



Case Report

Challenging the myth of outpatient craniotomy for brain tumor in a Sub-Saharan African setting: A case series of two patients in Ibadan, Nigeria

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ABSTRACT

Background: The concept of modern neuro-oncology hinges on strategic innovation and refinement of procedures with the intention to enhance safety, optimize extent of tumor resection, and improve not only survival but also the quality of life as well. One of such refinements includes same-day hospital admission, as well as early discharge following brain tumor surgeries. The latter has been further stretched to same-day discharge in particular settings to reduce the risk of nosocomial infections, cut brain tumor surgery costs, and improve patients' satisfaction. We highlight the challenges and possible benefits of outpatient craniotomy in a sub-Saharan African setting portrayed by the presence of lean resources and a predominant "out of pocket" health-care financing.

Case Description: Outpatient craniotomy was performed in two selected patients harboring intra-axial tumors: a right temporal low-grade glioma and a left frontal metastasis. The clinical outcome proved successful at short- and long-term in both patients; complications related to surgery and same-day discharge were not reported.

Conclusion: Outpatient craniotomy is practicable and safe in resource-challenged environments and can further make brain tumor surgery cost effective and acceptable in carefully selected patients. Further prospective studies in similar settings but involving larger groups of patients are warranted.

Keywords: Awake surgery, brain tumor, intensive care unit, outpatient craniotomy, sub-Saharan Africa

INTRODUCTION

Surgical neuro-oncology has remarkably evolved through a series of technological innovations and refinement of procedures aimed at maximizing tumor resection (or ablation in the face of radiosurgery and thermal-targeted procedures) and improving patient's safety while preserving key neurologic functions. The latter breakthroughs have allowed the betterment of preoperative imaging techniques to include physiologic and functional imaging modalities. In the realm of microsurgery, crucial developments have been achieved, with the introduction of adjuncts such as neuronavigation, intraoperative magnetic resonance imaging (MRI), direct cortical and subcortical stimulation mapping, navigable intraoperative ultrasound, fluorescence-guided resection, cavitron ultrasonic aspirator, laser, and neuroendoscopy.^[3,12] The structure and workflow during the postoperative period are also undergoing refinement, leaning toward short hospital stays, reducing the period of admission into the intensive care unit (ICU),^[10]

and early discharge from the hospital.^[22,28,31] The concept of performing brain tumor resections on an outpatient base has been undergoing evolution but has been largely limited to the developed world^[1,5,17,23] with no record of such an undertaking to our knowledge in a low- or middle-income country. We, therefore, wish to present the feasibility of this concept by reporting our experience with two patients undergoing outpatient craniotomy, highlighting the possible benefits of the procedure and some of the challenges posed by our practice environment in sub-Saharan Africa.

MATERIALS AND METHODS

The patient selection took place at the neurosurgical outpatient service of a 800-bed hospital, located in an urban setting with a population of about 3 million (University College Hospital, Ibadan, Southwestern Nigeria). The service serves as a referral center to a wide catchment area; most of the patients pay for their care from “out of pocket.” Case selection was structured with institutional approval and according to the criteria suggested by Carrabba *et al.*^[11] In addition, we followed the recommended protocol by Bernstein’s group^[11] in both cases. Since both patients had supratentorial intraaxial tumors, preserved neurological function, and no significant morbidities with a Karnofsky performance status (KPS) of >70 at the time of surgery, we opted for an awake procedure. The procedure was extensively discussed with the patients along with their chosen caregiver. The caregivers were educated enough to understand the procedure and instructions regarding what to look out for in the postoperative period, especially the features of neurological deterioration such as new deficits such as weakness of the limbs, seizures, and worsening level of consciousness. Both patients lived within a 60-min drive to the hospital, and their homes were reportedly comfortable. The anesthetist (OKI) reviewed the patients in their outpatient clinic and discussed intraoperative anesthetic aspects with them. Patients were admitted to the neurosurgical ward at 6 am on the day of the surgery. Resection was carried out according to a craniotomy protocol that was phased in an asleep-awake-asleep fashion with anesthesia achieved with intravenous propofol/dexmedetomidine and fentanyl with oxygen through facemask. Both patients had perioperative prophylactic antibiotics and dexamethasone. The patients were positioned supine with the head placed in a head ring. The scalp incision was marked and isolated with sterile drapes and then infiltrated with 0.25% bupivacaine and epinephrine in a regional block fashion.^[29] We did not have the privilege of an intraoperative neuronavigation. We preceded with uncomplicated resection in both cases and left no drain at the surgical site, and the wound was closed in a primary fashion. To mitigate concerns related to perioperative pain (as well as other postsurgery complications),^[20] patients were clinically assessed on postoperative days 1 and 3.

