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ORIGINAL ARTICLE

Efficacy of Surgery in Intradural Extramedullary Spinal Cord Tumors and Factors Affecting Prognosis

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Abstract

Introduction: Intradural extramedullary spinal cord tumors (IDEMSTs), albeit rare, can severely impair quality of life, mobility, and survival. They represent 15% of central nervous system tumors. Early discovery, effective treatment, and better outcomes require understanding these tumors. Our study investigated IDEMSTs predictive variables and clinical features. We aimed to improve the management of IDEMSTs by examining age, gender, initial symptoms, clinical history, comorbidities, smoking habits, preoperative and postoperative neurological states, tumor location and size, pathological diagnosis, and surgical complications.

Methods: Our analysis included 51 IDEMST patients who underwent surgery at our clinic. Demographics, presenting symptoms, time intervals between symptom onset, diagnosis, and surgery, comorbidities, smoking habits, preoperative and early postoperative neurological examinations, tumor location and size, surgical procedure, extent of tumor resection, pathological diagnosis, surgical complications, length of hospitalization, and preoperative and early postoperative assessment scales were evaluated. These factors were examined to determine surgical efficacy, patient outcomes, and prognosis.

Results: Older patients had worse recovery rates and Karnofsky scores. Additionally, longer hospital stays were linked to worse neurological conditions. Neurological functions improved better in early surgery patients. Ependymoma patients had better pre- and post-op neurological functioning, while meningioma and thoracic tumor patients improved significantly. However, thoracic tumor patients had severe neurological impairments. Males showed better pre- and post-op neurological status. Lower severity and duration of symptoms before surgery also increased postoperative neurological improvement. Our data indicate that demographic, tumor-specific, morphological, and functional neurological variables can affect IDEMST surgical efficiency.

Discussion and Conclusion: Surgical excision is safe and effective for these IDEMSTs. Our study identifies the impact of age, tumor level, pathology, Karnofsky score, Nurick scale, and gender on surgical outcomes. Nevertheless, prospective studies on larger scales are required. These studies may allow for a more comprehensive evaluation of the prognostic factors affecting IDEMST surgery and produce more reliable results.

Keywords: Intradural extramedullary spinal cord tumor; outcome; prognosis; surgery.

Spinal tumors, considered relatively rare, are a significant concern due to their potential to severely impact a patient's quality of life, mobility, and even survival. They account for an estimated 15% of central nervous system tumors and present a complex challenge due to their diverse nature[1]. Understanding these

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tumors is critical for early detection, effective treatment, and improved patient outcomes.

These tumors can broadly be categorized into three main groups based on their location: intramedullary, extramedullary, and epidural. Each category exhibits unique characteristics and clinical implications that require distinct diagnostic and therapeutic approaches. Intramedullary tumors originate within the spinal cord, while extramedullary tumors, more common than the former, develop outside the spinal cord but within the dural sac. Epidural tumors are found outside the dural sac and are often metastatic.

A subset of the extramedullary group is the intradural extramedullary spinal tumors (IDEMST), representing about 10% of primary central nervous system tumors. Predominantly, these are meningiomas and nerve sheath tumors[2]. These tumors often present diagnostic challenges due to their location and the subtle nature of the initial symptoms. Early diagnosis is crucial for the management of these tumors. Still, it's often complicated because these tumors tend not to manifest clinically until they have compressed the spinal cord or caused neurological deficits[3].

Despite the hurdles, significant advancements in modern medicine have facilitated improved management of spinal tumors. Modern imaging methods provide precise details about the tumor, aiding diagnosis and treatment planning. Microsurgery techniques and modern instrumentation systems allow for better surgical outcomes, minimizing damage to surrounding healthy tissues and optimizing tumor removal[4]. Understanding spinal biomechanics has also been instrumental in the surgical management of spinal tumors.

However, certain factors can complicate the postoperative prognosis. These include the duration of the patient's clinical history, the severity of preoperative neurological deficits, the histopathological type of the tumor, its anatomical location, and the occurrence of surgical complications[2]. Each of these factors can potentially contribute to less favorable postoperative outcomes.

