patients with comparatively bad prognosis.

Discussion

This is a two years retrospective and one year prospective study carried out involving 152 cases of spinal cord injuries admitted in Narayana Medical College & Hospital - Nellore, during the years 1st October 2010 to 30th September 2013 and the following observations were noted. The maximum cases 40 were in the age group of 41-50(26.31%), followed by 21-30(23.02%) and least number of cases were in the age group of less than 10 years (1.31%) followed by more than 61 years (6.57%). The mean age is 38.45 + 14.56. SCI cases were more common among males 115(75.66%), than in females 37(24.34%) and also the most common age group was between 41- 50 years 33(21.71%) followed by 21-30 years 30(19.73%).

In females the common age group involved was between 31-40 years was 12(7.89%) followed by 41-50 years was 7(4.60%). 0-10 age group in males showed no case, in females 2 cases(1.31%) and in more than 61 age group 2 cases(1.31%). Male to female ratio was 4.18: 1. It was observed that maximum cases were in rural area 132(86.80%),

followed by urban area 20(13.20%). It was observed that most common cause was fall from height 93(61.20%), followed by road traffic accidents 52(34.20%).

It was observed that most common site of injury was cervical 67(44.10%), followed by lumbar 54(35.50%), thoracic 29(19.10%), thoracolumbar 2(1.30%). It was observed that 26(17.10%) patients required CT scan brain to rule out brain injury. It was observed that 64(42.10%) patients required ICU stay indicating that they had more complications. It was observed that 130 patients (85.52%) required surgical management out of 118 patients (77.60%) spinal fusion, 12 patients (7.90%) laminectomy and 22 patients (14.50%) managed conservatively. It was observed that 5 patients (3.30%) died and 147 patients (96.71%) were alive. However of which 6 patients (3.90%) were referred and went to other centers and their prognosis is not known. It was observed that GCS score 15 is seen in 115 patients(75.70%), score 12 in 12 patients(7.90%) and score 14 in 10 patients(6.60%) indicates good prognosis and remaining patients had bad prognosis.

Comparative Analysis

This is a two years retrospective and one year prospective study carried out involving 152 cases of spinal cord injuries admitted in Narayana Medical College and Hospital - Nellore, during the period from 1st October 2010-30th September 2013. Details of the patient like name, age, gender, IPNo, occupation, contact information and contact number, locality, cause of injury, date of injury, time of injury, mechanism of injury, pre-hospital care, neurological status, level of injury, blood pressure, respiration, respiratory rate, pulse, spo₂, intubation, GCS, fluid management, X-rays, MRI, CT scan brain, ICU care, ventilation, chest care, medical management (conservative), surgical management duration of hospital stay and outcome are noted. The above details are statistically analyzed.

Age wise distribution of SCI reveals more common age group is 41-50 were 40(26.31%) and 21-30 were 35(23.02%) followed by 31-40 were 28(18.42%), 51-60 were 19(12.50%), 11-20 were 18(11.84%), 61+ were 10(6.57%), 0-10 were 2(1.31%). A study done by, Hong-Yong Feng³¹, show that largest group was 45-54 years followed by 35-44 years. A study done by, Roop Singh²³ shows that most prevalent age group was 20-29 were 203(42.03%), followed by 30-39 were 128(26.50%).

A study conducted by, Ziniya Mustarya Rah-

man²⁵ shows the most prevalent age group was 25-32 were 114(26.76%), followed by 43-75 were 106(24.88%). A study conducted by, Suraj Bajracharya²⁷ shows that most prevalent age group was 21-41 were 350(39.10%). A study conducted by, Asrvatham Alwin Robert²⁸ shows higher frequency in the 21-30(40.00%) and 31-40(19.70%) age groups. A study conducted by, Marleem Schonherr²⁹ shows higher frequency in age groups is 21-40 and 61-70 years. A study conducted by, F. Biering - Sorensen³⁰ shows higher frequency in age group is 15-24 years including 40% of all cases.

