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Role of MRI in the Evaluation of Compressive Myelopathy

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***Abstract*:**
Background: *Compressive Myelopathy is the term used to describe the spinal cord compression either from outside or within the cord itself. MRI is used to diagnose this problem*
Materials&methods: *A cross sectional study of 50 patients with clinical features of compressive myelopathy are evaluated for various causes by 1.5 Tesla MRI scanner*
Results: *In our study of 50 cases of compressive myelopathy we found various different causes for compression. Among these are trauma (22), infectious causes (12) primary neoplasms (08) and secondary neoplasm (Metastasis) (08).*
Conclusion: *MRI is very definitive, sensitive, accurate, though costly but very specific, non invasive, radiation free modality for evaluation of Compressive myelopathy.*
Keywords: *MRI, compressive myelopathy,trauma, neoplasm, metastases*

I. Introduction

Compressive Myelopathy is the term used to describe the spinal cord compression either from outside or within the cord itself. Compression may be due to herniated disc, post traumatic compression by fracture / displaced vertebra, epidural haemorrhage / abscess or epidural / intradural neoplasm.

Spinal cord injury is the major cause of quadriplegia and disability. Plain radiographs have a low sensitivity for identifying spinal lesions. MRI is the definitive modality in assessing spinal soft tissue injuries, especially in evaluation of spinal cord, intervertebral discs and ligaments. It also allows to differentiate spinal cord haemorrhage and edema which may have a prognostic value.

In case of spinal trauma, MRI demonstrates the relationship of fractured / subluxated vertebral bodies to the cord and highlights a significant stenosis. In suspected cord compression due to neoplasm MRI serves as an excellent method for imaging tumor involving spinal column, canal and cord. Of all the areas of spinal pathology, it may be in the field of spinal tumors that MRI has had the most impact. Today, MR is considered the procedure of choice for the work-up of all spinal tumors.

Many spinal cord diseases are reversible if recognized and treated at an early stage. The role of MRI is to distinguish compressive from non-compressive myelopathy. Once compressive lesions have been excluded, non-compressive cause of acute Myelopathy that are intrinsic to the cord are considered primarily vascular, inflammatory and infectious etiologies.

II. Materials And Methods

A cross sectional study was done on 50 patients with a clinical suspicion of compressive myelopathy attending the department of Radiodiagnosis, Government General Hospital, Kakinada between 2014 to 2015. A complete clinical history of the patient was taken with particular reference to the motor and sensory symptoms.
Inclusion criteria: All age groups, Both sexes of compressive myelopathy
Exclusion criteria: Cases of non compressive myelopathy,Degenerative disc herniation.
MRI was done on 1.5 Tesla GE Magnetom, Standard surface coils and body coils, were used for cervical, thoracic and Lumbar spine for acquisition of images. conventional spin echo sequences T1WI, T2WI, FLAIR Sag, STIR sag, T1WI, T2WI axial and GRE axial, and post contrast T1WI axial, Sag and coronal. Were done with a FOV:Sagittal : 30cm, Axial : 18cm;Matrix size : 256x 256;Slice thickness : 4.5mm x 5mm; Contrast: Gd – DTPA at a dose of 0.1 mmol/kg body wt

III. Observation & Results

TABLE 1 CAUSES OF COMPRESSIVE MYELOPATHY

MR DIAGNOSIS	No.of patients	PERCENTAGE
Traumatic Myelopathy	22	43.3
Infection/TB	12	23.3
Primary Neoplasm	8	16.7
Metastases	8	16.7

In our study conducted on 50 patients traumatic myelopathy is seen 22 patients (43.3%) infectious causes in 12 patients (23.3%) compressive myelopathy due to primay neoplasms is seen in 8 patients (16.7%) and due to metastases in 8 patients (16.7%). In our study trauma is predominant cause of compressive myelopathy.

