ORIGINAL ARTICLE
BASIC SCIENCES/OTHERS
http://dx.doi.org/10.1590/S1808-185120222104262528

PROFILE OF PATIENTS WITH SPINE TUMOR OPERATED IN A SOUTH AMERICAN REFERENCE SERVICE. EPIDEMIOLOGICAL STUDY

PERFIL DE PACIENTES COM TUMOR DE COLUNA OPERADOS EM UM SERVIÇO DE REFERÊNCIA SUL-AMERICANO. ESTUDO EPIDEMIOLÓGICO

PERFIL DE PACIENTES CON TUMOR DE COLUMNA OPERADOS EN UN SERVICIO DE REFERENCIA SURAMERICANO. ESTUDIO EPIDEMIOLÓGICO

MURILO ALEXANDRE[1], WILLIAM ZARZA SANTOS[1], RODRIGO GOES MEDÉA DE MENDONÇA[1], ALBERTO OFENHEJM GOTFRYD[1], MARIA FERNANDA SILBER CAFFARO[1], ROBERT MEVES[1]

1. Irmandade da Santa Casa de Misericórdia de São Paulo, Departamento de Ortopedia e Traumatologia. São Paulo, SP, Brazil.

ABSTRACT

Objective: The objective was to conduct an analytical epidemiological study to understand the profile, treatment, and outcome of patients with spinal tumors in a Brazilian Quaternary Hospital of the SUS. Methods: A retrospective cohort analysis of data from the last five years was performed. It was described qualitative characteristics evaluated by absolute and relative frequencies and quantitative characteristics by sintetized measures. Associations between characteristics were verified using chi-square tests or exact tests. Results: 92 patients met the eligibility criteria. The mean age was 56.1 years (±14.7), with 48 men (52.2%) and 44 women (47.8%). The types of tumors organized in the three proposed groups had 19 multiple myelomas (20.7%), 62 metastases (67.3%), and 11 other tumors (12%). The neurological status measured through the ASIA score was A: 5.4%, B: 22.8%, C: 26.1%, D: 35.9%, E: 9.8%. Karnofsky was prevalent in the 50-70 range with 65.2%. The total hospitalization period had a mean of 22.8±18 days, preoperatively 11.9±9.2 days, and postoperatively 10.9±14 days. Karnofsky presented lower values according to the worst ASIA ($p < 0.001$). A total of 12 patients (13%) died during hospitalization. The total and postoperative length of stay was longer in patients who died ($p = 0.002$ and $p < 0.001$). Conclusions: This study provides epidemiological data that allow an understanding of the profile of patients with spinal tumors in the Brazilian Public Health System. The severity of the patients is higher when compared to most of the series cases in the literature. The patients with longer hospitalization stay died. ***Level of evidence IV; Case series.***

Keywords: Spine; Neoplasms; Procedures, Surgical; Spinal Neoplasms; Neoplasm Metastasis; Multiple Myeloma.

RESUMO

Objetivo: Realizar um estudo epidemiológico analítico a fim de compreender o perfil, tratamento e desfecho dos pacientes com tumor na coluna operados em hospital quaternário brasileiro do SUS. Métodos: Foi realizado uma análise por estudo de coorte retrospectivo com os dados do prontuário correspondentes aos últimos 5 anos. Foram descritas as características qualitativas avaliadas por frequências absoluta e relativa, além das características quantitativas por medidas sumárias. Foram verificadas associações entre características com uso de testes qui-quadrado ou testes exatos. Resultados: 92 pacientes preencheram critérios de elegibilidade. A média etária foi de 56,1 anos (±14,7) com 48 homens (52,2%) e 44 mulheres (47,8%). Os tipos de tumores organizados nos três grupos propostos apresentaram 19 mielomas múltiplos (20,7%), 62 metástases (67,3%) e 11 outros tumores (12%). O status neurológico aferido através do escore ASIA teve distribuição de A: 5,4%, B: 22,8%, C: 26,1%, D: 35,9%, E: 9,8%. O Karnofsky foi prevalente na faixa de 50-70 com 65,2%. O período de internação total obteve média de 22,8±18 dias, pré-operatório 11,9±9,2 dias e pós-operatório 10,9±14 dias. O Karnofsky apresentou menores valores conforme pior ASIA ($p < 0,001$). Um total de 12 pacientes (13%) faleceram durante a internação. O tempo total de internação e o tempo de internação pós-operatório foram maiores nos pacientes que faleceram ($p = 0,002$ e $p < 0,001$). Conclusões: Este estudo traz dados epidemiológicos que permitem compreensão do perfil do paciente com tumor da coluna vertebral operado no Sistema Público de Saúde Brasileiro. A gravidade dos pacientes é maior quando comparada a maioria das séries de casos da literatura. Pacientes com maior tempo de internação foram a óbito. ***Nível de evidência IV; Série de casos.***

Descritores: *Coluna Vertebral; Neoplasias; Procedimento Cirúrgico; Neoplasias da Coluna Vertebral; Metástase Neoplásica; Mieloma Múltiplo.*

RESUMEN

Objetivo: Realizar un estudio epidemiológico analítico para comprender el perfil, el tratamiento y la evolución de los pacientes con tumores en la columna vertebral operados en un Hospital brasileño cuaternario del SUS. Métodos: Se realizó un análisis de cohorte retrospectivo de los datos de los últimos 5 años. Fueron descriptas características cualitativas evaluadas por frecuencias absolutas y relativas y características cuantitativas por medidas sumarias. Las asociaciones entre las características se verificaron mediante pruebas de chi-cuadrado o pruebas exactas. Resultados: 92 pacientes cumplieron con los criterios de elegibilidad. La edad promedio fue de 56,1 años (±14,7) con 48 hombres

Study conducted by the Irmandade da Santa Casa de Misericórdia de São Paulo, SP, Brazil.
Correspondence: Murilo Alexandre. 147, Rua Dona Veridiana, Apto. 121A, Higienópolis, SP, Brazil. 01238-010. m.alexandre.med@hotmail.com

Received on 06/29/2022 accepted on 07/19/2022
Reviewed by: Alexandre Fogaça Cristante

