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A STUDY ON EVALUATION OF SPINAL CORD INJURY WITH MAGNETIC RESONANCE IMAGING: A CROSS-SECTIONAL STUDY IN A TERTIARY CARE CENTRE

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ABSTRACT **Background:** MRI helps in evaluation of intervertebral disc, intramedullary space, extradural space and paravertebral soft tissue. The objective of this study was to identify various MRI imaging findings in case of Spinal cord injury and to correlate MRI with clinical features. **Methodology:** All cases with suspected spinal cord injuries were evaluated with clinical examination and neurological examination for spinal cord injuries. Radiological findings in different spinal column components studied and compared with clinical examination findings. **Results:** Most common age group involved was 21- 40 years (40%) and commonly involved in thoracic region (47.5%), followed by cervical region in 37.5% cases. Spinal cord injury is highly associated with concomitant osseous injury 35 (87.5) cases and ligamentous injury 30 (75.0) cases. **Conclusion:** We conclude that MRI can routinely evaluate integrity of the intervertebral discs and ligamentous complexes. MRI permits direct visualization of the morphology of the injured cord parenchyma and the relationship of the surrounding structures to the spinal cord.

KEYWORDS : Spinal Cord Injury (SCI), Magnetic Resonance Imaging (MRI), Neurological deficit

INTRODUCTION

Spinal trauma occurs with an annual incidence of approximately 15 to 40 cases per million. It commonly results from motor vehicle accident, fall from height, community violence and workplace related injury.[1] The incidence in South Asia is around 21 per million.[2] Trauma to the spine and spinal cord is a potentially devastating injury. Early detection of spinal cord lesions in patients of suspected acute spinal injury leads to better prognosis.

The imaging technique routinely used includes computed tomography and myelography along with conventional radiology, but these however cannot directly demonstrate changes in spinal cord.[3] Although conventional radiography may play a role in the evaluation of spinal disorders, the sensitivity and availability of higher imaging modality have resulted in a paradigm shift to the use of cross-sectional imaging. CT is frequently used to study spinal fractures. MRI is used for evaluation of suspected degenerative disc disease, infection, tumor, and soft tissue trauma, including suspected spinal cord injury and complications or spinal canal hemorrhage.[4]

Magnetic resonance imaging (MRI) is indicated in some cases of spinal trauma where detailed information about soft tissue structures is required. Evaluation of intervertebral disc, ligaments, intramedullary space, intradural extramedullary space, extradural space, paravertebral soft tissue and muscles are better evaluated with the help of MRI.[5] MRI can add vital information and influence the treatment options and outcomes in certain situations like traumatic disc herniation, expanding extramedullary hematomas compressing the spinal cord, cord edema, myelomalacia and syrinx formation, in which CT may not be helpful.[6] The present study was planned with an objective to identify various MRI imaging findings in case of Spinal cord injury and to correlate MRI with clinical features.

MATERIALS AND METHODS

The present study was cross-sectional study conducted on cases presenting with spinal cord injuries. All the cases with clinically suspected spinal cord injuries presenting with complaints of pain, difficulty in walking, upper & lower limb sensory and motor dysfunction of any age and both genders were included in the study. The cases with known pre-existing spinal cord pathologies, history of subacute or chronic trauma of spinal cord and any absolute contraindication for MRI like metal implants, pacemakers etc. are excluded from the study.

After taking the written informed consent, all cases with suspected spinal cord injuries were evaluated with clinical examination and neurological examination for spinal cord injuries. Depending on location and extent of pathological process, patients underwent MRI examination.

MRI examinations were performed using 1.5 Tesla MRI machine using Anterior and Posterior Neck coils for Cervical imaging and Phased array coils for Thoracic and Lumbar imaging.

- Axial and Sagittal T1W & T2W and Axial Gradient Recalled Echo (GRE) images for Cervical and Thoracic vertebrae
- Sagittal Fat Saturation Echo (FSE) T2-weighted sequences for Cervical and Thoracic vertebrae.
- Sagittal Spin Echo T1W and Sagittal & Axial FSE sequences sequences for Lumbar vertebrae.
- Short-tau inversion recovery (STIR) Sequences & FLAIR T2W Spin Echo sequences.
- Field of view 200 x 200mm, slice thickness 2-3 mm and matrix 256 x 256.

Radiological findings in different spinal column components studied and compared with clinical examination findings. The data was entered in MS Excel and analyzed using Epi Info software.

RESULTS

Table 1: Age, gender and mechanism of injury for Spinal cord Injury

Age group (Years)	No. (%)
0-10	1 (2.5)
11-20	4 (10.0)
21-30	8 (20.0)
31-40	8 (20.0)
41-50	7 (17.5)
51-60	6 (15.0)
61-70	4 (10.0)
>70	2 (5.0)
Gender	
Male	29 (72.5)
Female	11 (27.5)
Mechanism of Injury	
Hyperflexion (Compression wedge)	18 (45.0)
Extension	10 (25.0)
Flexion Rotation	6 (15.0)
Vertical Compression	4 (10.0)
Lateral Rotation/Hyper Extension	2 (5.0)
Total	40 (100.0)

The most common age group seen in our study was 21-30 years and 31-40 years, each comprising 20% of the total cases. There were 29 (72.5) males and 11 (27.5) females with sex ratio of 2.6:1. Overall Road traffic accidents (RTA) is the most common cause of Spinal cord

trauma with 26 (65.0) cases presenting with RTA. Although fall, especially in older age group causes spinal trauma but spinal cord injury is not seen frequently in spinal trauma due to fall. We observed 11 (27.5) cases with history of fall and 2 (5.0) cases with sports related injury. RTA most commonly causes spinal cord injury at the thoracic level followed by cervical cord.

