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Research Article

ROLE OF MAGNETIC RESONANCE IMAGING IN THE EVALUATION OF SPINAL CORD LESIONS IN A TERTIARY CARE HOSPITAL, HYDERABAD

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ABSTRACT

Objectives: Using other imaging modalities, subtle bone marrow, soft tissue, and spinal cord abnormalities, which may not be apparent, can be readily detected on magnetic resonance imaging (MRI). Prompt and accurate diagnosis, expeditious management, and avoidance of unnecessary procedures are achieved by early detection.

The aim is to study the role of MRI in diagnosing spinal cord lesions.

Methods: This study was conducted during the period from November 2018 to November 2020 and it is a prospective descriptive study of 50 patients who were referred to the Department of Radiodiagnosis Osmania General Hospital and MNJ Institute of Oncology and Regional Cancer Centre, Hyderabad, Telangana.

Results: In the present study of 50 cases, different spinal cord lesions were found. The most common spinal cord lesions were neoplastic (38%) followed by spinal cord trauma (28%), and congenital lesions (16%). The most common spinal lesions were found in the 20–29 age group (40%), with more male predilection of 72% in comparison to 28% female in the present study. Out of 19 neoplastic lesions, the most common type of intramedullary spinal cord tumor (IMSC) is ependymoma (31.5%). The second most common IMSC tumor is astrocytoma 15.7% of all neoplastic lesions in the present study and the most common tumor among children. The most common location of the lesion is the thoracic cord. Hemangioblastomas constitute 10.5% of all spinal cord tumors in the present study. Meningiomas which are intradural extramedullary lesions constituted 10.5%. Neurofibroma constituted 5.2% which are intradural extramedullary with extradural component noted in NF1. Spinal cord metastasis constituted 26.3%. Intradural intramedullary lesions constituted 48% followed by extradural lesions 40% followed by intradural extramedullary lesions 12%.

Conclusion: MRI by virtue of non-invasiveness, lack of radiation hazard, and the ability to demonstrate structural changes is an investigation of choice for spinal cord pathologies. The ability to image the cord directly rather than indirectly as in myelography, the absence of bone artifacts as in computed tomography, and the multiplanar capabilities indicate that MRI is the procedure of choice in the examination of the spinal cord.

Keywords: MRI, Astrocytoma, Spinal lesions.

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INTRODUCTION

A wide spectrum of diseases affects the spine and spinal cord including infections, neoplasms, and inflammatory disorders which subsequently cause compression of the spinal cord and constitute a neurological emergency, and if left untreated, can result in permanent irreversible neurological dysfunction. Patients with spinal cord diseases can manifest with a variety of symptoms. Neurologic deficit related to a spinal cord pathologic abnormality is termed as "myelopathy."

Myelopathy can clinically manifest as motor, sensory, and autonomic dysfunction. Clinical history and physical examination are critically important diagnostic tools in the initial assessment of myelopathy. A thorough neurologic evaluation usually points to the region of the spinal cord affected and helps determine the next diagnostic step.

Spinal cord lesions can be classified as follows:
1. Non-traumatic: Neoplastic and non-neoplastic
2. Traumatic

Many of the processes affecting the spinal cord may be reversible if recognized and treated early. The vast majority of spinal cord diseases may be treated medically, with surgical treatment reserved for compressive disorders, which constitute a neurological emergency [1].

Neuroimaging of the spinal cord and brain is indispensable for the assessment of structural causes of myelopathy. Among the different imaging modalities, contrast-enhanced magnetic resonance imaging (MRI) is the choice most of the time unless it is contraindicated. The location and extent of the MRI signal abnormality and contrast enhancement can be very helpful in deciphering the etiology of the myelopathy. Nonetheless, there is substantial overlap in the imaging appearance of myelopathy, and a systematic approach in the review of radiologic findings is imperative to narrow the differential diagnosis. The ability to visualize the spinal cord *in vivo* makes MRI of special value for the diagnosis of spinal cord diseases [2].

MRI is used for assessing spinal abnormalities by detecting small changes in the fat and water components of the medullary bone, intervertebral discs, spinal cord, and soft tissues around the vertebrae.

