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"CLINICAL AND SURGICAL OUTCOMES OF DORSAL SPINE INTRADURAL EXTRAMEDULLARY SPACE-OCCUPYING LESIONS: A PROSPECTIVE INSTITUTIONAL EXPERIENCE"

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Abstract

Background

Space-occupying lesions (SOLs) within the spinal canal can cause compression and distortion of nearby neural tissue. These lesions create space by causing atrophy in the surrounding spinal tissue, leading to neurological deficits. While advancements in neuroimaging techniques have significantly transformed neurologic diagnosis in recent decades, the definitive diagnosis of any central nervous system SOL still requires histological examination of tissue obtained through surgical biopsy.

Aims

To assess the outcome of space-occupying lesions in the spinal region and assess the prevalence of different lesions, including their clinical characteristics based on age, gender, compartmental distribution, and the specific spinal levels affected.

Materials and methods

In this prospective study spanning 1 year at a well-equipped tertiary care hospital in India with a neurosurgery department, 12 specimens (biopsy and surgical) from spinal cord and adjacent structure lesions were examined. The study included indoor patients from the neurosurgery department exhibiting clinical signs, symptoms, and imaging features indicative of spinal space-occupying lesions (SOL). Exclusions comprised primary bone tumors and congenital anomalies, including vascular malformations not involving the cord.

Results

The prevalent age group affected was 41-60 years, with an average age of 47 years, and a higher incidence among females. Neoplastic lesions constituted the majority at 87%, primarily benign or low-grade. Meningioma emerged as the most frequent histologic diagnosis, followed by schwannoma.

Conclusion

Tissue diagnosis is crucial given the diverse range of lesions in the spinal region, each with distinct prognoses and treatment approaches.

Recommendations

Early diagnosis and prompt surgical intervention are essential for managing dorsal spine intradural extramedullary lesions, attention should be given to common diagnoses like meningiomas and schwannomas, to ensure timely and effective treatment.

Keywords: *Spinal space-occupying lesion, pathologic spectrum, Histopathology, spinal lesion*
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Introduction

Approximately two-thirds of primary spinal tumors and 15% of tumors in the central nervous system are intradural extramedullary (IDEM) tumors, which are often benign. Although surgical removal is generally regarded as the best course of action, detailed treatment guidelines are missing due to their rarity. Surgeons must attempt to remove the tumor entirely while maintaining spinal stability and preoperative neurological removal plagiarism function because of the anatomical position of these tumors and the limited surgical area. (1) To reduce problems and improve functional results in intradural tumor procedures, advances in imaging, neuromonitoring, and minimally invasive approaches have been created. The research is still divided on the true therapeutic advantages of these novel surgical approaches for extramedullary lesions, though.

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Because it may identify neurological damage in real-time and perhaps direct corrective removal plagiarism procedures, intraoperative neurophysiological monitoring (IONM) has become a useful tool during surgery, aiding in the prediction of both short- and long-term clinical outcomes. (2,3) The importance of IONM in spinal surgeries has been further supported by class I evidence from the literature, leading to a growing number of publications and scientific meetings on the topic. However, only a small number of studies have provided substantial evidence of its role in IDEM tumor surgeries to remove plagiarism. .(4,5)

This study aimed to evaluate the outcomes of spinal region space-occupying lesions and analyze their prevalence and clinical characteristics. It focused on identifying the types of lesions and their distribution concerning age, gender, and spinal compartments. The research also examined the specific spinal levels most frequently affected, providing a comprehensive understanding of the clinical and demographic patterns associated with these lesions. By correlating these findings with patient outcomes, the study sought to enhance diagnostic accuracy and therapeutic approaches for managing spinal lesions.

Material and methods

Study Design

Prospective observational study

Study setting

Department of Neurosurgery, Madurai Medical College, Madurai

Participants

Inclusion criteria

1. Confirmed cases of dorsal spine intradural extramedullary (IDE) space-occupying lesions based on MRI findings.
2. Patients presenting with clinical symptoms such as back pain, radiculopathy, sensory deficits, motor weakness, or bowel/bladder dysfunction attributable to the IDE lesion.
3. Patients deemed fit for surgical intervention after preoperative evaluation.
4. Patients ready to give consent

Exclusion Criteria

1. Patients with lesions located in the cervical or lumbar spine, or intramedullary lesions.
2. Patients with a history of prior spinal surgery in the affected region.
3. Patients with uncontrolled systemic diseases (e.g., severe cardiac or respiratory conditions) contraindicating surgery.
4. Cases with active spinal infections or primary/metastatic malignancy involving the dorsal spine.
5. Pregnant patients to avoid risks associated with imaging and surgery.

