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Comparison study between Propofol plus Remifentanyl versus Propofol plus Dexmedetomidine in maintaining "Asleep Awake Asleep" Procedure During Awake Craniotomy After Scalp Block

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Abstract

Background: Awake craniotomy is a neurosurgical technique where pharmacological agents are used to modulate patient consciousness, enabling optimal tumor resection or functional mapping while preserving neurological function. This approach enhances the safety and efficacy of surgeries involving eloquent brain regions. The "asleep-awake-asleep" (AAA) method requires effective sedation protocols to ensure patient comfort, cooperation, and minimal side effects. **Objectives:** This study aimed to compare the efficacy, safety, and clinical outcomes of two anesthetic regimens-Propofol with Remifentanil versus Propofol with Dexmedetomidine-in maintaining the AAA protocol during awake craniotomy. **Methodology:** Sixty adult patients (aged 18–50 years) with brain tumors were operated on at the Department of Neurosurgery, National Institute of Neurosciences and Hospital, Dhaka, Bangladesh, from January 2021 to December 2024. Patients with ASA grade I or II were randomly assigned to two groups: Group A received Propofol plus Remifentanil, and Group B received Propofol plus Dexmedetomidine. All patients underwent scalp block prior to sedation. **Results:** Group A showed better heart rate control (75 ± 7) compared to Group B (82 ± 9). During sleeping phases, Group B had a lower respiratory rate (10 ± 2, p = 0.02) than Group A (12 ± 2, p = 0.01), but desaturation (SpO_2 < 95%) was more frequent in Group B (13%) than Group A (3%, p = 0.04). Patient satisfaction was higher in Group A (9.2 ± 0.8) than Group B (8.5 ± 1.1, p = 0.02). Instruction-following time was shorter in Group A (10.5 ± 2.1 minutes) than Group B (15.3 ± 2.5 minutes, p = 0.001). **Conclusion:** Both regimens effectively supported the AAA protocol, but Propofol with Remifentanil provided superior haemodynamic stability, smoother transitions, fewer adverse events, better analgesia, and faster recovery. It is therefore the more favorable option for awake craniotomy. *[Journal of National Institute of Neurosciences Bangladesh, January 2025;11(1):68-74]*

Keywords: Awake craniotomy, Propofol, Remifentanil, Remifentanil, Sedation, Asleep-awake-asleep technique, Neurosurgery.

Introduction

Awake craniotomy is a specialized neurosurgical procedure performed on patients with brain tumors, epilepsy, or other conditions requiring real-time neurological assessment during surgery[1-4]. The technique allows for intraoperative brain mapping, minimizing the risk of postoperative neurological deficits. To ensure optimal patient comfort and successful neurosurgical outcomes, an effective anesthetic regimen must maintain adequate sedation while allowing the patient to be alert and cooperative during the awake phase. The Asleep-Awake-Asleep (AAA) technique is one of the most commonly used approaches for awake craniotomy[5-6]. This technique involves three distinct phases: (1) the Asleep phase, where the patient is anesthetized during the opening of the cranium; (2) the Awake phase, where the patient is awakened for neurological testing and brain mapping; and (3) the

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Re-asleep phase, where the patient is re-anesthetized after tumor resection and closure[7].

The success of awake craniotomy hinges on the anaesthesiologist's ability to maintain a delicate balance between adequate sedation, analgesia, and rapid reversibility of anaesthesia during the awake phase. Anesthetic management must ensure patient comfort, hemodynamic stability, and cooperation during neurological testing while minimizing complications such as respiratory depression, nausea, vomiting, and agitation. Various anesthetic regimens have been employed for awake craniotomy, with propofol-based sedation being a widely accepted approach due to its rapid onset and short recovery time. However, the choice of adjunct agents for sedation remains a topic of ongoing research. Two commonly used adjuncts are Dexmedetomidine and remifentanil, each with distinct pharmacodynamic properties that influence their efficacy in maintaining the AAA protocol[8-11]. However, in AC patients with an unsecured airway, the use of propofol sedation in combination with opioids has been associated with intraoperative airway and / or respiratory complication and poor patient cooperation during cortical mapping[9,12-14].

Dexmedetomidine is a highly selective alpha-2 adrenergic receptor agonist that provides sedation, anxiolysis and mild analgesia while preserving respiratory function. Unlike traditional sedatives, dexmedetomidine induces a state of natural sleep-like sedation, allowing for easy arousability during the awake phase[15-18]. In contrast to other sedative agents, dexmedetomidine is not associated with respiratory depression[16,19,20].

