ORIGINAL RESEARCH ARTICLE

MRI Evaluation of Spinal Lesions

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ABSTRACT

Introduction: Human vertebral column is in median plane at dorsal part of trunk. Axial images provide good morphologic delineation of posterior elements of spine. Many spinal cord diseases are reversible if recognized and treated at an early stage. With help of MRI, it is more confidently characterize the spinal tumor based on location into extradural / intradural and assess integrity of spinal cord, intervertebral discs and ligament after acute spinal trauma. The aim of the present study was to evaluate the role of MRI in diagnosis of spinal lesions.

Materials and Methods: This observational (cross-sectional) study was conducted on 100 patients for 1 1/2 years from November 2019 to May 2021 in Department of Radiology, PDU Gov. Medical College and Civil hospital, Rajkot, Gujarat; after taking proper consent from them.

Result: In present study, spinal cord neoplasm was the most common spinal lesion which is most commonly associated with degenerative disease. Most patients had multiple disc bulges/herniation mostly found in lumbar region (L4-5 mostly) followed by cervical and dorsal regions. Most common associated findings in degenerative lesions are annular tear and vertebral body changes, followed by spinal cord edema. Mostly benign lesions were intradural extramedullary while malignant lesions were extradural. Most common nerve sheath tumors are neurofibromas followed by schwannomas. In present study, diagnostic accuracy of MRI is 100% in cases of schwannoma and astrocytoma, followed by cases of lymphoma (83.33%).

Conclusion: MRI is definitive, sensitive, accurate, though costly but very specific, non-invasive, radiation free modality for evaluation of various spinal lesions.

Keywords: MRI, MRI Spine, Spinal Lesions

INTRODUCTION

Spine constitutes the backbone of the body and contains spinal cord that runs into the spinal canal. Imaging of the spine has evolved markedly with the development of newer modalities.

Classification of spinal lesion

A) Congenital anomalies of spine and spinal cord, B) Trauma, C) Infectious diseases, D) Inflammatory lesions, E) Vascular diseases, F) Demyelinating diseases, G) Degenerative diseases, H) Neoplastic lesions of spine and spinal cord. Many spinal cord diseases are reversible if recognized and treated at an early stage; thus they are among the most critical of Neurologic emergencies. The efficient use of diagnostic procedures, guided by knowledge of the anatomy and the clinical features of common spinal cord diseases, is required for a successful outcome.

Different modalities

A) Since the discovery of x-rays in 1895 by Wilhelm Conrad Roentgen plain radiographs offer an inexpensive evaluation of bony structures. They are widely available, rapidly obtainable and reveal fine bony detail because of their high spatial resolution. They still remain important as the initial screening tool in evaluation of spinal diseases.

B) CT scan, a cross sectional imaging modality allows direct visualization of the bony and soft tissue structures of spine. CT scan after the instillation of water soluble intrathecal contrast (post Myelogram CT scan (PMCT) is also a useful modality in patients in whom MRI cannot be performed.

C) MRI has today progressed to the point where it has largely replaced many of the above mentioned modalities. Its advantages include superior resolution, multiplanar capability and lack of ionizing radiation. However it cannot be performed in postoperative patients with metallic implants in-situ. Other limitations at present include its cost and availability.

Aims and objectives

1. To evaluate role of MRI in the diagnosis and management of spinal lesions.
2. Use of MRI to identify morphological features of spinal lesions.
3. To study the age and sex predilection in patients with

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spinal lesions.
4. To study and characterize the different type of spinal lesions.

MATERIAL AND METHODS

This observational (cross-sectional) study was conducted on 100 patients for one and half years from November 2019 to May 2021 in Department of Radiology in PDU Gov. Medical college and Civil hospital, Rajkot, Gujarat; after taking proper consent from them. The indication and details of the radiological procedure is explained to the patient. A written consent is obtained either from patient or his/her relatives. Each patient had undergone MRI as indicated. Findings of different imaging modalities are correlated with surgical & clinical outcomes whenever available.

Inclusion criteria

- Cases in which clinically spinal lesions are suspected.
- Cases of spinal lesions identified radiologically during the study period.

Patient preparation

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

Equipment

GE 1.5 TESLA MRI Electro magnet. Standard surface coils and body coils, were used for cervical, thoracic and Lumbar spine for acquisition of images.

Sequences

Conventional spin echo sequence T1WI, T2WI, FLAIR, SAG, STIR SAG, AXIAL and GRE axial, DWI (sos) and post contrast T1WI axial, sagittal and coronal, according to protocol set in the algorithm.