Given this background, our study has sought to investigate prognostic factors and clinical characteristics in managing IDEMST in Türkiye. By examining factors such as age, gender, initial symptoms, duration of clinical history, additional diseases, smoking habits, preoperative and postoperative neurological statuses, tumor location and size, pathological diagnosis, and surgical complications, we aim to provide valuable insights that may enhance the management of IDEMST.

Materials and Methods

Data Collection

Data were gathered retrospectively for 51 patients diagnosed with IDEMST who underwent surgery at our clinic. Demographic characteristics, including age and gender, along with information on initial symptoms, comorbidities, and smoking habits, were collected. Clinical data such as pre- and postoperative neurological status, tumor location and size, surgical approach, extent of tumor removal, time between diagnosis and surgery, pathological diagnosis, and surgical complications were also obtained. The duration of the hospital stay was recorded as well.

Detailed neurological assessments were performed pre- and postoperatively using several health scales, including the American Spinal Injury Association scale (ASIA), the Nurick disability assessment scale, the Karnofsky performance scale, and the Glasgow outcome scale (GOS).

Imaging data were acquired for all patients using direct radiographs, computed tomography (CT), and magnetic resonance imaging (MRI). Advanced image analysis was conducted using the calculation method developed by Ahn et al.[5] to determine the relationship between preoperative findings and postoperative outcomes with MRI findings. Furthermore, to compute the proportions of the tumor and intradural region areas, the "Analyzing Digital Images" computer program (version 11) developed by the Boston Museum of Science was employed. This study was conducted in accordance with the Declaration of Helsinki.

Statistical Analysis

For the statistical analysis of the collected data, we used the Number Cruncher Statistical System (NCSS) 2007 & PASS 2008 Statistical Software. Descriptive statistics were calculated for all continuous variables, and results were presented as mean±standard deviation.

A comparison of groups for parameters showing normal distribution was performed using the Oneway Anova test, while the Tukey HSD test was used to identify the group causing the difference. For parameters not showing a normal distribution, comparisons were performed using the Kruskal Wallis test, with the Mann-Whitney U test applied to identify the group causing the difference. For comparing two groups, the Student t-test was used for parameters with normal distribution and the Mann-Whitney U test for those without.

Chi-square and McNemar tests were used for qualitative data comparison. A p-value<0.05 was considered statistically significant. The thorough statistical analysis ensured a comprehensive understanding of the prognosis and factors influencing the surgical outcomes of IDEMST patients.

Results

In our study, 51 cases diagnosed with IDEMST were operated on, meeting the predetermined parameters. Demographic characteristics and clinical findings of the patients are presented in Table 1. Out of the cases, 31 (60.8%) were female, and 20 (39.2%) were male. The age range of females at the time of diagnosis was 23-79, with a mean age of 51.29; for males, the age range was 16-75, with a mean age of 43.73. The overall age range was 16-79, with a mean age of 48.07. When examining the tumor levels, there were 6 cases (11.8%) with tumors at the cervical level, 23 cases (45.1%) at the thoracic level, 4 cases (7.8%) at the thoracolumbar level, 12 cases (23.5%) at the lumbar level, 2 cases (3.9%) at the lumbosacral level, and 4 cases (7.8%) with multiple tumors. Among the cases with multiple tumors, one had two myxopapillary ependymomas at the L2 and L4-S1 levels, one had two schwannomas at the C3-7 and T8 levels, one had three schwannomas at the L3-L4-L5 levels, and one had two glioblastoma metastases at the T9 and L1 levels, which led to surgical intervention. Pathology results showed that 24 cases (47%) had schwannomas, 19 cases (37%) had meningiomas, 7 cases (14%) had ependymomas, and 1 case (2%) had glioblastoma metastasis. Among the meningioma cases, 10 (19.6%) were transitional, 5 (9.8%) were psammomatous, and 4 (7.8%) were meningothelial type. All other cases were grade I except for all meningioma cases and one grade II ependymoma case. Malignant transformation was not observed in any of the schwannoma

