

Original Research Article

Role of magnetic resonance imaging in spinal trauma

Ajit Ahuja, Nitin Wadnere*, Simran Behl

Department of Radiodiagnosis, Sri Aurobindo Institute of Medical Sciences and PG Institute, Indore, M. P. India

Received: 01 January 2021

Accepted: 05 February 2021

***Correspondence:**

Dr. Nitin Wadnere,

E-mail: roshni.sahu933@gmail.com

Copyright: © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT

Background: Magnetic resonance imaging (MRI) is the modality of choice for evaluation of ligamentous and other spinal cord, soft tissue structures, disc, and occult osseous injuries. Objective evaluate the role of MRI as a non-invasive diagnostic tool in patient with spinal trauma.

Methods: This study was conducted in department of radiodiagnosis, Sri Aurobindo institute of medical sciences and PG institute, Indore and approval from the ethical and research committee. The duration of this study was April 2018 to May 2020. We included 60 patients of spinal trauma referred for MRI in this study.

Results: In 32 (53.3%) patients the mode of injury was road traffic accidents, in 23 (38.3%) patients it was fall and in 5 (8.3%) patients the mode of injury was any other mode. There was significant difference seen between the MR cord hemorrhage, cord compression, and cord transection.

Conclusions: MRI is an excellent modality for imaging of acute spinal trauma. Normal cord on baseline MRI predicts excellent outcome. When comparing patients with complete, incomplete spinal cord injury (SCI) and spine trauma without SCI, significant difference was seen in cord hemorrhage, cord transection, cord compression.

Keywords: Magnetic resonance imaging, Spinal trauma, Spinal cord injury

INTRODUCTION

Traumatic spinal cord injury (SCI) is the leading cause of death and disability in young age group. It is a major health problem; moderate society is facing. It can result in motor, sensory and autonomic dysfunction, all of which can be devastating for the individual, both socially and economically. The incidence of SCI in developing countries is 25.5/million/year and ranges from 2.1 to 130.7/million/year.¹ MRI has been playing an increasingly important role in the management of spinal trauma patients. MRI is the modality of choice for evaluation of ligamentous and other spinal cord, soft tissue structures, disc, and occult osseous injuries.² MRI is with superior tissue characterization provides the best evaluation of soft tissue pathology and essentially the only direct evaluation of the spinal cord. Information obtained regarding discs, ligaments, hematoma, and the spinal cord is often complementary to the evaluation of osseous pathology provided by computed tomography

(CT) scan.^{3,4} Imaging plays a critical role in diagnosis of acute spinal trauma and helps in initiating prompt and accurate treatment in these patients. Conventional radiographs and CT are the initial imaging modalities used in the diagnosis of most cases of spinal injuries. While stability of the spine may be adequately assessed with CT for surgical decision making by spine surgeons.⁵ Traumatic disc herniation are best evaluated with MRI due to excellent contrast between vertebral body, disc, and combined diffusion weighting (CSF) on pulse sequences.^{6,8} the American spinal injury association (ASIA) motor score is now used as the neurologic measurement tool at admission. It is considering the reference stander for neurologic examination of individual with SCI, Is a validated reliable measurement instrument with discriminative and evaluative value. The aim of this study was to evaluate the role of MRI as a non-invasive diagnostic tool in patient with spinal trauma.

METHODS

This study was conducted in department of radiodiagnosis, Sri Aurobindo institute of medical sciences and PG institute, Indore and approval from the ethical and research committee. The duration of this study was April 2018 to May 2020. We included 60 patients of spinal trauma referred for MRI in this study. Consent was obtained from each patient. The detail history regarding time and mode of trauma followed with general physical and systemic examination was done. X-ray of involved spinal region (AP and lateral views) wherever done were studied in detail trace the fractures.

ASIA grade A indicates complete motor and sensory impairments below the level of injury. ASIA grades B, C and D indicate incomplete SCI, with evidence of sacral sensory sparing. Patient with ASIA grade B status have complete motor impairment, whereas those with ASIA grade C status have motor function below the level of injury, with a muscle grade lower than 3 (on scale of 1-5) on the medical research council scale. Patient with ASIA grade D have motor function below the injury level, with key muscle groups graded 3 or higher. ASIA grade E corresponds to no motor or sensory deficit.⁹

Inclusion criteria

Patients were age group between 21-50 years and patients referred for MRI who has spinal injury were included in the study.

Exclusion criteria

Patients in whom neuro-sensory status could not be assessed and patients who refused to give consent to be part of study were excluded.

