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Original Article

# Comparison of Awake Craniotomy with Craniotomy Under General Anesthesia for Resection of Tumors in Eloquent Areas of Brain

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## ABSTRACT

***Objective***: To compare awake craniotomy with craniotomy under general anesthesia for early post-operative parameters in patients undergoing resection of tumors in eloquent areas of brain.
***Study Design***: Quasi experimental study.
***Place and Duration of Study***: Department of Anesthesia, Combined Military Hospital, Rawalpindi Pakistan Apr 2021 to May 2022.
***Methodology***: All the patients who underwent resection surgeries for brain tumors in eloquent areas of brain were included in the study. They were divided into two Groups via lottery method. Group A underwent awake craniotomy while Group B underwent craniotomy under general anesthesia. Relevant intraoperative and early post-operative parameters were compared in both the Groups.
***Results***: A total of 60 patients who underwent resection of eloquent area brain tumors in our hospital during the study period were included in the final analysis. Out of these 40(66.7%) underwent craniotomy under general anesthesia while 20(33.3%) underwent awake craniotomies. Mean age of the study participants was 45.61±7.889 years. Frontal lobe tumors were the most encountered brain tumors in our study participants. Patients who underwent awake craniotomy had statistically significantly lower KORNAFSKY score, lesser days of post-operative admission days and lesser neurological deficits ($p$-value <0.005) as compared to those who underwent craniotomy under general anesthesia.
***Conclusion***: Awake craniotomy emerged as superior option as compared to craniotomy under general anesthesia in terms of early post-operative parameters. Lower KORNAFSKY score, lesser days of post-operative admission days and lesser neurological deficits were seen in patients undergoing awake craniotomy.

**Keywords**: Awake craniotomy, Brain tumors, General anesthesia.

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## INTRODUCTION

Sub specialties of anesthesiology are evolving with passage of time and this is becoming a very sophisticated specialty.[1] Patients undergoing surgeries of sensitive and vital regions are usually high risk and require more attention of treating team before, during and after the surgery.[2] Neurosurgeries are very delicate surgeries and require highly specialized setting and expertise with regards to anesthesia as well.[3] With increase in trauma and diagnosis of head and neck lesions, number of neurosurgeries is on a rise in all parts of the word.[4] Various new modalities are introduced in anesthesiology to help the surgeon perfume these surgeries in smoother way with better results.[5] Awake craniotomies are done in well-equipped centers across the globe with promising results.[6] Anesthetists should be trained in this relatively newer away in order to provide better service to treating team.

Studies have been performed in recent past in order to compare traditional craniotomy under general anesthesia and awake craniotomy. A recent study performed in India on same topic revealed that tumor excision and neurological outcome was better in patients managed with awake craniotomy while blood loss and operative time was less in patients who underwent craniotomy under general anesthesia.[7] A case control study was published in 2019 regarding awake craniotomy versus craniotomy under general anaesthesia without surgery adjuncts for supra-tentorial glioblastoma in eloquent areas of brain. It was concluded that greater extent of resection and less late minor postoperative complications were seen in patients undergoing awake craniotomy as compared to those undergoing procedure under GA.[8] Zhang *et al*. published a meta-analysis of 14 studies in which 278 patients were evaluated. They came up with the

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conclusion that awake craniotomy is a viable option for surgical management of glioblastoma as it was associated with good resection rate and lesser neurological complications.[9] Availability of expertise and heterogeneity in available data still make routine use of this procedure debatable and both the types have been in practise.

Neurosurgery and anesthesia for specialized neurosurgeries, both are evolving field with limited experts and equipment available in our part of the world. Post-operative success and recovery depends a lot on teamwork between surgeon and anesthetists. Good teamwork leads to early recovery and lesser complication which is not only beneficial for the patients but also for health care system of a developing country with limited budget. Awake craniotomies have been performed in few tertiary care centers of our country. A recent study published from Karachi highlighted the benefits of awake procedure in comparison with traditional procedure under GA.[10] Limited local data has been available regarding this relatively novel procedure so we planned this study with the rationale to compare of awake craniotomy with craniotomy under general anesthesia for resection of tumors in eloquent areas of brain.

## METHODOLOGY

The quasi-experimental study was conducted at department of surgery and anesthesia at Combined Military Hospital, Lahore from Apr 2021 to May 2022. Sample size was calculated by using the WHO sample size calculation by using the population prevalence proportion of fresh neurological deficits after awake craniotomy as 10%.[11] Non probability consecutive sampling was used to gather the sample.

