

MRI Evaluation of Spinal Tumours

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ABSTRACT

BACKGROUND

A spinal tumour is an abnormal tissue within or surrounding the spinal cord and spinal column. MRI is the investigation of choice in evaluation of spinal cord tumours because of better soft-tissue contrast, multiplanar capability, better visualisation of anatomical details of the spinal column, and narrows down the differentials in diagnosis. We wanted to study the role of magnetic resonance imaging (MRI) in the evaluation of spinal tumours, classify the spinal tumours into extradural, intradural, extramedullary, and intramedullary compartments and review the differential magnetic resonance imaging (MRI) features of various spinal tumours.

METHODS

Our study included 36 patients with signs and symptoms of neurological deficit after clinical examination by clinician referred to the Department of Radiodiagnosis for MRI examination from various departments of Santhiram Medical College and General Hospital and also from other hospitals. MRI scan was performed for all those patients in sagittal plane T1W, T2W, axial plane T1, T2, coronal plane T2, fat-suppressed sequence STIR, T1 postcontrast axial, coronal, sagittal planes, and diffusion-weighted sequences.

RESULTS

The total number of patients studied was 36, of whom 24 were males, 12 were females. The age of patients ranges from 10 to 65 years. The commonest type of spinal tumours extradural (16 cases (44%)) followed by extramedullary intradural (11 cases-31%) followed by intramedullary tumours (9 cases (25%)). In extradural type, metastases are common. In extramedullary intradural type, meningioma is the commonest tumour, and the intramedullary type ependymoma is the commonest tumour. Lumbar spine is the commonest site of the tumours (44%), followed by the dorsal spine (35%), then the cervical spine (18%), and sacrococcygeal region 3%. In cervical region common pathologies were metastases followed by neurofibroma, in dorsal region metastases followed by meningioma, schwannoma, in lumbosacral region metastases is the common pathology followed by ependymoma.

CONCLUSIONS

Magnetic resonance imaging (MRI) is the investigation of choice in the evaluation of spinal tumours because of better soft tissue contrast, and better anatomic details. Gadolinium enhanced MRI narrows down differentials of spinal tumours diagnosis.

KEYWORDS

MRI, Spinal Tumours

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BACKGROUND

Spinal tumours classified into (1) extradural, (2) intradural extramedullary, and (3) intramedullary depending on anatomic location. Spinal tumours divided into primary tumours and secondary (metastatic) tumours. Primary tumours originate from the spine itself and its adjacent structures and secondary (metastatic) tumours of distant organs, which spread to the spine via blood and lymphatics. As the spine is a well-vascularized structure and has a close relationship with regional lymphatic and venous drainage systems (especially Batson's venous plexus), it is generally more susceptible to metastasis. Metastatic tumours are the most common (97%) tumours of the spine.¹ The adenocarcinomas especially metastasize to the spine.² Magnetic resonance imaging (MRI) is imaging modality of choice in evaluation spine tumours. In patients with spinal canal involvement, MRI is a useful technique for scanning the adjacent levels with full, cross-sectional sagittal images.

METHODS

Our study was a prospective study involving 36 patients of whom 24 were males, and 12 were females with signs and symptoms of neurological deficit. After taking a complete history and clinical examination by the clinician referred to the Department of Radiodiagnosis for MRI examination of the spine from various departments of Santhiram medical college and the general hospital also from outside hospitals. Our study carried out for a period of one year between July 2018 to June 2019.

Protocol for MRI Scan- Spine

MRI examination of the spine was performed in the supine position for all patients. The basic sequence is sagittal plane T1, T2, other sequences performed are axial plane T1, T2, coronal plane T2, fat-suppressed sequence STIR, T1 postcontrast axial, coronal, sagittal planes, and diffusion-weighted sequences. We performed all MRI spine scans with a 1.5-Tesla closed MR scanner (Siemens Magnetom Essenza A Tim+Dot System). The various MRI sequences performed in our institute for the spine, as shown in Table 1. After securing I.V. cannula, 10 ml of gadopentetate dimeglumine diethylene triamine penta-acetic acid (Gd-DTPA) injected through intravenous cannula. The MRI examination started immediately at the end of the injection. The scanning time varies from 15-30 min. for a complete study of the spine.