A study conducted by, Ravi Shankar. B G.²⁰ shows most prevalent age group was 31-40 were 16(40.00%), followed by 18-30 were 14(35.00%). A study conducted by, A. Soopramanien²⁶ shows that most prevalent age group was 51-60 were 88(21.40%) followed by 31-40 were 68(16.50%).

Sex wise distribution reveals SCI is more common in males 115(75.66%) than females 37(24.34%). Male to female's ratio is 4.18: 1. In the studies conducted by, Ravi Shankar. B G²⁰, Roop Singh²³, Liis Sabre²⁴, Ziniya Mustarya Rahman²⁵, A. Soopramanien²⁶, Suraj Bajracharya²⁷, Marleem Schonherr²⁹, F. Biering - Sorensen³⁰, Hong - Yong Feng³¹, Donna M. Dryden³², C Lan³³, Guang - Zhi Ning³⁴ shows similar findings i.e. male dominance is noted. Area wise distribution of SCI reveals rural population 132 (86.80%) is more than urban population 20(13.20%). In the studies conducted by, Ziniya Mustarya Rahman²⁵, Donna M. Dryden³² shows similar findings that SCI is more common in the rural than urban area. Mode of injury in SCI reveals fall from height 93 (61.20%) is more common than Motor Vehicle Accident. In the studies conducted by Roop Singh²³, Ziniya Mustarya Rahman²⁵, A. Soopramanien²⁶, Suraj Bajracharya²⁷, Hong- Yong Feng³¹ also shows similar findings that SCI was more common in Fall from height followed by Motor Vehicle Accidents. However studies conducted by, Liis Sabre,²⁴ Asirvatham Alwin Robert,²⁸ F. Biering - Schonherr³⁰, Donna M. Dryden,³² C Lan³³, Guang - Zhi Ning³⁴ shows that Motor Vehicle Accident was more common than Fall from height. Level of injury in SCI reveals cervical spine fracture 67(44.10%) is more common followed by lumbar 54(35.50%), Thoracic 29(19.10%) and Thoracolumbar 2(1.30%).

In the studies conducted by Liis Sabre²⁴, Ziniya Mustarya Rahman²⁵, Suraj Bajracharya,²⁷ Asirvatham Alwin Robert,²⁸ Marleem Schoherr,²⁹ F. Biering - Schonherr,³⁰ Hong -Yong Feng³¹ and Donna M. Dryden³² also showed that SCI was more common at cervical level. However study conducted by Roop Singh²³ reveals that Dorsolumbar spine

injury was the commonest fractured vertebra. ICU Stay in SCI reveals 64(42.10%) patients required and 88(57.90%) patients not required. A study conducted by Steven Casha³⁵ shows that 66% of patients that required ventilation did so within 48 h and that 19% required greater than 8 weeks of ventilation. Surgical Management in SCI reveals spinal fusion 118(77.60%) followed by conservative treatment 22(14.50%), laminectomy 12(7.90%). In a study conducted by, A. Soopramanien²⁶ shows that bone grafting (38.20%), laminectomy (6.90%), plates and screws (3.70%).

The study conducted by, Suraj Bajracharya²⁷ shows 216 (93%) out of 233 patients were treated conservatively, compared to operative treatment in 17(7.00%) patients in the initial five years of the study period. Prognosis and mortality reveals 141 (92.80%) patients alive, 5(3.30%) patients dead and 6(3.90%) was referral to other centers. A study conducted by, Liis Sabre²⁴ shows all patients with SCI, 162(27.22%) of whom were dead. A study conducted, A. Soopramanien²⁶ shows the mortality rate in the early days post injury fell from 22% (retrospective studies) to 10.1% (prospective studies). A study conducted by, Hong- Yong Feng³¹ shows 8 patients died after operation.

