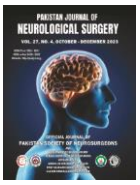

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Original Research

Radiological Verses Histological Evaluation of Spinal Space Occupying Lesions

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ABSTRACT

Objective: This study set out to evaluate radiology's diagnostic capacity in accurately establishing a preliminary working diagnosis for various spine tumor types.

Materials and Methods: This is a prospective study carried out and examined patients who had surgical resection with the collection of histopathology samples, regardless of age or gender. A full MRI examination from every angle and contrast-enhanced pictures were required. Inclusion criteria consisted of Patients of all ages of both genders, who underwent surgery a tissue sample was collected for histopathological diagnoses, and a complete MRI study with all views and contrast-enhanced images was available to give a preliminary diagnosis.

Results: Based on the evaluation by the senior radiologists, the lesions were most commonly intradural-extramedullary (50%) in position according to the dura, followed by intramedullary in 14 (26.9%) patients. Despite our series having a total of 16 misdiagnosed cases, the overall diagnostic accuracy of the MRI remained high at 69.2%.

Conclusion: MRI has superior diagnostic accuracy in diagnosing meningiomas as compared to nerve sheath tumors such as meningiomas. It also has good predictive accuracy of intramedullary lesions such as ependymomas.

Keywords: Metastasis, Spinal Canal Stenosis, Intradural-Extramedullary Lesions, Ependymoma, Astrocytoma, Schwannoma.

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INTRODUCTION

The diverse composition of the spinal cord with multitudes of ascending and descending tracts consisting of billions of neurons and surrounded

by an even more distinct assortment of layers and structures gives rise to a range of unique lesions each with their distinctive properties manifesting as clinical symptoms, and signs. The location of these lesions within the spinal canal influences the symptomatology, however, there is a considerable overlap, owing to the tight space within the canal with little room for a foreign lesion to grow. Therefore, spinal tumors usually present quite early on with indications of compression and/or invasion with timely management taking utmost priority to prevent irreversible neurological deficit.

Intramedullary lesions provide a varied and patchy heterogeneous enhancement, but intradural-extramedullary lesions, such as those caused by meningiomas and schwannomas, typically yield a uniform contrast enhancement. It's reasonable to state that MRI can accurately anticipate a significant portion of these lesions because there are additional characteristics that also aid in distinguishing all of these distinct lesions from one another. Nevertheless, tissue diagnosis—which is acquired following surgical excision or debulking—is the real diagnostic. Given that the lesion is infiltrative, predicting the type based on imaging may aid in appropriately counseling and preparing the patient for the operation, including the possibility that some residual illness may be left behind.

Lesions involving the bony structure of the spinal canal usually present with pain. Metastasis is the most common entity.[1] If the bony lesions lead to spinal canal stenosis and compression of the neural elements then radiculopathy and/or myelopathy ensues. The same principle applies to intradural, extramedullary, and intramedullary lesions. Intradural-extramedullary lesions present predominantly with nighttime pain and radicular symptoms typically early on in the course of the disease. Compression leads to myelopathic symptoms over time dominated by motor weakness and/or sphincter disturbances, quoted as being 20% and 12% respectively.[2,3] The literature review gives variable accounts as to which lesion is predominant in this location, some citing meningioma being the commonest, whereas some say that schwannoma takes precedence.[4-6] Approximately, 80 – 90% of the intramedullary spinal cord lesions consist of ependymoma and astrocytoma, with astrocytoma being more common in the pediatric population and ependymoma in the adult population [7.] Patients complain of a vague, dysesthetic type of pain which becomes persistent over time and neurological deficits are quick to appear.

MRI is accurately considered the diagnostic gold standard for spinal lesions providing exquisite details and helping delineate different types of lesions.[8] The majority of the lesions appear isointense to hypointense on T1-weighted images and hyperintense on T2-weighted images. However, it is the pattern of contrast enhancement that gives a better idea of the type of the etiology. Intradural Extramedullary lesions like schwannoma and meningioma usually give a homogenous contrast enhancement while intramedullary lesions give a variable and patchy heterogenous enhancement. There are certain other features as well that help differentiate all these various lesions from one another and it is safe to say that MRI can easily predict a big chunk of these lesions. However, the true diagnosis is tissue diagnosis which is obtained after surgically excising/debulking. Predicting the type based on radiology might help in properly counseling and preparing the patient on what to expect from the surgery, including the chances of leaving some residual disease due to the infiltrative nature of the lesion. It might also be useful in planning to properly and efficiently manage time to minimize the chances of neurological deficit and have a chance at a better outcome. Therefore, the objective of this study was to assess the diagnostic potential of radiology in correctly providing a preliminary working diagnosis of different types of tumors of the spine.

