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Intradural Spinal Cord Tumors Surgical Experience with Modified Sheehan Technique

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ABSTRACT

Background: *Primary spinal cord tumors are rare neoplasms that lead to significant morbidities. They representing about 2–4% of all tumors that affect the central nervous system. According to their relation to the dura, and spinal cord they are classified into extradural, intradural extramedullary and intradural intramedullary tumors. Magnetic resonance imaging is the radiological investigation of choice for the diagnosis of intradural tumors both intra and extramedullary. Surgical excision is the best treatment modality in the majority of patients.*

Patients and Methods: *This is a retrospective study of thirty patients, fifteen males, and fifteen females suffering spinal cord tumors. Median age at diagnosis 41years. Follow up period range from 6months to 43 months with average 24 months. Neurological assessment of the patients carried out by ASIA (American spinal injury association) scoring. Radiological evaluation occurs through MRI (magnetic resonance imaging) with contrast. Of the studied group seven cases were intradural intramedullary and twenty-three cases were intradural extramedullary. The utilized surgical approach was modified Sheehan technique and all the cases were operated by a single surgeon to avoid the inter surgeon variability. Histopathological assessment was done for the excised specimen for all patients.*

Results: *Thoracic region most affected 53.3%, followed by cervical 23.4%, then lumbar (20%) regions. 76.7% intradural extramedullary, and 23.3% intradural intramedullary. Schwannoma 43.3% and Meningioma (20%) were the most pathology. ASIA group C decreased from 40% to 6.7%, and ASIA group D decreased from 60% to 26.7%, and we got a new ASIA group E 66.7% didn't exist before surgery.*

Conclusion: *The utilized surgical technique is very effective and safe as we get wide corridor for tumor excision, so increasing the effectiveness of operative microscopy and other operative tools, and improve the surgical outcome as noticed in postoperative neurological status.*

Keywords
Spinal cord, Tumors, Surgical Excision, Microscopic surgery, modified Sheehan Technique.

Introduction

Primary spinal cord tumors are rare neoplasms occurring ten times less than the cranial neoplasms and represent about 2-4% of all tumors that affect the central nervous system. According to their relation to the dura, and spinal cord they are classified into extradural, intradural extramedullary and intradural intramedullary tumors [1,2]. The most common spinal neoplasms are the extradural type and they usually have metastatic origin. The most common primary intradural neoplasms are intradural extramedullary type; they only found in 0.3 out of 100,000 patients each year and represent up to 80%. The remaining 20 to 30% of the primary intradural neoplasms are intradural intramedullary type. Globally Intradural neoplasms show the preferentiality to be in the thoracic region, then the cervical region and lastly lumbar region [3-6]. The middle age group are most susceptible to intradural extramedullary lesions and most of them are benign in nature, the most common intradural extramedullary neoplasms are originated from spinal nerve sheath (schwannoma) followed by meningioma (originated from meningeal covering of the spinal cord). Myxopapillary ependymomas are not uncommon intradural extramedullary neoplasms arising from the filum terminalis. Less common intradural extramedullary lesions include epidermoid, dermoid, arteriovenous malformations, hemangiopericytomas, lipomas, paragangliomas, and arachnoid cysts [7,9]. Neoplasms originated from glial cells constitutes up to 80% of intradural intramedullary tumors; from which 60 to 70% are astrocytomas and 30 to 40% are ependymomas [5,6]. Hemangioblastomas, among intramedullary neoplasms represent up to 15% of them. The least intramedullary neoplasms to be reported are the metastatic tumors documented in 2% of all intramedullary tumors [8]. The radiological investigation of choice for the diagnosis of intradural tumors both intra and extramedullary is magnetic resonance imaging. It is the best radiological method to give detailed neural structure assessment and give idea about tumor histopathological subtype after gadolinium; also, magnetic resonance angiography or spinal angiogram can be beneficial in the case of vascular lesions [7,10].