Summary and Conclusions

The maximum cases were in the age group of 41-50(26.31%), followed by (23.02%). The least number of cases were in the age group of less than 10 years (1.31%) followed by more than 61 years (6.57%). The mean age is 38.45 ± 14.56 . SCI cases are more common among males 115(75.66%), than in females 37(24.34%). In males the most common age group involved is between 41- 50 years (21.71%) followed by 21-30 years(19.73%). In females the most common age group involved was between 31-40 years followed by 41-50 years. The least age group involved in males was 0-10 i.e. no cases found, In females the least age group involved was 0-10(1.31%) and more than 61(1.31%). Male to female ratio is 4.18: 1. It was observed that maximum cases noted in rural area 132(86.80%), followed by urban area 20(13.20%). It was observed that most common cause was fall from height 93(61.20%), followed by Road traffic accidents 52(34.20%). It was observed that most common site of injury is cervical 67(44.10%), followed by lumbar 54(35.50%), thoracic 29(19.10%), thoracolumbar 2(1.30%). It was observed that 26(17.10%) patients required CT scan brain to rule out brain injury. It was observed that 64(42.10%) patients required ICU stay indicating that they had more complications. It was observed that 130 patients (85.52%) required

surgical management. Out of 130 patients 118 (77.60%) underwent spinal fusion, 12(7.90%) underwent laminectomy and 22 patients(14.50%) were managed conservatively. It was observed that 5 patients (3.30%) died. 147 cases (96.71%) were alive. However 6 cases (3.90%) were referred and went to other centers and their prognosis was not known. It was observed that GCS score 15 is seen in 115 patients(75.70%), score 12 in 12 patients(7.90%) and score 14 in 10 patients(6.60%) indicates good prognosis and remaining patients had bad prognosis.

Limitations and Recommendations

Though the studies were conducted in tertiary centre due to location and availability of established centre within reach. The study population is limited. The sample size is small. Post mortem findings not including because post mortem conducted in other hospital. No information was available about referral case. SCI are most commonly associated with fall, road traffic accidents and sports. The above activities commonly involve active age groups ranging from 20-50 years, this age group commonly involved in SCI. TSCI results in socio - economic and domestic issue as it involve age group of 20-50 years and also males who are in the prime financial support of the family and also sexually active age.

One of the commonest causes of SCI is falls which are occupation related in young age group and in older age group due to age related instability. This can be prevented by taking necessary safety precautions in both work places, public places and in houses placing signs like slippery surface, rails for support and making necessary adjustment in house especially in bath rooms of elderly and aged. Road traffic accidents contribute to TSCI (railway spine, whiplash injury).

This can be avoided by making mandatory provisions for seat belts, head rest in all seats in cars and vehicles. Strict traffic rules to avoid accidents and patrolling to check drunk drivers. Sports activities contribute to TSCI (Probably caused Brazil to lose the world cup because of spinal injury to Neymar, a football player). This is on rise due to increased speed in sports. This can be avoided by passing stringent rules, usage of proper measures, educating the players about prevention etc. As this study is limited to a smaller area, smaller group and short duration, we recommend studies in larger area, larger group and longer duration.

Acknowledgement

Authors acknowledge the immense help received from the scholars whose articles are cited and

included in references of this manuscript. The authors are also grateful to authors/editors/publishers of all those articles, journals and books from where the literature for this article has been reviewed and discussed.

