Original Article

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Intradural Spinal Cord Tumor Resections by a Neurosurgeon at a Tertiary Care Hospital

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Abstract

Introduction: Intradural spinal cord tumors are rare. A retrospective analysis was conducted on patients who underwent surgical resection of an intradural spinal cord tumor between 9/4/1998 and 10/1/2010 by one surgeon.

Methods: Cases included adults (>18 years old) who had undergone spinal tumor resections. Endpoints examined included complication rates, discharge destinations, and lengths of hospitalization. Data was obtained via chart abstraction. Contingency tables were created, and estimates of relative risk (RR) with 95% confidence intervals (CIs) were calculated to determine the relationship between the endpoints of interest and a variety of variables (e.g., sex, ethnicity, tumor location). Sixty-six cases met the inclusion criteria.

Results: The median lengths of stay for males and females were 4 and 5 days, respectively; the distributions in the two groups differed significantly (Mann-Whitney U=541.5, nmale=30, nfemale=36, P<.05 two-tailed), but the two sexes did not have a statistically different risk of having non-home discharge destinations, or surgical complications. Whether or not a patient is Caucasian had no statistically significant correlation to the clinical outcomes of interest. Patients with intramedullary tumors were 3.0 (95% CI [1.7 – 5.2]) times more likely to have non-home discharge destinations and 2.3 (95% CI [1.1 – 3.0]) times more likely to encounter surgical complications than patients with extramedullary tumors. Finally, tumor resections that required arthrodesis were 2.1 (95% CI [1.1-4.0]) times more likely to be discharged to non-home destinations than resections that did not require arthrodesis.

Conclusion: Though this analysis is limited by the small number of tumors identified, it is one of the largest of its kind to date.

Key words: *Intradural, neoplasm, tumor, resection, outcomes, spinal*

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Introduction

Intradural spinal cord neoplasms (SCNs) have been insufficiently studied. They remain an important entity on the differential diagnosis for patients presenting with radicular pain, sensorimotor deficits, sphincter dysfunction, and/or back pain. SCNs comprise 4.6% of primary CNS tumors [1]. They have an annual incidence of .8-2.5 per 100,000 people [1, 2] and a prevalence of 9.1-13 per 100,000 people [2, 3]. Of these tumors, 70-80% are extramedullary, while 20-30% are intramedullary. The most common histological findings for intradural-extramedullary neoplasms are meningiomas and nerve sheath tumors,

whereas the most common intramedullary neoplasms are ependymomas and astrocytomas [4].

While over two thirds of adult spinal tumors are non-malignant [5], their ability to disable patients should not be underestimated. The most common symptoms of a primary intraspinal tumor are pain (52.2%), weakness and/or paralysis (52.0%), numbness and/or tingling (45.9%), and coordination and/or balance impairment (26.5%). The most common signs of such tumors are weakness, fasciculations, and atrophy (30.9%), decreased sensation, (29.8%), difficulty with gait (21.8%), and increased lower extremity reflexes (22.9%) [6].

A previous analysis demonstrated a significant correlation between good pre-operative McCormick statuses and improved scores at discharge. Additionally, extramedullary tumor resections were found to have better outcomes than intramedullary, as measured by the McCormick status [7]. An analysis of adult intramedullary tumor resections demonstrated no statistically significant correlation between negative outcomes and the "age, location of tumor, histology, extent of resection, [or] use of hypothermia for neuroprotection." That study did, however, reveal a significant postoperative morbidity with 43.6% of patients experiencing dorsal column dysfunction [8].

Emory Healthcare is one of the major tertiary care service providers in the greater Atlanta metropolitan area. As such, the Emory Department of Neurosurgery is one of the primary referral centers for complex spinal tumors in Georgia. Over the years, Emory has accumulated a large series of spinal tumor patients that have undergone resection of their lesions. In this study, Dr. Gerald Rodts, Professor of Neurosurgery and the Director of the Spine Fellowship for the Department of Neurosurgery at Emory University School of Medicine, was the only surgeon followed. His patients undergoing intradural spinal cord tumor resections between 9/4/1998 and 10/1/2010 were the patient population of interest.