Remifentanil, an ultra-short-acting opioid, provides potent analgesia and sedation with rapid onset and clearance. It allows for precise control of sedation depth and is easily adjusted to maintain patient comfort. Its rapid metabolism by nonspecific plasma esterases ensures a quick recovery, which is beneficial in procedures requiring frequent transitions between sedation and wakefulness[21,22]. However, remifentanil's opioid effects may cause respiratory depression, requiring close airway monitoring. Additionally, it lacks intrinsic sedative properties, necessitating its combination with propofol to achieve adequate sedation.

The primary objective of this study was to compare the efficacy and safety of Propofol with Remifentanyl versus Propofol with Dexmedetomidine in maintaining the AAA procedure during awake craniotomy. Specifically, the study aims to evaluate hemodynamic stability, recovery time, patient cooperation, and the incidence of adverse events. By addressing these key parameters, the study seeks to identify the optimal anesthetic regimen for awake craniotomy, ensuring patient safety, facilitating intraoperative neurological testing, and improving surgical outcomes.

Awake craniotomy represents a remarkable intersection of neurosurgery and anaesthesiology, where the anaesthesiologist's role is pivotal in ensuring the procedure's success. By comparing Propofol with Remifentanyl and Propofol with Dexmedetomidine, this study aims to optimize anesthetic management for awake craniotomy, ultimately improving patient outcomes and advancing the field of neuroanaesthesia.

Methodology

Study Settings and Population: This was a comparison study and this research work was carried out in National Institute of Neurosciences and Hospital, Department of Neuro-Anaesthesiology, Dhaka, Bangladesh. This study was carried out January 2021 to December 2024 for a period of four years. Patients with brain tumour who fulfil the inclusion criteria for anaesthesia ("Asleep-Awake-Asleep") and got admitted into the neurosurgery department of National Institute of Neurosciences and Hospital, Dhaka, Bangladesh.

Selection Criteria: Patients were randomly selected with ASA grade I and II and mallampati I & II of either sex between age group of 18 to 50 years, for the study from admitted patient scheduled to undergo elective awake craniotomy surgical procedures under "Asleep-Awake-Asleep" technique at National Institute of Neurosciences and Hospital Dhaka.

Study Procedure: Selected patients were dividing into two group by purposive sampling. The patient with group A were treated with Propofol plus Remifentanyl and the group B treated with Propofol plus Dexmedetomidine. Patients were randomly selected for the study from admitted patient scheduled to undergo elective awake craniotomy surgical procedures under "Asleep-Awake-Asleep" technique at National Institute of Neurosciences and Hospital Dhaka.

Statistical Analysis: The data were collected and edited manually. Statistical analyze was performed by windows-based software name as Statistical Package for Social Sciences version 23.0 for Windows (SPSS Inc., Chicago, Illinois, USA). The entered data were checked and verified. the same program analyzed the data. P values <0.05 was considered as statistically significant. The data were presented in tabulated form. Statistical calculation was performed by the same software.

Ethical implications: Ethical clearance was taken from the Institutional ethical body. The purpose and effects of the study was clearly explained to each of the subjects and the confidentiality was ensured. The study was done after taking proper informed written consent from all participants. Patient confidentiality and safety was prioritized throughout the study.

Results

The results of this study were brought the true picture of patient's in "Asleep-Awake-Asleep" technique undergoing craniotomy (surgical procedure).

The Male-to-Female Ratio Bar Graph for both study groups. The Propofol with Remifentanyl group has a 1:1 male-to-female ratio, while the Propofol with Dexmedetomidine group has an equal male-to-female distribution (1.1:1) (Figure I).

The average weight in male: female was 70:68 kg and average height were in male: female was 170: 165 cm (Figure II).

