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Evaluation of Perioperative Experiences of Patients Undergoing Awake Craniotomy: A Retrospective, Observational Study

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ABSTRACT

AIM: To evaluate the satisfaction and experiences of patients who underwent awake craniotomy, a relatively uncommon procedure.

MATERIAL and METHODS: Following institutional ethics committee approval, data from 60 patients who underwent awake craniotomy between January 2019 and September 2023 were retrospectively analyzed in this observational study. Demographic data, perioperative experiences, overall satisfaction levels, and patient recommendations were collected using surveys and retrospective evaluations. The data were analyzed using statistical methods.

RESULTS: The study revealed that most patients (93.3%) were satisfied with their communication with the surgical team, with 98.3% indicating that they received adequate information regarding anesthetic and surgical procedures. However, 21.7% perceived the written informational materials as insufficient.

CONCLUSION: These findings emphasize the necessity of a patient-centered approach throughout the surgical pathway, suggesting that comprehensive information and support systems can enhance patient experience. Furthermore, awake craniotomy can be successfully performed through close collaboration within a multidisciplinary team that prioritizes patient comfort and reassurance. However, improvements are needed in the quality of written informational materials and in reducing the discomfort associated with local anesthetic injections.

This study expands the existing evidence base by presenting patient-centered data on awake craniotomy practices in Turkey, highlighting the need for standardization and quality improvement initiatives aimed at optimizing patient experience.

KEYWORDS: Awake craniotomy, Tumor surgery, Patient experiences, Information, Satisfaction

ABBREVIATIONS: ASA: American Society of Anaesthesiology

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INTRODUCTION

Awake craniotomy is defined as an intracranial open surgical procedure in which the patient remains awake throughout all or part of the operation. It is regarded as the gold standard for resecting low-grade gliomas located in eloquent brain regions, as it allows for maximal tumor removal while preserving neurological function (6).

The primary objective of awake craniotomy is to preserve the patient's neurological integrity, including motor, sensory, and cognitive functions, during surgery (6). Patient's experiences of the surgical process play an important role in overall satisfaction and postoperative rehabilitation. However, there are few studies on patients' experiences of awake craniotomy. Most published studies included small cohorts, and while the necessity of a multidisciplinary approach is well recognized, the contribution of patient-centered feedback on optimizing these protocols requires further investigation.

This study evaluated the perioperative experiences, satisfaction, and recommendations of patients undergoing awake craniotomy at a tertiary care hospital. The findings are intended to contribute to the development of patient-centered surgical practices and improve the overall surgical process.

MATERIAL and METHODS

This retrospective observational study included patients who underwent awake craniotomy surgery at a tertiary care hospital between January 2019 and September 2023. Ethical approval was obtained from the Hacettepe University Health Sciences Research Ethics Committee prior to the commencement of the study SBA 23/309, 07.11.2023).

Eligible participants were patients who had undergone awake craniotomy and provided informed consent to participate. Patients who had succumbed, whose contact information could not be obtained, had communication barriers (such as hearing

loss, aphasia, or dementia) or declined participation were excluded. During the study period, 60 patients met the eligibility criteria and consented to participate (Figure 1).

Demographic information, pre- and postoperative experiences, and overall patient satisfaction were retrospectively assessed using medical records and telephone surveys. Survey results were recorded and analyzed statistically.

In our clinic, patients scheduled for awake craniotomy routinely undergo multiple face-to-face consultations. Once awake craniotomy is planned, the operating surgeon and anesthesiologist provide verbal and written information about the operation during the preoperative period, with additional verbal counseling on the day before surgery. All awake craniotomy procedures are conducted in our clinic according to a standardized protocol. The anesthesia protocol consisted of monitored anesthesia care. Sedation was achieved using propofol and dexmedetomidine infusions. In accordance with standard American Society of Anaesthesiology (ASA) monitoring, a bilateral six-point scalp block involving the supratrochlear, supraorbital, zygomaticotemporal, auriculotemporal, lesser occipital, and greater occipital nerves was performed. The scalp block was administered using 40 ml of local anesthetic (2 mg/kg 2% prilocaine and 2.5 mg/kg 0.5% bupivacaine) with a 22-gauge needle. An asleep-awake-asleep/monitored anesthesia care technique was used for all patients during awake craniotomy and scalp block. All patients underwent awake craniotomy in the park-bench position.

