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Diagnostic accuracy of MRI in the detection of intradural extramedullary spinal tumors

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Abstract

Background: The majority of intradural spinal tumors are extramedullary accounting for 40% of all spinal tumors with meningiomas and nerve sheath tumors being the most frequent.

Objective: To determine the diagnostic accuracy of MRI in the detection of intradural extramedullary spinal tumors taking histopathology as gold standard.

Methodology: This study comprised of 140 patients with clinical suspicion of intradural extramedullary spinal tumor. MRI was performed. The cases were operated and histopathological results were recorded. The results of MRI and histopathology were compared taking histopathology as gold standard.

Results: Out of 140 patients, 96 patients (68.6%) had an extramedullary tumor on MRI. After comparison of results of MRI with histopathology, the sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of MRI were 99%, 95.5%, 97.9%, 97.9% and 97.7% respectively.

Conclusion: MRI is a highly accurate, non-invasive, safe and convenient imaging modality for the evaluation of intradural spinal tumors and is valuable for early detection, planning management and guiding surgical biopsies.

Keywords: Extramedullary tumors; Intradural spinal tumors; Magnetic resonance imaging.

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Introduction

Spinal tumors are uncommon lesions but may cause significant morbidity in terms of limb dysfunction [1]. These account for 15% of all central nervous system tumors, with an incidence of 0.5 to 2.5 cases per 100,000 population. Defining the location of tumors and mass lesions of the spine in relation to the spinal cord and the dura is of the utmost importance as certain types of lesions tend to occur in certain locations. The differential diagnostic considerations, treatment and prognosis of these various lesions vary according to location of the mass lesions [2].

Intradural tumors can be divided into extramedullary and intramedullary tumors [3]. They are rare and the majority is extramedullary accounting for 40% of all spinal tumors [2] with meningiomas and nerve sheath tumors being the most frequent, making up for about 90% of all extramedullary intradural tumors [1]. Intramedullary tumors are uncommon spinal tumors accounting for 5 to 10% of all spinal tumors [2]. Astrocytomas and ependymomas comprise the majority of intramedullary tumors together making up for about 95% of all intramedullary tumors [1].

Myelography is a valuable but invasive procedure for the diagnostic evaluation of spinal cord lesions [4,5]. Neither the presence nor the absence of abnormal findings on plain film imaging, CT or CT myelography can exclude or sufficiently delineate and characterize an intradural tumor [3]. Magnetic resonance imaging is a non-invasive technique which has revolutionized the diagnosis of intraspinal tumors allowing for early detection and improved anatomical localization. It plays an integral role in evaluation of spinal tumors with increasing role in staging and treatment [6].

Contrast material and multi-planar imaging have broadened the use of magnetic resonance imaging with respect to imaging capabilities and pathophysiologic characterization [2]. Enhancement of tumors in the central nervous system is a common finding. In the spinal cord contrast enhancement has been shown in all tumor types, regardless of grade. However the absence of enhancement does not imply the absence of tumor [7]. Magnetic resonance imaging is 96.4% sensitive and 83.3% specific for the diagnosis of intradural spinal tumors [8].

The use of magnetic resonance imaging for the evaluation of spinal lesions has become the standard of care in locations where this modality is sufficiently available [2]. The rationale of performing this study is to assess the diagnostic accuracy of magnetic resonance imaging in intradural spinal tumors so as to consider it as a valuable, non-invasive, safe and convenient imaging modality for early detection of intradural spinal tumors in our setting.

Methodology

This study was carried out at the Department of Diagnostic Radiology, Ganga Ram Hospital, Lahore. It was cross-sectional survey.

Sample size: The calculated sample size was 140 cases, with 13% margin of error, 95% confidence level, taking expected percentage of intradural spinal tumors i.e. 50% with sensitivity and specificity of magnetic resonance imaging in the diagnosis of intradural spinal tumors i.e. 96.4% and 83.3%.

Study duration: 2 years.

Sample technique: Non-probability: purposive sampling.

