

# Epidemiological Profile of 96 Intracranial Tumors Treated in a Single Reference Center

## *Perfil epidemiológico de 96 tumores intracranianos tratados em um único centro de referência*

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### Abstract

**Objectives** The present study aims to categorize the prevalence of intracranial tumors surgically treated at the neurosurgery service of Hospital Universitário Evangélico Mackenzie (HUEM) between 2016 and 2018.

**Material and Methods** This survey included patients surgically treated due to primary or metastatic intracranial neoplasia between 2016 and 2018 at a referral center in the city of Curitiba. These patients were analyzed for epidemiological, histopathological, and topographic data, and they underwent an assessment of the outcome at the time of hospital discharge.

**Results** A total of 96 patients met the inclusion criteria. The most prevalent tumor was the glioma, with 39.6% of the sample, with glioblastoma being the most prevalent histological type. Brain metastases and meningiomas represented, respectively, 21.9% and 18.8% of the total. There was a predominance of supratentorial and intra-axial tumors in our sample.

**Conclusion** Glioma was the most commonly found tumor, directly associated with high morbidity and mortality. The development of new and more effective drugs with action directed at the molecular level of intracranial tumors may be the path to a longer survival and improvement in the quality of life of these patients.

### Keywords

- brain neoplasm
- primary brain neoplasms
- epidemiology
- brain metastasis

### Resumo

#### Palavras-chave

- tumor cerebral
- tumor cerebral primário
- epidemiologia
- metástase cerebral

**Objetivos** O presente estudo tem como objetivo levantar a prevalência dos tumores intracranianos abordados cirurgicamente pelo Serviço de Neurocirurgia do Hospital Universitário Evangélico Mackenzie (HUEM) entre 2016 e 2018.

**Material e Métodos** Foram selecionados pacientes com diagnóstico de neoplasia intracraniana primária ou metastática no intervalo de 2016 a 2018 tratados cirurgicamente em um centro de referência na cidade de Curitiba. Esses pacientes foram analisados quanto a dados epidemiológicos, histopatológicos, e topográficos e foram ainda submetidos a uma avaliação do desfecho no momento da alta hospitalar.

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**Resultados** O total de 96 pacientes preencheram os critérios de inclusão. O tumor mais prevalente foi o glioma, com 39,6% da amostra, sendo o glioblastoma o tipo histológico mais prevalente. As metástases cerebrais e os meningiomas representaram, respectivamente, 21,9% e 18,8% do total de pacientes. Houve um predomínio de tumores supratentoriais e intra-axiais em nossa amostra.

**Conclusão** O glioma foi o tumor mais encontrado, associado à elevada morbimortalidade. O desenvolvimento de fármacos novos e mais efetivos com ação direcionada ao nível molecular dos tumores intracranianos pode ser o caminho para uma maior sobrevida e melhora da qualidade de vida desses pacientes.

## Introduction

Tumors of the central nervous system (CNS) represent ~2% of all tumors that affect adults and 2.4% of all cancer deaths annually.<sup>1,2</sup> The incidence rate of primary brain tumors is 10.8 per 100,000 person-years,<sup>3</sup> while the incidence of brain metastases is estimated at 11 in every 100,000 individuals in the population.<sup>2</sup> They are a significant cause of cancer morbidity and mortality, especially in children and young adults, in whom they respectively account for ~30% and 20% of cancer deaths.<sup>4</sup> An increase in the incidence of CNS tumors has been observed in recent decades, especially among most advanced age groups. This is due to several causal factors, especially the improvement in diagnostic imaging techniques.<sup>5</sup>

As proposed by the World Health Organization (WHO), CNS tumors are divided into grade I to grade IV, in view of the histology and architectural pattern of primary lesions. There are other forms of classification that evaluate tumors using immunohistochemistry, cytogenetics, and molecular biology techniques.<sup>6</sup> The determining factors in the prognosis of brain tumors are the type of the tumor, its histological grade, location, age of the patient, and status of Karnofsky performance. In the case of metastases, the primary tumor location, sensitivity to therapy, and the number of lesions in the CNS are added.<sup>7</sup>

