Original Article

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Outcome of Awake Craniotomy at a Tertiary Care Hospital

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Author`s Contribution

[1,3]Substantial contributions to the conception or design of the work or the acquisition, methodology, analysis,[2] Final approval of the version to be published. [4,5]Active Participation in active, [6]Drafting the work or revising it critically for important intellectual content

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ABSTRACT

Objective: To evaluate the outcomes of awake craniotomy, in terms of complications and linguistic consequences at a tertiary care Hospital.

Methodology: A prospective cohort study was done at department of Neurosurgery of PIMS Islamabad, from June 2023 to March 2023. Patients aged 18 years or above, both genders, diagnoses with brain tumors (both low and high-grade gliomas) and patients who already scheduled for Awake Craniotomy as per indications and Hospital protocols were included. Following surgery, all patients were moved to the intensive care unit for overnight assessment. During surgery, the operative time was recorded. Post-surgery, patients were monitored for neurological deficits, seizures, brain swelling, hospital stay and linguistic outcomes in terms of good, average and poor. All the relevant information was entered and analyzed via SPSS version 26.

Results: Overall average age of the patients was 47.17+5.11 years, and their mean BMI was 29.12+2.96 kg/m2. Males were 16(40.0%) and females were 24 (60.0%). None of the patients found with neurological deficits or seizures, while brain swelling was observed in 23 patients (57.5%). Linguistic outcomes were uniformly positive, with all 40 patients (100%) reporting good outcomes. Mean operative time was 5.06 ± 0.80 hours, the mean Glasgow Coma Scale (GCS) score was 13.35 ± 1.20, and the average hospital stay was 6.32+1.84 days. Furthermore the brain swelling was statistically significant according to gender and operative time (p->0.05), while it was significantly high among patients with Grade II (Oligodendrogliomas) and with grade IV as pert he WHO grading (p-0.024).

Conclusion: The awake craniotomy observed to be a reliable and easily tolerated method for brain tumor removal. Individuals who underwent this treatment reported no substantial neurological abnormalities or seizures, and almost all of the cases showed good linguistic outcomes.

Key words: Brain tumor, Awake craniotomy, Complications, Linguistic outcomes.

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Introduction

Awake craniotomy is a neurosurgical method enabling neurophysiological testing with the patient's active participation while removing a brain tumor under regional anesthesia.[1] The primary benefit of performing an awake craniotomy, as opposed to one under full sedation, is the continuous assessment of vital brain structures and functional integrity.[2] Awake craniotomy was originally introduced to treat the patients of epilepsy,[3] while over the past few decades, it has been extensively used in brain tumor resections, enabling surgeons to conduct detailed brain mapping and continuously assess the patient's neuropsychological status.[2,3] This procedure results in a more extensive resection and a reduced occurrence of neurological deficits following surgery.[4] The significance of safely resecting gliomas that invade critical brain regions is well

documented in the literature, with various techniques for intraoperative cortical and subcortical mapping having been suggested.[5,6] Considering the patient discomfort and heightened risks associated with the awake setting, such as intraoperative seizures, challenging airway management, and brain swelling or bleeding, the increasing prominence of awake surgery in surgical practice encourages ongoing discussion regarding patient selection, including both indications and eligibility criteria.[5]

The utilization of awake surgery in patients with both low and high-grade gliomas proved advantageous for removing tumors situated within functional boundaries, resulting in reduced hospital stays and lower direct expenses.[7] Gliomas stand as among the predominant primary brain tumors, comprising 75% of all malignant primary brain tumors in adults.[8] The primary course of treatment involves surgical removal, followed by radiotherapy and chemotherapy. Despite advancements in treatment, gliomas persist as incurable lesions.[8] High-grade gliomas (classified as WHO III-IV gliomas) are formidable tumors known for their dire prognosis in oncology. Following surgery and a combination of chemotherapy and radiotherapy, median survival typically falls between twelve to fifteen months, with no curative treatment currently accessible.[9] Numerous studies indicate that maximizing the extent of resection of the contrast-enhancing portion of the tumor enhances survival rates among patients with GBM.[9,10]

In patients with gliomas, survival outcomes have been shown to correlate with various factors, including the histological and molecular subtype of the tumor, age of the patients, neurological deficits presentation, Karnofsky Performance Status (KPS) score, and tumor size at diagnosis.[8,11] Furthermore, numerous studies have underscored the substantial influence of extent of resection (EOR) during surgery on survival.[8,12] However, due to controversies in the literature and a lack of sufficient local evidence, this study has been conducted to evaluate the outcomes of awake craniotomy at a tertiary care hospital. This study explores the effectiveness, safety, and patient experiences associated with awake craniotomy.

