

Prevalence of Spinal Metastasis in Neurosurgical Procedures: A Descriptive Study

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Abstract

Objective: This study sought to identify the prevalence of operations for spinal epidural neoplastic metastases relative to other spine and neurosurgical operative procedures. **Methods:** This study was descriptive and involved a retrospective review of data collected from patients who underwent neurosurgeries between February 1997 and January 2015 at a single quaternary hospital. The examined population was distributed across five descriptive categories to perform numerical distributions among neurosurgical operative procedures. **Results:** A total of 12,802 neurosurgical procedures were identified. These procedures were classified as follows: Skull and brain, 11,192 (87.42%); spinal column and spinal nervous tissue, 1462 (11.42%); and peripheral nerves, 148 (1.16%). Surgical procedures for the 1462 (100%) cases of spinal column and spinal nervous tissue diseases were distributed by nosology as follows: Degenerative intervertebral disk and spondylosis, 768 (52.54%); neoplastic, 279 (19.08%); traumatic, 221 (15.11%); congenital, 163 (11.14%); infectious and inflammatory, 27 (1.85%); and vascular, 4 (0.28%). With respect to the distribution of the 279 (100%) surgical procedures for spinal column and spinal nervous tissue neoplastic diseases, 124 (44.44%) procedures were for intradural neoplasms, and 155 (55.56%) procedures were for epidural spinal column neoplasms. The 155 (100%) operations for epidural neoplastic diseases were distributed into two groups: Primary epidural neoplasms, 42 (27.10%); and secondary epidural neoplasms, 113 (72.90%). Spinal column epidural neoplastic metastases (secondary neoplasms) represented 0.88% of the 12,802 neurosurgical procedures. **Conclusions:** Surgical procedures for spinal metastasis are uncommon with respect to all neurosurgical operative procedures. Trend analysis reveals an unchanging trend of prevalence for these procedures.

Keywords

Epidemiology, Neoplasm Metastasis, Neurosurgical Procedures, Prevalence, Spine

1. Introduction

The vertebral column is the most common site of skeletal metastases and is involved in approximately 40% of cancer-related deaths [1] [2] [3] [4]. Spinal epidural neoplastic metastases as the initial clinical manifestation of cancer comprise 20% of all new diagnoses of spinal epidural metastases [5] [6], and the cumulative probability of spinal cord compression caused by malignant disease in the 5 years preceding death from cancer is 2.5% [6] [7]. The site of origin of a histologically documented carcinoma is not identified clinically in approximately 3% of patients [8]. Surgical treatment is required in 5% - 10% of patients [9], and a 3-month post-operative survival period justifies surgical treatment of patients for spinal epidural neoplastic metastasis [10] [11].

In 2014, the estimated incidence of new primary cancers in Brazil was 576,000 (2.84%) [12] among a total population of 202,768,662 [13]. No official government statistics exist regarding the prevalence of spinal metastases among cancer patients [12]. Knowledge of the descriptive prevalence of surgical operative procedures in patients who harbour spinal epidural neoplastic metastases remains lacking in the Brazilian medical literature, and this information could supplement the lack of epidemiological cancer data.

Reporting the prevalence of a specific disease among a population at a given point provides an accurate measurement of the studied problem [14]. Accurate cancer measurements improve population health by collective actions in public health policies [15]. The purpose of this study is the characterization of neurosurgical operative procedures into descriptive categories, which perhaps can indicate trends and patterns in spinal epidural neoplastic metastasis for future cancer research.

The objective of this study is to generate descriptive numerical distributions among patients undergoing operations for spinal epidural neoplastic metastases with respect to neurosurgical operative procedures and other surgically treated spinal column and spinal nervous tissue diseases.

2. Methods

The study design was observational and descriptive. This research involved a retrospective review of data collected from the electronic archives of patients who underwent neurosurgeries in the Division of Neurosurgery of a single quaternary hospital between February 1997 and January 2015. The primary author collected the study data from the registry files of the hospital's neurosurgical division.