MRI is a non-invasive investigative procedure. It uses a powerful magnetic field, radiofrequency pulses, and a computer to produce detailed pictures of organs, soft tissue, bone, and virtually all other internal body structures. The images can then be examined on a computer monitor, printed, or copied to CD [1]. MRI is an accurate, precise, specific, and non-invasive technique owing to its multiplanner capability and superior tissue resolution for diagnosing site, extent,

and characterization of spinal cord lesions. The establishment of an accurate early diagnosis can reduce the wide range of investigations performed for the diagnosis with the result that hospitalization and treatment costs can be reduced. Hence, this study was conducted to evaluate various spinal cord lesions and diagnostic accuracy of MRI in the differentiation of these lesions.

METHODS

This study was conducted during the period from November 2018 to November 2020 and it is a prospective descriptive study of 50 patients. The data for the study intended are to be collected from patients referred to MRI scan at the Department of Radiodiagnosis Osmania General Hospital and MNJ Institute of Oncology and Regional Cancer Center, Hyderabad, Telangana.

The patients who are clinically suspected of signs and symptoms related to the spine were studied and will be investigated with MRI. The study group will include a sample size of 50 patients selected by purposive sampling. The data will be analyzed by descriptive analysis. A complete clinical history of the patient was taken with particular reference to the motor and sensory symptoms-related spinal cord. The procedure will be briefly explained to the patient and consent will be taken. Detailed history for contraindication of MRI will be specifically taken.

All age groups, both sexes and only those patients who are willing to participate in the study will be included. Patients referred to the radiology department for MRI spine investigation, and found to have positive findings, will be included in this study. Already diagnosed cases of spinal lesions which need follow-up radiological investigations and are referred to our radiology department will be included in the study. Patients presenting to the radiology department having spinal lesions in the past and being cured completely will be excluded from the study, Patients having metallic instruments involving the spine, pacemaker and not giving consent, and degenerative diseases of the spine were excluded from the study. The procedure was briefly explained to the patient and consent was taken. Detailed history for contraindication of MRI was specifically taken. They were provided with light music to minimize the noise within the MRI room, GE 1.5 TESLA MRI Electromagnet, Version: VS.OE. Standard surface coils and body coils were used for the cervical, thoracic, and lumbar spine for the acquisition of images which were the equipment used. The sequences used were conventional spin-echo sequences T_1WI, T_2WI, FLAIR Sag, STIR sag, T_1WI, T_2WI axial and GRE axial, and post-contrast T_2WI axial, sag and coronal, FOV of 30 cm sagittal, 18 cm axial, matrix size of 256×256, slice thickness of 4.5 mm×5 mm. Patients were examined with MRI scan in the supine position with proper positioning and immobilization of the body. Omniscan (gadodiamide) or magnetism (dimeglumine gadopentetate) was used as contrast agents in dose of 0.1 mmoL/kg body weight in cases of neoplasms and infections.

For spinal trauma, contrast was not done. Whenever required, thinner sections were obtained in the region of interest.

The MRI images were analyzed based on location (cervical and thoracic lumbar) and segment of the spinal cord involvement. In cases of trauma, site and level of injury, vertebral fracture, ligamentous injury, and presence/absence of hematoma to classify into spinal subdural/extradural hematoma were noted. Neoplasms were classified based on appearance into benign/malignant, based on location into extradural, and intradural (extramedullary).

RESULTS

Table 1 shows that 40% of patients were between the age of 20 and 29 years with a predominant adult age group observed.

Seventy-two percent of patients were males with 28% females noted with a male-to-female ratio of 2.57 was observed.

