



Spinal Cord Tumors—Our 5-Year Experience

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Abstract

Purpose To study the demography, incidence, symptoms, histopathology, postoperative complications and recovery in operated patients of spinal tumor.

Overview of Literature Primary spinal cord tumors (SCT) are an uncommon entity. According to their location, spinal tumors are conveniently classified as extradural (ED) and intradural (ID), although some can be both inside and outside the dura. ID tumors can be intradural extramedullary (IDEM) or intramedullary SCT (IMSCT).

Methods This is a retrospective study of 122 patients with spinal tumors who were surgically treated at the department of neurosurgery from 2014 to 2019 over a period of 5 years.

Study Design This is a retrospective study.

Results Out of 122 patients, there were 19 patients with ED tumor, 73 had IDEM, and 30 had IMSCT. As many as 73 patients were males and the rest of the 49 patients were females. Mean age at time of surgery was 40.79 years. The thoracic region of spinal canal was most frequently involved (64; 52.4%). The common clinical symptom was motor weakness (90 cases; 73.77%). Majority of the patients had symptoms for duration of 6 to 12 months. Schwannomas were the most common tumor among IDEM and extradural location. Ependymomas were the most common type in IMSCT. We observed significant improvement in most of our cases. Four patients deteriorated at 3 months follow-up.

Conclusions There was a higher male:female ratio for all spinal cord tumors except meningiomas. There was also a higher proportion of nerve sheath tumors, and a lower proportion of meningiomas and neuroepithelial tumors. These results are similar to other studies from Asian countries.

Keywords

- ▶ spinal cord tumor
- ▶ intra dural extra medullary
- ▶ extradural
- ▶ intra medullary
- ▶ schwannoma

Introduction

Primary spinal cord tumors (SCT) are quite rare and can cause significant morbidity and occasional mortality.¹ There are few organs in our human body in which neoplastic disease occurs in a more benign form and the results of surgery

are more brilliant than in the spinal cord and its membranes. At the same time, there is no organ in which total restoration of function following the removal of the neoplasm is so completely dependent on an early diagnosis.²

Neoplasms can be benign or malignant. It can arise from intraspinal structures such as spinal cord, blood vessels,

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meninges, nerve roots, and other tissues. When compared with intracranial neoplasms, these are 10 times less frequent, with majority of them being benign tumors. According to their location, spinal tumors are conveniently classified as extradural (ED) and intradural (ID), although some can be both inside and outside the dura. Intradural tumors can be intradural extramedullary (IDEM) or intramedullary SCT (IMSCT).³

Lesions in the spinal canal cause compression of the structures which results in neurological deficits. Rapidly growing space-occupying lesions (SOLs) in the spinal canal cause severe loss of function, as there is no time for the spinal cord to adjust by itself. Normal movement of the cord is hampered due to the presence of the tumor which, in turn, results in cord damage. In long-standing tumors, gliosis in the spinal cord occurs due to ischemia in the cord. Despite complete removal of tumor, recovery may be incomplete. Primary assessment of the patient with a spinal tumor should always include a detailed history and clinical examination. Localizing the clinical level is very important. Patients with spinal tumor usually present with pain and motor sensory deficits of varying degree. Bowel and bladder involvement may be due to mass effect or neurological compression.⁴

In this study, we analyzed the patients of spinal tumors treated in our institute.

Materials and Methods

Our institute is a tertiary referral center for neurosurgical disorder. This is a retrospective single institute study of 122 patients with spinal tumors who were surgically treated at the department of neurosurgery from 2014 to 2019 over a period of 5 years.

Inclusion Criteria

Tumors of the spinal canal which were surgically treated.
SOLs like arachnoid cysts.

Exclusion Criteria

Infective pathologies including tubercular spine.

Vascular Pathology

Nonoperated spinal tumor patients.

Patients without follow-up at 3 months.

