Eduvest – Journal of Universal Studies
Volume 5 Number 8, August, 2025
p- ISSN 2775-3735- e-ISSN 2775-3727

Radiological MRI Images in Spinal Tumor: A Serial Case Report

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ABSTRACT

Spinal cord tumors, though rare, present significant clinical challenges due to their potential to cause severe neurological deficits. These tumors are classified by location as intramedullary, intradural extramedullary, or extradural, each with distinct clinical manifestations. Magnetic Resonance Imaging (MRI) is the gold standard for diagnosing and evaluating these tumors, offering detailed insights into their location, morphology, and compressive effects. This study aims to highlight the diagnostic and therapeutic importance of MRI in managing spinal tumors through a series of three cases. The research employed a case series methodology, analyzing three patients with spinal tumors: an 18-year-old female with a cervical hemangioblastoma, a 42-year-old male with a cervical schwannoma, and a 49-year-old female with metastatic spinal lesions. MRI findings were correlated with clinical symptoms and histopathological results. Key findings demonstrated MRI's superiority in delineating tumor characteristics, such as signal intensity, enhancement patterns, and spinal cord compression, which were critical for surgical planning. All cases underscored the necessity of early detection and intervention, with surgical resection yielding favorable outcomes for benign tumors, while metastatic cases required multidisciplinary palliative care. The study concludes that MRI is indispensable for accurate diagnosis, treatment planning, and improving patient outcomes in spinal tumor management. It also emphasizes the need for a structured approach to evaluating spinal masses based on imaging and clinical correlation.

KEYWORDS Spinal cord tumors, MRI, malignancy, diagnostics

INTRODUCTION

Spinal cord tumors are tumors that develop within the spine or its contents and usually cause symptoms due to involvement of the spinal cord or nerve roots (Dawes L, Knipe H, 2025). The first step in evaluating any spinal mass is to determine its compartment of origin: intramedullary (within the substance of the spinal cord), intradural extramedullary (within the thecal sac but outside the cord), or extradural (outside the thecal sac). Clinical manifestations differ based on tumor location. Extradural tumors tend to grow rapidly, often causing severe and progressive symptoms due to spinal cord

compression, such as spastic *paresis* of the body parts supplied by the spinal cord below the lesion, and eventually bladder and bowel dysfunction. Pain is a common symptom. Intradural extramedullary tumors often arise from around the posterior roots (Srinivas, Shanker and Naleer, 2023).

Early symptoms include radicular pain and *paresthesia*. As the tumor grows, spastic *paresis* may worsen in the lower extremities, and *paresthesia* may appear in both lower limbs, accompanied by sensory disturbances—initially *ipsilateral* and later becoming bilateral. Sensory disturbances usually ascend from the distal ends toward the cranial level, eventually reaching the level of the lesion. Pain can be exacerbated by coughing or sneezing (Wein S, Hacking C, 2024). Clinical manifestations in intradural intramedullary lesions also depend on their location (Gaillard F, Hacking C, 2024). If the lesion is at the cervical level, the patient may experience pain, paresthesia, numbness, or weakness in the lower extremities, often due to compression of corticospinal and dorsal column pathways (Badhiwala et al., 2020). Thoracic lesions are frequently associated with slowly progressive spastic weakness of the lower extremities, typically followed by sensory disturbances such as paresthesia (Payer et al., 2019). Lesions in the lumbosacral region may present with radicular pain, numbness, or weakness in the lower extremities, reflecting involvement of lumbar nerve roots or conus medullaris (Klekamp, 2017). In contrast, lesions affecting the cauda equina can cause back pain, rectal pain, and lower extremity pain, often accompanied by saddle anesthesia and autonomic disturbances including bowel and bladder dysfunction (Choi et al., 2018; Korse et al., 2017). These distinct clinical patterns are crucial for lesion localization and guiding appropriate imaging and management strategies.