According to the Central Brain Tumor Registry of the United States (CBTRUS), from tumors diagnosed between 2007 and 2011, meningiomas were the most frequently reported ones and the most common brain tumors in adults (36%).<sup>8</sup> The incidence of meningioma increases with age and is twice as common in women as in men. The majority of meningiomas are benign (grade I), followed by 5 to 20% atypical (grade II), and 1 to 3% malignant type (grade III). Gliomas are the second most frequent tumor (28%), and approximately half of them (45.6%) are glioblastomas. Grade I glioma (pilocytic astrocytoma) is more common in children and young adults while grade II (oligodendroglioma) glioma has a peak incidence between the 3rd and 4th decade of life, and the incidence of glioma malignancy increases with age. Pituitary tumors, on the other hand, are the third most common type of tumor in adults, observed mainly in women, with an increase in age-related incidence (peak 7th decade), and the majority being benign adenomas, usually asymptomatic and diagnosed incidentally. Meningiomas are also

tumors that can be discovered in a asymptomatic presentation as well.

Approximately 1 in 2,000 children are diagnosed with a brain tumor by the age of 14 in the United States according to the CBTRUS. Brain tumors are the most common solid tumors, and they are responsible for the most cancer deaths in children.<sup>9</sup> Approximately half of pediatric tumors are gliomas, mostly pilocytic astrocytoma.

Compared with other cancers, brain tumor has a lower incidence but a huge oncological and neurosurgical standing due to its high rates of morbidity and mortality, complications, and the presence of metastases. There is also a disproportionate number of deaths and sequelae compared with other types of cancer, which makes intracranial tumors an important public health problem.

## Objectives

The present study aimed to conduct a survey of intracranial neoplasms surgically treated at a referral center over a period of 3 years (2016–2018) at a University Hospital located in Brazil's south that serves predominantly the Unified Health System to raise the epidemiological profile of these tumors. The secondary objective is to describe the functional outcome of these patients after the surgical treatment.

## Material and Methods

The ethics committee of Faculdade Evangélica Mackenzie do Paraná authorized the research under protocol number 17991119.1.0000.0103. This present study consists on a retrospective cohort which included all patients surgically treated in a 3-year interval (2016–2018) at the neurosurgery service of Hospital Universitário Evangélico Mackenzie (HUEM) with initial diagnosis of primary or metastatic intracranial tumor. Patients whose medical records were lacking anatomopathological data were transferred to other services, denied surgery or had no operative treatment were excluded from this series.

The analyzed patients' data were epidemiological criteria were sex and age, histopathological and topographic placement of the tumor. The patients outcome was analyzed through the patients work capacity and autonomy. Those evaluations were performed at the hospital discharge.

## Results

A total of 96 patients were included in this study, 46 men (48%) and 50 women (52%).

► **Table 1** shows the distribution of patients' gender and the histopathological types of intracranial tumors. There was an equal number of men and women treated for gliomas, meningiomas, and miscellany tumors (chordomas, craniopharyngiomas, glomus jugulare, medulloblastomas, neuroblastoma and paragangliomas) in this series.

Gliomas were the most prevalent type of tumor, totalizing 38 (39.6%) out of the 96 patients. Glioblastoma was the most found glioma, identified in 27 patients (71%), followed by diffuse

astrocytoma, anaplastic astrocytoma, and oligodendroglioma with 6 (15.7%), 3 (7.9%), and 2 cases (5.4%), respectively.

When analyzing the topography of gliomas, supratentorial tumors were the most frequent, with 12 located in the temporal lobe (31.6%), 11 in the parietal lobe (28.9%), 10 in the frontal lobe (26.3%), 2 in the basal ganglia (5.3%), and 2 in the frontotemporal region (5.3%). Only 1 glioma was in the posterior fossa (2.6%).

