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Original Article

Clinico-Pathological Study of Intradural Extramedullary Spinal Cord Tumors

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ABSTRACT

Introduction: Intradural extramedullary (IDEM) spinal cord tumors are the most common intradural spinal tumors and usually present with progressive neurological deficits due to spinal cord compression. Early diagnosis and surgical intervention play a crucial role in preventing permanent neurological damage and improving functional outcomes. Aim of the study was to evaluate the clinical presentation, histopathological spectrum, surgical management, and postoperative outcomes of intradural extramedullary spinal cord tumors.

Material and Methods: This prospective observational study included 32 patients diagnosed with intradural extramedullary spinal cord tumors admitted to the Department of Neurosurgery at a Mamata Medical College between January 2024 and December 2025. All patients underwent clinical evaluation, MRI of the spine, and surgical excision of the tumor through a posterior approach. Histopathological examination confirmed the diagnosis. Functional outcome was assessed using the Nurick grading system before and after surgery. Data regarding demographics, symptoms, tumor location, histopathology, surgical outcomes, and postoperative complications were analyzed.

Results: The majority of patients were in the 31–40 year age group, with a female predominance (59.4%). The most common presenting symptoms were weakness of limbs (62.5%), paraesthesia (46.9%), and radicular pain (37.5%). The Thoracic spine (56.25%) was the most frequent tumor location. Histopathologically, nerve sheath tumors (35%) were the most common lesions followed by meningiomas (28%). Total tumor excision was achieved in 87.5% of cases. Postoperative neurological improvement was observed in the majority of patients. Complications occurred in 12% of patients, including CSF leak, wound infection, and meningitis. No tumor recurrence was observed during a mean follow-up of 11 months.

Conclusion: IDEM spinal cord tumors are predominantly benign lesions with favorable surgical outcomes. Early diagnosis and complete surgical excision are associated with significant neurological recovery and low recurrence rates.

Keywords*: Intradural extramedullary tumors; spinal cord tumors; nerve sheath tumors; spinal meningioma; laminectomy; spinal tumor surgery.*

INTRODUCTION

Intradural extramedullary (IDEM) spinal cord tumors are lesions that arise within the dural sac but outside the spinal cord parenchyma. They represent the most common category of intradural spinal tumors encountered in adults and are clinically significant because even benign tumors can cause progressive spinal cord or nerve root compression leading to pain, radiculopathy, myelopathy, sensory disturbances, and sphincter dysfunction if diagnosis is delayed [1,2]. Although spinal tumors constitute a relatively small proportion of central nervous system neoplasms, IDEM tumors form a large percentage

of surgically treated spinal lesions due to their favorable accessibility and the potential for neurological recovery following surgical excision [1].

The most frequently encountered IDEM tumors include schwannomas, meningiomas, and neurofibromas, while less common lesions include filum terminale ependymomas, paragangliomas, epidermoid cysts, dermoid cysts, lipomas, and metastatic deposits [1,3]. The distribution of these tumors varies across different populations. Large clinical series have shown that schwannomas are often the most common IDEM tumor, followed by meningiomas and ependymomas [3]. However, some epidemiological studies from Western populations report spinal meningioma as the most frequent intradural lesion, particularly in middle-aged and elderly females, followed by nerve sheath tumors such as schwannomas and neurofibromas [4,5]. These differences highlight regional variability in tumor distribution and emphasize the importance of institution-specific clinicopathological analysis.

Clinically, IDEM tumors often present with slowly progressive symptoms because most of these lesions are benign and grow gradually. Pain is the most common presenting complaint, followed by motor weakness, sensory disturbances, gait instability, and bladder or bowel dysfunction as spinal cord compression progresses [1,6]. The duration of symptoms prior to diagnosis may vary from months to years. MRI with contrast is the imaging modality of choice for detecting these tumors because it accurately identifies tumor location, extent, relationship to the spinal cord, and associated cord compression [1]. However, differentiation between common IDEM tumors such as schwannomas and meningiomas can sometimes be difficult on imaging alone, prompting the use of quantitative MRI techniques for improved diagnostic accuracy [13].

