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ARTICLE OF THE MONTH

Awake Craniotomy to Maximize Glioma Resection: Methods and Technical Nuances Over a 27-Year Period

Hervey-Jumper SL, Li J, Lau D, Molinaro AM, Perry DW, Meng L, Berger MS.
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In this September edition of the SNACC Article of the Month, we look at an article which describes a 27-year experience with awake craniotomies, delving into the technical details that characterize these operations. This is a descriptive article in which many features of awake craniotomies, including sedation regimens and airway management techniques, as well as operative features, are explored. Obviously, as techniques have changed and evolved over the years, this article proves to be very interesting to those of us who deal with this operation often. Shedding a bit more light on this paper is someone who has certainly published widely and is highly regarded in this realm, Dr. Pirjo Manninen. Pirjo holds the position of Consultant Neuroanesthesiologist at The Toronto Western Hospital, University Health Network in Toronto. She is Associate Professor at University of Toronto. Her research interests include clinical neuroanesthesia, with an emphasis on neuromonitoring, awake craniotomy, and cerebrovascular surgery. Of note, she is a founding member of the Neuroanesthesia Section of the Canadian Anesthesia Society and a longstanding SNACC member and contributor. Please enjoy this Article of the Month, and let your thoughts be known on ***SNACC LinkedIn feed*** the ***Twitter feed***, or the ***Facebook page***.

~John F. Bebawy, MD and Oana Maties, MD

Commentary

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Awake craniotomy for tumor resection has been used extensively to maximize removal of a tumor mass with minimal injury to eloquent brain function especially motor, sensory, speech, and language. This is especially true for gliomas, as these tumors have no distinct boundaries making a complete safe excision difficult. The greater extent of removal of tumor has been shown to improve patient outcome. In order to minimize neurological injury, the accepted standard technique for mapping of eloquent function involves direct cortical electrical stimulation while the patient is awake.

Throughout the years, there have been many developments and advances in the surgical and anesthetic management of these procedures. This article by Hervey-Jumper *et al.* is the story of the experience of a single neurosurgeon who has performed awake craniotomies for over 27 years. The purpose and goal in presenting this review was to identify the optimal techniques that he has used to maximize the perioperative safety and to decrease risk of failure of awake craniotomy for tumor surgery.

The history of awake craniotomy dates back to the original description by Horsley 120 years ago, followed by further developments by Penfield in the 1950s of the use of awake craniotomy for epilepsy surgery. In the 1980s, Ojemann further developed the concepts of mapping especially for language. Since then, many different techniques, surgical approaches, anesthetic techniques and agents have been used and studied.

The authors reviewed the process of an awake craniotomy from the beginning with patient selection, contra indications, and preoperative assessment. Data is presented from 611 patients. Anesthetics have changed through the decades from the era of “neurolept anesthesia,” to the ease of use of the combination of propofol and remifentanil, and more recently, the advantages of dexmedetomidine. There are different techniques of anesthesia which range from conscious sedation with no or minimal airway manipulation to “asleep, awake, asleep” procedures. The authors report their use of conscious sedation with a nasal trumpet used only as needed for all their procedures with only eight (1%) patients requiring a LMA. Their drugs of choice have been propofol and remifentanil, with the addition more recently of dexmeditomidine as an alternative. Generally, it is recognized that most experienced neuroanesthesiologists will have developed their own preferred techniques and consider their own approaches to be the safest and the best.

The process and evolution of the surgical techniques are well described in this review ranging from a craniotomy that had a wide exposure to the use of a more focused exposure encompassing the lesion with only a 2-4 cm margin. This allows for shorter duration of the procedure. Cortical mapping is the reason for an awake craniotomy to achieve maximum resection of the tumor without injury to the patient. Mapping techniques have also evolved over time to the current practice of site specific mapping and the recognition of the value of negative mapping. The acceptance of negative mapping (no positive response from the patient to the stimulation) allows for a smaller, more tailored craniotomy and tumor resection. In addition, the benefits of mapping are increased with the use of ECoG and subcortical mapping. Stimulation testing usually begins with the sensory motor cortex, followed by speech and language mapping.

However, failures of an awake craniotomy do occur, thus limiting the use or acceptance of the procedure by some centers. The failure rates have been quoted ranging from 2.3 to 6.4%. The complication that often leads to failure is an intraoperative seizure. The risk is high as many patients have a preoperative history of seizures. The occurrence of seizures is most frequently during stimulation testing. In their patient population the authors found the incidence of seizures to be 3% and all were rapidly terminated irrigation of cortex with cold Ringer’s lactate. Failure to complete the procedure occurred in three (0.5%) patients; one due to emotional inability of the patient and seizures in two cases. Other perioperative complications including stroke (0.7%) and hemorrhage (0.5%).

Overall the authors contributed the evolution of awake craniotomy techniques over 27 years to improved neuroanesthesia, improved surgical technique and mapping, better intraoperative seizure management and language mapping.