Awake Craniotomy: Comparison between Two Anesthetic Techniques

Thesis
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By

Amr Ali Abdel Aziz
MBBch, M.Sc. Anesthesia

Under Supervision of

Prof. Dr. Omar Wagih Abbas
Professor of Anesthesia
Faculty of Medicine, Cairo University

Dr. Mohamed Waleed Fouad Awad
Assistant Professor of Anesthesia
Faculty of Medicine, Cairo University

Dr. Hesham Abdel-Wahab Abul-Dahab
Assistant Professor of Anesthesia
Faculty of Medicine, Cairo University

Dr. Safinaz Hassan Osman
Lecturer of Anesthesia
Faculty of Medicine, Cairo University

Faculty of Medicine
Cairo University
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بسم الله الرحمن الرحيم

﴿قُلْ إِنَّ صَلَاتِي وَنُسُكِي وَمَحْيَايَ وَمَمَاتِي لِلَّهِ رَبِّ ٱلْعَالَمِينَ﴾

صدق الله العظيم

Dedication

I dedicate this work to my family, whom without their sincere emotional support, pushing me forward, this work would not have ever been completed.

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Abstract

Objectives: Our aim is to compare awake craniotomy using conscious sedation with asleep-awake-asleep technique using a laryngeal mask airway (LMA) for resection of supratentorial tumors encroaching on eloquent brain areas regarding anesthetic and neurological complications. **Patients & Methods:** Forty patients ASA I and II, aged 20-50 y harboring supratentorial tumors were included in this study. We excluded patients with confusion, extreme anxiety, morbid obesity, COPD, obstructive sleep apnea, complicated airway, end organ affection and history of allergy to local anesthetics or drugs used in the study. Surgeries done in non-supine position or lasting more than 5 hours were also excluded. **Results:** A better control of hemodynamics was observed in the AAA group. On average, the intraoperative mean arterial blood pressure and heart rate were 7% to 10% lower in the AAA group than the CS group and this difference was statistically significant ($P < 0.05$). Severe pain was encountered in 15% of the CS group versus 10% of the AAA group with no statistically significant difference between the groups ($P = 0.63$). The CS group had shorter mean operative time (231±16.5 min) than the AAA group (277±14.1 min). The mean difference was 46 minutes. **Conclusion:** conscious sedation technique for awake craniotomy is a relatively simple procedure that needs less time to perform and perhaps better achieves the goal of providing a smooth transition to alertness, and obviates the difficulties of airway intervention.

Key words:

Supratentorial craniotomies; Conscious Sedation; Scalp Block; Awake-Asleep-Awake technique

Abbreviations

ASA	American Society of Anesthesiologists
BBB	Blood Brain Barrier
BIS	Bispectral Index Scale
BUN	Blood Urea Nitrogen
CBF	Cerebral Blood Flow
CBV	Cerebral Blood volume
CGMP	Cyclic Guanosine Monophosphate
CMR	Cerebral Metabolic Rate
$CMRO_2$	Cerebral Metabolic Rate of Oxygen
CO_2	Carbon dioxide
CPP	Cerebral Perfusion Pressure
CSF	Cerebro-spinal fluid
CT	Computed Tomography
CVR	Cerebral Vascular Resistance
ECF	Extra Cellular Fluid
ECG	Electrocardiogram
ECoG	Electrocorticography
EEG	Electroencephalogram
$EtCO_2$	End tidal carbon dioxide
ETT	Endotracheal tube
GABA	Gama amino butyric acid
ICP	Intracranial Pressure
ICU	Intensive Care Unit
KPa	Kilo Pascal
LMA	Laryngeal mask airway
MAP	Mean Arterial Pressure
HR	Heart Rate

Mm Hg	Millimeter Mercury
MRI	Magnetic resonance imaging
NO_2	Nitrous oxide
O_2	Oxygen
OR	Operating room
$PaCO_2$	Partial Pressure of carbon dioxide
PACU	Post anesthesia care unit
PaO_2	Partial Pressure of oxygen
SPO_2	Oxygen saturation
TIVA	Total intravenous anesthesia
VAS	Visual Analogue Scale