Classic syndromes indicating spinal cord lesions include transverse myelopathy, syringomyelia, and myeloradiculopathy, each presenting with distinct neurological deficits depending on the level and extent of spinal cord involvement (Bhat et al., 2021; Karikari et al., 2020). Suspicion of a spinal cord tumor should be confirmed with further investigations such as radiological imaging, given that clinical findings alone are often insufficient for accurate localization (Khan et al., 2019). While plain radiographs may be useful in detecting gross osseous abnormalities, they frequently fail to reveal spinal cord pathology in many cases (Song et al., 2018). Magnetic resonance imaging (MRI) is considered superior to computed tomography (CT) in the evaluation of spinal cord disease due to its enhanced soft-tissue contrast and multiplanar capability (Shin et al., 2021; Aljuboori et al., 2020). Definitive diagnosis of many spinal cord tumors often requires histopathological confirmation through biopsy or complete surgical excision (Safavi-Abbasi et al., 2017; Fehlings et al., 2022).

Management of these tumors also varies according to their location. Intramedullary tumors are treated only with surgical resection. There are no established guidelines regarding postoperative adjuvant chemotherapy or

radiotherapy for these tumors. Intradural extramedullary tumors are the most common benign spinal tumors and can cause symptoms through nerve compression. The treatment of choice is surgical resection. These tumors typically grow slowly and may take years to become symptomatic or to recur. Initial management of extradural lesions usually involves radiotherapy; however, surgical resection is indicated in cases that are undiagnosed, clinically stable with rapidly progressive neurological deficits, associated with spinal column instability, or radioresistant disease (Amadasu, Panther and Lucke-Wold, 2022).

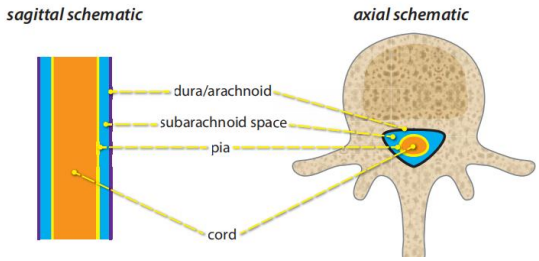

Figure 1. Spinal anatomy

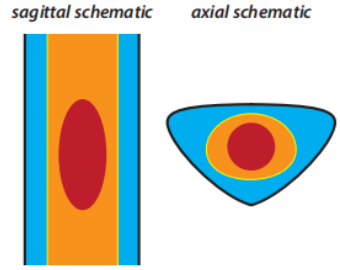

Figure 2. Intradural Intramedullary lesion

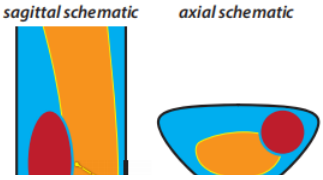

Figure 3. Intradural Extramedullary lesion

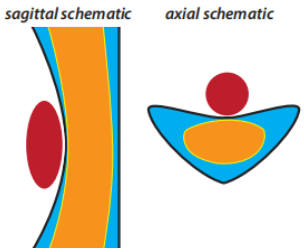

Figure 4. Extradural lesion

(Sun, Shi and Mandell, 2021)

RESEARCH METHOD

This study employed a *case series* research design, focusing on three patients diagnosed with spinal cord tumors to evaluate the role of MRI in diagnosis and management. The research type was qualitative and descriptive, aiming to provide detailed clinical and radiological insights into each case. By analyzing individual patient presentations, imaging findings, and histopathological results, the study highlighted the diagnostic and therapeutic significance of MRI in spinal tumor cases.

The *data population* consisted of patients presenting with spinal cord tumors at a tertiary care hospital, while the *data sample* included three

purposively selected cases representing distinct tumor types: intramedullary hemangioblastoma, intradural extramedullary schwannoma, and extradural metastatic tumor. *Purposive sampling* was used to ensure diversity in tumor location, pathology, and clinical presentation. The primary *research instrument* was MRI scanning, supplemented by clinical records, histopathology reports, and surgical findings. To ensure *validity*, radiological assessments were cross-verified by two independent radiologists, while *reliability* was maintained through standardized imaging protocols and diagnostic criteria.