MATERIALS AND METHODS

Study Design & Setting

This is a prospective study carried out at Jinnah Post-graduate Medical Center, Karachi from 1st August 2021 to 28th November 2022. A predesigned proforma was used to collect demographic data, clinical symptoms and signs, radiological assessment, and histopathological diagnoses of the patients.

Inclusion Criteria

Patients of all ages and both genders who underwent surgical resection with histopathological sample collection were included in this study. Complete MRI study with all views and contrast-enhanced images were prerequisites.

Exclusion Criteria

Patients who were either not operated on or those whose tissue sample was inadequate to make a diagnosis or was not representative of the lesion were excluded. Patients undergoing surgery for recurrent lesions and those having contraindications to getting an MRI were also not included in the study.

Data Collection/Clinical History and Examination

The presenting complaints of the patients were documented such as backache, radiating pain, lower or upper limb weakness, etc. A detailed examination was done to evaluate for neurological deficits and upper or lower motor neuron signs. Statistical analysis was done using SPSS version 22.

Radiological Evaluation

MRI in different sequences and cuts were examined and the general characteristics of the lesions such as Spinal location, level, and position within the vertebral column (i.e. bone, extradural, intradural extramedullary, and intramedullary) were documented. Then specific characteristics of the lesion, such as intensity signals on different sequences, presence or absence of contrast enhancement along with the pattern and certain features typical to various lesions were evaluated. These included the involvement of the neural foraminae, absence or presence of dural tail, cord dilatation, etc. A preliminary diagnosis based on these radiological parameters was made.

Histopathological Evaluation

After surgical intervention, a tissue diagnosis was made of the lesion which was then compared with the preliminary radiological diagnosis and it was ascertained whether a strong radiological and histopathological correlation was present.

RESULTS

Age and Gender

During the study, fifty-two patients with spinal space-occupying lesions were operated on and included in the study, with half (26) being male and half (26) female. Five patients not meeting the study criteria were excluded. The mean age of the patients was 31.25 ± 17.1.

Clinical Presentation and Location

Pain (either back or neck pain) was present in all the patients and was according to the location of the lesion. This was followed in frequency by motor deficit which was seen in 41 (78.8%), in which lower limb weakness alone was the most common (65.3%; n = 34), and urinary sphincter involvement (78.8%, n = 41). Incontinence was more common (48.1%, n = 25) than retention (13.8%, n = 16). The sensory deficit was seen in 28 (53.8%) patients and radicular pain in 20 (38.5%). Tenderness at the site of the lesion was present in very few individuals (13.5%, n = 7). The lesions were most commonly seen in the dorsal spine

(51.9%, n = 27) in our study, followed by the lumbar spine (23.1%, n = 12). Table 1 summarizes the demographical characteristics of the study population as well as the presenting symptomatology and signs.

Table 1: Demographics and clinical symptomatology (n=52).

Variables	Frequency (Percentage)
Gender	
Male	26 (50%)
Female	26 (50%)
Age Groups	
<10 years	6 (11.5%)
>10 – 18 years	6 (11.5%)
>19 – 30 years	16 (30.8%)
> 31 – 50 years	16 (30.8%)
> 50 years	8 (15.4%)
Clinical Presentation	
Motor deficit	41 (78.8%)
Sensory deficit	28 (53.8%)
Radicular pain	20 (38.5%)
Sphincter dysfunction	41 (78.8%)
Location	
Cervical	4 (7.7%)
Cervicodorsal	3 (5.8%)
Dorsal	27 (51.9%)
Dorsolumbar	5 (9.6%)
Lumbar	12 (23.1%)
Lumbosacral	1 (1.9%)
Sacral	0 (0%)

Radiological Evaluation

Based on the evaluation by the senior radiologists, the lesions were most commonly intradural extramedullary (50%; n = 26) in position according to the dura, followed by intramedullary in 14 (26.9%) patients. The radiological diagnosis is shown in Table 2.