Technique

After proper positioning of the patient, localizers were taken in axial and sagittal planes. The MRI protocol consisted of T1 weighted sequences in sagittal plane, T2 weighted sequences in sagittal plane, T1 weighted sequences axial plane, T2 weighted in axial plane, sagittal plane Short TI inversion recovery (STIR) in coronal plane. Additional T2 gradient recalled echo (GRE), half Fourier single-shot turbo spin-echo (HASTE) images were obtained wherever required. MRI findings were recorded on proforma structured for the study and analyzed.

Statistical analysis

All the results were compiled and recorded in Microsoft excel sheet and were analyzed descriptively by GraphPad.

RESULTS

The mean age was 39.69±16.85. There were 46 (76%) male and 14 (23.3%) females in this study. In 32 (53.3%) patients the mode of injury was road traffic accidents, in 23 (38.3%) patients it was fall and in 5 (8.3%) patients the mode of injury was any other mode. There were 24 (40%) patients who had injury up to the level of cervical, 7 (11.6%) had injury up to dorsal level, 20 (33.3%) had injury up to dorso-lumbar level and 9 (15%) patients had injury up to lumbar level (Table 1).

Table 1: Base line characteristic (n=60).

Variables	Findings (%)
Mean age (year)	39.69±16.85
Gender	
Male	46 (76)
Female	14 (23.3)
Mode of injury	
Rode traffic accidents	32 (53.3)
Fall	23 (38.3)
Other	5 (8.3)
Level of injury	
Cervical	24 (40)
Dorsal	7 (11.6)
Dorso-lumbar	20 (33.3)
Lumbar	9 (15)

Value indicated mean ± stander deviation number (%)

There was predominance of male subjected in present study. Females constituted a higher percentage of cases in incomplete SCI (57.1%) as compared to those with complete SCI (42.8%) (Figure 1).

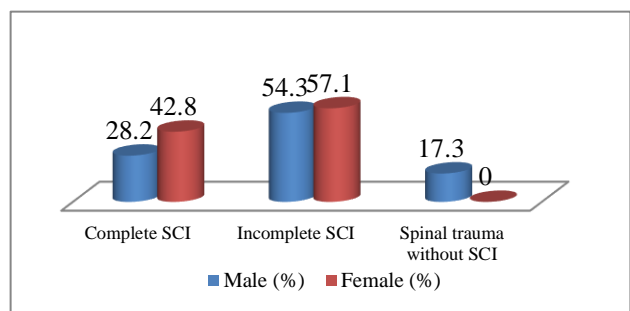


Figure 1: ASIA grading in relation to gender.

There was no significant difference association seen between the MR subluxation/dislocation of facet joints, cord edema, epidural hemorrhage, ALL/PLL/ISL injury and pre/para vertebral collection. There was significant difference seen between the MR cord hemorrhage, cord compression, and cord transection. When comparing patients with complete, incomplete spinal cord injury (SCI) and spine trauma without SCI, significant difference was seen in cord hemorrhage, cord transection, cord compression (Table 2) (Figure 2, 3 and 4).

Table: 2 Frequency of qualitative MR variables in patients with complete SCI, incomplete SCI and in those with spine trauma without SCI.

Variable	Complete (18) (%)	Incomplete (33) (%)	Spine trauma without SCI (9) (%)	P value	Total
Subluxation/dislocation of facet joints	11 (61.1)	13 (39.3)	2 (22.2)	0.125	26/60
Epidural hemorrhage	7 (38.8)	13 (39.3)	2 (22.2)	0.621	22/60
Cord edema	15 (83.3)	23 (69.6)	0 (0)	0.285	38/60
Cord hemorrhage	8 (44.4)	0 (0)	0 (0)	-	8/60
Cord compression	15 (83.3)	23 (69.6)	2 (22.2)	0.005*	40/60
Code transaction	4 (22.2)	0 (0)	0 (0)	-	4/60
ALL/PLL/ISL	9 (50)	14 (42.4)	2 (22.2)	0.382	
Pre/para vertebral collection	12 (66.6)	18 (54.5)	3 (33.3)	0.259	33/60

Anterior longitudinal ligament; PLL: Posterior longitudinal ligament, ISL: Interspinous ligament, *chi square<0.005 sign. differences.

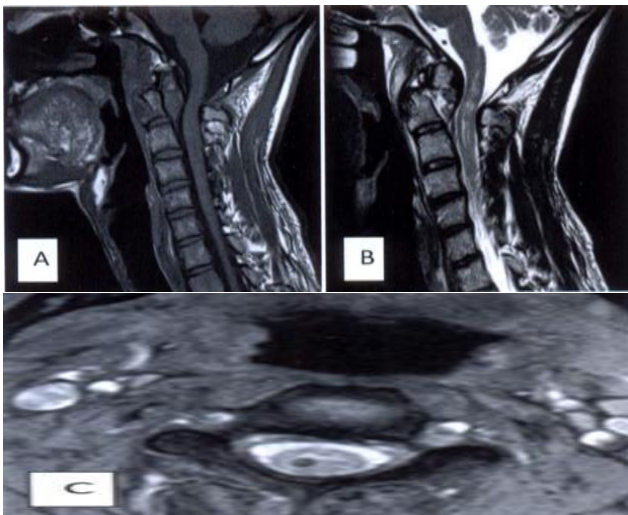


Figure 2: Hemorrhage: sagittal T1 (A) and sagittal T2 weighted (B) axial GRE image (C) hemorrhage of ill-defined irregular intra-modularly abnormal signal intensity at level of C1-C2 which is predominantly hyperintense on T2 weighted with hypodense foci in it with blooming on GRE. There is fracture of dens with prevertebral collection noted from C1-C2.