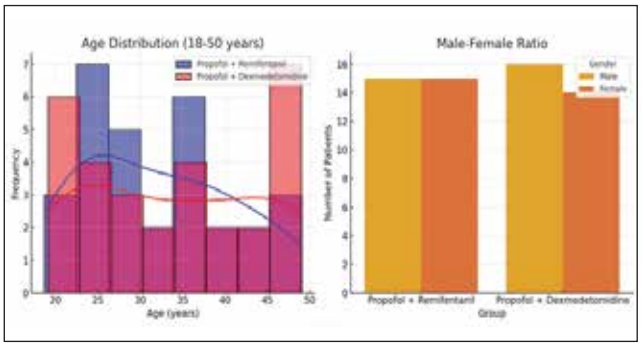

Figure I: Age Distribution and Male – Female ratio in the study group. (n=60)

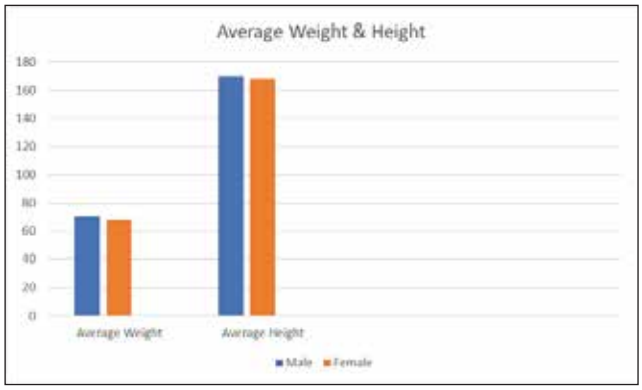

Figure II: Average weight and Height in the study group. (n=60)

The Propofol with Remifentanyl group shown better control on Heart rate during the awake phase compared to the Propofol with Dexmedetomidine group (p=0.02). No significant differences were observed during the asleep phases. The Propofol with Remifentanyl group maintained more stable MAP during the awake phase (p=0.01). Hypotension was more frequent in the Propofol with Dexmedetomidine group (20% vs. 7%, p=0.04). The Propofol with Remifentanyl group had fewer episodes of tachycardia (3% vs. 17%, p=0.03). Both groups had comparable rates of bradycardia and hypertension (Table 1).

The Propofol with Dexmedetomidine group had a significantly lower respiratory rate during the asleep phases compared to the Propofol with Remifentanyl group (p = 0.02 and p = 0.01 respectively). No

Table 1: Comparison of Haemodynamic Stability. (n=60)

Parameter	Propofol with Remifentanyl (n=30)	Propofol with Dexmedetomidine (n=30)	p-value
Heart Rate (HR)			
- Baseline (beats/min)	80 ± 8	78 ± 7	0.45
- Asleep phase (beats/min)	68 ± 6	70 ± 5	0.32
- Awake phase (beats/min)	75 ± 7	82 ± 9	0.02*
- Asleep phase 2 (beats/min)	70 ± 6	72 ± 7	0.38
Mean Arterial Pressure (MAP)			
- Baseline (mmHg)	85 ± 6	86 ± 5	0.56
- Asleep phase (mmHg)	80 ± 5	78 ± 6	0.28
- Awake phase (mmHg)	82 ± 6	75 ± 7	0.01*
- Asleep phase 2 (mmHg)	81 ± 5	79 ± 6	0.34
Hemodynamic Instability			
- Hypotension (n, %)	2 (7%)	6 (20%)	0.04*
- Hypertension (n, %)	3 (10%)	5 (17%)	0.40
- Bradycardia (n, %)	1 (3%)	8 (27%)	0.02*
- Tachycardia (n, %)	1 (3%)	5 (17%)	0.03*

(*p-value < 0.05 indicates statistical significance.)

significant differences were observed during the awake phase. Both groups maintained good oxygen saturation throughout the procedure, but the Propofol with Dexmedetomidine group had a higher incidence of desaturation (SpO_2 < 95%) compared to the Propofol with Remifentanyl group (13% vs. 3%, p = 0.04). The Propofol with Dexmedetomidine group required more airway interventions (e.g., jaw thrust, oral/nasal airway placement) compared to the Propofol with Remifentanyl group (20% vs. 7%, p = 0.03) (Table 2).