Table 2: Radiological diagnoses of different spinal lesions (n = 52).

Diagnosis	Frequency (Percentage)
Meningioma	11 (21.2%)
Ependymoma	11 (21.2%)
Schwannoma/Neurofibroma	7 (13.5%)
Tuberculoma/Abscess	6 (11.5%)
Astrocytoma	5 (9.6%)
Arachnoid Cyst	3 (5.8%)
Plasmacytoma/Multiple myeloma	2 (3.8%)
Lymphoma	2 (3.8%)
Dermoid	1 (1.9%)
Metastasis	1 (1.9%)
Neuroblastoma	1 (1.9%)
Giant cell tumor	1 (1.9%)
Inconclusive	1 (1.9%)

The following radiological parameters were evaluated and a preliminary diagnosis was made, which is described in Table 3.

Table 3: Radiological parameters evaluated to reach a preliminary radiological diagnosis

	Meningioma	Schwannoma	Ependymoma	Astrocytoma	AC	MM	Lymphoma	NB	Mets	Dermoid
Position										
Bone	0	0	0	0	0	1	0	0	0	0
ED	0	4	0	0	1	1	2	0	0	0
IDEM	11	2	4	0	1	0	0	0	1	1
IM	0	0	7	5	1	0	0	0	0	0
ED + ID	0	1	0	0	0	0	0	1	0	0
T1										
Hyperintense	0	0	0	0	0	0	0	0	0	0
Isointense	9	2	7	3	1	1	0	1	0	1
Hypointense	2	5	4	2	2	1	2	0	1	0
Mixed	0	0	0	0	0	0	0	0	0	0
T2										
Hyperintense	6	6	8	4	3	1	2	1	1	1
Isointense	2	0	0	0	0	0	0	0	0	0

Hypointense	3	0	2	0	0	0	0	0	0	0
Mixed	0	1	1	1	0	1	0	0	0	0
Contrast										
Homogenous	10	5	3	1	0	0	1	0	0	0
Heterogenous	1	2	8	4	0	2	1	1	1	0
None	0	0	0	0	3	0	0	0	0	1
Broad-Based										
Present	9	0	1	0	1	0	0	0	0	0
Absent	2	7	10	5	2	2	2	1	1	1
Cysts										
Present	0	0	6	1	3	0	0	1	0	1
Absent	11	7	5	4	0	2	2	0	1	0
Dural Tail										
Present	8	1	0	0	0	0	0	0	0	0
Absent	3	6	11	5	3	2	2	1	1	1
Foraminal Widening										
Present	1	6	1	0	0	1	2	1	1	0
Absent	10	1	10	5	3	1	0	0	0	1
Cord Dilatation										
Present	0	0	7	4	1	0	0	0	0	0
Absent	11	7	4	1	2	2	2	1	1	1

Key: AC – Arachnoid cyst; MM – Multiple Myeloma; NB – Neuroblastoma; Mets – Metastasis; ED – Extradural; IDEM – Intradural extramedullary; IM – Intramedullary; ID – Intradural**.**

Correlation between Radiological and Histopathological Diagnoses

Radiologically, 11 lesions were diagnosed as being meningiomas. Histopathology proved that 9 (81.8%) of these tumors were correctly diagnosed preoperatively, one of the remaining lesions proved to be a schwannoma and the other lesion was a giant cell tumor. Out of the 11 lesions preoperatively diagnosed as ependymoma, 8 (72.7%) were correctly diagnosed. The remaining three lesions were diagnosed as a neurofibroma, simple cyst, and infective lesion. Preliminary diagnoses of 5 (71.4%) out of 7 schwannomas/neurofibromas were proven to be accurate. The remaining two were histopathologically diagnosed as ganglioglioma and a case of fibrous dysplasia. Only 2 (40%) of the 5 radiologically diagnosed cases of astrocytomas were accurate. Two were histopathologically identified as neurofibroma, while in the remaining case, the biopsy was inconclusive. Table 4 summarizes the above-mentioned findings in a tabulated form.

Table 4: Total no of diagnosed and misdiagnosed cases.