The goal of this analysis was to identify associations between variables and clinical outcomes, such as non-home discharge rates, complication rates, and lengths of hospitalization. Prior to analyzing the data, it was suspected that intramedullary tumors, cervical tumors, and operations that required arthrodesis were all likely to contribute to poorer clinical outcomes. Identification of these associations will assist clinicians in improving outcomes and making the best decisions for their patients who suffer from intradural spinal cord tumors.

Methods

The Emory University Healthcare billing database was queried for Dr. Rodts' patients with operations between 9/4/1998 and 10/1/2010 with the ICD procedure code 3.4 ("Excision or destruction of lesion of spinal cord or spinal meninges"). Exclusion criteria were applied, such that all patients were older than 18 years of age and had an intradural spinal cord tumor. Only patients whose primary surgical goal was tumor resection were included. Patients who endured multiple surgeries by Dr. Rodts were only included in the analysis once, with their primary surgery used for data analysis. Sixty-six cases remained after exclusion criteria were applied.

Contingency tables were created and estimates of relative risk (RR) with 95% confidence intervals (CIs) were calculated to determine the relationship between predetermined variables and outcomes of interest. The variables analyzed were age, sex, race, tumor type, tumor location, and whether arthrodesis was performed. Tumors were classified as either intramedullary or extramedullary, and their vertebral location (e.g., cervical, thoracic) was determined using the superior border of the tumor. The outcomes of interest were discharge destination, complication rate, and length of hospitalization. The Mann-Whitney U test was utilized to assess the distribution of lengths of hospital stays for each variable.

Results

Table 1 describes the patient demographics and

Table 1: Demographics and general outcomes.

Demographic/Outcome	
Average Age	50.2
% Female	54.5
% White	69.7
% Intramedullary Involvement	13.3
% D/C to Non-home Destination	33.3
% Experiencing Complications	28.8
% Surgeries Requiring Fusion	15.2

Table 2: Tumor pathology distribution.

Tumor Pathology/Cases (%)	
Adenocarcinoma	1 (1.5)
Cystic Teratoma	1 (1.5)
Dermoid/Epidermoid Cyst	1 (1.5)
Enterogenous Cyst	1 (1.5)
Ependymoma	15 (22.7)
Hemangioblastoma	2 (3.0)
Lipoma	1 (1.5)
Meningioma	15 (22.7)
Metastatic Neuroendocrine Carcinoma	1 (1.5)
Neurofibroma	5 (7.6)
Schwannoma	22 (33.3)
Unspecified Nerve Sheath Tumor	1 (1.5)
Total Cases	66 (100)

Table 3: Tumor region distribution.

Region/Cases (%)	
Cervical	16 (24.2)
Cervicothoracic	4 (6.1)
Thoracic	17 (25.8)
Thoracolumbar	5 (7.6)
Lumbar	18 (27.3)
Lumbosacral	6 (9.1)
Sacral	0 (0)

surgical outcomes included in the analysis. Table 2 describes the distribution of tumor pathologies. As expected, ependymomas, meningiomas, and schwannomas were the most common pathologies encountered. Table 3 depicts the distribution of intradural tumors by spinal location.

Predetermined variables were compared to discharge destination in Table 4. Patients with intramedullary tumors were 3.0 (95% CI [1.7 – 5.2]) times more likely to be discharged to a non-home destination than patients with extramedullary tumors. Additionally, patients whose surgeries required arthodesis were 2.1 (95% CI [1.1-4.0]) times more likely to be discharged to a non-home destination than cases that did not require arthrodesis. No other variables were found to be statistically significant risk factors for a non-home destination discharge.

Predetermined variables were compared to complication rates in Table 5. Complications encountered by patients in this study included pseudomeningocele (13 cases), CSF leak (9 cases), hematoma (1 case), wound infection (4 cases), atrial fibrillation (1 case), DVT (4 cases), and meningitis (2 cases). Patients with intramedullary tumors were 2.3 (95% CI [1.1 – 3.0]) times more likely to encounter complications than pa-

Table 4: Discharge destination analysis.

