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Original Research Paper

Radiodiagnosis

"WHAT MRI CAN DO IN SUSPECTED NON-DEGENRATIVE CASES OF COMPRESSIVE MYELOPATHY"

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ABSTRACT

BACKGROUND: Compressive Myelopathy is described as 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 hemorrhage / abscess or Epidural / Intradural (Intramedullary and Extramedullary) neoplasm. Study aimed to to study the role of MRI in evaluation of compressive myelopathy

MATERIAL & METHOD: It is a cross sectional observational study conducted during Jan 2019 to June 2020 in patients presenting to the Department of Radiodiagnosis with features of compressive myelopathy at Sharda Hospital, SMS&R. Total of 30 patients who fulfilled inclusion criteria and provided the informed consent. Philips Achieva 3.0T MRI. Standard surface coils and body coils, were used for cervical, thoracic and Lumbar spine for acquisition of images was used to assess the compressive myelopathy.

RESULTS: In present study, total of 30 patients were included in the present study. Among them 20 were males and 10 were female with the ratio of 2:1 showing the male predominance. The mean age of the patients was found to be 39.23 years. Extra dural compartment was the most commonly involved (n=26). POTTs (n=12) and TM (n=11) were most common located in extradural compartment, followed by metastasis (n=2). (p<0.001)

CONCLUSION: MRI was able to successfully classify the spinal tumor based on Extradural / Intradural position and evaluate the integrity of the spinal cord, intervertebral disks and ligament following acute spinal trauma.

KEYWORDS : compressive myelopathy, POTTS, Trauma, MRI, Metastasis, Extradural

INTRODUCTION

Compressive Myelopathy is the term used to describe the spinal cord compression either from outside or within the cord itself.[1] Compression may be due to Herniated disc, post traumatic compression by fracture / spondylolisthesis, epidural hemorrhage / abscess or Epidural / Intradural (Intramedullary and Extramedullary) neoplasm.

Spinal cord injury is one of the major causes of quadriplegia and disability.[2] Plain radiographs/CT scan have a low sensitivity for identifying traumatic spinal lesions. MRI is the best modality in assessing spinal soft tissue injuries, especially in evaluation of spinal cord, intervertebral discs and ligaments. It also allows differentiate spinal cord hemorrhage and edema which may have a prognostic value.[3] In case of suspected cord compression due to neoplasm MRI serves as an excellent method for imaging tumor involving spinal column, canal and cord.[4] Spinal tumors are often classified as extradural, intradural extramedullary, or intramedullary in location.

Myelopathies present with severe neurological consequences like para-/quadriparesis, neurogenic bladder, decubitus ulcers, spasticity, etc which impair the quality of life and independence of the affected individual.[5,6]

The sequalae of spinal cord disorders are myriad, with few diseases like subacute combined degeneration showing dramatic response to treatment, producing only a mild impact on the patient's daily life.

Compressive lesions [7] usually require urgent neurosurgical intervention and decompression of the spinal cord, whereas non compressive myelopathies [8] are usually amenable to medical treatment itself. MRI distinguishes compressive from non-compressive myelopathy. Thus, MR plays an important role in management of such patients.

AIM & OBJECTIVE

To study the role of MRI in evaluation of compressive myelopathy

OBJECTIVES

1. To evaluate various causes of compressive myelopathy.
2. MR characterization of spinal cord compressive lesions.
3. To classify the lesions based on location into extradural / intradural compartments.

MATERIAL & METHOD

Study duration: 18 months (1 Jan 2020 to 30 Jun 2020)

Study area: Radiology department of Sharda Hospital, SMS&R, Greater Noida.