Radiological Diagnosis	Total Number	Diagnosed	Misdiagnosed	Percentage
Meningioma	11	9	Schwannoma, Giant Cell tumor	81.8%
Ependymoma	11	8	Schwannoma, Cyst, Infective lesion	72.7%
Schwannoma	7	5	Ganglioglioma, Fibrous dysplasia	71.4%
Tuberculoma	6	3	Metastasis, Metastasis, Inconclusive	50%
Astrocytoma	5	2	Neurofibroma, Neurofibroma, Inconclusive	40%
Arachnoid Cyst	3	3	-	100%

Despite our series having a total of 16 misdiagnosed cases, the overall diagnostic accuracy of the MRI remained high at 69.2%.

Table 5: Radiological parameters of correctly diagnosed and radiologically misdiagnosed cases of Meningioma.

MRI Characteristics	Diagnosed	Misdiagnosed
T1 Weighted Image		
Hyperintense	0	0
Isointense	7	2
Hypointense	2	0
T2 Weighted Image		
Hyperintense	6	0
Isointense	2	0
Hypointense	1	2
Contrast Enhancement		
Homogenous	8	2
Heterogenous	1	0
Patchy	0	0
None	0	0
Broad-based		
Present	8	1
Absent	1	1
Dural Tail		
Present	7	1
Absent	2	1
Cystic		
Present	0	0
Absent	9	2

Table 6: Radiological parameters of correctly diagnosed and radiologically misdiagnosed cases of Ependymoma.

MRI Characteristics	Diagnosed	Misdiagnosed
T1 Weighted Image		
Hyperintense	0	0
Isointense	6	1
Hypointense	2	2
T2 Weighted Image		
Hyperintense	6	2
Isointense	0	0
Hypointense	1	1
Mixed	1	0
Contrast Enhancement		
Homogenous	3	0
Heterogenous	5	3
Patchy	0	0
None	0	0
Cord Expansion		
Present	5	2
Absent	3	1
Cysts		
Present	5	1
Absent	3	2

COMPARISON OF LESIONS

Meningioma was identified radiologically in 11 patients (21.2%), with a broad base present in 9 patients and absent in 2, cysts absent in 11 patients and present in none, a dural tail present in 8 patients and absent in 3, foramen widening present in 1 and absent in 10, and cord dilatation absent in 11. Histopathology confirmed meningioma in 9 (81.8%) of the cases. A large base was present in 1 and absent in 10, a cyst was present in 6 and absent in 5, a dural tail was present in none and absent in 11, foramen widening was present in 1 and absent in 10, cord dilatation was present in 7 and absent in 4. Histopathology confirmed 8 accurate diagnoses (72.2%).

A large base was present in none and absent in seven, cysts in none and absent in seven, a dural tail in one and absent in six, foramen narrowing in six and absent in one, and cord dilatation in zero and absent in seven. Histopathology indicated the presence of 5 (71.4%) appropriately identified schwannomas. Astrocytoma was found in 5 (9.6%) of the cases, with broad-base present in none and absent in 5, cysts present in 1 and absent in 4, dural tail present in 0 and absent in 5, foramen narrowing present in none and absent in 5, cord dilatation present in 4 and absent in 1. Histopathology proved 2(40%) correctly diagnosed.

The biopsy of the remaining lesion was inconclusive. In our investigation, the overall diagnostic accuracy of MRI in accurately interpreting spinal lesions was 69.2%. An examination of the literature confirms this, revealing a comparable accuracy of 69.8%.

DISCUSSION

The overall diagnostic accuracy of MRI in correctly interpreting the lesions of the spine in our study was 69.2%. A literature review supports this showing a similar accuracy of 69.8%.[9] Individual tumors and their radiological-histopathological correlation are discussed below.

Meningioma

Meningiomas represent one of the most common spinal tumors ranging from 25 – 45% in frequency.[10,11] They are benign, slow-growing lesions that present early on owing to the tight space within the spinal canal which leads to compressive effects on the adjacent neural structures. As with all meningiomas, the female preponderance precedes the male gender by a ratio of 4:1.[12] Meningiomas have a very distinctive look on magnetic resonance imaging, having well-defined demarcated margins and shape. Their location is intradural and extramedullary in over 90% of the cases[13,14] and the majority of the lesions manifest in the thoracic spine.[13,15,16] This was re-demonstrated in our study where 6 out of 9 meningiomas were located purely in the dorsal spine, one in the cervicodorsal region, one in the cervical spine, and the last lesion in the lumbar spine.