(52,2%) y 44 mujeres (47,8%). Los tipos de tumores organizados en los tres grupos propuestos fueron: 19 mielomas múltiples (20,7%), 62 metástasis (67,3%) y otros tumores 11 (12%). El estado neurológico medido a través del puntaje ASIA tuvo la siguiente distribución A: 5,4%, B: 22,8%, C: 26,1%, D: 35,9%, E: 9,8%. Karnofsky prevaleció en el rango 50-70 con 65,2%. El tiempo total de hospitalización tuvo un promedio de 22,8±18 días, preoperatorio 11,9±9,2 días y postoperatorio 10,9±14 días. Karnofsky presentó valores más bajos según el peor ASIA ($p < 0,001$). Un total de 12 pacientes (13%) fallecieron durante la hospitalización. La duración total de la estadía y la duración de la estancia postoperatoria fueron más largas en los pacientes que fallecieron ($p = 0,002$ y $p < 0,001$). Conclusiones: Este estudio proporciona datos epidemiológicos que permiten comprender el perfil de los pacientes con tumores de columna operados en el Sistema Público de Salud brasileño. La gravedad de los pacientes es mayor en comparación con la mayoría de las series de casos en la literatura. Los pacientes con estancias hospitalarias más prolongadas fallecieron. ***Nivel de evidencia IV; Serie de casos.***

Descriptores: *Columna Vertebral; Neoplasias; Procedimiento Quirúrgico; Neoplasias de la Columna Vertebral; Metástasis de la Neoplasia; Mieloma Múltiple.*

INTRODUCTION

Data from the World Health Organization show that approximately one in six deaths is from Cancer, making the disease the second leading cause of death worldwide, second only to cardiovascular causes.[1] Approximately 70% of these deaths occur in low/middle-income countries, and presentation in an advanced stage, inaccessible diagnosis and treatment are common.[2] The *International Agency for Research on Cancer* estimates that in 2018 there were 9.6 million deaths and an increase of about 18.1 million new cases, with a projection of 29.5 million cases by 2040.[2] In Brazil, the estimate for each year of the triennium 2020-2022 is 625,000 new cases of cancer, with the highest incidence of non-melanoma skin cancer followed by breast and prostate cancers.[3]

The spine is the most common site of skeletal metastases, and its incidence is growing.[4] About 70% of cancer patients have spinal metastases, which are present in 40% of patients who die of the disease.[4,5] Up to 10% of cancer patients will develop neurological symptoms.[4] In these cases, the metastases are located 70% in the thoracic segment, 20% lumbosacral, 10% cervical, and in 17% to 30% of cases, they are present in multiple vertebrae.[5] When evaluating the segment affected in isolation, there is a prevalence of involvement of the vertebral bodies (85%) compared to the paravertebral spaces (10%-15%).[5]

In contrast, primary tumors of the spine are rare and comprise only 10% or less of all bone tumors.[6] Their distribution varies significantly with age. In adults, hemangioma (20%-30%) and plasmacytoma (30%) are the most prevalent benign and malignant histological subtypes, respectively. In children, osteoidosteoma/osteoblastomaa (12%) and Ewing's sarcoma (4%-10%) are the most prevalent benign and malignant subtypes, respectively.[6]

Classifications and scores such as the American Spinal Cord Injury Association (ASIA),[7] the Karnofsky performance scale (Karnofsky),[8] the Spinal Instability Neoplastic Score (SINS),[9] among several others, are important to guide the treatment, prognosis, and survival of patients with a spinal tumor.[4,9,10] Even with these tools, the discussion about the timing and treatment for these patients is complex and dependent on multidisciplinary action and defined protocols.[9-16] However, due to the complexity and/or rarity of the cases, no official national statistics are available to evaluate these patients, which impacts and makes treatment difficult.[3]

Therefore, this study aimed to perform an analytical epidemiological study to understand the profile and treatment of patients with spinal tumors treated surgically in a Brazilian quaternary hospital of the SUS.

METHODS

We performed a retrospective cohort analysis of inpatient data. Convenience sampling was performed on the medical records of patients diagnosed with spinal tumors operated on by the spine surgery group from 01/01/2017 to 12/31/2021 (five years).

The inclusion criteria were: known clinical outcome, patients with a primary or secondary spinal tumor, histologically confirmed diagnosis of neoplasia, both genders, all age groups, telephone or face-to-face contact with the patient or their guardian available, and undergoing surgical treatment. Exclusion criteria: unknown clinical outcome, patients operated on at other institutions, no histologically confirmed diagnosis of neoplasia, and incomplete data.

The parameters collected in the clinical protocol were sociodemographic characteristics (initials/registration number, age, gender), anatomopathological diagnosis, date of hospitalization and discharge, length of stay, date of surgery, date of death, if it occurred during hospitalization, the visual analog scale for neck/lumbar and leg/arm pain, neurological status (ASIA),[7] functional performance scale (Karnosfsky),[8] SINS score,[9] approach route, surgical technique, instrumentation, instrumented region, instrumented levels, compressed region, decompression/resection levels. For certain statistical analyses, evaluated parameters were organized as follows: age, subdivided into children (0-17 years), adults (18-64 years), and elderly (≥65 years); tumor type, grouped according to the prevalence of our group's diagnoses (metastases, multiple myeloma and other tumors); the visual analog scale of pain, grouped into absent/light (0-2), moderate (3-7), and intense (8-10); Karnofsky, divided into bad (0-40), average (50-70), and good (80-100); and SINS into stable (0-6), indeterminate (7-12), and unstable (13-18). Patients undergoing a biopsy, decompressive or otherwise, were included in the study group.

Qualitative characteristics were described using absolute and relative frequencies, and quantitative characteristics were described using summary measures (mean, standard deviation, median, minimum, and maximum).[19] Relationships of interest were described using contingency tables, and associations between characteristics were verified using chi-square or exact tests (Fisher's exact test or likelihood ratio tests).[19]

Postoperative length of stay was described according to characteristics of interest and compared between categories using Kruskal-Wallis tests (more than two categories) or Mann-Whitney tests (2 categories only), and Spearman correlations of the postoperative length of stay with quantitative variables were calculated (20). A joint model was fitted to explain the postoperative length of stay with variables that in the literature usually influence the length of stay, using a generalized linear model (GLM) with normal distribution and logarithmic link function.[20]

The analyses were performed using IBM-SPSS *for Windows* version 22.0 *software* and tabulated using Microsoft-Excel 2013 *software,* and the tests were performed at a 5% significance level.