Sample size

The sample size for the study was determined based on the study duration. Over the entire study period, 12 subjects who met the inclusion and exclusion criteria were selected.

Patient recruitment

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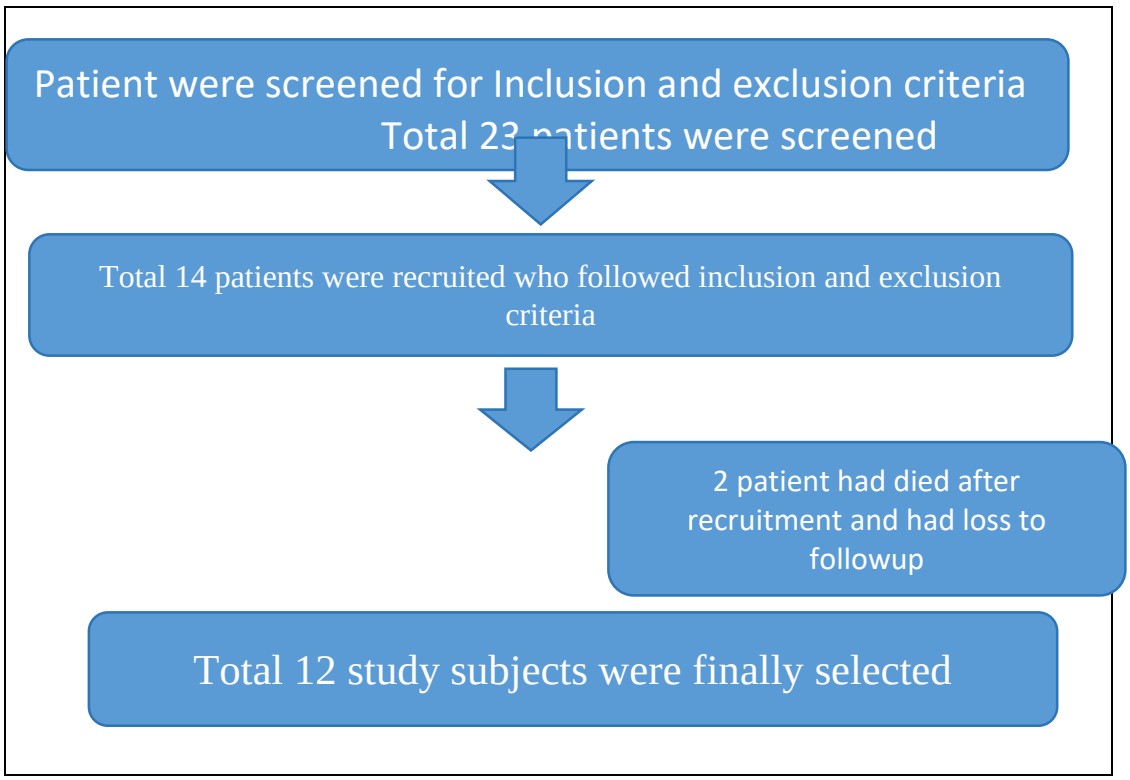

The patient's medical history, physical examination findings, and radiological examination records were obtained. Patient registration details, symptom duration, and the nature of complaints were documented. Preoperative pain severity was evaluated using the Denis Pain Scale (DPS), while functional status was assessed using the Frankel grading system. Written informed consent was obtained from all patients and their representatives, confirming their participation in the study and follow-up process. Each patient underwent a contrast-enhanced MRI of the spine as part of the initial surgical evaluation. The tumor's location on sagittal and axial MRI images was noted preoperatively. Following the necessary investigations, patients were scheduled for elective laminectomy and gross total tumor excision under general anesthesia.

In this study, a microsurgical facet-sparing posterior approach was employed in all cases. After performing a laminectomy and exposing the dura, the dura was opened, and the arachnoid was incised to allow for tumor mobilization. Tumor decompression was initiated using a Cavitronic ultrasonic aspirator. No attempts were made to dissect the tumor until its core had been removed, leaving only a thin rim of the tumor capsule, as attempting to remove the tumor without reducing its bulk could risk damaging nearby normal neural structures. The tumor's dural origin was coagulated using a bipolar coagulator. In cases of schwannoma, the affected nerve root was typically coagulated and cut, while for meningiomas, the involved dura was either excised or, more commonly, completely coagulated. Tumor excision was performed using an operating microscope, and the dura was primarily closed with 4-0 Proline sutures. Closed wound suction drainage was applied in all cases. Patients were able to walk within a few hours post-surgery and were typically discharged on the 2nd or 3rd day after drain removal. For meningioma patients where the dural repair was not feasible, a thoracolumbar fascia or fat graft was applied over the defect and covered with a gelatin sponge. These patients were kept on bed rest in the prone position with a wound drain for 4–5 days before mobilization, and this technique largely prevented cerebrospinal fluid (CSF) leaks. The goal during meningioma surgeries was to achieve a Simpson Grade 2 resection. Following surgery, the primary outcome assessment was done. Patients were graded postoperatively on the Frankel scale immediately postoperatively, at a two-week follow-up, and six-month follow-up for the evaluation of functional status. The tumor histopathology report was recorded. A postoperative MRI scan was done at six months, whenever required, in patients who underwent subtotal resection or who did not improve symptomatically or functionally.