Study design: Institutional review board approved cross sectional observational study

Study population: patients presenting to the Department of Radiodiagnosis with clinical features of compressive myelopathy

Sample size: 30 cases are considered for the study

SELECTION OF SUBJECTS:

I. INCLUSION CRITERIA

All cases of compressive myelopathy

II. EXCLUSION CRITERIA

Any contraindication to MRI
Degenerative disc herniation

METHODOLOGY

CASE SELECTION

The patients who are clinically suspected as a case of compressive myelopathy were investigated with MRI. The study group included a sample size of 30 patients selected by a purposive sampling.

A complete clinical history of the patient was taken with particular reference to the motor and sensory symptoms.

PATIENT PREPARATION

The procedure was briefly explained to the patient and informed consent was taken. Detailed history for contraindication of MRI was specifically taken.

EQUIPMENT:

Philips Achieva 3.0T MRI. Standard surface coils and body coils, were used for cervical, thoracic and Lumbar spine for acquisition of images.

SEQUENCES:

Conventional spin echo sequences T_1WI, T_2WI, STIR sagittal, T_1WI, T_2WI axial and GRE axial, and post contrast T_1WI axial, Sagittal and coronal.

In few cases axial DWI and axial ADC images also acquired.

TECHNIQUE:

Patients were examined with MRI scan in the supine position with proper positioning and immobilization of the body. Standard surface coils were used for acquisition of images.

CONTRAST:

Omniscan (Gadodiamide) were used as contrast agents in dose of 0.1mmol /kg body weight in cases of neoplasms and infections. For spinal trauma contrast was not done. Post contrast T1WIsag, axial and coronal images were obtained.

STATISTICAL ANALYSIS

All the patient's details are recorded in the pre-prepared proforma and entered in Microsoft excel. The demographic details are presented as frequency, percentage, proportions in form of tables, graphs and pie chart. The continuous variables presented as mean and standard deviation. The comparison of distribution of categorical variables was done by chi-square test. All the analytical statistics was performed using the SPSS version 21 operating on windows 10. The statistical significance level was kept as $p<0.05$.

RESULTS

Among 30 participants, 26 patients were having the extradural compartment involvement, 3 patients with extramedullary-intradural compartment and 1 in intramedullary compartment.

Table 1: Showing compartment involvement in patients

		Frequency	Percent
Compartment	Extra-Dural	26	86.7
	Extra-Medullary-Intra-Dural	3	10.0
	Intra-Medullary	1	3.3
	Total	30	100.0

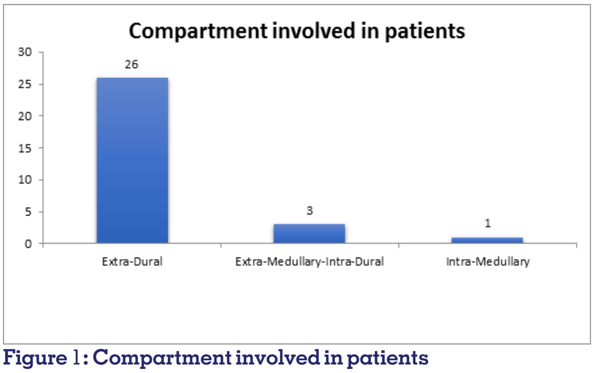


Figure 1: Compartment involved in patients

Among the 30 patients included, 17 had dorsal level of lesion, 5 were with the cervical lesion, 4 with the dorso-lumbar, 2 each in cervico-dorsal and lumbar level of lesion.

Table 2: Showing the level of lesion in patients

		Frequency	Percent
Level of Lesion	Cervical	5	16.7
	Cervico-dorsal	2	6.7
	Dorsal	17	56.6
	Dorsao-lumbar	4	13.3
	Lumbar	2	6.7
	Total	30	100.0

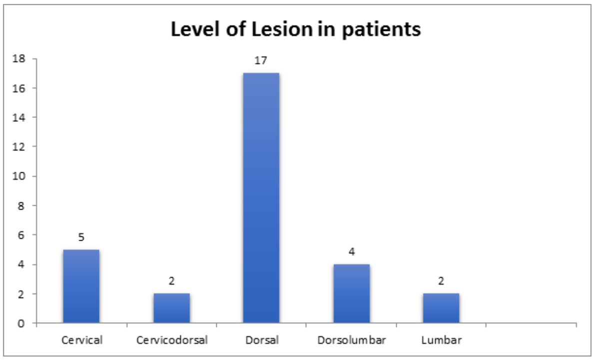


Figure2: Level of lesion in patients

In present study, 11 patients had cord changes and 19 patients were with no cord changes when evaluated.