The work was carried out with the due approval of the ethics and research committee (CAAE: 32572320.0.0000.5479). The Informed Consent Form (ICF) was applied whenever possible to the patients and/or their legal guardians.

RESULTS

Obtained initial sampling of 156 patients over the five years between 01/01/2017 and 12/31/2021, of which only 92 met eligibility criteria for the study. The average age was 56.1 years (±14.7), with a median of 58.5 years (17; 81). There was no significant difference between the sexes, with 48 men (52.2%) and 44 women (47.8%). The tumor types organized into the three proposed groups showed

19 multiple myelomas (20.7%), 62 metastases (67.3%), and 11 other tumors (12%). The breakdown of pathology diagnoses, absolute values, and percentage distribution is specified in Table 1.

Most patients had moderate low back/neck pain (50%) and absent/light leg/arm pain (80.4%). The neurological status as measured by the ASIA score had a distribution of A = 5.4%, B = 22.8%, C = 26.1%, D = 35.9%, E = 9.8%. Karnofsky was most significant in the 50 to 70 range (average performance) with 65.2%. Most patients (55.6%) were classified within the SINS Score in the indeterminate range. (Table 1)

The main approach was the isolated posterior approach in 65 patients (70.7%), followed by the posterolateral approach in 15 patients (16.3%). The main surgical technique was laminectomy associated with arthrodesis in 59 patients (64.1%), followed by the Capener technique in 15 patients (16.3%). Instrumentation was performed in 66 patients (71.7%), with the isolated thoracic region being instrumented the most in 35 cases (53%). The same applies to the region with the highest number of injuries (thoracic = 66.3%). The mean number of decompressed levels was 1.5 ± 0.7, and the mean number of instrumented levels was 6.1 ± 1.9. (Table 2)

The total length of stay averaged 22.8 ± 18 days, with a median of 17 days (0; 95). The preoperative hospital stay had a mean of 11.9 ± 9.2 days and a median of 10 days (0; 46), while the postoperative hospital stay had a mean of 10.9 ± 14 days and a median of 6 days (0; 80). (Table 2)

When evaluating the Karnofsky performance scale, there were lower values according to the worse ASIA ($p < 0.001$), and the distribution of its categories was statistically different according to the technique used ($p = 0.001$) (Table 3). There was no statistically significant correlation between age group, tumor type, SINS and instrumentation with the Karnofsky ($p = 0.059$, $p = 0.090$, $p = 0.174$ and 0.963 respectively). (Table 3)

Association of SINS according to characteristics of interest was statistically significant for age group, tumor type and technique ($p = 0.049$, $p = 0.003$ and $p = 0.042$ respectively) (Table 4). There was no statistically significant correlation between SINS and ASIA ($p = 0.098$). (Table 4)

The distribution of ASIA were statistically different across tumor types and the techniques used ($p = 0.040$ and $p = 0.037$, respectively). Most patients with multiple myeloma and metastases had ASIA D (42.1% and 35.5%, respectively), while the prevalence for the other tumors was ASIA E with 36.4%. There was no statistically significant correlation between ASIA and the age range of the patients ($p = 0.560$). (Table 5)

The age group showed a statistically significant association with tumor types ($p = 0.004$), with multiple myeloma more frequent in the elderly, metastases more common in adult patients, and other tumors more frequent in children. Technique distribution and compressed region/injury show statistically significant association with tumor types ($p = 0.013$ and $p = 0.033$, respectively). (Table 6) However, there was no statistically significant association between surgical techniques and patients' age ($p = 0.488$). (Table 7)

Postoperative hospitalization times did not differ statistically when evaluated in isolation with age group, gender, tumor type, ASIA, Karnofsky, Technique, instrumentation, region instrumented, the number of levels instrumented, region compressed/injured, and the number of levels decompressed ($p > 0.05$). (Table 8) Together, only the type of tumor had a statistically significant influence on the length of postoperative hospital stay, independent of the other characteristics evaluated, with the length of postoperative hospital stay in tumors of other types being 143% longer than in multiple myelomas ($p = 0.043$). The other characteristics did not statistically influence the postoperative length of stay ($p > 0.05$). (Table 9)

A total of 12 patients (13%) died during hospitalization. Mortality showed no statistically significant association with the qualitative characteristics evaluated ($p > 0.05$). But total length of stay and postoperative length of stay was statistically significantly longer in patients who died ($p = 0.002$ and $p < 0.001$, respectively) (Table 10).

Table 1. Description of the patients personal and clinical characteristics.

Variable	Description (N = 92)
Age group, n (%)	
Child	2 (2,2)
Adult	60 (65,2)
Elder	30 (32,6)
Age (years)	
mean ± SD	56,1 ± 14,7
median (min; max)	58,5 (17; 81)
Sex, n (%)	
Male	48 (52,2)
Female	44 (47,8)
Type of tumor, n (%)	
Myeloma	19 (20,7)
Metastases	62 (67,3)
Other	11 (12)
Final anatomopathology	
Chondrosarcoma	1 (1,1)
Primary chondrosarcoma	1 (1,1)
Lymphoma	4 (4,3)
Multiple Myeloma	19 (20,7)
Hemangioma	2 (2,2)
Breast metastasis	14 (15,2)
Lung metastasis	9 (9,8)
Kidney metastasis	3 (3,3)
Thyroid metastasis	11 (12)
Melanoma metastasis	2 (2,2)
Undetermined metastasis	15 (16,3)
Colorectal metastasis	3 (3,3)
Urogenital metastasis	1 (1,1)
Pancreas metastasis	2 (2,2)
Liver metastasis	1 (1,1)
Cervical metastasis	1 (1,1)
Osteoblastic Osteosarcoma	1 (1,1)
Secondary Osteosarcoma	1 (1,1)
Hemangioendoteliomakaposiforme	1 (1,1)
Lumbar/Cervical VAS Classification, n (%)	
Absent/Light	27 (29,3)
Moderate	46 (50)
Intense	19 (20,7)
VAS Leg/Arm Classification, n (%)	
Absent/Light	74 (80,4)
Moderate	16 (17,4)
Intense	2 (2,2)
ASIA, n (%)	
A	5 (5,4)
B	21 (22,8)
C	24 (26,1)
D	33 (35,9)
E	9 (9,8)
KARNOFSKY Classification, n (%)	
80 a 100	13 (14,1)
50 a 70	60 (65,2)
0 a 40	19 (20,7)
SINS Classification, n (%)*	
Stable	10 (11,1)
Undetermined	50 (55,6)
Unstable	30 (33,3)

* Not everyone has the information.