Table 1. Demographics, characteristics and clinical findings of patients

	n	%		n	%
Number of patients	51		Initial symptom(s)		
Age, years (range/median)	16-79/48.7		Weakness	10	19.6
Sex			Pain	35	68.6
Male	20		Spasm	1	2
Female	31		Numbness	10	19.6
Pathology			Neurological findings at admission		
Schwannoma	24	47	Motor deficit	35	68.6
Meningioma	19	37	Sensory deficit	30	58.8
Ependymoma	7	14	Long tract signs	16	31.3
Glioblastoma metastasis	1	2	Reduced anal tone and perineal sense	2	3.9
Tumor location			None	6	11.7
Cervical	6	11.8	Comorbidities		
Thoracic	23	45.1	Hypertension	16	
Thoracolumbar	4	7.8	Diabetes	9	
Lumbar	12	23.5	Coronary artery disease	3	
Lumbosacral	2	3.9	Other	22	
Multiple	4	7.8			

Table 2. Distribution of pathologies based on tumor levels

Tumor level	Schwannoma		Meningioma		Ependymoma		Glioblastoma metastasis	
	n	%	n	%	n	%	n	%
Cervical	4	16.6	2	10.6				
Thoracic	6	25	17	89.4				
Thoracolumbar	4	16.6	0					
Lumbar	7	29.1	0		5	71.4		
Lumbosacral	1	4	0		1	14.3		
Multiple	2	8	0		1	14.3	1	100

Table 3. Time intervals between onset of symptoms, diagnosis and operation

Time interval between	Min-max	Mean
Operation date and the onset of symptoms (months)	1.07-73.1	11.99±16.97
Onset of symptoms and diagnosis (months)	0.27-71.30	10.97±16.30
Diagnosis and operation (days)	2-212	30.61±35.6

Table 4. Distribution of tumor levels by age

	Age		
Tumor level	Mean	Median	p
Cervical (n, %)	38.0±12.56	31.5	
Thoracic (n, %)	57.91±13.24	62	
Thoracolumbar (n, %)	49.25±17.65	51	**<0.01**
Lumbar (n, %)	38.75±9.51	42	
Multiple (n, %)	36.0±18.85	25.8	

Table 5. Distribution of preoperative symptoms based on tumor levels

Preoperative symptoms	Cervical		Thoracic		Thoracolumbar		Lumbar		Multiple	
	n	%	n	%	n	%	n	%	n	%
Motor deficit	6	17.1	20	57.1	2	5.7	5	14.3	2	5.7
			p=0.016							
Sensory deficit	2	6.7	21	71	1	3.3	4	13.3	2	6.7
			p=0.002							
Decreased deep tendon reflexes	0	0	3	50	1	16.7	2	33.3	0	0
Reduced anal tone and perineal sense	0	0	2	100	0	0	0	0	0	0
Long tract signs	3	18.8	11	68.8	0	0	0	0	2	12.5
			p=0.021							

cases. In our study, one case of NF type 2 was operated on due to schwannoma at the C7 level. None of the cases showed bone involvement in radiological imaging or pathological examinations. Distribution of pathologies based on tumor levels are presented in Table 2. Among the meningioma cases, 89.4% had tumors at the thoracic level. In contrast, among the schwannoma cases, 29.1% had tumors at the lumbar level, 25% at the thoracic level, 16.6% at the cervical level, and 16.6% at the thoracolumbar level. Among the ependymoma cases, 71.4% had tumors at the lumbar level. Two cases with multiple tumors had a pathological diagnosis of schwannoma, one had ependymoma, and one had glioblastoma metastasis. Four schwannoma cases showed a widening of the interpedicular distance in plain radiographs. CT and MRI images of these cases also showed increased spinal canal width. Contrast-enhanced CT images revealed no significant contrast enhancement of the tumors. On T1-weighted MR images, the tumors were hypointense in 6 cases, hyperintense in 7 cases, and isointense in 11 cases. On T2-weighted MRI images, the tumors were hyperintense in 22 cases and hypointense in 2 cases. Contrast-enhanced T1-weighted images showed homogeneous contrast enhancement in 20 cases and heterogeneous contrast enhancement in 4 cases. No specific features were detected in plain radiographs of meningioma cases. Four cases showed calcifications on CT images, two of which were transitional, one was psammomatous, and one was meningothelial type. No specific features were detected in CT images of other meningioma cases. On T1-weighted MR images, the tumor appeared isointense in 10 cases, hypointense in 7 cases, and hyperintense in 2 cases. On T2-weighted MR images, the tumor appeared isointense in 12 cases, hyperintense in 4 cases, and hypointense in 3 cases. No specific features were detected in plain radiographs and CT scans of ependymoma cases. On T1-weighted MRI images, three cases showed hyperintensity, two showed isointensity, and two showed hypointensity. Six cases showed homogeneous contrast enhancement, and one case showed heterogeneous contrast enhancement on MRI images. Five cases showed hyperintensity on T2-weighted MR images, and two showed isointensity. The majority of the cases (66.6%) presented with pain as their initial complaint. This was followed by weakness in 7 cases (13.7%), numbness in 6 cases (11.7%), and spasms in the lower extremities in 1 case (1.9%). Three cases (5.8%) reported the simultaneous onset of weakness and numbness, and one (1.9%) reported the simultaneous onset of pain and numbness. At admission, 68.6% of the cases had motor deficits, 58.8% had sensory deficits, 31.3% had long tract signs, and 3.9% had anal sensory and tonus deficits. Six cases (11.7%) did not show any neurological symptoms at admission.