	Cases	Non-home Discharge Risk	Relative Risk	Standard Error	95% CI LL	95% CI UL
Sex vs. Discharge Destination						
Female	36	.44	1	-	-	-
Male	30	.2	.45	.41	.20	1.004
Ethnicity vs. Discharge Destination						
White	46	.35	1	-	-	-
Other	20	.54	1.5	.39	.71	3.3
Medullary Involvement vs. Discharge Destination						
No Intramedullary Involvement	57	.26	1	-	-	-
Intramedullary Involvement	9	.78	3.0	.28	1.7	5.2
Most Superior Region Involved vs. Discharge Destination						
Cervical	20	.4	2.4	.53	.84	6.8
Thoracic	22	.45	2.7	.51	.99	7.5
Lumbar	24	.17	1	-	-	-
Fusion vs. Discharge Destination						
No Fusion	56	.29	1	-	-	-
Fusion	10	.60	2.1	.33	1.1	4.0

Table 5: Complication rate analysis.

	Cases	Complication Risk	Relative Risk	Standard Error	95% CI LL	95% CI UL
Sex vs. Complications						
Female	36	.25	1	-	-	-
Male	30	.33	1.3	.39	.62	2.8
Ethnicity vs. Complications						
White	46	.35	1	-	-	-
Other	20	.54	1.5	.39	.71	3.3
Medullary Involvement vs. Complications						
No Intramedullary Involvement	57	.25	1	-	-	-
Intramedullary Involvement	9	.56	2.3	.38	1.1	3.0
Most Superior Region Involved vs. Complications						
Cervical	20	.35	1.4	.47	.56	3.5
Thoracic	22	.27	1.1	.50	.41	2.9
Lumbar	24	.25	1	-	-	-
Fusion vs. Complications						
No Fusion	56	.25	1	-	-	-
Fusion	10	.50	2.0	.39	.92	4.3

Table 6: Tumor pathology and associated risks.

	Cases (%)	Complications Risk	Non-home Discharge Risk
Adenocarcinoma	1 (1.5)	1	0
Cystic Teratoma	1 (1.5)	1	1
Dermoid/Epidermoid Cyst	1 (1.5)	0	1
Enterogenous Cyst	1 (1.5)	0	0
Ependymoma	15 (22.7)	.27	.27
Hemangioblastoma	2 (3.0)	.5	.5
Lipoma	1 (1.5)	0	0
Meningioma	15 (22.7)	.13	.4
Metastatic Neuroendocrine Carcinoma	1 (1.5)	1	1
Neurofibroma	5 (7.6)	.6	0
Schwannoma	22 (33.3)	.27	.32
Unspecified Nerve Sheath Tumor	1 (1.5)	0	1
Total	66 (100)	.29	.33

tients with extramedullary tumors. No other variables were found to be statistically significant risk factors for encountering surgical complications.

Due to the great variety of tumor pathologies and the low frequency of each tumor type, statistical analysis of pathologies could not be performed with confidence. Table 6 compares tumor pathologies to their associated complication rates and non-home discharge rates.

The distribution of lengths of hospitalization was compared for each variable, and results can be seen in Table 7.

Discussion

It was initially hypothesized that poorer clinical outcomes would be associated with cervical tumors, intramedullary tumors, and surgeries that required arthrodesis. In summary of the data above, the following conclusions can be made:

Table 7: Length of hospitalization snalysis.

	Cases	Median Length of Hospitalization	Mann-Whitney U	P<.05?
Sex vs. Length of Stay				
Female	36	5	-	-
Male	30	4	541.5	Yes
Ethnicity vs. Length of Stay				
White	46	4	-	-
Other	20	5	521	No
Medullary Involvement vs. Length of Stay				
No Intramedullary Involvement	57	4	-	
Intramedullary Involvement	9	5	207	No
Fusion vs. Length of Stay				
No Fusion	56	4	-	
Fusion	10	4.5	287	No

Females were more likely to have longer hospitalizations than males, but did not have an increased risk of complications. Although they were not quite statistically significant, females were 2.2 (95% CI [.20-1.004]) times more likely to be discharged to non-home destinations, which may explain the longer lengths of hospitalization in this sample; they were likely awaiting placement at other facilities.

Caucasian patients did not have an increased risk of complications, longer hospitalizations, or non-home discharges when compared to non-Caucasian patients. Whether a patient is Caucasian or not seems to have no correlation to the outcomes analyzed.