Table 3: Showing the cord changes in patients.

		Frequency	Percent
Cord Changes	NO	19	63.3
	YES	11	36.7
	Total	30	100.0

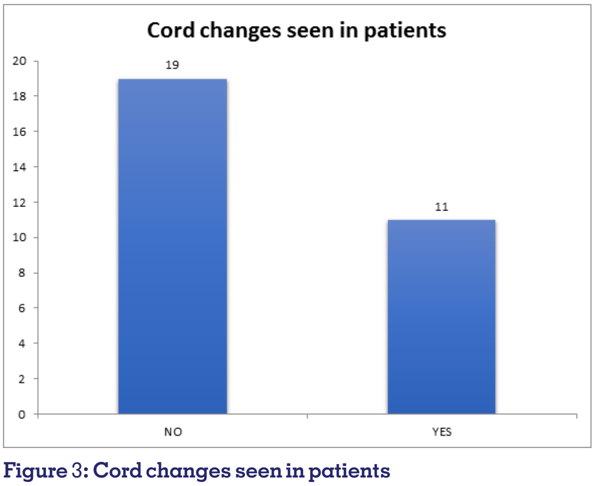


Figure 3: Cord changes seen in patients

In present study among the 30 patients, diagnosis was made on MRI with POTTs in 14 patients which was most common presentation at the centre. 9 patients were with the traumatic myelopathy (TM), 5 patients with presence of tumor, 2 patients with metastasis, 2 with NF/schwannoma and 1 each patient with haemangioma and ependymoma. (Table 4)

Table 4: Showing the various diagnosis in patients

		Frequency	Percent
Diagnosis	Meningioma	1	3.35
	Hemangioma	1	3.35
	Metastasis	2	6.7
	NF/Schawnnoma	2	6.7
	POTTS	12	40.0
	TM	11	36.6
	Ependymoma	1	3.3
	Total	30	100.0

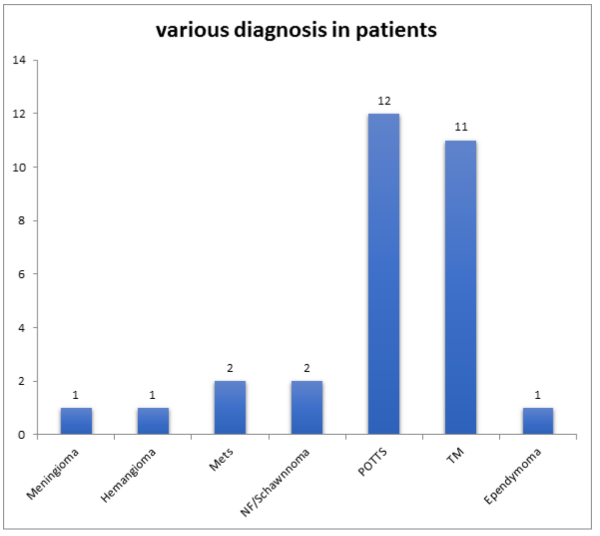


Figure 4: Showing various diagnoses in patients

In present study, the common compartment associated with the disease was extra dural. Among which, 13 patients with POTTs were in extradural compartment, and traumatic myelopathy was in 11 patients with extradural compartment involvement. Metastasis was found in 2 patients with the extradural compartment involvement. The chi-square test found a significant association with the type of disease and the compartment involvement identified on MRI. (chi square χ^2 =35.25, p<0.002) (Table 5)

