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Clinical commentary

# Comparison of Conscious Sedation and Asleep-Awake-Asleep Techniques for Awake Craniotomy

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ABSTRACT

Since awake craniotomy (AC) has become a standard of care for supratentorial tumour resection, especially in the motor and language cortex, determining the most appropriate anaesthetic protocol is very important. The aim of this retrospective study is to compare the effectiveness of conscious sedation (CS) to "awake-asleep-awake" (AAA) techniques for supratentorial tumour resection. Forty-two patients undergoing CS and 22 patients undergoing AAA were included in the study. The primary endpoint was to compare the CS and AAA techniques with respect to intraoperative pain and agitation in patients undergoing supratentorial tumour resection. The secondary endpoint was comparison of the other intraoperative complications. This study results show that the incidence of intraoperative agitation and seizure were lower in the AAA group than in the CS group. Intraoperative blood pressures were significantly higher in the CS group than in the AAA group during the pinning and incision, but the level of blood pressures did not need antihypertensive treatment. Otherwise, blood pressures were significantly higher in the AAA group than in the CS group during the neurological examination and the severity of hypertension needed statistically significant more antihypertensive treatment in the AAA group. As a result of hypertension, the amount of intraoperative bleeding was higher in the AAA group than in the CS group. In conclusion, the AAA technique may provide better results with respect to agitation and seizure, but intraoperative hypertension needed a vigilant follow-up especially in the wake-up period.



## 1. Introduction

Awake craniotomy (AC) is a preferred approach in the resection of brain lesions in the eloquent cortex that controls language and motor function [1]. The primary aim of AC is to perform optimum resection with minimal neurological deficit. AC has become a standard of care for supratentorial tumour resection, because intraoperative cortical mapping or functional testing provides better outcomes if the lesion is within or close to the eloquent cortex [2,3].

There are different protocols for anaesthetic care during AC, based on conscious sedation (CS) and the asleep-awake-asleep (AAA) technique. These variations depend on patient selection, local experience and the expected duration of the surgery [4].

Spontaneous ventilation is maintained during the surgery, while giving supplemental oxygen in CS. Propofol, fentanyl and remifentanil are commonly used drugs. Recently, dexmedetomidine has been used to treat discomfort in patients sedated with propofol and remifentanil. Dexmedetomidine has been shown to reduce the necessary amount of other drugs and, therefore, sedative and opioid related adverse effects [5].

The AAA technique consists of general anaesthesia before and after cortical mapping and functional testing. Lariyngeal mask airway (LMA) is commonly used to control ventilation [6]. Fibre optic awake intubation, video laryngoscopes, different types of supraglottic airways can be used for this purpose. The general anaesthesia in the AAA technique is commonly provided by propofol and remifentanil infusions. Drug infusion is interrupted 15 min before the functional testing. When the spontaneous ventilation starts the patient is stimulated, and the LMA is removed when the patient obeys commands. At the end of neurological testing, re-induction of anaesthesia is performed.

The AAA technique is especially preferred for prolonged surgeries because it provides airway protection and seems more comfortable than CS for patients [4]. Otherwise, repositioning of the

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LMA could be difficult, especially with the fixed head, and may cause hypoxia and hypercarbia [7]. Moreover, possible sudden patient movements, cough, nausea and vomiting at the periods of awakening or repositioning of the LMA may cause raised intracranial pressure [7]. On the other hand, respiratory depression, hypoventilation, hypoxia, agitation, pain, cough, nausea, vomiting and seizures are the complications that can be seen during CS [8].

Although the outcomes of general anaesthesia have been compared to the AAA technique for supratentorial tumour resection and efficacy of different drugs, as far as we know, no study has compared different anaesthesia protocols for awake craniotomy [9–11]. The aim of the present study was to compare the effectiveness of CS to AAA techniques for supratentorial tumour resection. Thus, the primary endpoint of the present study was compare the CS and AAA techniques with respect to intraoperative pain and agitation in patients undergoing supratentorial tumour resection. The secondary endpoint was to compare the other intraoperative complications.

## 2. Materials and methods

Ethical approval for this study (no: 83045809-604.01.02) was provided by the Ethical Committee of the Cerrahpasa School of Medicine, Istanbul University, Istanbul Turkey (Cheirperson Prof. Dr. med. Ozgur Kasapcopur) on 12 July 2016. Medical records of patients who had undergone awake craniotomy for supratentorial tumour resection were reviewed between March 2011 and April 2016. Patients were divided into two groups based on the type of anaesthesia: conscious sedation (CS) and asleep-awake-asleep technique (AAA). A total of 66 medical records were reviewed retrospectively, 43 from the CS group and 23 from the AAA group.

The most comfortable surgical position was determined for all patients following operating room admission.