Brain metastases were second in terms of the prevalence of tumors in the CNS in our study (21.9%), presenting more often in women (61.9%) in this series. Breast cancer metastasis accounted for 1/3 of the total of metastases, and representing the most frequent primary location of cancer with

**Table 1** Epidemiological and histopathological analysis of the tumors

Gliomas	Number of patients (n)	Men (n)	Woman (n)	Age average (years) ± SD	Most prevalent location
Glioblastoma	27	15	12	59.7 ± 10.92	Temporo-parietal
Diffuse astrocytoma	6	3	3	54 ± 10.75	Frontal
Anaplastic astrocytoma	3	0	3	62.3 ± 2.88	Temporal
Oligodendroglioma	2	1	1	50.5 ± 2.12	Frontal
<b>Metastasis source</b>					
Breast	7	0	7	54.42 ± 10.96	Frontal
Lung	5	3	2	61.8 ± 12.67	Parietal
Melanoma	4	1	3	46 ± 21	Posterior fossa
Unknown	3	2	1	60.66 ± 13.50	Frontal
Colon	1	0	1	59 ± 0	Temporal
Kidney	1	1	0	77 ± 0	Parietal
<b>Meningiomas (location)</b>					
Convexity	9	4	5	48.3 ± 17.10	—
Parafalcine	3	2	1	64 ± 1.42	—
Olfactory groove	2	1	1	47.5 ± 4.94	—
Sphenoid wing	2	1	1	63 ± 14.14	—
Parassellar	1	0	1	51 ± 0	—
Petroclival	1	1	0	44 ± 0	—
<b>Central nervous system glands</b>					
Pituitary macroadenoma	4	2	2	65 ± 8.97	Sella turcica
Pituitary microadenoma	2	1	1	54.5 ± 10.60	Sella turcica
Pineal disgerminoma	1	1	0	24 ± 0	Pineal region
<b>Miscellany</b>					
Neuroblastoma	3	3	0	37 ± 21.93	Frontal
Glomus jugulare	3	0	3	36.67 ± 13.05	Jugular foramen
Craniopharyngioma	2	1	1	36.5 ± 13.5	Sella turcica
Chordoma	1	1	0	51 ± 0	Clivus
Medulloblastoma	1	1	0	31 ± 0	4th ventricle
Paraganglioma	1	1	0	27 ± 0	Jugular foramen
Osteoid osteoma	1	0	1	18 ± 0	Parietal
<b>Total</b>	96	46	50		

Abbreviation: SD, standard deviation.

metastasis to the CNS, followed by lung cancer (23.8%), and melanoma (19%). The supratentorial compartment was the most affected by brain metastasis.

Out of the 96 patients, 6 had a pituitary adenoma (3 were microadenomas and were treated due to hormonal production), and one was a pineal dysgerminoma.

Miscellaneous tumors grouped 12 tumors which included neuroblastomas, glomus jugulare, craniopharyngiomas, choromas, medulloblastomas, paragangliomas, and an osteoid osteoma. The most frequent tumors in this group were the glomus jugulare and neuroblastomas—with three tumors each. Two craniopharyngiomas were treated in this period, while only one chordoma, medulloblastoma, and paraganglioma.

The meningiomas represented 18.8% of the 96 intracranial tumors, totaling 18 tumors. The most frequent location was the hemisphere convexity, representing 50%. There were three cases of parafalcine meningioma, and two cases of sphenoid wing and two cases of olfactory groove. Only one case of petroclival meningioma and parasellar meningioma were reported in this series.

► **Table 2** evidences that brain metastasis had the worst outcomes, followed by the gliomas. The meningiomas patients who passed away died due to cerebrospinal fluid (CSF) leak followed by meningitis, an usual postoperative complication of skull base meningiomas.

## Discussion

The most common pediatric intracranial tumors are usually represented by posterior fossa tumors and low-grade gliomas. The CNS represents the most frequent solid neoplasm location in this group. In this sample, the youngest patient was 18 years-old and was treated for an osteoid osteoma.

Although CNS tumors are not common, they are an important cause of cancer morbidity and mortality, especially in children and young adults, being responsible for ~30% and 20% of cancer deaths, respectively.<sup>4</sup> In epidemiological study at the University of New York, in 2016, it was found that women over 35 years-old present greater occurrence of meningioma, constituting the most common histological type among intracranial tumors in adults, which differ from the findings of the present study, in which gliomas were more prevalent (39.6%) equally in both genders.<sup>4,10</sup>

Meningiomas are the most common primary intracranial tumors. They are usually slow growing, circumscribed (non-infiltrating), benign lesions that arise from the arachnoid cap cells. Histologically malignant (incidence is 1.7% of meningiomas) and/or rapidly growing varieties are also described. There may be multiple meningiomas in up to 8% of cases, and they may occur in any area where arachnoid cells are found (between brain and skull, within ventricles, and along spinal cord).<sup>11</sup>

The most frequent meningioma location is the parasagittal region, due to the high number of arachnoid granulations. In the present sample, the most common location was the hemisphere convexity. The meningioma prevalence in woman/men in this series differs from the literature because it represents a small piece and universe of patients.