Table 1: Distribution based on age

Age group	Total cases	Percentage of cases
0–9 years	9	18
10–19 years	3	6
20–29 years	20	40
30–39 years	8	16
40–49 years	6	12
50–59 years	2	4
60–69 years	2	4
Total	50	100

Table 2: Spectrum of spinal cord lesions

Spinal cord lesions	No of cases	Percentage
Congenital anomalies	9	18
Arachnoiditis	1	2
Transverse myelitis	1	2
Multiple sclerosis	4	8
NMO	2	4
Spinal cord trauma	14	28
Spinal cord neoplasms	11 19	38
Total	50	100

Table 2 shows that the most common spinal cord lesions were neoplastic (38%) followed by spinal cord trauma (28%) and congenital lesions (18%) and 14 patients with spinal cord trauma. MRI findings were cord contusion in 11 patients, two patients had post-traumatic myelomalacia, and one patient had post-traumatic intramedullary cyst formation. Ten patients had associated extramedullary involvement causing spinal cord compression including vertebral fracture, wedging, listhesis, traumatic disc herniation, and epidural hematoma. Other associated findings included prevertebral hematoma in three patients and para-spinous muscle hematoma in one patient. There were four patients with multiple sclerosis, out of them, one patient showed discrete plaques of demyelination at multiple levels including brain lesions with mild-to-moderate post-contrast enhancement and another patient showed demyelinating plaques with cord atrophy and no contrast enhancement. One patient of acute transverse myelitis and both showed long segment cord involvement of more than 50% of cross-sectional area, with cord expansion.

Table 3 shows that of a total five patients of spinal dysraphism, three were open types (60%) and two are closed types (40%). Arnold Chiari malformation, syringohydromyelia, intraspinal lipoma, and low-lying tethered cord were associated anomalies in spinal dysraphism.

Table 4 shows total of 19 patients with spinal cord neoplasm. Out of these, 14 had primary cord tumors and five had metastasis to cord. Intravenous contrast administration showed contrast enhancement.

The thoracic cord was the most common site involved (44.44%), followed by the lumbar (33.33%) and cervical cord (22.22%). Whole spinal column involvement and multiple levels of involvement are seen in one patient each.

Table 5 shows that the primary tumor for metastasis is carcinoma lung (60%) and carcinoma breast in 20% of patients. The intracranial tumor was present in 20% of patients on MRI brain.

There were three patients (60%) with intramedullary spinal cord metastasis and two (40%) had leptomeningeal metastasis.

Table 6 shows that there were 24 patients (48%) with intramedullary location in the spinal cord, 6 (12%) had an extramedullary location in the spinal cord, and 20 patients (40%) had extradural.

Table 7 shows that nerve sheath tumor (1), meningioma (2), ependymoma (6), hemangioblastoma (2), and astrocytoma (3) were the

Table 3: Congenital lesions of the spinal cord

Congenital lesions of the spinal cord	No of cases	Percentage
Spinal dysraphism		
Open	3	44. 33.3
Closed	2	11. 22.2
Intraspinal lipomas	1	11.1
Tethered spinal cord	2	22 22.2
Tarlov cyst	1	10 11.1

Table 4: Spinal cord neoplasms

Spinal cord neoplasms	No of cases	Percentage
Spinal cord primary tumors		
Ependymoma	6	31.5
Astrocytoma	3	15.7
Hemangioblastoma	2	10.5
Meningioma	2	10.5
Neurofibroma	1	5.2
Spinal cord metastasis	5	26.3
Total	19	100

Table 5: Primary lesion in spinal cord metastasis

Primary lesion	No of cases	Percentage
Carcinoma Lung	3	60
Carcinoma breast	1	20
Intracranial Tumors	1	20
Medulloblastoma		
Total	5	100

Table 6: The spinal pathology was categorized according to location

Location	No of cases	Percentage
Intradural (intramedullary)	24	48
Intradural (extramedullary)	6	12
Extradural	20	40
Total	50	100

Table 7: Number of cases according to MRI diagnosis

Type of disease	MRI	No.
Benign	Nerve sheath tumor	1
	Meningioma	2
	Ependymoma	6
	Hemangioblastoma	2
	Astrocytoma	3
Malignant	Metastatic	5
Tumor Mimics	Tarlov Cyst	1
Others	Transverse Myelitis	1
	Congenital	9
	NMO	2
	Multiple Sclerosis	4
	Trauma	14

MRI diagnosis for benign disease. Metastasis (5) was the MRI diagnosis for malignant disease. Tarlov cyst (1) was the MRI diagnosis for tumor mimics and others constituted 30 cases.