Surgical demographic data were collected using the direct method of census, *i.e.*, the performed neurosurgeries were counted. The prevalence of spinal metastases was compared with those of other surgical spinal column and spinal nervous tissue diseases. Trend analysis was applied to determine the yearly pattern of prevalence (whether the trend was increasing, decreasing or unchanging) of surgical procedures for spinal metastases relative to the total number of neurosurgeries. Individual patient demographics and clinical characterizations were neither collected nor analysed. Magnetic resonance and computerized tomography spinal imaging were used to locate neoplasms in the vertebrae and indicate their relationship to the thecal sac. Pathologists from the institution's

pathology department reviewed the post-operative histological diagnoses of tumours. All patients in this study received treatment at no cost to them.

In the conceptual framework for the studied population, the research data were organized into the following five descriptive categories for numerical comparisons:

1. Neurosurgical procedures with respect to anatomical regions.
2. Spinal column and spinal nervous tissue disease patients classified by nosology as follows: degenerative intervertebral disk and spondylosis; neoplastic; traumatic; congenital; infectious/inflammatory; and vascular.
3. Spinal column neoplasms classified as intradural and epidural with respect to their thecal sac anatomical localization. All histological cancer types were included in the intradural anatomical classification system, and intramedullary and extramedullary diseases were not distinguished.
4. Spinal column epidural neoplasms classified into primary and secondary tumours based on their biological aetiology. Primary epidural neoplasms originated from the vertebrae, and secondary (metastatic) epidural tumours were transmitted from a distant primary tumour via a haematogenous route, direct neighbour-organ extension, or intradural cerebrospinal fluid-brain drop metastasis.
5. Neurosurgical procedures and secondary (metastatic) epidural spinal column neoplasms.

The research project was approved on January 27, 2016 by the Ethics Committee on Human Research in the Faculdade de Ciências Médicas da Santa Casa de Misericórdia de São Paulo (protocol number 1.396.194, cepsc@santacasasp.org.br; National Research Registry Number 52519116.2.0000.5479, <http://aplicacao.saude.gov.br/>). Patient identities were not accessed, and informed oral consent was exempted. The ethics conformed to the standards of the Declaration of Helsinki of 1975, as revised in 2000.

Statistical analyses were limited to quantitatively describing the primary features of the collected information, expressed by frequency, and the interval estimate of the sample, expressed by the confidence interval. Trend analysis was utilized to estimate the surgical prevalence of spinal metastases. IBM Statistical Package for the Social Sciences (SPSS, Inc., Chicago, IL, USA), version 13.0, was used for the statistical analysis.

3. Results

Censuses included 12,802 (100%) neurosurgeries performed during the 19-year study period. Surgical demographic data were distributed into five descriptive categories.

1. Neurosurgical procedures, 12,802 (100%), distributed as follows with respect to anatomical regions (**Table 1**).
2. Spinal column and spinal nervous tissue disease, 1462 (100%), classified based on nosology as follows (**Table 2**).
3. Spinal column neoplasms, 279 (100%), distributed as follows relative to their thecal sac anatomical localization (**Table 3**).
4. Spinal column epidural neoplasms, 155 (100%), categorized into primary and secondary tumours as follows based on their biological aetiology (**Table 4**).

5. Neurosurgical procedures relative to secondary (metastatic) epidural spinal column neoplasms: Spinal column epidural neoplastic metastases were involved in 0.88% of the 12,802 neurosurgical procedures (**Table 5**).

Table 1. Distribution of neurosurgical procedures with respect to anatomical region between February 1997 and January 2015.

Anatomical Location	# Neurosurgeries	Percentage	95% CI
Skull and brain	11,192	87.42%	16.85-88.00
Spinal column and spinal nervous tissue	1462	11.42%	10.87-11.97
Peripheral nerves	148	1.16%	0.971-1.34
Total	12,802	100%	

*Number of.

Table 2. Distribution of spinal column and spinal nervous tissue disease patients subjected to surgery with respect to nosology between February 1997 and January 2015.

Nosology	*Spine surgeries	Percentage	95% CI
Degenerative intervertebral disk and spondylosis	768	52.54%	49.98 - 55.10
Neoplastic	279	19.08%	17.07 - 21.09
Traumatic	221	15.11%	13.27 - 16.94
Congenital	163	11.14%	9.57 - 12.75
Infectious and inflammatory	27	1.85%	1.15 - 2.54
*Vascular	4	0.28%	0 - 0.6
Total	1462	100%	

*Number of; *Vascular spinal column and spinal nervous ailments were almost exclusively treated using percutaneous endovascular procedures.