Each patient's history, clinical findings on the physical examination performed at the department, and radiological examination records were reassessed. Each patient was followed-up after 3 months and their clinical findings

were recorded. We used the modified McCormick's grade to evaluate the neurological and functional status of patients. According to this grading,

Grade 1—intact neurologically, normal ambulation, minimal dysesthesia.

Grade 2—mild motor or sensory deficit, functional independence.

Grade 3—moderate deficit, limitation of function, independent with external aid.

Grade 4—severe motor or sensory deficit, limited function, dependent.

Grade 5—paraplegia or quadriplegia, even w/flickering movement.

All patients were investigated by MRI of the spine including contrast MRI. Postoperatively and at follow-up, appropriate imaging was obtained, depending on clinical status of patient.

Observations

There were a total of 122 patients who fulfilled the inclusion criteria. Out of 122 patients, there were 19 patients with ED tumor, 73 had IDEM, and 30 had IMSCT.

Seventy-three patients were males and the rest of the 49 patients were females. Mean age at time of surgery was 40.79 years (→ Table 1).

Location

The thoracic region of spinal canal was most frequently involved (64; 52.4%), followed by thoracolumbar (25; 20.4%), and lumbar (22; 18%) region. Cervical was less commonly involved, comprising seven cases (5.73%) (→ Table 2).

Clinical Profile

The common clinical symptom was motor weakness (90 cases; 73.77%), followed by paresthesia (76 cases; 62.2%), and sensory loss (63 cases; 51.6%). Localized pain was present in 64 cases and radiculopathy in 50 cases. Local tenderness was present in 28 patients (22.9%). Sphincter disturbances were present in 32 patients (26.22%). The weakness in the majority was spastic. Wasting was observed in seven patients.

Duration of Symptoms

Majority of the patients had symptoms for duration of 6 to 12 months. The shortest was 2 weeks and longest was 168 weeks. Two ED lesions had symptoms for 168 and 108 weeks, respectively. The mean duration for ED was 24.2 months. After excluding the two cases in ED group

Table 1 Demographic profile of patients

Age group (in years)	Gender (M/F)	ED (M/F)	IDEM (M/F)	IMSCT (M/F)	Total
< 20	M = 8, F = 5	3 (2/1)	9 (5/4)	1 (1/0)	13
21–40	M = 30, F = 22	3 (2/1)	35 (17/18)	14 (12/2)	52
41–60	M = 29, F = 21	9 (6/3)	27 (11/16)	14 (12/2)	50
61–80	M = 6, F = 1	4 (3/1)	2 (2/0)	1 (1/0)	7

Abbreviations: ED, extradural; F, female; IDEM, intradural extramedullary; IMSCT, intradural spinal cord tumor; M, male.

Table 2 Duration of symptoms

Duration (months)	ED	IDEM	IMSCT	Total
0–1	3	3	2	8
1–3	4	9	7	20
3–6	3	21	3	27
6–12	2	17	10	29
12–24	3	13	4	20
> 24	4	10	4	18
Mean (months)	24.2	14.25	12.93	15.47

Abbreviations: ED, extradural; IDEM, intradural extramedullary; IMSCT, intradural spinal cord tumor.

who had 168 months and 108 months duration of symptoms, the mean duration for ED was 10.82 months. In the IDEM group, mean duration was 14.25 months, and for IMSCT group, it was 15.47 months (► **Table 3**).

Histopathological Diagnosis

Out of 73 IDEM cases, 48 cases were schwannomas, followed by 17 cases of meningioma. Four cases were malignant peripheral nerve sheath tumor, three cases were neurofibroma, and one case of metastasis.

Out of 30 cases of IMSCT, 24 cases were ependymoma, and three cases were astrocytoma. There was one case each of dermoid cyst, hemangioma, and hemangioblastoma.

Out of 19 ED cases, six cases were schwannomas, five were arachnoid cysts, and four were metastases. Two cases were neurofibroma. One case each of plasmacytoma and multiple myeloma were also in this group (► **Table 4**).