Surgical excision is the best treatment modality in the majority of patients with symptomatic intradural lesions either extra or intramedullary. The surgical outcome has improved in past few decades due to development of more precise diagnostic tools such as computed tomography, MRI for understanding the anatomical structures, and with the advancement of surgical instruments and techniques especially with the use of high-resolution intraoperative microscopes, intraoperative ultrasonography and intraoperative neurophysiological monitoring [11,13,14]. Other modalities of adjuvant radiotherapy and or chemotherapy are utilized in special situations as in metastatic neoplasms, high grade tumors, or with contraindication of surgical intervention. Although there are reported drawbacks for radiotherapy as radiation myelopathy, also the role of chemotherapy is limited [1,11,12].

Patient and Method

This is a retrospective study of thirty patients were operated upon at neurosurgery department of Elsahil teaching hospital from November 2014 to November 2019 for intradural spinal cord tumor excision. All patients were assessed neurologically by ASIA scoring preoperatively as a base line for the patient's neurological status to be compared during the follow up period. All patients were assessed radiologically by spine MRI with contrast according to their neurological level; to be compared with another contrast enhanced MRI during the postoperative follow up. Of the studied group seven cases were intradural intramedullary and twenty-three cases were intradural extramedullary. The utilized surgical approach was posterior midline approach with laminectomy and partial bilateral or unilateral fascetopediclectomy. All the cases were operated by a single surgeon to avoid the inter surgeon variability. Histopathological assessment was done for the excised specimen for all patients. Follow up period range from 6months to 43 months with average 24 months.

Aim of the work

Review of literature. Evaluation of the pathological type of spinal cord tumors, as regard to the incidence and distribution in relation to spine regions among studied group. Evaluation of the surgical excision of that lesion utilizing modified Sheehan technique.

Surgical approach

In all cases (100%) the surgical approach was Posterior standard decompressive laminectomy with unilateral or bilateral partial fascetopediclectomy (we described it as modified Sheehan technique, referring to the original work of Sheehan et.al. 1997 first described partial pediclectomy), with microscopic total excision in intradural extramedullary lesions and near total in the intramedullary lesions (Figure 1).

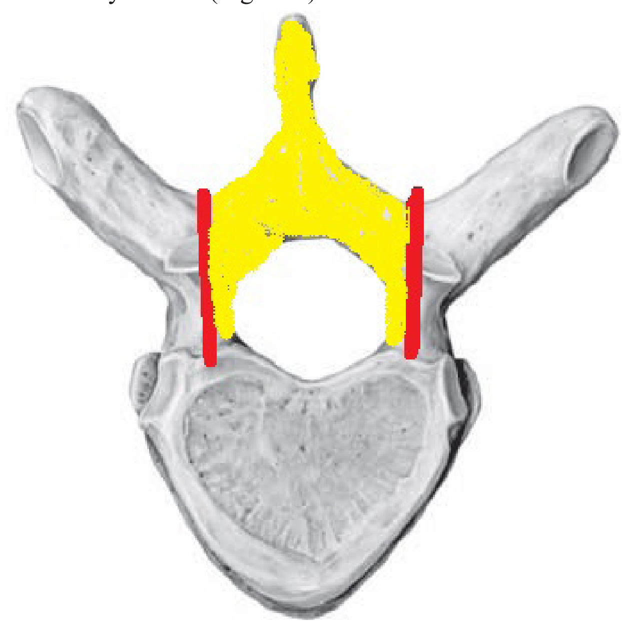
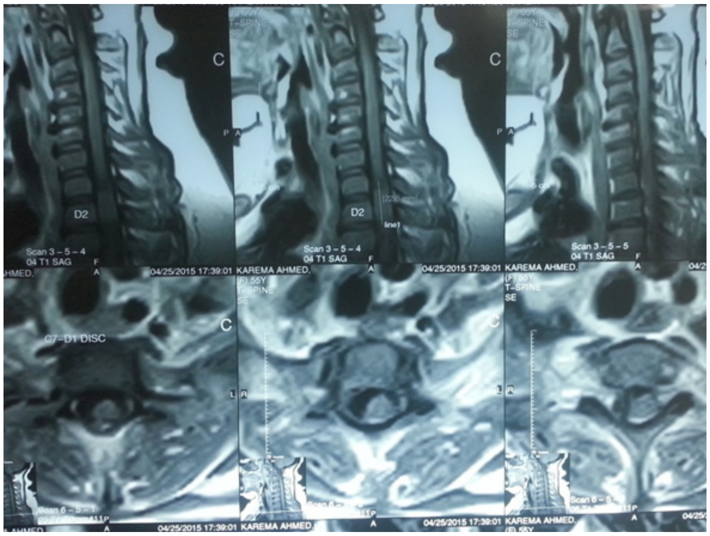