Table 2. Description of the characteristics during hospitalization of all patients.

Variable	Description (N = 92)
Approach route, n (%)	
Previous	3 (3,3)
Posterior	65 (70,7)
Percutaneous	6 (6,5)
Postero-lateral	15 (16,3)
Posterior+Anterior	1 (1,1)
Another	2 (2,2)
Technique, n (%)	
Arthrodesis	1 (1,1)
Biopsy	7 (7,6)
Capener	15 (16,3)
Laminectomy	3 (3,3)
Vertebroplasty	1 (1,1)
Hemilaminecotomy	1 (1,1)
Corpectomy+Arthrodesis	3 (3,3)
Laminectomy+Arthrodesis	59 (64,1)
Resection+Arthrodesis	2 (2,2)
Instrumentation, n (%)	
No	26 (28,3)
Yes	66 (71,7)
Region instrumented, n (%)*	
Cervical	3 (4,5)
Thoracic	35 (53)
Cervical and Thoracic	7 (10,6)
Lumbar	1 (1,5)
Thoracic and Lumbar	13 (19,7)
Lumbar and Sacral	6 (9,1)
Thoracic, Lumbar and Sacral	1 (1,5)
Number of levels instrumented*	
mean ± SD	6,1 ± 1,9
median (min; max)	6 (3; 11)
Compressed region/injury, n (%)	
Cervical	6 (6,5)
Thoracic	61 (66,3)
Cervical and Thoracic	1 (1,1)
Lumbar	16 (17,4)
Thoracic and Lumbar	4 (4,3)
Sacral	3 (3,3)
Iliac	1 (1,1)
Number of decompressed levels*	
mean ± SD	1,5 ± 0,7
median (min; max)	1 (1; 4)
Total length of stay (days)	
mean ± SD	22,8 ± 18
median (min; max)	17 (0; 95)
Preoperative length of stay (days)	
mean ± SD	11,9 ± 9,2
median (min; max)	10 (0; 46)
Postoperative length of stay (days)	
mean ± SD	10,9 ± 14
median (min; max)	6 (0; 80)

* Not all have the information or only for valid cases; Test of comparison between pre- and postoperative hospitalization times (p = 0.024)

Table 3. Description of the Karnofsky classification according to features of interest and results of association tests.

Variable	KARNOFSKY Classification			Total	p
	80 a 100	50 a 70	0 a 40		
Age Group					**0,059**
Child	2 (100)	0 (0)	0 (0)	2	
Adult	7 (11,7)	42 (70)	11 (18,3)	60	
Elder	4 (13,3)	18 (60)	8 (26,7)	30	
Type of tumor					**0,090**
Myeloma	2 (10,5)	12 (63,2)	5 (26,3)	19	
Metastases	6 (9,7)	43 (69,4)	13 (21)	62	
Other	5 (45,5)	5 (45,5)	1 (9,1)	11	
ASIA					**<0,001**
A	0 (0)	3 (60)	2 (40)	5	
B	0 (0)	13 (61,9)	8 (38,1)	21	
C	0 (0)	16 (66,7)	8 (33,3)	24	
D	8 (24,2)	24 (72,7)	1 (3)	33	
E	5 (55,6)	4 (44,4)	0 (0)	9	
SINS Classification					**0,174**
Stable	3 (30)	6 (60)	1 (10)	10	
Undetermined	8 (16)	34 (68)	8 (16)	50	
Unstable	2 (6,7)	18 (60)	10 (33,3)	30	
Technique					**0,001**
Arthrodesis	1 (100)	0 (0)	0 (0)	1	
Biopsy	3 (42,9)	4 (57,1)	0 (0)	7	
Capener	0 (0)	9 (60)	6 (40)	15	
Laminectomy	0 (0)	3 (100)	0 (0)	3	
Vertebroplasty	1 (100)	0 (0)	0 (0)	1	
Hemilaminecotomy	0 (0)	1 (100)	0 (0)	1	
Corpectomy+Arthrodesis	3 (100)	0 (0)	0 (0)	3	
Laminectomy+Arthrodesis	5 (8,5)	41 (69,5)	13 (22)	59	
Resection+Arthrodesis	0 (0)	2 (100)	0 (0)	2	
Instrumentation					**0,963**
No	4 (15,4)	17 (65,4)	5 (19,2)	26	
Yes	9 (13,6)	43 (65,2)	14 (21,2)	66	

Data expressed as n (%); Likelihood ratio test.

Table 4. Description of the SINS classification according to features of interest and results of the association tests.

Variable	SINS Classification			Total	p
	Stable	Undetermined	Unstable		
Age Group					0,049
Child	2 (100)	0 (0)	0 (0)	2	
Adult	5 (8,6)	32 (55,2)	21 (36,2)	58	
Elder	3 (10)	18 (60)	9 (30)	30	
Type of tumor					0,003
Myeloma	0 (0)	12 (63,2)	7 (36,8)	19	
Metastases	6 (9,7)	33 (53,2)	23 (37,1)	62	
Other	4 (44,4)	5 (55,6)	0 (0)	9	
ASIA					0,098
A	2 (40)	3 (60)	0 (0)	5	
B	3 (14,3)	8 (38,1)	10 (47,6)	21	
C	1 (4,2)	12 (50)	11 (45,8)	24	
D	3 (9,4)	22 (68,8)	7 (21,9)	32	
E	1 (12,5)	5 (62,5)	2 (25)	8	
Technique					0,042
Arthrodesis	0 (0)	1 (100)	0 (0)	1	
Biopsy	3 (42,9)	4 (57,1)	0 (0)	7	
Capener	1 (6,7)	11 (73,3)	3 (20)	15	
Laminectomy	0 (0)	3 (100)	0 (0)	3	
Vertebroplasty	0 (0)	1 (100)	0 (0)	1	
Hemilaminecotomy	1 (100)	0 (0)	0 (0)	1	
Corpectomy+Arthrodesis	0 (0)	2 (66,7)	1 (33,3)	3	
Laminectomy+Arthrodesis	5 (8,5)	28 (47,5)	26 (44,1)	59	

Data expressed as n (%); Likelihood ratio test.

