ORIGINAL ARTICLE

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Retrospective Analysis of Tumor Location with Residue Rates in High-grade Glial Tumors

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Abstract

Objective: Glioblastoma is the most commonly seen and quite an aggressive type of primary brain tumor. Location of the tumor, age, and sex are important prognostic factors. The aim of this study was to present the retrospective data about glioblastoma patients in which location of glioblastoma and calculation of residual tumor tissue was performed at our clinic.

Methods: Tumor location, age and sex distributions, and residue presence in control magnetic resonance imaging (MRI) of 99 patients treated at our clinic within the last two years with a high-grade glial tumor were examined retrospectively. Variables included in the analysis were demographic data and the presence of residue on the control MRI within 24 hours. Chi-square test was used for comparisons. The data were analyzed by SPSS version 24.0 package program.

Results: Of a total of 99 glioblastomas, the male/female ratio was 2:1, the average age of the patients was 54±37 (minimum: 18, maximum: 88; standard deviation: 15.08). In MRI, tumor was located at the frontal and temporal lobes with maximal percentile. In 55 of the cases, total resection was seen. In 38 of the cases, residue under 10% was seen, and in 6 of the cases, residual mass over 10% was seen. Relationship of tumor location with residual mass was not statistically significant (p=0.562).

Conclusion: The aim of neurosurgery in glioblastomas is surgical excision to remove as much tumor as possible with minimal neurological deficit. Preoperative characterization of the tumor through current imaging methods makes a significant contribution to mortality and morbidity. New prognostic parameters are needed based on new surgical approaches and imaging techniques.

Keywords: Glioblastoma, glioma, magnetic resonance imaging, prognosis, residual mass

INTRODUCTION

High-grade gliomas are the most common brain tumors that form about 80% of the primary malignant tumors of the brain (1,2). In addition to the basic cell type and differentiation, their immunological profiles constitute the World Health Organization (WHO) 2016 classification system. Among them, the most aggressive and most common glioma is grade 4 glioblastoma. It is more common in men than in women, but its etiology is unknown. Neurosurgical resection, radiotherapy, and chemotherapy are the current standard treatments. Despite all advanced treatment combinations, the average survival is less than 15 months. Patient's age at the preoperative period and tumor location are some of the current factors that determine the prognosis. In adult age groups, the incidence of high-grade glial tumors increases (3-5). Advanced age, especially over 70, is seen as a sign of poor prognosis. There are brain areas functionally defined as elegant regions which cause serious neurological loss when damaged. The factor limiting the surgical approach to these areas is the potential magnitude of neurological loss. Safe total resection is the surgical goal in glial tumors, and the amount of resection is one of the most important factors determining prognosis (6-8). The aim

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of our study was to examine the effect of tumor location on postsurgical residue rate in 99 patients.

METHODS

Approval for this retrospective study was obtained from the Ethics Committee for Noninterventional Studies of our University Hospital, Bezmialem Vakıf University Faculty of Medicine (14/159). The study was planned so as not to pose any risk to the patients receiving treatment. Data of 99 patients who applied to our clinic between January 2016 and January 2018 and diagnosed with grade 4 glioblastoma were retrospectively analyzed. Patients who had needle biopsy or excisional biopsy via navigation were not included in the list. Patients who had WHO grade 1, 2, or 3 gliomas were also excluded (Table 1). Tumor volume at the time of admission and post-surgical residue volumes were calculated using Leksell Gamma Plan version 10.1 (Treatment planning software for Leksell Gamma Knife® Perfexion™, Stockholm) (Figure 1A, 1B).

Statistical Analysis

The analysis was performed by the chi-square test ($p<0.005$) using SPSS (Statistical Package for the Social Sciences) version 24.0 (SPSS Inc, Chicago, IL, USA).