Table 5: Comparison of the compartment involvement and the diagnosis in patients by chi-square test

		Diagnosis							
		Meningioma	Hemangioma	Metastasis	NF/Schwannoma	POTTS	Traumatic Myelopathy	Ependymoma	Chi-square (p-value)
Compartment	Extra-Dural	0	1	2	0	12	11	0	35.252 (0.002)*
	Extra-Medullary-Intra-Dural	1	0	0	2	0	0	0	
	Intra-Medullary	0	0	0	0	0	0	1	

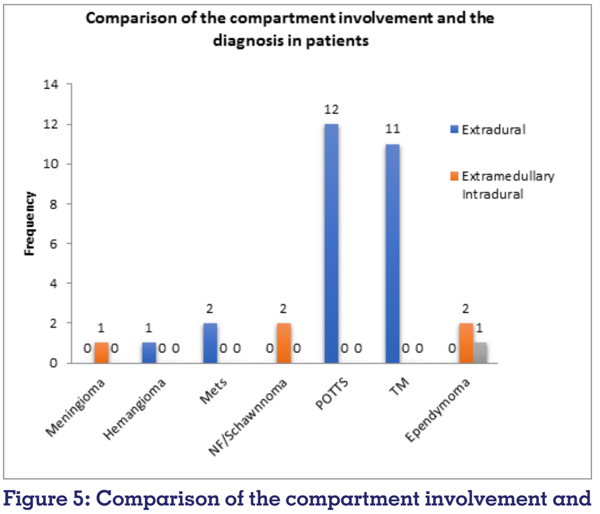


Figure 5: Comparison of the compartment involvement and the diagnosis in patients

Table 6: Table showing cause according to compartment

Cause	Total	Extradural	Intradural-Extramedullary	Intramedullary
Collection	13	13 (100%)		
Tumor	5	1 (20%)	3 (60%)	1 (20%)
Vertebral dislocation	12	12 (100%)		

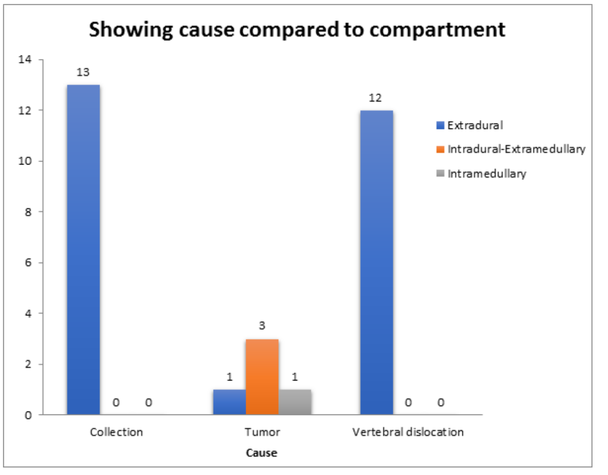
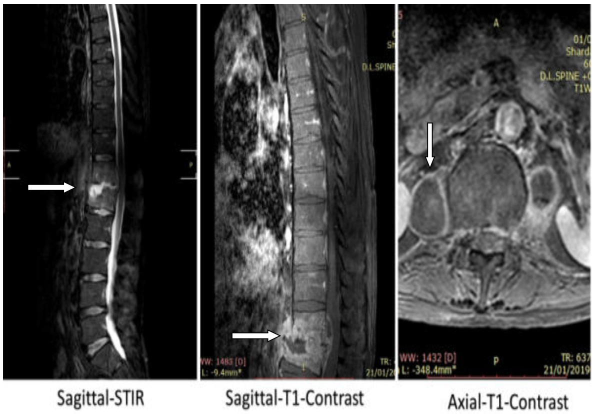