During surgery, bipolar cortical and unipolar subcortical mapping was performed in all patients using a constant-current neurostimulator (1–4 mA, 60 Hz, 4 μ s pulse width). Functional monitoring included standardized assessments of motor, language, and speech functions, incorporating spontaneous and dual-task paradigms, picture naming, the Pyramid and Palm Trees Test, formal aphasia assessment, and selected components of the Mini-Mental State Examination. Intraoperatively, if the patients experienced pain due to prolonged positioning, analgesia was administered using intravenous paracetamol, non-steroidal anti-inflammatory drugs, or dexmedetomidine infusion, as appropriate.

Following hospital discharge, patients were contacted by phone to complete a survey. The survey instrument was a non-validated, custom-designed questionnaire developed by the authors based on previously published literature and comprised both multiple-choice and open-ended questions. Responses were evaluated using a descriptive scoring system. The mean interval between surgery and survey administration was 415 days (range, 70–1351 days).

Statistical Analysis

Statistical analyses were performed using IBM SPSS 27.0 software. Continuous variables are expressed as mean $\pm$ SD, whereas percentage and frequency analyses were performed for categorical variables. The Student's *t* test was employed for normally distributed continuous variables, while the Mann-Whitney *U* test was used for non-normally distributed data. Categorical variables were compared using the chi-square test (χ^2) or Fisher's exact test, as appropriate.

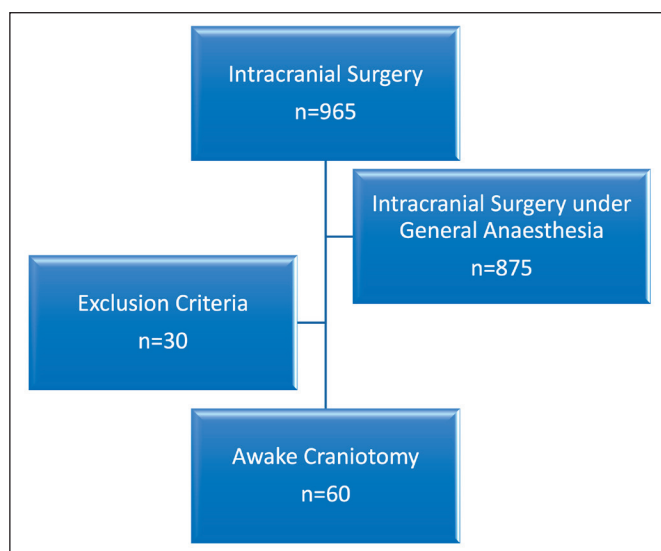


Figure 1: Flowchart of patient selection between January 2019 and September 2023.

■ RESULTS

This study included 60 patients, comprising 45 (75%) males and 15 (25%) females with a mean age of 44 ± 15.4 years (range, 14–81 years). Based on the ASA classification, 52 patients (86.7%) were classified as ASA class II, while 8 (13.3%) were classified as ASA class III.

The primary indications for awake craniotomy were low-grade glioma (68.3%), high-grade glioma (23.3%), metastatic tumor (6.7%), and epilepsy (1.7%). Comorbidities were present in 48.3% of patients, including hypertension in 11 (18.3%), additional malignancy in 4 (6.7%), diabetes in 3 (5%), hypothyroidism in 2 (3.3%), rheumatologic disease in 2 (3.3%), and other medical conditions in 7 (11.7%).

All patients remained cooperative throughout the surgery, and none required conversion to general anesthesia intraoperatively. Additionally, no patient experienced nausea or vomiting intraoperatively.

Most patients (86.7%, $n=52$) reported being adequately involved in surgical decision-making with their physicians, while 1.7% ($n=1$) felt insufficiently involved, and 11.7% ($n=7$) could not recall the process.

Similarly, 83.3% ($n=50$) of patients agreed that they had sufficient time to discuss their questions and concerns with their physicians before surgery, while 1.7% ($n=1$) disagreed and 15% ($n=9$) could not remember the process.

Overall, 93.3% ($n=56$) described the treating physician as friendly and sincere, which made them feel comfortable, whereas 5% ($n=3$) reported that the consultation did not influence their emotional state.

Nearly all patients (98.3%, $n=59$) reported receiving adequate information about the procedure. However, 21.7% ($n=13$) reported not receiving written information during or after the outpatient clinic visit explaining that the surgery would be performed while they were awake. In addition, 8.3% ($n=5$) considered the written material inadequate, whereas 36.7% ($n=22$) could not recall receiving any such material. The interval between the time of surgery and survey completion was not significantly associated with the patients' inability to recall receiving written information ($p=0.118$).

