ISSN 1220-8841 (Print)
ISSN 2344-4959 (Online)

ROMANIAN
NEUROSURGERY

Vol. XXXIX | No. 2 June 2025

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Vasant Padhiyar,
Gaurav Jaiswal,
K.G. Lodha,
Mukesh Singh,
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Suresh Kumawat

DOI: 10.33962/roneuro-2025-024

Romanian Neurosurgery (2025) XXXIX (2): pp. 132-137
DOI: 10.33962/roneuro-2025-024
www.journals.lapub.co.uk/index.php/roneurosurgery

Primary spinal tumours. A single centre study: clinical assessment, treatment and outcome

Vasant Padhiyar, Gaurav Jaiswal, K.G. Lodha, Mukesh Singh, Kritesh Goel, Suresh Kumawat

Department of Neurosurgery, Rabindranath Tagore Medical College and Associated Hospital, Udaipur, INDIA

ABSTRACT

Primary spinal cord tumours are rare conditions that comprise 3% of all primary CNS tumours in adults. The present study analyses the clinical presentation, prognostic factors, radiological assessment, treatment, histological examination and their correlation with the outcome of these spinal tumours, in an urban setup of India. The study presents our single institution's surgical experience and clinical outcomes on patients who have undergone surgical excision for spinal tumours. *Methodology:* This retrospective and prospective observational study was conducted among 36 patients admitted to the Department of Neurosurgery at Rabindranath Tagore Medical College and Associated Hospital, Udaipur, between May 2022 and September 2024. All patients were clinically evaluated along with preoperative and post-operative modified Nurick grading with 3 months of follow-up. Statistical analysis was performed using SPSS. *Results:* Our study included 36 patients; mean age was 38.4 years. Of the participants, 13 (36.1%) were men and the remaining 23 (63.9%) were women. Motor Weakness was the most common symptom noted in all patients. The tumours were commonly seen in the thoracic region, 14 cases (38.9%). Schwannoma was the commonest lesion, and there was a male preponderance. *Conclusion:* Our study clearly demonstrates that surgical treatment of spinal tumours offers very good functional outcomes irrespective of the age of the patient or the neurological status.

Keywords
primary,
spinal,
tumours

Corresponding author:
Vasant Padhiyar

Department of Neurosurgery, Rabindranath Tagore Medical College and Associated Hospital, Udaipur, India

vpadhiyar02@gmail.com

INTRODUCTION

The prevalence of spinal tumors is rare in comparison to brain tumors which encompass most central nervous system tumors.[1,2] Tumors of the spine can be divided into primary and metastatic tumors with the latter being the most common presentation. Primary tumors are subdivided based on their location on the spinal column and in the spinal cord into intramedullary, intradural extramedullary, and primary bone tumors.[3,4] Back pain is a common presentation in spine cancer patients; however, other radicular pain may be present.[5] Magnetic resonance imaging (MRI) is the imaging modality of choice for intradural extramedullary and intramedullary tumors.[6] Plain radiographs are used in the initial diagnosis of primary bone tumors while Computed tomography (CT) and MRI may often be necessary for further characterization. Complete surgical resection is the treatment

ISSN online 2344-4959
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First published
June 2025 by
London Academic Publishing
www.lapub.co.uk

of choice for spinal tumours and may be curative for well circumscribed lesions. However, intralesional resection along with adjuvant radiation and chemotherapy can be indicated for patients that would experience increased morbidity from damage to nearby neurological structures caused by resection with wide margins. Even with the current treatment options, the prognosis for aggressive spinal cancer remains poor. Advances in novel treatments including molecular targeting, immunotherapy and stem cell therapy provide the potential for greater control of malignant and metastatic tumors of the spine.

Materials and methodology

2.1 Study design: This is a retrospective and prospective observational study.

2.2. Study population, place, duration: Data for this study was obtained from 36 patients admitted in the Department of Neurosurgery at Rabindranath Tagore Medical College and Associated Hospital, Udaipur between May 2022 and September 2024.

2.3. Inclusion and exclusion criteria: All patients with a diagnosis of Intra-medullary, IDEM and extradural spinal tumor were included in the study. Patients with recurrent tumors also included, secondaries, infective collection and vascular abnormalities were excluded from the study.

2.4. Study procedure: Pre-operative MRI was done in all cases satisfying the inclusion criteria. All patients were clinically evaluated along with preoperative and post-operative modified Nurick grading with 3 months of follow up. Patient centered questions were present for assessment and follow-up. The number of points in Joa score and European assessment score was more. The people educational status was the main factor in which they could be assessed with the questions of Nurick grade.