Data collection involved a retrospective analysis of patient records, MRI images, and histopathology reports. Clinical symptoms, radiological features, and treatment outcomes were systematically documented. *Myelography* and contrast-enhanced MRI were used to assess tumor characteristics and cerebrospinal fluid dynamics. The study adhered to ethical guidelines, ensuring patient confidentiality and informed consent. The integration of clinical, radiological, and pathological data provided a comprehensive evaluation of each case, reinforcing the critical role of MRI in spinal tumor management.

RESULTS AND DISCUSSION

Case Description

Case 1

The patient was 18 y.o female with an initially complaint of intermittent numbness and tingling in the right hand. These symptoms have progressively worsened during 3 months. The patient also told a loss of sensation. Bowel and bladder functions remain normal. No history of trauma was reported. The physical examination and cervical X-ray did not give specific result, therefore, advanced radiological modalities are required

MRI whole spine revealed an intradural intramedullary lesion at the C5-6 level, measuring approximately 0,5 x 0,6 x 0,7 cm, associated with spinal cord expansion and the presence of an intramedullary syrinx extending from C2 to C7, suggestive of spinal hemangioblastoma and from myelography suggest a partial obstruction at Cerebrospinal Fluid (CSF) flow at the level of the lesion. The patient was managed with surgical resection and has a good prognosis. Histopathological examination confirmed the presence of vascular proliferation and atypical cells, suggestive of hemangioblastoma.

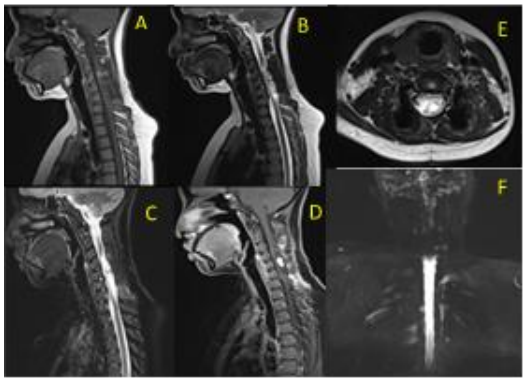

Figure 5. MRI whole spine sagittal and axial results show an intradural intramedullary lesion at the C5 level with syrinx intramedullary. (A) The lesions appear isointense to the spinal cord on T1WI, (B,C) slightly hyperintense on T2WI/STIR, (D, E) demonstrate strong homogeneous contrast enhancement. (F) Myelography MRI show partial obstruction at Cerebrospinal Fluid (CSF) flow.

Case 2

The second case was 42 y.o male with chronic neck pain radiating to the left arm. The pain progressively worsened, and over the past 7 months, he also told weakness in the left arm and leg, causing in an inability to grasp objects with his left hand and difficulty walking. There is a loss of sensation in the left extremities. Bowel and bladder functions are normal. There is no history of trauma. The results from general examination did not give specific result, therefore, patient undergo additional examination.

MRI whole spine revealed an intradural extramedullary lesion at the C2-3 level, measuring approximately 1,8 x 1,2 x 1,9 cm with perifocal edema. suggestive of a spinal schwannoma, along with central disc protrusion and from myelography suggest partial obstruction of cerebrospinal fluid (CSF) flow at the level of the lesion. The patient has undergone surgical resection and the prognosis is favorable. Histopathological examination confirmed a cellular spindle cell tumor, with features suggestive of a cellular schwannoma.

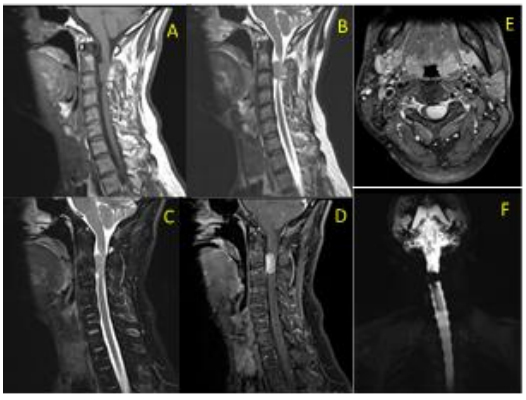

Figure 6. MRI whole spine sagittal and axial showing a solid mass intradural extramedullary at the C2–C3 level with perifocal edema. (A) The mass

appears isointense on T1WI (B,C) slightly hyperintense on T2WI/STIR, (D,E) it shows heterogeneous contrast enhancement. (F) The mass causes partial obstruction of cerebrospinal fluid (CSF) flow.