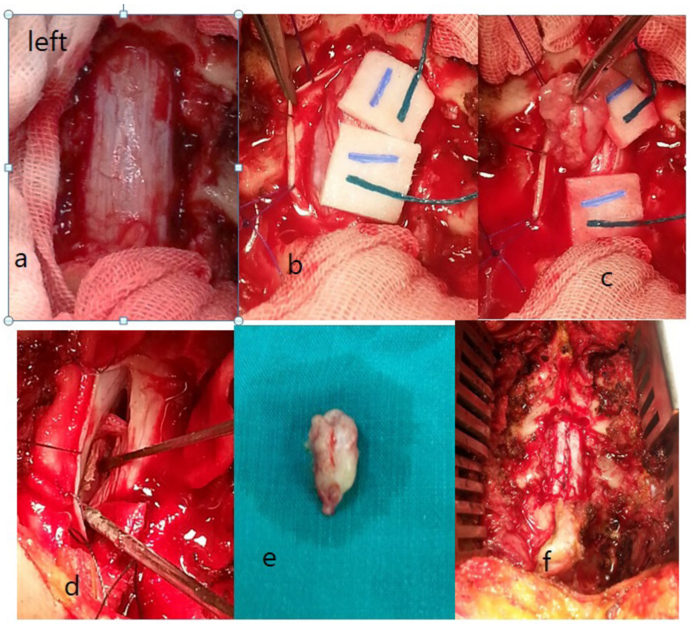
Figure 1: Superior view of thoracic vertebra demonstrating the amount of bone excision in laminectomy with bilateral partial fascetopediclectomy; yellow parts between the two red lines (from THIEME Atlas of Anatomy, General Anatomy and Musculoskeletal System, (c) Thieme 2005, Illustration by Karl Wesker).

Demonstrative case for the approach

Female patient 47years, suffering progressive paraparesis G4, urinary urgency (ASIA grade D). Has intradural extramedullary lesions at D2 level. Operated microscopically totally excised utilizing the modified Sheehan technique and patient regain the full motor power and voiding control (ASIA grade E). Late (39 months) follow up MRI no residual lesion. The lesion histopathologically was psammomatous meningioma.

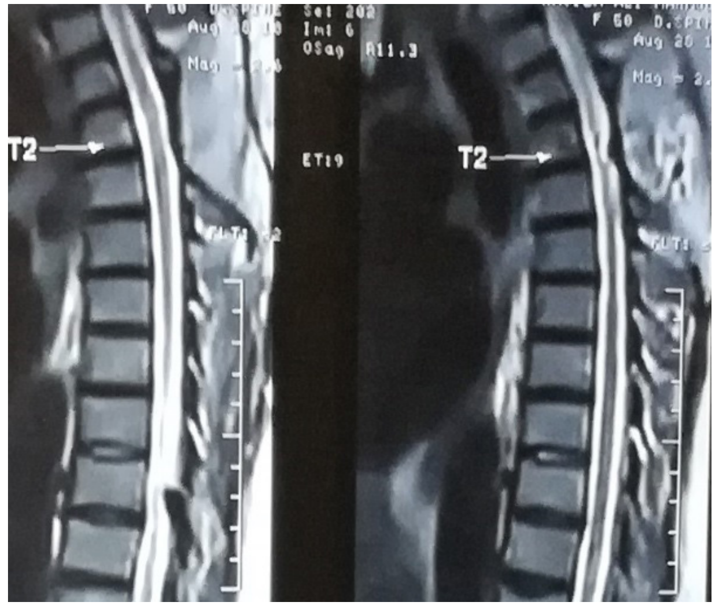
Preoperative MRI cervicodorsal region show intradural extramedullary lesions at D2 level relatively Isointense with contrast compressing the cord from left to right side.