Consultation with the Anesthesiologist and Patient Confidence

Almost all (98.3%) patients reported meeting with the anesthesiologist preoperatively and receiving information about the procedure. Most patients ($n=48$, 80%) perceived the anesthesiologist as friendly and courteous, while 12 (20%) stated that the consultation had no effect on their emotional state. A total of 51 patients (85%) reported that the anesthesiologist adequately explained the awake craniotomy procedure.

Furthermore, 52 patients (86.7%) reported having sufficient time during the consultation with the anesthesiologist to clarify further questions and problems, while 2 (3.3%) found the consultation time insufficient, and six (10%) could not remember the encounter.

Following discussions with the surgical team, 98.3% of patients understood the rationale for awake craniotomy, and 52 patients (86.7%) expressed confidence that they would receive appropriate care during surgery.

Preoperative Concerns

The most common preoperative concerns were death, postoperative neurological sequelae, inadequate tumor removal, intraoperative pain, and remaining awake during surgery. There was no significant difference between male and female patients in terms of concerns regarding death, disability, or incomplete tumor removal ($p=0.881$, $p=0.224$, and $p=0.095$, respectively).

Experiences with Local Anesthesia and Operating Room Recall

Before surgery, 32 patients (53.3%) were aware that local anesthetic would be administered through multiple scalp injections, whereas 21 (35%) patients were unaware, and 7 (11.7%) could not recall this information. No significant association was observed between surgery-to-survey interval and patients' recall of this information ($p=0.982$). Fourteen patients (23.3%) described the injection of the local anesthetic as very unpleasant, with no significant sex difference (26.6% ($n=4$) in females vs. 22.2% ($n=10$) in males; $p=0.406$).

Regarding intraoperative recall, 30% of patients remembered most of their time in the operating room, 61.7% remembered only a small portion, and 8.3% stated that they had no recollection.

While 95.6% of male patients recalled (some or most of) the time spent in the operating room, this rate was 80% for female patients ($p=0.074$). The mean age of patients who remembered most, some, and none of their time in the operating room was 45.1 ± 17.5 years, 44.3 ± 14.8 years, and 37.2 ± 12.5 years, respectively ($p=0.593$).

Thirty-one patients (51.7%) recalled the local anesthetic injection before surgery, 4 patients (6.7%) recalled the sound of the drill after the surgery had begun, 40 patients (66.7%) recalled the naming of various objects, and 2 (3.3%) recalled experiencing pain. Overall, 91.7% of patients reported feeling comfortable during the operation.

Twelve patients (20%) reported pain or discomfort during surgery. Among them, 5 patients (41.7%) described stabbing pain, 3 (25%) burning pain, and 2 (16.7%) reported feeling cranial fixation pins and skin closure sutures, while one patient reported pain during skin closure. Seven (58.3%) of these patients reported that their discomfort was relieved following intervention, 3 (25%) received no intervention, and 2 (16.7%) reported persistent discomfort despite the intervention. Pain or discomfort during surgery was not associated with sex or ASA class ($p=1.000$ for both), and the mean age was comparable between patients with and without pain or discomfort (44.5 ± 12.9 years vs. 43.8 ± 16.1 years, $p=0.892$). Overall, 71.7% of patients stated that the anesthesiologist helped them feel comfortable during the procedure, while 28.3% could not recall the experience.

Postoperative Experience and Discharge

Forty-three patients (71.1%) reported pain in the recovery room or on the ward after the surgery, 11 patients (18.3%) reported no pain, and 6 patients (10%) could not remember it. The prevalence of postoperative pain was comparable between female and male patients (81.8% vs. 79.1%, $p=1.000$) and between ASA class-II and ASA class-III patients (80.9% vs. 71.4%, $p=0.621$).

In the postoperative period, 25 patients (41.7%) experienced nausea. Although the incidence of nausea was higher in men, the difference was not statistically significant ($p=0.378$). Similarly, postoperative nausea was not associated with age or ASA class ($p=0.622$ and $p=0.703$, respectively).

All patients were discharged at least 3 days after surgery. Two (3.3%) patients considered their discharge premature, whereas 3 (5%) considered their hospital stay longer than necessary.

Magnetic resonance imaging was performed on all patients within the first 72 hours after surgery, and the extent of resection was evaluated. Residual disease was identified on imaging in 30% of patients ($n=18$). Abnormal motor examination findings were observed in 17% of patients ($n=10$) during the same period; however, long-term follow-up was not available. Patients with speech disorders were excluded from the study.