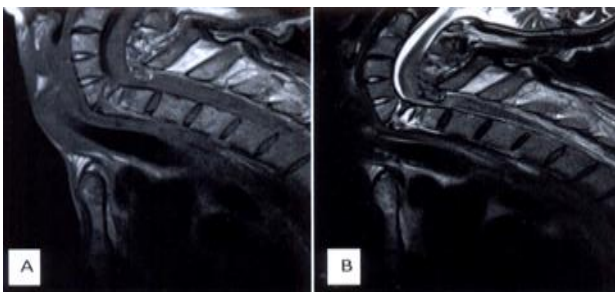


Figure 3: Cord compression: sagittal T1 (A) and sagittal T2 weighted (B) compression with marked anterior lithiasis of C6 over C7 with secondary impingement of underlying cord parenchyma causing altered signal in the cord above and below this level. Mild prevertebral collection is also seen.



Figure 4: Cord transection: sagittal T1 (A) and sagittal T2 weighted (B) Transection with complete anterior subluxation of C6 over C7. There is disruption in posterior longitudinal ligament with altered signal intensity in the cord extending from C3-C4 level superiorly and D1 level inferiorly. Prevertebral collection noted extending superiorly to base of skull.

DISCUSSION

Spinal trauma represents one of the most devastating health problems to afflict human. It causes enormous physical, emotional and economic burden because large number of affected patients are relatively young. Spinal cord injury could not be directly evaluated. Myelography and CT were further advancements in imaging but were still unable to show the cord injury directly. Extrinsic compression of the spinal cord and the internal architecture of the spinal cord are best visualized with MRI. It is also the best modality for visualization of the soft tissue injury. The para-spinal soft tissue injury and post traumatic herniation are well demonstrated. It can also show the extent of spinal hematoma in surgical evaluation. The most important feature of MRI is in the evaluation of hemorrhagic and non-hemorrhagic cord injuries.^{10,12} In present study the mean age was 39.69±16.85. The most common cause of spinal trauma was road traffic accident accounting for 53.3% of the cases. Next most common cause was fall from height

38.3 and 8.3% of injuries were due to other causes. Other studies have also reported a similar. All have reported road traffic accidents as the most common cause of spinal injury.^{1,13-20} Ligamentous tears can be partial or complete. Partial tears are seen as high signal areas on STIR images related to hemorrhage and with edema varying degrees of intact fibers. Complete tears are seen as complete lack of intact fibers with high signal intensity on STIR images due to associated edema and hemorrhage.²¹ In present study the most common site of injury in the spine was cervical spine, accounting for 40% of the cases, similarly observed by other study.^{15,19,20} In this study cord hemorrhage were significantly more frequently associated with complete injuries compare to Incomplete and Spine Trauma without SCI. Similar result was also noted by previous study.¹⁷ Showed the crudity of MRI in determining the management of spinal trauma.²² They showed that MR is also indicated for the evaluation of patients with late complications and sequelae following spinal trauma. Andreoli showed the strong correlation between MRI appearance of traumatic spinal cord injuries in acute phase and long-term recovery of motor and sensory functions.²³

CONCLUSION

Magnetic resonance imaging (MRI) is an excellent modality for imaging of acute spinal trauma. Normal cord on baseline MRI predicts excellent outcome. MRI is also helpful in predicting the prognosis by demonstrating the hemorrhagic cord injuries. When comparing patients with complete, incomplete SCI and spine trauma without SCI, significant difference was seen in cord hemorrhage, cord transection and cord compression.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