Inclusion criteria:

- Age 10 to 70 years.
- Both genders.
- Patients with clinical suspicion of intradural spinal tumor such as neck pain, backache, quadriplegia, or paraplegia referred by neurosurgeon.

Exclusion criteria:

- Patients having contraindication to magnetic resonance imaging including those with cardiac pacemakers, prosthetic heart valves, cochlear implants, brain aneurysm clips or coil confirmed by medical record.
- Post-operative patients of intradural spinal tumors confirmed by medical record to exclude residual or recurrent intradural spinal tumors.
- Patients of other known primary malignant tumors such as lung carcinoma, breast carcinoma, malignant melanoma, renal cell carcinoma, colorectal carcinoma, lymphoma and medulloblastoma diagnosed by the referring doctor on the basis of history and investigations and confirmed by medical record to exclude metastatic intradural spinal tumors.
- Patients with spinal trauma confirmed by history and medical record.

Data collection

All patients presenting with clinical suspicion of intradural spinal tumor referred by neurosurgeons from outdoor of Sir Ganga Ram Hospital, Lahore meeting the inclusion criteria were taken. Patients with residual, recurrent or metastatic intradural spinal tumors and spinal trauma were excluded from the study to avoid confounding variables. Informed consent for magnetic resonance imaging and histopathology from all the patients included in the study was taken. All the patients were recorded for their demographic features i.e. age, gender and address. Magnetic resonance imaging on a 1.5-T Philips whole body MR system using standard imaging coil was then be carried out. T2-weighted and both unenhanced and contrast-enhanced T1-weighted images in the sagittal and axial projections were obtained. Magnetic resonance imaging diagnosis i.e. presence or absence of intradural spinal tumor and other magnetic resonance imaging findings i.e. compartment and location were recorded. The cases were operated and histopathological results were recorded. The results of magnetic resonance imaging and histopathology were compared taking histopathology as gold standard. All this information was collected through a specially designed proforma which is attached here with.

Data analysis

All the data was analyzed with SPSS version 10. The variables included age, gender, magnetic resonance imaging diagnosis i.e. presence or absence of intradural spinal tumor and histopathological result. For quantitative data i.e. age, mean and standard deviation were calculated. For qualitative data i.e.

gender, magnetic resonance imaging diagnosis i.e. presence or absence of intradural spinal tumor and histopathological result, frequencies and percentages were calculated. A 2x2 table was used to calculate sensitivity, specificity, positive predictive value, negative predictive value and accuracy of magnetic resonance imaging for intradural spinal tumors taking histopathology as gold standard.

Results

The detail of results is given in Tables 1-10.

Table 1: Distribution of subjects by gender of intradural extramedullary spinal tumors (n = 96).

Compartment	Male		Female		Total	
	N=	%age	N=	%age	N=	%age
Extramedullary	38	39.6	58	60.4	96	100
Total	38	39.6	58	60.4	96	100

Table 2: Distribution of subjects by location of intradural extramedullary spinal tumors (n = 96).

Location	Male		Female		Total	
	N=	%age	N=	%age	N=	%age
Cervical	18	18.75	18	18.75	36	37.5
Dorsal	18	18.75	30	31.25	48	50.0
Lumbosacral	02	2.1	10	10.4	12	12.5
Total	38	39.6	58	60.4	96	100.0

Table 3: Distribution of subjects by MRI diagnosis (n = 140).

MRI diagnosis	N=	%age
Neurofibroma	38	27.2
Schwannoma	28	20.7
Meningioma	30	21.4
Ependymoma	16	12.1
Astrocytoma	08	5.7
Haemangioblastoma	02	1.4
Lymphoma	06	4.3
Caries spine	06	4.3
Plasmacytoma	04	2.9
Total	140	100.0

Table 4: Distribution of subjects by diagnosis of intradural extramedullary spinal tumors (n = 96).

