DISTRIBUTION OF ASTROCYTIC TUMORS AND BRAIN METASTASES BY ANATOMICAL LOCATION: A STUDY CONDUCTED ON 91 PATIENTS

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DISTRIBUTION OF ASTROCYTIC TUMORS AND BRAIN METASTASES BY ANATOMICAL LOCATION: A STUDY CONDUCTED ON 91 PATIENTS (Abstract): This retrospective study examines the distribution of astrocytic tumors and brain metastases based on anatomical location. **Materials and methods:** the study included a cohort of 91 patients treated at "Prof. Dr. N. Oblu" Emergency Clinical Hospital in Iasi, Romania, between 2011 and 2023. The study focuses on tumors localized in the frontal, parietal, and temporal lobes, with a particular emphasis on the association between these tumors and pre-diagnosis psychiatric symptoms. **Results:** Data were collected from pathology records, including patient demographics, tumor type, location, and histopathological characteristics. The analysis reveals a significant prevalence of astrocytic tumors in the frontal lobes for both male and female patients, with glioblastoma multiforme being the most common tumor type. The study also highlights the impact of tumor location on the presentation and progression of psychiatric symptoms, underscoring the need for tailored treatment approaches. **Conclusions:** These findings contribute to a better understanding of the relationship between tumor location, patient outcomes, and the potential for targeted therapeutic strategies. **Keywords:** ASTROCYTIC TUMORS, BRAIN METASTASES, ANATOMICAL LOCATION, GLIOBLASTOMA, HISTOPATHOLOGICAL ANALYSIS.FRONTAL LOBE TUMORS, TEMPORAL LOBE TUMORS, PARIETAL LOBE TUMORS, TUMOR DISTRIBUTION.

Astrocytomas are a group of brain tumors that most commonly affect individuals between the ages of 30 and 40, with a slightly higher incidence in men. High-grade tumors, such as glioblastomas, are the most common malignant brain tumors, accounting for approximately 54% of all gliomas and 16% of all primary brain tumors (1, 2). Symptoms of low-grade astrocytomas may be subtle, as the brain can temporarily compensate for the slow growth of the tumor. In contrast, high-

grade tumors can cause acute and severe symptoms, such as headaches, seizures, and personality changes (3, 5).

The treatment of astrocytic tumors requires a multidisciplinary approach, involving surgical interventions, chemotherapy, and radiotherapy. For low-grade tumors, complete surgical resection is often curative, with radiotherapy used in cases of tumor recurrence or progression (7). High-grade tumors typically require a combination of maximal surgical resection and radiochemotherapy (8). Despite technological advancements and the identification of molecular markers that have improved prognostic stratification, managing these complex tumors remains challenging (9, 10).

This study aims to investigate the anatomical distribution of astrocytic tumors and brain metastases in the frontal, parietal, and temporal lobes, analyzing the impact of these locations on pre-diagnosed psychiatric symptoms. The study contributes to a better understanding of tumor behavior and the improvement of personalized therapeutic approaches.

SIGNS AND SYMPTOMS

The signs and symptoms of grade I and grade II astrocytomas are difficult to observe, as the brain can temporarily adapt to the presence of a slow-growing tumor. The signs of grade III and IV astrocytomas can appear suddenly and can strongly affect the body (5). The symptoms and signs of brain tumors result in a general increase in intracranial pressure, focal changes in brain function, or, in some cases, a combination of both (6).

Headache is one of the main symptoms often associated with brain tumors (7). The usual pain is felt bilaterally in the frontal area (8), is non-throbbing in quality (9), and is moderate in intensity. Headache is often accompanied by other symptoms that indicate a diverse impairment of intracranial structures, such as personality changes, seizures, and/or specific neurological signs, along with signs of increased intracranial pressure (nausea, vomiting, optic nerve swelling, blurred vision) (7).The exact location of the tumor cannot be predicted just based on the location of the headache, but a predilection for frontal headaches is observed in supratentorial and skull base tumors, while occipital headaches are more commonly found in infratentorial tumors (9). According to a study conducted by Lowry and his colleagues (10), headaches were much more common in patients under the age of 45 suffering from a malignant primary brain tumor, compared to those aged 65 or older.