Patients in the Propofol with Remifentanyl group reported higher satisfaction scores compared to the Propofol with Dexmedetomidine group (9.2 ± 0.8 vs. 8.5 ± 1.1, p = 0.02). Both groups showed good cooperation during the awake phase. The Propofol with Dexmedetomidine group had a higher incidence of discomfort or pain during the procedure (23% vs. 10%, p = 0.04). Patients in the Propofol with Dexmedetomidine group required rescue analgesia more frequently than those in the Propofol with Remifentanyl group (20% vs. 7%, p = 0.03). The Propofol with Dexmedetomidine group had a higher incidence of anxiety during the procedure (27% vs. 13%, p = 0.04). Both groups had low rates of nausea/vomiting, with no significant difference between the two (3% vs. 10%, p = 0.30). (Table 3)

Patients in the Propofol with Remifentanyl group were able to full orientation faster than those in the Propofol with Dexmedetomidine group (18.3 ± 4.2 minutes vs. 25.6 ± 5.1 minutes, p < 0.001). The Propofol with Dexmedetomidine group had a higher incidence of postoperative sedation (13% vs. 3%, p = 0.18), though this was not statistically significant (Table 4).

Discussion

Awake craniotomy is a crucial neurosurgical technique that is mostly used to remove brain tumors that are

Table 2: Comparison of Airway and Respiratory Parameters. (n=60)

Parameter	Propofol with Remifentanyl (n=30)	Propofol with Dexmedetomidine (n=30)	p-value
Respiratory Rate (RR) (breaths/min)			
- Baseline	14 ± 2	14 ± 3	0.85
- Asleep phase	12 ± 1	10 ± 2	0.02*
- Awake phase	14 ± 2	14 ± 2	0.70
- Asleep phase 2	12 ± 2	10 ± 2	0.01*
Oxygen Saturation (SpO_2) (%)			
- Baseline	98 ± 1	98 ± 1	0.99
- Asleep phase	97 ± 1	96 ± 2	0.08
- Awake phase	98 ± 1	97 ± 1	0.10
- Asleep phase 2	97 ± 1	96 ± 2	0.07
Incidence of Desaturation (SpO_2 < 95%) (n, %)	1 (3%)	4 (13%)	0.04*
Airway Interventions (n, %)	2 (7%)	6 (20%)	0.03*

*p-value < 0.05 indicates statistical significance

Table 3: Comparison of Patient Cooperation and Comfort. (n=60)

Parameter	Propofol with Remifentanyl (n=30)	Propofol with Dexmedetomidine (n=30)	p-value
Patient Satisfaction (VAS 0-10)	9.2 ± 0.8	8.5 ± 1.1	0.02*
Cooperation During Awake Phase (n, %)	18 (60%)	15 (50%)	0.25
Incidence of Discomfort or Pain (n, %)	3 (10%)	7 (23%)	0.04*
Need for Rescue Analgesia (n, %)	2 (7%)	6 (20%)	0.03*
Incidence of Anxiety (n, %)	4 (13%)	8 (27%)	0.04*
Incidence of Nausea/Vomiting (n, %)	1 (3%)	3 (10%)	0.30

*p-value < 0.05 indicates statistical significance

Table 4: Comparison of Recovery Time. (n=60)

Parameter	Propofol with Remifentanyl (n=30)	Propofol with Dexmedetomidine (n=30)	p-value
Time to Eye Opening (min)	8.2 ± 1.8	12.5 ± 2.3	0.001*
Time to Following Commands (min)	10.5 ± 2.1	15.3 ± 2.5	0.001*
Time to Full Orientation (min)	18.3 ± 4.2	25.6 ± 5.1	0.001*
Postoperative Sedation (n, %)	1 (3%)	4 (13%)	0.18

*p-value < 0.05 indicates statistical significance

situated in or close to eloquent brain regions, like those related to language, motor function, or sensory processing[1-3]. The patient's capacity to maintain comfort and safety during the sleepy periods while remaining cooperative and responsive during the waking phases is crucial to the procedure's effectiveness. A common anesthetic method for awake craniotomy is the asleep-awake-asleep (AAA) technique, which alternates between periods of sedation and wakefulness[4-5]. Propofol and remifentanil and propofol and remifentanil are two anesthetic regimens that are frequently utilized in this situation. The effectiveness, safety, and pragmatic factors of these two regimens in preserving the AAA surgery are contrasted in this debate. This discussion compares the efficacy, safety and practical considerations of these two regimens in maintaining the AAA procedure[7].

In this study observed that the Male-to-Female ratio in Propofol with Remifentanyl group was a 1:1, while the Propofol with Dexmedetomidine group was an equal male-to-female distribution (1.1:1).

In this study observed that the average weight and height in male: female was 70:68 kg and average height were in male: female was 170: 165 cm[8-10].