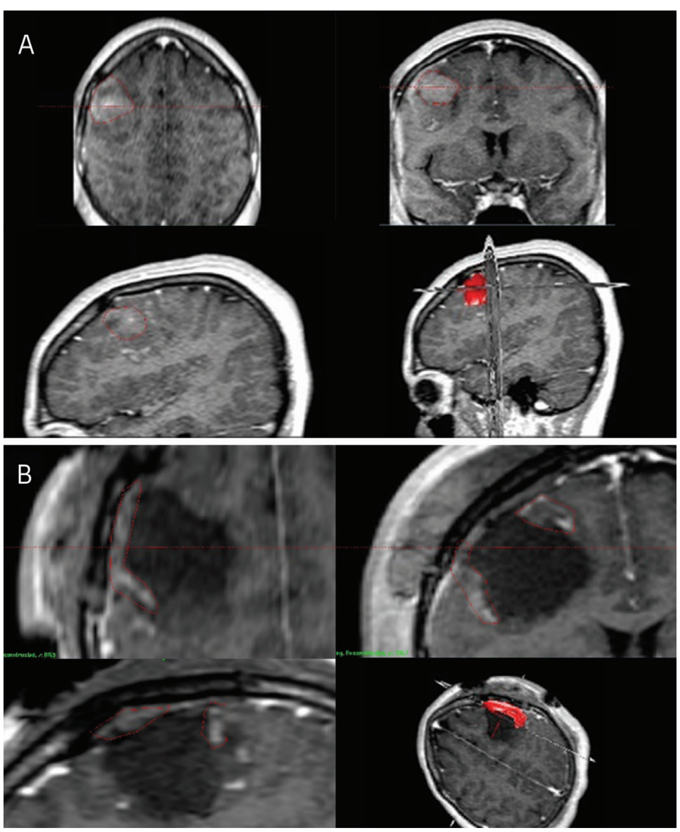


Figure 1. Tumor (A) and residual mass (B) volumes with Leksell Gamma Plan version 10.1 (Treatment planning software for Leksell Gamma Knife® Perfexion™)

RESULTS

There were 60 males (60.6%), 39 females (39.4%) and their mean age was 54.37 (minimum: 18, maximum: 88; standard deviation: ±15.08) (Table 1). In magnetic resonance imaging (MRI), tumor was located in right frontal lobe in 16 patients (16.2%), left temporal lobe in 10 patients (10.1%), left occipitotemporal lobe in 2 patients (2%), right parietooccipital lobe in 4 patients (4.0%), left parietal lobe in 6 patients (6.1%), bilateral frontal lobes in 2 patients (2%), right parietal lobe in 8 patients (8.1%), right occipitotemporal lobe in a patient (1%), right temporal lobe in 12 patients (12.1%), right occipital lobe in 5 patients (5.1%), right frontotemporoparietal lobe in 2 patients (2%), left frontal lobe in 15 patients (15.2%), left frontotemporal lobe in 4 patients (4%), left occipital lobe in 6 patients (6.1%), and left temporoparietal lobe in 4 patients (4%) (Table 2, Graphic 1). Total resection was

Table 1. Age and sex distribution of glioblastoma patients

		Sex		Total
		Male	Female	
Age	18-30	5	2	7
	31-50	16	14	30
	51-60	17	6	23
	61-88	22	17	39
Total		60	39	99

Table 2. Tumor locations in pretreatment MRI with contrast

Location	Number	%
Right frontal	16	16.2
Left temporal	10	10.1
Left occipitotemporal	2	2.0
Right parietooccipital	4	4.0
Left parietal	6	6.1
Suprasellar	1	1.0
Left temporooccipital	1	1.0
Bifrontal	2	2.0
Right parietal	8	8.1
Right occipitotemporal	1	1.0
Right temporal	12	12.1
Right occipital	5	5.1
Right frontotemporoparietal	2	2.0
Left frontal	15	15.2
Right frontotemporal	2	2.0
Left Occipital	6	6.1
Left frontotemporal	2	2.0
Left temporoparietal	4	4.0
Total	99	100.0