Table 5. Description of ASIA according to characteristics of interest and results of association tests.

Variable	ASIA					Total	p
	A	B	C	D	E		
Age Group							**0,560**
Child	0 (0)	0 (0)	0 (0)	1 (50)	1 (50)	2	
Adult	2 (3,3)	13 (21,7)	18 (30)	21 (35)	6 (10)	60	
Elder	3 (10)	8 (26,7)	6 (20)	11 (36,7)	2 (6,7)	30	
Type of tumor							**0,040**
Myeloma	2 (10,5)	5 (26,3)	3 (15,8)	8 (42,1)	1 (5,3)	19	
Metastases	2 (3,2)	13 (21)	21 (33,9)	22 (35,5)	4 (6,5)	62	
Other	1 (9,1)	3 (27,3)	0 (0)	3 (27,3)	4 (36,4)	11	
Technique							**0,037**
Arthrodesis	0 (0)	0 (0)	0 (0)	0 (0)	1 (100)	1	
Biopsy	0 (0)	0 (0)	0 (0)	4 (57,1)	3 (42,9)	7	
Capener	0 (0)	5 (33,3)	6 (40)	4 (26,7)	0 (0)	15	
Laminectomy	0 (0)	0 (0)	1 (33,3)	2 (66,7)	0 (0)	3	
Vertebroplasty	0 (0)	0 (0)	0 (0)	0 (0)	1 (100)	1	
Hemilaminecotomy	0 (0)	0 (0)	1 (100)	0 (0)	0 (0)	1	
Corpectomy+Arthrodesis	0 (0)	0 (0)	0 (0)	2 (66,7)	1 (33,3)	3	
Laminectomy+Arthrodesis	5 (8,5)	16 (27,1)	16 (27,1)	20 (33,9)	2 (3,4)	59	
Resection+Arthrodesis	0 (0)	0 (0)	0 (0)	1 (50)	1 (50)	2	

Data expressed as n (%); Likelihood ratio test.

Table 6. Description of the characteristics of interest according to tumor types and results of association tests.

Variable	Type of tumor			Total	p
	Myeloma	Metastases	Other		
Age Group					**0,004**
Child	0 (0)	0 (0)	2 (18,2)	2 (2,2)	
Adult	8 (42,1)	45 (72,6)	7 (63,6)	60 (65,2)	
Elder	11 (57,9)	17 (27,4)	2 (18,2)	30 (32,6)	
Technique					**0,013**
Arthrodesis	0 (0)	1 (1,6)	0 (0)	1 (1,1)	
Biopsy	0 (0)	4 (6,5)	3 (27,3)	7 (7,6)	
Capener	7 (36,8)	7 (11,3)	1 (9,1)	15 (16,3)	
Laminectomy	0 (0)	3 (4,8)	0 (0)	3 (3,3)	
Vertebroplasty	0 (0)	0 (0)	1 (9,1)	1 (1,1)	
Hemilaminecotomy	0 (0)	1 (1,6)	0 (0)	1 (1,1)	
Corpectomy+Arthrodesis	1 (5,3)	2 (3,2)	0 (0)	3 (3,3)	
Laminectomy+Arthrodesis	11 (57,9)	44 (71)	4 (36,4)	59 (64,1)	
Resection+Arthrodesis	0 (0)	0 (0)	2 (18,2)	2 (2,2)	
Compressed region/injury					**0,033**
Cervical	1 (5,3)	4 (6,5)	1 (9,1)	6 (6,5)	
Thoracic	17 (89,5)	40 (64,5)	4 (36,4)	61 (66,3)	
Cervical and Thoracic	0 (0)	1 (1,6)	0 (0)	1 (1,1)	
Lumbar	0 (0)	13 (21)	3 (27,3)	16 (17,4)	
Thoracic and Lumbar	1 (5,3)	3 (4,8)	0 (0)	4 (4,3)	
Sacral	0 (0)	1 (1,6)	2 (18,2)	3 (3,3)	
Iliac	0 (0)	0 (0)	1 (9,1)	1 (1,1)	

Data expressed as n (%); Likelihood ratio test.

Table 7. Description of the techniques according to age groups and association test results.

Variable	Age Group			Total	p
	Child	Adult	Elder		
Technique					**0,488**
Arthrodesis	0 (0)	1 (1,7)	0 (0)	1 (1,1)	
Biopsy	1 (50)	3 (5)	3 (10)	7 (7,6)	
Capener	0 (0)	6 (10)	9 (30)	15 (16,3)	
Laminectomy	0 (0)	2 (3,3)	1 (3,3)	3 (3,3)	
Vertebroplasty	0 (0)	1 (1,7)	0 (0)	1 (1,1)	
Hemilaminecotomy	0 (0)	1 (1,7)	0 (0)	1 (1,1)	
Corpectomy+Arthrodesis	0 (0)	1 (1,7)	2 (6,7)	3 (3,3)	
Laminectomy+Arthrodesis	1 (50)	43 (71,7)	15 (50)	59 (64,1)	
Resection+Arthrodesis	0 (0)	2 (3,3)	0 (0)	2 (2,2)	

Data expressed as n (%); Likelihood ratio test.

DISCUSSION

Case series of patients with spinal tumors in the literature usually rely on databases of specialized centers/exclusive for treating cancer patients or organized national databases.[21,22] The United States of America currently has 1500 cancer treatment centers, 71 of which are considered centers of excellence by the so-called NCI Cancer Center Program, which focuses on research to develop approaches to prevent, diagnose, and treat cancer.[23] In Brazil, the numbers are lower. There are currently 317 assistance centers qualified for cancer treatment.[24] Still, some of these institutions, as in our case, are not specialized in the oncologic treatment and present differences in approach and available resources. This situation makes it difficult to understand the profile of the spinal tumor patient who seeks care in non-specialized centers and its management in a manner appropriate to the local reality.