Surgical Technique and Extent of Resection

Irrespective of location of tumor, posterior approach using standard microsurgical techniques was performed in all cases. Total excision was achieved in 80 (65.57%). Near total excision (i.e., > 90%, small part of tumor adherent to vital structures was left behind) was done in 32 cases (26.22%). Subtotal excision (40–60% decompression) was done in six cases (4.9%). Only biopsy was performed in four cases (3.2%).

Complications

Twelve patients had persistent pain postoperatively. Eight patients had no improvements in bladder and bowel complaints, and four patients had postoperative neurological deterioration. Four patients had cerebrospinal fluid (CSF)

leak, who were managed conservatively. Eight patients had persistent postoperative paresthesia. One patient of cervical IM ependymoma expired postoperatively due to pulmonary embolism (PE).

In our series, “recurrence” has been assessed on the basis of new symptoms due to tumor regrowth or tumor regrowth found on routine radiological assessment. Six patients had recurrence in our series. Out of three IDEM cases, two were malignant peripheral nerve sheath tumor and one was schwannoma. Two cases of IM ependymoma and one case of ED schwannoma had recurrence.

Outcome

We found significant improvement in most of our cases. Four patients deteriorated at 3 months follow-up. Two patients each of IMSCT and IDEM were in this group. Both the IDEM patients had dorsal level lesion. Ten patients remained same in their neurological status. One patient of cervical IM ependymoma expired postoperatively due to PE.

A total of 29 patients were in grade 4 and 5 of modified McCormick’s grade preoperatively. Postoperatively, there were only 17 patients in this group (► **Table 5**).

Discussion

Primary SCT accounts for approximately 4 to 10% of all central nervous system (CNS) tumors. They are classified based on their location as ED, IDEM, and IMSCT.⁵ Totally, 2/3rd of all spinal tumors are IDEM and 10% are IMSCT.⁶ In our study,

Table 3 Location of lesions

Location of tumor	Total (ED, IDEM, IMSCT)
Cervical	7 (3/3/1)
Cervicothoracic	3 (1/0/2)
Thoracic	64 (9/42/13)
Thoracolumbar	25 (2/11/12)
Lumbar	22 (4/16/2)
Lumbosacral	1 (0/1/0)

Abbreviations: ED, extradural; IDEM, intradural extramedullary; IMSCT, intradural spinal cord tumor.

Table 4 Histopathological diagnosis of cases

ED tumor (n = 19)	IDEM tumor (n = 73)	IMSCT (n = 30)
Schwannoma (6)	Schwannoma (48)	Astrocytoma (3)
Arachnoid cyst (5)	Meningioma (17)	Ependymoma (24)
Neurofibroma (2)	Neurofibroma (3)	Dermoid (1)
Metastasis (4)	Malignant peripheral nerve sheath tumor (4)	Hemangioma (1)
Multiple myeloma (1)	Metastasis (1)	Hemangioblastoma (1)
Plasmacytoma (1)		

Abbreviations: ED, extradural; IDEM, intradural extramedullary; IMSCT, intradural spinal cord tumor.

Table 5 Outcome (modified McCormick's grade)

Modified McCormick's grade	Preoperative grade (n = no. of patients)				Postoperative grade (n = no. of patients)			
	ED	IDEM	IMSCT	Total	ED	IDEM	IMST	Total
1	5	7	0	12	11	29	0	40
2	2	20	0	22	3	25	12	40
3	8	31	20	59	2	11	11	24
4	2	9	5	16	2	4	5	11
5	2	6	5	13	1	4	1	6

Abbreviations: ED, extradural; IDEM, intradural extramedullary; IMSCT, intradural spinal cord tumor.

we had nearly 60% of IDEM (73/122) and 24.6% of IMSCTs (30/122). This difference may be due to referral of cases from different hospitals as ours is a tertiary referral center.