Meningiomas mostly give isointense to hypointense signals on MRI T1 weight images and isointense to slightly hyperintense signals on MRI T2 weighted images as seen in the literature.[9,17] In our study, 7 histopathologically proven meningiomas were isointense on the T1 weighted image and 2 were hypointense, which is in accordance with the norms. Two lesions which were misdiagnosed radiologically as meningiomas but later proved to be other lesions histopathologically, were isointense on T1 weighted images. On T2 weighted images, histopathologically proven meningiomas appeared hyperintense in 6 cases, isointense in 2 cases, and hypointense in 1 case. In contrast, two lesions radiologically misdiagnosed as meningiomas appeared hypointense on T2 weighted images. All of the 11 lesions radiologically clustered as meningiomas had contrast enhancement, which was homogenous in 10 cases and heterogenous in 1. Out of these, the two misdiagnosed cases also had homogenous contrast enhancement. Literature also supports the homogenous contrast enhancement that is characteristic of a typical meningioma [9.] Table 5 summarizes these findings (please see the results section above).

The presence of a dural tail is significant for radiological diagnosis of a meningioma, present in approximately 60 – 70% of meningiomas.[9, 18,19] This was demonstrated in our study as well where 7 out of 9 meningiomas (63.6%) had an associated dural tail. The two misdiagnosed cases also had features that were consistent with the finding seen in a meningioma such as either having a dural tail, broad base, or homogenous enhancement, which led to the lesions being misdiagnosed. The overall diagnostic accuracy of MRI for meningiomas was 81.8% in our series. In a separate research conducted in Ethiopia, only 30.8% were correctly diagnosed as meningioma.[20] All of the cases of suspected meningioma in our study were intradural extramedullary in concordance with other research,[21,22] however in another study by Santos et al, the intradural intramedullary location was predominant.[23]

Schwannomas

Nerve sheath tumors are the main differentials considered for spinal intradural extramedullary lesions alongside meningiomas. The age range at diagnosis is between 40 – 60 years with no specific gender predilection [24]. In our study, however, the mean age of the patients having schwannoma was 27.8 years with the age range between 20 – 40 years of age. As seen with meningiomas, these lesions also exhibit isointense to hypointense signals on T1-weighted imaging and hyperintensity on T2-weighted

images.[9] In our study, 4 out 5 biopsy-proven schwannomas were hypointense and 1 lesion was isointense in T1 weighted images, whereas, 4 lesions were hyperintense on T2 weighted images and 1 lesion was giving mixed hyperintense to isointense signals. The two misdiagnosed lesions were also either hypointense or isointense on T2 and both were hyperintense on T2 weighted images, which resembled the normal schwannoma appearance. This, along with the contrast enhancement was responsible for wrongly attributing this appearance to a schwannoma. One of the lesions was histopathologically proven to be a ganglioglioma, whereas the other one was fibrous dysplasia. 4 of the correctly radiologically diagnosed schwannomas had homogenous contrast enhancement, whereas in one lesion, the enhancement was heterogeneous.

An important feature that can help delineate a schwannoma from a meningioma is foraminal widening, with or without dumb bell-shaped morphology.[25,26] The foraminal widening was present in 4 out of 5 schwannomas. It was present in both misdiagnosed cases as well, which again contributed to wrongly diagnosing the lesions as schwannoma radiologically. None of the lesions were broad-based and only one lesion exhibited a dural tail, which helped differentiate them from meningiomas.

Ependymoma

Spinal ependymomas are essentially intramedullary lesions, which arise from the ependymal cell lining of the central canal. They tend to displace the tracts and the MRI appearance is of a dilated and expanded cord.[27,28] Another feature is the presence of tumoral and non-tumoral cysts which are seen in 22% and 62% of cases respectively [9,28]. These can cause signal changes otherwise typical pattern of T1 iso- to hypointensity and T2 hyperintensity.[9] 8 out of 11 lesions were correctly diagnosed as ependymomas and were iso- to hypointense on T1 and mostly hyperintense on T2 (one lesion had mixed signals while another was hypointense). The misdiagnosed lesions also showed similar patterns as depicted in Table 6 displayed in the results section above.

