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Research Article

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Anesthesia for Awake Craniotomy in Patients with Metastatic Brain Tumor in Ibadan, Nigeria

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Abstract

Introduction: *Craniotomies can be performed under general anaesthesia or with the patients awake known as awake craniotomy. Awake craniotomy requires that the patients be conscious and cooperative during intraoperative neurological testing.*

Methods: *This was a retrospective study of the anaesthetic protocol and the complications encountered during the perioperative management of patients who had awake craniotomy for metastatic brain resection in a developing country over a 3- year period. The information retrieved were demographic data, tumor location, anaesthetic technique and perioperative complications.*

Results: *There were ten patients comprising of 9 (90%) females and 1 (10%) male. The age ranged from 33 to 66 years with a mean age of 44.00 ± 12.02 years. Eight patients had metastatic brain tumor from the breast carcinoma, one from the lung and the last patient had metastasis from the colon. Four patients had tumor excision from the frontal lobe while 6 patients had excision from the parietal lobe. They all had solitary brain tumor. The anaesthetic technique used was conscious sedation and scalp block. Propofol and fentanyl were used for the conscious sedation while 0.25% Plain Bupivacaine and 1% Lidocaine with adrenaline (1: 200,00) were used for the scalp block. Patients were allowed to breathe spontaneously 100% oxygen. Two patients had respiratory depression with oxygen saturation less than 95% and laryngeal mask airway was inserted. Hypertension and tachycardia were seen in 4 patients, focal seizure in 2 patients and aphasia in 1 patient. Intensive care unit admission was for 24 hours and the today length of hospital stay was 2-7 days. No mortality in this series.*

Conclusion: *Conscious sedation with scalp block is a safe and a tolerable technique for awake craniotomy. The complications observed were minimal and can be treated to obtain a good outcome.*

Keywords: Awake craniotomy, Conscious sedation, Local anaesthesia, Metastatic brain tumor.

Introduction

Metastatic brain tumor occurs in approximately 20-40% of all cancers [1]. The primary sources of brain metastases include breast, lungs, renal cells, colon cancers and melanoma. The diagnosis of brain metastasis is often considered to be a sign of poor prognosis and without any treatment, the expected survival time of patients with brain metastasis is about one month [2]. The optimal therapy for patients with brain metastasis is steroids, anti-convulsant, radiation therapy, radio surgery and surgical resection [3].

Awake craniotomy dates back to the second half of the 19th century for the treatment of epilepsy under local anaesthesia [4]. The indication for awake craniotomy was later extended to the removal of lesions located in or near the eloquent areas of the brain and more recently the technique is being used for the removal of any supratentorial tumor regardless of the location in the cortex [4]. Awake craniotomy is said to be a misleading term as patients will require some level of sedation at some points of the procedure. The anaesthetic technique for awake craniotomy includes the asleep-awake- asleep technique, monitored anaesthetic care (MAC) and the awake -awake-awake (AAA) [5]. The asleep-awake-asleep is general anaesthesia given before and after brain mapping, the MAC also known as conscious sedation is the use of sedation for pain and anxiety whereas AAA uses regional anaesthesia and intravenous analgesia [5].

The challenge before the anesthetist is to provide adequate analgesia and sedation, respiratory and hemodynamic stability and safe airway with the patient alert and cooperative enough for intraoperative neurological testing.

Sacko et al. [6] compared patients who had craniotomy for brain tumor excision in the eloquent area under general anaesthesia with awake craniotomy and found that patient done under awake craniotomy had a significant better neurological outcome and quality of resection than those under general anaesthesia other benefits noted were shorter intensive care unit stay, shorter total length of hospital stay, less resource utilization and high patient satisfaction [6,7]. We present our experience of anaesthesia for awake craniotomy in patients with supratentorial metastatic brain tumor in a developing country.

Patients and Methods

This was a retrospective study of all patients who had awake craniotomy for metastatic brain tumor excision at the main operating room of the University College Hospital, Ibadan over a 3-year period (2016-2018). The operating room records of the patients were retrieved and the information obtained included the demographic data, tumor location, anaesthetic technique and incidence of perioperative complications, length of intensive care unit stays and the total length of hospital stay.

Anaesthetic Technique

The consultant neuro-anesthetist involved with the procedure visited the patient one day prior to the surgery to obtain the history, physical examination, explain the sequence of the procedure to the patient, also took consent for the procedure. Patients were pre-medicated with Tab Diazepam 5mg par oris at night and on the morning of the surgery.

On arrival into the operating room, intravenous (IV) access was established for IV fluid administration (crystalloid) and premedication with IV Dexamethasone 8 mg to reduce brain oedema, IV Ranitidine 50 mg and IV ondansetron 8mg to reduce nausea and vomiting. Routing monitoring included noninvasive blood pressure, heart rate, respiratory rate and oxygen saturation. Patients were either positioned lateral or supine depending on the surgical site and the pressure areas were adequately padded to ensure patient comfort. The anaesthetic technique was monitored anaesthetic care (conscious sedation) and scalp block. Intravenous fentanyl 1ug/kg and IV propofol 10-20mg were given to all patients at the beginning of the procedure to obtain analgesia and sedation. A mixture of plain Bupivacaine 0.25% (20ml) and plain lidocaine 1% (20 ml) in 1: 200,000 of adrenaline was used to block the supraorbital, auriculotemporal and occipital nerves (Scalp block). Mayfield head pin holder site and the proposed surgical incision were also infiltrated with local anaesthesia. Anesthetists had access to the patients face throughout the procedure.