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.

Precontrast scanning was done using T_1WI, T_2Wl, FLAIR Sagittal, STIR sagittal, T1WI, and T2WI axial with slice thickness 4.5mm x 5mm.

Omniscan (Gadodiamide) or Magnevist (dimeglumine gadopentetate) 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 T_1WIsag, axial and coronal images were obtained.

Whenever required, thinner sections were obtained in the region of interest. A special MRI sequences like FLAIR and STIR were routinely obtained.

The MRI images were analyzed based on location (cervical, thoracic lumbar), segment of the spinal cord involvement, and severity of injury. In cases of trauma, site and level of injury, vertebral fracture, ligamentous injury, 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, intradural (extramedullary).

Follow up: Whenever possible patients were followed up for histopathological diagnosis in cases of neoplasms and outcome in cases of spinal trauma.

RESULTS

100 patients from Nov 2019 to May 2021 with suspected spinal lesions i.e. presenting with backache, paraplegia & bowel bladder dysfunction were studied

Incidence of various spinal lesions

100 cases of spinal lesions were studied with in present study. In present study, spinal cord neoplasm was the most common spinal lesion accounting for approx. 37% of the cases (table-1).

A. Degenerative disc diseases

In this study total 47 cases of degenerative disease were studied, among which 26 cases were associated with various spinal lesions.and 21 cases had exclusive degenerative changes.

In present study, spinal cord neoplasm (61.5%) is most commonly associated with degenerative disease.

B. Distribution according to level

In present study, 75% patients had multiple disc bulges/ herniation. Highest numbers of disc bulges were found in lumbar region accounting for 71% of total disc bulges, followed by cervical and dorsal regions. Maximum numbers of bulges were seen at L4-5 accounting for approx 60% of the total lumbar disc disease. In the cervical region C4-5 and C5-6 accounted for approximately 85% cervical disc bulges.

C. Distribution according to sex

In present study, 31(55.35%) male were affected and 16(36.41%) females were affected in degenerative cases.

Distribution according to associated findings:

In present study, most common associate findings in degenerative lesions are annular tear (31.25%) and vertebral body changes (31.25%), followed by spinal cord edema (18.75%).

Spinal cord neoplasms

A Distribution according to types

Table-2 shows distribution of tumor according to types.

B. Distribution according to morphology and location:

Approximately 68% tumors are benign in nature, malignant lesions contributing approx. 32%. 52% of benign lesions were seen in the intradural extramedullary location while 88% of the malignant lesions were seen in the extradural component majority of them being either lymphoma of secondaries.

A. Nerve sheath tumours

8 cases of nerve sheath tumors were included in present study.

Among nerve sheath tumors neurofibromas accounted for 66% and Schwannomas constituted 33%. 66% of nerve sheath tumors showed intra as well as extradural component (dumb bell shaped).

B. Spinal meningiomas

6 cases of spinal meningiomas were included in this study.

75% of spinal meningiomas were found in females in the 40-60 year age group. All the spinal meningiomas were in the dorsal region.

C. Intramedullary tumors

7 cases of intramedullary tumors are studied.

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Among the Intramedullary tumors astrocytomas constituted 60% in this study. Cervical spinal cord was affected in 40% cases. Associated cyst/syrinx formation was seen in 60% of Intramedullary tumors.

D. Comparison with histopathological findings

In present study, diagnostic accuracy of MRI is 100% in cases of schwannoma and astrocytoma, followed by cases of lymphoma (83.33%).

Congenital anomalies

In this study, 11 cases of spinal dysraphism and 4 cases of craniovertebral anomalies were studied.

In this study vertebral body anomalies were found in 50% and diastemetomyelia was found in 40% cases of spinal dysraphism (table-3).

Infective lesions

8 cases of infective spinal lesions were studied.

In this study Pott's spine was found in dorsal region in 62% of cases. 20-40 year age group was affected in 66% cases. In this study pre and paraspinal abscess was found in 83% cases.

Demyelinating diseases

7 cases of demyelinating diseases were included in present study.

In this study all the demyelinating lesions were found in the dorsal spinal cord. 80% of patients were in the 0-40 year age group. Males were affected in 60% cases. Multiple sclerosis and Myelitis accounting for 40% each.