Parameters	Sagittal T1	Sagittal T2	Axial T1	Axial T2	T2 Coronal STIR
TR	71	3360	575	3500	5500
TE	10	95	10	98	51
FOV	340	280	220	220	280
FA	150	150	150	150	150
Slice Thickness	4 mm	4 mm	4 mm	4 mm	4 mm
NAQ	2	2	2	2	2

Table 1. MRI Protocols in Spinal Tumour Imaging

RESULTS

The total number of patients studied was 36, of whom 24 were males, 12 were females. The age of patients ranges from 10 to 65 years. The commonest type of spinal tumours extradural (16 cases (44%)) followed by extramedullary intradural (11 cases-31%) followed by intramedullary tumours (9 cases (25%)). In extradural type metastases (16 cases-44%) are the commonest tumour. In extramedullary intradural type Meningioma (5 cases-13.8%) is the commonest tumour, in the intramedullary type, Ependymoma (4 cases-10%) is the commonest tumour. The most common site of the metastases in the lumbar spine (44%), followed by a dorsal spine (35%), then cervical spine (18%), sacrococcygeal region 3%. Cervical region pathologies were metastases followed by neurofibroma, dorsal region metastases followed by meningioma, schwannoma, in lumbosacral region Metastases is common pathology followed by ependymoma

Anatomic Location of Tumour	No. of Cases	%
Extradural Lesions	16	44%
Intradural extramedullary	11	31%
Intramedullary	9	25%

Table 2

Type of Tumour	No. of Cases	%
Metastasis	16	44.4%
Meningioma	5	13.8%
Neurofibroma	4	10.8%
Schwannoma	2	5.4%
Lipoma	1	2.7%
Ependymoma	4	10.8%
Astrocytoma	3	8.3%
Lumbosacral teratoma	1	2.7%

Table 3

Most of the cases show hypointense signal intensity on T1WI (88%), hyperintense signal intensity on T2WI (92%). 10 cases (27.4%) show homogenous enhancement on the gadolinium contrast study. Few of them show characteristic enhancement patterns like homogenous enhancement with dural tail sign in meningioma, target sign in neurofibroma.

DISCUSSION

Spine tumours broadly divided into (1) extradural, (2) intradural extramedullary, and (3) intramedullary depending on anatomical location. Spinal tumours classified into primary tumours and secondary (metastatic) tumours. Primary tumours originate from the spine itself and its adjacent structures and secondary (metastatic) tumours of distant organs, spread to the spine via blood and lymphatics. As the spine is a well-vascularized structure and has a close relationship with regional lymphatic and venous drainage systems (especially Batson's venous plexus), it is generally more susceptible to metastasis. Metastatic tumours are the most common (97%) tumours of the spine.¹ The organ of the origin of adenocarcinomas is the lung, breast,

prostate, kidney, gastrointestinal tract, and thyroid. The percentage of patients who had had bone metastasis before death was between 50% to 70%, in the case of breast cancer percentage, more accounts for 85%.³ The thoracic and thoracolumbar spine accounts for 70% of cases of metastases, and the lumbar spine and sacrum accounts for more than 20% of metastatic lesions. The cervical spine is a less frequent metastasis site.¹

Extradural	Intradural Extramedullary	Intramedullary
1. Metastases from systemic cancers	1. Meningioma	1. Ependymoma, Myxopapillary ependymoma,
2. Primary Malignant Vertebral Tumours Multiplemyeloma, Plasmacytoma, chondrosarcoma, osteosarcoma, and Ewing's sarcoma.	2. Neurofibroma	2. Astrocytoma
3. Benign Primary Vertebral Tumours Osteoid osteomas and osteoblastoma Aneurysmal bone cyst, Chordoma, haemangiomas	3. Schwannomas	3. Hemangioblastoma
	4. Metastases	4. Gangliogliomas
	Less-frequent paraganglioma, lipoma, epidermoid and dermoid cysts.	Less Frequent epidermoid cyst, lipoma, oligodendroglioma, metastasis, lymphoma.