Among the cases, 31.4% had hypertension (HT), 17.6% had

Table 6. Distribution of pathology by age

	Age		
Pathology	**Mean**	**Median**	**p**
Meningioma	56.26±15.75	63	**0.009**
Ependymoma	39±11.04	44	>0.05
Schwannoma	43.58±15	41.50	>0,05

Table 7. Distribution of pathology by gender

	Female		Male		
Pathology	**n**	**%**	**n**	**%**	**p**
Meningioma	16	84.2	3	15.8	
Ependymoma	4	57.1	3	42.9	
Schwannoma	11	45.8	13	54.2	**0.035**

Table 8. Postoperative complications

Complications	n	%
None	40	78.5
Discharge at the surgical site	5	9.8
Fever	2	3.9
Surgical site hematoma	1	1.9
Cosalgia	1	1.9
Cerebellar hematoma (died in clinical follow-up)	1	1.9
Globe vesicale	1	1.9

Table 9. Duration of postoperative hospitalization

	Postoperative hospitalization		
Tumor level	**Mean**	**Median**	**p**
Cervical (n, %)	9.60±4.03	7	
Thoracic (n, %)	7.54±2.15	7	
Thoracolumbar (n, %)	10.25±2.50	10.5	**0.046**
Lumbar (n, %)	6.83±2.41	6	
Multiple (n, %)	13.25±8.22	11	

Table 10. Preoperative Karnofsky Scores based on pathology

	Preoperative Karnofsky Score	
Pathology	**Mean**	**p**
Meningioma	68.94±14.10	
Ependymoma	91.42±6.90	**0.001**
Schwannoma	82.50±14.52	

diabetes mellitus (DM), 5.9% had heart diseases, and 43.1% had other comorbidities. The time interval between the operation date and the onset of symptoms ranged from 1.07 to 73.1 months, with a mean of 11.99±16.97 months. The time interval between the onset of symptoms and diagnosis ranged from 0.27 to 71.3 months, with a mean of 10.97±16.30 months. The time interval between diagnosis and operation ranged from 2 to 212 days, with a mean of 30.61±35.6 days. Time intervals between onset of symptoms, diagnosis, and operation are presented in Table 3. In the majority of cases, laminectomy was performed using a posterior approach for microsurgical tumor resection. Hemilaminectomy and total laminectomy were combined in two cases; total laminectomy and laminotomy were performed in one case, laminotomy alone was performed in one case, and costotransversectomy was performed in one case. In one case, we extended the previous C4-5 hemilaminectomy performed at another center using a posterior approach and removed the tumor. Laminoplasty was performed in four cases. None of the cases required spinal instrumentation.

The study achieved complete tumor removal in 49 cases (96.07%). There was a statistically significant difference in age according to tumor level ($p<0.01$, Table 4). Distribution of preoperative symptoms based on tumor levels are presented in Table 5. Motor deficit presence varied significantly based on tumor level, with thoracic region tumors showing a higher incidence than other regions. Similarly, sensory deficit and long tract findings were significantly more common in thoracic tumors.

