**CASE REPORTS**

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**Case report**

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**Introduction**

The awake craniotomy technique is well established for surgical treatment of epilepsy, and only recently it has become more popular for surgical management of supratentorial tumours, arteriovenous malformations and mycotic aneurysms near critical regions of the brain [1]. Awake craniotomy for tumour resection presents many challenges for the neurosurgeon and the anaesthesiologist [2]. The challenge for the anaesthesiologist is to find a technique that provides adequate sedation, analgesia, and assures cardiorespiratory stability, as well as an awake and cooperative patient, without interfering with electrophysiological monitoring and cognitive tests.

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**Summary**

**Introduction.** There is an increasing trend towards performing awake craniotomy procedures. The method is indicated for surgical treatment of brain changes located in functional regions. This technique poses a unique challenge for the anaesthesiologist in view of providing adequate sedation, analgesia, hemodynamic and respiratory stability yet to keep the patient awake and cooperative during the procedure. **Case Report.** After the adequate preoperative preparation of the patient, the surgical procedure on tumorous change in the left frontoparietal area (Broca’s area) was performed. Due to the tumour localization, the surgical treatment was performed in awake condition under intraoperative neurophysiological monitoring of the patient. Analgosedation (Ramsay score 2-3) was provided via continuous infusion of propofol and remifentanil. Local infiltration anesthesia (scalp block) was performed with levobupivacaine. The surgical procedure proceeded without any major incidents and complications. **Conclusion.** A propofol/remifentanil combination provided safe and effective analgosedation of the patient.

**Key words:** Anesthesia; Brain Neoplasms; Neurosurgical Procedures; Wakefulness; Craniotomy; Neurophysiological Monitoring; Conscious Sedation

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**Sažetak**

**Uvod.** Izvođenje kraniotomija u budnom stanju je trend koji je sve više u porastu. Metoda je indikovana za hirurško zbrinjavanje promena na mozgu lociranih u funkcionalnim regijama mozga. Ova tehnika predstavlja jedinstven izazov za anesteziologe zato što treba da obezbeđe adekvatnu sedaciju, analgosedaciju, hemodinamičku i respiratornu stabilnost, a da pacijent tokom izvođenja procedure bude budan i kooperativan. **Prikaz slučaja.** Nakon adekvate preoperativne pripreme pacijentkinje, izvedena je planirana hirurška procedura na tumorskoj promeni u levoj frontoparietalnoj regiji (Brokina zona). S obzirom na lokalizaciju tumor, hirurška procedura je sprovedena u budnom stanju, uz upotrebu neurofiziološkog monitoringa. Analgosedacija (Remzijev skor 2-3) obezbedena je kontinuiranom infuzijom propofola i remifentanila. Lokalna infiltrativna anestezija (skalp blok) izvedena je levobu­ pivakainom. Hirurška procedura je protekla bez većih incidenata i komplikacija. **Zaključak.** Propofol/remifentanil kombinacija omogućava sigurnu i efikasnog analgosedaciju pacijenata tokom izvođenja operacija tumor na mozgu u budnom stanju.

**Ključne reči:** anestezija; tumor mozga; neurohirurške procedure; budnost; kraniotomija; neurofiziološki monitorin; svesna sedacija

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Scalp block performed by the neurosurgeon allows reducing the dose of drugs used for analgosedation and thus reduces adverse effects of these drugs. It also results in lower pain scores and less need for analgesics in the first 48 hours after supratentorial craniotomy. Few anaesthetic methods can be used for awake craniotomy. Monitored anæsthesia care (MAC) is a procedure during which the patient is analgosedated and remains spontaneously breathing throughout the entire procedure. Asleep-aware-asleep (A.A.A) technique is the method where patient is anæsthetized during the first and third phase and laryngeal mask (LM) or an endotracheal tube (ET) is used for ventilation. During the second phase when mapping is performed,
the patient allowed to be fully awake and the LM or the ET is removed. Asleep-awake (AA) method is similar to the previous one, yet without the third phase [3].

The aim of this case report was to present MAC, the technique involving propofol and remifentanil combined with levobupivacaine for scalp block in neurosurgical procedure of tumour resection in the awake patient.

**Case Report**

A female patient visited the neurologist reporting episodes of forgetfulness (forgetting what she was trying to say or do) and intermittent speaking inability. According to the obtained anamnestic data, clinical and neurological examination (motor dysphasia), computed tomography, magnetic resonance imaging and functional magnetic resonance of the endocranium, a multicentric infiltrative tumorous change was diagnosed in the left frontoparietal region. Approximate dimensions of the tumour were 5.5 X 4.0 X 5.2 cm. Electroencephalography revealed irritative dysrhythmia and slow activity over the central-parietal regions. Since the tumour was in the Broca’s area, the neurosurgeon indicated surgical treatment in awake condition under intraoperative neurophysiological monitoring of the patient.

During the preoperative preparation period, the patient was administered dexamethasone and phenobarbitone. The patient had history of hypertension, thus she had been receiving triple antihypertensive therapy (losinopril, metoprolol, amiodipine). The preoperative laboratory and biochemistry findings were within the reference range. Immediately before entering the operation room, the patient was administered cefuroxime 1.5 g i.v., ranitidin 50 mg i.v, metoclopramide 10 mg i.v, dexamethasone 4 mg i.v.

