ORIGINAL RESEARCH ARTICLE

Role of CT and MRI in Spinal Trauma

Preethi Ganesan[1], Abubacker Sulaiman F[2], Soorya Prakash[3], E.A Parthasarathy[4], Rajamani Anand[5], Ramya Kalaiarasan[6]

[1]Final Year Post Graduate Student, [2]Professor, [3]B.Sc Allied Health Science Student, [4]Assistant Professor, [5]Assistant Professor, [6]Senior Resident, Department of Radiology and Imaging sciences, Chettinad Hospital and Research Institute, Kelambakkam, Kanchipuram-603103, Tamil Nadu, India.

Corresponding author: Prof. Dr. Abubacker Sulaiman F, Professor Department of Radiology and Imaging sciences, Chettinad Hospital and Research Institute, Kelambakkam, Kanchipuram-603103, Tamil Nadu, India.

DOI: 10.21276/ijcmsr.2018.3.2.4

How to cite this article: Preethi Ganesan, Abubacker Sulaiman F, Soorya Prakash, E.A Parthasarathy, Rajamani Anand, Ramya Kalaiarasan. Role of CT and MRI in Spinal Trauma. International Journal of Contemporary Medicine Surgery and Radiology. 2018;3(2):B11-B14.

A B S T R A C T

Introduction: MRI gives detailed evaluation of traumatic changes in the spine that allow the physicians to provide optimal treatment to the patients with best outcome and also with minimal risk of complication. Study was done to compare the diagnostic value of CT and MRI in evaluating acute spinal injuries and to provide information that may assist the clinician in making appropriate decisions.

Material and Methods: 50 patients with acute spinal injury was taken up for evaluation with CT and MRI in department of Radiology in Chettinad Hospital from May 2016 to February 2017.CT was done using 128 slice Philips ingenuity and MRI was done using GE HDxt 1.5 T. Separate spine coils were employed for imaging the spine.

Results: Out of 50 patients, 32 patients had fractures and it was clearly visualized in CT when compared to MRI. MRI is the best technique to visualize these lesions, to diagnose if they are hemorrhagic or not, to detect and determine the cause of spinal cord compression.

Conclusion: While CT is considered adequate in evaluating stable and unstable spinal injuries especially bony elements. Thus, it is recommended that CT and MRI are complementary to each other in evaluation of spine injuries.

Key words: Computed Tomography, Magnetic Resonance Imaging, Trauma

INTRODUCTION

Patients with Spine injuries are commonly seen in trauma and can be fatal, particularly if not identified in a short time.[1] Most spinal injuries are due to Road Traffic Accidents (RTA) and sports injuries. Injuries in this region may produce neurologic defects, sometimes severe and fatal. CT plays an essential role in rapid assessment of trauma patients.[2,3] Multi detector 3D reconstructed CT are preferred. Spine CT has very good sensitivity, specificity and good diagnostic accuracy in picking up spinal fractures but is inadequate in detecting purely ligamentous injury. CT evaluation is more complicated in patients with severe degenerative disease.[4,5] Traumatic and Non traumatic disc herniation appear identical on MRI. Both can cause cord compression leading to central cord syndrome. Traumatic disc herniation are best evaluated with MRI due to excellent contrast between disc, vertebral body and CSF on pulse sequences[6-8] (Table 1). Hence; under the light of above mentioned data, we planned the present study to compare the diagnostic value of CT and MRI in evaluating acute spinal injuries.

MATERIAL AND METHODS

50 patients with acute spinal injury was taken up for evaluation with CT done using 128 slice Philips ingenuity and MRI done using GE HDxt 1.5 T in the Department of Radiology in Chettinad Hospital from May 2016 to February 2017. CT protocol includes High resolution with 1mm thin section with 1mm of affected segments and Axial, Coronal and Sagittal Reconstruction images were taken. Ethical clearence and informed consent was obtained from the institution and patients respectively before the start of study.

MRI sequences include Axial T2, Sagittal T1 and T2, T2 Selective partial Inversion Recovery (SPIR)/FAT and Coronal Proton Density (PD).