Age also differed significantly based on pathology ($p<0.01$, Table 6). Meningioma cases had significantly higher ages compared to ependymoma and schwannoma cases. Gender distribution varied significantly according to pathology, mainly driven by the schwannoma group having fewer females than meningiomas (Table 7).

A few complications were observed (Table 8), including one case requiring reoperation for hematoma evacuation (1.9%) and two cases (3.9%) experiencing postoperative fever, which resolved with antibiotic therapy. Serous discharge at the surgical site was observed in five cases (9.8%) but resolved with follow-up. One patient underwent emergency surgery for a cerebellar hematoma that developed on the day of operation after removal of a meningioma at the T6 level. The hematoma was drained, and EVD was applied, but the patient died during clinical follow-up.

Postoperative hospitalization significantly differed by tumor level ($p<0.05$), with the thoracolumbar group having a longer duration than the lumbar group (Table 9). No decrease in Karnofsky scores was observed postoperatively, indicating overall preservation or improvement in functional status.

There is a statistically significant difference between the preoperative Karnofsky score distributions according to pathologies (Table 10). The preoperative Karnofsky score of meningioma cases was significantly lower than that of ependymoma and schwannoma cases (p<0.01). The study revealed significant relationships between preoperative and postoperative Karnofsky scores, age, and time between diagnosis and surgery (p<0.01). Nurick scores, a measure of disability, did not show significant changes postoperatively in most cases.

In summary, the study demonstrated successful tumor resection, with various factors such as age, tumor level, pathology, and gender influencing the clinical characteristics and outcomes of patients undergoing surgery for these tumors.

Discussion

Studies on managing IDEMST have explored factors influencing neurological findings and determining prognosis. However, these studies are often limited by unreliable radiological and clinical assessments and the rarity of IDEMST, resulting in a small number of cases; they primarily focus on surgical outcomes. Levy et al.[6], Solero et al.[7], and Gezen et al.[8] reported on preoperative motor and sensory deficits and sphincter dysfunction in their patients. Additionally, the literature includes studies assessing the relationship between tumor level and preoperative neurological symptoms[3,9,10], as well as the influence of tumor level and amount of resection on surgical outcomes[11].

Song et al.[3] identified pain (radicular or local), sensory disturbances, weakness, and sphincter problems as the main complaints in their IDEMST series. Contrarily, another series found no significant correlation between initial complaints and types of pathology[4].

In terms of surgical success, complete tumor removal rates in the literature vary between 57.6% and 98.1%[2,12,13]. Klekamp and Samii reported a complete removal rate of 77%, a subtotal rate of 20%, and a decompressed tumor rate of 3% in their series of 436 cases[4]. In contrast, Stawicki and Guarnaschelli noted that subtotal removal of tumors was associated with poor surgical outcomes[11].

The most commonly reported complication is CSF leakage, with rates varying between 0-4%[6,7,10]. Gezen et al.[8] reported a CSF leakage rate of 3% and a wound infection rate of 6%. Another study noted a complication rate of 33%, with a CSF leakage rate of 16.6%[3]. Mortality rates in various series range from 0-3%, with pulmonary embolism, aspiration pneumonia, stroke, and myocardial infarction cited as the most common causes[6,7,10].

Ahn et al.[5] analyzed the correlation between the ratio of intracanal tumors (referred to as "ratio A" in our study) and preoperative pain severity, as well as the Nurick staging system in their 11-case series. They observed that both pain and Nurick scores increased with tumor size. This underscores the complex interplay between tumor characteristics and clinical outcomes, highlighting the need for precise and individualized surgical approaches to optimize patient results in IDEMST management.

They reported an average intracanal tumor ratio of 82.9±9.4% but found no significant correlation between this ratio and preoperative symptoms, symptom duration, or tumor location. Similarly, Schaller assessed tumor size based on the longest diameter on axial MRI slices and found no significant correlation between tumor size and postoperative improvement or worsening[14].

