ORIGINAL ARTICLE

The Demographic and Clinico-radiological Profile of Spinal Injury-an Institutional Experience

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ABSTRACT

Background: Traumatic spinal cord injury (TSCI) is a major health hazard throughout the world. Its incidence is increasing both in the developed and under-developed world.
Methods: This prospective study was conducted in the Department of Neurosurgery, SKIMS, Kashmir, for one year. The data collected included the demographic profile, mode, circumstances and timing of the injury, neurological grade using the ASIA scale, imaging findings, type of management and outcome. A follow-up evaluation was done at 1-yr.
Results: Fall from height was the most common cause of spinal injury. Young men were most affected. The injury was more common in the morning hours and it peaked during summer and autumn, both seasons being busy for apple and walnut harvesting.
Conclusion: Spinal injury mostly involves young males. Fall from trees is the most common cause. Poor ASIA scale, large kyphotic angles, severe canal compromise and presence of cord contusion are bad prognostic factors.
Keywords: spine, spinal injuries, paraplegia, quadriplegia, road traffic accidents
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INTRODUCTION

Traumatic spinal cord injury (TSCI) is one of the most debilitating injuries resulting in different grades of paraplegia or quadriplegia with or without sphincter disturbances. It is responsible for an enormous financial burden on resources and psychological issues for patients and their families. Falls from height and road traffic accidents are common causes. Young men are often affected. The clinical outcome of TSCI depends on the severity and location of the lesion.[1-3].

AIMS AND OBJECTIVES

We aimed to determine the demographic and clinical-radiological profile of spinal injuries and identify prognostic factors of the outcome.

MATERIALS AND METHODS

This prospective study was conducted in the Department of Neurosurgery, SKIMS, Kashmir, for one year from January 2019 to December 2019 and included all the patients with spinal injuries at our centre which is the only referral centre for all spinal injuries in the valley with a 7 million population. We enrolled a total of 116 patients.

Data included the demographic parameters, mode of injury severity of injury, management, complications and outcome. A thorough clinical examination was done, followed by relevant imaging. Any associated injury like head trauma, and chest and abdominal trauma was also noted at the time of examination. We used the American Spinal Injury Association (ASIA) scale for classifying the severity of injury and neurological grade.[4] The wedge angle

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on the CT scan was measured by Gardner's method which is the angle formed between a line drawn parallel to the lower end plate of a fractured vertebra and the superior end plate of an adjacent cephalad vertebra. Kyphotic angulation on the CT scan was measured as the angle between the superior end plate one level above and the inferior end plate one level below the fractured segment. We identified intrinsic traumatic spinal cord lesions on MRI as (a) cord transection[anatomical discontinuity of the cord on T1-W sequence]; (b) cord contusion [area of hypointensity in the centre with peripheral hyperintensity on T2-W sequence] and (c) acute cord edema [area of hyperintensity on T2-W sequence]. Patients were then subjected to either conservative or surgical management. A minimum follow-up of 1-yr was done to assess the outcome. Patients were seen in the outpatient department (OPD) on follow-up and in 28 patients who did not report to OPD, a telephonic interview was conducted. Data was analysed by using Graph Pad Prism. A p-value of 5% or lower was considered significant. Bar charts were drawn using MATLAB, version 2020a.

Definition of improvement

A good outcome on follow-up was defined as a shift of the ASIA scale from poor grade (A-C) to good grade (D, E) or an increase in the ASIA scale by at least 1 grade within the good grade group.

RESULTS

In our study, males outnumbered females (83 vs 33). The range of age was from 3 years to 72 years with a mean age of 38.27 years. The majority of cases i.e. were seen in the age group of 30 – 40 yrs (Fig-1). The majority of our patients were labourers (46.5%) followed by the student community (15.1%). Most of the spine injuries happened during July and September and most of the injuries happened in the morning hours (Figs-2, 3). Fall from height (80.17%, 93/116) was the most common cause of spine trauma followed by road traffic accidents (19.83%, 23/116). (Table 1).

