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Original research

Long-term surgical and seizure outcomes of frontal low-grade gliomas

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HIGHLIGHTS

- Seizure is the most common symptom in frontal low-grade gliomas.
- Duration of epilepsy and extent of resection are predictors of seizure outcome.
- Patients with worse seizure outcomes have tumour in the primary motor area.
- Patients with frontal low-grade gliomas benefit from postoperative rehabilitation.

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ABSTRACT

Introduction: Low-grade gliomas are infrequent lesions requiring special emphasis because of their relatively long follow-up time, and therefore the need for patients' well-being. Surgery provides not only increased survival but also improved quality of life for these patients. The purpose of this study was to present surgical series of frontal low-grade gliomas that were operated in our clinic and to discuss their epileptic and functional outcomes.

Methods: A series of 40 patients with low-grade glioma (WHO Grade II) were retrospectively analysed for patient characteristics, tumour location, epileptic history, surgery type (awake craniotomy, general anaesthesia), extent of resection and complications.

Results: Tumour was localized to primary motor area in most of the cases (35%, n = 14), 25 patients were operated under general anaesthesia and 15 with awake craniotomy. New deficit rate in the early post-operative period was 32.5% (dysarthria in one patient and motor deficits in 12). Karnofsky scores were ≥90 in 92.5% of the patients at the late follow-up. 31 patients were Engel I (77.5%), 5 were Engel II (12.5%) and 4 were Engel IV (10%) postoperatively.

Conclusion: Frontal LGGs are eligible to resect vigorously without persistent functional deficits. Patients with immediate postoperative complications benefit from neuro-rehabilitation. However, pre-existing speech dysfunctions are hard to recover with surgery. Surgical resection ends with favourable epileptic outcomes whereas tumour location may influence the results.

1. Introduction

Low-grade gliomas (LGGs) including tumours arising from glial cell lines pose a special concern in neuro-oncology due to their slow and continuous growth and the risk of malignant transformation for WHO Grade II tumours [1]. Neurological deficits are rare to detect at the time of diagnosis even after detailed neurocognitive tests. Main controversies amongst neurosurgeons arise about increasing the survival by the extent of surgery and adjunct therapies, and further providing a near-normal life during chronic course of the disease [2]. In this regard, factors offering an extended and safe resection gain importance in the surgical planning. This is particularly interrelated with the proximity of tumour to the eloquent structures. LGGs are reported to have predilection for invading frontal lobes [3]. The resection of tumours in the frontal lobe offers attention mainly due to the possible involvement of motor area, frontal operculum and language networks on the dominant side (mainly the frontal terminations of arcuate and inferior fronto-occipital fascicles), and supplementary motor area

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[4]. On the other hand, situation of LGGs in non-eloquent areas, even in the dominant hemisphere, may permit to perform extensive resection in the frontal lobes [5]. Surgical strategies according to tumour localization have been previously discussed for temporal lobe, frontal operculum and central area [6–8]. In the present paper, we report frontal LGGs that were operated and followed in our clinic and discuss their surgical and seizure outcomes.

2. Materials and methods

2.1. Patient population

In this study, 40 patients (18 female, 22 male) who were operated on frontal LGG at the Department of Neurosurgery, Istanbul University Cerrahpasa Medical Faculty, between 2004 and 2015 were the subject. The patients were diagnosed as WHO Grade II gliomas with different subgroups. The tumour location was designated as "frontal" denoting that it was localized in front of the central sulcus, above the sylvian fissure including the extensions to the supplementary motor area (SMA) and cingulate gyrus medially. Clinical findings of the patients are presented in Table 1.

2.2. Surgical considerations

The patients were operated awake with regard to dominance and location of the tumour in or close to eloquent areas. A neuronavigation (Medtronic Navigation Inc., USA) system was used to delineate the borders of tumours in all cases. Early cranial magnetic resonance imaging (MRI) was performed within the first 48 h of resections. Tumour removal was accepted gross total in cases with the absence of preoperative hyperintense signal abnormalities on T2-weighted fluid-attenuated inversion-recovery (FLAIR) images on the MRIs and the rest was designated as subtotal [9].