Table 2: Spinal Column Components Injury

Level of Injury	Spinal cord		Disc Injury	Ligament Injury	Osseous Injury	Epidural Hematoma	Vascular Injury
	Edema	Hemorrhage					
Cervical	15 (37.5)	4 (10.0)	11 (27.5)	14 (35.0)	18 (45.0)		
Thoracic	19 (47.5)	6 (15.0)	5 (12.5)	13 (32.5)	15 (37.5)		
Lumbar	5 (12.5)	1 (2.5)	2 (5.0)	3 (7.5)	2 (5.0)	3 (7.5)	0
Sacro-Coccygeal	1 (2.5)	0	0	0	0	0	0
Total (%)	40 (100.0)	11 (27.5)	18 (45.0)	30 (75.0)	35 (87.5)	16 (40.0)	

Spinal cord injury is highly associated with concomitant osseous injury 35 (87.5) cases and ligamentous injury 30 (75.0) cases. Vascular injury is more commonly associated with facetal dislocations and fractures involving foramen transversarium of cervical vertebrae as in our study 75 % patients with vascular injury (3 out of 4) were having cervical region injury.

Table 3: Level of Injury associated with Neurological deficit

Level of Injury	Neurological deficit with cord trauma (%)
Cervical (n=15)	5 (33.3)
Thoracic (n=19)	12 (63.2)
Lumbar (n=5)	1 (20.0)
Sacro-Coccygeal (n=1)	0
Total (n=40)	18 (45.0)

Spinal cord involvement is more common in thoracic region with total of 19 patients affected constituting largest portion 47.5 % of traumatic spinal cord injury whereas 15 patients had cord injury in cervical region comprising 37.5 of total patients.

Table 4: Neurological deficit and Severity of Spinal trauma according to TLICS Grading

Neurological deficit	Total No of Cases (n=18)
Incomplete Tetraplegia	8 (44.4)
Complete Paraplegia	5 (27.8)
Incomplete Paraplegia	4 (22.2)
Complete Tetraplegia	1 (5.6)
TLICS Score	(n=24 Thoracolumbar Injury)
0 – 3	7 (29.2)
4	2 (8.3)
>4	15 (62.5)

Neurological deficit was observed in 18 (45.0) cases. Incomplete tetraplegia was the commonest neurological deficit observed in 8 (44.4) cases. Most patients with spinal cord injury had score >4 suggesting severe spinal trauma and require further surgical management.

DISCUSSION

In the present study, most common age group involved was 21- 40 years comprising 40% of the total cases. Young- and middle-aged men were the most common age group involved. Again, a similar trend that has been reported in other studies.7 There were 29 (72.5) males and 11 (27.5) females with sex ratio of 2.6:1. Ravindra Naik et al in their study observed 86% of males suffering from spinal cord injuries.8 Similar trend was observed in other studies.9

Overall Road traffic accidents (RTA) is the most common cause of Spinal cord trauma with 26 (65.0) cases presenting with RTA. Although fall, especially in older age group causes spinal trauma but spinal cord injury is not seen frequently in spinal trauma due to fall. We observed 11 (27.5) cases with history of fall and 2 (5.0) cases with sports related injury. RTA most commonly causes spinal cord injury at the thoracic level followed by cervical cord. A review conducted by Chiu et al. also reported that the most common modes of injuries were fall from height, followed by RTA, in concordance with our study.10 Other studies among Indian population have reported fall from height as the most common cause of SCI followed by RTA (44.5%–50.9%).11 Singh et al. also reported that falls were more common in young adults, it partly explains the higher number of patients presenting with a history of fall from height.12 It is possible that young- and middle-aged men are more active outdoors and this may probably explain their increased numbers in our study.

In the present study, spinal cord involvement is more common in thoracic region 47.5% followed by cervical region in 37.5% cases. Cervical spine is probably the most common site for injury due to its excessive mobility and lack of supporting structures.9 Cervical spine fractures are also more common among the elderly and uncommon among children.6 But our study reported higher proportion of spinal cord injury in thoracic region. Other studies have reported that thoracolumbar spinal injuries are more common compared with cervical spine fractures which are similar to our results.6

In the present study, spinal cord injury is highly associated with concomitant osseous injury 35 (87.5) cases and ligamentous injury 30 (75.0) cases. In study conducted by Ravindra Naik et al, abnormal cord findings were observed in >75% of patients.8 Various studies have also reported large proportion of patients with abnormal cord findings ranging from 70% to 75%.13 In our study Cord edema was observed in 100% cases which is in agreement with the studies done by Parashari et al.14 and Andreoli et al.15 Other cord abnormalities observed were cord contusion/edema only, spinal canal stenosis due to retropulsion, cord transection with cord contusion/edema, cord hemorrhage, and epidural hematoma.

CONCLUSION

The greatest impact that MRI has made in the evaluation of SCI has been in assessment of the intracanalicular and paraspinal soft tissues. The integrity of the intervertebral discs and ligamentous complexes can be routinely evaluated with MRI. In addition, MRI permits direct visualization of the morphology of the injured cord parenchyma and the relationship of the surrounding structures to the spinal cord. MRI is also an essential diagnostic modality in cases of SCI without radiographic abnormality.

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