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Role of magnetic resonance imaging in neoplastic diseases of spine

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Abstract:

Background: Incidence of neoplastic disease has seen an increase in last decade especially last few years. Spinal tumors have presented as a challenge in imaging studies for many decades. MRI with the help of multiplanar imaging and high soft tissue contrast provides a perfect solution to this diagnostic challenge. **Aims & Objectives:** To determine the role of 1.5T MRI in evaluation of spinal tumors and find the common tumors present in our population. **Materials & Methods:** Forty- nine patients who were admitted in the Dept. of Neurosurgery with clinical suspicion of spinal tumor were evaluated on a GE Medical System, Sigma 1.5 T, Sys # GEMSOW scanner. T1W and T2W along with advanced sequences & Post Gadolinium contrast agent images were evaluated in axial, coronal and sagittal planes. All the results were correlated histopathologically. **Results:** Spinal tumors were assessed according to the various compartments they were present in. Intradural extramedullary tumors formed the most common group of tumors with nerve sheath tumors being the most common sub group of spinal tumors. Extradural metastasis formed the next most common type of lesions. **Conclusion:** Magnetic resonance imaging especially done at higher tesla systems like 1.5T & 3T with the use of contrast and advanced sequences is highly useful in the evaluation of spinal tumors not only for diagnosis but for surgical planning also.

Key words: Magnetic Resonance Imaging, Nerve Sheath Tumor, Spinal Tumors

Introduction:

Tumors of the spine constitute approximately 15-20% of CNS tumors [1]. They primarily occur in young or middle aged adults and are less frequent in children and the elderly. No significant sex predilection is seen [2,3]. Primary tumors involving multiple levels are seen in only 1%. Apart from knowledge of correct clinical history and patient's age, availability of a sensitive and specific imaging modality is of immense importance especially to localize the lesion.

Radiologists have tried to image the internal structures of central nervous system for many decades. Radiographs were the first modality to be used but were able to give information only about the shape and size of the spinal canal but not of the contents of the canal. Invasive imaging procedures started with injecting air into spinal canal followed by injection of iodinated contrast media. Apart from their inherent limitations these procedures had severe even life threatening complications.

With the advent of MRI the imaging of spine gained leaps and bound because of its multiplanar imaging and better soft tissue contrast. With the production of higher strength magnets for MRI, today MRI has become the imaging tool of choice for diseases of the spine. MRI is non-invasive and offers better understanding of the pathology, which was not possible previously.

MRI is much more specific in differentiating lesions according to the various compartments in the spine i.e. intramedullary, extradural & intradural extramedullary. MRI helps to differentiate the lesion according to signal density as well as paramagnetic chemical shift, or susceptibility effects and motion.

The objective of our study was to study the common spinal neoplasms present in Indian population and the efficacy of MRI in diagnosing them, and therefore to reemphasize the importance of MRI in imaging of spinal lesions.

Materials and Methods

One year prospective study was done in patients admitted in the Department of Neurosurgery.

All patients with probable clinical and radiological diagnosis of spinal tumors were included in our study irrespective of age group.

Patients who were deemed unfit for MRI or surgery, were excluded from our study.

A total of 49 patients were evaluated according to the inclusion and exclusion criteria following informed written consent by the patients. All patients underwent MR imaging examination using a GE Medical System, Sigma 1.5 T, Sys # GEMSOW MR scanner. Two data acquisitions were planned, one to yield T1 Weighted Images and the other to yield T2 Weighted Images. Scans were taken in axial, coronal and sagittal planes using matrix size of 512x256 and slice thickness of 3mm with 1.5mm interslice gap. Post contrast study using intravenous Gadolinium contrast agent was acquired using T1Weighted-Fat Saturated in all cases. Advanced sequences like diffusion images and inversion recovery images eg. Short Tau Inversion Recovery, were acquired as per case basis.

Spinal tumors were evaluated by primarily classifying them according to the compartments i.e. Intradural extramedullary, Extradural and Intramedullary [4]. All the cases were correlated with histopathological diagnosis. Correlation was also done with per- operative findings in the patients, which were operated upon.

Results

A total of 49 patients including 26 males and 23 females were evaluated.

The youngest patient was a 9-month old infant and the oldest patient was 70 years old. Most patients were in the age group of 21-30 years including 13 patients, closely followed by 41-50 years age group including 12 patients. Majority of male patients were in the age group of 41-50 years whereas maximum females were present in the age group of 21-30 years.