Figure 6: Showing cause compared to compartment

Case Number: 1

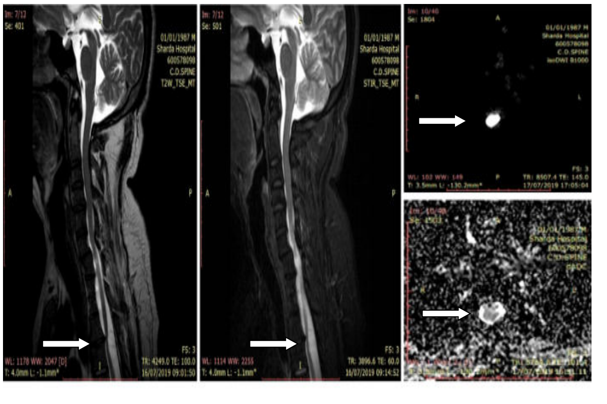


Sagittal-STIR Sagittal-T1-Contrast Axial-T1-Contrast

Pott's spine with bilateral psoas abscess

- Partial osteolysis of L1 and D12 vertebral body with post contrast enhancement of the marrow.
- Enhancing anterior subligamentous and intraosseous collection is noted. Epidural collection causing compression of spinal cord at D12 vertebral body level. Peripherally enhancing collection note in bilateral psoas muscle.

Case Number: 2

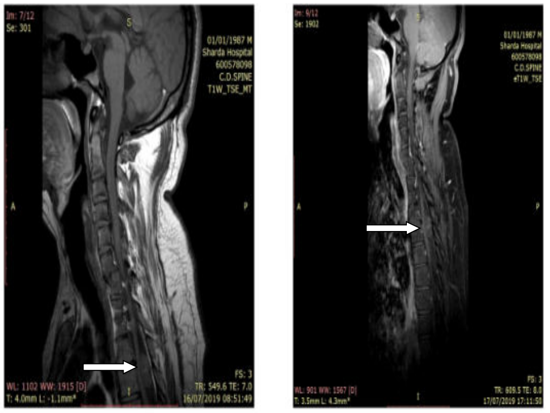


Sagittal-T2 Sagittal-STIR DWI and ADC

Intradural extramedullary mass (schwannoma/ neurofibroma)

Well-defined oval shaped extramedullary intradural spinal tumor seen on posterior aspect of dorsal spine at D4 vertebral level causing significant posterior cord compression. Lesion appears mildly hyperintense signal on T2/STIR and causing compression of cord.

DWI and ADC images shows diffusion restriction of the lesion.



Sagittal-T1 Sagittal-T1- Contrast

Showing mild heterogeneous enhancement on post contrast T1 weighted images.

Well-defined oval shaped extramedullary intradural spinal mass seen on posterior aspect of dorsal spine at D4 vertebral level causing significant posterior cord compression. Lesion displays iso to iso-hyperintense signal on T1 and causing compression of cord. Lesion showing mild heterogeneous enhancement on post contrast T1 weighted images.

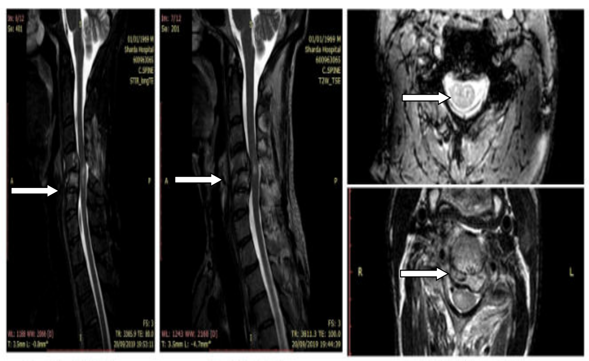
Case Number: 3

Sagittal-T1 Sagittal-T2 Sagittal-STIR

Showing Expansile intra-dural intra-medullary mass (Ependymoma)

- Oval shaped expansile intra-dural intra-medullary lesion appears isointense on T1 and mild hyperintense signal on T2/STIR seen at D10-D11 vertebral body.