Table 4. Classification of Spinal Tumours

Magnetic resonance imaging (MRI) is superior to all imaging modalities in spine tumours, especially in the evaluation of the bone marrow and the spinal canal, the relationship of the tumour with neurovascular structures and tumour vascularity. In patients with spinal canal involvement, MRI is a useful technique for scanning the adjacent levels with full, cross-sectional sagittal images. In 10% of spine metastases with spinal canal involvement, neurological compromise in adjacent or distant levels has been shown.³ In our study, the extradural tumours were the most common intraspinal tumours representing about 44% of cases, followed by intradural extramedullary lesions representing 31% of cases, then intramedullary lesions representing 25% of cases. Our study correlates with the study done by Han et al.⁴ In our study, the histopathology of the patients with metastases revealed that the most frequent metastatic lesion was bronchogenic carcinoma (16%) followed by breast (12%), prostate (6%).

Shah and Salzman⁵ stated that metastases to the spine could involve the bone, epidural space, leptomeninges, and the spinal cord. Metastases commonly involves lung, liver, and spine. The spine is the third common site for metastatic disease, and it is the most common osseous site. In patients with spinal metastases, 60–70% of them had systemic cancers. Tumours that metastasize to the spinal cord are carcinoma breast (72%), carcinoma of the prostate (84%), carcinoma thyroid (50%), lung carcinoma (31%), renal carcinoma (37%), and pancreatic carcinomas (33%). Altogether, it accounts for greater than 80% of primary tumours in patients presenting with metastases.⁵

In our study, metastatic extradural tumours showed isointense (two cases) and hypointense (four cases) on T1 and four cases hyperintense, two cases hypointense, and four cases isointense on T2. Our study correlates with the

study by Latchaw et al.,⁶ who reported that metastasis would have less signal intensity than bone marrow on a T1WI and higher signal on a T2WI. In our study, four female patients with meningioma accounting for 10.8% of intradural extramedullary tumours, located at the cervical and the dorsal regions, and the age ranged between 40 and 46 years. They were isointense on T1W and intermediate hyperintense on T2, and one of them showed calcification on the computed tomographic study. Post-contrast study shows that homogenous enhancement showed a dural tail sign. Our study agrees with the study by Arnautovic and Arnautovic,⁷ who stated that spinal meningiomas are isointense to the cord or hypointense to the cord on T1-weighted images and slightly hyperintense on T2-weighted MRI. Postcontrast study meningiomas show homogenous enhancement (except for acalcified part) and may show a characteristic 'dural tail' sign.⁷

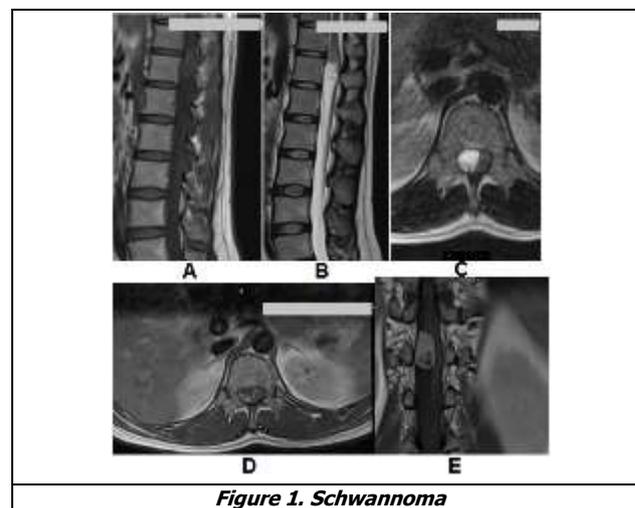


Figure 1. A) Sagittal T1W MR image shows mass isointense with cord, B & C) sagittal and axial T2W MR image of thoracic spine shows hyperintense intradural extramedullary mass at D11-D12 level which on post-contrast. D & E) (T1+C axial and coronal) Shows moderate enhancement and non-enhancing cystic areas.

In our study, there was one case of intramedullary lipoma, at the dorsal region, the lesion was hyperintense on T1W and less hyperintense on T2WI, Fat suppression on STIR with no significant enhancement on the post-contrast study, which shows fat suppression on STIR. In our study, three cases of astrocytoma reported, found in the cervical (two cases) and dorsal regions (one case). They showed iso intensity to the cord (two cases), hypointensity (one case) on T1WI, and hyperintensity (five cases) on T2WI, post-contrast study shows homogeneous enhancement. Syring found in one case.