Depending upon the Age, Gender, Etiology, Level of neurological impairment and type of diagnostic imaging (CT and MRI):

- Vertebral compression fracture.
- Burst fracture and dislocations.
- C1 and C2 lesions.
- Posterior element fractures include pedicle, articular facets, lamina, spinous and transverse process, lateral mass and joint capsule were investigated Radiologically(

Inclusion Criteria

- Patients complaining of spinal cord pain
- Instability caused by mechanical stress
- Autonomic dysfunction

S. No	Pathological fractures	Role of MRI
1.	Ligamentous injury	When compared to CT, MRI is more sensitive in differentiating complete or partial tear. Helps in differentiating stable Vs unstable fractures for clinical management[2].
2.	Herniation of the disc and its damage	Detection of abnormal signal intensity of the disc (traumatic herniation). Undetected disc herination can cause more severe cord injury.
3.	Extra medullary hemorrhage	MRI is helpful in assessing hematoma. Extra-dural hematoma can cause cord compression.
4.	Vascular Injury	Complete occlusion, Pseudo-aneurysms, Intimal flap are types of injuries. If its undetected, it causes spinal cord infarction.
5.	Cord Injury	Detection of hemorrhagic from non-hemorrhagic injuries
6.	Fractures of Vertebrae	Fractures were classified independent of age by CT and are of two types Acute or Old fractures based on their bone marrow edema.
7.	Benign Vs Malignant Fracture	Benign fractures present with bands of marrow edema(horizontal), concave appearance of posterior vertebral margin and usually a lack of soft tissue mass. Malignant fractures present with fractures involving the vertebral body, convex posterior margin of the vertebral body and often associated with soft tissue mass

Table-1: Role of MRI in various pathological conditions of spine.

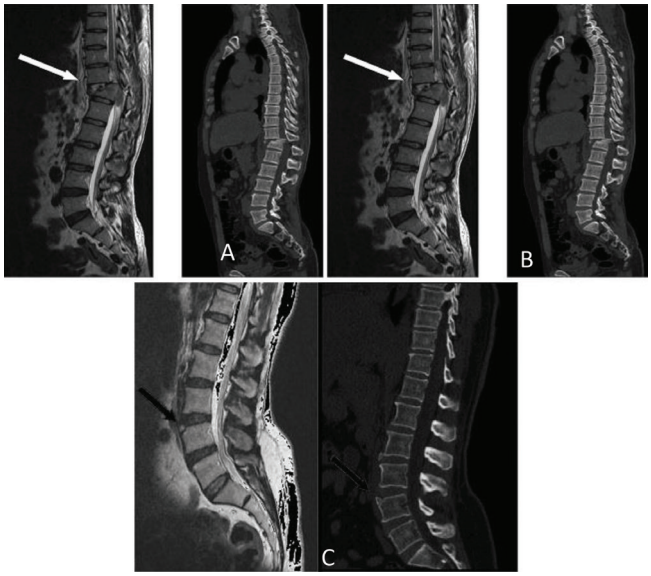

Figure-1: A - T2 weighted Sagittal MRI and Sagittal Reconstructed CT Image shows Comminuted fracture of D12 with retropulsion of body and extension of fracture into posterior elements. **B -** Sagittal T2 weighted MRI and Sagittal Reconstructed CT Image shows Anterior Wedge Compression fracture noted in the body of the L1 Vertebra seen extending into posterior elements with T2/STIR hyperintense marrow signal changes. **C -** Sagittal T2 weighted MRI and Sagittal Reconstructed CT Image shows Limbus deformity noted in anterior superior margin of L4 vertebra.

Exclusion Criteria

- Pregnant women in CT.
- Patients with metallic implant in MRI.
- Claustrophobic patients.

The typical MRI protocol for spinal injury includes sagittal T1 weighted (T1W) and T2 weighted (T2W) spin echo sequences, and T2* weighted (T2*W) gradient recalled echo (GRE) sequence, and sagittal short tau inversion recovery (STIR) sequences, as well as axial T2W and T2*W GRE sequences. T1W images are mainly used for depiction of anatomy and osseous fractures. STIR images are very sensitive for detection of edema and is helpful in diagnosing the soft tissue and ligamentous injuries, particularly of the interspinous or supraspinous ligaments. Although fat-suppressed T2W images can also be used for detection of edema, STIR images provide more uniform fat suppression. T2W images are very good in detecting the cord edema, and T2*W GRE images are used to detect the hemorrhage in and around the cord.[5]

STATISTICAL ANALYSIS

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

RESULTS

T2 weighted Sagittal MRI and Sagittal Reconstructed CT Image shows Comminuted fracture of D12 with retropulsion of body and extension of fracture into posterior elements (Figure 1). Spinal canal is severely narrowed at D11-D12 level by the retro-pulsed bony fragment with cord contusion from D10- D11 disc space to D12 body level. Sagittal T2 weighted MRI and Sagittal Reconstructed CT Image shows Anterior Wedge Compression fracture noted in the body of the L1 Vertebra seen extending into posterior elements with T2/STIR hyperintense marrow signal changes (Figure 2). Sagittal T2 weighted MRI and Sagittal Reconstructed CT Image shows Limbus deformity noted in anterior superior margin of L4 vertebra (Figure 3).