Traumatic spinal lesions

5 cases of Spinal trauma were studied.

a) Distribution according to level

In present study, cervical spine was the most common site affected by spinal trauma accounting for 75% of the cases.

b) Distribution according to associate findings

Extraspinal hematoma was seen in 50% cases while spinal cord and vertebral column involvement was seen in 75% cases. In present study, all the patients were male in 20-40 year age group (table-4).

DISCUSSION

In our study of 100 cases of different spinal lesion, we found various different causes for spinal compression. Among these are degenerative, trauma, infectious causes, primary neoplasms and secondary neoplasm.

In this study Degenerative disc disease was the commonest spinal lesion accounting 47% for lesions. This is comparable to Russell E G[1] study. In his study degenerative lesion occupy 41% of spinal lesions.

Degenerative spinal lesions

In present study lumbar disc disease constituted 82% of disc diseases with L4-5 and L5-S1 level constituting 100% of lumbar disc bulges/herniation and cervical disc disease accounted for 19% disc diseases with C4-5, C5-6 and C6-7 levels being involved.

One case of thoracic disc disease was included that is comparable with study of Russell E G[1] who states that 90% of lumbar disc herniations occur at L4-5 and L5-S1 level. In the cervical spine C6-7 is the commonest site accounting for 60% cervical PIDs. Thoracic spine is involved in only less than 1%.

In present study 16 cases of disc bulge/herniations were studied and in 75% case multiple levels were involved and s/o total number of bulges in lumbar region were 21 this is compared with study of Grenier N[2] who studied 16 cases of lumbar disc herniations and observed.

Traumatic spinal lesions

Out of 100 cases of spinal lesion, we had 5 (43.3%) cases of spinal trauma. a study conducted by Kulkarni et al[5], 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 11 were males and 2 were females (M: F = 11:2): This is in comparison to the study conducted by Yamashita et al[6].

In our study the level of injuries among the 5 patients was thoracic (53.8%), cervical (46%) and lumbar (15.4%). This is comparable to the study conducted by Kerslake et al[4].

MRI depicted not only the spinal cord changes in our patients but also the relationship of subluxed / dislocated vertebral bodies to the cord (4 patients), posterior elements fracture (4 patients), ligamentous disruption (3 patient), soft tissues injuries (5 patients) and epidural hematomas (2 patients).

The advantage of MRI in demonstrating all these changes is shown by many studies done by Yamashita et al[6], Kulkarni et al[5] etc.

Spinal cord neoplasm

In our study of 100 cases, 7 are of metastatic disease of the from different type of spinal lesion.

Intraspinal extradural masses that caused cord compression extended from an abnormal part of the vertebra in all the 7 patients.

This is substantiated by a study conducted by Lien et al18 in which 90% showed extradural masses extended from an abnormal part of a vertebra.

Out of 7 patients, 4 (60%) showed more than one lesions. This is in comparison to study done by Lien et al[7] in which 78% had more the 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 (80%). This is in comparison to the study done by Livingston et al[8] 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 1 patient with primary carcinoma bronchus, 1patient had breast carcinoma, 1 lymphoma, 1 carcinoma prostate, and 1 patients with unknown primary.

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 5 out of 7 patients which showed mild Homo-to- Heterogeneous enhancement. Observation have shown that post- contrast MR does not improve the

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detection of extradural spinal metastases even though it has great value in intradural disease.

We had 14 cases of primary intradural extramedullary neoplasms, among which 8 were nerve sheath (neurofibroma) and 6 was meningioma. All the 5 cases showed spinal cord compression. Of the 8 cases of neurofibromas MR diagnosed 6 cases as neurofibroma. In 2 cases MR could not differentiate between meningioma and neurofibroma.

Neurofibromas were iso- to- hypointense on T1WI and hyperintense on T2WI and showed intense enhancement on post contrast.

One case showed extension into the neural foramina. Studies done by David et al[9], and Matsumo et al[10] 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.

Neurofibromas showed marked enhancement which was heterogeneous. Of the 14 intradural extramedullary neoplasm, 6 was meningioma. On MRI it was given as meningioma / neurofibroma as differential diagnosis. It showed iso intensity on T1 & T2WI and showed moderate homogeneous enhancement on post contrast. Several studies by Matsumoto et al10, showed signal characteristic of meningioma as iso intense to the cord on T1 and T2WI with intense homogenous enhancement on post contrast.

Intramedullary tumour like Astrocytomas and ependymomas in this study were hypointense on T1WI, hyperintense on T2WI with spinal cord expansion and showed enhancement on post contrast study. Intramedullary teratoma showed fat signal intensity within the lesion.