In our study, four cases of ependymoma reported, found in the cervical (one case), dorsal (one case). Lumbar (two cases), They showed iso intensity (one case), hypointensity with respect to the cord (three cases) on T1WI, and hyperintensity with respect to cord (four cases) on T2WI, post-contrast study showed homogeneous enhancement in two cases, heterogeneous enhancement in one case, and marginal enhancement in one case. They were associated with cystic degeneration in two cases. Our

study correlate with the studies done by Nemoto et al.⁸ and Fulbright et al.⁹

According to a study done by Kocher et al.¹⁰ ependymoma is located in the cervical spinal cord (44%), followed by the thoracic spinal cord (23%), and the least commonly affected is distal thoracic spinal cord or conus medullaris (6.5%). Sites of the spinal cord affected by Astrocytomas are thoracic spinal cord, followed by the cervical spinal cord, and rarely seen as an isolated or focal lesion in the conus.



Figure 2. Intramedullary Lipoma

Figure 2. A) Sagittal T1W, B) Sagittal T2 and MR image of dorsal spine shows T1 & T2 hyperintense mass which suppressed on C) Coronal STIR noted from D2 TO D7 vertebral body level.

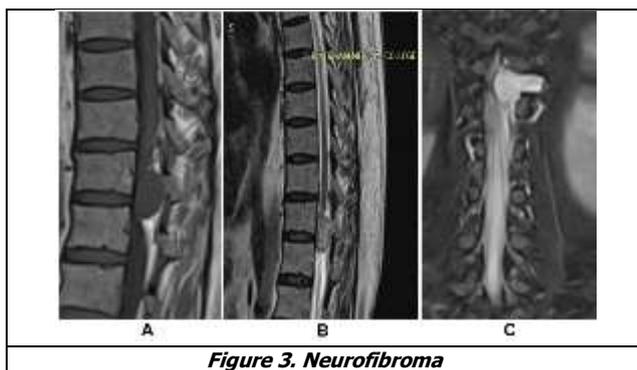


Figure 3. Neurofibroma

Figure 3. A) Sagittal T1 W, B) Sagittal T2W, and C) conal STIR MR image shows a well-defined intradural extramedullary mass (T1 isointense, T2 heterogeneous hyperintense, intense hyperintense on STIR) noted at D11-D12 vertebral levels on left side displacing cord to the right side and extending to left neural foramina at D11 & D12.

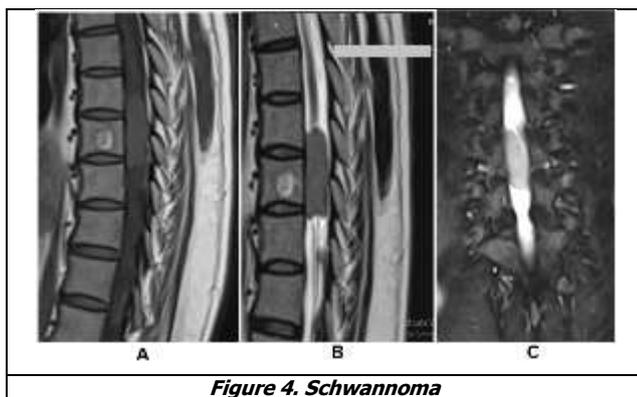


Figure 4. Schwannoma

Figure 4. A) Sagittal T1W MR, B) T2W MR image C) STIR shows extramedullary intradural altered signal intensity (T1 intermediate T2 & STIR hyperintense) at D8 & D9 vertebral level on the right-side causing compression and displacement of cord towards left.



Figure 5. Metastases

Figure 5. A) Sagittal T1, B) Sagittal T2W, and C) coronal T2 STIR MR image shows a hypointense lesion in D9 & D10 vertebral bodies involving posterior elements causing spinal canal stenosis with indentation over the cord and bilateral neural foraminal narrowing.

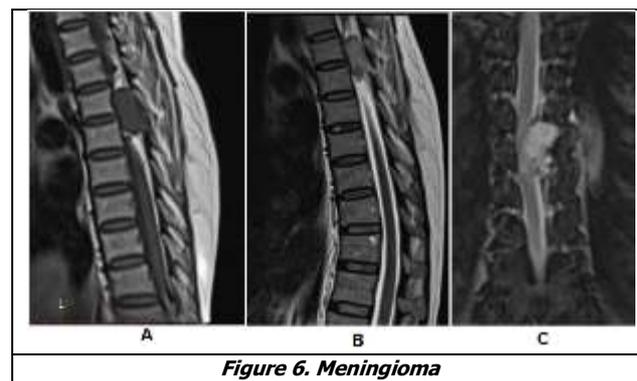


Figure 6. Meningioma

Figure 6. A) Sagittal T1W, B) Sagittal T2W, and C) coronal T2 STIR MR image shows a well-defined intradural extramedullary mass lesion isointense on T1 hyperintense on T2 & STIR at D5-D6 level extending into the left neural foramen of D4-D5 & D5-D6 causing mass effect over the cord and displacing cord to the right side.