In the secondary outcome assessment, patients were assessed for remission in pain postoperatively using the DPS during the immediate postoperative period, two weeks, and six months. Complications of the surgical procedure were recorded.

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Frankel grading

A: Complete (no sensory or motor function is preserved)
B: Incomplete (Sensory, but no motor function is preserved below the neurological level)
C: Incomplete (Motor function is preserved below the neurological level, and the majority of key muscles below the neurological level have a muscle power grade of <3)
D: Incomplete (Motor function is preserved below the neurological level, and the majority of key muscles below the neurological level have a muscle power grade of >3)
E: Normal (sensory and motor function is normal).[12]

DPS

P1: No pain
P2: Occasional minimal pain; no need for medication
P3: Moderate pain, occasionally medications; no interruption of work or activities of daily living
P4: Moderate to severe pain, occasionally absent from work; significant changes in activities of daily living
P5: Constant, severe pain; chronic pain medications.
The statistical analysis was done using the Statistical Package for the Social Sciences (SPSS Statistics) version 22 (IBM Corp., Armonk, USA). Paired Student's *t*-test, multivariate analysis of variance, and Mann–Whitney U-test were performed on the data.
We defined a "Significant improvement" as an improvement of ≥2 Frankel grade. Patients with an improvement of <2 Frankel grade or unchanged grade were labeled as having insignificant improvement.

Result

Tab 1: Distribution of study subjects as per age

		Frequency	Percent
Valid	21-30	2	16.7
	31-40	2	16.7
	41-50	4	33.3
	51-60	2	16.7
	61-70	2	16.7
	Total	12	100.0

The age distribution of study subjects shows that the majority (33.3%) are in the 41-50 age group, while the remaining participants are evenly distributed across the 21-30, 31-40, 51-60, and 61-70 age groups, each constituting 16.7%. This indicates a relatively balanced representation of middle-aged and older adults in the study.

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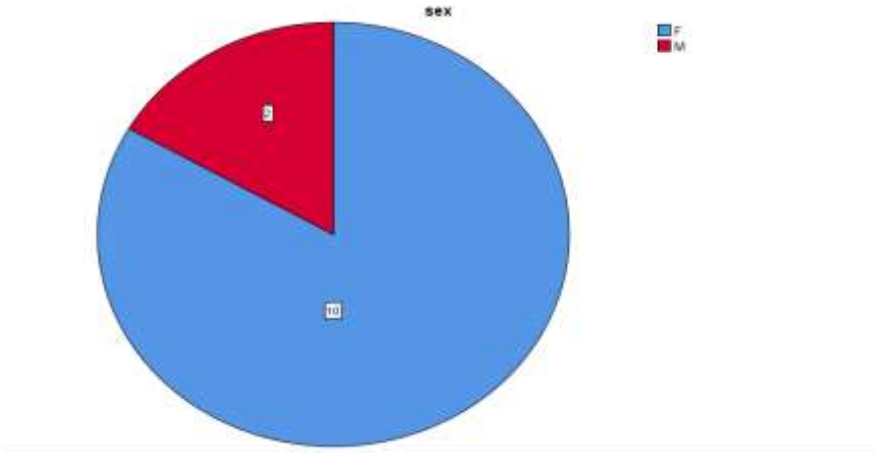
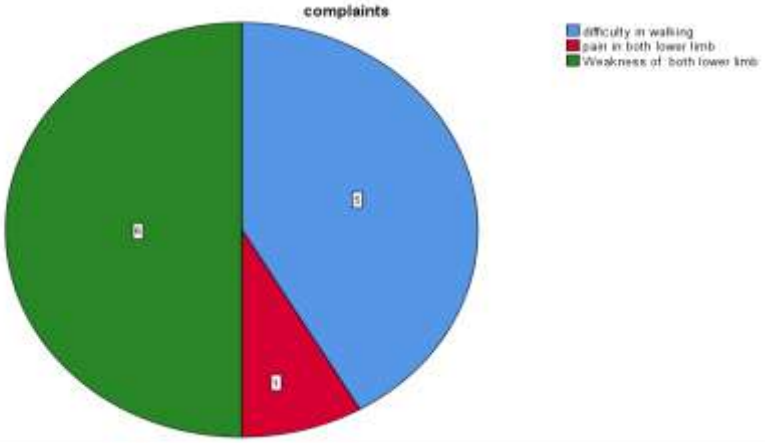
Fig 1: Distribution of study subjects as per sex