Table 3. Distribution of intradural and epidural spinal column neoplasms between February 1997 and January 2015.

Anatomical distribution	*Spine surgeries	Percentage	95% CI
Intradural neoplasms	124	44.44%	38.61 - 50.27
Epidural neoplasms	155	55.56%	49.73 - 61.39
Total	279	100%	

*Number of.

Table 4. Classification of primary and secondary epidural spinal column neoplasms between February 1997 and January 2015.

Biologic tumour aetiology	*Spine surgeries	Percentage	95% CI
Primary epidural neoplasms	42	27.10%	20.10 - 39.09
Secondary epidural neoplasms	113	72.90%	65.91 - 79.90
Total epidural neoplasms	155	100%	

*Number of.

Table 5. Distribution of the neurosurgical procedures and secondary (metastatic) epidural spinal column neoplasms between February 1997 and January 2015.

Types of surgeries	#Surgeries	Percentage
Neurosurgeries	12,802	100%
Spinal secondary epidural neoplasms	113	0.88%

*Number of.

Trend analysis revealed an unchanging trend (event rate, 0.88%/year) for 113 (0.88%) surgical procedures in spinal metastases relative to the total of 12,802 (100%) neurosurgeries between February 1997 and January 2015.

4. Discussion

The purpose of this study was to determine the prevalence of surgical patients who harbour spinal epidural neoplastic metastasis, apply the findings to cancer epidemiology research, and foresee trends and patterns of this disease in defined populations. These data contribute to public health policies, evidence-based practice, and neurosurgical demographic data.

This study differs from the published literature due to the numerical descriptive comparisons among neurosurgical procedures with a focus on patients undergoing operations for spinal column epidural neoplastic metastasis.

The overall descriptive census of neurosurgical procedures is not commonly revealed by single neurosurgical divisions. A paucity of information exists concerning the neurosurgical demographic prevalence among surgical patients treated for spinal epidural neoplastic metastasis with respect to all neurosurgical operative procedures. This descriptive result is not available among the accessed literature.

In 1982, Perrin *et al.* [16] reported the presence of 11 (5.5%) intradural spinal column metastases among 200 symptomatic epidural spinal metastases. In 2013, Daniel [17] characterized 212 (100%) surgical cases of epidural and intradural spinal column tumours over a 14-year time span. Among these 212 cases, 110 (51.89%) and 102 (48.11%) cases involved epidural and intradural tumours (including all histological types), respectively. Of the 110 (100%) epidural spinal column tumours, 74 (67.27%) were secondary (metastasis), and 36 (32.73%) were primary tumours (localized in vertebrae).

The obtained descriptive results in this study indicate that surgical operative procedures for spinal metastases are uncommon. Trend analysis also indicates an unchanged annual trend of surgical prevalence for these procedures during the study period. Surgical cases of spinal column epidural neoplastic metastases represented 0.88% of the 12,802 neurosurgical procedures. However, relative to the 1462 (100%) total spinal column and spinal nervous tissue surgeries, the 113 (7.72%) operative procedures for spinal metastases seemed common. The reason for this discrepancy is that in our neurosurgical division, the demand for neurosurgical operative procedures for ailments of the central nervous system is greater than that for spinal column ailments. This finding may represent an epidemiological regional characteristic for high-volume quaternary

care centres including teaching hospitals.

This study's limitation lies in its conceptual framework. Descriptive research is limited to descriptions of past facts of a population's characteristics and precedes the hypotheses of exploratory research. Knowledge of past facts allows researchers to structure the scientific questions prompting hypotheses. Thus, descriptive studies in observational epidemiology do not explain causal relationships. Internal validity is a less important scientific requirement. No attempt was made to explore the causes underlying the obtained numerical frequency results. Future studies will be performed to identify the epidemiological reasons underlying the observed unchanging trend of prevalence for spinal metastasis surgeries at our health institution.

5. Conclusion

Surgical procedures for spinal metastasis are uncommon with respect to all neurosurgical operative procedures but are common compared to the overall number of spinal column and spinal nervous tissue surgeries. Surgical spinal (secondary) epidural neoplastic metastasis procedures were more common in this study relative to other spinal column and spinal nervous tissue tumours. Trend analysis indicates an unchanging trend of prevalence for spinal metastasis surgeries during the 19-year study period.

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