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INTRODUCTION AND AIM OF THE WORK

Introduction

For decades, general anesthesia with endotracheal intubation has been the standard anesthetic technique for resection of brain tumors where vital parameters are controlled, airway is secured, analgesia and immobilization are ensured and – moreover – the intracranial pressure and acid-base status are controlled by mechanical ventilation. However, a great concern during surgery on the brain is how we can best preserve the person's level of functioning. This is especially important when an abnormality – such as brain tumor – lies close to an area of the brain that controls vital functions such as speech, movement. [1]

Indeed, evolution of general anesthesia in neurosurgery has permitted adequate control of vital parameters, neurological function and intracranial pressure; at the same time these aspects ensure optimal working conditions for the neurosurgeon; but intraoperative monitoring of functional lesions of the central nervous system is severely inhibited by general anesthesia: some higher cortical brain functions (i.e. Speech) cannot be monitored during surgery. Functional magnetic resonance imaging has produced considerable progresses in non-invasive mapping of brain functional areas, allowing very early tumor stratification. However, its employ during surgery is not feasible on a routine basis and devastating deficits may result from millimeter-sized errors during resection under general anesthesia, therefore intraoperative testing of language and motor function continues to be the gold standard for a radical surgical resection while minimizing eloquent brain damage. [2-4] This should alert the surgeon to the possibility of postoperative deficits to change the surgical strategy.

Thus the surgeon can resect tumor safely, with the knowledge that he has not damaged neurological function thus maximizing the tumor resection and minimizing neurological deficits. [5]

Awake craniotomy has been routinely performed for many years for epilepsy surgery. [6] It is now also used for the resection of tumors located near the cortex, which include motor strip and Broca's speech area in the frontal lobe of the dominant hemisphere where intraoperative neurological testing allows maximal tumor resection with minimal postoperative neurological dysfunction. [7-9] Despite the risks in such cases, maximal tumor resection seems to be an important determinant in prognosis, increasing median survival time and time to recurrence. This enables patients previously deemed inoperable to benefit from surgery. [7] It has been suggested that awake craniotomy should be a standard approach to certain supratentorial tumors. [10, 11]

A shorter hospital stay and shorter use of high dependency facilities result in considerable cost reductions and some centers are even advocating day-case procedures. [12, 13] Awake craniotomy has become an increasingly frequent procedure due to improved patient satisfaction with awake craniotomy for brain tumor surgery. [14]

The duration of the scalp blocks well exceeds any reasonable surgical time, so an additional benefit of this technique is a reduced requirement for opioid analgesia in the postoperative period and a more alert, cooperative patient for postoperative neurological testing. Emergence hypertension often seen at the time of extubation with general anesthesia is also avoided. [15]

Awake craniotomy literally means a procedure where the patient is awake during critical portions of the surgery so that his vital functions such as speech and movement can be monitored continuously. Along with this functional mapping may be done which ensures that the outer edges of the operation will not overlap surrounding eloquent areas of the brain that control speech and movement. [16]

The major challenge to the anesthetist is to have the patient comfortable enough to remain immobile through a long procedure but sufficiently alert and cooperative to comply with testing. Patient cooperation is critical for the success of the procedure. The analgesic and sedative drugs employed must have minimal interference with intraoperative neurological testing. [8]

The majority of awake craniotomy failures is preventable by adequate patient selection and avoiding side effects of drugs administered during surgery. Lack of intraoperative communication with the patient is an important cause of failure that requires conversion to general anesthesia. Careful patient selection, high levels of motivation and meticulous preparation are essential to the success of awake intracranial procedures. [17]

Current indications of awake craniotomies:

Over the past 10 years, brain surgery in awake patients has become an increasingly frequent procedure, even in patients of young age. [18] Indications have extended from lesions located in eloquent brain areas and epilepsy surgery to other procedures necessitating precise functional or electrophysiological testing, and to less specific procedures with no