5 out of 8 lesions should solid cum cystic appearance and one misdiagnosed also had cysts present. In 5 out of 8 ependymomas, cord dilatation was also present. Most of the spinal ependymomas, enhance strongly with contrast, but the pattern is somewhat heterogeneous [9]. The spinal ependymomas in this study all showed contrast enhancement, mostly heterogeneous. The enhancement was also heterogenous in all three misdiagnosed lesions. One of these misdiagnosed lesions was an intramedullary schwannoma, which was isointense on T1 and hypointense on T2 without the presence of cysts or cord expansion. These lesions pose great difficulty in differentiating from other intramedullary lesions.[29]

Astrocytoma

In contrast to spinal ependymomas which originate from the central canal, astrocytomas tend to be more eccentric within the cord parenchyma.[30] Owing to their direct origin from astrocytes and poorly demarcated margins, gross total resection of these lesions is a challenge. In comparison to ependymomas, these lesions exhibit 20% intratumoral and 15% peritumoral cysts.[9] As with most neoplasms, they appear iso- to hypointense on T1 weighted sequences and hyperintense on T2 weighted sequences. There is patchy contrast enhancement present and cord expansion spanning a few levels is typical. The pattern of signal intensity in our study was the same as in the literature. None of the two astrocytomas demonstrated cysts. In one lesion, cord expansion was present. Most of the lesions were radiologically misdiagnosed and turned out to be Neurofibromas in two cases histologically.

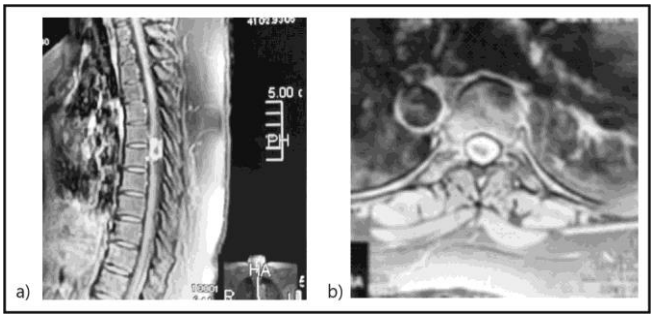

Figure 1: Thoracic magnetic resonance imaging of an adult patient who had presented with complaints of severe backache for the past 1 month. The patient had also developed bilateral lower limb weakness with urinary retention with urge incontinence. There was no history of any other comorbidities or malignancy. The tuberculosis contact history was negative. There were no associated systemic symptoms or fever. **(a)** Sagittal contrast-enhanced T1 weighted images show a ring-enhancing lesion at the D7 and D8 vertebral level which is intramedullary in location. (**b)** In this axial section of the contrast-weighted imaging, the lesion doesn't appear to be causing any cord dilatation with a heterogeneous pattern of enhancement. The lesion was suspected to be an intramedullary metastatic lesion owing to the pattern of enhancement. However, the metastatic workup was still pending. He underwent near-total resection and spinal cord decompression. Histopathology confirmed the lesion to be an intramedullary tuberculoma.

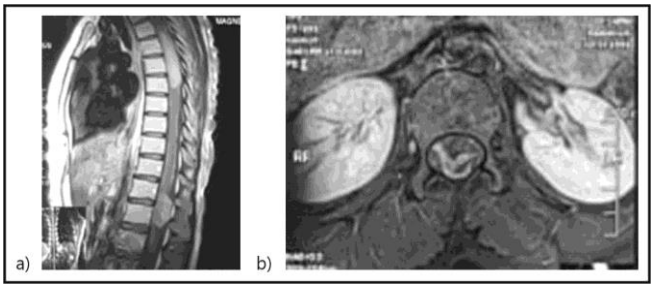

Figure 2: A patient in their 30s presented in our outpatient department with a history of backache and progressive lower limb weakness for the past 6 months. The patient was also unable to perceive any sensations in the lower limbs bilaterally. Magnetic resonance imaging was done which showed **(a)** two separate homogenously contrast-enhancing lesions in the dorsal spine. The lesions are intramedullary in location with associated cord expansion and syrinx formation. **(b)** The axial images better depict the patchy contrast uptake by the lesion. Surgical excision was done of both the lesions and histopathological diagnoses of Grade II ependymoma were made, correlating with the radiological diagnosis.