Thoracic spine was the most commonly involved region of spine, with 34 cases appearing in it, followed by lumbar (ten lesions), cervical (nine lesions) and sacrum (six lesions). Ten cases had multiple vertebral level involvements. These were primarily nerve sheath tumors (four neurofibromas and three schwannomas) along with two cases of metastasis. No lesion was seen involving the coccyx.

Thirty cases were diagnosed as intradural extramedullary followed by extradural lesions including fifteen patients. Only four cases were diagnosed as primary intramedullary lesions.

Histopathologically the most commonly found lesions were nerve sheath tumors (twenty-five patients), including thirteen neurofibromas and twelve schwannomas. Vertebral metastasis, were the next most commonly diagnosed lesions. Five cases of meningiomas were detected and two cases of astrocytomas were diagnosed. Chordoma, osteoclastoma, lymphoma and hemangioblastoma contributed one case each.

Nerve sheath tumors were present most commonly in the third decade with about three fourths of these tumors presenting before 40 years of age. Maximum number of vertebral metastasis was present in 5^{th} decade in our study.

Magnetic resonance imaging done at High Tesla was successful in effectively defining the size, shape and position of tumor along with accurate localization of particular compartment of tumor and thecal sac impingement.

Table 1: Vertebral Level of Lesions

	No. of cases	Male	Female
Cervical	9	5	4
Thoracic	34	20	14
Lumbar	10	6	4
Sacral	6	2	4
Coccyx	0	0	0

Table 2: Histological Types of Spinal Tumors

	Number
Nerve Sheath Tumors	25
Schwannomas	12
Neurofibromas	13
Vertebral metastasis	13
Meningioma	5
Astrocytoma	2
Chordoma	1
Osteoclastoma	1
Lymphoma	1
Hemangioblastoma	1