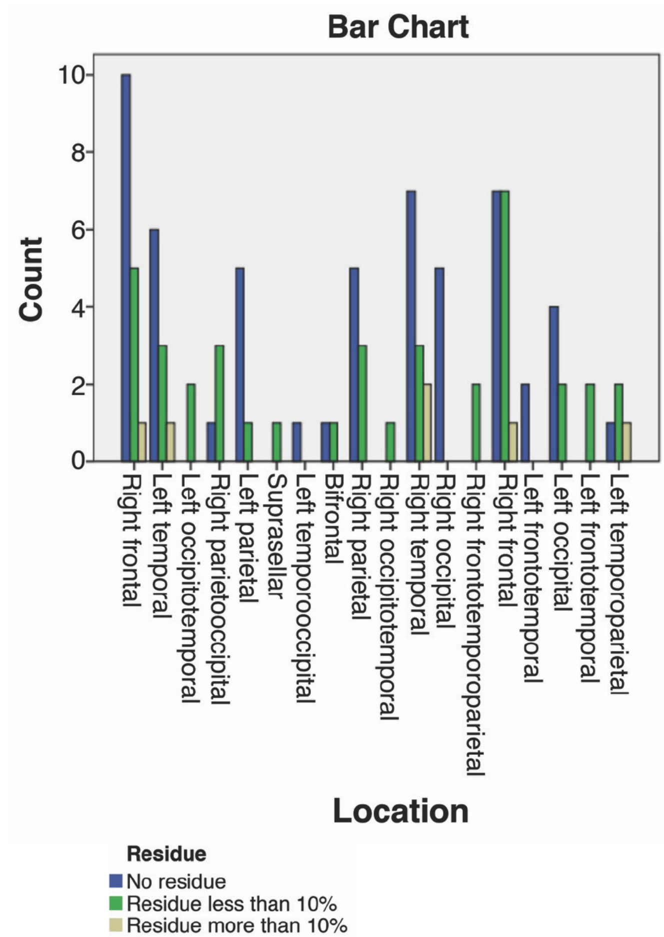
MRI: Magnetic resonance imaging

found in 55 patients (55.6%), lower than 10% residue in 38 patients (38.4%), and higher than 10% residue in 6 patients (6.1%) (Graphic 2, Graphic 3).

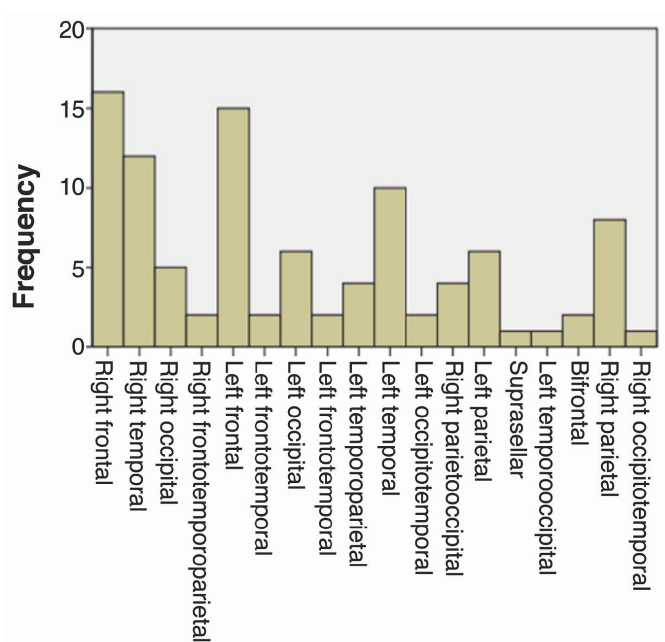
DISCUSSION

The mean age of onset of glioblastoma in the literature was 54-60 and in our study it was 55. The frequency in male sex was in parallel with the literature. The frontal lobe, which was the most common location in literature, was also the most common location in our study (Table 3). No statistically significant relation was found between tumor location and the rates of postsurgical residue (p=0.562) (Table 4). This finding was not consistent with the literature.

Glioblastoma is characterized by malignant cell proliferation at different steps, neovascularization in aberrant structure and function, various degrees of infiltration, and treatment resistance. Today, glial tumor, glioma, and brain tumor can be used interchangeably (9). Many prognostic factors have been defined to predict the survival of the patients with glioblastoma. These include the age of the patient at the time of diagnosis, preoperative performance score (especially the Karnofsky Performance score), tumor location, characteristic features of tumor in preoperative MRI, history of reoperation for recurrent tumor, radiotherapy, and chemotherapy. These factors are related to one another. Despite technological advances, age, location, and amount of surgery have remained