The sex distribution of the study subjects shows a predominant representation of females (83.3%), with males accounting for only 16.7%. This indicates a significant gender disparity among the participants.

Fig 2: Distribution of study subjects as per the complaint



The distribution of study subjects based on their complaints reveals that the most common issue is weakness in both lower limbs (50.0%), followed by difficulty in walking (41.7%). Pain in both lower limbs is the least reported complaint, affecting only 8.3% of the participants.

Tab 2: Distribution of study subjects as per Nurick grading

		Frequency	Percent
Valid	4	6	50.0
	5	6	50.0
	Total	12	100.0

The distribution of study subjects according to Nurick's grading shows an equal proportion of participants in grade 4 (50.0%) and grade 5 (50.0%). This indicates that the study population is evenly distributed between these two levels of functional impairment.

Tab 3: Distribution of study subjects as per surgical procedure

		Frequency	Percent
Valid	C7-T1 laminectomy and excision of SOL	2	16.7
	D11-L1 laminectomy and excision of SOL	2	16.7

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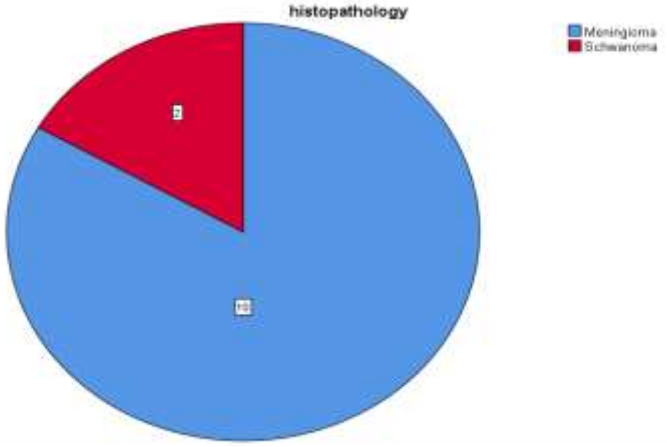
	D3, D4, D5 laminectomy and excision of SOL	2	16.7
	D6, D7, D8 laminectomy and excision of Sol	2	16.7
	D8-D9 laminectomy and excision of SOL	4	33.3
	Total	12	100.0

The distribution of study subjects based on the surgical procedure indicates that the most common procedure was D8-D9 laminectomy and excision of SOL, performed in 33.3% of cases. The remaining procedures—C7-T1, D11-L1, D3-D5, and D6-D8 laminectomies with excision of SOL—were equally distributed, each accounting for 16.7% of the total. This highlights a slightly higher focus on the D8-D9 region in the study.

Fig 3: Distribution of study subjects as per histopathology



The histopathology findings reveal that the majority of cases were diagnosed as meningioma (83.3%), while schwannoma accounted for 16.7% of the cases. This indicates a predominance of meningioma among the study subjects.

In our series, 6/12 (50%) patients had significant improvement of ≥2 grades on Frankel score, and 5/12 (42%) patients had good improvement as per Frankel score at the time of last follow-up, and therefore, 11/12 (91.7%) patients had "good outcome." However, 1 (8.3%) patients had no improvement in postoperative Frankel grade and had "poor outcomes."

Discussion

The evaluation and management of spinal space-occupying lesions (SOLs) present a complex challenge, requiring a multidisciplinary approach due to the diverse nature of these lesions, ranging from neoplastic to non-neoplastic entities.

In a recent study conducted at our institute, we analyzed twelve cases of spinal SOLs diagnosed over a specific period. The findings revealed that the most commonly affected age group was 41-60 years, with an average age of 47 years. Interestingly, this aligns with the findings of Srinivas DD Gubbala et al **(6)**., who reported a majority of cases occurring in the 40-60 years age group. These findings are consistent with previous studies conducted by Gadgil et al.(7) and Moein. p et al **(8)**, further emphasizing the demographic trends observed in spinal SOLs.

