



#### ABSTRACT

The symptoms of CNS tumors vary according to the location and tumor neurobiology, the mass effect of the neoplasm increases intracranial pressure (ICP), favoring seizures, headaches, projectile vomiting, optic nerve edema, compression of cranial nerves pairs, among other manifestations, which can be confused with numerous differential diagnoses. The objective of this article is to review therapeutic, multidisciplinary approaches performed with patients diagnosed with CNS tumors on different continents over the last decades, contributing to more precise therapeutic decisions on the subject, whether through clinical or surgical approaches. This study is an integrative literature review, which searched through the DeCS/MeSH descriptors “Neurology,” “Neurosurgery,” “Central Nervous System Tumors,” “Treatment,” and “Diagnosis” on PubMed, ScienceDirect, and BVS databases. Multidisciplinary involvement is essential to improve surveillance and decision-making for patients with CNS tumors. Interactions between different healthcare areas are crucial for enhancing the diagnostic process and the treatment of patients with these tumors. Imaging technology proved to be extremely useful for the diagnosis and assessment of the patient’s preoperative course. In terms of tumor incidence analyzed, it is predominantly female, and the main age group ranges from 41 to 50 years, varying according to each patient’s individual situation. Meningioma was the most frequently observed diagnosis, encompassing neurosurgery as one of the widely used treatments for various types of CNS tumors. The average hospitalization period for patients varied from 8 to 25 days, depending on the needs and personal issues of each patient.

**Keywords:** Central Nervous System Tumors; Neurosurgery; Intracranial Pressure; Magnetic Resonance Imaging; Meningioma

#### RESUMO

Os sintomas dos tumores do sistema nervoso central (SNC) variam de acordo com a localização e a neurobiologia do tumor. O efeito de massa da neoplasia aumenta a pressão intracraniana (PIC), favorecendo crises epiléticas, dores de cabeça, vômitos em jato, edema do nervo óptico, compressão dos pares de nervos cranianos, entre outras manifestações, que podem ser confundidas com inúmeras diagnósticos diferenciais. O objetivo deste artigo é revisar abordagens terapêuticas multidisciplinares realizadas com pacientes diagnosticados com tumores do SNC em diferentes continentes nas últimas décadas, contribuindo para decisões terapêuticas mais precisas sobre o assunto, seja por meio de abordagens clínicas ou cirúrgicas. Este estudo é uma revisão integrativa da literatura, que buscou nos descritores DeCS/MeSH “Neurologia”, “Neurocirurgia”, “Tumores do Sistema Nervoso Central”, “Tratamento” e “Diagnóstico” nas bases de dados PubMed, ScienceDirect e BVS. O envolvimento multidisciplinar é essencial para melhorar a vigilância e a tomada de decisões para pacientes com tumores do SNC. Interações entre diferentes áreas da saúde são cruciais para aprimorar o processo diagnóstico e o tratamento de pacientes com esses tumores. A tecnologia de imagem provou ser extremamente útil para o diagnóstico e a avaliação do curso pré-operatório do paciente. Em termos de incidência de tumores analisada, é predominantemente feminina, e a principal faixa etária varia de 41 a 50 anos, variando de acordo com a situação individual de cada paciente. O meningioma foi o diagnóstico mais frequentemente observado, englobando a neurocirurgia como um dos tratamentos amplamente utilizados para vários tipos de tumores do SNC. O período médio de internação dos pacientes variou de 8 a 25 dias, dependendo das necessidades e questões pessoais de cada paciente.

**Palavras-chave:** Tumores do Sistema Nervoso Central; Neurocirurgia; Pressão Intracraniana; Imagens por Ressonância Magnética; Meningioma

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## INTRODUCTION

The central nervous system (CNS) is susceptible to both benign and malignant neoplasms, characterized by a complex physiopathology dependent on the onco-precursor cell<sup>[1]</sup>. Generally, these neoplasms result from mutations in the genetic material, favoring the activation of oncogenes and reduced activity of tumor suppressor genes. The author identifies primary benign CNS tumors such as meningiomas and craniopharyngiomas. In contrast, malignant CNS tumors include astrocytomas, oligodendrogliomas, medulloblastomas, and primary CNS lymphomas, each exhibiting distinct histopathological characteristics, clinical manifestations, and personalized therapeutic approaches.