Diagnosis	Male		Female		Total	
	No.	%age	No.	%age	No.	%age
Neurofibroma	20	20.8	18	18.75	38	39.55
Schwannoma	12	12.5	16	16.7	28	29.2
Meningioma	06	6.25	24	25.0	30	31.25
Total	38	39.55	58	60.45	96	100.0

Table 5: Distribution of subjects by age of intradural extramedullary spinal tumors (n = 96).

Age (years)	Neurofibroma		Schwannoma		Meningioma		Total	
	No.	%age	No.	%age	No.	%age	No.	%age
10-20	02	2.1	0	0.0	0	0.0	02	2.1
21-30	04	4.2	0	0.0	0	0.0	04	4.2
31-40	16	16.6	24	25.0	10	10.4	50	52.0
41-50	14	14.6	02	2.1	20	20.8	36	37.5
51-60	02	2.1	0	0.0	0	0.0	02	2.1
61-70	0	0.0	02	2.1	0	0.0	02	2.1
Total	38	39.6	28	29.2	30	31.2	96	100.0
Mean ± SD	39.47 ± 9.68		39.21 ± 6.65		42.07 ± 4.30		40.21 ± 7.43	

Table 6: Distribution of subjects by location of neurofibromas (n = 38).

Location	Male		Female		Total	
	N=	%age	N=	%age	N=	%age
Cervical	08	21.05	08	21.05	16	42.1
Dorsal	12	31.6	06	15.8	18	47.4
Lumbosacral	0	0.0	04	10.5	04	10.5
Total	20	52.65	18	47.35	38	100.0

Table 7: Distribution of subjects by location of schwannomas (n = 28).

Location	Male		Female		Total	
	N=	%age	N=	%age	N=	%age
Cervical	10	35.7	04	14.3	14	50.0
Dorsal	0	0.0	06	21.4	06	21.4
Lumbosacral	02	7.2	06	21.4	08	28.6
Total	12	42.9	16	57.1	28	100.0

Table 8: Distribution of subjects by location of meningiomas (n = 30).

Location	Male		Female		Total	
	N=	%age	N=	%age	N=	%age
Cervical	0	0.0	06	20.0	06	20.0
Dorsal	06	20.0	18	60.0	24	80.0
Lumbosacral	0	0.0	0	0.0	0	0.0
Total	06	20.0	24	80.0	30	100.0

This study was conducted on 140 patients with clinical suspicion of intradural spinal tumor for a period of six months in the Department of Diagnostic radiology, Sir Ganga Ram Hospital, Lahore with collaboration of neurosurgical unit. Out of 140 patients, 122 patients (87.2%) had intradural spinal tumor on MRI while 18 patients (12.8%) had no intradural spinal tumor on MRI.

Out of the 122 patients who had an intradural spinal tumor on MRI, 96 patients (68.6%) had an extramedullary spinal tumor. After comparison of results of MRI with histopathology, the sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of MRI were 99%, 95.5%, 97.9%, 97.9% and 97.7% respectively.

Table 9: Distribution of subjects by histopathology diagnosis (n = 140).

Histopathology diagnosis	N=	%age
Neurofibroma	38	27.1
Schwannoma	28	20.0
Meningioma	30	21.4
Ependymoma	16	11.4
Astrocytoma	08	5.7
Haemangioblastoma	02	1.4
Lymphoma	07	5.1
Caries spine	06	4.3
Plasmacytoma	04	2.9
Dermoid	01	0.7
Total	140	100.0

Table 10: Comparison of MRI and Histopathology (n = 140).

MRI	Histopathology (Gold Standard)		Total
	Positive	Negative	
Positive	95 (TP)	02 (FP)	97
Negative	01 (FN)	42 (TN)	43
Total	96	44	140

Sensitivity=99%, Specificity =95.5%, Diagnostic Accuracy=97.9%, Positive Predictive value= 97.9%, Negative Predictive value= 97.7%.