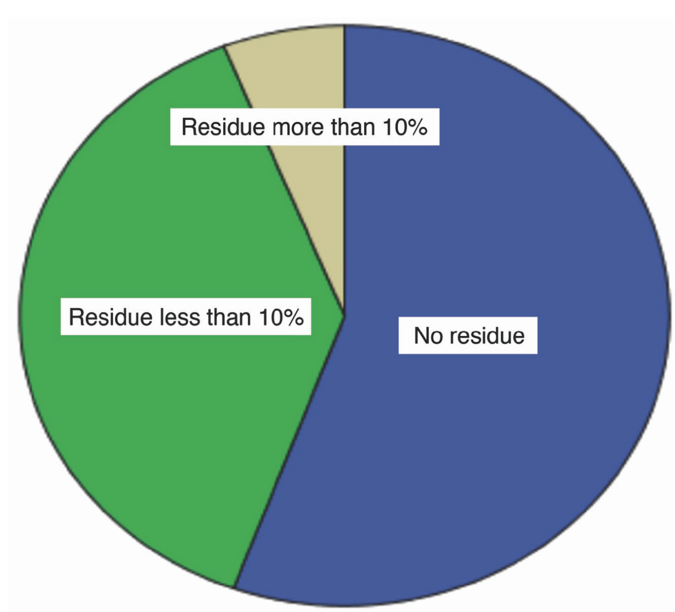


Graphic 2. The association between residue rates and tumor locations



Graphic 1. Frequency of tumor locations in pretreatment MRI with contrast

MRI: Magnetic resonance imaging



Graphic 3. Residue rates in MRI with contrast performed at postoperative first 24 hours. We found that 55.6% of the cases had a total resection, 38.4% had residue below 10%, and 6.1% had residue above 10%

MRI: Magnetic resonance imaging

Table 3. Distribution of tumor-residue rates according to locations in contrasted and perfusion MRI evaluations					
		Residue			**Total**
		No residue	**Residue below 10%**	**Residue above 10%**	
Location	Right frontal	10	5	1	16
	Left temporal	6	3	1	10
	Left occipitotemporal	0	2	0	2
	Right Parietooccipital	1	3	0	4
	Left parietal	5	1	0	6
	Suprasellar	0	1	0	1
	Left temporooccipital	1	0	0	1
	Bifrontal	1	1	0	2
	Right parietal	5	3	0	8
	Right occipitotemporal	0	1	0	1
	Right temporal	7	3	2	12
	Right occipital	5	0	0	5
	Right frontotemporoparietal	0	2	0	2
	Left frontal	7	7	1	15
	Left frontotemporal	2	0	0	2
	Left occipital	4	2	0	6
	Left frontotemporal	0	2	0	2
	Left temporoparietal	1	2	1	4
Total		55	38	6	99

MRI: Magnetic resonance imaging

Table 4. Results of the chi-square test			
	Value	**df**	**Asymp. Sig. (2-sided)**
Pearson chi-square	32.085[a]	34	0.562
Likelihood ratio	37.528	34	0.311
Linear-by-Linear association	0.009	1	0.926
N of valid cases	99		

[a]48 cells (88.9%) have expected count less than 5, the minimum expected count is 0.06

as major prognostic factors in the literature for many years (10,11).

Age is an important prognostic factor in glioblastomas (12). In our study, the mean age of admission was 55 years. In the literature, the peak age of incidence is 54-60 (6,13). Our finding is consistent with the literature. Eighteen months survival rate after the diagnosis was 60% below 40 years of age and 8% above 60 years of age. In another study, two-year survival was only 2% in the group at or above 65 years of age and 30% in the group at or below 45 years of age. In all glial tumors, the frequency in males is higher than the frequency in females. Males were also predominant in our study. However, the prognostic effect of sex has not been proven. It can't be used as a prognostic factor (12,14,15).

The location of the lesion is the most important prognostic factor in neuroimaging (16). For this purpose, MRI is the first method to be used in clinical practice. It guides surgical treatment by revealing the shape, volume, and characteristics of the lesion. Perfusion weighted MR imaging plays major roles in both the detailed demonstration of tumoral tissue and the determination of surgical resection margins by dynamic contrast-enhanced MR and dynamic susceptibility contrast MR (16,17) (Figure 2).

In three different studies in which three-dimensional volumetric analysis was performed with MRI, gross-total tumor resection (>98% tumor tissue removal) increased the average life span by 2-8 months compared to subtotal resection (50-98% tumor tissue removal) (18). On the other hand, there are few studies showing that there is not always a correlation between resection rate and average survival time. Therefore the need for extensive and homogenized studies was emphasized (19). Prognosis is very poor in deep brain areas like thalamic region or brainstem gliomas. Compression to nuclei in their neighborhood and difficulty to access surgically are among the causes of poor prognosis. Cranial nuclei and sensitive structures such as corticospinal and cortico-