Cranial tumors can cause severe ocular manifestations and symptoms in addition to the neurological consequences caused by increased pressure inside the cranium, nerve damage or brain compression (11). Common initial symptoms include gradual decrease in visual acuity, possible optic nerve atrophy, visual field impairment, and paralysis of the extraocular nerves (12).

TREATMENT

A team consisting of oncologists, radiologists, and neurosurgeons with individualized experience make treatment decisions. The treatment is determined by the type and location of the tumor, the degree of malignancy, the age, and the health condition of the patient (13). Chemotherapy, radiotherapy, and surgical intervention are the three most commonly used treatment options. In cases where brain tumors are benign, surgical intervention can be effective (14).

Pilocytic astrocytoma has a low rate of malignant progression. The main treatment is surgical resection. Radiotherapy is indicated for the area affected by the tumor in the absence of other surgical options and if there are radiographic evidence of progression (15). The removal of grade II tumors is achieved through microsurgical intervention. Radiation therapy may be recommended for patients who have undergone partial surgical intervention, have observed tumor growth, or cannot undergo surgery (16). Radiochemotherapy may be postponed until disease progression, as surgical intervention is potentially curative (17).

The maximum safe resection of grade III tumors, followed by radio chemotherapy, is considered standard in their treatment (18). Temozolomide administered together with radiotherapy does not have a significant additional effect (19). Current technological and conceptual advances have increased the safety of surgical procedures, while also expanding the possibilities and indications for surgery in the treatment of grade IV tumors (20). Usually radiotherapy follows surgery in most cases. Chemotherapy can sometimes be administered together with or after radiotherapy. However, there is no standard chemotherapy treatment protocol, and each regimen must be customized for each patient (21).

Low grade tumors can be approached through various methods, such as the administration of anticonvulsant/antiepileptic drugs, steroids or surgical interventions. Studies have found that between 30-50% of individuals diagnosed with brain tumors experience at least one seizure, while 10-30% of them face repeated convulsions (22). Nowadays, all those diagnosed with brain tumors should receive treatment with antiepileptic drugs due to the frequency of seizures associated with these tumors (23).

The therapy for neuropsychiatric symptoms involves both medications and non-pharmacological therapies. Non-pharmacological interventions require collaboration efforts from doctors, nurses, and family/caregivers (24). In order to provide the best psychopharmacological and psychotherapeutic intervention, it is essential to assess patients' symptoms through a rigorous neuropsychological and psychiatric evaluation in specialized clinics. Regarding patients' families, the importance of an educational, supportive, and psychosocial-oriented intervention has been consistently highlighted (25, 26). Oncological psychology and social oncology are, compared to biomedical therapies for cancer, new additions in contemporary cancer care (27).

MATERIALS AND METHODS

This retrospective study included 91 patients treated at the "Prof. Dr. N. Oblu" Emergency Clinical Hospital in Iasi, Romania, between February 17th, 2011, and May 8th, 2023. All patients underwent pathological examination of tissue samples removed during surgery. The Pathology Department's biopsy registry recorded the patients' identification details (name, gender, age), the tumor's location and type, and the stains used. Patients were informed about the necessity of histopathological tests and consented to the use of biological material for diagnostic and research purposes.

RESULTS

In this study, we analyzed the distribution of tumors based on their anatomical location, utilizing cerebral MRI and native CT scans for diagnosis. The findings revealed that, for male patients, the left and right frontal lobes were the most common

sites for tumor occurrence, each accounting for 40% of the cases (Fig. 1). This indicates a significant concentration of tumors in these regions compared to other anatomical areas. The next most frequent site was also within the frontal lobe, but with a considerably lower incidence of 7%. This distribution pattern highlights the frontal lobe as a primary site of tumor development in men.

Just like in the case of men, in women most of the tumors are found in the left and right frontal lobes, the percentage being 32% (fig. 2). This finding shows a significant predilection for these areas compared to other anatomical regions. The following areas by frequency are the right fronto-temporal lobe with 4 cases (9%) and the right fronto-parietal lobe with 3 cases (6%). Other observed locations, each with 2 cases (4%), include the left fronto-parietal lobe, the left fronto-temporo-insular lobe, and the left fronto-parieto-temporal lobe.