Figure 1: Location of Spinal Tumors

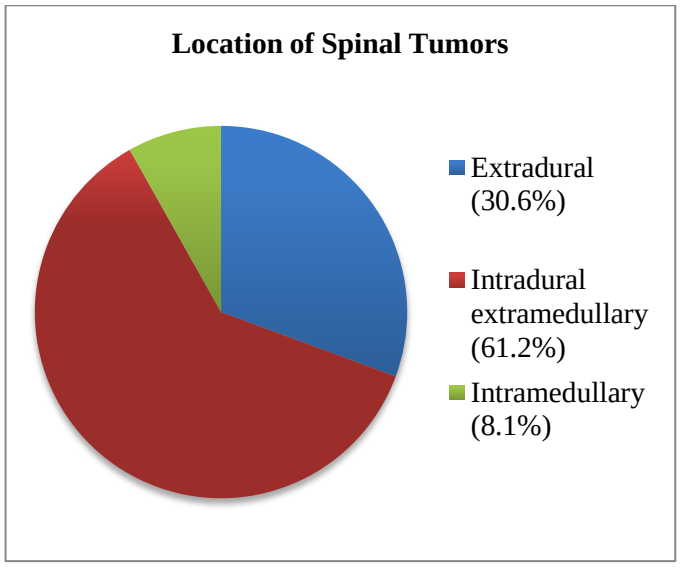


Figure 2: Age Related Distribution of Spinal Tumors

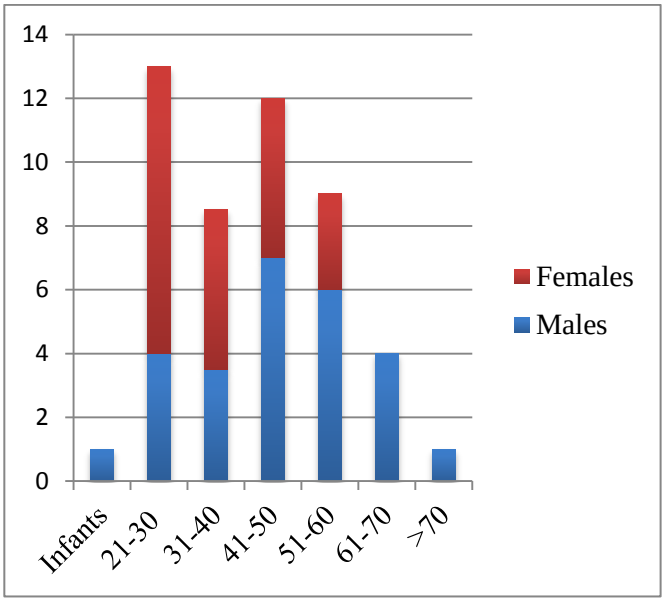


Figure 3: Histological Types of Spinal Tumors

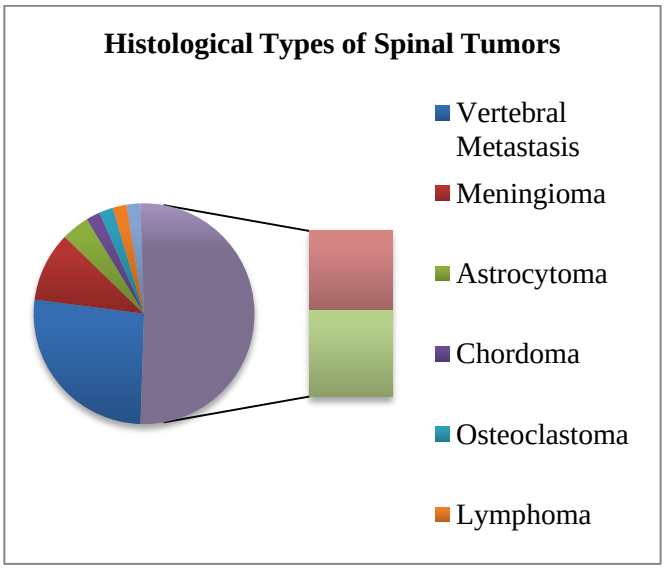
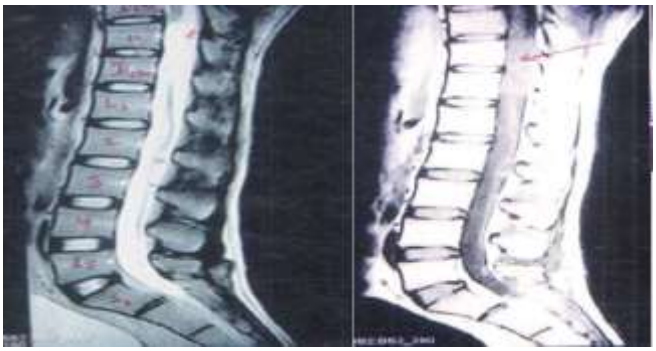


Figure 4: Sagittal T2Wi & T1WI showing an Intradural Extramedullary Lesion appearing Hyperintense on T2 and Hypointense on T1 at D11/12 vertebral body level. Biopsy showed a Schwannoma



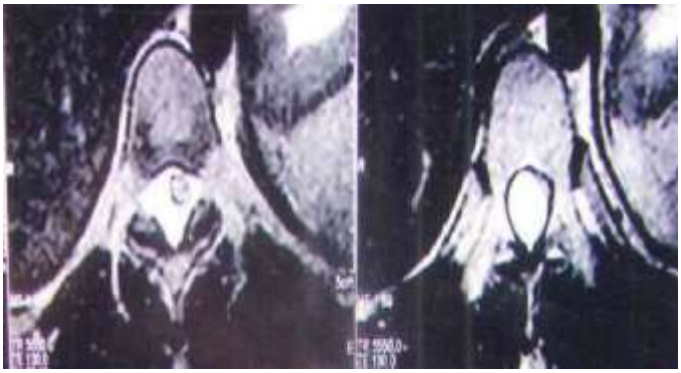


Figure 5: Sagittal T1 & T2 Post Contrast images showing T1

Figure 6: Post Contrast T1W Sagittal and Coronal Images showing an Oval shaped Cystic Lesion with a Cenral Necrotic Nidus. Histopathology showed a Hemangioblastoma

Figure 7: A 37-year-old male patient. Sagittal T2W & T1WIs showing Collapsed D7 Vertebral body with Altered Signal Intensity area in D9 & D11 Vertebrae. Biopsy showed Metastasis from an Adenocarcinoma Primary

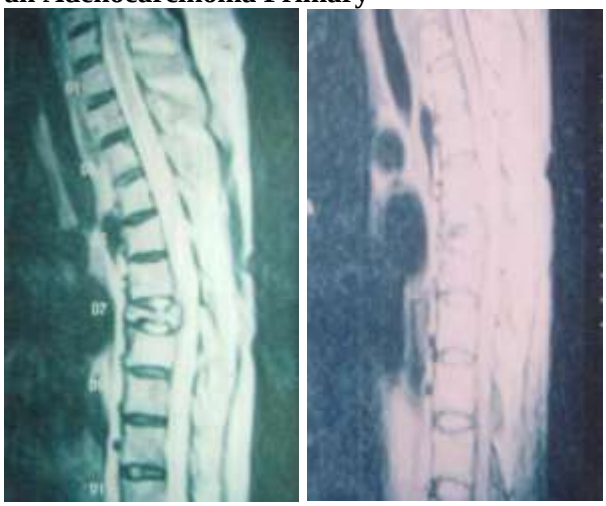
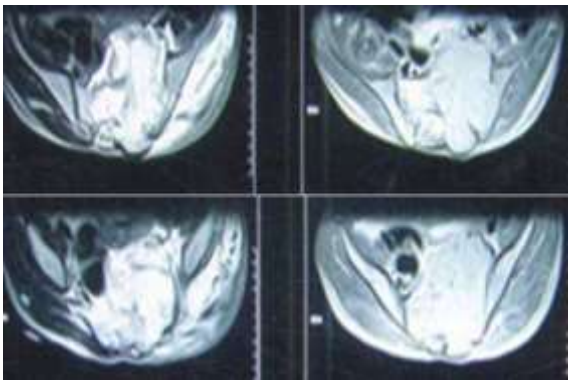