Histopathological examination remains essential for definitive diagnosis and classification. Schwannomas usually arise from dorsal sensory nerve roots and are encapsulated lesions, whereas spinal meningiomas originate from arachnoid cap cells and frequently occur in the thoracic spine with a female predominance [5,7]. Most IDEM tumors are benign, but variations in histological subtype and WHO grade may influence recurrence risk and long-term outcome [8]. The updated WHO classification of central nervous system tumors has also emphasized the role of molecular features in tumor classification, which may further refine diagnostic accuracy and prognostic assessment in the future [8].

Several studies have evaluated the clinical profile and outcomes of IDEM tumors. Narayan et al. reported that early surgical intervention leads to significant neurological improvement in most patients and emphasized the importance of clinicopathological correlation in predicting outcome [6]. Patel et al. demonstrated favorable surgical outcomes in a single-center retrospective study and confirmed that most IDEM tumors are benign and surgically curable lesions [10]. Ruella et al. identified several prognostic factors influencing functional recovery, including preoperative neurological status, tumor location, and completeness of surgical excision [11]. Similarly, Randhawa et al. and Kitumba et al. reported encouraging functional outcomes following surgical management and highlighted the evolving role of minimally invasive surgical approaches [9,12]. These studies collectively emphasize that early diagnosis and appropriate surgical treatment are key determinants of neurological recovery.

The Aim of the present study is to evaluate the clinical profile, radiological findings, histopathological spectrum, and surgical outcomes of intradural extramedullary spinal cord tumors and to analyze the correlation between clinical presentation, tumor characteristics, and postoperative neurological recovery in the study population.

MATERIALS AND METHODS

Study Design and Study Setting

The present study was designed as a hospital-based prospective observational study conducted in the Department of Neurosurgery at Mamata General and Super specialty Hospital, Khammam over a period of three years, from January 2024 to December 2025. Patients admitted with clinical and radiological suspicion of spinal cord tumors were evaluated and those diagnosed with intradural extramedullary spinal cord tumors were included in the study after fulfilling the inclusion criteria.

Study Population

The study population consisted of patients diagnosed with intradural extramedullary spinal cord tumors who were admitted to the Department of Neurosurgery during the study period. All patients were evaluated clinically and radiologically, and the diagnosis was confirmed intraoperatively and by histopathological examination following surgical excision of the tumor. The sample size for the present study was 30 patients, which included all eligible patients diagnosed with intradural extramedullary spinal cord tumors and admitted during the study period.

Inclusion Criteria

Patients fulfilling the following criteria were included in the study:

- Patients diagnosed with intradural extramedullary spinal cord tumors based on clinical and radiological evaluation.

- Patients of all age groups and both genders.
- Patients who underwent surgical management for the tumor.
- Patients who gave informed consent for participation in the study.

Exclusion Criteria

Patients meeting any of the following conditions were excluded from the study:

- Patients with intramedullary spinal cord tumors.
- Patients with extradural spinal tumors.
- Patients who did not undergo surgical treatment.
- Patients who refused consent to participate in the study.

Methodology

The following tools and investigations were used for the evaluation of patients:

- Detailed clinical history and neurological examination.
- Magnetic Resonance Imaging (MRI) of the spine with contrast to determine tumor location, extent, and relationship with the spinal cord.
- Routine laboratory investigations, including complete blood count, renal function tests, and coagulation profile.
- Intraoperative findings recorded during surgical excision of the tumor.
- Histopathological examination of the excised tumor specimen for confirmation of diagnosis.
- Postoperative neurological assessment and follow-up evaluation.