2.5. Statistical analysis: Statistical analysis was performed using Statistical Package for Social Science (SPSS). Multiple Logistic regression method was used to predict the independent variables. A two-sided p value less than 0.05 was considered statistically significant.

Result

Our study included 36 patients, age ranging from 06 to 64 yrs. The majority of the patients (72.2%) were between 20 and 60 years of age. Mean age of our cohort was 38.4 years. (Table 1). Of the participants, 13 (36.1%) were men and the remaining 23 (63.9%) were women. There was a correlation between age and outcomes, older age portends a worse outcome, with a p value of 0.04. There was no correlation between gender and outcome. (Table 1). Motor Weakness was the most common symptom noted in all patients (100 %) followed by spasticity noted in 34 patients. Sensory Impairment was seen in 30 patients. There was a considerable overlap of the symptoms as well. Bladder or bowel symptoms were noted in 50 % of our study population. (Table 2). Motor Symptoms were the predominant complaints in patients with spinal tumors while the proportion of patients with bladder and bowel involvement had advanced disease. Twenty four patients had a worse Nurick Grade of 4 or worse. All 30 patients with bladder dysfunction had poor Nurick Grade. (Table 2). The tumors were commonly seen in thoracic region 14 cases (38.9%) followed by cervical 8 cases (22.2 %) and lumbar 5 cases (13.9 %). We also had four cases with cervico-dorsal and five cases with dorso-lumbar involvement (Table 3).

Table 1. Socio-demographic details of the participants.

S.No.	Variable	Frequency	Percentage
1. Gender			
Male		13	36.1 %
Female		23	63.9 %

Table 2. Symptoms of the participants.

S.No.	Variable	Frequency	Percentage
1. Type of symptoms			
Motor weakness		36	100 %
Spasticity		34	94.4 %
Sensory impairment		30	83.3 %
	Bladder or bowel Involvement	18	50 %
2. Complications			
CSF leak		0	0 %
Worsening of power		3	8.3 %

Table 3. Tumor characteristics.

S.No.	Variable	Frequency	Percentage
1. Region of tumor			
Thoracic		14	38.9 %

Lumber 5 13.9 %
Cervical 8 22.2 %
Cervico-dorsal 4 11.1 %
Thoracolumbar 5 13.9 %

2. Tumor Diagnosis
NST- Schwnomma 11 30.6 %
Neurofibroma 2 5.6 %
Meningioma 7 19.4 %
Ependymoma 3 8.3 %
Astrocytoma 2 5.6 %
Dermoid/epidermoid
(recurrent) 4 11.1 %
Lymphoma/
leukemic infiltration 2 5.6 %
lipoma 1 2.8 %
hydatid cyst 2 5.6 %
arachnoid cyst 2 5.6 %

All the patients included in the study underwent excision of the lesions identified by imaging. Standard posterior midline approach employed. Laminectomies and hemi-laminectomies were employed. Microscope was used to achieve maximum safe excision of the lesion. Histopathological examination was done for all the cases. Dorsal approach was used in all patients. Gross Total Excision of the lesion was possible in extramedullary tumors with tumor remnant in case of intramedullary tumors. The epidural space was obliterated with fat after water-tight Dural closure.

Three pathologies, namely, Schwannoma, Neurofibroma and Meningioma accounted for 55.6 % of all primary spinal tumors (n = 20). Other lesions with multiple occurrences include three cases of ependymomas, two cases of arachnoid cyst, two cases of Lymphomas, one case of lipoma. Schwannoma was the commonest lesion and there was a male preponderance. The mean age of presentation was 40.8 years and the mean duration of symptoms was 7 months. Nerve sacrifice was necessary in 6 patients. Meningiomas were common in women and had a mean age of 40.3 yrs and average duration of symptoms was 8 months. Involved dura was cauterized in the 3 cases where the tumor had adherence to the dura. Rest of the tumors were easily separated from the dura.

Nurick Grade was assessed at the time of presentation and discharge as well as during the periodic follow up. 28 patients were available for follow up for 3 months. The average duration of follow up was 7 months. The outcome at the time of discharge is discussed here. Seven patients had a pre operative Nurick grade of 3 and worse while 29 patients had Grades 0, 1 and 2. The average pre operative Nurick's was 1.87. Post operatively, 27 patients belonged to Grade 2 or better. Four patients had Grade 3, while one patient had Grade 4. One patient had Grade 5. The average Post Operative Nurick's Grade was 1.1. thirty two of the 36 patients had a good outcome with a Nurick Grade of 2 or less. 2 patients had a fair outcome while 2 patients had a poor outcome.