DISCUSSION

The "standard of care" in imaging of the spine in trauma patients is constantly changing with the increasing availability of new technology. Multidetector helical computed tomography (CT) allows the spine to be imaged more accurately and expeditiously than previously.[9-11] MRI also has an important role in the imaging algorithm. The aim of the following article was to provide a contemporary review of imaging in spinal trauma. Indications for Imaging

There have been multiple studies investigating the necessity of imaging in trauma of the cervical spine. The general goal of these guidelines is to accurately predict which patients are at risk of cervical spine fractures, avoiding the potentially disastrous consequences of not diagnosing a cervical spine fracture. The secondary benefit of such guidelines is to reduce unnecessary examinations.[12-15]

CT demonstrates fracture or any bony injuries as similar to that of X ray, due to superior contrast definition and absence of superimposed structures which helps in accurate diagnosis of fractures. Axial CT performed in patients with neutral position, bony distraction of fracture fragments and subluxation of the spinal articulations may not be as significant on CT while compared to series of radiograph. MRI is helpful in detecting soft tissue injuries to the ligament, facet capsules and the pre vertebral spaces than the CT. T2* GRE sequence helps in detecting indirect signs of fracture such as cortical break in a bone as a low signal intensity in compression fractures whereas CSF and Spinal cord edema seen as high signal intensity. 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.[16-18]

Parashari UC et al evaluated the role of magnetic resonance imaging (MRI) as a non-invasive diagnostic tool in patients with acute and chronic spinal trauma and to compare and correlate the MRI findings with those of patients' clinical profile and neurological outcome according to ASIA impairment scale to assess prognostic and clinical value of MRI. Sixty two patients of spinal trauma formed the study group in a prospective fashion. The patients undergoing MR imaging and magnetic resonance images were analyzed and correlated with findings on neurological examination according to American Spinal Injury Association (ASIA) impairment scale (AIS) at the time of MRI examination and subsequently at sub-acute interval to assess neurological outcome. Sample profile was described in terms of 95% confidence limit and proportion. To describe strength of association between extent of spinal cord injury and outcome, odd's ratio, bivariate and multi variant analysis, was used. Pearson's chi square (χ) 2 statistics was applied to test the association between two categorical variables. Data were analyzed using statistical software package, STATA 9.2 and the difference was considered to be significant if 'P' value was <0.05. The cord edema without hemorrhage was the most common MR finding (41.5%). The others were sizable focus of hemorrhage within the cord (33%), epidural hematoma (5.0%), and normal cord (26%). Majority of MR findings correlated well with clinical profile of the patient according to ASIA impairment scale. This study demonstrated that patients with presence of sizable focus of haemorrhage had larger cord edema and more severe grade of initial ASIA impairment scale (AIS) with poor recovery at follow up (P=0.032).Improvement in upper extremity was more than lower extremity.[19] Silberstein M et al compared Magnetic Resonance Imaging (MRI) at 0.3T and Computed Tomography (CT) in the retrospective evaluation of 34 patients with acute spinal cord injury. MRI was highly accurate in the imaging of vertebral body fracture, and spondylitic changes, and is the method of choice for imaging ligament injury, traumatic disc protrusion and spinal cord compression. It was also useful for the identification of subtle subluxations in the sagittal plane. CT remains the method of choice for imaging neural arch fractures. MRI at 0.3T is a valid technique for assessing patients with acute spinal trauma.[13] Schröder RJ et al compared the diagnostic capacities of computed tomography (CT) and magnetic resonance imaging (MRI) in the diagnostic evaluation of acute cervical spinal column injuries. They examined 39 patients with cervical spine injury suspected either clinically or by plain radiography, or even confirmed. In 30 patients, 86 acute traumatic lesions were observed in the area of the cervical spine, 83% of which were retrospectively recognisable by CT and 95% on MRI films. In nine patients, no acute traumatic pathologic pattern could be found either by CT or by MRI or any other subsequently employed diagnostic methods. CT yielded 100% of the osseous acute traumatic findings, the degenerative lesions narrowing the spinal channel, and of the dislocations, but only 33% of the lesions of the longitudinal ligaments, 50% of intramedullary haemorrhages, 60% of paravertebral soft tissue haematomas, 83% of vertebral disc herniations of protrusions, and none of the six nonhaemorrhagic spinal cord contusions. Without exception, MRI revealed all the traumatic medullary and paravertebral soft tissue changes, dislocations, and spondylophytes narrowing the spinal channel, but only 50% of the C2-odonteous fractures, 89% of the transverse processes', and 92% of the vertebral lamina fractures. Basing on these results, after primary plain film radiograph imaging, the performance of MRI seems to be recommendable prior to CT in diagnostic evaluation of traumatic cervical spinal lesions, if possible with regard to the patient's clinical state and the global organization, unless immediate CT imaging of other body regions (i.e. of the head) is already being planned anyway, Nevertheless, MRI should not be abandoned within the overally framework of this disease pattern.[20]

CONCLUSION

Considering the severity of trauma, CT shows accurate and faster ways to evaluate spinal trauma. It also most cost effective. The bone anatomy is better visualized in CT whereas disc herniation and hemorrhage in MRI scans.