Namer et al.[15] reported in their 22-case spinal meningioma series that 86.5% of their cases showed complete or partial recovery in long-term follow-up exams. Roux et al.[16] reported the same rate as 85% in their series and found no correlation between sex, age, pathological diagnosis, and functional outcomes. Schaller reported no worsening after surgery in 75.75% of his cases and that the recovery rate was higher for cases under 60 years of age but decreased as the preoperative symptoms increased. He found no significant correlation between sex and functional outcomes[14]. Gottfried et al.[10] reported in their literature review on spinal meningiomas that functional recovery rates ranged from 53% to 95%, and deterioration rates varied between 0% and 10%.

Prevedello et al.[1] reported functional improvements in 56.8% of their 44 IDEMST case series during long-term control examinations, stable condition in 31.8%, and functional deterioration in 11.4%; they indicated a significant correlation between thoracic level tumors and advanced age with a poor prognosis. In another literature review of 556 cases conducted to evaluate the surgical management and outcomes of spinal meningiomas, whether neurological findings improved or not during long-term postoperative follow-up of the cases was evaluated. It was reported that 53-95% of the cases improved, and 0-10% deteriorated, but this study did not investigate the factors affecting the prognosis[10]. Solero et al.[7] evaluated preoperative and postoperative motor findings of their cases in their 174-case intradural extramedullary spinal meningioma series; they reported that early surgery and microsurgery significantly improved surgical results among the parameters they evaluated.

The most comprehensive series to date on spinal tumors is the one in which Klekamp and Samii evaluated 868 cases and 1081 tumors they operated on between 1978 and 2003[4]. They operated on 553 IDEMSTs in their series. Klekamp and Samii detailed the complete resectability of the tumors, the postoperative clinical conditions of the cases, whether the condition of the cases regressed during long-term follow-ups, the recurrence rates of the tumors, and the life span of the cases. They evaluated the functional neurological status of the cases before and after surgery using the Karnofsky score. They reported that the average Karnofsky scores of all cases increased from 70±15 to 81±16 due to long-term postoperative follow-ups. They reported that the amount of tumor resection affected long-term surgical results. The Karnofsky scores of the cases from which the tumors were subtotally removed tended to decrease statistically significantly after the 6th month. They reported that they did not detect a decrease in the Karnofsky scores of any cases from whom the tumor or tumors were entirely removed. When they examined the Karnofsky scores at the first-year controls, they reported that the control scores of the cases with high preoperative Karnofsky scores were significantly higher than the other cases. Sequentially, they reported that the first-year Karnofsky scores of the cases without postoperative dysesthesia syndrome, without NF diagnosis, with short symptom duration, and without arachnoid adhesions detected during surgery were also high. They also reported that even cases with severe neurological deficits before surgery could significantly benefit from surgery, but these cases very rarely showed complete recovery. In our study, the average preoperative and postoperative Karnofsky scores of the cases are 77.84±16.40 and 86.27±17.54, respectively. The average change in Karnofsky scores is 10.4±10.49. No decrease was observed in the postoperative Karnofsky score of any case.

The complete resection of IDEMST is one of the most successful procedures in neurosurgery. The postoperative period offers the possibility of improvement or even complete resolution of all symptoms and findings. Studies have shown that even in elderly patients, significant reduction or disappearance of neurological deficits can be achieved after surgery, highlighting the importance of tumor removal regardless of the patient's age.

Although studies investigating the management of IDEMST, factors affecting neurological findings, and prognostic factors have been conducted, the number of reliable radiological and clinical evaluations and studies with an adequate number of cases needs to be increased due to the rarity of IDEMST.

Surgical excision of IDEMST is a safe and effective treatment method. Complete neurological recovery can be achieved by performing surgical interventions without the development or progression of motor deficits. In our study, we evaluated the early postoperative outcomes of the cases and observed no deterioration compared to the preoperative period. Rare studies investigating factors that affect surgical outcomes in IDEMST have focused on long-term results. The long-term neurological outcomes of the cases would be better than the early outcomes due to factors such as applied physiotherapy and the resolution of spinal cord edema and secondary damage in the early postoperative period.

