Role of magnetic resonance imaging in spinal trauma

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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 code transaction.

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.⁶,⁷ 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.3

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 lumber level (Table 1).

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

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

Value indicated mean ± standard 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 code transaction. When comparing patients with complete, incomplete spinal cord injury (SCI) and spine trauma without SCI, significant difference was seen in cord hemorrhage, cord transaction, 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.

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

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

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-splinal 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.

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REFERENCES