Symptoms of CNS tumors vary depending on their location and tumor neurobiology. In general, the author asserts that the mass effect of the neoplasm increases intracranial pressure (ICP), leading to seizures, headaches, projectile vomiting, optic nerve edema, compression of cranial nerve pairs, among other manifestations. These symptoms may be confused with numerous differential diagnoses. Finally, the initial approach of the multidisciplinary team when suspecting CNS tumors involves a diagnostic process combining clinical examination with complementary tests, such as contrast-enhanced cranial computed tomography (CT) and/or gadolinium-enhanced

cranial magnetic resonance imaging (MRI), with the consideration of biopsy<sup>[2]</sup>.

The objective of this article is to review therapeutic, multidisciplinary approaches conducted with patients diagnosed with CNS tumors across various continents over the past decades, contributing to more precise therapeutic decisions on the subject. This encompasses both clinical and surgical approaches.

## METHODS

The present study is an integrative literature review that conducted research using the DeCS/MeSH descriptors “Neurology,” “Neurosurgery,” “Central Nervous System Tumors,” “Treatment,” and “Diagnosis” to search the PubMed, ScienceDirect, and BVS databases. The time frame considered for the search was from 1998 to 2023. In this process, 339 articles were identified based on inclusion criteria, which included articles in English, Portuguese, and Spanish, full-text availability, and relevance to the guiding question. The guiding question focused on the implications for individual patient health, considering both the neurological and lasting effects of the illness, as well as the overall health repercussions. Additionally, the study sought to explore the main findings, treatments, and prognostic aspects of the pathology. Ultimately, 100 articles were analyzed, and from these, 14 were selected to compose the present review based on their alignment with the established criteria.

## RESULTS

### Multidisciplinary Diagnosis

Multidisciplinary diagnosis, involving specialties such as neurosurgery, neurology, radiology, and pathology, plays a crucial role in the treatment of central nervous system tumors. Experts collaborate to provide a comprehensive assessment, considering clinical, radiological, and pathological factors [3]. The significance of neuroradiology in tracking advances in pathology, oncology, and surgery in this field is noteworthy. Advances in understanding primary central nervous system tumors are crucial, thanks to contributions from neurobiology research, offering a more specific understanding of carcinogenic processes, and molecular biology, enabling a better analysis of the development of primary central nervous system tumors [4].

The use of advanced imaging techniques for CNS tumors, such as magnetic resonance imaging and computed tomography, provides greater diagnostic precision, especially in critical moments before surgical procedures. Computed tomography (CT) serves as an important diagnostic tool, known for its ease of use and, in most cases, not requiring sedation or anesthesia. It is noteworthy that CT can provide data not distinguishable by MRI, such as calcifications. However, specific lesions may be challenging to visualize during this examination [5].

### Multidisciplinary Treatment

Modern neuro-oncology embraces a multidisciplinary approach, particularly in the treatment and management of central nervous system malignancies, integrating tumor cytoreduction, histopathological analysis, advanced imaging studies, genetic and molecular profiling, attempts at new therapies, and investments in pharmacodynamics and pharmacokinetics studies [6].

In the face of the complexities associated with primary CNS tumors and other tumor types, multidisciplinary care is essential in decision-making, assisting in the creation of an accurate patient image, and tailoring approaches to individual patient needs [7]. This aims for more active approaches, integrating tumor cytoreduction attempts, histopathological analysis, and the administration of new therapies [8].

### Neurosurgical Treatment

Neurosurgery must aim to provide patients with maximum safety and functional preservation, adapting to the challenges of neuro-oncological treatment [8]. Out of the 14 studies selected for analysis in this study on “Multidisciplinary Approaches in the Diagnosis and Treatment of Central Nervous System Tumors,” only three presented a suitable findings section for inclusion in the sample of results related to quantitative data on treatment types.

The general study sample from 2000 to 2015 included 571 patients, excluding the known

pediatric population. The average age of tumor onset varied from 41 to 50 years, depending on the country of origin of the study. Additionally, a higher incidence of CNS tumors was observed in women (approximately 62.52%) (n = 357). In a study on meningiomas [9], 233 patients underwent surgery for partial or total tumor removal. The remaining two studies identified meningiomas as the most common diagnosis in 84 patients, followed by gliomas (n = 55), and other tumor types in 104 patients.

In terms of neurosurgery, 103 patients underwent surgical procedures, with the average hospitalization period ranging from 8 to 25 days, depending on the disease progression and the patient's health status.

### Neurologist's Role

The neurologist continues to play a crucial role in advancing new therapies related to brain tumors [8]. In the remaining sample of 338 patients, the most commonly reported symptoms were headaches (n = 214), seizures (n = 119), and paresis (n = 51). Other symptoms included cranial nerve paralysis, gait disorders, cognitive disorders, vomiting, and visual deficits (n = 156).