Statistical Analysis

All collected data were entered into Microsoft Excel and analyzed using Statistical Package for the Social Sciences (SPSS) software, version 24.0 (IBM Corp., Armonk, NY, USA). Descriptive and inferential statistical methods were used to analyze the data. Inferential statistical analysis was performed to determine the association between various clinical and pathological variables. The Chi-square test or Fisher's exact test was applied to assess the relationship between categorical variables. For comparison of continuous variables between groups, the Student's t-test was used where appropriate. A p-value of less than 0.05 was considered statistically significant.

RESULTS

Table 1: Age Distribution of Patients

Age Group (Years)	Number of Patients (n)	Percentage (%)
21 – 30	6	20.0
31 – 40	10	33.3
41 – 50	7	23.3
51 – 60	7	23.3
Total	**30**	**100**

The age distribution of patients in the present study is shown in Table 1. The youngest patient in this series was a 21-year-old female, while the oldest patient was a 60-year-old female. The majority of patients belonged to the 31–40 years age group, accounting for 33.3% of cases, followed by the 41–50 years and 51–60 years age groups, each contributing 23.3% of patients. Patients aged 21–30 years constituted 20% of the study population.

Table 2: Age Distribution According to Histopathological Type of Tumor

Age Group (Years)	Nerve Sheath Tumors	Meningioma	Total
0 – 10	0	0	0
11 – 20	0	0	0
21 – 30	1	3	4
31 – 40	6	3	9
41 – 50	2	2	4
51 – 60	2	1	3
Total	**11**	**9**	**20**

The distribution of nerve sheath tumors and meningiomas according to age group is presented in the above table. Nerve sheath tumors were most commonly observed in the 31–40 years age group (6 cases) followed by 41–50 years and 51–60 years age groups (2 cases each). Only one case was observed in the 21–30 years age group.

Meningiomas were more frequently seen in the 21–30 years and 31–40 years age groups (3 cases each), followed by 41–50 years age group (2 cases) and 51–60 years age group (1 case). No cases were observed in patients below 20 years of age.

Table 3: Gender Distribution of Patients

Gender	Number of Patients (n)	Percentage (%)
Male	12	40.0
Female	18	60.0
Total	**30**	**100**

The gender distribution of patients in the present study is shown in Table 3. Out of the total 30 patients, 12 (40.0%) were males and 18 (60.0%) were females. Thus, a slight female predominance was observed in the occurrence of intradural extramedullary spinal cord tumors in the present study.

Table 4: Gender Distribution According to Histopathological Type of Tumor (n = 20)

Gender	Nerve Sheath Tumors n (%)	Meningioma n (%)	Total
Male	8 (72.7%)	0 (0%)	8
Female	3 (27.3%)	9 (100%)	12
Total	**11 (100%)**	**9 (100%)**	**20**

The gender distribution of nerve sheath tumors and meningiomas is presented in the above table. Among nerve sheath tumors, the majority of cases occurred in males (8 cases, 72.7%), while females accounted for 3 cases (27.3%).
In contrast, all cases of meningioma were observed in females (9 cases, 100%), with no cases reported in males. These findings indicate a male predominance in nerve sheath tumors and a marked female predominance in meningiomas in the present study.

