

Diagnostic Accuracy of MRI in the Detection of Intradural Intramedullary Spinal Tumors

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ABSTRACT

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

Methodology: This study comprised of 140 patients with clinical suspicion of intradural spinal tumor. Magnetic resonance imaging on a 1.5-T Philips whole body magnetic resonance system was performed. The cases were operated and histopathological results were recorded. The results of magnetic resonance imaging and histopathology were compared taking histopathology as gold standard.

Results: Out of 140 patients, 122 patients (87.2%) had an intradural spinal tumor, out of which 26 patients (18.6%) had an intramedullary tumor on MRI. After comparison of results of MRI with histopathology, the sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of magnetic resonance imaging were 96.2%, 98.2%, 97.9%, 92.6% and 99.1% 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.

Key Words: Intradural Intramedullary tumors, Magnetic resonance imaging

INTRODUCTION

Spinal tumors are uncommon lesions but may cause significant morbidity in terms of limb dysfunction.¹ They 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

Investigations include plain X-ray film, myelography, CT, MRI and needle biopsy.³ Magnetic resonance imaging is the best imaging modality for evaluating most spinal tumors.⁴ It easily allows tumors to be classified as extradural, intradural extramedullary or intramedullary which is very useful in tumor characterization.⁵

Myelography is a valuable but invasive procedure for the diagnostic evaluation of spinal cord lesions.^{7,8} 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.⁶ 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.⁹

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

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 herewith.

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).

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, Lahore General Hospital, Lahore with collaboration of neurosurgical units of Lahore General Hospital, Lahore.

On comparison of results of MRI with histopathology taken as gold standard, out of 140 patients, 25 patients were true positive, 112 patients were true negative, 02 patients, false positive and one patient was false negative. The sensitivity of MRI was 96.2%, specificity 98.2%, diagnostic accuracy 97.9%, positive predictive value 92.6% and negative predictive value 99.1%.

DISCUSSION

In the present study, on comparison of results of MRI with histopathology taken as gold standard, out of 140 patients, 25 patients were true positive, 112 patients were true negative while 2 patients were false positive and one patient was false negative. The overall sensitivity of MRI was 96.2%, specificity 98.2% and diagnostic accuracy 97.9% while the positive predictive value of MRI was 92.6% and its negative predictive value was 99.1%. These results are very close to results of other studies. In a study by De Verdelhan et al¹⁰, 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 al¹⁸, 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.

All the patients with intradural spinal tumors in this study demonstrated contrast (Gadolinium-DTPA) enhancement on post-contrast images. Parizel et al¹² reported contrast enhancement of all the intradural spinal tumors in their study. This contrast enhancement also supports the observations of Dillon et al¹¹, Chamberlain et al¹⁴ and Sze et al^{13,15} 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.¹² 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}

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. It easily allows tumors to be classified as intradural extramedullary or intramedullary which is very useful in tumor characterization and plays an integral role in early detection, planning management and estimating patient's prognosis.

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Table 1: Distribution of subjects by gender of intradural intramedullary spinal tumors (n = 26)

Compartment	Male		Female		Total	
	No.	%age	No.	%age	No	%age
Intramedullary	16	61.5	10	38.5	26	100.0
Total	16	61.5	10	38.5	26	100.0

Table 2: Distribution of subjects by location of intradural intramedullary spinal tumors (n = 26)

Location	Male		Female		Total	
	No.	%age	No.	%age	No.	%age
Cervical	08	30.75	02	7.7	10	38.45
Dorsal	02	7.7	04	15.4	06	23.1
Lumbosacral	06	23.05	04	15.4	10	38.45
Total	16	61.5	10	38.5	26	100.0

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

MRI diagnosis	Number	Percentage
Neurofibroma	38	27.2
Schwannoma	28	20.0
Meningioma	30	21.4
Ependymoma	16	11.4
Astrocytoma	08	5.7
Haemangioblastoma	02	1.4
Lymphoma	06	4.3
Caries spine	08	5.7
Plasmacytoma	04	2.9
Total	140	100.0

Table 4: Distribution of subjects by diagnosis of intradural intramedullary spinal tumors (n = 26)

Diagnosis	Male		Female		Total	
	No.	%age	No.	%age	No.	%age
Ependymoma	12	46.1	04	15.4	16	61.5
Astrocytoma	04	15.4	04	15.4	08	30.8
Haemangioblastoma	0	0.0	02	7.7	02	7.7
Total	16	61.5	10	38.5	26	100.0

Table 5: Distribution of subjects by age of intradural intramedullary spinal tumors (n = 26)

Age (years)	Ependymoma		Astrocytoma		Hemangio-blastoma		Total	
	No.	%age	No.	%age	No.	%age	No.	%age
10-20	02	7.7	0	0.0	0	0.0	02	7.7
21-30	10	38.4	06	23.1	0	0.0	16	61.5
31-40	04	15.4	02	7.7	02	7.7	08	30.8
41-50	0	0.0	0	0.0	0	0.0	0	0.0
51-60	0	0.0	0	0.0	0	0.0	0	0.0
61-70	0	0.0	0	0.0	0	0.0	0	0.0
Total	16	61.5	08	30.8	02	7.7	26	100.0
Mean $\pm$ SD	26.50 $\pm$ 6.95		29.25 $\pm$ 4.35		35.00		28.00 $\pm$ 6.24	

Table 6: Distribution of subjects by location of ependymomas (n = 16)

Location	Male		Female		Total	
	No.	%age	No.	%age	No.	%age
Cervical	04	25.0	0	0.0	04	25.0
Dorsal	02	12.5	0	0.0	02	12.5
Lumbosacral	06	37.5	04	25.0	10	62.5
Total	12	75.0	04	25.0	16	100.0

Table 7: Distribution of subjects by location of astrocytomas (n = 8)

Location	Male		Female		Total	
	No.	%age	No.	%age	No.	%age
Cervical	04	50.0	02	25.0	06	75.0
Dorsal	0	0.0	02	25.0	02	25.0
Lumbosacral	0	0.0	0	0.0	0	0.0
Total	04	50.0	04	50.0	08	100.0

Table 8: Distribution of subjects by location of haemangioblastoma (n = 2)

Location	Male		Female		Total	
	No.	%age	No.	%age	No.	%age
Cervical	0	0.0	0	0.0	0	0.0
Dorsal	0	0.0	02	100.0	02	100.0
Lumbosacral	0	0.0	0	0.0	0	0.0
Total	0	0.0	02	100.0	02	100.0

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

Histopathology diagnosis	Number	Percentage
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 for intradural intramedullary tumors (n = 140)

MRI	Histopathology (Gold Standard)		Total
	Positive	Negative	
Positive	25 (TP)	02 (FP)	27
Negative	01 (FN)	112 (TN)	113
Total	26	114	140

Sensitivity=96.2%, Specificity =98.2%,
 Diagnostic Accuracy=97.9%
 Positive Predictive value= 92.6%
 Negative Predictive value= 99.1%