Patients with intramedullary tumors were more likely to have non-home discharge destinations and surgical complications than patients with extramedullary tumors. These findings were as predicted, given the obvious risks of heavily manipulating the parenchyma of the spinal cord. Previous studies have also confirmed the significant risks and hefty morbidity associated with intramedullary spinal cord tumor resections [9]. Surprisingly, however, patients with intramedullary tumors did not have a significant difference in the distribution of hospitalization times, compared to extramedullary tumor patients.

There was no significant correlation between tumor location (e.g., cervical, thoracic, lumbar) and risk of non-home discharge or complications. This finding is surprising given our assumption that the increased nerve tracts in the cervical region would put cervical resection patients at an increased risk of poor outcomes. Perhaps if analysis had been more focused on functional outcomes, these findings may have been more apparent.

Tumor resections that required arthrodesis were more likely to be discharged to non-home destinations than resections that did not require arthrodesis. This is likely explained by the increased complexity of the procedure the patient endured. At the same time, however, these patients had no increased risk of complications or longer hospitalizations. These conclusions may be limited by the small number of cases requiring arthrodesis in this analysis (n=9). Given this limitation, it should be noted that the risk of complications in fusion cases was twice that of those not requiring arthrodesis (RR=2, 95% CI [0.92 – 4.3]).

Finally, although the total number of cases identified prohibits statistical analysis of tumor pathology, it appears that neurofibroma resections may pose a greater risk of complication than many other tumor types. Sixty percent (3 of 5) neurofibroma resections encountered complications, whereas only 27% (4 of 15) ependymoma resections and 13% (2 of 15) meningioma resections encountered complications. This finding will have to be confirmed by future studies because the small numbers prevent any strong assessment of whether this is merely an expression of chance.

Though this analysis is limited by the small num-

ber of tumors identified, it is one of the largest of its kind to date. A separate limitation of this study is that we did not compare patients' pre-operative functional statuses to those of the post-operative period. Looking at discharge destinations is a very gross measure of a functional status, which can be improved upon in future studies. Another limitation of this analysis is that only one surgeon's patients were included. In future investigations, multiple surgeons at multiple institutions should be considered to better portray clinical outcomes in the field of neurosurgery as a whole. This analysis is only a small step in the direction future research must move in to better understand intradural spinal neoplasms and improve upon clinical outcomes.

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Conflict of interest statement

The authors do not declare any conflict of interest or financial support in this study.

References

1. Cole GC, Wilkins PR, West RR. An epidemiological survey of primary tumours of the brain and spinal cord in South East Wales. Br J Neurosurg 1989;3:487-493.
2. Fogelholm R, Uutela T, Murros K. Epidemiology of central nervous system neoplasms. A regional survey in Central Finland. Acta Neurol Scand 1984;69:129-136.
3. Kurland LT. The frequency of intracranial and intraspinal neoplasms in the resident population of Rochester, Minnesota. J Neurosurg 1958;15:627-641.
4. Preston-Martin S. Descriptive epidemiology of primary tumors of the spinal cord and spinal meninges in Los Angeles County, 1972-1985. Neuroepidemiology 1990;9:106-111.
5. Schellinger KA, Propp JM, Villano JL, McCarthy BJ. Descriptive epidemiology of primary spinal cord tumors. J Neurooncol 2008;87:173-179.
6. Engelhard HH, Villano JL, Porter KR, Stewart AK, Barua M, Barker FG, et al. Clinical presentation, histology, and treatment in 430 patients with primary tumors of the spinal cord, spinal meninges, or cauda equina. J Neurosurg Spine 2010;13:67-77.
7. Nambiar M, Kavar B. Clinical presentation and outcome of patients with intradural spinal cord tumours. J Clin Neurosci 2012;19:262-266.
8. Manzano G, Green BA, Vanni S, Levi AD. Contemporary management of adult intramedullary spinal tumors-pathology and neurological outcomes related to surgical resection. Spinal Cord 2008;46:540-546.
9. Cristante L, Herrmann HD. Surgical management of intramedullary spinal cord tumors: functional outcome and sources of morbidity. Neurosurgery 1994;35:69-74.