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Clinicopathological Profile, Surgical Management, and Neurological Outcomes of Spinal Cord Tumors: A Five-Year Tertiary Care Experience

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Abstract: ***Background: Spinal cord tumors constitute a heterogeneous group of lesions arising from extradural, intradural extramedullary, and intramedullary compartments. Although uncommon, they are an important cause of progressive neurological disability. Early diagnosis using magnetic resonance imaging (MRI) followed by timely surgical intervention remains the cornerstone of management. Histopathological examination is essential for definitive diagnosis and guides postoperative treatment and prognosis. Understanding the clinicopathological spectrum and surgical outcomes in different populations is important for improving patient care. Objectives: To evaluate the demographic profile, anatomical distribution, histopathological spectrum, surgical management, and postoperative neurological outcomes of patients undergoing surgery for spinal cord tumors at a tertiary care teaching hospital. Methods: A retrospective observational study was conducted in the Department of Neurosurgery, Kurnool Medical College and Government General Hospital. Thirty-five consecutive patients who underwent surgery for spinal cord lesions with histopathological confirmation between June 2021 and June 2026 were included. Demographic details, clinical presentation, MRI findings, anatomical location, compartmental distribution, operative procedures, histopathological diagnosis, and postoperative neurological outcomes were reviewed from hospital records and analyzed descriptively. Results: Thirty-five patients with an age range of 4–77 years underwent surgical treatment. Females slightly outnumbered males. Thoracic lesions were the most common anatomical location. Extradural lesions constituted the largest compartment, followed by intradural extramedullary lesions. Schwannoma was the most frequent benign tumor, whereas metastatic tumors represented the predominant malignant pathology. Gross total excision was the commonest surgical procedure. Most patients demonstrated postoperative neurological improvement, while only a small proportion experienced neurological deterioration. Conclusion: Spinal cord tumors demonstrate considerable clinicopathological diversity. Careful clinicoradiological evaluation, accurate localization, histopathological confirmation, and individualized surgical planning are associated with favorable neurological outcomes. Early diagnosis and prompt surgical intervention remain the key determinants of successful management.***

Keywords: Spinal cord tumor; Schwannoma; Meningioma; Intradural extramedullary; Intramedullary; Extradural; Neurosurgery; Surgical outcome

1. Introduction

Spinal cord tumors are a heterogeneous group of lesions arising from the vertebral column, meninges, nerve roots, or spinal cord parenchyma. Although they account for a relatively small proportion of all central nervous system tumors, they are associated with significant morbidity because of their proximity to critical neural structures. Progressive spinal cord compression frequently results in pain, motor weakness, sensory disturbances, gait impairment, autonomic dysfunction, and permanent neurological disability if diagnosis or treatment is delayed. Consequently, early recognition and timely surgical intervention are essential for preserving neurological function and improving quality of life.

Spinal tumors are commonly classified according to their anatomical location into extradural, intradural extramedullary (IDEM), and intramedullary lesions. Extradural tumors constitute the majority of spinal lesions and are predominantly metastatic in origin, although primary vertebral tumors, plasma cell neoplasms, infectious granulomas, and other pathological entities may also occur. Intradural extramedullary tumors originate from the meninges or nerve roots and include schwannomas, neurofibromas, and meningiomas, which are generally benign and amenable to complete surgical excision. Intramedullary tumors arise within the spinal cord substance and commonly include astrocytomas and ependymomas, posing greater surgical challenges because of their intimate relationship with functional neural tissue.

The clinical manifestations of spinal tumors depend upon the anatomical compartment, level of involvement, biological behavior, and duration of symptoms. Localized spinal pain is often the earliest symptom and may precede neurological deficits by several months. Progressive weakness, sensory disturbances, gait instability, sphincter dysfunction, and radicular pain usually develop as the lesion enlarges and produces spinal cord or nerve root compression. Because these symptoms often mimic degenerative spinal disorders or inflammatory diseases, diagnosis may be delayed, resulting in irreversible neurological injury. Therefore, maintaining a high index of suspicion and obtaining appropriate neuroimaging are essential for early diagnosis.