TABLE 2 LOCATION OF THE PATHOLOGY

Compartment	No.of patients	%
Extradural	42	83.3
Intra dural	8	16.7
Total	50	100

Location of pathology confined to extradural compartment is seen in 42 patients (83.3%) and intradural extramedullary lesions is seen 8 patients (16.7%). Extradural compressive lesions (83.3%) are the most common cause for compressive myelopathy

In extradural compartment in a number of 42 patients, spinal injury is seen in 22 patients (52%) infective in 12 patients (28%) and metastases in 8 patients (16.7%) pathology in intradural extramedullary compartment patients is seen in 8 patients (100%). Spinal injuries is the most common cause for extradural compression while Primary neoplasms are more common in intradural compartment in our study.

TABLE 4 LEVEL OF SPINAL INJURY

LEVEL OF LESION		NUMBER OF PATIENTS n = 22	PERCENTAGE
CERVICAL (C)		6	27.2
THORACIC (T)	UPPER THORACIC, T6 & ABOVE (UT)	4	18.2
	LOWER THORACIC BELOW T6 (LT)	8	36.4
LUMBAR (L)		4	18.2
TOTAL		22	100

Spinal injury in cervical region is seen in 6 patients (27.2%) and 12 patients thoracic region {upper thoracic in 4 patients (18.2%) , Lower thoracic in 8 patients (36.4%) } and lumbar region in 4 patients (18.2%).

TABLE 5 CORD CHANGES IN SPINAL INJURY

Patients	No. of cases	Percentage
With cord change (Contusion/Edema)	20	**90.91%**
Without cord change	2	**9.09%**

In 22 patients suffered from spinal trauma cord changes in the form of contusion / Edema are seen in 20 patients (90.91%), and 2 patients did not show changes in cord. The pattern of signal intensity changes have prognostic value. Cases associated with Edema /Contusion have favourable outcome as compared to cord hemorrhage which has protracted course.

TABLE 6 CHARACTERISATION OF SPINAL INJURIES BY MRI

MRI findings	No of patients	Percentage
Posterior elements freactures	11	50.0%
Ligamentous injury	11	50.0%
Cord changes	20	90.9%
Epidural haematoma	11	50.0%
Pre and para vertebral collection	12	54.5%

Posterior elements freactures are seen in 11 patients (50%) Ligamentous injury in 11 patients (50%) cord changes in 20 patients (90.91%) epidural Haematoma in 11 patients (50%) and Pre and para vertebral collection in 12 patients (54.5%).

TABLE 7 CHARACTERISATION OF NON TRAUMATIC SPINAL COMPRESSION

MRI	No of patients	Percentage
Stable fractures	2	7.1%
Unstable fractures	1	3.5%
Posterior elements fracture	9	32.1%
Ligamentous disruption	2	7.1%
Cord changes	13	46.4%
Epidural Soft tissue component (EST)	20	71.4%
Pre and paravertebral collection	13	46.4%

In non traumatic causes of spinal cord compression epidural soft tissue component is seen in 20 patients (71.4%) cord changes are seen in 13 patients (46.4%), pre and paravertebral collection in 13 patients (46.4%) Ligamentous disruption in 2 patients (7.1%) posterior elements abnormality in 9 patients (32.1%) stable fractures in 2 patients (7.1%) unstable fractures in 1 patients (3.5%).

TABLE 8 SITE OF METASTASES

Level of lesion in secondary neoplasm/ Metastases		Number of patients	Percentage
Cervical		1	12.5%
Thoracic	Upper Thoracic T6 & ABOVE (UT)	3	37.5%
	Lower Thoracic Below T6 (LT)	2	25%
Lumbar		2	25%

In group of 8 patients in our study Metastatic lesions are found to cause cord compression and metastases in cervical region is seen in 1 patients (12.5%) 5 patients in Thoracic region 62.5%{ upper thoracic in 3 patients (37.5%) Lower thoracic in 2 patients (25%)} and in lumbar region in two patients (25%). Thoracic region is most common site for spinal metastases

Multiplicity of lesions in found in 6 patients in a group of 8 patients having metastases and 2 patients does not show multiplicity.Multiplicity of lesions is a strong evidence for a metastatic disease