Case Number: 4

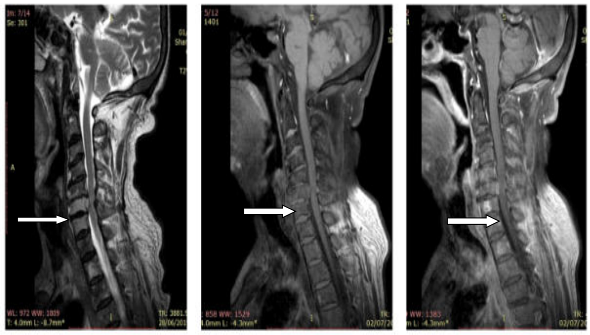


Sagittal-STIR Sagittal-T2 Axial GRE and T2

Traumatic cord compression causing edema and contusion

- T2/STIR marrow hyperintensity involving C3, C4 and part of C5 vertebrae suggestive of edema with subluxation at the level of C3-C4.
- T2/STIR isointense collection noted in anterior subdural space causing compression on spinal cord and cord appears bulky with intramedullary hyperintensity with foci of blooming on GRE at C3-C4 level suggestive of edema with cord contusion.

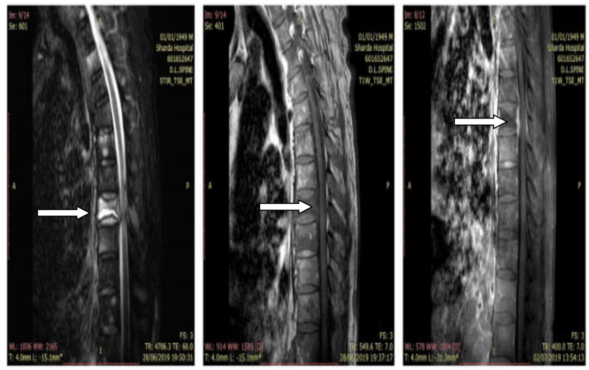
Case Number: 5



Sagittal-T2 Sagittal-T1 Sagittal-T1-Contrast

Vertebral metastasis from abdominal lymphoma – Cord edema

- Reduce height of C6 vertebra with end plate irregularity and altered T2 hyperintense marrow signal with bulging posterior cortex causing cord compression. Altered T2 intramedullary bright signal suggestive of cord edema.



Sagittal-STIR Sagittal-T1 Sagittal-T1-Contrast

Vertebral metastasis from abdominal lymphoma - compression fracture of D8 vertebra

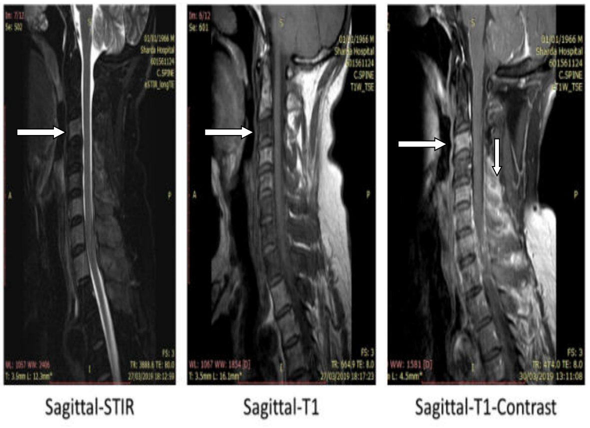
- Compression fracture of D8 vertebra seen with fluid signal intensity seen within the collapsed anterior vertebral segment.
- Enhancing epidural collection seen at D8 vertebral level causing compression of spinal cord.