Upon entering the operation room, two peripheral venous lines were placed (17G, 18G), as well as an arterial cannula (a. radialis), urinary catheter and a body heater. The patient’s position was semi-lateral on the right side. The patient manifested moderate hypertension (150/90 mmHg), normocardia (68/min), pulse oximetry (SpO₂) 96%. The following parameters were monitored and recorded: bispectral index (BIS), electrocardiogram, invasive measurement of arterial blood pressure, pulse oximetry, arterial blood gas analysis, and hourly diuresis. Before MAC started, preoxygenation therapy via the face mask (7 L/min) was performed along with slow infusion of Ringer’s solution, and midazolam 2 mg i.v. and fentanyl 50 µg i.v. were administered. Anaesthesia was started with propofol (target controlled infusion, plasma-target 1 µg/ml). When the desired propofol concentration was reached, continuous infusion of remifentanil was induced at a dose of 0.025 µg/kg/min, while reducing the p-target concentration of propofol to 0.7 µg/ml. After 10 minutes, scalp infiltration (scalp block) with levobupivacaine (0.5%) was performed at a total dose of 150 mg with adrenaline 5 µg/ml. The patient’s head was positioned into the Mayfield scull clamp. Immediately before placing the Mayfield immobilizer, paracetamol 1g i.v. was administered, and remifentanil dose increased to 0.05 µg/kg/min. During positioning of the scull clamp and craniotomy, the patient was completely calm, hemodynamically stable and without pain sensation. When the dura mater was opened, the dose of p-target propofol was reduced to 0.1 µg/ml, and the remifentanil dose was decreased to 0.01 µg/kg/min. Direct cortical stimulation with bipolar electrode in the region of anticipated Broca’s area, i.e. the tumour lower margin, resulted in anosmia and “speech arrest”. The motor response in the upper limb and face, which defined the postero-superior resection margin, was provided by direct cortical stimulation with monopolar electrode.

Intraoperative ex tempore diagnosis revealed glioblastoma multiforme. After successful neurophysiological monitoring and mapping, the tumour was reduced. The doses of p-target propofol and remifentanil were increased to 0.5 µg/ml and 0.05 µg/kg/min respectively. The aforementioned doses remained unchanged until the end of surgical procedure.

Hypertension and tachycardia episodes occurring during the neurophysiological monitoring were managed by means of urapidil and metoprolol, respectively. Throughout anaesthesia, the SpO₂ values ranged from 96 to 100%, whereas partial pressure of CO₂ in arterial blood ranged from 34.0 to 46.6 mmHg. During anaesthesia and surgical procedure, the patient did not experience any respiratory arrest. BIS values ranged within the interval of 85-95.

Postoperatively, the patient was transferred to intensive care unit and she was awake, conscious, oriented and communicative, without major neurological episodes and satisfied.

**Discussion**

Awake craniotomy for tumour surgery has recently become more popular [4]. It allows cortical mapping, which is crucial during brain tumour resection in order to prevent neurological injury.

The safest way to do resection of a tumour close to the eloquent areas of the cortex is in an awake patient, who can thus provide continuous feedback to the neurosurgeon on the integrity of neurological function [5].

The role of the anaesthesiologist is to provide analgesedation and cardiorespiratory stability without interfering with electrophysiological monitoring and cognitive tests, so optimal anaesthetic management remains a challenge [6].
There are several anaesthetic methods that can be used for awake craniotomy, and our decision was to use MAC. When providing MAC as a method, the patient is sedated and remains able of spontaneous breathing throughout the entire procedure. We wanted to establish control of pain during the entire period of surgery, and this method allowed the main surgical steps to be carried out without major complications (such as psychomotor agitation, respiratory depression, hemodynamic changes, and excessive sleepiness) and airway manipulation. It did not affect the patient’s cognitive evaluation [7].

Not all patients can tolerate an awake craniotomy. Our patient was conscious, highly motivated, without communication difficulties and extreme anxiety. It is necessary to make psychological evaluation. People with mental disorders cannot be included in this procedure.

To prevent complications of awake craniotomy, such as seizures, cerebral oedema, nausea and vomiting, the patient was peripherally given anti-convulsion therapy and dexamethasone as well as antiemetic medication.

All preparations had been completed before the patient arrived in the room including extra pillows, soft mattress and warming system to ensure maximum comfort for the patient during positioning. In addition to the routine monitoring of non-invasive blood pressure, electrocardiogram and pulse oximetry, which is essential, BIS was also monitored, which is routinely used in neurosurgical procedures, invasive blood pressure and hourly diuresis. BIS is standard practice in anesthetic care [8].

A bolus of fentanyl and midazolam for anxiolysis and anterograde amnesia was used as our premedication. We used the combination of remifentanil and propofol because it promotes synergistic analgesia, ensures acceptable sedation, and decreases the incidence of nausea and vomiting [9, 10]. Manninen et al compared the combination of fentanyl and propofol with the combination of remifentanil and propofol. They have found that the use of remifentanil infusion in conjunction with propofol is a good alternative to fentanyl and propofol, but they reported a higher number of respiratory complications when using fentanyl [11].

Propofol infusion was carefully titrated to keep the patient comfortably sedated and to avoid hyperventilation, with hypercapnia, cerebral hyperaemia and the tense brain.

One of the major concerns during the intraoperative period is to ensure spontaneous breathing in the patients and their being oriented and cooperative. This problem primarily arises in the most painful phase where heavy sedation is often necessary [11]. This problem did not occur in our case because we titrated intensity of analgesia with infusion of remifentanil and we used scalp block as well. Remifentanil has a rapid action onset, and short duration, which makes titration relatively easy with minimal effects on hemodynamic profile.

Except for hypertension, which is a relatively common complication during the procedure, we did not have any complications and the patient manifested early mobilization and was discharged uneventfully.

**Conclusion**

Our experience is in accordance with literature data, which report that awake craniotomy is practicable and safe anaesthetic technique. The successful outcome depends on the anaesthesiologist’s skill in the pharmacological titration, as well as his/her capability to maintain the close psychological contact with the patient throughout the surgery.

**References**