TABLE 10INTRADURAL EXTRAMEDULLARY LESIONS

Primary neoplasms	No of patients
Neurofibroma	3
Meningioma	5
Total	8

In a group of 8 patients having Intradural extramedullary lesions 3 cases are diagnosed as neurofibromas and rest 5 cases are meningiomas. Primary neoplasms are more common in intradural compartment than metastases

IV. Discussion

MRI is the modality of choice to image spine and spinal cord pathologies because of its ability to depict cross sectional anatomy in multiple planes without ionizing radiation, exquisit soft tissue delineation and non invasiveness. In our study of 50 cases of compressive myelopathy we found various different causes for compression. Among these are trauma (22), infectious causes (12) primary neoplasms (08) and secondary neoplasm (Metastasis) (08).

Out of 50 cases of compressive myelopathy, we had 22 (43.3%) cases of spinal trauma. Among 22 patients the mode of injury was RTA (70%) and fall from height (30%). In a study conducted by Kulkarni et al[1]

, most common mode of injury to the spinal cord was vehicular accident and least cause was the fall. The similar finding of the mode of injury is found in our study conducted.

The age of the patient in our study ranged from 12-70years, mean 42 years and 19 were males and 3 were females (M : F = 19:3) : This is in comparison to the study conducted by Yamashita et al[3]. In our study the level of injuries among the 22 patients were thoracic (54.6%), cervical(27.2%) and lumbar (18.2%). This is comparable to study conducted by Kerslake et al[2].

The spinal cord abnormalities demonstrated by MR imaging were cord compression and abnormal signal intensities within the spinal cord. Spinal cord compression was observed in all the 22 cases of spinal injury. The causes of spinal cord compression included retropulsion of fractured vertebral fragments in 12 patients and epidural hematoma in 10 patients. Abnormal signal intensities from the spinal cord were observed in 20 of 22 patients and 2 patients had no cord changes.

20 patients showed hypointensity on T1WI and hyperintensity on T2WI and STIR images suggestive of cord edema. These signal changes are in consistent with studies done previously by Hackney et al[4].The cord signal intensity has the prognostic implication where patient with cord edema recovered completely / partially. This has also been shown by studies done by Hackney et al [4] and Flanders et al. Of the 6 cervical injury patients, 5 patients expired during the period of hospitalization. This may be attributed to severity of cord compression and multisegment involvement of the cord changes.

MRI depicted not only the spinal cord changes in our patients but also the relationship of retropulsed fractured fragments of vertebral bodies to the cord (12 patients). posterior elements fracture (11 patients),ligamentous disruption (11 patient), soft tissues injuries (11patients) and epidural hematomas (11 patients) . The advantage of MRI in demonstrating all these changes is shown by many studies done by Qureshi IA et al[5] , Kulkarni et al[1] etc.

In our study of 50 cases, 8 (16.7%) are of metastatic disease of the spine as a cause of compressive myelopathy. Intraspinal extradural masses that caused cord compression extended from an abnormal part of the vertebra in all the 8 patients. This is substantiated by a study conducted by Lien et al[6] in which 90% showed extradural masses extended from an abnormal part of a vertebra. Out of 8 patients, 6 (75%) showed more than one lesions.This is in comparison to study done by Lien et al[6] in which 78% had more than one lesions which include vertebral metastases in addition to those compressing the cord. In our study most common site of involvement was the thoracic spine (62.5 %). This is in comparison to the study done by Livingston et al[7] where site of epidural tumor in thoracic spine was 68%.

The three most common primary tumors with metastases to the spine and extradural space were lung carcinoma (15%), breast (carcinoma 14%) and lymphoma (11%). In our study we had 2 patients with primary carcinoma bronchus, 2 patients had breast carcinoma, 1 renal cell carcinoma, 1 carcinoma prostate, and 2 patients with thyroid malignancy. We used T1WI, T2WI and STIR sequence and post contrast to image spinal metastases. T1WI was useful in the detection of bone marrow metastases and STIR helped in picking up more marrow lesions.

IV Gd-DTPA was used in 6 out of 8 patients which showed mild Homo-to- Heterogeneous enhancement. Observation have shown that post- contrast MR does not improve the detection of extradural spinal metastases even though it has great value in intradural disease.