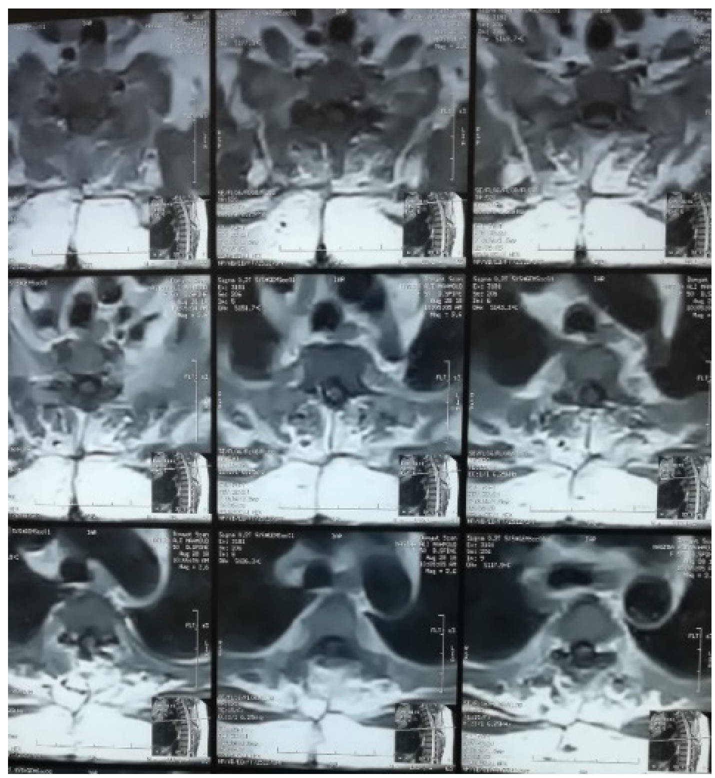




Operative photo demonstrating steps of the surgical approach
(a) the extent of laminectomy which include full D2 lamina and partial D1, and the created longitudinal space at the left side after partial fascetopediclectomy. **(b)** Left eccentric durotomy the cord with overlying dura covered by cottonoied patty, the dura maximally retracted and stitched to the left side filling the created space with initial good exposure of the lesion. **(c)** The lesion excised without any neural manipulation. **(d)** Surgical site after lesion excision shows the rootlet exit and no residual. **(e)** The excised mass (meningioma) **(f)** after dural closure displaying the usual laminectomy and left side partial fascetopediclectomy.

39 months follow up MRI of the same patient show good neural decompression, no recurrence and no intraspinal soft tissue mass and no abnormal enhancement.





Results

The study group was thirty patients, fifteen males, and fifteen females suffering spinal cord tumors. Median age at diagnosis 41years (Table 1). Thoracic region most affected (53.3%) followed by cervical (23.4%) then lumbar (20%) regions. Distribution of lesions were (76.7%) intradural extramedullary, and (23.3%) intradural intramedullary. Schwannoma (43.3%) and Meningioma (20%) were the most pathology (Table 2). The neurological status pre and postoperative; it was notable that ASIA group C decreased from 40% to 6.7%, and ASIA group D decreased from 60% to

