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ORIGINAL PAPERS

# COMPREHENSIVE ANALYSIS OF INTRADURAL EXTRAMEDULLARY SPINAL TUMORS: INSIGHTS FROM CASES OF CYSTIC SCHWANNOMA AND MENINGIOMA: CASE REPORT

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## ABSTRACT

**Introduction:** Intradural extramedullary (IDEM) spinal tumors represent a crucial focus in neurosurgery due to their potential to pose significant diagnostic and therapeutic challenges. Consequently, their management necessitates careful planning. This study reports and analyzes a series of cases involving IDEM tumors of the spinal cord, specifically cystic schwannoma and meningioma.

**Case presentation:** Case 1: A 28-year-old man presented with intermittent pain radiating to the left thigh without associated numbness. Magnetic resonance imaging (MRI) revealed a complex cystic lesion within the spinal canal at the level of the inferior end plate of L4 to the mid-body of S1, associated with cystic schwannoma. The lesion was completely excised through a surgical procedure, resulting in the complete resolution of the patient's symptoms. Case 2: A 51-year-old woman complained of difficulty walking over the past 2 months and persistent tingling sensations in both legs. MRI imaging indicated the presence of a solid intradural extramedullary mass associated with spinal meningioma at the T6-T7 level. The lesion was entirely removed through a surgical procedure, leading to an improvement of motor strength in both legs.

**Conclusion:** Spinal IDEM tumors, particularly cystic schwannoma and meningioma with thoracolumbar spondylosis, present complex diagnostic and therapeutic challenges. Imaging, especially MRI, supports the diagnosis by delineating the characteristics of the lesions and guiding therapeutic procedures. Careful planning of therapeutic interventions, such as total laminectomy, total laminectomy with arthrodesis, or limited unilateral laminectomy, is essential to minimize the risk of complications.

**Key words:** intradural extramedullary tumors, surgical intervention, cystic schwannoma, spinal meningioma, magnetic resonance imaging

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## INTRODUCTION

Intradural extramedullary (IDEM) spinal tumors can pose significant diagnostic and therapeutic challenges in neurosurgery. A deeper understanding of IDEM tumors is crucial for formulating appropriate diagnostic and therapeutic strategies. IDEM tumors in the spinal cord account for approximately 40% to 60% of the total tumors within the spinal space.[1] There are various types of spinal tumors; among them, schwannoma accounts for 30%, with an incidence rate of approximately 0.3–0.4 cases per 100,000 people annually. Meningioma constitutes 25%, with an incidence rate of around 0.32 cases per 100,000 people annually. Furthermore, other classifications include teratoma, neurofibroma, lipoma, and metastatic tumors.[2] [3] The clinical presentation of IDEM tumors is significantly influenced by the specific location of the tumor within the spinal cord. Common symptoms are predominantly characterized by pain (72%), which can vary from back pain (27%) and radicular pain (25%), to central pain (20%). Motor disturbances follow as the most prevalent presentation symptom (55%), followed by sensory loss (39%) in a dermatomal, saddle, or segmental pattern. [4] Magnetic resonance imaging (MRI) is a widely utilized imaging method that provides anatomical details and facilitates the identification of histological subtypes.[5] [1] In the realm of intricate diagnostic and therapeutic interventions, the management of IDEM tumors requires a multidisciplinary approach and careful planning. This study reports and analyzes a series of cases involving IDEM tumors of the spinal cord,

specifically cystic schwannoma and meningioma. The aim of this study is to provide a deeper understanding of the characteristics, clinical presentations, and management strategies applied to patients with IDEM tumors. Therefore, this study is expected to contribute to the medical literature and offer valuable guidance to neurosurgeons when dealing with similar cases.