Methodology

A prospective cohort study was done at department of Neurosurgery of PIMS Islamabad. Study was conducted during a period of Nine months from June 2023 to March 2023. Patients aged 18 years or above, both genders, diagnoses with brain tumors (both low and high-grade gliomas) and patients who already scheduled for Awake Craniotomy as per indications and Hospital protocols were included. Each patient underwent a preoperative assessment by the neuropsychologist, anesthesiologist, and the neurosurgeon. A collective decision determined the patient's suitability for awake craniotomy. The inclusion criteria included a good clinical, physical, and emotional condition. Patients with pre-existing neurological deficits, psychological or medical conditions and who were not agreeing to participate in the study were excluded. Informed consent was taken from each patient after explaining the purpose of the study and patients were assured that their information will kept confidential and only used for research purpose. Anesthesia was administered by the senior anesthesiologist, utilizing standard intraoperative monitoring. The patients were supine, with their heads twisted about 45 degrees to the side. Patients were encouraged to select the most comfortable position and were given ample padding as needed. A Mayfield clamp was used to secure the head under a scalp block containing dexmedetomidine. Prior to creating the skin and dura incisions, more local anesthetic was injected along the skin incision line and between the dural sheets. During the procedure, dexmedetomidine was used to maintain sedation, and remifentanil boluses were used to manage pain. Following surgery, all patients were moved to the intensive care unit for overnight assessment. During surgery, the operative time was recorded. Post-surgery, patients were monitored for neurological deficits, seizures, brain swelling, and length of hospital stay.

Furthermore patients were evaluated for the linguistic outcomes in terms of good (Defined as: speaking fluently with few hesitations, easily understands difficult directions and conversations, successfully communicates thoughts clearly, appropriately names common items, and properly repeats statements), average (Frequent verbal hesitations but typically understandable, comprehends most directions and conversations, can repeat phrases with some difficulty, needs additional time to communicate thoughts, and has occasional trouble naming common items but performs sufficiently) and poor (Significant speech concerns include frequent hesitations, struggles with simple instructions and discussions, considerable difficulties expressing thoughts, poor performance in naming familiar items, and significant obstacles in repeating words). All the relevant information as per study objective was collected via study

Proforma and data analysis was done using SPSS version 26.

Results

Overall average age of the patients was 47.17±5.11 years, and their mean BMI was 29.12±2.96 kg/m^2. The mean duration of symptoms was 1.81 ± 0.74 years. According to gender distribution males were 16(40.0%) and females were 24 (60.0%). Regarding WHO grade of tumors, 60.0% had grade I, 15.0% had grade II (astrocytoma), 7.5% had grade II (Oligodendrogliomas) and 17.5% had high grade. Furthermore, the types of lesions and location of the tumors presented in table I.

Table I: Descriptive statistics of demographic and clinical variables. (n=40)

Variables		Statistics	
Mean age of the patient		47.17±5.11 years	
Mean BMI of patients		29.12±2.96 kg/m^2	
Mean duration of symptoms		1.81±0.74 years	
Gender	Male	16	40.0%
	Female	24	60.0%
	Total	40	100.0%
Types of lesions	Low grade glioma	18	45.0%
	Meningioma	11	27.5%
	High grade glioma	6	15.0%
	Oligodendrogliomas	3	7.5%
	Tuberculoma	1	2.5%
	Butterfly glioma	1	2.5%
	Total	40	100.0%
WHO grade of tumors	Grade I	24	60.0%
	Grade II (astrocytoma)	6	15.0%
	Grade II (Oligodendrogliomas)	3	7.5%
	High grade	7	17.5%
	Total	40	100.0%
Location of tumors	L parietal	9	22.5%
	Frontal parietal	10	25.0%
	L frontal	10	25.0%
	Occipital	3	7.5%
	Temporal	6	15.0%
	R frontal convexity	2	5.0%
	Total	40	100.0%

In terms to the outcomes none of the patients found with neurological deficits or seizures, while brain swelling was observed in 23 patients (57.5%). Linguistic outcomes were uniformly positive, with all 40 patients (100%) reporting good outcomes. Although the mean operative time was 5.06 ± 0.80 hours, the mean Glasgow Coma Scale (GCS) score was 13.35 ± 1.20, and the average hospital stay was 6.32±1.84 days as shown in table II.

Furthermore, the brain swelling was statistically significant according to gender and operative time (p->0.05), while it was significantly high among patients with Grade II (Oligodendrogliomas) and with grade IV as pert he WHO grading (p-0.024). Table III

Table II: Complications and linguistic outcomes. (n=40)

Variables			Statistics	
Complications	Neurological deficient	Yes	--	--
		No	40	100.0%
		Total	40	100.0%
	Seizures	Yes	--	--
		No	40	100.0%
		Total	40	100.0%
	Brain swelling	Yes	23	57.5%
		No	17	42.5%
		Total	40	100.0%
Linguistic outcomes		Good	40	100.0%
		Average	--	--
		Poor	--	--
		Total	40	100.0%
Operative time			5.06±0.80 hours	
Mean GCS score			13.35±1.20	
Mean Hospital stays			6.32±1.84 days	

Table III: Brain swelling according to gender, operative time and WHO grade of lesion. (n=40)