About 58.62% (68/116) of patients had ASIA grades A-C, at the time of admission (Table-2). In our study, there was evidence of injury on CT scans in 114 patients. No vertebral fracture or subluxation was seen in 2 cases but MRI of both these patients showed cord injury. The commonest site of injury was a thoracolumbar junctional area in 28.44% (33/116) and the thoracic spine in 23.27% (27/116) together, followed by the cervical spine in 32.75% (38/116). (Table 3).

The most common type of fracture was burst fracture which accounted for 31.89% (37/116) cases, followed by wedge fracture. MRI study revealed cord transection in 7 patients, cord contusion in 31, and acute cord oedema in 44 (Figs-4, 5). Normal MRI was seen in 34 patients (Table 4, 5). No patient with cord transection improved and only 6 patients (19.35%) with cord contusion improved while 25 patients(56.82%) with acute cord edema improved to good ASIA grade at follow-up (Table 5). In a subgroup analysis of thoracolumbar junctional injuries, we correlated wedge angle, Kyphosis angle and percentage canal compromise with ASIA grading and found that higher ASIA grade had kyphotic/wedge angle of more than 25o along with >50% canal compromise. Our 19/33 patients had kyphotic angle of 25 degrees or less and 14/33 had it more than 25 degrees. The canal compromise was 50% or less in 23/33 and more than 50% in 10/33 patients (Table 6).

In our study, 62% (72/116) of patients underwent surgery while 38% (44) were managed conservatively. Head injury was the most common (8.6%) associated injury seen in our study followed by chest injury (3.4%), long bone fracture (2.5%), visceral (2.5%) and electric burns in 0.86%. In our study, 51.72% (60/116) of patients had a hospital stay of < 10 days, 31.03% (36/116) had a stay of 2 weeks, 4.3% (5/116) had a stay of 3 weeks and 12.9% (15/116) had a stay of 1-month or more. Tracheostomy had to be done in 7.7% (9/116) patients. Deep venous thrombosis complicated 6.9% (8/116) of our patients. At 1-year the good ASIA grade (D & E) which was seen in 41.37 %(48/116) of patients at the time of admission was seen in 66.37% (77/116) of patients at follow-up. (Table 2).

DISCUSSION

The majority of patients in our study were males with a ratio of 2.7: 1. This is in concordance with the literature. 5 The male preponderance is because the males being the primary source of economy in most families are exposed to work-related hazards, and hence have more exposure to the outside environment than females.

The majority of cases i.e., (48.8%) were seen in the age group of 20 – 39 yrs. In North America, the average age reported is 32-55 yrs, in European studies the average age is

Table-1: Mode of Injury (n=116)

Mode of Injury	
Falls from:-	**No. of patients**
Tree	*44*
○ Walnut	23
○ Apple	16
○ Poplar	5
Balcony	*25*
Stairs	*12*
Bathroom	*8*
Fall of wall on back	*1*
Fall of a log of wood	*2*
Fall from electric pole	*1*
Road Traffic Accidents	**23**

Table-2:-ASIA scale

ASIA Scale	**At the time of injury**	**At follow up of 1 year**
	n (%)	n (%)
A (Complete injury)	42 (36.20%)	22 (18.96%)
B (Incomplete injury, Only sensory function)	9 (7.75 %)	7(6.03%)
C (Incomplete injury with Motorpower < grade 3)	17 (14.65%)	10(8.62%
D (Incomplete injury with Motorpower > grade 3)	17 (14.65%)	23(19.82%)
E (Normal)	31 (26.72%)	54(46.55%)
Total	116	116

Table 3:- Level of injury on CT scan

Level of Fracture / Subluxation	n (%)
Cervical Spine	38(32.75)
Thoracic spine	27 (23.27)
Lumbar spine	14 (12.06)
Cervico-thoracic junction	1 (0.86)
Thoraco-lumbar junction	33 (28.44)
Sacral spine	1 (0.86)
No fracture/subluxation	2(1.72)

Table 4:- Types of Fracture dislocations on CT scan

Fracture type	n (%)
Burst #	37 (31.89)
Wedge #	33 (28.44)
Avulsion #	5 (4.31)
Subluxation #	19 (16.37)
Subluxation with jumped facet #	8 (6.89)
C1 arch #	2 (1.72)
Odontoid #	6 (5.17)
Hangman #	1 (0.86)
Spinous process #	2 (1.72)
S1 S2 linear #	1 (0.86)
No fracture	2 (1.72)
TOTAL	116