In trauma patients, spinal cord lesions have a major concern. MRI is ideal choice of modality in diagnosing, detecting and determining the cause of spinal cord compression. Also helps in diagnosing bone marrow edema, posterior ligament complex injuries and disc related pathologies.

MRI should be taken whenever spinal cord lesion is suspected and it is more sensitive in assessing soft tissue and spinal cord injuries than any other modalities. Therefore it is recommended that CT and MRI are complementary to each other in evaluation of spine injuries.

REFERENCES

1. Parizel PM, Van der Zijden T, Gaudino S, Spaepen M, Voormolen MH, Venstermans C, De Belder F, Van Den Hauwe L, Van Goethem J. Trauma of the spine and

spinal cord: imaging strategies. European Spine Journal. 2010;19(1):8-17.
2. Norman D, Mills CM, Brant-Zawadzki M, Yeates A, Crooks LE, Kaufman L. Magnetic resonance imaging of the spinal cord and canal: potentials and limitations. American Journal of Roentgenology. 1983;141(6):1147-52.
3. Verbiest H. A lateral approach to the cervical spine: technique and indications. Journal of neurosurgery. 1968;28(3):191-203.
4. Jost RG, Sagel SS, Stanley RJ, Levitt RG. Computed tomography of the thorax. Radiology. 1978;126(1):125-36.
5. Bogduk N. Clinical and Radiological Anatomy of the Lumbar Spine E-Book. Elsevier Health Sciences; 2012 Jan 30.
6. Whelan MA, Gold RP. Computed tomography of the sacrum: 1. Normal anatomy. American Journal of Roentgenology. 1982;139(6):1183-90.
7. Woon JT, Stringer MD. Clinical anatomy of the coccyx: a systematic review. Clinical anatomy. 2012;25(2):158-67.
8. Denis F. The three column spine and its significance in the classification of acute thoracolumbar spinal injuries. spine. 1983;8(8):817-31.
9. Mettler Jr FA, Wiest PW, Locken JA, Kelsey CA. CT scanning: patterns of use and dose. Journal of radiological Protection. 2000;20(4):353.
10. Gamal GH. Evaluation of spinal trauma by multi detector computed tomography and magnetic resonance imaging. The Egyptian Journal of Radiology and Nuclear Medicine. 2014;45(4):1209-14.
11. Muchow RD, Resnick DK, AbdelMP,Munoz A, Anderson PA.Magnetic resonance imaging (MRI) in the clearance of the cervical spine in blunt trauma: a metaanalysis. J Trauma 2008;64(2):179–89.
12. Hogan GJ, Mirvis SE, Shanmuganathan K, Scalea TM. Exclusion of unstable cervical spine injury in obtunded patients with blunt trauma: is MR imaging needed when multi-detector row CT findings are normal? Radiology 2005;237(4): 106–13.
13. Spiteri V, Kotnis R, Singh P, Elzein R, Madhu R, Brooks A, et al. Cervical dynamic screening in spinal clearance: now redundant. J Trauma 2006;61(3):1171–7
14. Stassen NA, Williams VA, Gestring ML, Cheng JD, Bankey PE. Magnetic resonance imaging in combination with helical computed tomography provides a safe and efficient method of cervical spine clearance in the obtunded trauma patient. J Trauma 2006;60(1):171–7.
15. Brohi K, Healy M, Fotheringham T, Chan O, Aylwin C, Whitley S, et al. Helical computed tomographic scanning for the evaluation of the cervical spine in the unconscious, intubated trauma patient. J Trauma 2005;58(5):897–901.
16. 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.
17. Kumar Y, Hayashi D. Role of magnetic resonance imaging in acute spinal trauma: a pictorial review. BMC musculoskeletal disorders. 2016;17(1):310.
18. Parashari UC, Khanduri S, Bhadury S, et al. Diagnostic and prognostic role of MRI in spinal trauma, its comparison and correlation with clinical profile and neurological outcome, according to ASIA impairment scale. Journal of Craniovertebral Junction and Spine. 2011;2:17-26.
19. Silberstein M1, Tress BM, Hennessy O. A comparison between M.R.I. and C.T. in acute spinal trauma. Australas Radiol. 1992;36(3):192-7.
20. Schröder RJ, Vogl T, Hidajat N, Schedel H, Südkamp N, Haas N, Felix R. Comparison of the diagnostic value of CT and MRI in injuries of the cervical vertebrae. Aktuelle Radiol. 1995;5(4):197-202.

Source of Support: Nil; **Conflict of Interest:** None

Submitted: 01-04-2018; **Published online**: 30-04-2018