## CASE PRESENTATION

### CASE 1

A 28-year-old male patient presented with back pain that occasionally radiates to the left thigh without accompanying numbness. Bowel and bladder functions were within normal limits, and there was no reported erectile dysfunction. On physical examination, the patient's vital signs were within the normal range, including a blood pressure of 118/78 mmHg, a heart rate of 84 beats per minute, a respiratory rate of 20 breaths per minute, an axillary temperature of 36.5°C, and an oxygen saturation of 98% on room air. No signs of anemia or icterus were observed in the head or neck. A chest examination revealed normal cardiovascular conditions. Neurological status using the Glasgow Coma Scale (GCS) scored 456. Motor and sensory examinations at various nerve levels yielded normal results. Physiological reflexes were all normal with scores of +2/+2. Laboratory support examination results were within normal limits. Contrast-enhanced lumbosacral MRI identified a complex cystic lesion within the intraspinal canal. This lesion exhibited well-defined and regular borders, with iso-hypointense signals on T1-weighted images, while on T2-weighted images/T2FS, it displayed hyperintense signals. Signal enhancement occurred in the walls and septae following the administration of contrast. The lesion, located from the inferior end plate of L4 to the mid-body of S1, was associated with the diagnosis of cystic schwannoma. This lesion exerted pressure on the cauda equina nerve roots on both the right and left lateral sides. Additionally, there was suspicious distension of the bladder, indicative of a neurogenic bladder. The patient underwent a series of surgical procedures, including laminectomy, decompression at the L4-L5 level, and tumor excision using appropriate instrumentation. The procedures were conducted by a spine consultant and a senior surgical resident. The lesion was successfully completely excised through the surgical procedure. The patient experienced postoperative symptom improvement with complete resolution of symptoms, including relief from back pain and restoration of normal motor and sensory strength.

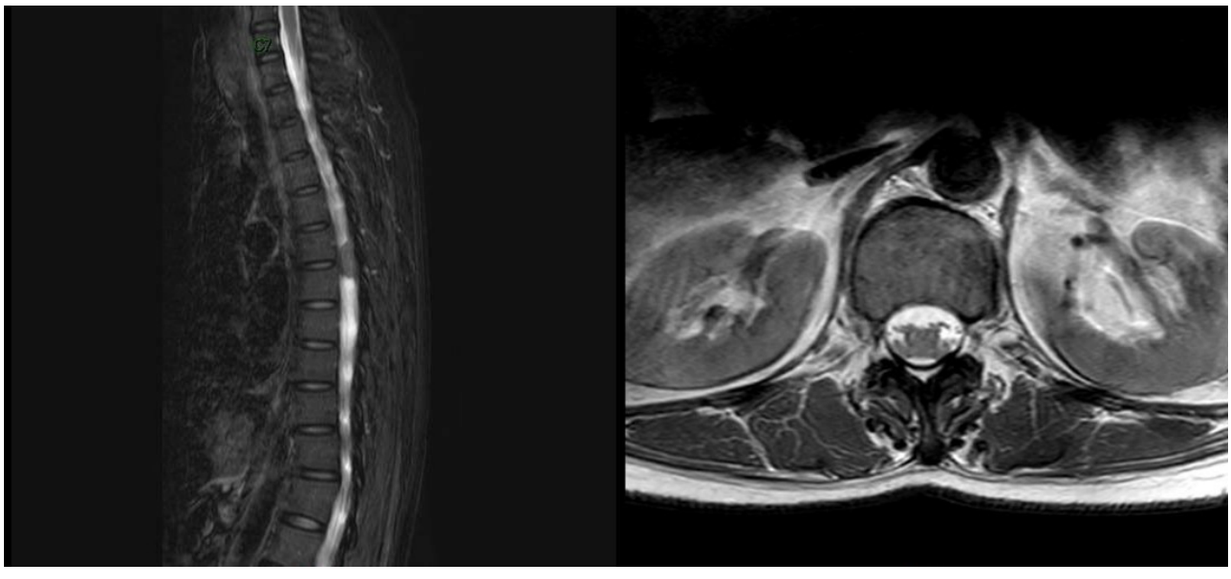

**Figure 1.** Contrast-enhanced lumbosacral MRI identified a well-defined complex cystic lesion in the intraspinal canal from the inferior end plate of L4 to the mid-body of S1. The lesion, diagnosed as cystic schwannoma, exerted pressure on both right and left cauda equina nerve roots. It exhibited iso-hypointense signals on T1-weighted images and hyperintense signals on T2-weighted images/T2FS. Signal enhancement in walls and septae was observed post-contrast administration.