Source of funding: Nil

Conflict of Interest: Nil

References

1. Bohlman H. Acute fractures and dislocation of the cervical spine: an analysis of three hundred hospitalized patients and review of the literature. *J Bone Joint Surg* 1979;61A:1119-42
2. Bohlman H, Board E. Fractures and dislocation of the lower cervical spine. In: *Cervical Spine Research Society (ed.) The cervical Spine*. Philadelphia: Lippincott; 1983:232-67.
3. Heiden J, Weiss M, Rosenberg A, Apuzzo M, Kurze T. Management of cervical spine cord trauma in southern California. *J Neurosurg* 1975;43:732-6.
4. Sonntag V, Hadley M. Management of nonodontoid upper cervical spine injuries. In: Cooper P (ed). *Management of Posttraumatic Spinal Instability: Neurosurgical Topics*. Rolling Meadows, IL: AANS Publications; 1990:99-109. Wiss J. Mid- and lower cervical spine injuries. In: Wilkins R (ed.). *Neurosurgery*. New York: McGraw-Hill; 1985:1708-15.
6. Joint Section on Disorders of the spine and Peripheral nerves of the American Association of Neurological Surgeons and the Congress of Neurological surgeons and the Congress of acute cervical spine and spinal cord injuries. Ch.3. *Neurosurgery* 2002;50:S21-9.
7. Harris P, Karmi M, McClemon E, Matlhoko D, Paul K. The prognosis of patients sustaining severe cervical spine injuries (C2-C7 inclusive). *Paraplegia* 1980;18:324-30.
8. Heiden L, Weiss M. Cervical spine injuries with and without neurological deficit. *J Contemp Neurosurg* 1080;2:1-6.
9. Mesard L, Carmony A, Mannrino E, Ruge D. Survival after spinal cord trauma: a life table analysis. *Archiv Neurol* 1978;35:78-83.
10. Riggins R, Kruss J. The risk of neurological damage with fractures of the vertebrae. *Trauma* 1997;17:126-33.
11. Hadley M, Dickman C, Browner C, Sonntag V. Acute axis fractures: a review of 229 cases. *J Neurosurg* 1989;71:642-7.
12. Reiss S, Raque G, Jr, Shields C, Garretson H. Cervical spine fractures with major associated trauma. *Neurosurgery* 1986;18:327-23.
13. Sonntag V, Hadley M. Management of upper cervical spinal instability. In: Wilkins R (ed.) *Neurosurgery Update*. New York: McGraw-Hill; 1991:222-3.
14. Hadley M, Zabramski J, Browner C, Rekate H, Sonntag V. Pediatric spinal trauma: a review of 122 cases of spinal cord and vertebral column injuries. *J Neurosurg* 1988;68:18-24.
15. Ruge J, Sinson G, McLone D, Cerullo L. Pediatric spinal injury: the very young. *J Neurosurg* 1988;68:25-30.
16. Schneidre R. High cervical spine injuries. In: Wilkins R (ed.) *Neurosurgery*. New York: McGraw-Hill; 1985:1701-8.
17. Pollack I, Pang D, Sclabassi R. Recurrent spinal cord injury without radiographic abnormalities in children. *J Neurosurg* 1988;69:177-82.
18. Hadley M, Fitzpatrick B, Browner C, Sonntag V. Facet fracture-dislocation injuries of the cervical spine. *Neurosurgery* 1992;30:661-6.
19. Gehweiler J, Jr, Clark W, Schaaf R, Powers B, Miller M. Cervical spine trauma: the common combined conditions. *Radiology* 1979;130:661-86.
20. Ravi Shankar B G. A study on quality of life of persons with spinal cord injury, 2009-2010.
21. Richard S Snell, *A clinical Neuroanatomy*, 7th Edition, 2010, Page No. 219-36.
22. World Health Organization, *International Prospective on Spinal Cord Injury*, 2013, Page No. 4-21.
23. Roop Singh, Sansar Chand Sharma, Rajeev Mittal, Ashwini Sharma, *Traumatic spinal cord injuries in Haryana: An epidemiological study*, 2002.
24. Liis Sabre, *Epidemiology of traumatic spinal cord in Estonia. Brain activation in the acute phase of traumatic spinal cord injury*, 2013.
25. Ziniya Mustary Rahman, *Demographic profile of spinal cord injury: A retrospective study*, 2007-2008
26. Soopramanien A. *Epidemiology of spinal injuries in Romania*. *Paraplegia*. 1994 1994/11//;32(11):715-22. eng.
27. Bajracharya S, Singh M, Singh GK, Shrestha BP. *Clinico-epidemiological study of spinal injuries in a predominantly rural population of eastern Nepal: A 10 years' analysis*. *Indian J Orthop*. 2007 2007/10//;41(4):286-9. eng.
28. Robert AA, Zamzami MM. *Traumatic spinal cord injury in Saudi Arabia: a review of the literature*. *Pan African Medical Journal*. 2013 2013;16. en.
29. Schönherr MC, Groothoff JW, Mulder GA, Eisma WH. *Rehabilitation of patients with spinal cord lesions in The Netherlands: an epidemiological study*. *Spinal Cord*. 1996 1996/11//;34(11):679-83. eng.
30. Biering-Sørensen E, Pedersen V, Clausen S. *Epidemiology of spinal cord lesions in Denmark*. *Paraplegia*. 1990 1990/02//;28(2):105-18. eng.