**Inclusion Criteria**: Patients of both the genders between the age of 18 and 60 years who were diagnosed with tumors in eloquent areas of brain and underwent craniotomy at our hospital during the study period.

**Exclusion Criteria**: Patients with any contraindications to any of the procedures included in the study. Those who after description of study refused to undergo any one type of craniotomy and chose themselves one type were also not made part of the study. Those with multiple tumor focuses or metastatic disease were also excluded from the study. Those undergoing emergency procedures were excluded.

Ethical approval was taken from the ethical committee of hospital via letter no 232/5/22. Patients who agreed for participation in the study after written informed consent were included in the study. Tumor workup, diagnosis and management plan was already devised by neurosurgery team after multidisciplinary team meeting. Patients after application of criteria were randomly divided into two Groups via lottery method (Figure). Awake craniotomy was performed undertrained anaesthetist who had prior training and experience of this procedure and it was done by set protocol.[12] Craniotomy under general anaesthesia was performed as per traditional way and patient had monitoring by consultant anaesthetist throughout the procedure.[13] Patients were followed up for two weeks to look for early and short-term complications in both the Groups, specifically side effects related to neurosurgical procedure.

Statistical analysis was done by Statistical Package for social Sciences (SPSS 24.0. Frequency and percentage were calculated for the qualitative variables whereas mean and standard deviation was calculated for the quantitative variables like age and duration of hospital stay. Chi-square and Fischer exact test was used to look for the difference in parameters like wound infection, neurological deficits, KORNAFSKY score, and duration of hospital stay. The *p*-value less than or equal to 0.05 was considered significant.

## RESULTS

A total of 60 patients who underwent resection of eloquent area brain tumors in our hospital during the study period were included in the final analysis. Table-I summarized the general characteristics of study participants. Out of these 40(66.7%) underwent craniotomy under general anesthesia while 20(33.3%) underwent awake craniotomies. Mean age of the study participants was 45.61±7.889 years. Frontal lobe tumors 30(50%) were the most encountered brain tumors in our study participants followed by insular 15(25%) and parietal region tumors 8(13.3%). 07(11.6%) had post-operative infection, 17(28.3%) had neurological deficits, 02(3.3%) had seizures while 06(10%) patients had post craniotomy headache. Table-II summarized the findings of statistical analysis. It was revealed that patients who underwent awake craniotomy had statistically significantly lower KORNAFSKY score (*p*-value-0.005), lesser days of post-operative admission days (*p*-value-0.007) and lesser neurological deficits (*p*-value<0.001) as compared to those who underwent craniotomy under general anesthesia while chances of post-operative infection were not statistically significantly different in both the Groups (*p*-value-0.225).

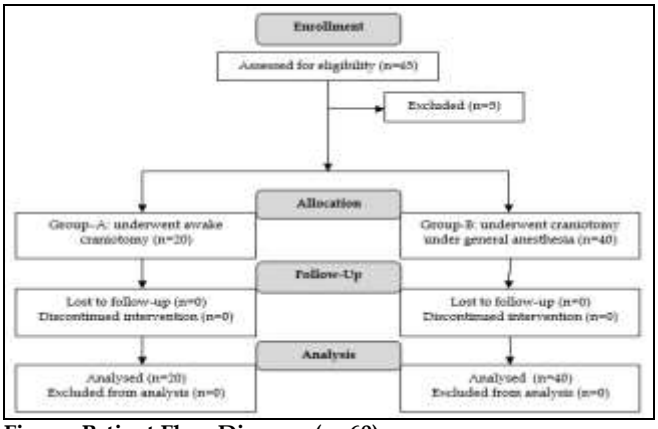


**Figure: Patient Flow Diagram (n=60)**

**Table-I: Characteristics of Patients with Brain Tumors (n=60)**

| Parameters | n(%) |
|---|---|
| **Age (years)** | |
| Mean+SD | 45.61±7.889 years |
| Range (min-max) | 18 years - 56 years |
| **Gender** | |
| Male | 40(66.7%) |
| Female | 20(33.3%) |
| **Side** | |
| Left | 39(65%) |
| Right | 21(35%) |
| **Areas of Brain** | |
| Frontal | 30(50%) |
| Insular | 15(25%) |
| Occipital | 1(1.6%) |
| Parietal | 8(13.3%) |
| Temporal | 04(6.7%) |
| Others | 02(3.3%) |
| **Post-operative Complications** | |
| Infection | 07(11.6%) |
| Neurological deficits | 17(28.3%) |
| seizures | 02(3.3%) |
| post craniotomy headache | 06(10%) |
| Others | 02(3.3%) |