26.7%, and we got a new ASIA group E 66.7% didn't exist before surgery. This is statistically significant as the probability of value is <0.001, and reflect the higher incidence of improvement in neurological status, also reflect the effectiveness of the utilized surgical approach in both preservation of neural structures and degree of respectability (Table 3). All cases of schwannoma (13 cases) and meningioma (6 cases) were intradural extramedullary. All cases of Ependymoma GII (3 cases) and Low-grade astrocytoma (3 cases) were intradural intramedullary. Myxopapillary ependymoma of the filum (one case) considered intradural extramedullary. Arteriovaneous malformation (2 cases) was 50% intradural extramedullary, and 50% intradural intramedullary. These finding statistically significant as the probability of value is 0.005 (Table 4). 54% of schwannoma cases (13cases) existed at dorsal spine, while other cases 15.3% at cervical spine 30.7% at lumbar spine. 66.7% of meningioma cases (6 cases) existed at dorsal spine and 33.3% at cervical spine. 66.7% of Cases of both low-grade astrocytoma (3 cases) and ependymoma (3cases) are existed at cervical spine and 33.3% at dorsal spine. 100% of cases of Myxopapillary ependymoma (one case) existed at the filum at lumbar spine. This relation between pathology and location in relation to spine region is statistically significant as the probability of value is 0.046 (Table 5).

Table 1: Demographic data among the studied group.

Variables	The study groups (n=30)
Age/ years	
Mean ± SD	41.37 ± 17.38
Median	41
Min-Max	3.0-72
Sex	
Male	15 (50%)
Female	15 (50%)

Table 2: Lesion characteristics among the studied group.

Lesion characteristics	The study groups (n=30)
Spine region	
S(sacral)	1 (3.3%)
D(dorsal)	16 (53.3%)
C(cervical)	7 (23.4%)
L(lumbar)	6 (20%)
Location	
Intradural extramedullary	23 (76.7%)
Intramedullary	7 (23.3%)
Approach	
Posterior decompressive laminectomy with unilateral or bilateral partial fascetopediclectomy	30 (100%)
Pathology	
Schwannoma	13 (43.3%)
Meningioma	6 (20%)
Ependymoma GII	3 (10%)
Low grade astrocytoma	3 (10%)
Arteriovaneous malformation	2 (6.7%)
Myxopapillary ependymoma G1	1 (3.3%)
Neuroblastoma with focal differentiation	1 (3.3%)
Undifferentiated malignant tumor	1 (3.3%)

Table 3: Preoperative and 6th months Post-operative ASIA scoring.

	Preoperative ASIA scoring	Post-operative ASIA scoring	P value
D	18 (60%)	8 (26.7%)	<0.001*
C	12 (40%)	2 (6.7%)	
E	0 (0%)	20 (66.7%)	

Table 4: Relation between location in relation to spinal cord and pathology.

Pathology	location			P value
	no	Intradural extramedullary	Intramedullary	
Schwannoma	13	13 (100%)	0 (0%)	0.005*
Meningioma	6	6 (100%)	0 (0%)	
Ependymoma GII	3	0 (0%)	3 (100%)	
Low grade astrocytoma	3	0 (0%)	3 (100%)	
Arteriovaneous malformation	2	1 (50%)	1 (50%)	
Myxopapillary ependymoma	1	0 (0%)	1 (100%)	
Neuroblastoma with focal differentiation	1	1 (100%)	0 (0%)	
Undifferentiated malignant tumor	1	1 (100%)	0 (0%)	

Table 5: Relation between pathology and location in relation to spine region.

Pathology	Spine region					P value
	no	S	D	C	L	
Schwannoma	13	-	7	2	4	0.046*
meningioma	6	-	4	2	-	
Ependymoma GII	3		1	2	-	
Low grade astrocytoma	3	-	1	2	-	
Arteriovaneous malformation	2	-	2	-	-	
Myxopapillary ependymoma	1	-	-	-	1	
Neuroblastoma with focal differentiation	1	-	1	-	-	
Undifferentiated malignant tumor	1	- 1	-	-	-	

Statistical analysis

Data were analyzed using the Statistical Package of Social Science (SPSS) program for Windows (Standard version 24). The normality of data was first tested with one-sample Kolmogorov-Smirnov test.

Qualitative data were described using number and percent. Association between categorical variables was tested using Chi-square test while Monte Carlo test were used when expected cell count less than 5 while Continuous variables were presented as mean ± SD (standard deviation).