Post-Discharge Support and Overall Evaluation

Forty-six patients (76.7%) reported feeling well supported by the hospital after discharge, whereas 14 patients (23.3%) did not. The proportion of patients who did not feel adequately supported by the hospital after discharge was significantly higher among females than males ($p=0.030$). The mean age of patients who did not feel adequately supported by the hospital after discharge was 49.5 ± 16.8 years, while the mean age of those who felt adequately supported was 42.3 ± 14.7 years ($p=0.125$).

Forty-six patients (76.7%) reported having a positive recollection of their awake surgery experience. Eight (13.3%) patients described their experience as unpleasant but were nevertheless satisfied with having undergone awake surgery, whereas 2 patients reported regretting the procedure.

When asked for suggestions to improve the experience for future patients, 5 patients recommended eliminating pain during surgery, 4 felt that being awake should be made less distressing, 3 suggested better adjustment of the surgical position, and 2 recommended minimizing discomfort from the initial scalp injections.

When asked about their worst experiences with awake surgery, patients frequently cited receiving local anesthetic injections ($n=16$), being awake during surgery ($n=15$), and prolonged positioning ($n=12$). Less commonly reported were remembering the surgery ($n=2$), the presence of too many people in the operating room ($n=1$), and postoperative vomiting ($n=1$).

DISCUSSION

This study evaluated the perioperative experiences, satisfaction, and recommendations of patients who underwent awake craniotomy. Most patients reported high satisfaction with their communication with the surgical and anesthesia teams, felt adequately informed about the procedure, and were involved in treatment decisions. These results are consistent with previous studies and reflect the effectiveness of the patient-centered approach and multidisciplinary approach adopted at our center. However, concerns regarding inadequate written informational materials, discomfort during local anesthetic injection, and limited post-discharge support reveal crucial areas for improving the patient experience.

In a survey by Goebel et al. in 2010, 96% of patients rated the preoperative preparation for awake craniotomy as “excellent” (2). Similarly, in the multicenter survey by Beez et al. involving 105 patients from five centers, 94.9% considered the preoperative preparation adequate (1). In a survey by Wahab et al. that investigated the perioperative status of 45 patients who underwent surgery between 2006 and 2010, 42 patients (93.3%) felt sufficiently involved in the decision-making process for awake craniotomy and had sufficient time to address their questions and concerns (8). Similarly, 86.7% of patients in our study reported being sufficiently involved in treatment decisions, suggesting that the decision-making process for awake craniotomy was conducted through effective patient-physician collaboration.

In our study, 50 patients (83.3%) reported having enough time to address their main questions and problems, while 9 patients could not remember this aspect. Although 98.3% of the patients stated that they were adequately informed during the outpatient clinic visit, 22 patients could not recall whether they had received written material, and 13 were certain they had not. As written information material is routinely provided during outpatient visits, the local recall rate (41.6%, $n=25$) is likely attributable to the retrospective design of this study. However, no statistically significant difference was found when the patients who recalled receiving written material and the other patients were compared in terms of the interval between surgery and survey completion.

In a survey by Tan et al. involving 18 Asian patients, all participants reported that the anesthesiologist visited them before surgery (7). In our study, all but one patient reported a preoperative anesthesiologist visit, and 40 expressed satisfaction with this visit. Overall, 96.7% of patients felt that this visit was of sufficient duration. The preoperative anesthesia visit is an essential component of any surgical procedure, particularly for awake craniotomy, where patients may experience greater anxiety about both the surgery and anesthesia. In this context, patients should get to know their anesthesiologists preoperatively, to whom they will confide during the procedure, and build a relationship of trust, which will contribute to a more successful management of the procedure.

Thirty-five percent ($n=21$) of patients indicated having no prior knowledge of scalp block injections, and 14 (23.3%) described the injections as a “very bad experience.” In our study,

female patients found local anesthetic injections more uncomfortable than male patients, which may be related to greater pain sensitivity or higher levels of anxiety. These findings suggest that patients should receive more detailed preoperative information regarding scalp block and its application and that the scalp block should be applied carefully to each patient. Although scalp blocks are typically performed under sedation, the high rate of discomfort (23.3%) suggests a need for deeper sedation levels or refinement of local anesthetic techniques during this phase of the procedure.

During the preoperative period, patients' main fears included death, neurological sequelae, inadequate tumor removal, pain during the surgery, and being awake during the operation. It is likely that providing patients with lesions in functional brain regions with adequate information about the procedure may reduce their fear of postoperative neurological sequelae.