**Table-II: Difference in various Post-Operative Parameters in both the Groups (n=60)**

| Factors | Awake craniotomy (n=20) | Craniotomy under General Anaesthesia (n=40) | *p*-value |
|---|---|---|---|
| **KARNOFSKY Score** | | | |
| <80 | 01(5%) | 14(35%) | 0.005 |
| >80 | 19(95%) | 26(65%) | |
| **Length of Hospital stay** | | | |
| <7 days | 18(90%) | 23(57.5%) | 0.007 |
| >7 days | 02(10%) | 17(42.5) | |
| **Post-Operative Infection** | | | |
| No | 19(95%) | 34(85) | 0.225 |
| Yes | 01(5%) | 06(15%) | |
| **Neurological Deficits** | | | |
| No | 20(100%) | 23(57.5%) | <0.001 |
| Yes | 00(0%) | 17(42.5%) | |

## DISCUSSION

Patients who underwent awake craniotomy had better results as compared to those who underwent craniotomy under general anesthesia for resection of tumors in eloquent areas of brain. Recent advances in anaesthesia techniques have revolutionized the field of surgery and difficult procedures are now done with better results.[12-14] Neurosurgical procedures have always been challenging for anaesthesia team and especially when they involve tumors in eloquent areas of brain. Awake surgeries have been in practice for quite a few years now especially in well-established neurosurgical institutes with trained anesthesia teams. Developing countries are also evolving in this aspect and we conducted this study with an aim to compare of awake craniotomy with craniotomy under general anesthesia for resection of tumors in eloquent areas of brain. Li *et al*. in 2021 published merits of Awake Craniotomy for Glioblastoma in the Left Hemispheric Eloquent Area of brain. They came up with the findings that Karnofsky Performance Score and extent of resection were better in awake craniotomy Group and so was overall survival.[15] Our results supported the findings generated by Li *et al*. Our limitation was that we did not follow up patients for long to look for better long-term survival rate in both the Groups.

A French study was published in 2021 regarding feasibility, safety, and efficacy of awake resection in adult patients suffering from glioblastoma. They revealed that awake method was clearly superior to craniotomy under general anaesthesia in terms of extent of resection, safety and overall survival.[16] Our results demonstrated that awake craniotomy was a superior option as compared to craniotomy under general anaesthesia in terms of early post-operative parameters. Lower KORNAFSKY score, lesser days of post-operative admission days and lesser neurological deficits were seen in patients undergoing awake craniotomy. Eseonu *et al*. in 2017 evaluated the differences between awake craniotomies vs surgery under GA for resecting perirolandic, eloquent, motor-region gliomas.[17] They concluded that better KORNAFSKY score, and lesser days of post-operative admission days were observed in patients undergoing awake procedures. Peri-operative complications were equal in both Groups. In our study infection rate was not different in both the Groups but neurological deficits were seen less in patients undergoing awake procedures as compared to those undergoing craniotomies under general anaesthesia. Natalini *et al*.

in 2020 published a systematic review and meta-analysis with an objective to compare Asleep-Awake-Asleep Technique and monitored anaesthesia care during awake craniotomy. It was revealed that monitored anaesthesia care during awake craniotomy was better than Asleep-Awake-Asleep Technique in terms of failure rates, length of procedure and post-operative seizures.[18] Our study was slightly different as we compared awake procedure with procedure under general anaesthesia for short term outcome parameters and found awake procedure better than procedure under GA for resection of brain tumours in eloquent areas of brain.

## LIMITATION OF STUDY

It was a single center study which is a tertiary care teaching neurosurgery and anesthesia unit so results can't be generalized for all the settings of our country. Patients were just followed up for a week therefore long-term consequences and their relationship with type of anesthesia technique could not be established with current study design.

## CONCLUSION

Awake craniotomy emerged as superior option as compared to craniotomy under general anesthesia in terms of early post-operative parameters. Lower KORNAFSKY score, lesser days of post-operative admission days and lesser neurological deficits were seen in patients undergoing awake craniotomy.

**Conflict of Interest:** None.

**Authors' Contribution**

Following authors have made substantial contributions to the manuscript as under:

WA & FHF: Data acquisition, data analysis, data interpretation, critical review, approval of the final version to be published.

MS & BY: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

MUK & WT: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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