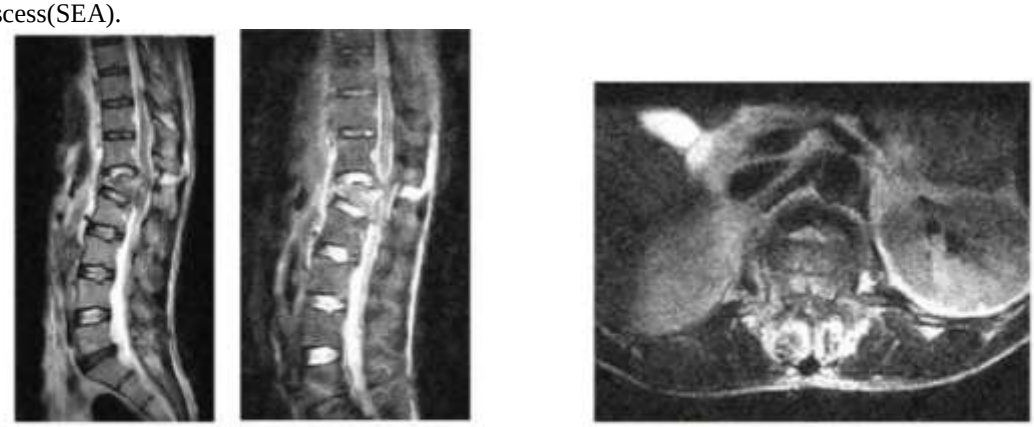
We had 8 cases of primary intradural extramedullary neoplasms, among which 3were nerve sheath tumors(NST) and 5 were meningiomas. All the 8 cases showed spinal cord compression.

Nerve sheath tumors were iso to hypointense on T1WI and hyperintense on T2WI and showed intense heterogenous enhancement on post contrast. One case showed extension into the neural foramina. Studies done by Dorsi et al[8] and Matsumo et al[9] showed that on T1WI the signal varied from hypo to isointense to the cord and on T2WI they are hyperintense in signal and also may show decreased signal in the central portion consistent with necrosis. Nerve sheath tumors showed marked enhancement which was heterogeneous. Of the 8 intradural extramedullary neoplasm, 5 were meningiomas and three were nerve sheath tumors which were pathologically proved. Those lesions which showed intense homogenous enhancement on post contrast images were given meningioma as primary differential and in those which showed areas of T2 hyperintensities and heterogenous contrast enhancement on post contrast images were given as nerve sheath tumors as primary differential. Above findings coincided with the pathological diagnosis of intradural extramedullary neoplasms. Several studies by Matsumoto et al[9], Genzen et al[10] and Saweidane et al[11] showed signal characteristic of meningioma as iso intense to the cord on T1WI and T2WI with intense homogenous enhancement on post contrast.

In our study, 12 cases of infective spondylitis were associated with compressive myelopathy. Ten cases were in the thoracic region and 2 in the lumbar region. X-ray showed some abnormality(like decreased disc space and wedge compression fracture) in 9 cases. MRI showed vertebral body destruction with pre and para vertebral collection in 9 cases. Epidural component compressing the cord was seen in all the 12 cases which was hypointense on T1WI, hyperintense on T2WI and STIR images suggestive of cord edema. Cord edema was associated with all the 12 cases. Study by Roos DEA et al[12] showed thoraco lumbar junction as the most common affected site as in our cases. They showed rim enhancement around the intra – osseous and paraspinal soft tissues abscess. In our observation, contrast study was not done in some cases due to various reasons. Though provisional diagnosis of tubercular etiology was given, ideally contrast study should have been done to increase the specificity of MRI however follow up MRI after course of proper prescribed treatment (either

