Phenotyping of a Large Primary Spinal Cord Tumor Cohort Identified through an Observational Healthcare Database

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Background

Meningiomas are arachnoid cell tumors that occur both intracranially and in the spinal meninges. While intracranial meningiomas are the most common type of adult intracranial tumor,[1] spinal meningiomas account for only 1.2% of meningiomas.[2] However, because primary spinal neoplasms are rare, spinal meningiomas account for 25-46% of all spine tumors.[3]

There is female predominance among patients with both intracranial and spinal meningiomas, but the gender ratio is even more skewed for spinal meningiomas, with females accounting for 75%-90% of cases.[1] Women with breast cancer may be at increased risk of developing a spinal meningioma later on, with one 2020 study demonstrating a 26% increased risk for women with breast cancer compared to the general population.[4]

While the extant literature includes extensive analysis of the pathogenesis, natural history, management, and behavior of intracranial meningiomas, similar data on spinal meningiomas—particularly on the link between breast cancer and spinal meningiomas—remains limited.[3] Population-level evidence has the potential to advance our knowledge of these tumors.

Methods

We performed a retrospective cohort analysis of patients identified through the Observational Health Data Sciences and Informatics (OHDSI) network. Columbia University Irving Medical Center (CUIMC)'s anonymized Observational Medical Outcome Partnership (OMOP) database comprises a mixture of inpatient and outpatient visits, spans a time period of 4 decades (1990s-present), and represents a population of 6 million patients. The data in the OMOP database were extracted from CUIMC and New York-Presbyterian Hospital's electronic health record systems. We used ATLAS to construct our patient cohorts.

We used a series of procedure codes such as ICD-09 procedure code 03.4 ("Excision or destruction of lesion of spinal cord or spinal meninges") to indicate excision of a spinal cord lesion. We identified primary spinal cord malignancies with a series of codes such as SNOMED-CT code 363475005 ("Malignant neoplasm of spinal cord") or a related code. We identified secondary malignancies with a series of codes such as SNOMED-CT 128462008 ("Secondary malignant neoplastic disease") or related codes.

Our primary spinal cord malignancy cohort consisted of patients who had a first spinal cord tumor excision and an antecedent spinal cord malignancy diagnosis within 1 year prior to the procedure. All patients were between 18 and 80 years old. We excluded patients who were diagnosed with a secondary malignancy on all days before and 1 year after. By the nature of the

inclusion coding, any patients with a spinal meningioma diagnosis who did not receive surgical intervention were excluded. In accordance with Columbia University IRB (Protocol #AAAT4533), we reviewed the charts of identified patients and gathered data on: 1) pathology, 2) number of involved spinal levels, 3) tumor location, 4) tumor volume, 5) World Health Organization (WHO) tumor grade, 6) patient comorbidities, 7) date of birth, 8) date of surgery, 9) gender, and 10) meningioma recurrence.

Cranial neoplasm data were extracted from a Columbia tumor bank dataset from 2012, which included patient gender, race, ethnicity, tumor diagnosis, WHO grade, and age at time of surgery.

Results

Of 1,000 patients with spinal tumors identified in OHDSI, 146 had spinal meningiomas and were included in analyses (Table 1). From the tumor bank data, 606 patients with intracranial meningiomas were included. The majority of spinal meningioma patients were female (84%). Gender subgroup analysis of spinal meningiomas revealed a 5:1 female:male ratio compared to a 2:1 female:male ratio in the intracranial meningioma cohort. Breast cancer was the most common oncologic association with spinal meningiomas, diagnosed in 6.2% of these patients.

	Male	Female	p-value
N (%)	24 (16%)	122 (84%)	**< 0.05**✢
Age at time of surgery, mean (range)	63 (43 - 80)	61 (22 - 91)	0.40
Number of involved spinal levels, mean (range)	2.6 (1 - 8)	2.4 (1 - 5)	0.46
Tumor volume (cm^3), median (interquartile range)	0.88 (.58)	1.014 (1.4)	0.39
WHO Grade I, n (%) *	15 (94%)	73 (100%)	
Involved Spinal Levels, n (%)			
Cervical	9 (37.5%)	37 (30%)	0.49
Cervical-Thoracic	4 (16.7%)	6 (4.9%)	**0.04**
Thoracic	9 (37.5%)	68 (56%)	0.16
Thoracic-Lumbar	0 (0%)	6 (4.9%)	0.27
Lumbar	2 (8.3%)	5 (4.1%)	0.37
Confirmed recurrence, n (%)	0 (0%)	5 (4.1%)	0.31

✢ compared to percentage female in general population from US Census

*Percent of non-missing values

Table 1. Male vs. Female Spinal Meningioma Cohort.

Conclusions

This analysis of spinal meningioma patients is one of the largest and most comprehensive reviews of these tumors in the extant literature.[2,5–9] It reports a male:female gender ratio double that of intracranial meningiomas and higher than the 4:1 value recently reported in the literature.[3]

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