Research Journal of Medical Science

# Low Tesla MRI in Acute Spinal Injuries

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**Key words:** Spinal, Tesla, MRI, injuries, acute injury, Trauma

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Page No.: 354-357
Volume: 9, Issue 6, 2015
ISSN: 1815-9346
Research Journal of Medical Sciences


**Abstract:** MRI is one of the most comprehensive, non-invasive, safe diagnostic modality for delineation of spinal anatomy and diagnosis of various patterns of injury. In most countries, acute spinal cord injury occurs at an annual rate of 20-40 persons per million causing neural deficit and physical impairment. With the inception of CT and MRI, cervical spine injuries have been extensively studied. This was a prospective study of "Low Tesla MRI in Acute Spinal Injuries" 120 patients were studied of which the most common age group affected was between 21-60 years of age (81%). MRI acts as complementary investigation to define cord and soft tissue injuries, also shows bony injuries as marrow oedema& fractures.

## INTRODUCTION

In most countries, acute spinal cord injury occurs at an annual rate of 20-40 persons per million causing neural deficit and physical impairment. The main causes of spinal cord trauma are motor vehicle accidents, sports, accidents at work and falls at home (Khandelwal *et al*., 2004). An acute injury is an injury that occurred recently. The most frequent cause of acute injury is trauma. Injury to the bony spine can be considered acute if it has occurred within 3 weeks, as during this period most fractures behave like fresh fractures (Kerslake, 1991). In some cases there is primary injury at the level of cervical spine for which patient gets treated and after some days secondary lesion is found at some other place, till significant neural deficit develops (Calenof *et al*., 1978). Magnetic resonance has been able to demonstrate a variety of spinal cord abnormalities including hemorrhage, edema, cyst and myelomalacia in traumatized patient (Yamashita *et al*., 1991). CT scan is done for detailed evaluation, it helps in clear visualization of bone injuries and undetected non-displaced fractures of neural arch, clear information of free bony fragments in spinal canal which need surgical intervention, however evaluation spinal cord is not possible with CT and that of ligamentous injuries is suboptimal. MR Imaging is significantly better than CT in assessment of damage to Anterior, posterior and interspinous ligaments (Benedetti *et al*., 2000). Unique soft tissue resolution of MR imaging has permitted direct visualization of spinal cord although the presence or absence of cord lesion could be inferred on myelography and post myelography CT, MR imaging allows specific assessment of cord parenchyma itself (Sze, 1992).

**Aim and objectives:** To evaluate the Low Tesla MRI findings in cases of suspected acute spinal injuries.

**Literature review:** With the inception of CT and MRI, cervical spine injuries have been extensively studied. Considering the mortality and morbidity it is required for urgent diagnosis and treatment.

Nunez *et al*. (1996) retrospectively compared radiographs and helical CT scans of the cervical spine of

88 severely traumatized patients. They concluded that clinically important and treatable fracture of the cervical spine can be initially missed if we rely only on plain radiographic findings.

Curati *et al*. (1992) in "The Early Evolution of Spinal Cord Lesions on MR Imaging following Traumatic Spinal Cord Injury", stated that spinal cord oedema increases significantly during the early time period after injury, whereas intramedullary haemorrhage remains comparatively static.

Curati *et al*. (1992) in their article "Spinal pseudomeningoceles and cerebrospinal fluid fistulas" stated that MRI is the neurodiagnostic modality of choice, but computerized tomography myelography and radionuclidemyelography may be helpful in difficult cases.

MR spectroscopy may be used to measure the biochemical characteristics of the brain and spinal cord following SCI (Lammertse *et al*., 2007).

## MATERIALS AND METHODS

Patients to Krishna Hospital, Karad with suspected history of spinal injury between time period of 1st October, 2010 to 30th September, 2012 which comprised of a total 120 patients of suspected spinal injuries. All of patients were imaged within 2 days of trauma. Informed consent of obtained from the patient participating in the study and information is obtained. MRI of the affected Spine was done as per standard imaging protocol. Data analysis of the findings was separately and collectively performed. All of patients were imaged within 2 days of trauma. In cases where suspicion of listhesis, radiographs were done following MRI to see for superior and articular processes. For the cases in which marrow oedema was noted without fracture line on MRI or suspicion of unstable fracture, in those cases CT was done following MRI. Out of 120 study population, due to various reasons, 16 patients were transferred where MRI was repeated on 1.5T. All patients having cardiac pacemakers, prosthetic heart valves, cochlear implants on any metallic orthopedic implants. Females in the first 12 weeks of pregnancy although there are no proven hazards. All patients with previous history of surgery in the injured spine, infections and neoplasms.

MAGNETOM! (0.35 Tesla) SIEMENS India Ltd. with suitable environment held with the Department of Radiodiagnosis. Body coil is available which was used for imaging of the spine.