#### Advanced Therapies

Advanced therapies play an undeniable role in treating CNS tumors. Mass spectrometry, for example, enables the analysis of brain tissues, where different metabolites suggest a preoperative diagnosis or assist in monitoring the

tumor treatment response [10]. In pediatric cases, advanced neurosurgery has allowed for higher rates of complete tumor resection, associated with improved outcomes [11]. Targeting tumor cells opens new perspectives in CNS tumor treatment, with gene therapy playing a significant role [6].

Combining different treatment modalities, known as “multimodal therapy,” is crucial for achieving higher success rates in treating malignant brain tumors, integrating procedures such as surgery, radiotherapy, and chemotherapy. This integrated approach allows for different treatment goals and maximizes patient outcomes [4]. Advances in neuropathology and oncogenetics have allowed for a better molecular characterization of low-grade brain tumors, leading to the development of more targeted therapies, such as BRAF inhibitors [12].

## DISCUSSION

Multidisciplinary approaches, with collaboration between neurosurgeons, neurologists, oncologists, and other specialists, are necessary for the effective diagnosis and treatment of patients [8]. The improvement in brain tumor treatment is also attributed to promising results from innovative surgical methodologies, including fluorescence-guided resection and laser thermocoagulation. Identifying biologically significant mutations has paved the way for targeted therapies that significantly improve patient survival rates [4].

The application of mass spectrometry in fresh intraoperative samples has been a useful tool for quantifying drug penetration in different parts of the tumor and analyzing pharmacodynamics. This can aid in characterizing parameters relevant to clinical trial development and improving the pharmacological treatment of central nervous system tumors<sup>[8]</sup>.

However, early identification of brain tumors and improving the quality of life of patients after treatment remain current challenges. For a more promising future and advances in the treatment of central nervous system tumors, experts must collaborate and conduct continuous research to overcome the challenges involved in the overall framework of these neoplasms<sup>[12]</sup>.

Providing individualized care to patients in the specialty is a crucial aspect emphasized in multidisciplinary. This approach can be implemented in various health areas, not only in the diagnosis and treatment of brain tumors<sup>[6]</sup>.

The multidisciplinary approach to the diagnosis and treatment of CNS tumors is complex, given the ongoing difficulty in fully achieving Sustainable Development Goals (SDGs), largely due to unequal access to healthcare among different countries worldwide. This discrepancy is five times less access to CNS tumor diagnosis in developing and/or underdeveloped countries compared to developed countries<sup>[13]</sup>. This disparity may impact the incidence of CNS tumors among countries due to inequalities in diagnostic infrastructure capacity, hindering the

creation of global neurosurgery proposed by SDGs.

Regarding multidisciplinary therapeutic approaches,<sup>[14]</sup> involving 166 patients under 15 years with CNS tumors, showed that 59 patients underwent complete surgical resection (38.0%). Simultaneously, Kakusa's study (2019) in Uganda indicated higher survival rates after tumor resection compared to patients who did not undergo surgical intervention. This suggests the technical capacity of underdeveloped countries to also receive global investments in neuro-oncology services, similar to developed countries.

## CONCLUSION

Multidisciplinary involvement is essential to enhance surveillance and determine the best course of action for patients affected by central nervous system (CNS) tumors. Interactions among different healthcare areas are crucial for improving the diagnostic process and the treatment of patients with these tumors. Neurosurgeons are indispensable professionals for the care, intervention, and follow-up of patients, alleviating symptoms caused by the mass effect of the tumor and improving the quality of life for each individual. Additionally, neurosurgery plays a crucial role in the surgical resection of tumors, enhancing patients' survival and incorporating advantages mentioned by specialists in the field.

The implications of these findings for clinical practice and future research are highly relevant. Strengthening collaboration across different specialties, such as neurosurgeons, radiologists, oncologists, and other experts, allows for a more comprehensive and individualized approach to each patient. This approach leads to better treatment decisions and more positive clinical outcomes, expanding the perspective of patient case management. Thus, multidisciplinary is not only a practical strategy but also promises even more positive future benefits. Furthermore, it is emphasized that long-term studies assessing the impact of current treatments on the quality of life of these patients and their potential outcomes should be provided. More research on the incidence and treatment of CNS tumors, as well as studies investigating the impact of multidisciplinary approaches on patient survival and quality of life, is warranted. Such studies can help predict the number of people likely to encounter these tumors and facilitate the implementation of public health policies for this group. Therefore, the fusion of diverse disciplines, spanning neurosurgery, neurology, and innovative therapies, is a crucial component for the precise identification and effective treatment of these tumors.

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**Observação:** os/(as) autores/(as) declaram não existir conflitos de interesses de qualquer natureza.