In Western populations, according to literature, the primary spinal tumors are more commonly seen in females, whereas studies in Asia show a slight male preponderance.^{7,8} We had a male to female ratio of 1.4:1 among our patients. Similar male to female ratio has been reported by other Indian studies.⁹ In some Indian studies, male to female ratio of around 2.5:1 was noted.^{10,11}

We observed that all histopathological subtypes were more common in males, except meningiomas, where female preponderance was seen. In our series, all 17 patients with meningioma were females. It is a well-known fact that there is a female preponderance of meningioma.⁸ Our study is in concordance with it.

The mean age of presentation of patients with ED tumors was 45.74 (18–76 years), IDEM tumors in our study was 37.42 (range 14–62 years), and those having IMSCT was 39.23 (15–63 years).

In the study conducted by Arora et al, the mean age of presentation of patients with IDEM tumors was 35.8 years, those having IMSCT was 25.7 years, and in ED tumors was 30.7 years.¹⁰ In Bansal et al study, mean age of patients with IMSCT was 26 years, however 40% of cases were less than 20 years.¹¹ In Chamberlains et al study, mean age of patients with IMSCT was 41 years.⁶

The mean age of IMSCTs in our series is more as compared with that of the Indian reports. This may be due to less number of pediatric cases in our series.

Ependymomas and astrocytomas represent the most common types of IM spinal tumor. Ependymomas are the most frequent IMSCTs in adults, while astrocytomas are more frequent in the pediatric population. Other IM lesions include lipomas, dermoid, epidermoids, hemangioblastomas, hemangiomas, gangliogliomas, lymphomas, and metastases.^{11,12}

Out of 30 cases of IMSCT, 24 cases were ependymomas and three cases were astrocytomas; one case each of dermoid cyst, hemangioma, and hemangioblastoma. The reduced number of astrocytomas can be attributed to less pediatric cases in our series.

The most common IDEM SCT are nerve sheath tumors, followed by meningiomas. Other lesions include dermoid, epidermoids, cysts, paraganglioma, metastases, etc.¹⁰

Out of 73 IDEM cases, 48 cases were schwannomas, followed by 17 cases of meningiomas. Four cases were malignant peripheral nerve sheath tumors, three cases were neurofibromas, and one case of metastasis. This compares favorably with existing literature.

The common ED tumors include metastasis, lymphomas, and various benign and malignant bony tumors.⁶

Out of 19 ED cases, six cases were schwannomas, five were arachnoid cysts, and four were metastases. Two cases were neurofibromas, and one case each of plasmacytoma and multiple myeloma were also in this group.

Overall, the most common histological subtypes were benign nerve sheath tumors (57/122; 46.72%), followed by neuroepithelial tumors, that is, ependymoma + astrocytomas (27/122; 22.1%) and meningiomas (17/122; 13.9%).

When compared with other studies from Western countries, we observed increased frequency of nerve sheath tumors in our study.^{13,14} However, as compared with Asian studies, similar incidence was seen.^{7,8} Around 90% of them are ID in location.

The incidence of neuroepithelial tumors were also comparable to studies of Asian countries.^{7,8} We observed decrease in incidence of these tumors as compared with Western countries.^{7,8}

The incidence of meningioma was low (13.9%) as compared with that reported by Western authors (16–46%).^{14–16} However, the latter was similar to report by studies from Asian countries (11–15%).^{7,8} This compares favorably with epidemiological studies that Asian populations have a relatively less incidence of spinal meningioma than Western population and relatively increased incidence of nerve sheath tumors.

The extent of surgical resection mainly depends on location and histopathology of the tumor. IDEM tumors, mainly schwannomas, neurofibromas and meningiomas, are usually amenable to surgical resection. Ependymomas often can be surgically resected. However, astrocytomas infiltrate the spinal cord and complete resection is difficult. The extent of resection is mainly dependent on cleavage plain intraoperatively. Presence of syrinx associated with IMSCTs favors the resectability of the tumor, up to great extent.¹⁷

In ED tumors, benign lesions are usually managed by marginal excision. Those lesions with a tendency for local recurrence are best excised with a wide margin.