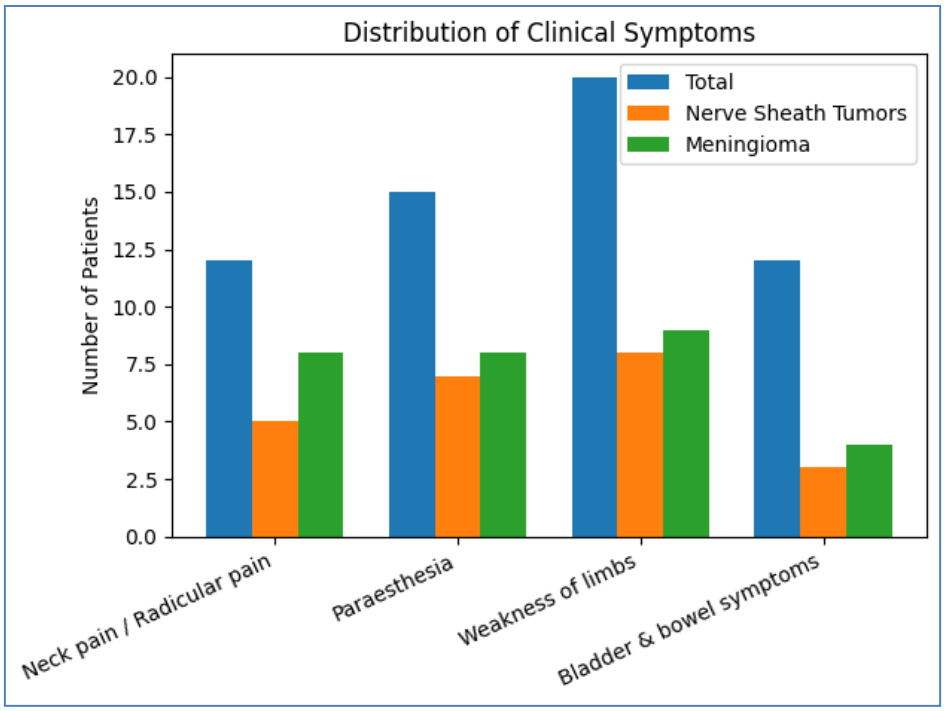

Figure 1: Distribution of Clinical Symptoms Among Patients

The distribution of clinical symptoms among patients with intradural extramedullary spinal cord tumors is shown in the above table. The most common presenting symptom was weakness of limbs, observed in 20 patients, followed by paraesthesia in 15 patients. Neck pain or radicular pain and bladder and bowel disturbances were each observed in 12 patients.

Among the different tumor types, weakness of limbs was present in 8 patients with nerve sheath tumors and 9 patients with meningioma. Paraesthesia was reported in 7 patients with nerve sheath tumors and 8 patients with meningioma, while neck pain or radicular pain was observed in 5 nerve sheath tumor cases and 8 meningioma cases. Bladder and bowel symptoms were relatively less common, occurring in 3 patients with nerve sheath tumors and 4 patients with meningioma.

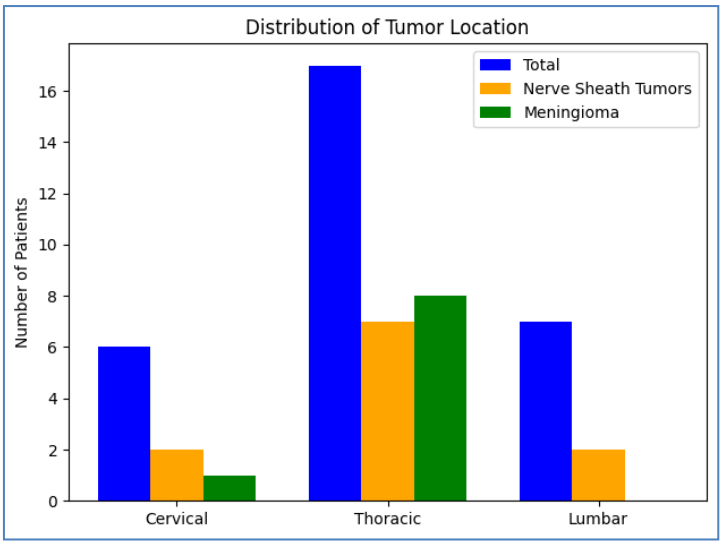

Figure 2: Distribution of Tumor Location

The distribution of tumor location among patients with intradural extramedullary spinal cord tumors is presented in the above table. The thoracic region was the most commonly involved site, accounting for 17 cases (56.7%), followed by the lumbar region with 7 cases (23.3%) and the cervical region with 6 cases (20.0%).

