Surgery Clinics Journal

ISSN: 2687-6973

Case Report

A Case of Complementary SmartPilot® View Monitoring in Anesthesia Management during awake Craniotomy

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Abstract

The objective of anesthesia management during awake craniotomy is to allow patient cooperation, preserve general homeostasis, and limit anesthetic drug interaction with neuropsychological testing, electrophysiological recording, or mapping quality. SmartPilot® View (SPV) is a unique monitor that assesses the combined hypnotic-opioid impact and displays the actual and expected anesthetic level. During some stages of an awake craniotomy process, maintaining adequate anesthetic depth becomes extremely valuable. It is hypothesized that SPV monitoring could help minimize the patient's awakening period and predict recovery of consciousness, allowing for reliable intraoperative testing and the start of brain tumor removal. We describe the combination use of target-controlled propofol and remifentanil anesthesia with dexmedetomidine and scalp block in a patient who underwent intraoperative monitoring, mapping and operculum mass excision under the guidance of SPV monitoring.

Keywords: Anesthetics; Intravenous; Consciousness monitors; Monitoring; Intraoperative; Awake craniotomy

Introduction

Awake Craniotomy (AC) is a common procedure that aims to remove more lesions while limiting injury to the eloquent cortex [1]. With the advancement of technology, the role of the awake craniotomy has grown in importance [1,2]. Asleep-awake-asleep anesthesia technique is widely used during the procedure. However, the paradox of delivering adequate sedation and analgesia during painful stimuli in a patient who is expected to remain awake and cooperative for neurological testing provides unique problems for the anesthetist during asleep-awake craniotomy [3-5]. The patient is asleep at the start and end of the surgery, but is completely awake and alert during the neurological testing part of the procedure. The mapping step and the surgery's outcome are dependent on a rapid recovery of consciousness and full orientation.

The SmartPilot View (SPV) software (Drager Medical, Lubeck, Germany) is a novel monitor that analyzes and predicts depth of anesthesia. Based on pharmacokinetic/pharmacodynamic models, SPV depicts the current anesthesia level as well as the predicted anesthesia course over the next 10 minutes, taking into account hypnotic-opioid interactions [6,7].

Citation: Inan G, Celtikci E, Aykol S, Satirlar OZ. A Case of Complementary SmartPilot® View Monitoring in Anesthesia Management during awake Craniotomy. Surg Clin J. 2021; 2(5): 1036.

Publisher Name: Medtext Publications LLC

Manuscript compiled: Aug 10th, 2021

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The usefulness of SPV monitoring in a case of opercular mass excision under multimodal anesthesia technique with target control infusions and dexmedetomidine and scalp block is discussed in this case report. We hypothesized that SPV monitoring could help shorten the patient's awakening time by optimizing anesthetic consumption and anticipate recovery of consciousness so that reliable intraoperative testing and brain tumor removal could be started.

Case Presentation

A 42-year-old ASA I male patient with a history of new onset speech problem was scheduled for operculum tumor excision. It was decided to perform an AC with intraoperative monitoring and mapping. The patient was informed about AC and our anesthetic plan during preoperative examination and gave his consent.

No premedication was administered. Electrocardiogram, non-invasive/invasive arterial blood pressure, end-tidal carbon dioxide, pulse oximetry, and Bispectral Index (BIS) were all used to monitor the patient perioperatively in the operating room (Infinity Delta XL, Drager Medical, Lübeck, Germany). 1 µg/kg dexmedetomidine loading was given in 10 minutes, followed by a 0.2 µg/kg/hour-0.7 µg/kg/hour infusion.

Anesthesia induction was achieved with Target Controlled Infusion (TCI) of propofol; Schnider model, 2 µg/ml effect-site concentration and remifentanil; Minto model, 2 ng/ml effect-site concentration. A bladder catheter, an arterial line, and an LMA were all inserted following induction. Scalp block was performed with 20 mL of 0.25% bupivacaine before attaching a head frame to the patient.

SmartPilot View software (Version 3.00.12) was integrated to the anesthesia machine (Perseus, Drager Medical, Lubeck, Germany) so that monitoring, ventilation and anesthetic settings were automatically merged. Anesthesia was maintained with TCI propofol and remifentanil targeting the predefined noxious stimulation

response index (NSRI) isobole graphs showing the specific anesthesia levels on the SPV monitor; the dark and medium grey isobole during craniotomy and tumor excision stages and the light-grey isobole during dura opening and brain exposure. Target-controlled infusions were reduced and terminated at 2.5 hours of infusions to allow patient awakening mapping and LMA removal with the guidance of SPV. At that time BIS value of the patient was 73. When the patient was able to open his eyes, obey simple orders, and breathe spontaneously, the LMA was removed. The patient opened his eyes at the 4th minute and the LMA was removed at the 5th minute of cessation of infusions. The BIS was 86 at the time of LMA removal.

At the 12th minute, the patient was able to dependably do sophisticated language tasks, and brain mapping began. Electrical cortical stimulation was used to map the brain, and EMG and clinical response were used to evaluate the results. The BIS was 89 at the start of brain mapping, 73 at the start of closure, and 89 at the end of operation. During the mapping process, there was no speech impairment. Throughout the procedure, the patient was comfortable, all hemodynamic indicators were constant and no neurological impairments worsened. While the patient was arousable and cooperative, the tumor was effectively removed. After mapping, the anesthesia was deepened once more during the closure step. The operation was completed in the 4th hour without any problems. The total amount of propofol consumed was 780 mg, and the total amount of remifentanil consumed was 600 µg.