Overall, we could attain total excision in 80/122 (65.57%) patients. Near total excision was done in 32/122 (26.22%)

patients. In four patients, we could do only biopsy of the lesion. These rates are comparable to resection rates reported by others.^{10,11}

In our study, there were 93 patients who had grade 3 or < 3, according to modified McCormick score, preoperatively and 29 patients who had grade 4 and 5. Postoperatively, there were only 17 patients in grade 4 and 5. The patients with a good preoperative status (i.e., score < 3) had a better outcome as compared with patients having a preoperative score of 4 or 5. This is in accordance to observations as per other studies.^{11,18,19}

In the study conducted by Arora et al, the common clinical symptom was motor weakness (78 cases; 70.27%), followed by sensory loss, and pain.¹⁰ In the study conducted by Engelhard et al, most common symptoms were pain (52.2%) and weakness (52.0%). Numbness and/or tingling sensation occurred in 45.9%, followed by difficulty with coordination and/or imbalance (26.5%), and urinary incontinence (13.0%).¹⁴

In our study, most common clinical symptom was motor weakness (90 cases; 73.77%), followed by paresthesia (76 cases; 62.2%), and sensory loss (63 cases; 51.6%). Localized pain was present in 64 cases and radiculopathy in 50 cases. Sphincter disturbances were present in 32 patients (26.22%).

A delay in diagnosis or management plays a major role in recovery of patients. Patients with SOLs cause compression of neural tracts in the spinal cord, which may result in residual neurological deficits and poor outcome. Jellema et al published a series of 108 patients with both ID and ED tumors.²⁰ They found that 35% of their patients were diagnosed > 2 years after the onset of initial symptoms. Delayed presentation is one of the major factors leading to poor neurological grade at time of surgery and hence poor postoperative outcome. The long-standing compressive pathologies cause profound, irreversible neuronal degeneration.²¹

Majority of the patients in our series had preoperative symptoms for duration of 6 to 12 months. The shortest was 2 weeks and longest was 168 weeks. Two ED lesions had symptoms for 168 and 108 weeks, respectively. The mean duration for ED was 24.2 months. After excluding the two cases in ED group who had 168 and 108 months duration of symptoms, the mean duration for ED was 10.82 months. In the IDEM group, mean duration was 14.25 months and IMSCT was 15.47 months.

We observed that patients ED had less preoperative duration of symptoms and patients with long preoperative duration had comparatively lesser recovery as compared with patients with short preoperative duration.

The most common reasons for delayed diagnosis were “classical symptoms with a wrong diagnosis” and “delayed imaging.”⁵

The reported recurrence rate in spinal tumors is 7.2% and IDEM tumor is more common to recur as compared with others.²² We observed 6/122 (4.9%) recurrences, out of which 3/6 (50%) were from IDEM group.

A study done by Sharma et al, based on database (2003–2010) in US, has reported the overall inpatient mortality rate of 0.46% in operated spinal tumor patients.²³ We had one

(0.81%) mortality in a patient with an IMSCT due to PE in the postoperative period.

Many published series on spinal tumors have a good functional outcome in 15 to 90% of patients.^{10,24,25} In our series, a total of 85.24% patients were mobile at follow-up. This compares favorably with other series. In our series, 29 patients were in grade 4 and 5 of modified McCormick's grade preoperatively. Postoperatively, there were only 17 patients in this group.

Conclusion

On analyzing the data in our study, there is a higher male:female ratio for all SCT except meningiomas. There is also a higher proportion of nerve sheath tumors, and a lower proportion of meningiomas and neuroepithelial tumors. These results are similar to other studies from Asian countries.

We recommend minimal delay for surgical intervention in spinal tumor patients, irrespective of preoperative neurological grade. A high level of suspicion is required for diagnosis. Complete removal of tumor should be the primary goal.

Conflict of Interest

None declared.

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