### CASE 2

A 51-year-old woman presented with a complaint of progressive weakness in both lower limbs over the past 3 months. This weakness has been worsening, and the patient has experienced difficulty walking for the last 2 months. Additionally, the patient reported persistent tingling sensations in both legs for the past 3 months. There were no complaints of back pain, fever, vomiting, or seizures. The patient had no history of trauma,

heavy lifting with bending, and bowel and bladder functions were within normal limits. On physical examination, the patient appeared generally well with a blood pressure of 138/74 mmHg, a heart rate of 72 beats per minute, and a respiratory rate of 20 breaths per minute. No signs of anemia or jaundice were observed. The chest examination revealed no abnormalities or lesions, and auscultation of the heart and lungs was within normal limits. The thoracic and abdominal examinations were unremarkable. The patient's neurological status indicated a GCS score of 15. Motor examination revealed weakness in several muscle groups, particularly at the L2-S1 level with a score of 2/1. Physiological reflexes were all normal with scores of +2/+2. Laboratory support examination results were within normal limits. Thoracic MRI with contrast identified a solid mass isointense on T1WI/T2W2/FS/STIR, intensifying post-contrast administration in the intradural extramedullary region associated with spinal meningioma at the T6-T7 level and exhibiting a dural tail sign. This condition led to compression of the spinal cord and myelum edema. A hyperintense lesion on T1WI/T2W1 at the corpus 7 was observed, consistent with Modic II changes. Mild spinal canal stenosis occurred at the T10-T11 level, with disc protrusion, thoracic spondylosis, a straight spine, and degeneration at the T11-T12 level, corresponding to Pfirrman IV. Based on these findings, the patient was diagnosed with chronic progressive paraparesis, of the inferior UMN type, attributed to suspected spinal meningioma and thoracolumbar spondylosis. The patient underwent a series of surgical procedures, including laminectomy at the T6-T7 level with tumor excision. The procedure was performed by a spine consultant and a senior surgical resident. The lesion was successfully completely excised through the surgical procedure. The patient experienced postoperative symptom improvement with an increase in motor strength in both legs. There was an improvement in the muscle strength score in several muscle groups, particularly at the L2-S1 level, with a score of 3/4.