Discussion

Intradural spinal tumors comprise a wide spectrum of tumors due to different compartments and locations in the spinal canal. Accurate preoperative diagnosis helps in the correct decision making for the optimal surgical management of the patient [13]. Magnetic resonance imaging is a non-invasive and safe imaging modality which has revolutionized the diagnosis of intradural spinal tumors allowing for early detection and improved anatomical localization. It plays an integral role in evaluation of spinal tumors with increasing role in staging and treatment [6]. One of the most significant impacts of magnetic resonance imaging has been its ability to exquisitely depict normal and pathologic anatomy of the spine. Direct acquisitions acquired in multiple planes coupled with the ability to study the spine with different T1- and T2-weighted images have enabled critical assessment of the spinal cord and its surroundings not previously available to the medical imaging specialist. The development of contrast media has further extended the capability of MR imaging of the spinal cord by improving its sensitivity [12]. With the advent of MRI, it has been easier to diagnose these lesions preoperatively accurately [13].

Intradural spinal tumors can be divided into extramedullary and intramedullary tumors. Intradural extramedullary tumors originate within the dura but outside the actual spinal cord and are located within the subarachnoid space. Intramedullary tumors arise from the spinal cord itself and are typically characterized by expansion of the cord [2]. Intradural extramedullary spinal tumors are realatively frequent neoplasms [14].

In this study, out of the 122 patients with an intradural spinal tumor, 96 patients (68.6%) had an intradural extramedullary tumor this is in agreement to literature findings which state that extramedullary tumors make up 80% of intradural tumors and intramedullary tumors make up 20% [3]. Out of the 96 patients with an extramedullary spinal tumor, 38 patients (39.55%) had neurofibroma, 28 patients (29.2%) had schwannoma and 30 patients (31.25%) had meningioma. These results are in agreement to literature findings which state nerve sheath tumors (neurofibromas and schwannomas) as being the most common intradural extramedullary spinal tumors and meningiomas and nerve sheath tumors together making up for about 90% of all intradural extramedullary tumors [1]. In a review by Beall et al [2] neurofibromas were reported to be the most common type of nerve sheath tumors which is the case in this study.

Out of the 96 intradural extramedullary tumors, 36 (37.5%) were located in the cervical region, 48 (50%) in the dorsal region and 12 (12.5%) in the lumbosacral region. The results of this study are consistent with the study by Lohani and Sharma [13] who reported in their study that intradural extramedullary tumors were common at both cervical and thoracic regions. Out of the 38 neurofibromas, 16 (42.1%) were located in the cervical region, 18 (47.4%) in the dorsal region and 4 (10.5%) in the lumbosacral region. Van Goethem et al [1] reported neurofibromas to be most often seen in the cervical or lumbar region followed by the dorsal region.

All the patients with intradural spinal tumors in this study demonstrated contrast (Gadolinium-DTPA) enhancement on post-contrast images. Parizel et al [10]. Reported contrast enhancement of all the intradural spinal tumors in their study. This contrast enhancement also supports the observations of Dillon et al [9], Chamberlain et al [12] and Sze et al [11,15] in that all of the intramedullary spinal tumors in their studies became enhanced after administration of gadolinium contrast material. Intramedullary tumors enhance with contrast media due to breakdown of blood-cord barrier [10]. Intradural extramedullary tumors enhance due to the permeability of open gap junctions between endothelial cells composing blood vessels thus facilitating the movement of Gd-DTPA from vascular to extracellular space [16,17].

In the present study, on comparison of results of MRI with histopathology taken as gold standard, out of 140 patients, 95 patients were true positive, 42 patients were true negative while 2 patients were false positive and one patient was false negative. The overall sensitivity of MRI was 99%, specificity 95.5% and diagnostic accuracy 97.9% while the positive predictive value of MRI was 97.9% and its negative predictive value was 97.7%. These results are very close to results of other studies. In a study by De Verdelhan et al [11], MRI was reported to have a sensitivity of 96.4%, specificity of 83.3%, positive predictive value of 87.1% and a negative predictive value of 95.7%. The diagnostic accuracy was reported to be 92% in this study. In a study by Pourissa et al [18], the sensitivity of MRI for diagnosis of intradural spinal tumors was reported to be 94%. This shows that MRI has a high sensitivity, specificity and diagnostic accuracy in the detection of intradural spinal tumors, therefore, it is doubtlessly the best imaging modality for evaluating intradural spinal tumors.