At 3 months follow up, none of the two patients with a fair outcome and none of the two patients with poor outcome improved. Six of the 30 patients with bladder dysfunction had some degree of improvement at 3 months follow up. Both of the patients with a poor outcome had a thoracic lesion. None of the lesions were predominantly ventral in location. We had 2 patients that developed wound dehiscence and none had CSF leak from the wound site. Secondary suturing was done in these cases and resolution was achieved. One patient had meningitis which was medically managed. There was one mortality in our study due to respiratory complication.

Discussion

Spinal tumors are rare, comprising of 5%-12% of total tumor of central nervous system, with an overall incidence of 0.74/ 100,000 person years.[7-8] Primary spine tumors are generally uncommon. However, this remains an important topic because they can cause considerable morbidity for patients by causing pain and affecting motor and sensory function. Spine tumors can arise within the spinal cord itself, or from the adjacent structures. These tumors can broadly be divided into primary and secondary (metastatic) tumors. Metastatic spine tumors spread to the vertebral column via hematogenous route (eg, via the Batson plexus). Contrary to primary spine tumors, metastatic spine disease (MSD) is extremely prevalent. In a postmortem study involving patients with breast or prostate cancer, the prevalence of MSD was between 70% and 90%.[9]

In general, spine tumors can be classified according to their anatomic location into intradural-intramedullary, intradural-extramedullary, and extradural. Intradural-intramedullary tumors are

neoplasms arising within the spinal cord. They account for 20% of all intraspinal tumors in adults and 35% of all intraspinal tumors in children.[10] Intradural-intramedullary tumors may arise from intrinsic cells within the spinal cord (intra-axial lesions), or via seeding/ systemic spread. Most primary intra-axial tumors are either ependymomas or astrocytomas. Tumors are labeled as intradural-intramedullary if the epicenter arises at the level of C1 to the level of the conus (L1/L2). Lesions above C1 and involving the medulla are labeled as cervicomedullary. Intradural-extramedullary tumors are located within the dura but outside the spinal cord.

Meningiomas and nerve sheath tumors (NSTs) are the 2 most common types of tumors.[11] Extradural tumors are the most common (60% of all spine tumors). These tumors arise outside the dural sac, typically from the vertebral bodies. These are usually metastatic in nature. These tumors are particularly important because of the risk of epidural spinal cord compression. In this review article, we will provide a broad overview of the various types of tumors that can occur in the spine. We will discuss primary tumors of the spinal cord (benign and malignant), primary vertebral column tumors (benign and malignant), and metastatic spinal tumors separately. For each we will provide brief epidemiology, radiological and histopathological pearls, and touch on the natural history of the entity.

Primary Spinal Cord Tumors

Primary spinal cord tumors are rare conditions that comprise 3% of all primary CNS tumors in adults. Age adjusted incidence rates are slightly higher for men than women, 0.67 compared with 0.59 per 100 000 population, respectively.[12]

Benign Spinal Cord Tumors

Spinal Meningioma. Meningiomas can arise from arachnoidal cap cells anywhere along the neural axis. Most of them occur intracranially, whereas approximately 10% can be found adherent to the spinal dura. The age adjusted incidence is 0.33 per 100 000 with women in the seventh to eighth decades having the highest incidence.[13] Approximately 80% of spinal meningiomas arise in the thoracic region, with the cervical region being the second most common (15%).[14] Prior exposure to ionizing radiation and neurofibromatosis type 2 (NF2) syndrome are known risk factors.[15] Radiologically, the majority are intradural extramedullary in location, having a well-circumscribed appearance on MRI. They often have a broad-based dural attachment and most exhibit a dural tail sign. They can be isointense on T1 and T2 imaging and exhibit homogeneous contrast enhancement. Histologically, they show a lobulated architecture with whorls and psammoma bodies, and stain positive for vimentin. The majority are World Health Organization (WHO) grade 1, with the meningothelial subtype being the most common in the spine. WHO grade II clear cell subtypes have a predilection for the spine and are thought to arise from the denticulate ligaments.[16] Surgical removal is the treatment of choice, with a consideration for adjuvant radiotherapy in higher grade, or recurrent, tumors.