Tuberculoma

Intradural extramedullary and intramedullary tuberculomas of the spine are rare with only a few reported incidences.[31] They usually present as a ring-enhancing lesion, with metastasis being the top differential diagnosis. Two of the six suspected metastatic lesions, turned out to be meningioma, whereas in one lesion the biopsy was inconclusive. Three cases were correctly interpreted radiologically as Tuberculomas.

CONCLUSION

MRI is undoubtedly a powerful tool for radiologically interpreting the histopathological nature of spinal lesions. Routine use of MRI in the evaluation and management planning of these lesions takes utmost precedence. MRI has superior diagnostic accuracy in diagnosing meningiomas as compared to nerve sheath tumors such as meningiomas. It also has good predictive accuracy of intramedullary lesions such as ependymomas. However, Astrocytomas were often incorrectly diagnosed. The main limitation of this study is the small sample size and larger studies evaluating a higher number of spinal lesions are recommended.

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REFERENCES

1. Lewandrowski KU, Anderson ME, McLain RF. Tumors of the Spine. In: Herkowitz HN, Garfin SR, Eismont FJ, Bell GR, Balderston RA, et al., editors. Philadelphia: Elsevier Saunders; 2011: pp. 1480–1512.
2. Jeon JH, Hwang HS, Jeong JH, Park SH, Moon JG, Kim CH. Spinal schwannoma; analysis of 40 cases. Journal of Korean Neurosurgical Society. 2008;43(3):135.

3. Jellema K, Van Overbeeke JJ, Teepen HL, Visser LH. Time to diagnosis of intraspinal tumors. European journal of neurology. 2005;12(8):621-4.
4. Ruggeri AG, Fazzolari B, Colistra D, Cappelletti M, Marotta N, Delfini R. Calcified spinal meningiomas. World Neurosurg. 2017;102:406–412.
5. Westwick HJ, Shamji MF. Effects of sex on the incidence and prognosis of spinal meningiomas: a Surveillance, Epidemiology, and End Results study. J Neurosurg Spine 2015;23(3):368–373.
6. Koeller KK, Shih RY. Intradural extramedullary spinal neoplasms: radiologic-pathologic correlation. Radiographics. 2019;39(2):468-90.
7. Azad TD, Jiang B, Bettegowda C. Molecular foundations of primary spinal tumors-implications for surgical management. Ann Transl Med. 2019;7(10):222.
8. Davies AM, Cassar-Pullicino VN. Principles of detection and diagnosis. Imaging of Bone Tumors and Tumor-Like Lesions: Techniques and Applications. 2009:111-37.
9. Asilturk M, Abdallah A, Sofuoglu E. Radiologic–Histopathologic correlation of adult spinal tumors: A retrospective study. Asian Journal of Neurosurgery. 2020;15(02):354-62.
10. Weber C, Gulati S, Jakola AS, Habiba S, Nygaard ØP, Johannesen TB, Solheim O. Incidence rates and surgery of primary intraspinal tumors in the era of modern neuroimaging: a national population-based study. Spine. 2014;39(16):E967-73.
11. Duong LM, McCarthy BJ, McLendon RE, Dolecek TA, Kruchko C, Douglas LL, Ajani UA. Descriptive epidemiology of malignant and nonmalignant primary spinal cord, spinal meninges, and cauda equina tumors, United States, 2004-2007. Cancer. 2012;118(17):4220-7.
12. Solero CL, Fornari M, Giombini S, Lasio G, Oliveri G, Cimino C, Pluchino F. Spinal meningiomas: review of 174 operated cases. Neurosurgery. 1989;25(2):153-60.
13. Soderlund KA, Smith AB, Rushing EJ, Smirniotopolous JG. Radiologic-pathologic correlation of pediatric and adolescent spinal neoplasms: Part 2, intradural extramedullary spinal neoplasms. AJR Am J Roentgenol. 2012;198:44-51.
14. Setzer M, Vatter H, Marquardt G, Seifert V, Vrionis FD. Management of spinal meningiomas: Surgical results and a review of the literature. Neurosurg Focus. 2007;23:E14.
15. Voldřich R, Netuka D, Beneš V. Spinal meningiomas: is Simpson grade II resection radical enough? Acta neurochirurgica. 2020;162:1401-8.
16. Birch BD, McCormick PC, Resnick DK. Intradural extramedullary spinal lesions. InSpine Surgery 2005; (pp. 948-960). Churchill Livingstone.
17. De Verdelhan O, Haegelen C, Carsin-Nicol B, et al. MR imaging features of spinal schwannomas and meningiomas. J Neuroradiol. 2005;32(1):42–49.
18. Alorainy IA. Dural tail sign in spinal meningiomas. EurJ Radiol. 2006;60(3):387–391.
19. Goldsher D, Litt AW, Pinto RS, Bannon KR, Kricheff II. Dural "tail" associated with meningiomas on Gd-DTPA enhanced MR images: characteristics, differential diagnostic value, and possible implications for treatment. Radiol. 1990;176(2):447–450.
20. Antonescu CR, Louis DN, Hunter S, Perry A, Reuss DE, Stemmer-Rachamimov AO. Schwannoma. In: Louis DN, Ohgaki H, Wiestler OD, et al, eds. WHO classification of tumours of the central nervous system. Revised 4th ed. Lyon, France: IARC, 2016;214–218.
21. Emel E, Abdallah A, Sofuoglu OE, Ofluoglu AE, Gunes M, Guler B, et al. Long-term surgical outcomes of spinal schwannomas: Retrospective analysis of 49 consecutive cases. Turk Neurosurg. 2017;27:217-25.
22. Mahder Tewodros Bezu, Amal Saleh Nour, Tesfaye Gizaw Tefera, Kibruyisfaw Zewdie shumbash, Mersha Abebe Woldemariam. Preliminary Review Of Spine Tumor Radiologic, Intra-Operative And Histopathology Finding, Addis Ababa, Ethiopia. Ethiop J Health Sci. 2022;32(si1):41.
23. Muraad A, Anas A, Erhan OS. Radiologic-Histopathologic correlation of Adult Spinal Tumors: A Retrospective Study. Asian J Neurosurg. 2020;15(2):354-62.
24. Drashti P, Smita S, Hansa G. Histopathological Study of Primary Spinal Cord Tumor. International Journal of Clinical and Diagnostic Pathology. 2021;4(2);35-38.
25. Santos Junior EC, Dantas F, Caries ACV, Cariri GA, Reis MTD, Botelho RV, et al. Evaluation Of surgically Treated Primary Spinal Cord Tumors In a single Brazillin institution. A Case series study of