Level of significance

For all above mentioned statistical tests done, the threshold of significance is fixed at 5% level (p-value). The results were considered:

- Non-significant when the probability value is more than 5% ($p > 0.05$).
- Significant when the probability of value is less than 5% ($p < 0.05$).

The smaller the p-value obtained, the more significant are the results.

Discussion

Spinal cord tumors lead to significant morbidity and in spite of its rarity, the middle age groups (productive age) are most susceptible to intradural extramedullary lesions, and this was as the median age at diagnosis for patients in this work was 41years [7,9]. The distribution of cases in relation to the dura and spinal cord among the studied group were (76.7%) intradural extramedullary, and (23.3%) intradural intramedullary; and the distribution in relation to spine regions were thoracic region (53.3%) followed by cervical (23.4%) then lumbar (20%) regions. These results in concordance to the reported finding in the literatures, where the intradural extramedullary neoplasms represent from 70 to 80% from the primary intradural neoplasms, and the remaining 20 to 30% are intradural intramedullary type, also the intradural neoplasms mostly found in the thoracic region, then the cervical region and lastly lumbar region [3-6]. In case of intradural neoplasms (extra or intramedullary) there is evidence of compromised neural structures (cord or thecal sac and nerve root). Sheehan et al. 1997 described unilateral pediclectomy to relieve the compressed nerve roots in advanced cases of spinal canal stenosis, in association with standard decompression [15]. In spite of operative microscope improve the surgical view, the surgical corridor with standard total or hemilaminectomy is actually narrow corridor. In this work the standard total laminectomy is utilized in association with unilateral or bilateral partial fascetopediclectomy, aiming at widened the surgical corridor and decreasing the manipulation of neural structures and decreasing the complications (modified Sheehan technique), also it's known that partial facetectomy does not affect the spine stability. The effectiveness of this surgical technique in maximum tumor resectability and decreasing neurological complications is reflected on the postoperative neurological status of the studied group. It was notable that ASIA group C decreased from 40% to 6.7%, and ASIA group D decreased from 60% to 26.7%, and we got a new ASIA group E 66.7% didn't exist before surgery, and these results are statistically significant as the probability of value is <0.001. As regard to pathological types of the studied group intradural extramedullary neoplasms, Schwannoma (43.3%) and Meningioma (20%) were the most pathology, and all cases of schwannoma (13 cases) and meningioma (6 cases) were intradural extramedullary. Myxopapillary ependymoma of the filum (one case) considered intradural extramedullary. Arteriovaneous malformation (2 cases) was 50% intradural extramedullary, and 50% intradural intramedullary. These finding concomitant with El-Mahdy et al. 1999 and Venugopal G et al. 2015, where they cited that the most common intradural extramedullary neoplasms are schwannoma, followed by meningioma then Myxopapillary ependymomas which are not uncommon, and lastly Less common lesions as epidermoid, dermoid, arteriovenous malformations [7,9]. As regard to pathological types of intramedullary neoplasms, Ependymoma GII (3 cases) and Low-grade astrocytoma (3 cases). These results in accordance to the stream of literature where the tumors from glial cells representing up to 80% of intramedullary tumors [5,6]. From the other point the previous finding statistically significant as the probability of value is (0.005). As regard to pathology and location in relation to spine region in this work it was statistically significant as the probability of value is 0.046, where the dorsal spine was hosted more than the cervical and lumbar spine, and these results almost similar to the literature review [3-6].

Conclusion

Although spinal cord tumors are rare tumors, they are one of the major health problems and can lead to significant morbidity. The relation between pathology and location in relation to spine region is statistically significant. In this work all cases of schwannoma and meningioma were intradural extramedullary, all cases of ependymoma GII and Low-grade astrocytoma were intradural intramedullary, myxopapillary ependymoma of the filum considered intradural extramedullary and arteriovaneous malformation was 50% intradural extramedullary, and 50% intradural intramedullary. The utilized surgical technique is very effective and safe as we get wide corridor for tumor excision, so increasing the effectiveness of operative microscopy and other operative tools, and improve the surgical outcome as noticed in postoperative neurological status.

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