Overall, the multifaceted nature of spinal SOLs underscores the importance of a comprehensive approach to their evaluation and management. Early detection, accurate diagnosis, and timely intervention are paramount in optimizing outcomes for patients affected by these conditions. Collaboration among various medical specialties is essential to navigate the intricacies associated with these lesions and provide patients with the best possible care.

The differing findings regarding the gender distribution of spinal lesions between the present study and the study conducted by Srinivas DD Gubbala et al **(6).** highlight the complexity and variability in epidemiological patterns of spinal SOLs. In the present study, a higher incidence was observed among females, contrasting with the male preponderance reported by Srinivas DD Gubbala et al. **(6)**, except in the case of meningiomas where female predominance was evident. Several factors could contribute to these differences in gender distribution across studies. Firstly, variations in the study populations, including demographics and geographic locations, may influence the observed gender disparities. Additionally, differences in study methodologies, such as sample size, selection criteria, and diagnostic techniques, can also impact the reported findings.

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The distribution of study subjects based on their complaints highlights a significant prevalence of lower limb weakness, which was reported by 50.0% of the participants. This suggests that weakness in both lower limbs is a major concern among the study population, potentially indicating a more severe neurological or muscular condition. Difficulty in walking was also a common complaint, affecting 41.7% of participants, further emphasizing mobility issues within the group. In contrast, pain in both lower limbs was the least reported issue, affecting only 8.3% of the subjects. This could indicate that while some participants experience discomfort, the primary complaint appears to be related to functional limitations, such as weakness and difficulty in movement, rather than pain.

Furthermore, the specific types of spinal lesions included in each study may contribute to the observed gender differences. For instance, the present study may have included a higher proportion of lesions that are more commonly seen in females, leading to the observed higher incidence among females. Conversely, Srinivas DD Gubbala et al **(6)**. may have focused on lesions that typically affect males, resulting in their reported male preponderance.

The findings from the present study regarding the predominance of neoplastic lesions, particularly benign or low-grade tumors, reflect a common trend observed in spinal tumor epidemiology. Neoplastic lesions accounted for the majority of cases, with a significant proportion being benign, aligning with previous research indicating that benign tumors are more prevalent in the spinal region compared to malignant tumors.

Meningioma emerged as the most frequent histologic diagnosis in the present study, followed by schwannoma, which is consistent with findings from Srinivas DD Gubbala et al. (6) and other reference studies. The predominance of meningiomas in the 40-60 years age group and the observed female preponderance align with established epidemiological patterns documented in numerous national and international studies.

The clinical presentation of patients with spinal tumors, as described in the present study, commonly includes localized or radicular pain, motor deficits, and sensory deficits. These symptoms reflect the varied neurological manifestations associated with spinal cord compression or irritation by the tumor mass, highlighting the importance of recognizing and promptly addressing these symptoms for early diagnosis and intervention.

Conclusion

The study demonstrates a predominantly middle-aged and female cohort, with lower limb weakness and difficulty in walking as the most common complaints. A balanced distribution of participants across Nurick's grades 4 and 5 suggests significant functional impairment. The majority of patients underwent D8-D9 laminectomy and excision of SOL, with meningioma being the predominant histopathological finding. Postoperative outcomes were favorable, with 91.7% of patients showing good improvement in Frankel scores, indicating a positive surgical impact.

Generalizability

The generalizability of this study on the clinical and surgical outcomes of dorsal spine intradural extramedullary space-occupying lesions may be limited by several factors. While the study provides valuable insights into patient outcomes and post-operative recovery, its findings may not be directly applicable to other healthcare settings with different surgical practices or patient populations. Therefore, larger, multi-center studies with diverse patient groups would be necessary to enhance the generalizability of these findings.

Limitation

The limitations of this study include a small sample size of only 12 patients, which may limit the generalizability of the findings. The subjective nature of outcome assessment, such as the Frankel score, may introduce variability in interpreting clinical improvements.

Acknowledgment

We would like to express our sincere gratitude to all the patients who participated in this study, as their cooperation and trust were essential for the successful completion of this research. We also extend our thanks to the medical and surgical teams at our institution for their invaluable support, expertise, and dedication.

List of abbreviation

CSO - Clinical and Surgical Outcomes
DSE - Dorsal Spine Extramedullary
ISOL - Intradural Space-Occupying Lesions
DSE-SOL - Dorsal Spine Extramedullary Space-Occupying Lesions
DSE-IM - Dorsal Spine Extramedullary Intradural Lesions
PSO - Prospective Surgical Outcomes
DSE-EO - Dorsal Spine Extramedullary and Extracranial Outcomes
IESOL - Intradural Extramedullary Space-Occupying Lesions Study

Source of funding

No Source of funding

Conflict of interest

No Conflict of interest

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