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Correlation between Tumor Location and Size in Intracranial Tumor Patients and Seizure Types

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ABSTRACT

Introduction: Brain tumors are rare with a worldwide incidence of 296,851 cases worldwide. A large tumor size indicates a long duration of silent growth, allowing more time for seizures to develop. The aim of this study was to determine the correlation between tumor location and size in patients with intracranial tumors and the type of seizure.

Methods: This study used a cross-sectional design in patients who encountered seizure and had been diagnosed with intracranial tumors undergoing treatment at H. Adam Malik Hospital Medan We used Fisher Exact analysis test to determine the relationship of seizure generation type in intracranial tumor patients based on tumor location and Chi-Square analysis test to determine the relationship of seizure generation type in intracranial tumor patients based on tumor size. This study included 43 patients with intracranial tumors accompanied by seizures.

Results: Statistical analysis showed insignificant results between tumor location and type of seizure with p value of 0.543 was obstained, indicating that the relationship between tumor location and type of seizure was not significant ($p < 0.05$). The results of statistical analysis showed a significant result between tumor size and type of seizure with p value of 0.048.

Conclusion: There was no association between tumor location in intracranial tumor patients and the type of seizure. However, there was a relationship between tumor size in intracranial tumor patients and the type of seizure.

Keywords Seizure, Brain tumor, Intracranial Tumor

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INTRODUCTION

Central nervous system (CNS) tumors include tumors that originate from the brain, spinal cord, meninges, and metastatic tumors.[1] Brain tumors and other CNS tumors are the most common tumors in children aged 0–14 years and the second most common tumors in adolescents aged 15–19 years. The majority of brain and other CNS tumors diagnosed in adults aged >20 years are non-malignant tumors, while malignant brain and other CNS tumors are less common in this age group.[2]

The prevalence of CNS tumors in Asia is 15 per million people per year.[3] n Indonesia, research on the epidemiology of intracranial tumors is still lacking. The estimated incidence and mortality of CNS tumors in Indonesia in 2016 were 6,337 and 5,405 cases, respectively.[4] The incidence of brain tumors in adults is 1.9/100,000 adults. Research on the prevalence of CNS tumors in children in Indonesia has not been extensively conducted.[5]

Brain tumors may present with different clinical symptoms depending on the anatomical location involved.[6] Clinical manifestations and neurological symptoms can include headache, seizures, vomiting, vision problems, decreased consciousness, balance disorders, cranial nerve paresis, hydrocephalus, and others.[7] An increase in tumor mass based on larger neoplasm volume is associated with a poorer prognosis in patients with most solid cancers because the skull contains a rigid volume; a larger intracranial tumor mass results in the displacement of normal brain tissue. This phenomenon is known as the mass effect, and its increase is associated with a higher risk of neurological deficits.[8]

These tumors are highly heterogeneous and can be broadly classified as malignant and benign (or non-malignant), with their specific histology varying in frequency based on age, gender, and race/ethnicity. Epidemiological studies have explored various potential risk factors, and so far, the only validated associations with brain tumors are ionizing radiation (which increases the risk in both adults and children) and a history of allergies (which decreases the risk in adults).[9]

METHODS

This study is a descriptive study with cross-sectional design. The research was carried out at H. Adam Malik General Hospital Medan. The inclusion criteria for this study were patients at H. Adam Malik General Hospital Medan from August 2021 to August 2023, who were over 18 years old and diagnosed with intracranial tumors, with the first seizure occurring after the diagnosis of the intracranial tumor and no tumors found elsewhere. Based on these criteria, a total of 43 patients were obtained using a consecutive nonrandom sampling method. The data in this study used secondary data obtained from patient medical records based on anamnesis and physical examination, complete blood tests, and CT-Scan results at H. Adam Malik General Hospital Medan. The characteristics assessed in this study include age category, gender, ethnicity, contraception use, smoking habits, use of antiepileptic drugs, type of seizure, and type of tumor present.