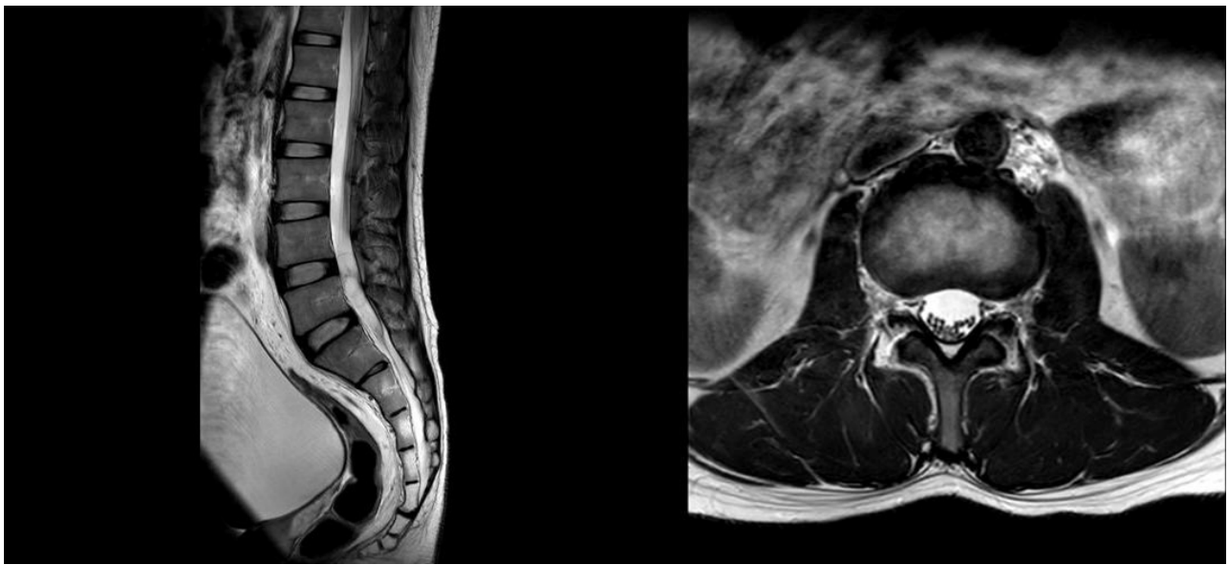

**Figure 2.** Thoracic MRI with contrast revealed a solid mass in the intradural extramedullary region at the T6-T7 level, suggesting spinal meningioma. The dural tail sign was present, causing spinal cord compression and myelum edema. A hyperintense lesion at corpus 7 on T1WI/T2W1 indicated Modic II changes.

## DISCUSSION

IDEM spinal tumors encompass approximately 40% to 60% of the total tumors within the spinal space. [1] Schwannoma represents the most common IDEM spinal tumor, with an incidence rate of approximately 0.3–0.4 per 100,000 people annually, followed by meningioma with an incidence rate of around 0.32 per 100,000 people annually. [6] Due to their rarity, specific treatment guidelines for intradural tumors are yet to be established, posing a continued challenge in the field of neurosurgery. [4] This case series makes a significant contribution to the scientific understanding of IDEM tumors of the spine, providing an explanation of the diagnosis and therapeutic interventions tailored to the characteristics of each case.

The first case, involving cystic schwannoma, is a type of non-malignant peripheral nerve sheath tumor originating from Schwann cells. [7]This tumor has the potential to grow along the spine. Approximately 25% of IDEM Schwannomas are entirely extradural, while 15% exhibit both intra- and extradural characteristics; only a small number of cases are intramedullary. [8] The second case involves spinal meningioma and thoracolumbar spondylosis. Meningioma is a non-malignant tumor originating from the meningothelial cells of the arachnoid layer. [9] This tumor type contributes to 25% to 46% of primary spinal tumors. [9] The incidence of

Schwannoma can occur at any age but tends to increase in young adults, while meningioma is more commonly found in the elderly female population.[3]

IDEM spinal tumors often exhibit characteristics such as spinal cord deformity, subarachnoid expansion on the same side as the tumor, displacement in the opposite direction, and subarachnoid narrowing on the opposite side. [10] The clinical presentation is significantly influenced by the specific location of the tumor within the spinal cord, including severe pain or neurological symptoms due to gradual pressure on the spinal cord. [11] In the first case, the tumor's location within the spinal canal exerted pressure on the cauda equina nerve roots, resulting in clinical presentations encompassing pain and potential neurogenic bladder dysfunction. In the second case, the patient experienced progressive weakness in both lower limbs, worsening over time. Additionally, the patient reported persistent tingling sensations in both legs with no complaints of back pain.

In the assessment of IDEM tumors, the utilization of imaging methods is pivotal for obtaining a comprehensive overview. MRI with contrast is the primary method that significantly contributes to evaluating and managing complex neurological conditions.[12] In MRI results, schwannomas typically exhibit hyperintense signals on T2-weighted images, with brighter areas indicating the presence of Antoni A, while darker areas indicate Antoni B.[6] These tumors are eccentrically located on the peripheral nerves or spinal nerve roots. In the reported case studies, lumbosacral MRI revealed detailed characteristics of cystic schwannoma lesions, providing not only profound anatomical information but also depicting their impact on the cauda equina nerve roots and the bladder (neurogenic bladder).