Even considering that case series separately address metastases from other tumors, there were no significant divergences between the data from our series compared to the literature. Most patients are in the adult range (65.2%) with a mean age of 56.1 ± 14.7 years and no predilection between genders, even for primary tumors.[6]

Metastases were the most prevalent tumor group with 62 patients (67.4%). As expected, the most prevalent known metastases were breast (15.2%) and prostate (12%), following the prevalence of national tumors.[3] Metastases of unknown site showed a total of 15 patients (16.3%), consistent with that described in the literature.[25]

Although established prevalence data point of the thoracic spine for metastatic implants,[5] we see that this predilection for the thoracic region in our sample (66.3%) is present either in its entirety or in the individual evaluation of the three proposed groups. The prevalence of primary tumors of the spine follows something close to that exposed in the literature (10%) with 12% in our sample.[6] As in large series in the literature, the technique of decompression and arthrodesis had the highest prevalence with 64.1% (De la Garza Ramos *et al.* = 57.7%) and the posterior approach with 70.7% (De la Garza Ramos *et al.* = 76.6%).[22] Again, tumor type did not generate significant differences for these two variables.

In a 10-year retrospective evaluation, Kobayashi *et al.* evaluated the postoperative length of stay trend in a multicenter study for patients undergoing spine surgery.[26] The mean postoperative length of stay was 22.3 ± 21.3 days, and they found a significant correlation between age, approach to the thoracic region, and instrumentation. Although the study described did not exclusively consider patients with spinal tumors, it was believed there might be a similar

Table 8. Description of postoperative times according to the characteristics of interest and results of comparative tests and correlations with quantitative characteristics.

Variable	Postoperative length of stay (days)		N	p
	mean ± SD	median (min; max)		
Age Group				**0,337**
Child	5,5 ± 3,5	5,5 (3; 8)	2	
Adult	12,8 ± 16,3	5,5 (1; 80)	60	
Elder	7,6 ± 7,4	6 (0; 29)	30	
Sex				**0,054***
Male	8,5 ± 9,4	5 (0; 45)	48	
Female	13,6 ± 17,5	7 (0; 80)	44	
Type of tumor				**0,559**
Myeloma	8,2 ± 8,4	6 (2; 39)	19	
Metastases	10,1 ± 12,5	5 (0; 76)	62	
Other	19,9 ± 24,6	8 (1; 80)	11	
ASIA				**0,42**
A	6,4 ± 3,6	5 (3; 12)	5	
B	10,5 ± 9,9	8 (2; 48)	21	
C	10,8 ± 10,5	6 (2; 39)	24	
D	11,7 ± 18,9	4 (0; 80)	33	
E	12 ± 15,3	4 (0; 45)	9	
KARNOFSKY Classification				**0,754**
80 a 100	14,4 ± 15	8 (1; 45)	13	
50 a 70	10,6 ± 15	5 (0; 80)	60	
0 a 40	9,5 ± 10,1	8 (2; 48)	19	
Technique				**0,209**
Arthrodesis	4 ± 0	4 (4; 4)	1	
Biopsy	14,3 ± 19	3 (0; 45)	7	
Capener	7,8 ± 4,8	7 (2; 18)	15	
Laminectomy	3,3 ± 0,6	3 (3; 4)	3	
Vertebroplasty	1 ± 0	1 (1; 1)	1	
Hemilaminecotomy	5 ± 0	5 (5; 5)	1	
Corpectomy+Arthrodesis	15,7 ± 13,5	16 (2; 29)	3	
Laminectomy+Arthrodesis	10,6 ± 12,9	6 (2; 76)	59	
Resection+Arthrodesis	46,5 ± 47,4	46,5 (13; 80)	2	
Instrumentation				**0,160***
No	8,6 ± 10,7	5 (0; 45)	26	
Yes	11,8 ± 15,1	6 (2; 80)	66	
Instrumented Region				**0,249**
Cervical	15,7 ± 13,5	16 (2; 29)	3	
Thoracic	8,7 ± 10	5 (2; 48)	35	
Cervical and Thoracic	13,4 ± 11,7	9 (4; 36)	7	
Lumbar	2 ± 0	2 (2; 2)	1	
Thoracic and Lumbar	10,2 ± 8,3	5 (2; 27)	13	
Lumbar and Sacral	32,5 ± 35,5	14 (3; 80)	6	
Thoracic, Lumbar and Sacral	5 ± 0	5 (5; 5)	1	
Number of instrumented levels	-0,009**		65	0,945
Compressed region/ injury				**0,635**
Cervical	12,5 ± 11,2	10 (2; 29)	6	
Thoracic	8,2 ± 8,2	6 (0; 48)	61	
Cervical and Thoracic	36 ± 0	36 (36; 36)	1	
Lumbar	14,6 ± 20,4	5 (0; 76)	16	
Thoracic and Lumbar	7,5 ± 7	4,5 (3; 18)	4	
Sacral	39,3 ± 39,6	37 (1; 80)	3	
Iliac	13 ± 0	13 (13; 13)	1	
Number of decompressed levels	0,029**		89	0,784

Kruskal-Wallis test; * Mann-Whitney test; ** Spearman Correlation.

Table 9. Joint model to explain postoperative length of stay according to the characteristics that clinically usually influence length of stay.

Variable	Exp (coefficient)	CI (95%)		p
		Lower	Superior	
Sex (female)	1,51	0,90	2,51	0,118
Type of tumor (Ref: Myeloma)				
Other	2,43	1,03	5,75	0,043
Metastases	1,27	0,55	2,89	0,576
Instrumentation	1,29	0,73	2,29	0,385
Age (years)	1,006	0,991	1,022	0,409
KARNOFSKY	1,007	0,991	1,024	0,397

MLG with normal distribution and logarithmic link function.

Table 10. Description of mortality during hospitalization according to the characteristics of interest and results of association tests.