## RESULTS AND DISCUSSION

A total number of 120 patients were included in this study. Most of them were referred for MRI. A brief clinical history with importance to mode of trauma, neurological deficit and any other associated chest and abdominal injuries were noted. Correlation with the general examination, local examination findings and relevant investigation (radiographs) was done. The observation and results were tabulated as follows:

Table 1: Mode of Trauma

| Mode of Trauma | No. of patients |
|---|---|
| Fall from height | 75 (63%) |
| RTA | 45 (37%) |

Table 2: Gender

| Gender | No. of patients |
|---|---|
| Male | 86 (72%) |
| Female | 34 (28%) |

Table 3: Age group

| Age groups | No. of patients |
|---|---|
| 1-20 | 3 (2%) |
| 21-40 | 57 (48%) |
| 41-60 | 41 (34%) |
| 61-80 | 19 (16%) |

Table 4: Site of injury

| Site of injury | No. of patients |
|---|---|
| Cervical | 55 (46%) |
| Dorsal | 14 (12%) |
| Dorsolumbar | 29 (24%) |
| Lumbar | 20 (17%) |
| Sacral | 2 (1%) |

Table 1 shows 120 patient included in the study, majority (i.e., 63%) had "fall from height" as a mode of injury followed by "Road Traffic Accident" (RTA) (37%).

Table 2 indicated that of 120 patients, 86 (72%) were male and 34 (28%) were female. In Table 3 shows that the most common age group affected was between 21-60 years of age (81%). Least affected age group was between 1-20 and >60 years of age.

In Table 4 indicated, the most common site of injury is the cervical spine (46%) followed by dorsolumbar (24%) and lumbar spine (17%).

In this study of "Low Tesla MRI in Acute Spinal Injuries" 120 patients were studied, of which the most common age group affected was between 21-60 years of age (81%). Males were the most affected sex (71%). These demographic characteristics are similar to other previously published studies. In a study of 465 spine trauma patients, Rahman *et al*. (2002) observed that most (56%) patients were young, in the age range of 21-40 years with a male to female ratio of 5:1.

The most common mode of trauma in our study population was fall from height (62%), followed by Road Traffic Accident (RTA) (37%). This finding was also consistent with other similar study done on Indian population over a period of 3 years from 2004-2006. The differences in the percentage of fall from height and road traffic accident in between both studies were due to the different number of study population.

The incidence of cervical spine injury in our study was in concordance with the studies mentioned above. Dorsolumbar spine was the next frequently affected followed by lumbar and dorsal spine. This finding varied from the study by Rahman *et al*. (2002) possibly due to different study population, economic conditions and geographic distribution (Lenehan *et al*., 2009).

MRI was sensitive for detection of fractures. Our study showed evidence of 85 vertebral body fractures in MR imaging. MRI was capable of showing marrow changes. However, in our study it is seen that alteration in signal intensity characteristic of the vertebral marrow was a strong indicator of a significant injury to the vertebral body, even when discrete fracture was not visible which was also confirmed on CT, these findings are corresponding to the study done by Khandelwal *et al*. (2004). The incidence of burst fracture in our study was 27% while that of wedge compression fracture was 43%. Our study revealed that, compression fracture most commonly occurred at cervical spine whereas burst fracture was common at dorsolumbar and lumbar spine, similarly (Bensch *et al*., 2006) in their study on incidence and distribution of burst fractures, done on 152 patients reported.

Of 55 patients with cervical spine injury included in our study, 11 patients had spinal cord injury as demonstrated on MRI without bony injury. SCIWORA in adults is a rare phenomenon. In a series of 40 adult patients, Tewari *et al*. (2005) reported 12% incidence of SCIWORA. The incidence in the series was less (9.5%). Cord compression, disc herniation, ligamentous injury (ALL, PLL), epidural hematoma (11%) and prevertebral/ paravertebral hematoma (17%) were better appreciated on MRI. Cord oedema associated with disc herniation was seen in six of these patients which was well demonstrated on MRI.

## CONCLUSION

This was a prospective study conducted at the MRI Centre, Department of Radiodiagnosis, Krishna Institute of Medical Sciences, Karad, aimed at studying MRI appearance and spectrum of imaging presentations of spinal trauma. The study area covers a population of low socio-economic status. MRI detected vertebral body fractures in 82%, posterior elements fracture in 19%, facet subluxation/dislocation in 16%, para and prevertebral hematoma in 17% and epidural hematoma in 11% of patients. The dorsolumbar region was the most common site for burst fractures (55%), followed by lumbar (24%) and dorsal region (12%). Compression fractures were more common in cervical region (52%), followed by dorsolumbar region (32%). In our study, like in other studies worldwide, MRI helped in demonstrating cord injury (60%), traumatic disc herniations (26%) and soft tissue injury (22%) accurately. The pattern of spinal cord injury could be identified at 0.3 T MRI with cord oedema, cord haemorrhage and cord transection (despite its limitation) seen in 64 (86%), 7 (12%) and 2 (2%) patients, respectively. Out of 7 patients of cord haemorrhage, 2 had complete neurological deficit (Frankel category A) and 5 had only motor deficit (Frankel category B). This suggested a strong association between cord haemorrhage and severity of injury. MRI allows direct visualization and confirmation of cord and soft tissue injuries. It is excellent for detection of cord injury in patients with acute spinal trauma, especially in patients with no evidence of injury on CT (SCIWORA). Therefore it is preferred over the CT, for evaluating the patient having spinal trauma as it readily detects the injury of the cord which is having greater influence on the mortality and morbidity on the patient. Thus, in a patient with spine trauma, especially in obtunded patients where clinical examination is unreliable having neurological deficit, MRI acts as complementary investigation to define cord and soft tissue injuries, also shows bony injuries as marrow oedema and fractures.

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