On the other hand, meningiomas typically present as discrete intradural tumors, appearing round or oval in MRI results.[5] These tumors may exhibit isointense signals on T2-weighted images and frequently demonstrate the presence of a dural tail, which is a contrast-enhanced area along the surface of the dura mater. [13] The dural tail serves as a crucial indicator in identifying this tumor, appearing as a part of the tumor protruding beyond its normal boundaries, indicating pressure on the nerves or surrounding tissues.[6] From the imaging findings of the case studies, contrast-enhanced thoracic MRI becomes a pivotal tool in confirming the diagnosis of spinal meningioma, providing a comprehensive depiction of the spinal condition.

Histological examination of tumors is crucial to establishing the histogenesis of intradural tumors in nearly all cases. However, for the majority of schwannomas, which tend to be benign and can be identified through MRI, a tissue biopsy before surgery is not always necessary. [14] In the case of schwannoma, a biopsy was performed on tissue measuring 1.5 x 1 x 1 cm, presenting as a solid, rubbery, brownish-white mass. Schwannomas typically manifest as single, well-defined, encapsulated masses. [5] Conversely, for spinal meningioma cases, a biopsy was conducted on tissue measuring 1.8 x 1.2 x 0.7 cm, presenting as a solid, rubbery, gray-white mass. Biopsy results revealed the proliferation of round to oval-shaped cells with round, oval, uniform, hyperchromatic nuclei, and some cells displayed intranuclear and eosinophilic cytoplasm. [6]

Based on the established diagnosis, therapeutic intervention planning involves selecting a surgical procedure that aligns with the characteristics and location of the identified pathology. In cases where patients exhibit severe symptoms, management often entails tumor removal. [15] Research findings indicate that following tumor resection, patients with benign IDEM tumors demonstrate significant and sustained improvement, including disability reduction, pain alleviation, overall health status enhancement, and a low likelihood of recurrence.[15][11]

In the first case, the presence of cystic schwannoma exerting pressure on the cauda equina warrants a laminectomy procedure, L4-L5 decompression, and tumor excision using an instrumented approach. Meanwhile, in the second case, the existence of spinal meningioma necessitates a medical approach through laminectomy and tumor excision at the T6-T7 level. These procedures are performed to completely remove the tumor with minimal perioperative risk of mortality and morbidity.

Several studies have proposed that the total laminectomy procedure is effective in removing tumors; however, other studies have reported that this procedure carries a significant risk of inducing spinal instability, deformities, and postoperative pain in the long term. [16] This is associated with the iatrogenic destruction of the posterior elements of the spinal column. To minimize these complications, some studies recommend the use of total laminectomy with arthrodesis or unilateral limited laminectomy.[1] However, unilateral limited laminectomy is challenging to perform due to restricted visibility, necessitating careful consideration to avoid damage to normal nerves or incomplete lesion exposure. Neurophysiological monitoring is maintained to reduce the risk of complications and ensure optimal surgical outcomes. Postoperative management involves pain care strategies, close monitoring of changes in neurological status, and radiological evaluations to measure the efficacy of the intervention. Postoperative assessment includes monitoring patient responses and assessing radiological and neurological outcomes.

## CONCLUSSION

The IDEM tumors in the spine, particularly cases involving cystic schwannoma and spinal meningioma with thoracolumbar spondylosis, present complexities in diagnosis and management. These two cases exhibit varied clinical presentations. Imaging, especially MRI, supports the diagnosis by depicting lesion characteristics and guiding therapeutic procedures. A tissue biopsy is required to establish histogenesis, although for schwannoma cases, a biopsy may not always be necessary due to the identification capabilities of an MRI.

Planning therapeutic interventions, such as total laminectomy, total laminectomy with arthrodesis, or unilateral limited laminectomy, needs to be approached cautiously to reduce the risk of complications. It is crucial to engage in neurophysiological monitoring and meticulous postoperative management for optimal clinical outcomes.

### Informed consent

Written informed consent was obtained from the patient for their participation in our study.

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### Author Contribution

TAN contributed to performing the surgical procedure, data collection, data analysis and writing the paper. FB contributed to data analysis and writing the paper. DWW contributed to data analysis and writing the paper. CP contributed to data collection, writing the paper, and manuscript preparation for submission.

### Declaration of competing interest

The authors declare that there is no conflict of interest regarding publication of this paper.

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