Variable	Death		Total	p
	No	Yes		
Age group, n (%)				**0,754#**
Child	2 (100)	0 (0)	2	
Adult	52 (86,7)	8 (13,3)	60	
Elder	26 (86,7)	4 (13,3)	30	
Sex, n (%)				**0,872**
Male	42 (87,5)	6 (12,5)	48	
Female	38 (86,4)	6 (13,6)	44	
Type of tumor, n (%)				**0,841#**
Myeloma	17 (89,5)	2 (10,5)	19	
Metastases	54 (87,1)	8 (12,9)	62	
Other	9 (81,8)	2 (18,2)	11	
Lumbar/Cervical VAS Classification, n (%)				**0,542#**
Absent/Light	24 (88,9)	3 (11,1)	27	
Moderate	41 (89,1)	5 (10,9)	46	
Intense	15 (78,9)	4 (21,1)	19	
VAS Leg/Arm Classification, n (%)				**0,749#**
Absent/Light	64 (86,5)	10 (13,5)	74	
Moderate	14 (87,5)	2 (12,5)	16	
Intense	2 (100)	0 (0)	2	
ASIA, n (%)				**0,074#**
A	5 (100)	0 (0)	5	
B	16 (76,2)	5 (23,8)	21	
C	19 (79,2)	5 (20,8)	24	
D	31 (93,9)	2 (6,1)	33	
E	9 (100)	0 (0)	9	
KARNOFSKY Classification, n (%)				**0,102#**
80 a 100	13 (100)	0 (0)	13	
50 a 70	52 (86,7)	8 (13,3)	60	
0 a 40	15 (78,9)	4 (21,1)	19	
SINS Classification, n (%)				**0,211#**
Stable	10 (100)	0 (0)	10	
Undetermined	44 (88)	6 (12)	50	
Unstable	25 (83,3)	5 (16,7)	30	
Instrumentation, n (%)				**>0,999***
No	23 (88,5)	3 (11,5)	26	
Yes	57 (86,4)	9 (13,6)	66	
Total length of stay (days)				**0,002£**
mean ± SD	20,7 ± 15,6	36,8 ± 26,1	80	
median (min; max)	16,5 (0; 86)	23,5 (17; 95)	12	
Preoperative length of stay (days)				**0,680£**
mean ± SD	11,7 ± 9,1	12,9 ± 10	80	
median (min; max)	10 (0; 46)	9,5 (3; 41)	12	
Postoperative length of stay (days)				**<0,001£**
mean ± SD	9 ± 10,3	23,8 ± 25,8	80	
median (min; max)	5 (0; 48)	13,5 (6; 80)	12	

Chi-square test; * Fisher's exact test; # Likelihood ratio test; £ Mann-Whitney test.

relationship for these cases when analyzed separately. However, none of the variables in Kobayashi *et al.* were significant in our analysis.[26] Only the joint model showed a significant relationship of longer hospitalization for the other tumors when comparing multiple myelomas with the other tumors, with the latter group showing a 143% longer hospitalization period.

De la Garza Ramos et al. proposed a metastatic spinal tumor fragility index that significantly correlates with perioperative complications, mortality, and length of stay.[22] In their sample, the authors analyzed 4583 patients with a mean length of stay of 10.5 ± 8.6 days and an in-hospital mortality rate of 3%. According to the index, patients with severe frailty (≥3 points) had a mortality rate of 5.5% and a length of stay of 12.7 days.[22] In our study, we obtained a mortality rate during hospitalization of 13%, a mean total length of stay of 22.8 ± 18 days, and a postoperative length of stay of 10.9 ± 14 days. These data suggest that the patients seen in our service have greater frailty and a higher chance of perioperative complications.

Another analysis that also suggests greater severity of our patients is the comparison with the work of Wagner et al.[21] In this study, an evaluation of 667 patients operated on in a single oncologic center was performed and a total of 305 patients (45.7%) with some neurological deficit were found, of which only 17 ASIA A (2.5%) and 7 ASIA B (1.1%).[21] Our sample showed 90.2% of patients with some degree of neurological deficit, 5.4% ASIA A and 22.8% ASIA B. Candido et al.,[25] who conducted their study in an institution with a similar profile to ours, found 64.07% of patients with some neurological deficit. The statistically significant correlation between Karnofsky's performance scale and ASIA obtained in our analysis, added to these data, could indicate that patients seen in non-specialized SUS quaternary institutions arrive more severely. In this case, the condition for this greater severity is unclear and could be justified by socioeconomic conditions, delay in diagnosis, and referral, among other socioeconomic factors.

This study had some limitations, despite obtaining statistically significant results. The first of these was the sample space. Many patients were lost during the collection phase, which made more detailed evaluation of metastatic subtypes unfeasible. The sample of metastatic patients is extremely heterogeneous, and perhaps a detailed analysis of each subtype could indicate prolonged hospitalization periods, as suggested by Zehri *et al.* for patients with metastatic lung tumor.[27] The same limitation is reflected in the correlations of surgical techniques. Despite presenting statistically significant results, do not individually allow a more in-depth analysis of the variables in question. Finally, another significant limitation of our study relates to our service's non-specialized oncology structural limitations. Since we operate in a SUS on-demand institution, it is not uncommon to have more inpatient cases than we can operate on immediately. Our pre-operative hospitalization time is variable and not always directly related to the patient's clinical picture due to this non-specialized cancer flow.

CONCLUSION

The study brings epidemiological data that allow an understanding of spinal tumor patients' profile in the Brazilian Public Health System. The patients have greater severity when compared to large series in the literature. Further studies are needed to identify the main severity factors of these patients, as well as the creation of strategies for triage and referral of cases.

All authors declare no potential conflict of interest related to this article.

CONTRIBUTIONS OF THE AUTHORS: Each author contributed individually and significantly to the development of the manuscript. MA: data collection, writing, preparation of the research project, performing the surgeries; WZS: performing the patients' surgeries, discussion of results, review, and approval of the final version of the paper; RGMM: performing the patients' surgeries, discussion of results, review, and approval of the final version of the paper; AOG: Performance of the patients' surgeries, discussion of results, review, and approval of the final version of the work; MFSC: Performance of the patients' surgeries, discussion of results, review, and approval of the final version of the work; RM: Performance of the patients' surgeries, discussion of results, review, and approval of the final version of the work.