Figure 8: Sagittal & Axial T1W & T2W images showing a Large Expansile Lytic lesion involving Sacrum, more towards left side also Involving Soft Tissue. It appears Heterogeneously Hyperintense on T2WIs. Biopsy showed a Giant Cell Tumor



Discussion

Evaluation of spinal tumors has been a problem area for many decades. Robert et al in 1988 & Thomas et al in 1991 separately reported that the single largest group of spinal tumors is that of intradural extramedullary tumors [5,6]. Nitter et al had done a review study of 4885 adult spinal cord tumors and found that schwannomas were the most common lesions accounting for 23% of lesions, followed by meningiomas (22%) and intramedullary glial tumors (13.2%) [1]. Gautier et al [7] in their study regarding clinical aspects of spinal neurofibromatosis found nerve sheath tumors to be the most prevalent of the spinal tumors. In our study also we found that intradural extramedullary tumors constituted the majority of our primary tumors amounting to 30 out of 49 cases with nerve sheath tumors forming a major part of 25 tumors. The imaging features useful for formation of diagnosis in case of spinal tumors were intensity characteristics of the lesions, incidence of tumor in the compartment, multiplicity of lesion, level of vertebral column involvement and age & sex distribution of the tumor.

Out of total of forty-nine cases forty-seven cases were correctly diagnosed including the differential diagnoses. In twenty- six cases two provisional diagnoses were kept. A maximum of only two differential diagnoses were considered for any particular case. In two cases we completely failed to diagnose the histological type of tumor, although we had correctly localized them. They were quite rare tumors, one being an intradural extramedullary lymphoma in a 9-month old infant and the other being an intramedullary schwannoma.

In the extradural compartment of the fifteen cases studied thirteen were metastasis. One case each of sacral chordoma and osteoclastoma was seen. Twelve of the thirteen cases of metastasis showed multiple level involvements. Multilevel involvement was the primary feature in the favor of the diagnosis. Sacral chordoma presented as a destructive soft tissue lesion involving the last three sacral segments. The site of the lesion was the major factor in helping form the diagnosis with scarum being the most common site for chordomas. Osteoclastoma also presented as a sacral lesion in a young patient and showed absence of calcification. Osteoclastomas of spine though rare lesions but are present most commonly in sacrum [8,9].

Thirty cases were seen in the intradural extramedullary compartment. Eighteen cases of nerve sheath tumors were seen and eleven cases of meningiomas. Both of these lesions were part of the differential diagnosis for each other with twelve cases having the wrong first provisional diagnosis. This difficulty in exact diagnosis was because of overlapping features of both of these lesions and very few differentiating features. The features favoring the diagnosis of nerve sheath tumors are multiplicity of lesions, lumbar and sacral locations, anterior location within the spinal canal, central area of hypointensity on T2 weighted images and absence of calcifications. These features were in concordance with other authors [10-13]. A rare case of intradural extramedullary lymphoma was also seen in this compartment.

Only four primary intramedullary tumors cases were seen. Two of these lesions came out to be astrocytomas with one case each of hemangioblastoma and intramedullary schwannoma. Ependymomas form the major differential for astrocytomas [14,15,2,16-18].

Irrespective of the radiological or histopathological diagnosis, thecal sac impingement was correctly delineated in all the cases.

Magnetic resonance imaging was efficient in successfully defining the exact compartment, size,

shape and extent of the tumors. Although the exact histopathological diagnosis was not established in all our cases, MRI was successful in directing towards the correct differential diagnosis in all but two of our cases. MRI uses multiplanar imaging, high soft tissue contrast and advanced scanning techniques for establishing the correct diagnosis. Retrospectively we can also suggest that MRI done at 1.5T was extremely helpful in surgical planning of the tumors. We would like to conclude by saying that magnetic resonance imaging at a high tesla scanner i.e. 1.5T or higher should be advised in all patients of suspected spinal tumors.

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