RESULTS

Table 1. Demographical Characteristics

Demographical Characteristics	n (43)
Age, Year	
Mean (SD)	49,26 (±14,590)
Age, n (%)	
18 - 40 years	13 (30,2)
> 40 years	30 (69,8)
Gender, n (%)	
Male	20 (46,5)
Female	23 (53,5)
Ethnicity, n (%)	
Batak	25 (58,1)
Javanese	14 (32,6)
Chinese	1 (2,3)
Malay	3 (7,0)
Contraceptive use, n (%)	
Yes	7 (30,4)
No	16 (69,6)
Smoking, n (%)	
Yes	13 (31,0)
No	30 (69,0)
Use of Anticonvulsant Drugs, n (%)	
Monotherapy (Phenytoin)	36 (83,3)
Polytherapy (Phenytoin + Valproic Acid)	7 (16,7)
Type of Seizure, n (%)	
Generalized Onset Motor Tonic Clonic	28 (65,1)
Focal Onset Motor Tonic Clonic	15 (34,9)
Type of Tumor, n (%)	
Meningioma	19 (44,2)
Glioma	9 (20,9)
Glioblastoma Multiforme	13 (30,2)
Astrocytoma	2 (4,7)

The frequency distribution data was obtained in (Table 1). Most subjects in this study were over 40 years old (69.8%), and there were more women (53.5%) than men (46.5%). The Batak tribe dominates the study population (58.1%), followed by the Javanese tribe (32.6%). Smoking habits were relatively low, with 69.0% of patients not smoking. Contraceptive use was also low, with 83.7% not using contraception. Most patients received monotherapy (83.3%), indicating a preference for monotherapy in the management of this condition. The most common tumor type was meningioma (44.2%), followed by glioblastoma multiforme (30.2%) and glioma (20.9%). Tumor locations were most found in the left parietal area (25.6%), indicating this area of the brain may be more susceptible to tumors causing seizures. The most common type of seizure is generalized or generalized seizures (65.1%), indicating that generalized seizures occur more frequently than focal seizures (34.9%).

This study also analyzed the relationship between the location of the intracranial tumor and the type of seizures experienced by the patient. The following are the results of the analysis which can be seen in Table 2.

Table 2. Relationship between tumor location and type of seizure

Tumor Location	Type of Seizure Arousal		P value
	Focal n (%)	General n (%)	
Frontal Lobe	4 (50,0)	4 (50,0)	0,543
Temporal Lobe	5 (38,5)	8 (61,5)	
Parietal Lobe	6 (31,6)	13 (68,4)	
Occipital Lobe	0 (0,0)	3 (100,0)	

**Uji Fisher Exact*

The relationship between tumor location and the type of seizure generation shows a variable proportion of data based on different locations. In the frontal lobe, focal and generalized seizures occur with the same frequency (50% each). In the temporal lobe, generalized seizures were more common (61.5%) compared with focal seizures (38.5%). Likewise, in the parietal lobe, generalized seizures (68.4%) occurred more frequently than focal seizures (31.6%). For the occipital lobe, all cases (100%) showed generalized seizures, without focal seizures.

In this study, the Fisher Exact test was carried out to assess the relationship between tumor location and the type of seizures in patients. Then a p value of 0.543 was obtained, indicating that the relationship between tumor location and type of seizure was not significant ($p<0.05$). This shows that the location of the tumor does not have a significant influence on the type of seizure experienced by the patient. This study also sought to determine the relationship between the location of the intracranial tumor and the type of seizures experienced by the patient (Table 3).

Table 3. Relationship between tumor size and type of seizure

Tumor Size	Type of Seizure Arousal		Total	p*
	Focal n (%)	General n (%)		
< 30 mm	2 (100%)	0	2	0.048
≥ 30 mm	13 (31.7%)	28 (68.3%)	41	

*Uji *Chi-square*

Based on the analysis carried out, the relationship between tumor size and type of seizure can be seen through the proportion of data showing that of the 2 patients with tumors measuring less than 30 mm, all (100%) experienced focal seizures, while none experienced generalized seizures. In contrast, of the 41 patients with tumors measuring 30 mm or more, 13 patients (31.7%) experienced focal seizures, while 28 patients (68.3%) experienced generalized seizures.

After testing the hypothesis, a p value of 0.048 was obtained from the Chi-square test, indicating that the relationship between tumor size and type of seizure was statistically significant ($p < 0.05$). This indicates that tumor size has a significant influence on the type of seizures experienced by patients, with larger tumors being more likely to cause generalized seizures.