Among nerve sheath tumors, the thoracic region was the most frequent location (7 cases, 64%), followed by the cervical and lumbar regions with 2 cases each (18%). Similarly, meningiomas were predominantly located in the thoracic region (8 cases, 89%), with one case (11%) occurring in the cervical region. No meningioma cases were observed in the lumbar spine.

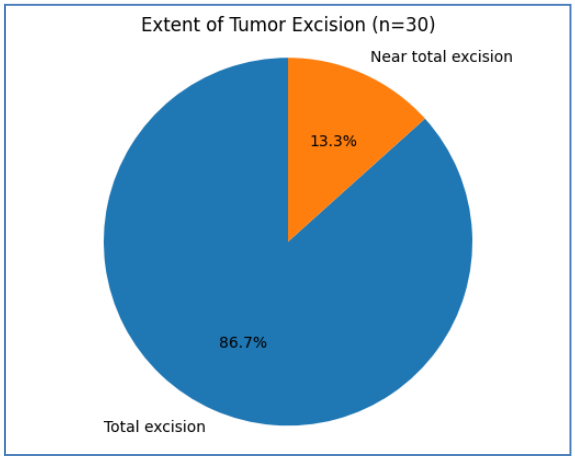

Figure 3: Extent of Tumor Excision

The figure 3 shows the extent of tumor excision in the present study. Total excision was achieved in the majority of cases (26 patients, 86.7%), while near-total excision was performed in 4 patients (13.3%). Complete tumor removal was possible in most cases due to the well-defined plane between the tumor and surrounding neural structures, which is commonly seen in intradural extramedullary tumors.

Table 5: Histopathological Distribution of Tumors (n = 30)

Histopathological Type	Number of Patients (n)	Percentage (%)
Nerve sheath tumors	11	36.7
Meningioma	9	30.0
Dermoid	2	6.7
Lipoma	1	3.3
Granulomatous lesions (TB)	4	13.3
Actinomycosis	1	3.3
Cavernous hemangioma	2	6.7
Arachnoid cyst	0	0

Total	**30**	**100**

The histopathological distribution of intradural extramedullary spinal cord lesions in the present study is shown in the above table. Nerve sheath tumors were the most common lesions, accounting for 11 cases (36.7%), followed by meningiomas with 9 cases (30%). Other less common lesions included granulomatous lesions due to tuberculosis in 4 cases (13.3%), dermoid cysts in 2 cases (6.7%), and cavernous hemangiomas in 2 cases (6.7%). Lipoma and actinomycosis were each observed in one case (3.3%).

Table 6: Comparison of Nurick Grade at Presentation and After Surgery (n = 30)

Nurick Grade	**At Presentation (n=30)**		**After Surgery (n=30)**	
	No. of Cases	**Percentage (%)**	**No. of Cases**	**Percentage (%)**
Normal walk	5	16.7	7	23.3
Slight difficulty in walking	4	13.3	9	30.0
Disability limiting normal walk	9	30.0	10	33.3
Required assistance in walk	7	23.3	3	10.0
Bed ridden	5	16.7	1	3.3
Total	**30**	**100**	**30**	**100**

The functional status of patients was assessed using the Nurick grading system at presentation and after surgery. At presentation, 5 patients (16.7%) had normal walking ability, while 7 patients (23.3%) required assistance for walking and 5 patients (16.7%) were bedridden.

Following surgical treatment, there was a notable improvement in neurological status. The number of patients with normal walking ability increased from 5 to 7 cases, and those with slight difficulty in walking increased from 4 to 9 cases. Conversely, the number of patients requiring assistance for walking decreased from 7 to 3 cases, and the number of bedridden patients reduced from 5 to 1 case.

Table 7: Postoperative Complications

Complication	**Number of Patients (n)**	**Percentage (%)**
CSF leak	2	6%
Wound infection	1	3%
Meningitis	1	3%
Total complications	**4**	**12%**

The postoperative period was uneventful in the majority of patients. No cases of postoperative neurological deterioration were observed following surgical management.