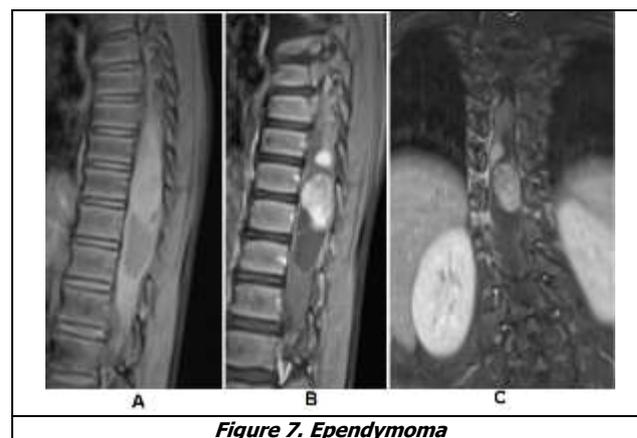


Figure 7. Ependymoma

Figure 7. A) Sagittal T1WI, B) T1+C, C) coronal FS dorsal spine shows intramedullary mass, which is heterogeneously hypointense on T1, moderate enhancement on contrast study with non-enhancing cystic areas.

CONCLUSIONS

Magnetic Resonance Imaging (MRI) is the investigation of choice in evaluation of spinal tumours because of better soft tissue contrast, and better visualisation of anatomical details. Depending on anatomical location, spinal tumours can be divided into (1) extradural, (2) intradural extramedullary, and (3) intramedullary tumours. Gadolinium enhanced MRI narrows down differentials of spinal tumours diagnosis. In our study, the commonest type of spinal tumour is extradural followed by extramedullary intradural followed by intramedullary tumours. In extradural type, metastases are the commonest tumour. In extramedullary intradural type, meningioma is the commonest tumour, in the intramedullary type, Ependymoma is the commonest tumour.

REFERENCES

- [1] Lewandrowski KU, Anderson ME, McLain RF. Tumours of the spine. In: Herkowitz HN, Garfin SR, Eismont FJet al, eds. Rothman-Simeone the spine. 6th edn. Philadelphia: Elsevier Saunders 2011:1480-1512.
- [2] Choi D, Crockard A, Bungler C, et al. Review of metastatic spine tumour classification and indications for surgery: the consensus statement of the Global Spine Tumour Study Group. *Eur Spine J* 2010;19(2):215-222.
- [3] Aboulafia AJ, Levine AM. Musculoskeletal and metastatic tumours. In: Fardon DF, Garfin SR, eds. *OKU: Spine 2*, Rosemont. American Academy of Orthopaedic Surgeons 2002:411-431.
- [4] Han JS, Koufman B, Yousef SJ, et al. NMR imaging of the spine. *Am J Roentgenol* 1983;141(6):1137-1145.
- [5] Shah LM, Salzman KL. Imaging of metastatic spinal disease. *Int J Surg Oncol* 2011;2011:1-12.
- [6] Latchaw RE, Charles AJ, William ER. Tumours and infection of the spine and spinal cord: MR & CT imaging of the head. *Neck Spine* 1991;177:209.
- [7] Arnautovic K, Arnautovic A. Extramedullary intradural spinal tumours: a review of modern diagnostic and treatment options and a report of a series. *Bosn J Basic Med Sci* 2009;9 Suppl 1:40-50.
- [8] Nemoto Y, Inoue Y, Tashiro T, et al. Intramedullary spinal cord tumours: significance of associated hemorrhage at MR imaging. *Radiology* 1992;182(3):793-796.
- [9] Fulbright R, Ross JS, Sze G. Application of contrast agents in MR imaging of the spine. *J Magn Reson Imaging* 1993;3:219-232.
- [10] Kocher B, Smirniotopoulos JG, Smith AB. Intradural spinal lesions. *Applied Radiology* 2009.