Table-5 MRI findings and ASIA grade

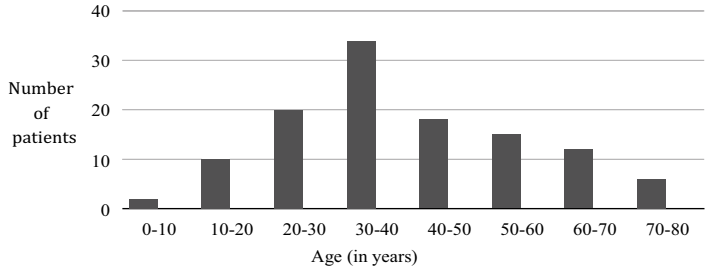
MRI findings	No. of patients	ASIA grade at admission		ASIA grade at 1-yr follow-up		
		Poor	Good	Poor	Good	P value
Cord transection	7	7	0	7	0	
Cord contusion	31	27	4	21	10	0.127*
Cord edema	44	36	8	11	33	0.0001**
Normal	34	0	34	0	34	

*-not significant, **-significant

Table-6- CT parameters of thoracolumbar junctional injuries

Outcome	No. of patients	Wedge angle 25 ^{0} or less	Wedge angle >25 ^{0}	Kyphotic angle 25 ^{0} or less	Kyphotic angle >25 ^{0}	Canal compromise 50 % or less	Canal compromise >50 %
Good	23	19	4	19	4	20	3
Poor	10	4	6	3	7	3	7
P value			0.0349		0.0059		0.0024