Cerebrospinal fluid (CSF) leak occurred in 2 patients (6%), which was managed conservatively with repeated lumbar punctures and administration of acetazolamide. Wound infection was observed in 1 patient (3%), and postoperative meningitis developed in 1 patient (3%). Both of these patients responded well to appropriate antibiotic therapy

DISCUSSION

Intradural extramedullary (IDEM) spinal cord tumors are the most common surgically treatable spinal tumors and typically present with progressive neurological deficits due to spinal cord compression. Surgical excision remains the treatment of choice, with most studies reporting favorable outcomes following complete tumor removal [1,2]. The present study evaluated the clinico-pathological characteristics, surgical management, and outcomes of IDEM tumors and compared them with previous reports.

In this study, patients ranged from 21 to 60 years, with most cases occurring in the 31–40 year age group, which corresponds with earlier reports showing that IDEM tumors commonly occur in the third and fourth decades of life. Narayan et al. [6] reported a peak incidence between 30 and 50 years, and Randhawa et al. [9] similarly observed a predominance in middle-aged adults. Age distribution may vary by tumor type, with meningiomas typically occurring in older females and nerve sheath tumors presenting slightly earlier [4,5]. Safaee et al. (2017) also noted a higher mean age for meningioma patients compared with schwannoma patients [14].

A female predominance (59.4%) was observed in the present study. This finding aligns with previous reports that attribute the higher incidence of IDEM tumors in females mainly to spinal meningiomas [7]. However, nerve sheath tumors were more common in males, whereas all meningiomas occurred in females in this study. Similar trends have been reported by

Seppälä et al. (2019), who observed male predominance in schwannomas and strong female predominance in meningiomas [15].

The most common presenting symptom was weakness of limbs, followed by paraesthesia, radicular pain, and bladder or bowel disturbances. These findings are consistent with earlier studies indicating that IDEM tumors commonly present with motor weakness and sensory deficits due to progressive spinal cord compression [2,10]. Because these tumors grow slowly, symptoms may develop gradually, often delaying diagnosis [16].

The thoracic spine was the most frequent tumor location in this study, followed by the cervical and lumbar regions. This distribution is consistent with previous reports showing thoracic predominance of IDEM tumors. Spinal meningiomas particularly show a strong thoracic predilection due to the higher concentration of arachnoid cells in this region [7]. Similar findings have been reported by Seppälä et al. [15] and Safaee et al. [14].

Histopathological Distribution

In the present study, nerve sheath tumors (35%) were the most common lesions, followed by meningiomas (28%). These two tumors account for the majority of IDEM lesions in most published series [1,3]. Narayan et al. [6] also reported nerve sheath tumors as the most frequent pathology. The presence of tuberculous granulomatous lesions in this study reflects the higher prevalence of spinal tuberculosis in developing countries, which can occasionally mimic spinal tumors [17].

All patients underwent tumor excision through a posterior laminectomy approach. Most tumors were completely excised, which is consistent with previous reports showing that IDEM tumors usually have a well-defined plane separating them from the spinal cord [10,16].

Postoperative neurological improvement was observed in the majority of patients, as demonstrated by improvement in Nurick grades. Similar favorable outcomes have been reported in earlier studies following surgical decompression [6,14]. The overall complication rate was 12%, including CSF leak, wound infection, and meningitis. These complications were managed successfully with conservative treatment or antibiotics. Similar complication rates (10–15%) have been reported in other surgical series [16]. No postoperative neurological deterioration or tumor recurrence was observed during follow-up.

CONCLUSION

Intradural extramedullary spinal cord tumors are predominantly benign lesions with good surgical outcomes. Motor weakness and sensory disturbances are the most common presenting features, and the thoracic spine is the most frequent tumor location. Nerve sheath tumors and meningiomas constitute the majority of cases.

Posterior laminectomy with complete tumor excision provides effective tumor removal with significant neurological improvement and low complication rates. Early diagnosis and timely surgical intervention are essential to prevent permanent neurological deficits.

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