Variables		BRAIN SWELLING Yes	No	Total	p-value
GENDER	Male	11	5	16	0.240
		27.5%	12.5%	40.0%	
	Female	12	12	24	
		30.0%	30.0%	60.0%	
OPERATIVE TIME	≤4Hours	6	6	12	0.573
		15.0%	15.0%	30.0%	
	5 hours	9	4	13	
		22.5%	10.0%	32.5%	
	≥6 hours	8	7	15	
		20.0%	17.5%	37.5%	
WHO GRADE	Grade I	13	11	24	0.024
		32.5%	27.5%	60.0%	
	Grade II (Astrocytoma)	3	3	6	
		7.5%	7.5%	15.0%	
	Grade II (Oligodendrogliomas)	0	3	3	
		0.0%	7.5%	7.5%	
	Grade IV	7	0	7	
		17.5%	0.0%	17.5%	

Discussion

Awake craniotomy is a neurosurgical method enabling neurophysiological testing with patient cooperation while respecting a brain tumor under regional anesthesia. This technique helps identify and preserve critical functional brain areas during surgery. This study was conducted on 40 patients to evaluate the outcomes of awake craniotomy, focusing on complications and linguistic results. The average patient age was 47.17±5.11 years, their mean BMI was 29.12±2.96 kg/m^2 with a slight female predominance, as 24 patients (60.0%) were females. In comparison to other studies, Bakhshi SK et

al[13] reported a mean patient age of 45.8 ± 10.5 years, and Moniz-Garcia D et al[14] found a mean age of 49.9 ± 15.7 years, with a male majority of 60%. However, Lai YM et al[15] reported an average patient age of 39 ± 12 years and a slight male predominance of 56%. Staub-Bartelt F et al[16] found mean age of patients underwent Awake craniotomy was 55 years, females 21 and males were 14 out of 35 patients. The gender differences observed in our study compared to others may be attributed to significant variations in the sample sizes of these studies.

In this study regarding WHO grade of tumors, 60.0% had grade I, 15.0% had grade II (astrocytoma), 7.5% had grade II (Oligodendrogliomas) and 17.5% had high grade. In the comparison of this study Bakhshi SK et al[13] reported that the out of 17 patients, eleven had grade I meningioma, while six had grade II meningioma. However, Zele T et al[1] reported that the gross total resection was achievable in 60% (6 out of 10) of malignant glioma cases and in 29% (4 out of 14) of low-grade glioma cases.

In this study, none of the patients experienced neurological deficits or seizures, while brain swelling was observed in 23 patients (57.5%). Brain swelling was not statistically significant with respect to gender and operative time ($p > 0.05$) but was significantly high among patients with Grade II (Oligodendrogliomas) and with grade IV as pert he WHO grading (p-0.024). Comparatively, Kwinta BM et al[17] reported intraoperative seizures in 4 cases (16%) and postoperative seizures in 2 cases (8%). Zanello M et al[18] observed early postoperative seizures in 7.9% of patients, with an average onset of 5.1 ± 2.9 days post-surgery. Nossek E et al[19] found that 60 patients (12.6%) experienced intraoperative seizures, and the awake craniotomy procedure failed in 11 patients (2.3%) due to these seizures. The discrepancies in findings across studies may be attributed to differences in sample sizes, follow-up durations, disease severity, nature of disease and the surgeons' experience.

In this study the mean operative time was 5.06 ± 0.80 hours, the mean Glasgow Coma Scale (GCS) score was 13.35 ± 1.20, and the average hospital stay was 6.32±1.84 days. Consistently Bakhshi SK et al[13] demonstrated that the post-operative average Hospital stay was 3.1 ± 1.3 days and average operative time was 180.8 ± 36.2 minutes which was slightly lower compared to this study. Furthermore, in their study one case had a prolonged hospital stay of seven days, due to the post-operative seizures,[13] and in this study no any cases with seizures was noted during hospital stay. The discrepancies in results may be attributed to differences in patient populations, surgical techniques, and perioperative care protocols etc.

In this study according to the linguistic outcomes were uniformly positive, with all 40 patients (100%) reporting good outcomes. In aligns to this study Bonifazi S et al[9] reported that following surgery, 80% of patients experienced no changes in linguistic functions. However, around 50% of patients exhibited minor impairments in memory and executive functions. The one-year survival rate was 89%.[9] According to another study by Kwinta BM et al[17] reported that the most frequent postoperative complication was the development of a new language deficit, which was observed in 10 cases (40%) and became permanent in one case (4%). After surgery, linguistic functions remained unchanged in 80% of patients and approximately 50% of patients experienced minor impairments in memory and executive functions. This study indicates the procedure did not result in significant complications neurological deficits or seizures, with the majority of patients demonstrating favorable linguistic outcomes. However, the findings cannot be deemed conclusive due to limitations such as the small sample size and the lack of extended follow-up. Therefore, further large-scale studies are recommended to validate these results.

Conclusion

As per the finding, the awake craniotomy observed to be a reliable and easily tolerated method for brain tumor removal. Individuals who underwent this treatment reported no substantial neurological abnormalities or seizures, and almost all of the cases showed good linguistic outcomes. The high rate of brain swelling seen was controlled and had no meaningful impact on the overall safety of the surgery. The awake craniotomy approach enables precise identification and preservation of essential functional brain areas, which contributes to its efficacy and excellent patient outcomes. However further large-scale studies are recommended to prove the findings.

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