Mc. Cormick PC[11] stated that ependymomas constitute 60% of glial tumors and are Intramedullary in location usually seen in conus region.

Congenital spinal lesions

In this study, children with spinal dysraphism presented with back swelling, bowel and bladder dysfunction, neurological deficit and kyphoscoliotic deformity. One patient with myelomeningocele showed Chiari 2 malformation in brain. Tethered cord was seen in 3 cases and causes include myelomeningocele, diastematomyelia and intraspinal lipoma. One case of lumbosacral agenesis was studied and there was evidence of chisel shaped abrupt termination of conus.

These findings can be compared with following studies; however discrepancies may be due to the small number of cases in present study. According to this study in patients with myelomeningocele associated findings are Chiari 2 malformation (100%), syringohydromyelia (30-50%), hydrocephalus (80%) and diastemetomyelia (30-45%). Patient can have kypho-scoliotic deformity and hip deformities also.

Narasimhachari[13] reviewed 53 patients with clinical diagnosis of tethered cord. In 84% the level of tip of conus was below mid L2 vertebral body.

Infective spinal lesions

In present study Pott's spine was found in 66% cases in dorsal region with 66% cases in 20-40 year age group.

These findings are comparable with a study by Y.K. Bicakci[14] who studied 25 patients with tuberculous spondylodiscitis with MRI. Thoracic spine was involved in 11 cases (44%), lumbar in 9 cases and cervical in 5 cases.

Paraspinal and epidural abscess formation was seen in 95% cases as compared to present study where it is found in 83% cases.

Demyelinating spinal lesions

One case of subacute combined degeneration in the dorsal cord was studied. The lesion showed involvement of the posterior column with hyperintensity on T2WI.

This is consistent with Srikanth S G[18] who studied one case of SACD and found the cervical spinal cord to be the most

Lesions	No. of cases	%
Spinal cord neoplasm	37	37.00
Degenerative disc disease	21	21.00
Spinal dysraphism	11	11.00
Infective diseases	08	8.00
Demyelinating lesions	07	7.00
Traumatic lesions	05	5.00
Vertebral body tumors	04	4.00
Craniovertebral junction anomalies	04	4.00
Vascular lesions	03	3.00
Total	100	100

Table-1

Types	No of cases-37	Percentage
Nerve sheath tumor	08	21.62
Intramedullary tumor	07	18.92
Metastasis	07	18.92
Meningioma	06	16.22
Lymphoma	06	16.22
Cysts	03	8.10

Table-2: Distribution of tumor according to types.

Findings	No. of cases -15	Percentage
Vertebral body anomalies	04	50
Diastemetomyelia	03	40
Tethered spinal cord	02	30
Chiari malformation	02	30
Dural ectasia	01	20
Syringohydromyelia	02	20
Dorsal dermal sinus	01	10

Table-3: Findings

Associate findings	No of cases	Percentage
Spinal cord Involvement	04	75
Vertebral fractures / marrow edema	04	75
Pre and paraspinal Hematoma	02	45
IV disc injury	02	45
Pseudomeningocele formation	01	20

Table-4: Distribution according to associate findings

common site of involvement with hyperintensity involving the posterior column on T2WI.

In present study 2 cases of multiple sclerosis were studied involving dorsal cord.

E.M. Larsson[17] studied five cases of multiple sclerosis and showed that spinal cord enlargement and contrast enhancement was associated with clinically active lesion and cord atrophy was seen in clinically stable lesions.

Vascular spinal lesions

In this study two cases of spinal arteriovenous malformation were studied both the lesions were seen in 20-40 year age group patients with equal sex incidence.

Both the lesions appeared as bunch of flow voids in spinal cord in the cervicodorsal and upper dorsal region and showed linear enhancement on post contrast study.

D. Dormant[19] studied 34 cases of spinal AVMs that were angiographically proved with MRI. His detection rate was 100% and axial images could precisely locate spinal AVM in relation to spinal cord.

CONCLUSION

MRI is the definitive modality in assessing soft tissues of the spine and spinal cord abnormalities. It is the best modality 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 still relies on biopsy and histopathological examination. Till date, MRI is the only modality to directly image the spinal cord.

In our study with the help of MRI, we could successfully characterize the spinal tumor based on location into Extradural / Intradural and assess the integrity of spinal cord, intervertebral discs and ligament after acute spinal trauma. So in the end I can conclude that MRI is very definitive, sensitive, accurate, though costly but very specific, non invasive, radiation free modality for evaluation of various spinal lesions.

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