2.3. Post-operative evaluation

Tumour growth was followed by postoperative MRIs every 3 months in the first 6 months of surgery and every 6 months afterwards. Clinical and surgical results of the patients were evaluated in accordance with the presence of seizure, neurological examination, Karnofsky score and survival time. Seizure outcomes were assessed according to Engel's classification (Engel I: free of disabling seizures, Engel II: rare disabling seizures "almost seizure free", Engel III: worthwhile improvement, Engel IV: no worthwhile improvement) [10]. Karnofsky performance scale was used to assess the patients' functional status (100%: Normal, no complaints, 90%: Able to carry on normal activities. Minor signs or symptoms of disease, 80%: Normal activity with effort, <40%: Unable to care for self; requires equivalent of hospital care) [11].

Table 1
Clinical findings of the patients and lesion characteristics. DLPF: dorsolateral prefrontal, DLPM: dorsolateral premotor, MPF: medial prefrontal, PMC: premotor cortex, SMA: supplementary motor area, VLPF: ventrolateral prefrontal, VPMA: ventral premotor area.

Findings	Number of cases		
Sex			
• Male	22 (55%)		
• Female	18 (45%)		
Age (mean)	33.65 ± 11.2 years		
Symptoms			
• Headache	12 (30%)		
• Seizure	28 (70%)		
Neurological exam			
• Normal	36 (90%)		
• Motor deficit	2 (5%)		
• Language deficit	2 (5%)		
Tumour localization			
• Cingulate gyrus	4 (10%)	• PMC	5 (12.5%)
• DLPF	10 (25%)	• SMA	4 (10%)
• VLPF	7 (17.5%)	• MPF	5 (12.5%)
• VPMA	6 (15%)	• DLPM	1 (2.5%)
• Primary motor area	14 (35%)		
Preoperative antiepileptic USE	25 (62.5%)		
Lesion side			
• Left	22 (55%)		
• Right	18 (45%)		
Handedness			
• Left	0		
• Right	40 (100%)		

2.4. Statistical analysis

We used a commercially available statistical software package (SPSS version 22, IBM Corp.) for all the statistical analyses. The mean ± SD was calculated for each parameter. For all comparisons with respect to categorical variables (e.g. the difference between the surgery types over the extent of resection and the difference between total and subtotal resections with respect to seizure outcome), the nonparametric "Chi-square test" was used as a statistical method. For comparing the means such as comparing the seizure frequency before and after surgery, "one-sample *t*-test" was used. Correlation analysis was evaluated by using Fisher's exact test and the differences were considered statistically significant if p is < 0.05.

3. Results

3.1. Demographic data

40 patients were evaluated for the study. The mean age was 33.65 ± 11.2 years. All patients were right handed. 70% of the patients (n = 28) presented with seizures while 12 cases (30%) were incidentally discovered with headache being the presenting symptom. 62.5% of the patients (n = 25) were on antiepileptic medication before surgery. Most patients (90%) had normal examination before the first surgery while preoperative neurological deficits (speech deficits; n = 2, motor deficits; n = 2) were identified in 4 patients. 10 patients were re-operated due to recurrence of tumours.

The side preferences were left and right in 22 (55%) and 18 patients respectively. Tumour was localized to primary motor area in 35% (n = 14) and dorsolateral prefrontal cortex (DLPF) in 25% (n = 10) of the patients, followed by ventrolateral prefrontal cortex in 17.5% (n = 7). Ventral anterior premotor cortex (VAPM) was involved in 6 patients (15%).

Histopathological analysis revealed WHO grade II glial tumour for all patients. Oligodendroglioma was the most common pathology (52.5%), followed by oligoastrocytoma (35%), astrocytoma (10%) and pleomorphic xsantoastrocytoma (2.5%). Anaplastic transformation was observed in 3 patients (7.5%) who were re-operated due to recurrence within 1–3 years.

3.2. Surgical results

Twenty-five patients (62.5%) were operated under general anaesthesia (GA) and awake craniotomy was performed in 15 patients (37.5%). Although tumour resections were found to be total in 46.6% with awake craniotomies and 64% with GA in the first-time operations, the difference between the surgery types was not statistically significant ($p = 0{,}22$; χ^2).

Surgical outcomes of the patients are presented in Table 2. Thirteen patients (32.5%) developed new neurological deficits in the early postoperative period (dysarthria in one patient and motor