Sedation was stopped during dura opening and removal of the tumor and surgeon communicated with the patient during intraoperative neurological testing. Conscious level was evaluated using the Modified Observer's Assessment of Alertness/Sedation scale [8] patients were maintained at level 3, at which the patient will respond after their name is called loudly or repeatedly; otherwise the patient was considered over-sedated.

Sedation and analgesia were given if there was excessive pain and during the closure of the skin. Laryngeal mask airway (LMA) was inserted if there was respiratory depression and desaturation, otherwise the patient was allowed to breathe spontaneously 100% of oxygen.

Intraoperative arterial blood pressure, heart rate, oxygen saturation and respiratory rate were monitored and managed accordingly by titrating propofol and fentanyl accordingly. Also, the frequency of patient that had over-sedation and other complications like hypertension (systolic blood pressure >30% of baseline), hypotension (systolic blood pressure <30% of baseline) tachycardia and bradycardia (heart rate >140 and <50 beats/min respectively) respiratory depression (respiratory rate <8 breath /min), desaturation (SpO2 < 95%) and nausea and vomiting were recorded.

Postoperatively patients were admitted into the intensive care unit where they were monitored and cranial CT was performed within 24 hours of surgery.

Statistical Analysis

Data were analyzed using Statistical Package for Social Sciences (SPSS) version 20.0, Chicago Illinois. Continuous data were presented as means ± standard deviation whereas categorical variables were presented as frequency and percentages.

Results

A total number of ten patients had awake craniotomy within the study period, 9 (90%) females and 1 (10%) male. The age ranged from 33 to 66 years with a mean age of 44.00 ± 12.02 years. Nine (90%) patients were in American Society of Anesthesiologist (ASA) class 1 and II, while 10% was ASA III. Eight (80%) patients had metastatic brain tumor from the breast carcinoma, one (10%) from the lung and colon respectively. Four (40%) patients had tumor excision from the frontal lobe while 6 (60%) patients had excision from the parietal lobe. They all had solitary tumor excision. The preoperative symptoms among the patients were seizure 10 (100%) and headache 8 (80%). Table 1

Table 1: Patients Demographic Data.

Variables	Total
Age (years) mean ± SD	44.0 ± 12.02
Gender M:F	1:9
ASA I II III	2 (20%) 7(70%) 1(10%)
Source of metastasis Breast cancer Lung cancer Colon cancer	 8 (80%) 1 (10%) 1(10%)
Presenting symptoms Seizure headache	 10(100%) 8(80%)
Tumor location Frontal lobe Parietal lobe	 4 (40% 6 (60%)
Lesion laterality Right hemisphere Left hemisphere	 7(70%) 3(30%)

The mean preoperative Packed Cell Volume (PCV) was 37 ± 4.0 % while estimated blood loss 300ml and no patient was transfused intraoperatively. The mean operation time was 3 hours. The mean

dose of propofol was 200 mg and the mean dose of fentanyl was 150 µg.

Intraoperatively two patients had airway obstruction due to over sedation with oxygen saturation was less than 95% and laryngeal mask airway was inserted. Focal seizures occurred in 2 patients, hypertension and tachycardia in 4 patients and aphasia in 1 patient. Postoperatively 2 patients had mild pain. Table 2.

Table 2: Perioperative Complications.

Complication	N=12
Hypertension	4 (33%)
Desaturation	2 (17%)
Over-sedation	2(17%)
Pain	2 (17%)
Seizure	2 (17%)
Hypotension	0%
Tense brain	0%
Nausea and vomiting	0%

No case of air embolism or cerebral oedema was noted. There was no mortality in this series. Patients were transferred to the intensive care unit where they all spent one day and thereafter transferred to the ward. Length of hospital stay was between 2-7 days.

Discussion

Awake craniotomy is a craniotomy where a patient remains awake during whole or part of the surgery. It allows for cooperation of the patient during certain neurosurgical procedures located near the Broca´s and Wernicke´s speech area, in order to minimize the postoperative functional sequelae. This procedure is challenging to both the neurosurgeon and the neuro-anesthetist as it requires a team work approach and a fully cooperative patient. Successful outcome of patients depends on the careful selection of patients, as not all patients are fit for the procedure, there must be adequate preoperative preparation of the patient and prompt treatment of complication.

Assessment of the emotional and psychological preparation of the patient for the procedure is important as well motivated and willing patients should be selected [9]. The patients were psychologically prepared for the procedure by counselling and reassurance in addition Diazepam was prescribed as anxiolytic premedication, although benzodiazepines may interfere with electro corticography but our patients did not undergo this test [10]. Some authors also avoided the use of sedative premedication to minimize respiratory complications [10-13].