The CS group received dexmedetomidine after the electrocardiogram, pulse oximeter, capnogram, respiratory rate, non-invasive blood pressure and temperature monitoring. The dexmedetomidine infusion was started with 1 $\mu g^{-1} \cdot kg^{-1}$ for 10 min and then continued with 0.2–0.7 $\mu g^{-1}.kg^{-1} \cdot h.^{-1}$. The infusion rate was titrated to achieve the target Ramsey Sedation Score [12] between 2 and 4. Intraoperative bispectral index (BIS) monitoring was performed if the probes were available. The target BIS values were 75 to 85 during the surgery and higher than 85 during the neurological examination. Mostly, infiltration analgaesia was used with 0.05% bupivacaine (2 mg per kg) and 1:100.000 adrenalin at the pin and incision sites. Scalp nerve block was used for other patients. Two mg per kg 0.05% bupivacaine was used and applied in 3 mL injection on auriculotemporal, zygomaticotemporal, supraorbital, supratrochlear, greater occipital and lesser occipital nerves. Patients in the CS group had spontaneous ventilation with supplemental 2–6 $L \cdot min^{-1}$ oxygen through a nasopharyngeal airway during the procedure. This airway provides end-tidal $CO_2$ monitoring. Radial arterial cannulas for invasive blood pressure monitoring and urine catheter were placed. In patients who complained of pain, intravenous (IV) remifentanil infusion was started with 0.02–0.05 $\mu g^{-1} \cdot kg^{-1}.min^{-1}$ and intermittent IV boluses of fentanyl (25–50 μg) were used. In patients who complained of agitation, IV propofol infusion (20 $\mu g^{-1} \cdot kg^{-1} \cdot min^{-1}$) was used if the target sedation level was not achieved by intermittent IV boluses of propofol (10–20 mg).

The AAA group received IV propofol (1.5 $mg \cdot kg^{-1}$), remifentanil infusion (0.15 $\mu g^{-1} \cdot kg^{-1} \cdot min^{-1}$ in 5 min) and rocuronium (0.6 $mg \cdot kg^{-1}$) after routine monitoring. Positive pressure ventilation was performed with LMA. Radial arterial cannulas for invasive blood pressure monitoring and urine catheter were placed. Anaesthesia was maintained with IV propofol (50–250 $\mu g^{-1}.kg^{-1} \cdot min.^{-1}$) and remifentanil infusions (0.1 to 0.05 $\mu g^{-1}.kg^{-1} \cdot min.^{-1}$) until awakening. Intraoperative BIS monitoring was performed if the probes were available. The target BIS values were 45–60 during the general anaesthesia and higher than 85 during the neurological examination. Drugs infusions were interrupted 15 min before the neurological examination. Intravenous sugammadex (2 $mg \cdot kg^{-1}$) was administered. When the spontaneous ventilation started, the patient was stimulated and the LMA was removed when the patient obeyed commands. The neurosurgical examination was performed during cortical mapping and throughout the tumour resection. At the end of neurological testing, re-induction of anaesthesia was performed with IV propofol (1.5 $mg \cdot kg^{-1}$), remifentanil infusion (0.15 $\mu g^{-1} \cdot kg^{-1}.min.^{-1}$ in 5 min) and atracurium (0.6 $mg \cdot kg^{-1}$). Residual muscle relaxation was reversed with IV atropine (0.01 $mg \cdot kg^{-1}$) and neostigmine (0.02 $mg \cdot kg^{-1}$) at the end of the surgery.

Antiepileptic prophylaxis with IV phenytoin (20 $mg \cdot kg^{-1}$), antiemetic prophylaxis with IV ondansetron (8 mg) and antibiotic prophylaxis with IV cefazolin (1 g) were administered at the beginning of the surgery in both groups. Intravenous tramadol (2 $mg \cdot kg^{-1}$) was administered for postoperative analgesia at the closure of the dura in both groups. Blood gas analysis was performed after surgical incision, and forced-air warming devices were used to maintain normothermia in both groups. Supine or lateral decubitus positions were used for surgery.

Intraoperative hypertension was treated with esmelol infusion (0.05–0.2 $mg^{-1} \cdot kg^{-1} \cdot min^{-1}$).

Collected data included age, gender, body weight, height, body mass index, ASA physical status, location of the tumor, duration of surgery, need of postoperative intensive care admission, length of hospital stay, heart rate, systolic, diastolic and mean arterial blood pressures before induction of anaesthesia, during head pinning, during the surgical incision, during the neurological examination and emergence, technique of the local analgesia, intraoperative $P_aCO_2$ levels, episodes of intraoperative severe and moderate desaturation (peripheral oxygen saturation lower than 90% and 95% consequently), need of intraoperative antihypertensive treatment, coughing, nausea, vomiting, aspiration of gastric contents, seizure, intraoperative pain, agitation, brain oedema, need of mannitol treatment, amount of bleeding and intraoperative neurological deficits (such as, aphasia, hemiparesia and, hemiplegia). As well, intraoperative BIS values were recorded before induction of anesthesia, during head pinning, surgical incision and, the neurological examination and closure of the dura.

### 2.1. Statistical analysis

Statistical analysis was performed using SPSS (Statistical Package for Social Sciences) for Windows 15.0. Normal distribution of quantitative variables were analysed by the Shapiro–Wilk test. Homogeneity of variances were analysed by Levene's test. Student's *t*-test or Mann–Whitney tests were used to compare variables when applicable. Fisher's exact test was used when one or more of the expected frequencies were less than five. A *p*-value $< 0.05$ was considered significant for all tests.

## 3. Results

The medical records of 43 CS and 23 AAA patients were reviewed; two patients excluded from the study. One patient needed general anaesthesia because of uncontrolled hypertension in the CS group and one patient in the AAA group did not awakened during the operation because massive bleeding. Therefore, 42 CS and 22 AAA patients were included for statistical analysis.