Case 3

The third patient was a 49 y.o female complained of lower back pain and bilateral lower limb weakness, constipation, and urinary incontinence. There is loss of sensation in the both lower extremities. Patient already done of chemotherapy and radiotherapy for cervical cancer, with a histopathology report confirming adenocarcinoma. From MSCT found heterogeneous solid mass in the cervix. MRI examination revealed extradural lesions at the T7-9 levels, suggestive of metastatic mass. The mass causes grade III spinal canal stenosis and grade III bilateral neural foraminal stenosis, compressing the cauda equina, traversing and exiting nerve roots, and results in partial obstruction of cerebrospinal fluid (CSF) flow at the level of the lesion.

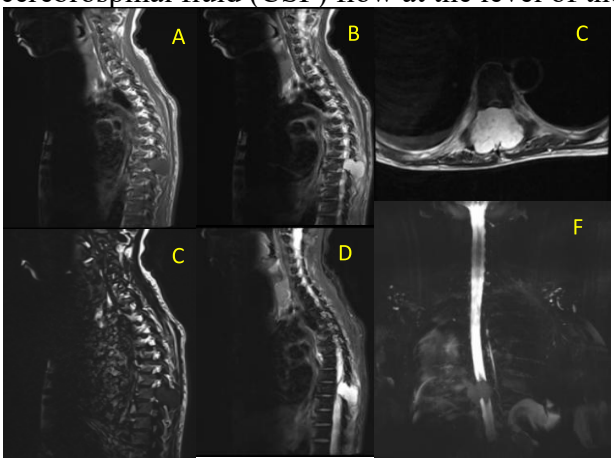

Figure 7. MRI Thoracolumbal sagittal and axial view show an extradural extramedullary mass at the posterior aspect of the vertebral bodies of T7–T9, extending into the epidural space, spinous processes, intradural space, and bilateral neural foramina. (A,C) The mass appears hypointense on T1WI/STIR, (B) hyperintense on T2-weighted images. (D) it show heterogeneous contrast enhancement. (E) Myelography show partial obstruction of cerebrospinal fluid (CSF) flow.

Discussion

Spinal cord tumors present a diagnostic and therapeutic challenge due to the diverse nature of their anatomical compartments, clinical presentations, and pathological types. In this case series, we report three distinct spinal tumor cases, each located in a different anatomical compartment: intramedullary, intradural extramedullary, and extradural. While spinal mass is identified, the following aspects should be evaluated, as they may help narrow the differential diagnosis or have clinical implications (Amadasu, Panther and Lucke-Wold, 2022):

Anatomical location:

- Extradural, intradural-extramedullary, or intramedullary.

- Involved vertebral level (cervical, thoracic, lumbar, sacral).
- Single vs multiple lesions
  Size and extent of the lesion:
- Vertical length of the lesion.
- Infiltration into surrounding structures (e.g., spinal canal, neural foramina, paraspinal soft tissues).
  Radiological characteristics:
- Signal intensity on MRI (T1, T2, STIR, post-contrast).
- Presence of spinal cord edema.
- Enhancement pattern (homogeneous, heterogeneous, rim-enhancing).
- Presence of: hemorrhage, calcification, necrosis.
  Mass effect:
- Compression of the spinal cord or nerve roots.
- Deformation or displacement of the spinal cord.
  Spinal stability:
- Involvement of the vertebral body, pedicles, laminae.
- Presence of pathological fractures or bony destruction.
  Extension into neural foramina / extraspinal component:
- Presence of a dumbbell-shaped tumor (commonly seen in schwannomas).
  Possibility of malignancy:
- Aggressive features such as ill-defined margins, soft tissue invasion, necrosis, or rapid growth.
  Relationship to neurovascular Structures:
- Proximity or involvement of major vessels (e.g., aorta, inferior vena cava).
- Relationship with nerve roots and the spinal cord.
  Others:
- Associated cysts (tumoral, non-tumoral) or syringomyelia.

