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Reply to the commentary. Risks and tasks of awake craniotomy under conscious sedation

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Dear Editor,

We are responding to the questions raised by our colleagues from Warsaw (commentary by Surówka *et al*.) [1] following the publication of our study "Awake craniotomy with dexmedetomidine during resection of brain tumours located in eloquent regions" [2]. We appreciate this discussion, as it could enhance the management of patients undergoing the awake craniotomy procedure.

The proper patient selection for awake craniotomy (AC) under conscious sedation (CS) is an important factor that influences possible adverse events during the procedure. Therefore, in our study, a psychologist carefully evaluated each patient at least one day before the procedure to identify the risk factors of uncooperativeness, overwhelming stress, and an inability to understand and follow commands or answer questions. Patients with significant intellectual or psychiatric disorders were disqualified from AC. Some patients with somnolence, aphasia or motor impairment were recognised as candidates for AC under CS because they could cooperate and answer questions once aroused, which was confirmed by the psychologist. In our study, we defined patients as having a "good neurological status" if they passed all psychological tests preoperatively. Additionally, in our group, only one patient had a Glasgow Coma Scale (GCS) of 14 points, and the rest had a GCS of 15 points (Table 1 should show GCS 14–15: $n = 26$, and GCS 8–13, $n = 0$). However, in our opinion, GCS is not appropriate and sufficient to describe a patient's psychological and intellectual condition in the context of selection for AC, although commonly used to define neurological status [3, 4].

It may be surprising that even patients with previous psychiatric diseases, as well as those with a poor performance status (Karnofsky scale: < 70 points), were selected for AC and CS in other centres. A significant correlation between an increase in intraoperative emotional intolerance, and further complications (uncooperativeness, respiratory insufficiency, conversion to general anaesthesia with intubation, or other instrumental upper airway support) during AC and CS, below 70 points of the Karnofsky scale has been noted [5]. This issue was addressed in other studies, which included patients with various neurosurgical procedures of AC/CS, based on dexmedetomidine sedation [5–7].

AC under dexmedetomidine-based CS is routinely performed in our centre. To date, we have operated on about 70 patients for brain tumour resection, and we noted no adverse events. All those procedures were completed successfully without conversion to general anaesthesia or any impact on respiration. The psychological, psychiatric, and intellec-

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tual risk factors of adverse events associated with AC under CS were also of interest to us, but they will be presented in a separate publication.

Patients with severe comorbidities are at higher risk for conversion to general anaesthesia and instrumental airway support, during AC/CS. This includes obese (BMI 30–35) and severely obese patients (BMI 35–40). The issue is that surgery close to eloquent areas of the brain poses the risk of injury and postoperative disability. AC increases the chance of the best postoperative neurological and intellectual result, preservation of multilingual skills, instrument playing, artistic skills and personality structure. To date, only intraoperative performance helps to preserve these skills. It is better to open up the chance for the patient than to risk irreversible disability and social disclosure. The study by Garavaglia *et al*. [8] presented three cases of successful AC under CS: one with severe obesity, one with asthma and one with a lung tumour. Recently other authors [9] presented a unique case of a patient with Eisenmenger syndrome who underwent two operations within a short period: the first under general anaesthesia and the second, successful AC/CS for resecting a large cyst in the third ventricle that was causing obstructive hydrocephalus and a risk of a brain inclination.

We agree that "difficult airways" is the "pearl" of AC. The head fixed in the Mayfield clamp makes it challenging to instrumentally support the upper airways. This procedure requires constant high attention, preparation and training of all surgical team members. Only staff (such as the neuro-anaesthesiologist and anaesthetic nurses) who are aware and experienced in AC/CS nuances can perform such procedures. Manual support through a face mask, nasopharyngeal, oropharyngeal tubes, laryngeal mask airway (LMA), videolaryngoscope, and fibrescope must be on hand, ready to be used by trained personnel, if needed. This is recommended in all anticipated and unexpected difficult intubations [10]. In the presented cohort of patients, we based our anticipation of difficult intubation on standard criteria (Mallampati classification, thyromental distance, head and neck movement, inter incisor gap) and the above-mentioned instrumentation was always prepared. To date, there has been no need to support upper airways in presented cases, as well as in all other AC/CS cases for brain tumour resection in our centre.

A report by Gruenbaum *et al*. [11] studied and presented the successful, fast, and useful ways of upper airway support during AC. This report showed that the most successful and fastest method (32 seconds) was LMA (laryngeal mask), followed by intubation on bougie/through LMA insertion. Videolaryngoscopic intubation and nasal/fibrescope intubation took longer (60–90 seconds and 70–120 seconds, respectively). Cricothyroidotomy was effective only in 40% of cases in the context of ventilation, whereas tracheotomy done by an experienced surgeon was more effective [12]. Respiratory insufficiency, even asystole, was reported by some authors, during AC [12, 13]. Various factors can cause respiratory insufficiency, not only the sedative drugs, as commonly believed, but electrical stimulation, neurophysiological monitoring, aspiration, epilepsy with trismus and tongue biting with bleeding, severe comorbidities, obesity, other rear diseases, and medications [13, 14] All the above aspects should be analysed individually for candidates for AC [15].

Patient positioning for neurosurgical procedures is dictated by the need to assess brain lesions and the neurosurgeon's preference. In some cases, one can discuss altered positioning, if it is possible. Lateral, park bench, prone, semi-sitting, and sitting positions are commonly used in neurosurgery. The need for upper airway instrumentation in prone and park bench positions is of the highest risk of failed intubation and ventilation. In our centre, no patients were operated on in the prone position. In the paper, it was given as the concern of anaesthesiologists. However, the study of Takami *et al*. [5] presented cases in lateral, park bench, sitting and semi-sitting positions for AC/CS.

In our study [1], small doses of fentanyl or midazolam were used for patient comfort only for the closing phase of the surgery if needed. Five patients were given 0.05–0.10 mg of fentanyl in boluses of 0.05 mg and two patients received 1.0 mg of midazolam when neurophysiological and psychological assessments were finished. No impact on respiration was observed. Other reports on AC/CS show no adverse impact on such management [5, 9]. We did not use oxycodone during the surgery; it was used for postoperative pain control, but from observations on ropivacaine with adrenaline scalp block, excellent pain control up to 8–12 hours was possible.

We believe that the development of robotic surgery opens a new approach to anaesthetic management, and AC/CS is becoming common for more neurosurgical procedures. Even recently, CS has been used for other surgery, such as deep brain stimulus: for Parkinson's disease, obsessive-compulsive disorder, severe obesity, depression, psychiatric diseases, and many others. The indications for intraoperative neuro-psycho-monitoring are still increasing. There is an urgent need to develop a mode of anaesthetic management that is safe and comfortable for the patient, and that is suitable for all groups of patients, including those with severe comorbidities. We hope that our study is a small step in this direction.

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