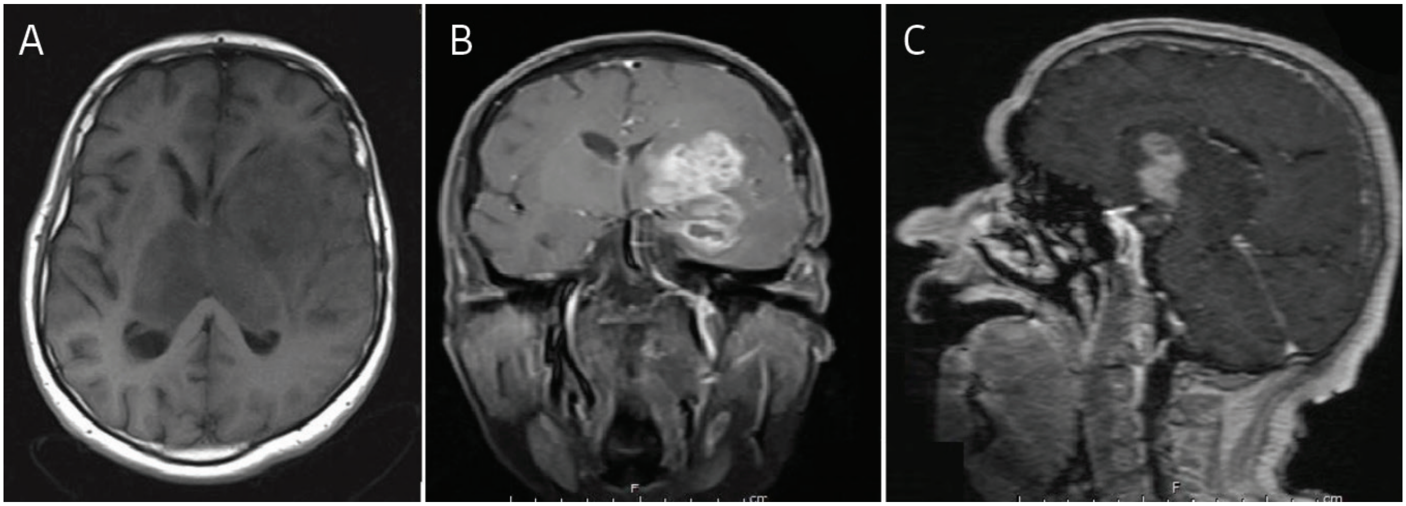


Figure 2. Contrast enhancement with gadolinium in T1 weighted (A), T1 weighted coronal, (B) and T1 weighted sagittal sections (C)

cortical tracts limit surgical access. Damage to these structures can cause much neurological impairment. On the other hand, surgical resection size is an independent factor affecting prognosis. A correlation between resected tumor volume and prognosis has been demonstrated. The aim is to resect as much as possible while paying attention to protect sensitive structures (7,8). Modalities such as MR-tractography, MR-perfusion used in preoperative planning make a significant contribution to the morbidity and prognosis due to the predetermination of the area of resection. The neuronavigation or neuroendoscopy devices used during the operation provide access to the lesion in the most convenient way. Thus, the least damage to elegant areas is aimed. Although these and similar advanced technologies are used in many clinics, novel prognostic factors related to them are not included in the literature (20,21). In our study, we investigated the relation of tumor location, which is the most important prognostic factor, with residue rates. In our study, no relation was found between tumor location and residual mass. We think that technological advances in medical equipment have reduced residual rates, especially in elegant regions. This was not consistent with the literature. One of the reasons for this is the use of advanced surgical equipment such as neuronavigation, intraoperative ultrasound, or ultrasonic aspirator before and during surgery. Thus, a safe surgical approach to these areas and maximal resection is possible.

CONCLUSION

There has been no change in the criteria to predict the survival of glioblastoma patients starting from diagnosis. New prognostic markers are needed, including pre and postoperative imaging, as well as molecular investigations. Evaluating the data used by the clinics at standard times will make an important contribution to determine new prognostic factors.

Ethics

Ethics Committee Approval: Ethics Committee for Noninterventional Studies of our University Hospital, Bezmialem Vakıf University Faculty of Medicine (14/159).

Informed Consent: In line with the ethical rules, patient information and patient approval were obtained.

Peer-review: Externally peer-reviewed.

Authorship Contributions

Surgical and Medical Practices: E.Ö., A.A., M.H.S., T.T.D., S.K., Concept: M.G.P., Design: M.G.P., Data Collection or Processing: M.G.P., E.Ö., M.H.S., Analysis or Interpretation: M.H.S., T.T.D., Literature Search: A.A., S.K., Writing: M.H.S., T.T.D.

Conflict of Interest: No conflict of interest was declared by the authors.

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