REFERENCES

1. World Health Organization[https://www.who.int]. Newsroom [acesso em 02 mai 2020]. Disponível em: https://www.who.int/news-room/fact-sheets/detail/cancer.
2. International Agency for Research of Cancer [https://www.iarc.fr/]. Global Cancer Observatory [acesso em 02 maio 2020]. Disponível em: https://gco.iarc.fr.
3. INCA. Estimativa 2020: Incidência de Câncer no Brasil. Rio de Janeiro: INCA; 2019. pp. 116.
4. Choi D, Crockard A, Bunger C, Harms J, Kawahara N, Mazel C, et al. Review of metastatic spine tumour classification and indications for surgery: The consensus statement of the Global Spine Tumour Study Group. Eur Spine J. 2010;19(2):215-22.
5. Daniel JW, Veiga JCE. Diretrizes no tratamento das metástases epidurais da coluna vertebral. Atualização. Arq Bras de Neurocir. 2007;26(3):93-110.
6. Chi JH, Bydon A, Hsieh P, Witham T, Wolinsky JP, Gokaslan ZL. Epidemiology and Demographics for Primary Vertebral Tumors.Neurosurg. Clin N Am. 2008;19(1):1-4.
7. Furlan JC, Fehlings MG, Tator CH, Davis AM. Motor and sensory assessment of patients in clinical trials for pharmacological therapy of acute spinal cord injury: Psychometric properties of the ASIA Standards. J Neurotrauma. 2008;25(11):1273-301.
8. Karnofsky DA, Young CW. Comparative aspects of the pharmacology of the antimetabolites. Fed Proc. 1967;26(4):1139-45.
9. Fisher CG, DiPaola CP, Ryken TC, Bilsky MH, Shaffrey CI, Berven SH, et al. A novel classification system for spinal instability in neoplastic disease: An evidence-based approach and expert consensus from the Spine Oncology Study Group. Spine. 2010;35(22):E1221-9.
10. Ahmed AK, Goodwin CR, Heravi A, Kim R, Abu-Bonsrah N, Sankey E, et al. Predicting survival for metastatic spine disease: a comparison of nine scoring systems. Spine. 2018;18(10):1804-14.
11. Daniel JW, Veiga JCE. Prognostic parameters and spinal metastases: A research study. PLoS ONE. 2014;9(10):29-33.
12. Anzuatégui PR, Cunha LAM, Mello GJP, Filho ES, Graells XS. Spinal metastasis surgery: A proposal for a predictive model of morbidity and mortality. RBO. 2019;54(6):665-72.
13. Bauman G, Charette M, Reid R, Sathya J. Radiopharmaceuticals for the palliation of painful bone metastases – A systematic review. Radiother Oncol. 2005;75(3):258.E1-13.
14. Carden CP, Rosenthal, MA. Immediate versus delayed chemotherapy in patients with asymptomatic incurable metastatic cancer. Asia Pac J Clin Oncol. 2007;3(4):187-98.
15. Janjan N, Lutz ST, Bedwinek JM, Hartsell WF, Ng A, Pieters Jr RS, et al. Therapeutic guidelines for the treatment of bone metastasis: A report from the American college of radiology appropriateness criteria expert panel on radiation oncology. JPM. 2009;12(5):417-26.
16. Lo WY, Yang SH. Metastatic spinal cord compression (MSCC) treated with palliative decompression: Surgical timing and survival rate. PloS ONE. 2017;12(12):1-16.
17. Bakitas MA, Tosteson TD, Li Z, Lyons KD, Hull JG, Li Z, et al. Early versus delayed initiation of concurrent palliative oncology care: Patient outcomes in the ENABLE III randomized controlled trial. J Clin Oncol. 2015;33(13):1438-45.
18. Fridley J, Gokaslan ZL. The evolution of surgical management for vertebral column tumors. J Neurosurg. Spine. 2019;30(4):417-23.
19. Kirkwood BR, Sterne JAC. Essential medical statistics. 2nd edition. Blackwell Science: Massachusetts; 2006. pp. 502
20. Neter J, Kutner M, Nachtsheim CJ, Wasserman W. Applied Linear Statistical Models. 4thedition. Ilinois: Richard D. Irwing;1996. pp. 1408.
21. Wagner A, Haag, E, Joerger, AK, Jost P, Combs SE, Wostrack M, et al. Comprehensive surgical treatment strategy for spinal metastases. Sci Rep. 2021;11(1):1-11.
22. De la Garza Ramos R, Goodwin CR, Jain A, Abu-Bonsrah N, Fisher CG, Betegowda C, et al. Development of a Metastatic Spinal Tumor Frailty Index (MSTFI) Using a Nationwide Database and Its Association with Inpatient Morbidity, Mortality, and Length of Stay After Spine Surgery. World Neurosurg. 2016;95:548-55.e4.
23. NCI [cancer.org]. Designated Cancer Centers[acesso em 14 fev 2021]. Disponível em: https://www.cancer.gov/research/infrastructure/cancer-centers.
24. INCA [https://www.inca.gov.br/]. Onde tratar pelo SUS[acesso em 14 fev 2021]. Sobre o INCA. Disponível em: https://www.inca.gov.br/onde-tratar-pelo-sus.
25. Candido PBM. Análise de custos da cirurgia de descompressão medular em pacientes com metástases ósseas e associação da sobrevida com as escalas prognósticas de Tokuhashi e Tomita. Ribeirão Preto. Tese (Doutorado em Ciências Médicas) – Faculdade de Medicina de Ribeirão Preto da Universidade de São Paulo; 2020.
26. Kobayashi K, Ando K, Kato F, Kanemura T, Sato K, Hachiya Y, et al. Trends of postoperative length of stay in spine surgery over 10 years in Japan based on a prospective multicenter database. Clin Neurol Neurosurg. 2019;177:97-100.
27. Zehri AH, Peterson KA, Lee KE, Kittel CA, Evans JK, Wilson JL, et al. National trends in the surgical management of metastatic lung cancer to the spine using the national inpatient sample database from 2005 to 2014. J Clin Neurosci. 2022;95:88–93.