DISCUSSION

The ability of MRI to show the spine and spinal cord with greater sensitivity and specificity than CT is well established for trauma, neoplastic, congenital, and degenerative disorders. MRI is the only currently available technique that provides direct visualization of the spinal cord. This has become 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, exquisitive soft tissue delineation, and non-invasiveness. In the present study of 50 cases, we found different spinal cord lesions, among these are congenital lesions (9), neoplastic lesions (19), primary neoplasms (14), secondary neoplasm (5), traumatic lesions (14), others include inflammatory (6), and infectious (2). The most common spinal lesions were found in the 20–29 age group (40%), with more male predilection of 72% in comparison of 28% female in the present study. Out of 19 neoplastic lesions, the most common type of intramedullary spinal cord tumor (IMSC) is ependymoma (31.5%) which corresponds with Koeller *et al*. [3] study and also in correspondence with the study of Campello *et al*. study [4]. They are centrally located with symmetrical cord expansion, typically isointense on T1, although they may have areas of hyperintensity due to hemorrhage, a complication that is uncommon with astrocytomas. On T2-weighted sequences, they are typically hyperintense, although they may be isointense relative to the cord and 65% of cases have shown homogenous enhancement; however, Duffau [5] reported that as for the pattern of contrast enhancement, neurinomas tend to exhibit ring-like enhancement.

The second most common IMSC tumor is astrocytoma 15.7% of all neoplastic lesions in our study and the most common tumor in children. The most common location of the lesion is thoracic cord. These neoplasms usually have poorly defined margins and are iso to hypointense relative to the spinal cord on T1-weighted images and hyperintense on T2-weighted images. The average length of involvement is seven vertebral segments. Virtually all cord astrocytomas show at least some enhancement following the intravenous administration of contrast material. Hemangioblastomas constitute 10.5% of all spinal cord tumors in our study in comparison to Xu *et al*. [6] found 1.0–7.2% of all spinal cord neoplasms with no gender predilection. Multiple lesions indicate the manifestation of von Hippel-Lindau syndrome. Hemangioblastomas manifest with diffuse cord expansion and variable signal intensity on T1-weighted images, with the most common appearance being isointense or hyperintense relative to the normal spinal cord. On T2-weighted images, these lesions characteristically have high signal intensity with intermixed focal flow voids.

Meningiomas which are intradural extramedullary lesions constituted 10.5% of all spinal cord neoplasms in the present study in comparison to Gezen *et al*. [7] mentioned that next to neurofibromas, meningiomas are the second most common intradural spinal tumor, accounting for approximately 25% of all primary spinal tumors, intradural–intramedullary (1%) and intradural–extramedullary in 83%. Classically, spinal meningiomas will appear isointense to the spinal cord on T1 and T_2WI with intense homogeneous signal after Gd infusion. Neurofibroma in our study constituted 5.2% which are intradural extramedullary with extradural component noted in NF1 in comparison to Dorsi and Belzberg [8] who reported that schwannomas and neurofibromas account for 16–30% of all intraspinal masses. In one series, intramedullary schwannomas were found to comprise 0.3% of intraspinal neoplasms and 1.1% of spinal schwannomas. Approximately 50 cases of pure intramedullary schwannomas have been reported. Dumbbell tumors account for 6–14% of spinal neoplasms. Spinal cord metastasis constituted 26.3% of all spinal cord lesions which carcinoma of lung constituted 60% followed by carcinoma breast 20%, drop mets constituted the rest of 20%. Out of which 60% are intramedullary, 40% constituted leptomeningeal metastasis in comparison to Lv et al. [9], lung carcinoma is the most common tumor for spinal metastasis. These lesions show T1 hypo T2 hyper with post-contrast heterogenous enhancement. Spinal cord trauma constituted 28% of all spinal cord lesions in this study, which has shown T1 hypo, T2/STIR hyperintensity within the cord in comparison to the study of Alizadeh et al. [10] trauma constituted 18.8% of all spinal cord lesions. Congenital lesions constituted 16% of all spinal lesions which includes spinal dysraphism 55.5%, intraspinal lipomas 11.1%, and tethered cord in 22.2% which is associated with spinal dysraphism. These lesions have shown consistent with the study of Alizadeh et al. [10].