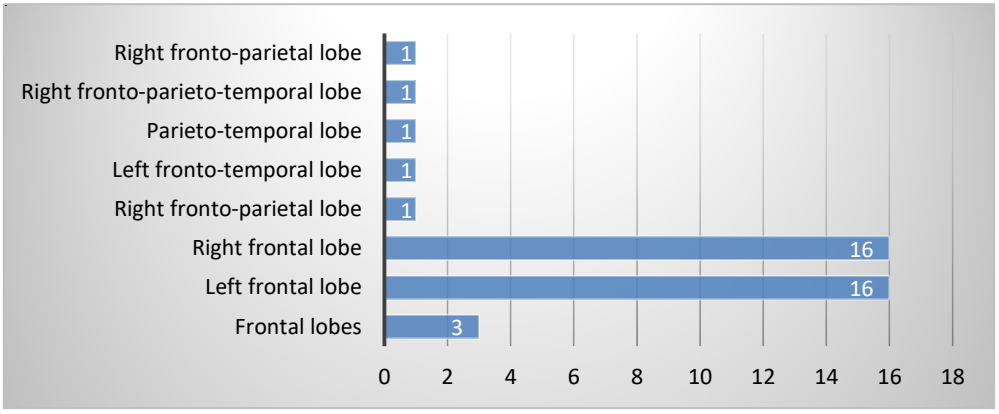

Fig. 1. Distribution of tumors by location in men

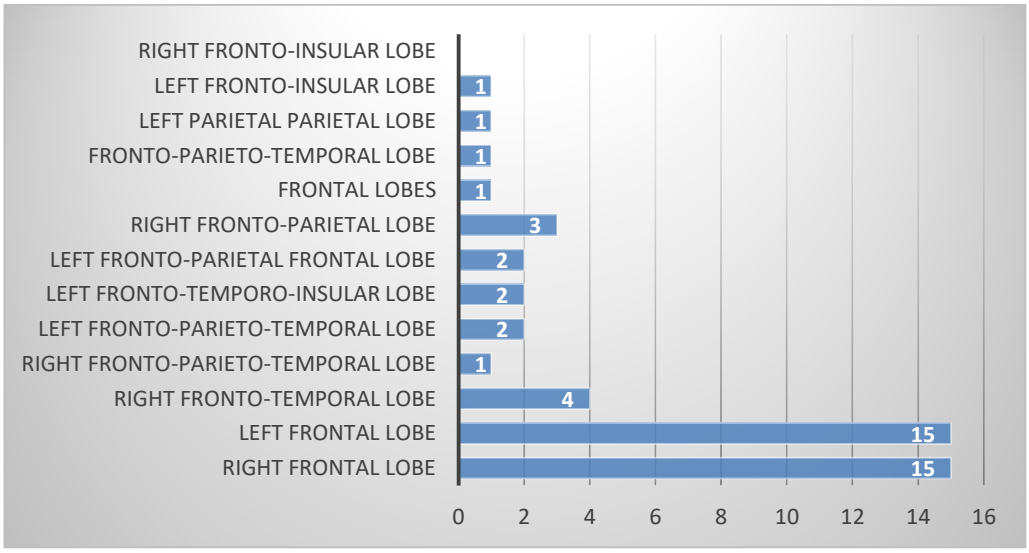

Fig. 2. Distribution of tumors by location in women

Next, we analyzed the distribution of different types of non-metastatic brain tumors, in order to provide a comprehensive perspective on the diversity and frequency of these conditions in our study context (fig. 3).