Nerve Sheath Tumors. NSTs are the most common intradural-extramedullary lesions. Most NSTs arise from the dorsal sensory roots. Spinal schwannomas are most common, followed by neurofibromas and ganglioneuromas. The peak incidence of schwannomas occurs in the fifth to seventh decade.[10] About 35% to 45% of patients with NST have neurofibromatosis. Neurofibromas are associated with NF1, and schwannomas are associated with NF2. These are well circumscribed and indistinguishable radiologically. The majority are isointense on T1, hyperintense on T2, and all exhibit contrast enhancement. CT imaging may exhibit chronic changes such as widening of the neural foramina and scalloping of the adjacent bone. Histologically, key features are that of a biphasic tumor with a highly ordered cellular component (Antoni A) that palisades (Verocay bodies) plus myxoid hypocellular component (Antoni B). These stain strongly for S100. Management is via surgical excision, and because of their well-circumscribed nature, can be peeled away from the parent nerve easily. Most do not recur and hence do not need adjuvant radiation. A minority of cases can undergo malignant transformation into malignant peripheral nerve sheath tumor, angiosarcoma, or epithelioid malignant change, for which the prognosis is poor.

Malignant Spinal Cord Tumors

Spinal gliomas. The majority of intramedullary spinal cord tumors are gliomas. The word glioma refers to

a tumor with histological similarity to normal glial cells. The major types of spinal glioma tumors are ependymomas and astrocytomas.

Ependymomas. Spinal ependymomas are the most common intramedullary tumors.[17] Ependymomas are glial tumors arising from ependymal cells and most commonly occur adjacent to the ventricular surface, along the spinal canal, or in the film terminale.[18] Though spinal cord gliomas are rare compared with cerebral lesions, ependymomas comprise approximately 60% to 80% of spinal gliomas compared with 3% of intracranial gliomas.[19] Among all spinal tumors in ages 0 to 19, ependymomas are the most common histology, comprising about 20%.[20] NF2 is a dominant hereditary condition and is manifested by multiple tumors of the nervous system.

Imaging evidence of ependymomas is seen in one-third of these patients. In contrast to sporadic spinal cord ependymomas, those associated with NF2 tend to display an indolent growth pattern, and potentially can be observed if found incidentally. In the WHO classification of brain tumors, ependymal tumors are divided into 4 major groups: subependymoma (grade I), myxopapillary ependymoma (grade I), ependymoma (grade II), and anaplastic ependymoma (grade III). [21] Radiologically, ependymomas present a well-circumscribed lesion with variable enhancement. These may be associated with cystic change, hemorrhage, or calcification. Key histological features include perivascular pseudorosettes and ependymal rosettes. Gross total removal should be attempted for all patients. Compared with lower-grade ependymomas, anaplastic tumors appear to have a higher recurrence rate and poorer survival.

Astrocytic tumors of the spinal cord. Spinal astrocytomas account for approximately 6% to 8% of all spinal cord tumors.[17] In children, they are the most common intramedullary tumor, and the second most common in adults. These tumors may occur throughout the spinal cord. The peak incidence is in the third decade, with males being affected more commonly. There is an increased incidence in patients with NF1. They arise from astrocytic glial cells. Compared to their intracranial counterparts, they generally have a lower histological grade (with ~ 75% being low grade). However, high-grade spinal astrocytomas have an increased risk of leptomeningeal dissemination.

Radiologically, astrocytomas arise from the cord parenchyma (as opposed to ependymomas, which arise from the central canal). They often span several segments and appear exophytic in nature, sometimes being mistaken for an extramedullary tumor. Margins are poorly defined because of their infiltrative nature. Peritumoral edema and cysts are seen in less than half of patients. They appear hyperintense on T2 imaging, and most lesions show contrast enchantment on T1 imaging. Astrocytic tumors are composed of infiltrative cells with irregular, hyperchromatic nuclei and eosinophilic, GFAP-positive cytoplasm. These tumors are graded histologically according to their most anaplastic-appearing areas.[22] Molecular parameters, used in the WHO classification, are based growth pattern, behavior, and isocitrate dehydrogenase–mutation status.[8-21]

The mainstay of treatment for primary spinal cord astrocytoma is surgical resection, with the goal of preservation of neurologic function, guided by intraoperative neuro-monitoring. Adjuvant radiotherapy and chemotherapy may be used depending on the extent of resection and tumor grade.

Conclusion

Our study clearly demonstrates that surgical treatment of primary spinal tumors offers very good functional outcomes irrespective of the age of the patient or the neurological status. Hence surgery should be offered to all patients presenting with primary spinal tumors.

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