Sagittal-STIR Coronal-STIR Sagittal-T1-Contrast

Vertebral metastasis from abdominal lymphoma - Multiple patchy areas

- Multiple patchy areas of altered marrow signal displaying hyperintense signal on T2/SPAIR seen involving the vertebral bodies at multiple levels throughout the dorso-lumbar spine. Post contrast study shows enhancement of the marrow lesions.
- Enhancing epidural collection noted

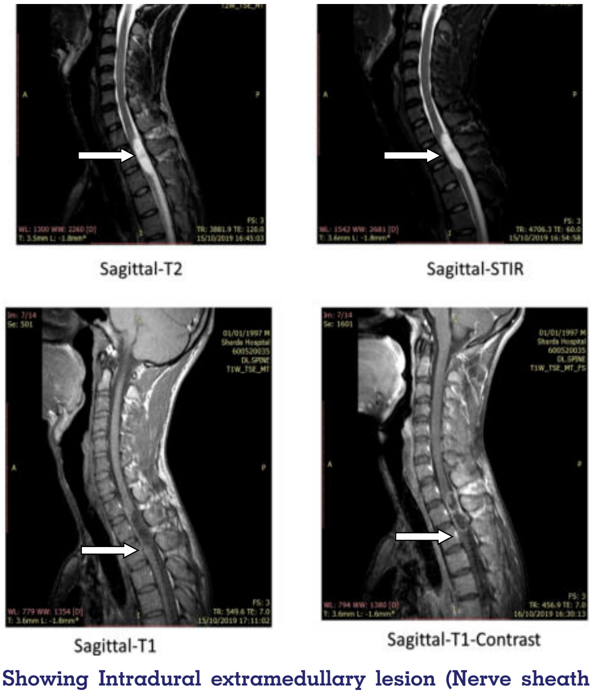
Case Number: 6



Multiple myeloma - STIR hyperintense signal

- STIR hyperintense signal seen involving the vertebral body as well as posterior element of C3, C5 to D1 vertebra.
- Post contrast study show mild enhancement of vertebral body, posterior element and interspinous ligament at the involved Levels. Enhancing soft tissue component in anterior and posterior epidural space at C7-D1 vertebral level causing spinal cord compression.

Case Number: 7



Showing Intradural extramedullary lesion (Nerve sheath tumor)

- Intradural extramedullary well-defined, sausage-shaped lesion noted at D2-D3 vertebra, appearing T1 hypointense, STIR and T2 hyperintense. The lesion is causing narrowing of the spinal cord, with its antero-lateral displacement and shows heterogeneous enhancement on post-contrast sequences.

Showing Intradural-extramedullary mass lesion showing intense enhancement - Meningioma.

- A well-defined extramedullary intradural mass lesion which is isointense to cord on T1W, T2W and STIR images noted at D8-D9 level. The mass lesion causing compression of spinal cord.
- Post contrast study show intense enhancement of the mass lesion.

DISCUSSION

MRI's potential to display greater sensitivity and precision to the spine and spinal cord than myelography and CT, is well known for trauma, neoplastic, congenital, & degenerative disease.

MRI is the only tool currently available that offers direct spinal cord visualisation. This has been the tool of choice for imaging spine and spinal cord pathologies due to its ability to represent cross-sectional anatomy in many planes without ionizing radiation, excellent delineation of the soft tissue and non-invasive.

In our study, included 30 patients who fulfilled the inclusion criteria and informed consent were given. The mean age of the patients was 39.23 years, with 53.3% of patients in age of 18-50 years and 33.3% in >50 years and 13.3% were in age lesser than 18yrs.

Among the 30 participants, 20 were male and 10 were female with ratio of 2:1 showing the male preponderance in present study similar to previous studies.[9]

In present study, 17 patients presented with the backache, 2 presented with numbness of lower limb and 7 presented with the trauma of various causes. 2 presented due to the road traffic accident, 1 presented due to multiple myeloma and lymphoma. Degenerative changes in the spine are known to be increasingly prevalent with age.(10) The spinal cord defects that MR imaging revealed were cord compression and irregular spinal cord signal intensities.