All p values are significant



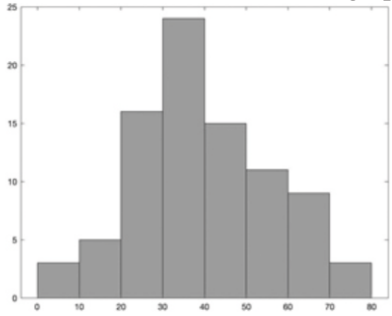


Fig. 1

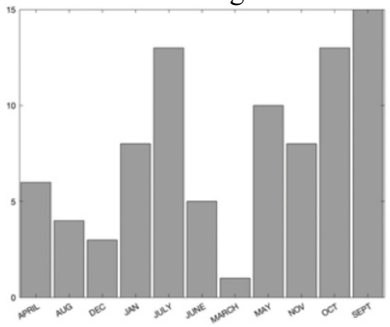


Fig. 2

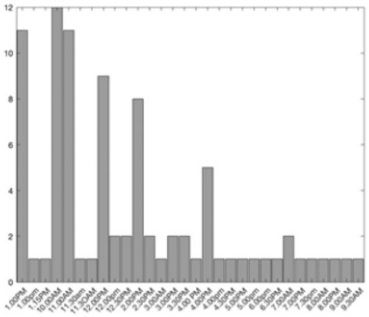


Fig. 3



Fig. 4a: CT scan sagittal images showing C5-C6 fracture-subluxation



Fig. 4b: Dorsolumbar junctional fracture-subluxation



Fig. 4c: mid-dorsal fracture

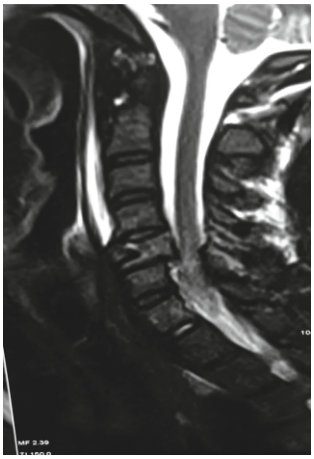


Fig. 5a: MRI sagittal images showing cervical cord contusion



Fig. 5b: D-12 fracture with cord injury

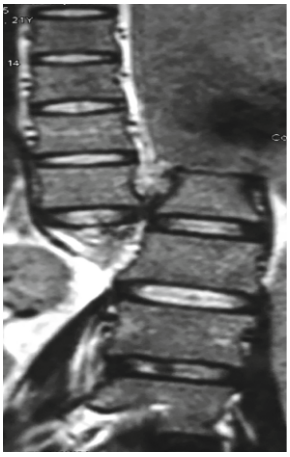


Fig. 5c: coronal image shows dorso-lumbar spondyloptosis

37-48 yrs, and in Asia the average age reported is 26.8-56.6 yrs.[6] However, a bimodal presentation has also been reported.[5] The second peak in the elderly is because of the high incidence of self-falls in them, especially from the western countries as their pool of geriatric population is increasing. The increase in the number of self-falls has recently been reported from China also which is again attributed to the enormous rise in the geriatric population.6 Gunshot wounds of the spine have been reported mostly from Afghanistan and southeast Turkey.[5,7] Age represents a clear negative prognostic factor for walking recovery: subjects younger than 50-yrs have a chance of achieving functional walking of 80–90%, but this percentage dramatically decreases to 30–40% in older patients.[8] However, in our study, we did not notice this feature.

In our study majority of spine injuries were seen in people who were labourers followed by students. Chhabra HS et al 9 reported that most of the spinal injuries were seen in nonprofessional job holders(18.02%) followed by professionals in private jobs (17.26%), students (12.26%) and labourers (8.04%). Liu J et al 10 found that the most common occupation of patients with spinal cord injury was coolies (28.6%) followed by office clerks (16.8%).

In our study, most of the spine injuries happened in July and September and most of the injuries happened in the morning hours. This is because of the harvest season of apples in July and the harvest season of walnuts in September. Of note is that most of the spinal injuries in our study happened secondary to falls followed by road traffic accidents. That also explains the fact why in our study, labourers constituted the majority of the patients. Johannson E et al[11] also reported the incidence of TSCI to be higher during the summer and autumn months. Other previous literature reported that most injuries occurred during the summer season due to increased travelling and adventure activities. We did not notice any predisposition of spinal injuries during the weekend as has been reported by a few earlier studies.[12] and as we noticed previously in head injuries.[13] Among patients with falls, fall from a tree was the most common cause. Literature from various centres mentions road traffic accidents as the commonest cause of spinal injury followed by falls[9] whereas there are reports which mention the reverse.[14-17] Joseph et al also reported that causes of spinal injury were almost exclusively limited to falls (58%) and transport-related events (40%) respectively.[18]

The maximum number of RTAs occurred on secondary and tertiary road systems. Rural roads directly merge with either the inter-district roads or the national highways and rural traffic generally comprises untrained drivers not comply with traffic rules and safety precautions. The secondary and tertiary road commuters are more likely to have collisions with stationary objects as roadsides do not have safety grills/pavements. This highlights the importance of education programmes to generate awareness in the community, especially among colleagues. A good number of our patients had fallen from balconies. This is because these balconies were not provided with the railing and were of open type. Fall from stairs was also a cause of spinal injury in a few of our patients. This is because many of our staircases are steep and narrow and are without balustrades. A similar observation has been noted in other studies also. 9

Regarding the neurological level, there is substantial variability in the proportion of TSCI,

resulting in tetraplegia and paraplegia. In the USA, tetraplegic injuries (54.1%) were commoner than paraplegic injuries over 30 years.[19] The reverse trend was seen in the Netherlands where tetraplegic injuries accounted for 39.8% and paraplegic for 60.2%.[20] In China, tetraplegic injuries were as high as 82%.[21] As mentioned above, China has an enormous number of elderly patients with degenerative cervical spine changes who are susceptible to incomplete tetraplegia following a minor fall.[6]

Roche SJ et al[22] reported 42.6%, 14.29%, 7.14% and 28.57% of cervical, thoracic, lumbar and sacral spine injuries respectively. Hagen EM et al[23] also reported that most of the spine injuries were seen in the cervical region which accounted for 52.4% of their patients. In our study, the majority of spine injuries occurred in the thoracolumbar junction and thoracic spine and consequently, we had more paraparesis/plegics than quadriplegics/plegics.

About 58.62% (68/116) of patients who presented with spine injury to our institute had poor ASIA grade at the time of admission and the commonest injury was ASIA grade A. Derakhshanrad N et al 24 reported that the most common neurological type of injury was ASIA grade A (53.5%) followed by 18,7%, 17.6%, 9.6% and 0.6% as ASIA grade B, C, D and E respectively. Halvorsen A et al 25 also reported that the most common injury at the time of admission was complete injury (ASIA grade A) which was seen in about 77%.