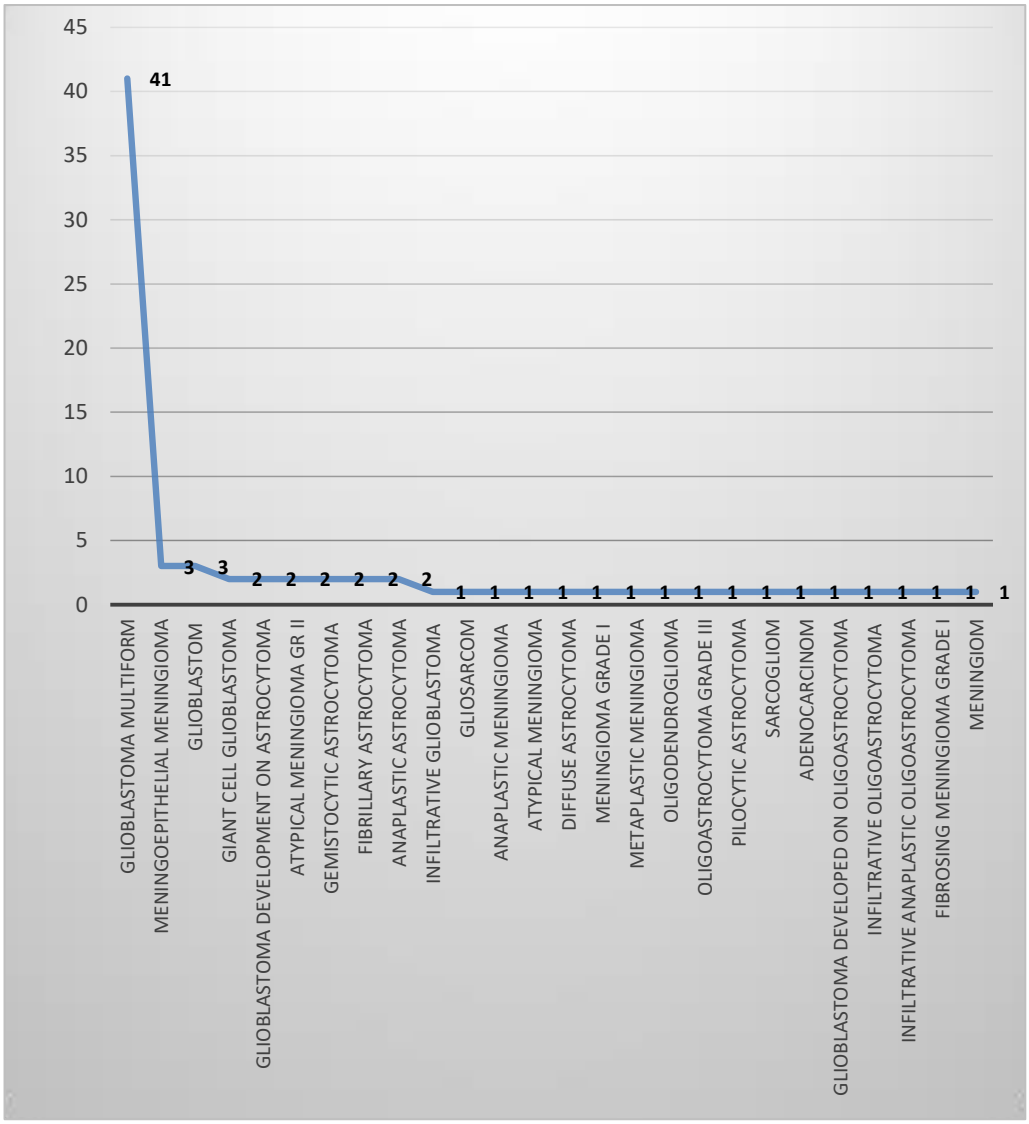

Fig. 3. Distribution of non-metastatic brain tumors

Examining the graph shows that "Glioblastoma Multiforme" is the most common type of tumor, constituting a significant part of the total cases studied, with 41 incidences (55%). Following in second place, at a significant distance, are "Meningoepithelial Meningioma" and "Glioblastoma", each having 3 cases (4%), while "Giant

Cell Glioblastoma" and "Differentiated Glioblastoma on Astrocytoma" have 2 cases each (3%). This distribution highlights the typological variety of non-metastatic brain tumors, with a clear predominance of glioblastoma multiforme.

To complete our analysis, it is essential to examine the distribution of brain metastases according to the affected lobes. This approach allows us to better understand not only the incidence and types of primary tumors, but also how they spread and impact different regions of the brain (fig. 4) illustrates the distribution of brain metastases, providing a clear picture of their prevalence and location within the studied population.