Magnetic resonance imaging (MRI) has revolutionized the evaluation of spinal tumors by providing excellent soft tissue resolution, precise localization, assessment of lesion extent, relationship to surrounding neural structures, and characteristic imaging features that help narrow the differential diagnosis. MRI also plays an indispensable role in preoperative planning by demonstrating spinal cord compression, vertebral involvement, foraminal extension, cystic changes, hemorrhage, edema, and contrast enhancement patterns. Nevertheless, imaging findings alone are insufficient for establishing a definitive diagnosis, and histopathological examination remains the gold standard for

confirming tumor type and guiding postoperative management.

Advances in microsurgical techniques, operative microscopy, neuroanesthesia, spinal instrumentation, and perioperative neurocritical care have significantly improved the safety of spinal tumor surgery over the past two decades. The primary goals of surgical treatment include obtaining tissue diagnosis, achieving maximal safe tumor excision, relieving neural compression, restoring or maintaining spinal stability when necessary, preventing recurrence, and maximizing postoperative neurological recovery. Surgical strategy should be individualized according to tumor pathology, anatomical compartment, spinal level, extent of disease, neurological status, and overall patient condition. Although gross total excision is feasible for many benign intradural extramedullary tumors, subtotal excision or biopsy may be appropriate for infiltrative intramedullary tumors or extensive malignant lesions where aggressive resection carries an unacceptable neurological risk.

Despite improvements in diagnostic imaging and operative techniques, spinal tumors continue to present considerable diagnostic and therapeutic challenges. The clinicopathological spectrum varies among institutions depending on referral patterns, demographic characteristics, disease prevalence, and healthcare accessibility. Regional data from tertiary care centers remain valuable because they contribute to understanding local disease patterns, facilitate comparison with published literature, and help optimize surgical management strategies. Furthermore, analysis of postoperative neurological outcomes provides important information regarding the effectiveness of contemporary surgical treatment and assists in counseling patients regarding prognosis.

The present retrospective observational study was therefore undertaken to evaluate the demographic characteristics, anatomical distribution, compartmental localization, histopathological spectrum, operative management, and postoperative neurological outcomes of surgically managed spinal cord lesions treated at the Department of Neurosurgery, Kurnool Medical College and Government General Hospital over a five-year period. By correlating clinical presentation, radiological findings, histopathological diagnosis, and surgical outcome, this study aims to contribute meaningful institutional data to the existing literature and provide insights that may improve the management of patients with spinal cord tumors in tertiary care settings.

2. Materials and Methods

Study Design

This retrospective observational study was conducted in the Department of Neurosurgery, Kurnool Medical College, Kurnool, Andhra Pradesh, India. The study evaluated patients who underwent surgical management for spinal cord lesions at Government General Hospital, Kurnool, between June 2021 and June 2026. Clinical records, neuroimaging findings, operative notes, histopathological reports, and postoperative follow-up records were reviewed from the departmental database.

Study Population

A total of 35 consecutive patients with histopathologically confirmed spinal cord lesions were included in the study. Only patients who underwent surgical intervention and had complete demographic, radiological, operative, histopathological, and postoperative neurological data were included for analysis. The study population comprised patients aged 4 to 77 years, representing both pediatric and adult age groups. All patient identifiers were anonymized before analysis to maintain confidentiality.

Inclusion Criteria

Patients fulfilling all of the following criteria were included:

- Histopathologically confirmed spinal cord lesion.
- Surgical treatment performed in the Department of Neurosurgery during the study period.
- Availability of complete clinical records.
- Availability of preoperative MRI.
- Documented postoperative neurological assessment.

Exclusion Criteria

Patients were excluded if they had:

- Incomplete medical records.
- No histopathological confirmation.
- Conservative (non-operative) management.
- Revision surgery performed elsewhere.
- Inadequate postoperative follow-up documentation.

Data Collection

Clinical information was retrieved from inpatient case records, operative registers, radiological reports, and histopathology reports. The following variables were collected: age, sex, clinical presentation, anatomical spinal level, MRI characteristics, anatomical compartment, surgical procedure performed, histopathological diagnosis, and postoperative neurological status.

The lesions were categorized anatomically into cervical, cervicodorsal, thoracic, thoracolumbar, and lumbar. Based on MRI and intraoperative findings, lesions were further classified into extradural, intradural extramedullary (IDEM), intramedullary, and other rare compartments where applicable. Histopathological diagnosis was established following examination of surgically excised specimens by the Department of Pathology and served as the definitive diagnosis for all included cases.