DISCUSSION

Glioblastomas accounted for nearly half (49%) of all malignant tumors in all age groups and nonmalignant meningiomas accounted for more than half (54%) of nonmalignant tumors. This epidemiological data is likely to cause the proportion of research subjects to be predominantly older. The results of this study were also similar to research conducted by Garcia et al., (2023), namely that the average age was reported to be 60 years and a significant relationship was found between age and the appearance of seizures ($p = 0.002$). In this study, the distribution of the most common histological types of tumors was also found, namely meningioma and glioblastoma. This is also similar to research conducted by Wasade et al., (2020) where meningiomas accounted for 1 in 5 tumors with seizures occurring in 1 in 4 cases ($p= 0.021$).[10]

The incidence of malignant brain and CNS tumors is more common in men than women, while the opposite occurs for non-malignant tumors. The sex differences are most pronounced in adults aged ≥45 years, where the incidence rate in women is 30% lower than in men for malignant tumors. In contrast, for nonmalignant tumors, the sex difference peaks in the 25 to 29 year age group, with the incidence rate in women being twice that of men, primarily due to the burden of pituitary adenomas in women in this age group. However, as women get older, the incidence of pituitary tumors decreases, and differences in tumor types in older adults are largely due to nonmalignant meningiomas. Variability in hormone exposure throughout life has been proposed as a potential cause for this differential risk, although published cohort studies show inconsistent results due to constraints in long-term hormone measurement. Further studies still need to be carried out in more optimal conditions to assess this.[4,11,12]

Based on the frequency distribution obtained in this study, it was found that the proportion of women (53.5%) was greater than men (46.5%). This is not in accordance with the epidemiological study conducted by CBTRUS mentioned above. However, the difference in proportions between genders in this study is not very significant numerically, so it is possible that this occurs because the sample size of this study is not large enough to describe the distributive characteristics of brain tumors in a larger population.[11]

In this study, the tumors found were mainly in the left parietal area (25.6%) with the majority measuring more than 30 mm, which may be related to generalized seizures which occur more frequently than focal seizures. The hallmark of focal seizures is aberrant electrical activity at a focused location in the brain, which can cause a variety of neurological symptoms. The quality of life in patients who experience seizures can be greatly influenced by various underlying diseases. A large portion of the adult population experiences focal seizures, sometimes called partial seizures, which cause severe neurological problems. These seizures have diverse clinical manifestations because they are determined by aberrant electrical activity localized in specific brain regions. Focal seizures are also important because of their origin and underlying causes. Congenital factors, acquired anatomical defects, inflammatory processes, and acquired brain trauma are just some of the causes of these seizures that frequently occur in adult patients.[13,14]

In this study, no statistically significant relationship was found between the location of the tumor and the type of seizure that occurred. In terms of the proportion of research samples, it was found that the number of samples with parietal tumor locations was in the highest order, followed by temporal and frontal locations.

The location of the tumor is one of the factors that greatly influences the signs and symptoms that appear in intracranial tumors, especially the incidence of seizures. Cortical tumors involving the frontal, temporal and parietal cortices as well as tumors in the cortical gray matter are associated with a greater frequency of seizures compared with lesions involving the infratentorial area, suprasellar area, or occipital lobe and this was reported in a study conducted by Larjavaara et al. , (2007). The type of seizure is also related to the anatomical location of the tumor. For example, focal involuntary seizures are associated with lesions involving the left and middle inferior frontal gyri, whereas focal involuntary seizures are associated with the right temporal insular region.[15]

In intracranial tumors, the diameter of the tumor size is 30 mm. An intracranial tumor is said to be small if it is found to be < 30 mm in size, not accompanied by mass effect, which is described as a midline shift of > 3 mm with cerebral edema found. Meanwhile, a tumor is categorized as large if it is found to be ≥ 30 mm in size accompanied by mass effect. In other findings, it was also stated that there was a correlation between the complications that occurred and the lesion volume, which was determined to be a lesion with a maximum of more than 30 mm.(16-18) This is also similar to the findings in research conducted by Puri et al., (2020) where tumors with a size of > 3 cm had a significant relationship with the incidence of seizures (p = 0.021).[19]

CONCLUSION

There is no relationship between the location of the tumor and the type of seizures experienced in patients with intracranial tumors. There is a relationship between tumor size and the type of seizures experienced in patients with intracranial tumors. The tumor location was most found in the left parietal area (25.6%), indicating this area may be more susceptible to tumors causing seizures. The most common type of seizure was generalized seizures (65.1%), more often than focal seizures (34.9%). Most tumor sizes found in patients with intracranial tumors were ⩾ 30 mm (95.3%).

DECLARATIONS

None

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The authors declare that there is no conflict of interest in this report.

AUTHORS' CONTRIBUTIONS

All authors are responsible for conceptualization, manuscript preparation, manuscript editing, and manuscript assurance.

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