The anaesthetic technique used in this series was conscious sedation and local anaesthesia similar to the works of many authors on awake craniotomy [10-13].

Conscious sedation involves the administration of sedatives and analgesia without the use of airway devices and the patients are allowed to maintain their airway and breath spontaneously. Propofol is the most commonly used anaesthetic agent in conscious sedation for awake craniotomy because of its easy treatability. It decreases cerebral oxygen consumption and reduces intracranial pressure. It has rapid onset and recovery from anaesthesia, antiemetic properties and gives clear headedness [10,12,13]. It is our choice of drug as an intravenous agent in this study. Although other intravenous anaesthetic agents such Ketofol, a combination of ketamine and propofol [14] and Dexmedetomidine [10,11] have also been used as sedative and analgesic during awake craniotomy in some studies. Propofol was used in addition with short acting opioid fentanyl in this study, although remifentanil is a good alternative because of its short half - life even after prolonged infusion with good hemodynamic stability [15]. However, Gignac et al [15] found no difference with the use of fentanyl and other newer opioids in terms of hemodynamics variables or incidence of complication.

Two patients had airway obstruction with oxygen desaturation with propofol/fentanyl combination due to over sedation in this series. Episodes of airway obstruction, desaturation and apnea have been observed in about 11.3% of patient receiving propofol/fentanyl in a study by Sokhal et al [10]. Manninen et al [16] reported 18% incidence of airway obstruction, five patients responded to jaw lifting, one required nasal airway and another required mask ventilation whereas Scukas et al [12] reported 1.8% airway compromised in an unsecured airway during awake craniotomy.

Patients that had airway obstruction in our series had laryngeal mask airway (LMA) inserted and patients were breathing spontaneously. Airway obstruction may require emergency airway intervention with either LMA [17] or endotracheal tube (ETT) or noninvasive ventilation pressure ventilation [18]. Due to this complication, some have advocated the Asleep -awake- asleep technique in which the airway is secured with LMA or ETT during the opening and the closing of the scalp whereas during the neurologic testing the patient is woken up and the LMA/ETT is removed [19].

Opioid administration may induce nausea and vomiting which may be extremely dangerous in unsecured airway as it may cause aspiration and raised intracranial pressure. Although no patient developed intraoperative nausea and vomiting in this study, this may be due to antiemetic premedication and the use of propofol in this study. Manninen et al [20] reported 0% incidence of nausea and vomiting similar to our study.

Local anaesthesia for awake craniotomy is said to be indispensable and is said to be the cornerstone of awake craniotomy, it helps to reduce the amount of sedatives and opioid used which reduces airway compromise [21]. Scalp block with long acting local anaesthetic agents will provide good and reasonable intraoperative and postoperative pain control for eight hours and longer. Bupivacaine 0.25% 20ml and lidocaine 1% 20ml mixture were used in this audit, similar to 40-60 ml mixture recorded by some authors, also ropivacaine and levobupivacaine were also used by some authors with success [21]. Bupivacaine also helps to blunt the hemodynamic response during craniotomy [22] Large volumes of local anaesthetic agents in a well vascularized scalp may lead to local anaesthetic toxicity, other complications reported with scalp block included hypertension, infection, hematoma, nerve injuries and inadvertent subarachnoid block [23], although no patient showed symptoms of local anaesthetic toxicity, nerve injuries or inadvertent subarachnoid block in this study.

Hemodynamic changes like hypertension and tachycardia were seen in some of our patients. Hypertension was also noticed in the study

by Sokhal et al, they observed hypertension in 16.7% of patients that had propofol/fentanyl during awake craniotomy [10]. Patients were treated with additional doses of fentanyl and propofol in our study. Hypotension and bradycardia due to the effect of propofol or fentanyl were not observed in this study probably due to the small sample size.

Two patients developed focal seizures. The intraoperative seizures may be due to cortical stimulation, treatment is usually with intravenous antiepileptic medication like phenytoin, propofol and midazolam or thiopentone in the secured airway. The incidence of intraoperative seizure has been reported to be 3-10% [10]. Sokhal et al observed the incidence of intraoperative seizure to be 4.5% with the use of propofol/fentanyl [10]. Propofol has anti-epileptic activities and this may have contributed to the low incidence in this study.

One patient developed aphasia (temporary) in our series a new neurological deficit, 9% of patients developed speech defect in a study by Sokhal et al [10] despite the use of electrocorticography. They attributed the high incidence of new neurologic deficit to the steep learning curve of the neurosurgeons.

All our patients spent only one day in the intensive care unit before been discharged to the ward, this is one of the advantages of the awake craniotomy observed in this series and some authors have even reported outpatient awake craniotomy in our center [24].

Conclusion

In our small series, scalp block with conscious sedation is a safe and well tolerated anaesthetic technique with few complications in patients with metastatic brain tumor. The purpose of awake craniotomy viz-a viz intraoperative motor testing, early returns of psychomotor performance and early discharge from intensive care unit were all observed in this study.

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