Radiological Evaluation

All patients underwent preoperative Magnetic Resonance Imaging (MRI) of the involved spinal region. MRI was used to determine the exact vertebral level of the lesion, anatomical compartment, size and extent of the lesion, degree of spinal cord compression, presence of surrounding edema, contrast enhancement pattern, and associated vertebral destruction or spinal instability. Radiological findings were correlated with intraoperative observations and final histopathological diagnosis.

Surgical Management

The surgical procedure was individualized according to anatomical location, histopathological suspicion, neurological status, extent of neural compression, and presence of spinal instability. Procedures included

laminectomy with gross total excision, laminectomy with subtotal excision, decompression with biopsy, decompression with spinal stabilization, and cyst excision. Whenever feasible, gross total excision was attempted while preserving neurological function. In infiltrative lesions or tumors densely adherent to neural structures, subtotal excision or biopsy was performed to minimize the risk of neurological deterioration.

Histopathological Examination

All excised specimens were fixed in formalin and examined by experienced pathologists. Histopathological diagnosis was considered the reference standard for final classification of lesions. Tumors were categorized into benign, malignant, inflammatory, infectious, and cystic lesions according to established pathological criteria.

Outcome Assessment

Postoperative neurological status was assessed during hospitalization and follow-up using clinical neurological examination. Outcomes were categorized as Improved (improvement in motor power, sensory function, gait, sphincter control, or pain compared with preoperative status), Stable (no significant neurological change), and Worsened (development of new neurological deficits or deterioration). The primary outcome measure was postoperative neurological status. Secondary outcome measures included histopathological spectrum, anatomical distribution, compartmental distribution, and type of surgical procedure performed.

Statistical Analysis

Clinical data were entered into Microsoft Excel and analyzed using Statistical Package for the Social Sciences (SPSS), Version 2023. Continuous variables were summarized using mean, standard deviation, median, and range. Categorical variables were expressed as frequencies and percentages. Results were presented using tables and descriptive summaries.

Ethical Considerations

The study was conducted in accordance with ethical principles outlined in the Declaration of Helsinki. Patient confidentiality was strictly maintained by anonymizing all identifiable information. Institutional ethical approval was obtained before commencement of the study.

3. Results

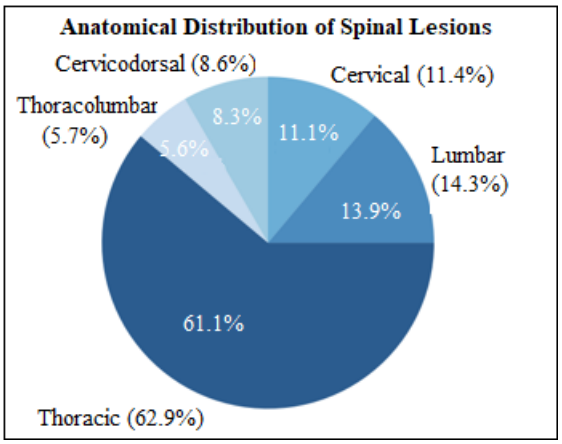
Demographic Characteristics

A total of 35 patients with histopathologically confirmed spinal cord lesions underwent surgical treatment during the study period. The patients ranged in age from 4 to 77 years, with a mean age of 46.4 years. The highest number of patients belonged to the 41–60-year age group. Among the study population, 20 patients (57.1%) were female, and 15 patients (42.9%) were male (female-to-male ratio ~1.3:1).

Anatomical Distribution

The thoracic spine was the most frequently involved anatomical region, accounting for 22 cases (62.9%). Lumbar lesions constituted 5 cases (14.3%), cervical 4 cases (11.4%), cervicodorsal 3 cases (8.6%), and thoracolumbar junction 2 cases (5.7%).