104 patients. Cureus. 2022;14(3):e23408.
26. Abul-Kasim K, Thurnher MM, McKeever P, Sundgren PC. Intradural spinal tumors: current classification and MRI features. Neuroradiol. 2008;50(4):301–314.
27. Sofuoğlu ÖE, Abdallah A. Pediatric Spinal Ependymomas. Med Sci Monit. 2018;24:7072-89.
28. Smith AB, Soderlund KA, Rushing EJ, Smirniotopolous JG. Radiologic-pathologic correlation of pediatric and adolescent spinal neoplasms: Part 1, Intramedullary spinal neoplasms. AJR Am J Roentgenol. 2012;198:34-43.
29. Navarro Fernández JO, Monroy Sosa A, Cacho Díaz B, et al. Cervical intramedullary schwannoma: case report and review of the literature. Case Rep Neurol. 2018;10(1):18–24.
30. Seo HS, Kim JH, Lee DH, Lee YH, Suh SI, Kim SY, et al. Nonenhancing intramedullary astrocytomas and other MR imaging features: A retrospective study and systematic review. AJNR Am J Neuroradiol. 2010;31:498-503.
31. Citow JS. Intramedullary Tuberculoma of the spinal cord: Case report. Neurosurg. 1994;35:327-330.

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AUTHORS CONTRIBUTIONS

Sr.#	Author's Full Name	Intellectual Contribution to Paper in Terms of:
1.	Sabika Aftab	1. Study design and methodology.
2.	Rabail Akber	2. Paper writing.
3.	Sabika Aftab	3. Data collection and calculations.
4.	Tanweer Ahmed	4. Analysis of data and interpretation of results.
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