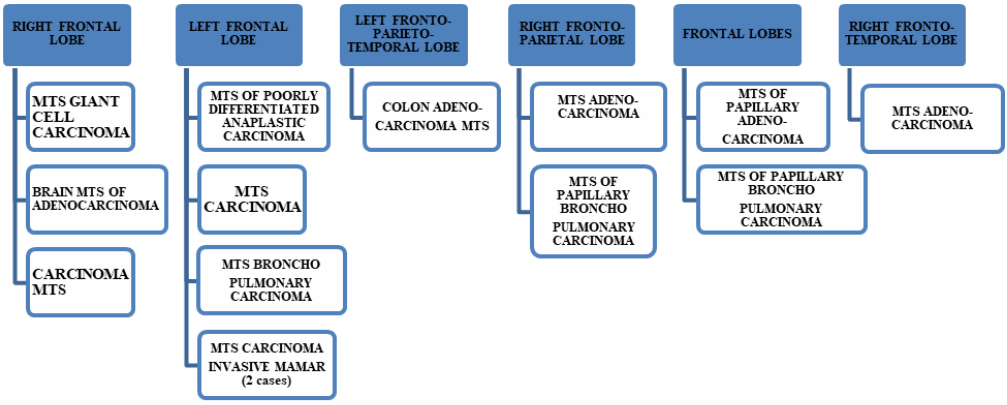

Fig. 4. Distribution of brain metastases (MTS = METASTASIS)

The right and left frontal lobes present the highest diversity of types of metastases, indicating a greater susceptibility of these regions to different types of cancer. In the right frontal lobe, the majority of affected patients are men, which may suggest a higher incidence of brain metastases in this region in men. On the other hand, metastases in the right frontoparietal and left frontoparietotemporal lobes seem to mainly affect women. Metastases from adenocarcinoma and papillary bronchopulmonary carcinoma are common in multiple regions of the brain, demonstrating an increased capacity of these types of cancer to spread to the brain. The frontal lobes (right and left) and frontoparietal lobes are critical regions for cognitive and motor functions. Metastases in these areas can lead to significant neurological deficits, such as movement problems, executive function, and behavior. Metastases in the left frontoparietotemporal lobe can affect language functions and spatial perception, having a major impact on the quality of life of patients. Metastases of adenocarcinoma are common and occur in various regions of the brain, indicating the aggressive and invasive nature of this type of cancer.

To create a more detailed and comprehensive overview of the distribution of non-metastatic brain tumors based on loca-

tion and sex, we have included a table summarizing this information (tab. I). The distribution of these tumors in various regions of the brain is presented for both men and women, offering a comprehensive perspective on the demographic and anatomical differences and similarities of the cases studied.

TABLE I.
Distribution of non-metastatic brain tumors by location and sex

Tumor type	Location	Number of cases	Gender distribution
GLIOBLASTOMA	Frontal lobes	2	M=2
	Right fronto-parietal lobe	1	M=1
	Right frontal lobe	14	W=7; M=7
	Left frontal lobe	18	W=8; M=10
	Right fronto-temporal lobe	2	W=2
	Right fronto-parieto-temporal lobe	2	W=1; M=1
	Left fronto-parieto-temporal lobe	1	W=1
	Left fronto-temporo-insular lobe	2	W=2
	Left fronto-temporal lobe	1	M=1
	Left parietal lobe	1	W=1
	Left fronto-parietal frontal lobe	3	W=1; M=1
	Right fronto-parietal lobe	1	W=1
	Right fronto-insular lobe	1	W=1
	Parieto-temporal lobe	1	W=1
MENINGIOMA	Right fronto-parietal lobe	2	W=2
	Right frontal lobe	6	W=5; M=1
	Fronto-parieto-temporal lobe	1	W=1
	Left frontal lobe	2	W=1, M=1
ASTROCYTOMA	Left frontal lobe	3	W=1; M=2
	Right frontal lobe	3	W=2, M=1
	Right fronto-temporal lobe	1	W=1
	Right fronto-insular lobe	1	W=1
OLIGOASTROCYTOMA	Left frontal lobe	2	W=2
	Right frontal lobe	1	M=1
GLIOSARCOMA	Right frontal lobe	1	W=1
ADENOCARCINOMA	Left frontal lobe	1	M=1
OLIGODENDROGLIOMA	Right frontal lobe	1	M=1
SARCOGLIOMA	Right frontal lobe	1	M=1