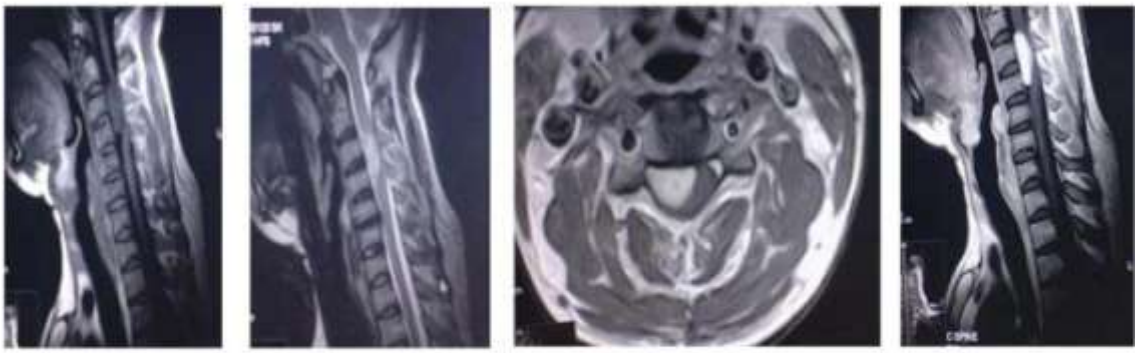
ATT/Antibiotics) showed complete resolution of epidural component confirming the infectious aetiology of lesion.

We had one case of epidural abscess compressing the spinal cord who presented with sudden onset of weakness in both lower limbs. MRI showed extradural soft tissue anterior to the cord extending from C2-C4 level causing compression on the spinal cord. It was isointense on T1WI and hyperintense on T2WI and showed peripheral minimal enhancement. however in my study prevalence of level of formation of epidural abscess could not be commented upon as there was only one case of infective spondylodiscitis forming spinal epidural abscess(SEA).



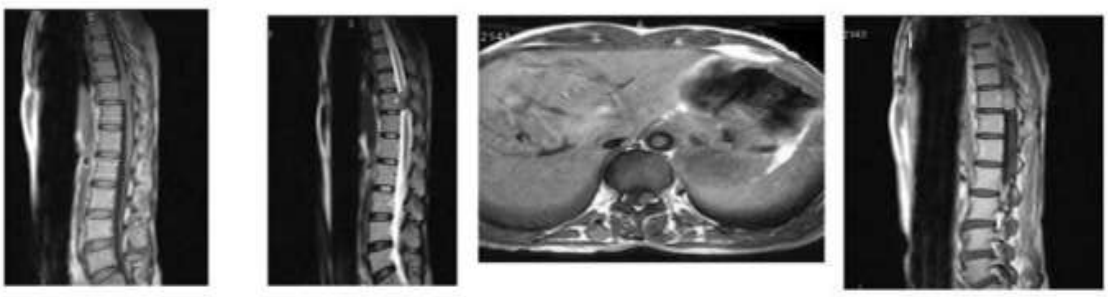
T2 Sag STIR Sag T2 axial

T1, T2, STIR Sag, T2 Axial images show partial collapse of L1 vertebra with retro pulsion of fracture fragment causing compression on conus medullaris with altered signal changes in cord suggestive of cord edema in trauma.



T1 Sag T2 Sag post contrast axial pc sagittal

T1 T2 Sag Post contrast Axial and Sag pictures showing Well defined enhancing lesion in intradural extramedullary region opposite to C3, C4 vertebral bodies causing compression on cord- Suggestive of intradural extramedullary meningioma.



T1 Sag T2 Sag post contrast axial pc saggital

T1 T2 Sag Post contrast Axial and Sag pictures showing well defined minimal homogenous enhancing lesion in intradural extramedullary compartment opposite to D10 vertebral body causing compression on cord- suggestive of nerve sheath tumor.

V. Conclusion

MRI is very definitive, sensitive, accurate, though costly but very specific, non invasive, radiation free modality for evaluation of Compressive myelopathy.MRI is the definitive modality in assessing soft tissues of the spine and spinal cord abnormalities, to evaluate cord edema/contusion and integrity of the intervertebral discs and ligaments. MRI is very sensitive and considered the imaging modality of choice to detect and characterize the spinal tumors and spinal infections. The final diagnosis for suspicious primary neoplastic lesions still relies on biopsy and histopathological examination. Till date, MRI is the widely used modality of choice to visualise the spinal cord and its pathology.

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