- Rahimi-Movaghar V, Sayyah MK, Akbari H, Khorramirouz R, Rasouli MR, Moradi-Lakeh M. Epidemiology of traumatic spinal cord injury in developing countries: a systematic review. *Neuroepidemiology*. 2013;41(2):65-85.
- Saifuddin A. MRI of acute spinal trauma. *Skeletal Radiol*. 2001;30(5):237-46.
- Brandt MM1, Wahl WL, Yeom K, Kazerooni E, Wang SC. Computed tomographic scanning reduces cost and time of complete spine evaluation. *J Trauma*. 2004 May; 56(5):1022-6.
- Flandears AE, Croul SE. Spinal trauma in: Atlas SW, editor. *Magnetic Resonance Imaging of the Brain and Spinal*. 3rd ed. Philadelphia: Lippincott, Williams, and Wilkins. 2002;1769-824.
- Rajasekaran S, Vaccaro AR, Kanna RM. The value of CT and MRI in the classification and surgical decision-making among spine surgeons in thoracolumbar spinal injuries. *Eur Spine J*. 2017;26(5):1463-9.
- Whelan MA, Gold RP. Computed tomography of the sacrum: 1. Normal anatomy. *Am J Roentgenol*. 1982;139(6):1183-90.
- Woon JT, Stringer MD. Clinical anatomy of the coccyx: a systematic review. *Clinical anatomy*. 2012;25(2):158- 67.
- Denis F. The three-column spine and its significance in the classification of acute thoracolumbar spinal injuries. *Spine*. 1983;8(8):817-31.
- Maynard FM Jr, Bracken MB, Creasey G, Ditunno JF Jr, Donovan WH, Ducker TB et al. International Standards for Neurological and Functional Classification of Spinal Cord Injury. *Spinal Cord*. 1997;35(5):266-74.
- Como JJ, Thompson MA, Anderson JS, Shah RR, Claridge JA, Yowler CJ et al. Is magnetic resonance imaging essential in clearing the cervical spine in obtunded patients with blunt trauma? *J Trauma*. 2007;63(6):544-9.
- Kumar Y, Hayashi D. Role of magnetic resonance imaging in acute spinal trauma: a pictorial review. *BMC musculoskeletal disorders*. 2016;17(1):310.
- Parashari UC, Khanduri S, Bhadury S. Diagnostic and prognostic role of MRI in spinal trauma, its comparison and correlation with clinical profile and neurological outcome, according to ASIA impairment scale. *J Craniovertebral Junction Spine*. 2011;2:17-26.
- Miyajima F, Furlan JC, Aarabi B, Arnold PM, Fehlings MG. Acute cervical traumatic spinal cord injury: MR imaging findings correlated with neurologic outcome--prospective study with 100 consecutive patients. *Radiology*. 2007; 243(3):820-7.
- Standring S, Gray H. *Grays anatomy. Anatomical basics of clinical practise*, 40th edition Churchill Livingstone: Elsevier Limited Publication: 2008;712-35.
- Kulkarni MV, McArdle CB, Kopanicky D, Miner M, Cotler HB, Lee KF et al. Acute spinal cord injury: MR imaging at 1.5 T. *Radiology*. 1987;164(3):837-43.
- Flanders AE, Schaefer DM, Doan HT, Mishkin MM, Gonzalez CF, Northrup BE. Acute cervical spine trauma: correlation of MR imaging findings with degree of neurologic deficit. *Radiology*. 1990;177(1):25-33.
- Terhaar M, Naidoo SM, Govender S, Parag P, Esterhuizen TM. Acute traumatic cervical spinal cord injuries: Correlating MRI findings with neurological outcome. *SA orthopaedic J*. 2017;10(1):35-41.
- Martínez-Pérez R, Paredes I, Cepeda S, Ramos A, Castaño-León AM, García-Fuentes C et al. Spinal Cord Injury after Blunt Cervical Spine Trauma: Correlation of Soft-Tissue Damage and Extension of Lesion. *AJNR* 2013;35(5):1029-34.

19. Gupta R, Mittal P, Sandhu P, Saggar K, Gupta K. Correlation of Qualitative and Quantitative MRI Parameters with Neurological Status: A Prospective Study on Patients with Spinal Traum. *J Clin Diagn Res.* 2014;8(11):RC13-7.
20. Magu S, Singh D, Yadav R, Bala M. Evaluation of Traumatic Spine by Magnetic Resonance Imaging and Correlation with Neurological Recovery. *Asian Spine J.* 2015;9(5):748-56.
21. Warner J, Shanmuganathan K, Mirvis SE, Cerva D. Magnetic resonance imaging of ligamentous injury of the cervical spine. *Emerg Radiol.* 1996;3(1):9-15.
22. Demaerel P. Magnetic resonance imaging of spinal cord trauma: A pictorial essay. *Neuroradiology.* 2006;48(4):223-32.
23. Andreoli C, Colaiacomo MC, Rojas Beccaglia M, Di Biasi C, Casciani E, Gualdi G. MRI in the acute phase of spinal cord traumatic lesions: Relationship between MRI findings and neurological outcome. *Radiol Med.* 2005;110:636-45.

Cite this article as: Ahuja A, Wadnere N, Behl S. Role of magnetic resonance imaging in spinal trauma. *Int J Res Med Sci* 2021;9:842-6.