Similar to previous studies, 30% of our patients remembered most of the time spent in the operating room, and 61.7% remembered only a small part of it (4).

In our study, 91.7% of patients felt comfortable during the operation, although some experienced an acceptable level of pain or slight discomfort. In a survey study conducted by Leon-Rojas et al., involving 38 patients, 8 (21%) reported feeling pain during surgery (5). In our study, 12 patients reported pain or discomfort during surgery. Of these, 7 reported that their discomfort was relieved by the anesthesiologist's intervention, 3 reported that no intervention was performed, and 2 reported persistent discomfort despite intervention. In another similarly designed study, 26.7% of patients experienced discomfort during surgery. One patient stated that the discomfort persisted until the end of the procedure (8).

In our study, 71.7% of patients reported having a very good relationship with their anesthesiologists during surgery, while 28.3% could not remember this aspect. None of the patients made negative comments, indicating that the intra-operative patient-anesthesiologist relationship was generally positive. This result highlights the importance of establishing good rapport with patients undergoing awake craniotomy.

All patients were discharged at least 3 days after surgery. Two patients (3.3%) felt that they were discharged too early, while 3 patients (5%) felt that they were discharged too late. Overall, 55% of patients were satisfied with the timing of discharge. In a similarly designed study, 8.8% of patients felt that they were discharged too early, and 6.6% felt that they were discharged too late (8).

Collectively, 76.7% of patients indicated receiving adequate support from the hospital after discharge, whereas 14 (23.3%) felt that they were not adequately supported. Notably, dissatisfaction with post-discharge support from the hospital was significantly higher among female than male patients. This may reflect differences in expectations of healthcare services or greater post-operative care needs among female patients. As similar results have not been reported in the literature, future studies should assess post-discharge care based on sex. In the study by Wahab et al., which assessed post-discharge

support without sex-based analysis, 80% of patients were satisfied with the support they received (8).

Similar studies have described awake craniotomy as a generally acceptable surgical experience for patients (1,3,4,8). In our study, most patients (76.7%) had a positive recollection of the awake craniotomy experience. Eight patients (13.3%) described it as a negative experience despite being satisfied with the overall process, whereas 2 patients (3.3%) regretted undergoing awake craniotomy. This high acceptance rate suggests that, in experienced hands, awake craniotomy is an appropriate option for carefully selected patients.

To improve the experience of future patients, patients were asked an open-ended question about their recommendations for awake craniotomy. Their suggestions included minimizing pain, reducing discomfort associated with being awake, improving surgical positioning, and preventing discomfort during scalp block injections. When asked about the "worst" experiences of the patients, the following were mentioned: Scalp block injections, being awake during surgery, prolonged positioning, remembering the operation, too many people in the operating room, and post-operative nausea and vomiting. To our knowledge, no other publication has explored these topics using open-ended patient responses. We believe that incorporating these recommendations into routine clinical practice may improve the patient experience of awake craniotomy.

The main limitation of the study is the interval between the surgery and survey administration. Conducting such surveys during the early postoperative follow-up periods would likely provide more accurate data.

CONCLUSION

In our study, we aimed to improve the awake craniotomy process through a patient-centered approach by evaluating patient experience and satisfaction in our tertiary care hospital. Our results demonstrated that most patients actively participated in the surgical process and were satisfied with the information processes. However, areas for improvement, including inadequate written informational material and discomfort associated with local anesthetic injections, were identified.

In conclusion, these findings emphasize that a multidisciplinary approach is crucial to ensure that patients feel safer during preoperative and postoperative periods. Comprehensive preoperative counseling can help mitigate patient anxiety and improve patient compliance during the procedure. In addition, improving the communication and coordination skills of the surgical team may play a crucial role in increasing patient satisfaction. Prospective studies examining patients' experiences throughout the surgical process are recommended.

Declarations

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Availability of data and materials: The datasets used and/or analysed during the current study available from the corresponding author on reasonable request.

Disclosure: The authors declare that there are no conflicts of interest related to this study.

AUTHORSHIP CONTRIBUTION

Study conception and design: MB, BA

Data collection: OO, MB

Analysis and interpretation of results: All, SH

Draft manuscript preparation: SH, OO, BA

Critical revision of the article: OO, BA

Other (study supervision, fundings, materials, etc...): All

All authors (MB, OO, All, SH, BA) reviewed the results and approved the final version of the manuscript.

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