The first case, an 18-year-old female, had an intradural intramedullary tumor at the C5–C6 level with associated syringomyelia, presenting with progressive numbness and paresthesia in the right hand. This lesion was suggestive of a hemangioblastoma, a rare but highly vascular tumor. MRI was crucial in demonstrating its well-demarcated appearance, spinal cord expansion, and associated syrinx formation. Hemangioblastomas, while rare, should be considered in younger patients with long-standing sensory symptoms and central cord expansion. Surgical resection is the mainstay of treatment with excellent outcomes, as seen in this case.

The second case involved a 42-year-old male with an intradural extramedullary tumor at the C2–C3 level, consistent with a schwannoma. Symptoms included chronic radicular pain and progressive motor weakness. Schwannomas are the most common benign intradural extramedullary tumors and often arise from the posterior spinal nerve roots. MRI showed characteristic imaging features including iso- to hyperintense signal on T1 and T2-weighted sequences with heterogeneous post-contrast enhancement. The presence of perifocal edema and compression of the spinal cord contributed to

the patient's symptoms. Surgical excision typically results in a favorable prognosis.

The third case, a 49-year-old female with a known history of cervical cancer, presented with lower back pain, bilateral lower extremity weakness, and autonomic dysfunction. Imaging revealed an extradural metastatic lesion at the T7–T9 levels causing severe spinal canal and neural foraminal stenosis. This case underscores the importance of considering spinal metastasis in patients with known malignancies presenting with new-onset neurological deficits. The lesion exhibited aggressive features on MRI, including heterogeneous contrast enhancement and vertebral body involvement, consistent with spinal metastasis. Treatment in such cases is often palliative, involving radiotherapy, chemotherapy, and surgical decompression when indicated to relieve spinal cord compression and maintain function.

Across all three cases, MRI with contrast was the most informative imaging modality, offering critical information about lesion location, extent, signal characteristics, contrast enhancement, and CSF flow obstruction. Myelography also played a role in evaluating CSF flow dynamics, particularly in intradural lesions. Histopathological confirmation remains essential for definitive diagnosis and treatment planning.

Proper diagnosis of spinal tumors depends heavily on understanding the compartment of origin, correlating clinical features with radiologic findings, and considering patient history, especially in cases of metastasis. Early detection and prompt surgical intervention in resectable cases yield the best neurological outcomes.

CONCLUSION

This *case series* highlights the clinical and radiological diversity of spinal cord tumors across three anatomical compartments. Accurate diagnosis of spinal tumors relies on correlating clinical presentation with advanced imaging, particularly *MRI*. Surgical resection remains the mainstay of treatment for most resectable lesions, offering favorable prognoses, especially in benign tumors such as *hemangioblastomas* and *schwannomas*. Meanwhile, metastatic spinal lesions, as seen in the third case, require multidisciplinary management, focusing on *palliation* and preservation of neurological function. A structured approach to evaluating spinal masses based on location, imaging features, and patient history is essential for effective management and improved patient outcomes.

Future studies should expand the sample size to include a broader spectrum of spinal tumors, enabling more generalized conclusions about diagnostic and therapeutic approaches. Longitudinal research could assess long-term patient outcomes post-surgery or with adjuvant therapy, particularly for malignant tumors. Additionally, exploring advanced imaging techniques, such as *diffusion tensor imaging* or *MR spectroscopy*, may provide deeper insights into tumor biology and early detection. Comparative studies

evaluating the efficacy of emerging treatments, including targeted therapies and minimally invasive surgical techniques, would further enhance clinical decision-making. Collaborative, multicenter research is recommended to validate findings and establish standardized protocols for spinal tumor management.

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