In a study undertaken by Sekhon et al, motor vehicle accident was also described as the most common mode of traumatic spinal cord injury.[11] Although the natural history of asymptomatic cervical spinal cord compression is not completely known secondary to degenerative changes, the risk of short-term myelopathy appears small.[12]

Complex lesions underestimated on static MRI can cause repeated neurovascular trauma to the spinal cord, leading to severe symptomatology and patient disability. This form of imagery is sadly not commonly available for general use. Other types of advanced imaging like DTI and PET are also promising, but are still a long way from regular clinical use.(13,14)

In present study, cervical – 5 patients, cervico-dorsal–2 patients, dorsal – 13 patients, dorso-lumbar – 4 patients, lumbar – 2 patients. The trauma was the most common cause among the multiplicity of the compressions. We found that the extra Dural compartment was involved in 76.7% of the patients and 11 patients had the multiplicity of the lesions, these findings were in concordance with the previous studies.[15,16] However research by Weaver P et al., showed lumbar junction of thoraco as the most common affected site.[17]

Cord compression and abnormal signal intensities within the spinal cord were the spinal cord abnormalities shown by MR imaging. Among the various reasons for the cord compression, collection was the most common cause (50%) followed by vertebral dislocation (30%).

The cord changes were observed in the 36.7% of the patients and 63.3% were with the no cord changes. Bednarik et al. reported pathological electrophysiology, hyperintense lesions of T2-weighted MRI, and radiculopathic symptoms in one of the few studies to prospectively detect asymptomatic cord compression.[18]Many studies by Qureshi IA et al, Kulkarni et al, show the advantage of MRI in demonstrating all of these changes.[19,20]

In present study, 13 patients were presented with the pre and para vertebral collection and 17 with no collections. The vertebral collection was distinctively seen under MRI and aids to confirmatory enhancement assessment.[21]Danchaivijitr N et al study showed thoraco – lumbar junction as the most frequently affected site as in our case. They demonstrated rim enhancement around the abscess of soft tissues intra-osseous and paraspinal.

In our observation, the study of comparison was not carried out because of various reasons. Although provisional tubercular etiology diagnosis was given, ideally contrast studies should have been done to increase the specificity of MRI.[22]

Among the various diagnosis made in patients, we have found that, common diagnosis was the POTTS (n=12), followed by traumatic myelopathy (n=11) and tumor in 7 patients. The association between the age group and the gender distribution with the diagnosis made was not significantly correlated in present study. However, we found a significant association between the compartment involved with the diagnosis ($p<0.001$) and the level of lesion ($p<0.001$).

Diagnosis of the POTT's, Metastasis, TM were most commonly found in the extradural compartment lesions on MRI investigation.[22-23] 12 cases of POTT's and 11 cases of TM were presented with the extra-dural compartment involvement. Three cases of tumors were in extra-medullary and intradural compartment and 1 in the intramedullary compartment. The MRI is effective in the detection and management of the compressive myelopathy due to the nontraumatic and traumatic.[4,24-26]

Two cases in our study, the compression was due to Schwannoma. Studies performed by Dorsi et al.,[28] and Matsumo et al.,[29] have shown that on T1WI the signal ranged from hypo to isointense to the thread, and on T2WI the signal is hyperintense and may also display decreased signal in the central portion consistent with necrosis.

Nervous sheath tumors display prominent, heterogeneous enhancement. This is explained by a study carried out by Lien et al.,[27] in which 90 per cent showed extradural masses extending from an irregular part of a vertebra. All lesions manifest multiplicity. This is compared to in study to 78 percent had more than one lesion that included vertebral metastases in addition to those that compressed the cord.

MRI's ability to show greater sensitivity and specificity to the spine and spinal cord than myelography and CT is well known for trauma, neoplastic, congenital, & degenerative disease. MRI is the preference for picture spine and spinal cord pathologies due to its ability to represent cross sectional anatomy in multiple planes without ionizing radiation, excellent delineation of soft tissue and non-invasiveness.

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