Region	Number	Percentage (%)
Thoracic	22	62.9
Lumbar	5	14.3
Cervical	4	11.4
Cervicodorsal	3	8.6
Thoracolumbar	2	5.7



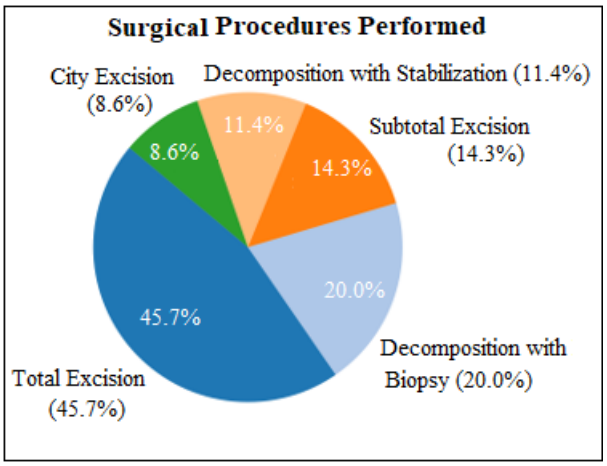
Compartmental Distribution & Histopathological Spectrum

Extradural lesions constituted the largest group, followed by intradural extramedullary (IDEM) lesions and intramedullary tumors. Histopathological examination demonstrated a broad spectrum of lesions. Schwannoma was the most frequently encountered benign tumor, followed by meningioma, neurofibroma, ependymoma, and astrocytoma. Malignant lesions primarily consisted of metastatic carcinoma, metastatic adenocarcinoma, lymphoma, and plasmacytoma. Inflammatory and infective lesions included tuberculomas and spinal tuberculosis.

Surgical Procedures

Laminectomy with gross total excision was the most commonly performed procedure (16 patients, 45.7%), followed by decompression with biopsy (20.0%), subtotal excision (14.3%), decompression with stabilization (11.4%), and cyst excision (8.6%).

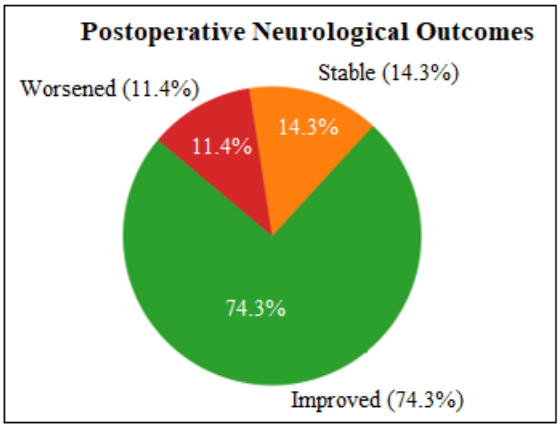
Procedure	Number	Percentage (%)
Laminectomy with Gross Total Excision	16	45.7
Laminectomy with Subtotal Excision	5	14.3
Decompression with Biopsy	7	20.0
Decompression with Stabilization	4	11.4
Cyst Excision	3	8.6



Postoperative Neurological Outcome

Of the 35 patients, 26 (74.3%) demonstrated neurological improvement, 5 (14.3%) remained stable, and 4 (11.4%) experienced neurological deterioration. Overall, 88.6% of patients achieved a favorable outcome.

Outcome	Number	Percentage (%)
Improved	26	74.3
Stable	5	14.3
Worsened	4	11.4



4. Discussion

The present retrospective observational study evaluated 35 surgically managed spinal cord lesions over a five-year period. The findings highlight the diverse clinicopathological spectrum of spinal lesions and reinforce the critical role of early diagnosis and timely surgical intervention in achieving favorable neurological recovery.

The mean age of patients was 46.4 years, with a peak incidence in the 41–60 age group, consistent with global literature. A slight female predominance (57.1%) was observed, largely driven by the higher frequency of meningiomas among females. The thoracic spine was the most common anatomical location (62.9%), reflecting the greater length of the thoracic spinal canal and susceptibility to metastatic and compressive lesions.

Histopathologically, schwannoma was the most common benign tumor, followed by meningioma, while metastatic lesions predominated among malignant pathologies. Gross total excision was achieved predominantly in benign IDEM tumors, whereas infiltrative and malignant tumors required decompression or biopsy to preserve neurological function. Approximately 88.6% of patients achieved favorable neurological outcomes (improved or stable), underscoring the efficacy and safety of contemporary microsurgical techniques.

Limitations of this study include its retrospective design, single-center experience, relatively small sample size, and lack of extensive long-term functional and survival follow-up. Future multicenter prospective studies are warranted to further evaluate long-term prognostic factors.