31. Hong-Yong Feng, Guang-Zhi Ning, Shi-Qing Feng, Tie-Qiang Yu, and Heng-Xing Zhou: A epidemiological profile of 239 traumatic spinal cord injury cases over a period of 12 years in Tianjin, China, 2009
32. Dryden DM, Saunders LD, Rowe BH, May LA, Yiannakoulis N, Svenson LW, et al. The epidemiology of traumatic spinal cord injury in Alberta, Canada. *Can J Neurol Sci.* 2003;30(2):113-21. eng.
33. C Lan, J S Lai, K H Chang, Y C Jean and I N Lien, Traumatic spinal cord injuries in the region of Taiwan : an epidemiological study in Hualien county, 1986-1990
34. Ning G-Z, Wu Q, Li Y-L, Feng S-Q. Epidemiology of traumatic spinal cord injury in Asia: a systematic review. *J Spinal Cord Med.* 2012;35(4):229-39. eng.
35. Steven Casha and Sean Christie; A systematic Review of intensive cardiopulmonary management after spinal cord injury. *J Neurotrauma* Aug 2011;28(8):1479-1495.
36. V Sebastia -Alcacer, M Alcanyis -Alberola, M Giner-Pascual and F Gomez-Pajares; Are the characteristics of the patient with a spinal injury changing, 2013.
37. Maharaj JC. Epidemiology of spinal cord paralysis in Fiji: 1985-1994. *Spinal Cord.* 1996;34(9):549-59. eng.
38. Ahoniemi E, Alaranta H, Hokkinen EM, Valtonen K, Kautiainen H. Incidence of traumatic spinal cord injuries in Finland over a 30-year period. *Spinal Cord.* 2008;46(12):781-4. eng.
39. Dahlberg A, Kotila M, Leppänen P, Kautiainen H, Alaranta H. Prevalence of spinal cord injury in Helsinki. *Spinal Cord.* 2004;43(1):47-50. en.
40. Pagliacci MC, Celani MG, Zampolini M, Spizzichino L, Franceschini M, Baratta S, et al. An Italian survey of traumatic spinal cord injury. The Gruppo Italiano Studio Epidemiologico Mielolesioni study. *Arch Phys Med Rehabil.* 2003;84(9):1266-75. eng.
41. Rahimi-Movaghar V, Saadat S, Rasouli MR, Ganji S, Ghahramani M, Zarei M-R, et al. Prevalence of Spinal Cord Injury in Tehran, Iran. *J Spinal Cord Med.* 2009;32(4):428-31.
42. S Manjeet, S Siddhartha, W Iftikhar, T Agnivesh, M Nirdosh, S Dara; Spine injuries in a tertiary health care hospital in Jammu: A clinic-epidemiological study, 2008.
43. Zubia Masood, Ghulam Mustafa Wardug, Junaid Ashraf ; Spinal injuries: Experience of a local Neurosurgical centre, 2008.
44. Zaheer Ahmed Gill, Nadeem Ahmed, Noreen Akhtar, Saquib Hanif, Amir Waheed Butt; Pattern of traumatic spinal cord injuries in armed forces, 2009.
45. Yang R, Guo L, Wang P, Huang L, Tang Y, Wang W, et al. Epidemiology of Spinal Cord Injuries and Risk Factors for Complete Injuries in Guangdong, China: A Retrospective Study. *PLoS ONE.* 2014;9(1).
46. Joshi M. Agrawal Mahima; Traumatic cervical spine injury pattern - A snapshot, 2011.