Discussion

Awake Craniotomy (AC) is a procedure that is commonly used to remove brain tumors from the eloquent cortex, treat epilepsy, manage vascular lesions in crucial brain areas, and perform deep brain stimulation surgery [1]. Higher lesion excision, less cortical damage and postoperative neurologic dysfunction, shorter hospital stay, therefore lower care costs, and a lower incidence of postoperative problems such as nausea and vomiting are only a few of the benefits [2]. Awake craniotomy, on the other hand, allows for intraoperative functional monitoring.

Airway patency, patient comfort, and optimization of real-time brain imaging, mapping or neuropsychological testing and brain tumor removal are among the anesthetic and surgical issues during AC. The ideal anesthetic strategy for an AC has yet to be determined [2,4,5]. Sedation alone or general anesthesia are the most common anesthetic methods, with the patient woken for cortical mapping and tumor removal, with the choice of re-starting anesthesia for closure [5].

BIS can only provide a posteriori information on the hypnotic anesthetic component as an anesthesia depth monitor. Despite that, the synergistic interaction between hypnotics and opioids should be taken into account. Recent monitors, on the other hand, optimize drug administration based on pharmacological models, which are promising for improving intraoperative decision-making and preventing drug overdose [8].

Response surface methods have been introduced to depict the combined clinical effects of two or more drug concentrations [9-11]. The hypnotic and opioid concentrations are anticipated on the x and y axes, respectively, and the synergic drugs' effects, are displayed on the z axis known as isoboles. The Noxious Stimulation Response Index (NSRI), a new anesthetic depth index with a range of 100 to 0, has been described based on these response surface models. NSRI has been proposed as a derivative of probability to tolerate and to predict intraoperative response to a noxious stimulus [12,13]. NSRI 100 means 100% probability of response and if NSRI approaches to 0, it reflects 0% probability of responding to stimuli [14].

SmartPilot View also utilizes similar mechanism of action and the combined effects of hypnotic and opioid drugs are displayed on the SPV screen as a graph of 3 layers of isoboles in different grey tones, while the NSRI can also be displayed quantitatively [5,6]. The dark grey isobole reflects anesthesia depth to tolerate intubation and surgical incision, the mild-grey isobole for the remainder of surgery and the light-grey isobole for surgical closure. Actual and predicted (for the next 10 minutes) anesthesia levels are depicted as dots on isoboles graphically on SPV display, which enables a priori anesthesia level prediction, to adjust anesthesia depth (Figure 1).

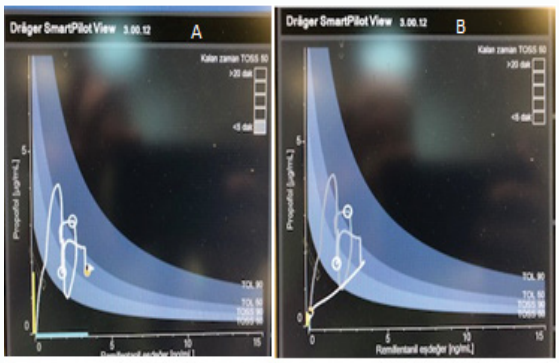

Figure 1: SmartPilot View (SPV) monitor's screenshot images. Noxious Stimulation Response Index (NSRI) isobole graphs showing the specific anesthesia levels on the SPV monitor during awake craniotomy. A: During craniotomy and tumor excision stages dark and mostly medium grey isoboles, B: Following dura opening light-grey isobole were preferred.

SmartPilot View also shows the patient's expected time of awakening. With the guidance of SPV, the patient was awakened just in time and fully cooperative for mapping. It took only 4 minutes for our patient to open his eyes and 5 minutes for LMA removal. These results are much shorter those previously reported findings [2]. Conte et al. analyzed BIS data of 27 consecutive asleep-awake craniotomies. Time to LMA removal following cessation of anesthetics was found in a range of 4 to 29 minutes, and the author's defined "short time for LMA removal following cessation of anesthetic drugs" as lower than 14 minutes. Such a significant difference can be attributed to the more reliable and effective working mechanism of SPV. Moreover, Conte et al. reported that higher BIS values at the time of cessation of the hypnotic drug were associated with short awakening. Inline with that finding, when compared to the BIS values of the patients in that study (a median BIS value of 49 (35-72)) our patient's extremely rapid awakening can be explained by his high BIS value (73) at the time of cessation of the anesthetics. Although the authors did not inform their anesthetic consumption, we assume that total consumed propofol and remifentanil in our case may be lower than theirs [2]. Our patient's comfort and tolerance even during shallow depth of anesthesia may be explained with good analgesia generated by dexmedetomidine and scalp block. At this point, there may be a limitation of SPV usage, as the software does not contain dexmedetomidine in its library so dexmetedomidine's contribution on hypnosis and analgesia could not be demonstrated.

Mai and colleagues also used effect site-target controlled infusion and SPV for anesthetic management in a patient who underwent AC for tumor excision [15]. Their report differs from ours in regard with anesthetic techniques and target anesthesia depths; we also used dexmedetomidine in addition to propofol and remifentanil and the authors preferred to keep BIS between 80 and 90, which they defined as a "semi-awake" state. Even so, both the authors and we found that having the depth of anesthesia displayed on the SPV monitor made it easier to maintain a steady level of anesthesia.

The level of anesthesia can be difficult to maintain during an asleep-awake craniotomy, especially when attempting to sustain a short period for the patient's awakening and predict recovery of consciousness, but the display of the level of anesthesia on the SPV makes it possible to maintain stable and quick awake anesthesia, and to coordinate the level of anesthesia required for the procedure, thus reduces anesthetic consumption. This case offered us a valuable experience, and we believe that using SPV during AC even under multimodal anesthesia can be beneficial. In conclusion, SPV during AC is advantageous in controlling the level of anesthesia required for the procedure's particular stages, as demonstrated in this case report.

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