5. Conclusion

Spinal cord tumors represent a diverse clinicopathological entity requiring meticulous preoperative evaluation, histopathological confirmation, and individualized surgical management. Thoracic spine involvement and extradural pathology were most prevalent in this cohort. Schwannomas and meningiomas represented the principal benign tumors, whereas metastatic lesions were the primary malignant etiology. With timely surgical intervention and precise microsurgical techniques, the vast majority of patients achieve significant neurological improvement or stabilization, establishing surgery as the cornerstone of effective management.

Declarations

Ethics Statement

Conducted using anonymized patient records from Kurnool Medical College and Government General Hospital in accordance with ethical standards.

Funding

No external funding was received.

Conflict of Interest

The authors declare no conflicts of interest.

Author Contributions

Dr. K. Giridhar Nayak: Conceptualization, data collection, drafting. Dr. Ram Balaji Naik: Supervision, surgical guidance, revision.

Data Availability Statement

Available from the corresponding author upon reasonable request.

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References

[1] Louis DN, Perry A, Wesseling P, Brat DJ, Cree IA, Figarella-Branger D, et al. The 2021 WHO Classification of Tumors of the Central Nervous System: a summary. Neuro Oncol. 2021;23(8):1231–1251.

[2] Greenberg MS. Handbook of Neurosurgery. 9th ed. New York: Thieme Medical Publishers; 2019.
[3] Klekamp J. Spinal Tumors. Berlin: Springer; 2015.
[4] McCormick PC. Intradural extramedullary tumors of the spine. Neurosurg Clin N Am. 1990;1(3):591–608.
[5] Sundaresan N, DiGiacinto GV, Hughes JE, Cafferty M, Vallejo A. Treatment of neoplastic spinal cord compression: results of a prospective study. Neurosurgery. 1991;29(5):645–650.
[6] Chamberlain MC, Tredway TL. Adult primary intradural spinal cord tumors: a review. Curr Neurol Neurosci Rep. 2011;11(3):320–328.
[7] Arnautovic KI, Arnautovic A. Extramedullary intradural spinal tumors: a review of modern diagnostic and treatment options and a report of a series. Neurosurg Focus. 2007;22(1):E16.
[8] Setzer M, Vatter H, Marquardt G, Seifert V, Vrionis FD. Management of spinal meningiomas: surgical results and a review of the literature. Neurosurg Focus. 2007;23(4):E14.
[9] Safaee M, Lyon R, Barbaro NM, Chou D, Mummaneni PV, Weinstein PR, et al. Neurological outcomes and surgical complications in spinal schwannomas. J Neurosurg Spine. 2017;26(1):103–111.
[10] Bilsky MH, Laufer I, Fourney DR, Groff M, Schmidt MH, Varga PP, et al. Reliability analysis of the epidural spinal cord compression scale. Spine. 2010;35(13):1221–1226.
[11] Fehlings MG, Nater A, Tetreault L, Kopjar B, Arnold PM, Dekutoski MB, et al. Survival and clinical outcomes in surgically treated metastatic spinal tumors. Spine. 2016;41(Suppl 20):S218–S225.
[12] Jain AK. Tuberculosis of the spine: a fresh look at an old disease. J Bone Joint Surg Br. 2010;92(7):905–913.
[13] Kumar R. Spinal tuberculosis: current concepts. Neurol India. 2005;53(4):443–448.
[14] Ozawa H, Kokubun S, Aizawa T, Hoshikawa T, Kawahara C. Spinal cord astrocytomas and ependymomas: surgical treatment and outcomes. Spinal Cord. 2004;42(3):171–178.
[15] Conti P, Pansini G, Mouchaty H, Capuano C, Conti R. Spinal neurinomas: retrospective analysis and long-term outcome. Acta Neurochir (Wien). 2004;146(10):1021–1029.
[16] Boström A, Bürgel U, Reinacher P, Krings T, Rohde V, Gilsbach JM, et al. Long-term outcome after surgical treatment of spinal meningiomas. Eur Spine J. 2008;17(9):1245–1251.
[17] Samartzis D, Gillis CC, Shih P, O'Toole JE, Fessler RG. Epidemiology of primary spinal osseous tumors and tumor-like lesions. Spine J. 2015;15(5):1037–1052.
[18] Vrionis FD, Germano IM, editors. Spinal Oncology. Neurosurg Clin N Am. 2004;15(4):1–150.