In this study observed that the Propofol with Remifentanyl group shown better control of Heart rate during the awake phase compared to the Propofol with Dexmedetomidine group (p=0.02). No significant differences were observed during the asleep phases. The Propofol with Remifentanyl group maintained more stable MAP during the awake phase (p=0.01). Hypotension was more frequent in the Propofol with Dexmedetomidine group (20% vs. 7%, p=0.04). The Propofol with Remifentanyl group had fewer episodes of tachycardia (3% vs. 17%, p=0.03). Both groups had comparable rates of bradycardia and hypertension[10-12].

In this study observed that the Propofol with Dexmedetomidine group had a significantly lower respiratory rate during the asleep phases compared to the Propofol with Remifentanyl group (p = 0.02 and p = 0.01). No significant differences were observed during the awake phase. Both groups maintained good oxygen saturation throughout the procedure, but the Propofol with Dexmedetomidine group had a higher incidence of desaturation (SpO_2 < 95%) compared to the Propofol with Remifentanyl group (13% vs. 3%, p = 0.04). The Propofol with Dexmedetomidine group required more airway interventions (e.g., jaw thrust, oral/nasal airway placement) compared to the Propofol with Remifentanyl group (20% vs. 7%, p = 0.03)[17-19].

In this study observed that Patients in the Propofol with Remifentanyl group reported higher satisfaction scores compared to the Propofol with Dexmedetomidine group (9.2 ± 0.8 vs. 8.5 ± 1.1, p = 0.02). Both groups showed good cooperation during the awake phase. The Propofol with Dexmedetomidine group had a higher incidence of discomfort or pain during the procedure (23% vs. 10%, p = 0.04). Patients in the Propofol with Dexmedetomidine group required rescue analgesia more frequently than those in the Propofol with Remifentanyl group (20% vs. 7%, p = 0.03). The Propofol with Dexmedetomidine group had a higher incidence of anxiety during the procedure (27% vs. 13%, p = 0.04). Both groups had low rates of nausea/vomiting, with no significant difference between the two (3% vs. 10%, p = 0.30)[21-22].

In this study observed that patients in the Propofol with Remifentanyl group were able to follow commands faster than those in the Propofol with Dexmedetomidine group (10.5 ± 2.1 minutes vs. 15.3 ± 2.5 minutes, p < 0.001). Patients in the Propofol with Remifentanyl group were able to follow commands faster than those in the Propofol with Dexmedetomidine group (10.5 ± 2.1 minutes vs. 15.3 ± 2.5 minutes, p = 0.001). Patients in the Propofol with Remifentanyl group were able to full orientation faster than those in the Propofol with Dexmedetomidine group (18.3 ± 4.2 minutes vs. 25.6 ± 5.1 minutes, p = 0.001). The Propofol with Dexmedetomidine group had a higher incidence of postoperative sedation (13% vs. 3%, p = 0.18), though this was not statistically significant[20].

Conclusion

In this comparison study between Propofol with Remifentanyl (PR) and Propofol with Dexmedetomidine (PD) for maintaining the Asleep-Awake-Asleep (AAA) technique during awake craniotomy suggests that both regimens provide effective sedation, but with notable differences. Propofol with Remifentanyl offers better haemodynamic stability, better analgesia, less respiratory depression and smoother during the awake phase due to Remifentanyl has analgesic properties without significant respiratory compromise. In contrast, Propofol with Dexmedetomidine provides deeper sedation with more rapid onset, but may lead to increased respiratory depression, requiring closer airway management. Patients in the Propofol with Remifentanyl group generally experience less postoperative nausea and a more cooperative awake phase, making it a favourable option for procedures requiring optimal patient interaction. For awake craniotomy, Propofol with Remifentanyl is the recommended option when haemodynamic stability and patient interaction are top priorities because it offers a more stable and secure sedative profile overall.

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Contribution to authors: Rony MRR, Hasnat MA, Haque T was involved in protocol preparation, Rony MRR was involved in data collection and literature search, Mustafa MM, Mamun MA was involved in manuscript writing, Rony MRR, Hasnat MA was involved in preparation and revision of this manuscript. All authors read and approved the final manuscript.

Data Availability
Any inquiries regarding supporting data availability of this study should be directed to the corresponding author and are available from the corresponding author on reasonable request.

Ethics Approval and Consent to Participate
Ethical approval for the study was obtained from the Institutional Review Board. As this was a prospective study the written informed consent was obtained from all study participants. All methods were performed in accordance with the relevant guidelines and regulations.

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