MS constituted 8% of all spinal cord lesions in this study, which are T1 hypo T2/STIR heterogeneously hyperintense with few lesions on post-contrast showing mild enhancement suggesting active lesions. NMO and archnoiditis constituted 2% of our study in comparison to the study of Alizadeh *et al*. [10] in which few active lesions were noted. Based on location lesions are classified into intradural and extradural, intradural was further classified into intramedullary and extramedullary lesions.

Intradural intramedullary lesions include 48% followed by extra dural lesions 40% followed by intradural extramedullary lesions 12% which in comparison with the study of Tiwari *et al*. [11] in which extramedullary lesions were more common followed by intramedullary then intradural extramedullary.

CONCLUSION

In our study of 50 patients with spinal cord lesions, neoplasms comprise the most common disease located at the dorsal spine followed by congenital lesions. Spinal cord ependymomas comprise the most common type of intramedullary spinal tumors followed by astrocytomas.

MRI has a special role in anomalies such as low-lying or tethered cords with thickened filum terminale, syringohydromyelia, and vertebral segmental anomalies. With the help of T1 sequence and sagittal MR, coronal images have a special role in patients with scoliosis. Sagittal MR images are more useful for associated skin changes in spinal dysraphism. T1WI is useful in evaluating anatomy in congenital anomalies. When a lipomatous component is suspected, fat-suppressed sequences (e.g., STIR) are useful. Contrast-enhanced scans are more helpful than unenhanced scans in diagnosing and defining tumor extent and in differentiating solid tumor components and tumoral cysts from syrinx or benign cysts or pseudotumor areas of cord expansion.

REFERENCES

1. Sanelli PC, Schaefer P, Loevner L. Neuroimaging: The Essentials. United States: Lippincott Williams and Wilkins; 2015.
2. Hauser SL. Diseases of the Spinal Cord. En: Harrison's Principles of Internal Medicine. 16th ed. New York: McGraw-Hill; 2005. p. 2438-47.
3. Koeller KK, Rosenblum RS, Morrison AL. Neoplasms of the spinal cord and filum terminale: Radiologic-pathologic correlation. Radiographics 2000;20:1721-49. doi: 10.1148/radiographics.20.6.g00nv151721, PMID 11112826
4. Campello C, Le Floch A, Parker F, Bauchet L, Dufau H, Dufour H, *et al*. Neuroepithelial Intramedullary Spinal cord Tumors in Adults: Study of 70 Cases. American Academy of Neurology Annual Meeting, Seattle; 2009.
5. Duffau H, Gazzaz M, Kujas M, Fohanno D. Primary intradural extramedullary ependymoma: Case report and review of the literature. Spine (Phila Pa 1976) 2000;25:1993-5. doi: 10.1097/00007632-200008010-00021, PMID 10908946
6. Xu QW, Bao WM, Mao RL, Yang GY. Magnetic resonance imaging and microsurgical treatment of intramedullary hemangioblastomas of the spinal cord. Neurosurgery 1994;35:671-5, discussion 675. doi: 10.1227/00006123-199410000-00013, PMID 7808610
7. Gezen F, Kahraman S, Canakci Z, Bedük A. Review of 36 cases of spinal cord meningioma. Spine (Phila Pa 1976) 2000;25:727-31. doi: 10.1097/00007632-200003150-00013, PMID 10752106
8. Dorsi MJ, Belzberg AJ. Paraspinal nerve shealth tumors. Neurosurg Clin N Am. 2004;15:217-22, vii. doi: 10.1016/j.nec.2004.02.007, PMID 15177320
9. Shah LM, Salzman KL. Imaging of spinal metastatic disease. Int J Surg Oncol 2011;2011:769753. doi: 10.1155/2011/769753, PMID 22312523
10. Alizadeh A, Dyck SM, Karimi-Abdolrezaee S. Traumatic spinal cord injury: An overview of pathophysiology, models and acute injury mechanisms. Front Neurol 2019;10:282. doi: 10.3389/fneur.2019.00282, PMID 30967837
11. Tiwari P, Rathva A, Zala S. MRI is the modality of choice for evaluation of spinal lesions. Int Arch Integr Med 2017;4:37-44.