Ahn et al.[5] reported a statistically significant correlation between tumor size and preoperative neurological findings and symptoms using their tumor size calculation method in an 11-case study. Our study with 51 cases did not find a statistically significant correlation between this calculation method (ratio A) or the method we developed (ratio B) and preoperative neurological status or postoperative outcomes. However, we observed that cases with higher ratio B values had more extended postoperative hospital stays compared to cases with higher ratio A values (p=0.079, p=0.38), ependymoma cases had higher mean ratio A and B values (73.54 and 59.87), cervical level tumors had higher mean ratio A and B values (78.04 and 60.30), as the ratio A and B values increased, the incidence of preoperative motor deficits increased, the number of cases discharged with GOS 5 increased as the ratio A and B values decreased, improvement in Nurick scores increased as the ratio A and B values decreased, improvement in preoperative and postoperative ASIA scores increased as the ratio A and B values decreased, and cases with no changes in neurological findings after surgery had higher ratio A and B values.

In our study, we observed that as age increased, the rate of improvement in cases decreased, and preoperative and postoperative Karnofsky scores decreased. Cases with deteriorating preoperative and postoperative neurological conditions had more extended hospital stays. Early operated cases showed more pronounced improvement in postoperative neurological function. Ependymoma cases had better preoperative and postoperative neurological function. Meningioma and thoracic-level tumor cases significantly improved more than in the preoperative period. Thoracic-level tumors were associated with more prominent motor deficits and other neurological findings. Male cases had better preoperative and postoperative neurological conditions. Improvement in postoperative neurological function was more pronounced as the severity and duration of preoperative neurological findings decreased. These findings indicate that various demographic, tumor-specific, anatomical, and functional neurological factors may affect the surgical outcomes of IDEMST. Although these relationships were statistically significant in this study, further studies with larger populations and evaluation of multiple parameters are needed to understand the factors influencing the surgical management and outcomes of IDEMST.

This study has several limitations. The retrospective nature of this study introduces inherent limitations, including the potential for selection bias, incomplete data, and uncontrolled confounding variables. While efforts were made to gather comprehensive data from medical records, the accuracy and completeness of the information might be compromised. The study's sample size of 51 patients may limit the generalizability of the findings. Intradural extramedullary spinal cord tumors are relatively rare, and the small cohort might not adequately represent the full spectrum of these tumors and their associated outcomes. The study was conducted at a single center, which might lead to institutional biases and a limited representation of diverse patient populations and surgical practices. The study's focus on short- to medium-term outcomes restricts the ability to assess the long-term effects of surgical intervention on patient quality of life, recurrence rates, and survival.

Conclusion

The findings of this study highlight the multifaceted nature of factors influencing surgical outcomes in IDEMST cases. Notably, advanced patient age was associated with a decreased rate of improvement, indicative of the potential challenges posed by age-related physiological changes and comorbidities. Moreover, the analysis revealed that tumor level within the spinal cord has a discernible impact on surgical outcomes. The variations in motor deficits and other neurological findings observed among thoracic-level tumor cases emphasize the critical importance of considering anatomical localization when assessing prognosis and planning surgical strategies.

The integration of patient-specific functional assessments, such as the Karnofsky and Nurick scores, provides a comprehensive framework for evaluating surgical outcomes beyond mere radiological measures. The correlation between preoperative and postoperative scores, as well as the observed improvements in cases with less severe preoperative neurological findings, emphasize the critical role of these functional assessments in predicting postoperative neurological recovery.

Furthermore, this study acknowledges the influence of gender on preoperative and postoperative neurological conditions, with male patients demonstrating better outcomes. This intriguing observation prompts further exploration into potential gender-related biological and physiological factors that might contribute to differential recovery rates.

In summary, this study's findings contribute to the growing body of evidence supporting surgical excision as an effective and safe treatment option for intradural extramedullary spinal cord tumors. By identifying and examining the interplay of age, tumor level, pathology, functional scores, and gender, this study advances our understanding of the nuanced factors affecting patient outcomes. To comprehensively address the challenges posed by these tumors and optimize surgical management, future research endeavors should adopt prospective designs with larger and more diverse patient cohorts, standardized assessment tools, and longer follow-up durations.

Ethics Committee Approval: This study was conducted in accordance with the Declaration of Helsinki.

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