W- woman, M- man

Glioblastoma is the most common type of brain tumor in the study, with a total of 50 cases. This suggests a high prevalence of this type of tumor among the patients analyzed. Its distribution is varied in multiple regions of the brain, with the majority of cases being located in the frontal lobe. Glioblastoma is almost equally distributed among men and women. However, a slight predominance of cases in the left frontal lobe in men is observed. These data highlight the importance of carefully analyzing the anatomical distribution of glioblastoma in order to better understand its behavior

and prognosis. There are cases of glioblastoma in various combinations of lobes (e.g. fronto-parieto-temporal), indicating the complexity and extent of these tumors.

Meningioma also appears quite frequently in the dataset, being especially located in the right frontal lobe. This tumor is much more commonly found in women, highlighting their predisposition to developing meningioma compared to men. Specifically, meningioma is predominantly located in the frontal lobe, with a significant concentration on the right side. This trend indicates that women have a higher prevalence for developing this type of tumor in certain regions of the brain.

Oligoastrocytoma, gliosarcoma, adenocarcinoma, oligodendroglioma, and sarcomato-glioma are fewer common tumors, but present, with a variable distribution between sexes and locations, having notable cases, especially in the frontal lobes.

The frontal lobe is generally the most frequent location for tumors in the table, with multiple cases for all types of tumors. Both the right and left frontal lobes are the most common location for tumors. This may indicate a vulnerability or predisposition of this lobe to develop tumors. The distribution of tumors between sexes is relatively balanced for certain types of tumors, such as astrocytoma, but disproportionate for others, such as meningioma.

DISCUSSION

The results of this study highlight a predominant distribution of astrocytic tumors in the frontal lobes for both men and women. This finding aligns with existing literature, which suggests a preference for astrocytoma, particularly glioblastoma, in this brain region (1, 2, 3). The similar distribution between sexes, with a slight predominance in the left frontal lobe in men, emphasizes the need for personalized treatment approaches considering both anatomical location and sex differences.

Our analysis of brain metastases revealed a higher susceptibility of the frontal lobes to various cancer types, particularly metastases originating from adenocarcinoma and papillary bronchopulmonary carcinoma. These findings underscore the complexity of tumor-brain interactions, highlighting the necessity of a multidisciplinary approach to managing both primary tumors and metastases.

The study also found a correlation between tumor location and pre-diagnosed psychiatric symptoms, suggesting that frontal lobe involvement can significantly impact patients' cognitive and behavioral functions. These findings emphasize the importance of rigorous neuropsychiatric evaluations in managing brain tumor patients to optimize their quality of life.

Our study contributes to a better understanding of the anatomical distribution of astrocytic tumors and brain metastases, offering valuable insights for personalized therapeutic approaches. However, further research is needed to explore the underlying biological mechanisms and to validate these findings in larger clinical studies.

CONCLUSIONS

This study presents a detailed exploration of the anatomical distribution of astrocytic tumors and brain metastases, focusing predominantly on the frontal lobes. The results indicate that the frontal lobes are the most common site for these tumors, particularly in men, suggesting a potential anatomical predisposition. The significant presence of glioblastoma multiforme further emphasizes the aggressive nature of

these tumors in this region. These findings underline the critical need for location-specific therapeutic strategies that consider both the type and site of the tumor to enhance patient outcomes.

Additionally, the study draws attention to the importance of using advanced imaging techniques, such as MRI and CT scans, for accurate diagnosis and localization of tumors, which is crucial for effective treatment planning. The variability in tumor types across different brain regions also suggests that personalized treatment protocols are essential to address the unique challenges presented by each tumor's location and characteristics.

Future research should aim to validate these findings in larger cohorts and explore the biological mechanisms that may contribute to the observed distribution patterns. Understanding these mechanisms could lead to the development of more targeted therapies, ultimately improving the prognosis and quality of life for patients with astrocytic tumors and brain metastases.

CONFLICTS OF INTERES AND FUNDING

The authors have declared that there are no conflicts of interest related to this research. Additionally, no external funding was obtained or secured for the study.

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