In our study, the most common type of fracture was burst fracture which accounted for 31.89% of fractures followed by wedge fracture. Andalib S et al[26] reported that the most common fracture in the cervical spine in their study was translational injury (19.4%), in the thoracic region it was burst fracture (62.7%), and in the lumbar region, the most common fracture was burst fracture (75.4%). Upon sub-group analysis of 33 patients who sustained junctional thoracolumbar injuries, we found large wedge angles, kyphotic angles, and severe canal compromise on CT scan to correlate statistically with the poor outcome. Our findings correlated with the literature. [27-29]

In the MRI study, we noted cord transection in 7 patients, cord oedema in 44 and cord contusion in 31 patients. MRI was normal in 34 patients. In a study by Bondurant et al 30 in 37 patients, 43.2% of the patients, demonstrated acute cord oedema, and 8.1% of the patients demonstrated a mixed signal of hypointensity centrally and hyperintensity peripherally consistent with a contusion. Parashari et al[31] also reported spinal cord abnormalities in 47 out of 62 patients i.e. 75.80% of his patients. On analysis of MRI features, we found cord transection and contusion to have a statistically significant correlation with poor neurological outcomes. Similar observations have been found in earlier studies.[30-33] We also noted that most of the patients who on MRI demonstrated acute cord oedema improved on follow-up in their neurological grade. Hence we consider cord transection and contusion as ominous signs.

We operated upon 62% of patients and 38% were managed conservatively. Wang ZM et al 34 in their study reported that 2763 (79.24%) received surgical treatment and 724 (20.76%) received conservative treatment. Mitchell J et al[35] in their study over the last 10-yrs reported that the surgical rate was seen in 77% (range 66–83%) of patients with a spine injury. Our surgical rate was almost similar to the previous studies in the literature. One randomized controlled trial showed no benefit to early (< 72-h) decompression, however, several recent prospective series suggest that early decompression (< 12-h) can be performed safely and may improve neurological outcomes. A recent meta-analysis showed that early decompression (< 24-h) resulted in statistically better outcomes compared to both delayed decompression and conservative management.[36] Unfortunately we could not study this parameter as we could not operate on any patient within 72-h. Further stratification of the period (>72-h) did not reveal any correlation with the outcome.

The profile of associated injuries in our series is in concordance with earlier studies. Wang ZM et al [34] reported that injuries associated with spine trauma include craniocerebral injury (198, 11.09%), facial injury (407, 22.79 %), chest and abdominal injuries (359, 20.10%), pelvic injury (258, 14.45%), and limb fracture (564, 31.58%).

In our study51.72% (60/116) of patients had a hospital stay of < 10 days, 31.03% (36/116) had a stay of 2 weeks, 4.3% (5/116) had a stay of 3 weeks and 12.9% (15/116) had a stay of 1-month or more. Wang HF et al 37 reported that the mean hospital stay in patients with traumatic spinal cord injury was 17 days (range 1-80 days). Santos EA et al 38 reported that medical complications were observed in 45% of the patients, pneumonia being the most frequent (30.2%) of all the complications. Long-term complications of spinal injuries also include anxiety, depression and suicidal tendencies.[39] All this highlights the massive burden of the disease and its financial implications on our resource-limited society.

On a 1-year follow-up, the percentage of good grade ASIA scale (41.37%) at admission improved to 66.37%. Motor incomplete patients had a better prognosis for walking than motor complete. Besides the radiological parameters, the best parameter of a good outcome was a better neurologic grade. Literature also reports the same. [40-43]

CONCLUSION

Spinal injury mostly targets young males. Fall from trees and RTA's are the major causes. Paraplegics outnumber quadriplegics. Poor ASIA scale, large kyphotic angles, severe canal compromise and the presence of cord contusion and transection are bad prognostic factors. The use of protective nets, harnesses and ropes should be made mandatory for people who climb trees to pluck walnuts and apples. Roads should be made safe and stringent traffic rules should be implemented by the state. Also, awareness amongst the public should be generated about this entity and for long-term management of patients health counsellors and psychiatrists should play their roles.

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