Conclusion

MRI is a highly accurate, non-invasive, safe and convenient imaging modality for the evaluation of intradural spinal tumors and is valuable for guiding surgical biopsies thereby decreasing unnecessary intervention.

References

1. Van Goethem JW, van den Hauwe L, Ozsarlak O, De Schepper AM, Parizel PM, et al. Spinal tumors. Eur J Radiol. 2004; 50: 159-176.

2. Beall DP, Googe DJ, Emery RL, Thompson DB, Campbell SE, Ly JQ, et al. Extramedullary intradural spinal tumors: A pictorial review. Curr Probl Diagn Radiol. 2007; 36: 185-98.

3. Abul Kasim K, Thurnher MM, Mckeever P, Sundgren PC. Intradural spinal tumors: Current classification and MRI features. Neuroradiology. 2008; 50: 301-314.

4. Akbar A. Myelography in spinal disorders - experience of 1400 cases. J Pak Med Assoc. 2004; 54: 604-609.

5. Rizwi SMR, Salahuddin T, Naseem A. Myelography & its diagnostic aspects. Pak Postgrad Med J. 2003; 14: 48-50.

6. Bloomer CW, Ackerman A, Bhatia RG. Imaging for spine tumors and new applications. Top Magn Reson Imaging. 2006; 17: 69-87.

7. White JB, Miller GM, Layton KF, Krauss WE. Non enhancing tumors of the spinal cord. J Neurosurg Spine. 2007; 7: 403-407.

8. De Verdelhan O, Haegelen C, Carsin-Nicol B, Riffaud L, Amlashi SF, Brassier G, et al. MR imaging features of spinal scwannomas and meningiomas. J Neuroradiol. 2005; 32: 42-49.

9. Dillon WP, Norman D, Newton TH, Bolla K, Mark A. Intradural spinal cord lesions: Gd-DTPA-enhanced MR imaging. Radiology. 1989; 170: 229-237.

10. Parizel PM, Balériaux D, Rodesch G, Segebarth C, Lalmand B, Christophe C, et al. Gd-DTPA-enhanced MR imaging of spinal tumors. Am J Roentgenol. 1989; 152: 1087-1096.

11. Sze G, KrolG, Zimmerman RD, Deck MD. Intramedullary disease of the spine: Diagnosis using gadolinium-DTPA enhanced MR imaging. Am J Roentgenol. 1988; 151: 1193-1204.

12. Chamberlain MC, Sandy AD, PressGA. Spinal cord tumors: Gadolinium-DTPA-enhanced MR imaging. Neuroradiology. 1991; 33: 469-474.

13. Lohani B, Sharma MR. Patterns of spinal tumors in Nepal: A clinico-radiological study. Nepal J Neurosci. 2004; 1: 113-119.

14. Albanese V, Platania N. Spinal intradural extramedullary tumors. Personalexperience. J Neurosurg Sci 2002; 46: 18-24.

15. Sze G, Bravo S, Krol G. Spinal lesions: Quantitative and qualitative temporal evolution of gadopentetatedimeglumine enhancement in MR imaging. Radiology. 1989; 170: 849-856.

16. Long DM. Vascular ultrastructure in human meningiomas and schwannomas. J Neurosurg. 1973; 38: 409-419.

17. Watabe T, Azuma T. T1 and T2 measurements of meningiomas and neuromas before and after Gd-DTPA. Am J Neuroradiol. 1989; 10: 463-470.

18. Pourissa M, Refahi S, Dehghan MH. Report and review of spinal cord tumors. Res J Biol Sci. 2007; 2: 654-657.