In addition, it is estimated that in the United States of America, 6 to 14% of newly diagnosed cancers will metastasize to the CNS. In these cases, the most common primary tumor sites/types are the lung (45%), breast (15%), melanoma (10%), and colorectal (5%).<sup>11</sup> These findings differed from those of the present study, in which the most common primary tumor site was the breast (33.3%) followed by lung (23.8%).

The most frequent primary tumors that metastasize to the CNS are the breast, lung, and melanoma. We found that the average age of women who presented with breast cancer was middle age. These tumors are more aggressive and tend to resist conventional chemo and radiotherapy, usually the triple-negative tumors (no hormonal receptors). Those tumors frequently send metastasis to the brain and present in woman in their 40 to 50's with a positive family history.

In the past, lung cancer was a men's disease, but after smoking became a trend also among women, the number of lung cancer cases in this group has increased a lot and so did metastatic brain cancer. In our sample, we had three men and two women being surgically treated for metastatic lung cancer.

As for CNS gland tumors, pituitary microadenomas are the most prevalent when compared with macroadenomas or tumors of the pineal gland, which is in line with the findings of the present study. If these tumors are functional, immediate drug treatment is indicated. The goal of the treatment is to decompress the optical pathways and cure any endocrinological disorder the tumor may be causing.<sup>12</sup>

When medication fails or when patients have an important impairment due to tumor compression or hormonal

**Table 2** Outcome analysis after surgery

Tumor	Death	Severe deficit	Mild deficit	Palliative care	Following	Total
Gliomas	18	3	1	12	4	38
Metastasis	15	1	1	3	1	21
Meningiomas	2	1	4	3	8	18
Central nervous system glands	1	2	0	0	4	7
Miscellany	4	1	5	0	2	12
<b>Total</b>	<b>40</b>	<b>8</b>	<b>11</b>	<b>18</b>	<b>19</b>	<b>96</b>

production, a skull base approach from the sphenoidal sinus is used to reach the sella turca. The pineal disgerminoma usually presents as headache associated with nausea, diplopia, and hydrocephalus. One possible surgical pathway for this topography is the supracerebellar infratentorial approach.

A severe deficit is defined by an impairment that leads to disabilities and deteriorates the quality of life, while a mild deficit produces loss of production and capacity, but the patient is still functional in the society. Depending on the lesion topography and tumor behavior, surgery is also deleterious to the patient and the risk of complications are high (CSF leak, infections, multiple surgeries, and long intensive care unit length of stay). The patients' conditions are also a challenge in terms of surgical management for the surgeon, anesthesiologist, and intensive care unit staff.<sup>13</sup>

The most frequent intracranial tumors are the meningiomas, and the most common brain tumor are brain metastases.<sup>11</sup> The difference between the results in literature and those of our sample may be due to the fact that HUEM is a skull base and oncology reference center. Most patients who were treated for brain metastasis were being followed by the clinical oncology group of the hospital. The number of patients can be considered low to infer the results numbers to a bigger population and is more likely to only represent a strict reality of a hospital in the south of Brazil. It may represent a locoregional reality and the tendencies from this 3-year period (2016–2018).

## Conclusion

Intracranial tumors account for an important share of neurosurgery wards, and the epidemiological knowledge may guide research to develop drugs and treatments to diminish brain cancer mortality. This sample showed a predominance of intra-axial tumors.

Gliomas and metastases represent the most life-threatening events in neuro-oncology and are also linked to high morbidity. There was a slightly predominance for females in

our sample, and an odd finding of an equal number of men and woman being treated for meningioma.

## Conflict of Interests

The authors have no conflict of interests to declare.

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