CASE SUMMARIES

Case background

The first patient was a 36-year-old female, with a prior history of surgery and chemotherapy for a left breast carcinoma about 13 months earlier. She presented with a 6-month history of headaches with intermittent vomiting, progressive bilateral visual loss, and right-sided weakness. Her visual acuity was decreased to perceive only hand movement on the right side and no light perception on the left side with evidence of bilateral optic atrophy and right hemiparesis. There was no evidence of local disease recurrence at the primary site at her left breast. Brain MRI revealed a solitary left frontal mass with moderate contrast enhancement and perilesional edema [Figure 1]. Given the high suspicion for a neoplasm, she underwent awake craniotomy with gross total tumor excision. Histology was reported as metastatic carcinoma from a likely breast primary.

The second patient was a 33-year-old male, who presented with a 3-month history of headache. Prior to presentation, he reported an episode of alteration in the level of consciousness, from which he fully recovered. He was otherwise neurologically intact. Brain MRI revealed a mixed intensity right temporopolar mass with a cystic anterior portion showing peripheral enhancement [Figure 2]. He was a Jehovah’s witness and hence refused any form of blood transfusion. He was operated on employing an awake craniotomy protocol, and we achieved a gross total excision. The histology was reported simply as a low-

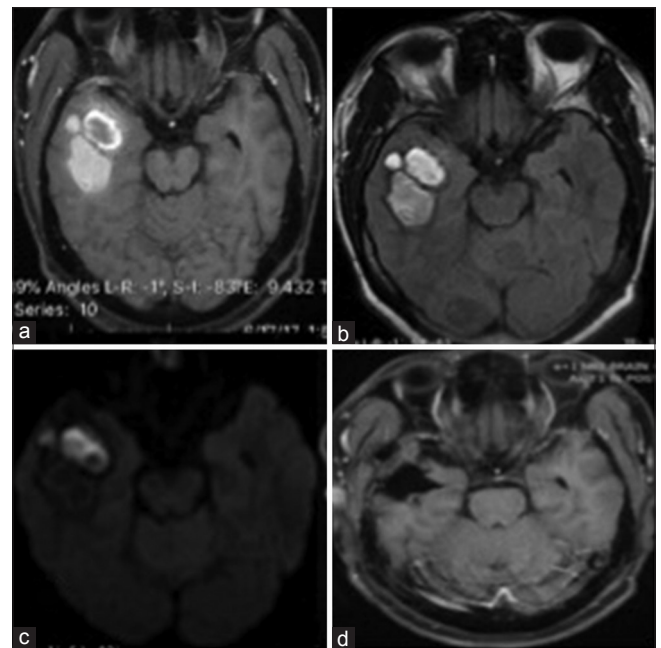


Figure 1: A left posterior frontal isodense tumor on T1-WI (a), some homogenous contrast enhancement (b), significant perilesional edema (c), and gross total tumor excision on postoperative computed tomography scan (d).

grade glioma without molecular profiling, as a facility for this was not available.

RESULTS

The operative time was about 4 h in each case. Patients were admitted to a postoperative care unit and observed for about an hour before transfer to the neurosurgical ward, as the hospital does not presently have a daycare admission unit. The patients were observed postoperatively for a minimum of 6 h before discharge

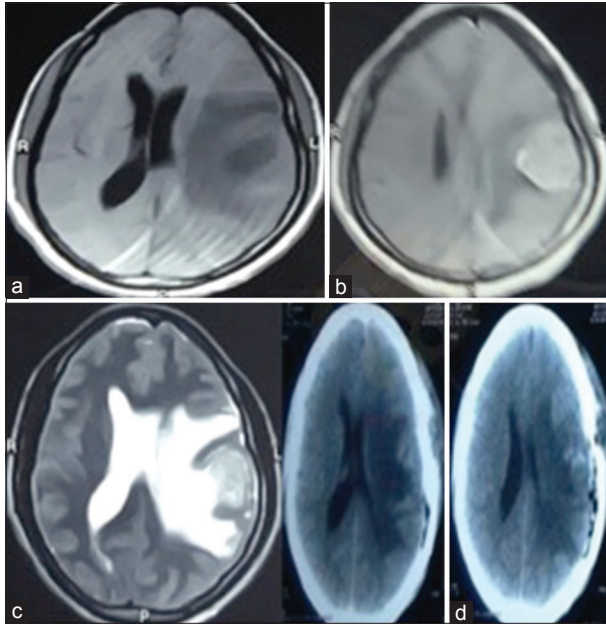


Figure 2: A right temporal tumor with mixed intensity suggesting cystic and solid portions with the anterior portion (a) demonstrating peripheral ring enhancement (b) and some restriction on diffusion-weighted image (c) Postoperative magnetic resonance imaging shows no recurrence at 8 months (d).

home in the postoperative unit using standard neurosurgical protocol. They were both discharged on analgesics and steroid, which was tapered off after review on the 1st day postsurgery. The first patient had a postoperative computed tomography (CT) scan done after being discharged home on the 1st day postoperative (due to hospital-related issues). She was clinically and neurologically stable, with no new postoperative deficits and an unchanged KPS at discharge. There was a financial constraint to do a postoperative MRI, which also delayed the start of radiation therapy to the tumor bed and whole brain radiation therapy. Review at the neurosurgery clinic, 6-week postoperative, showed no new neurologic deficits. The second patient had a postoperative CT scan before leaving the hospital as well as a follow-up MRI 8-month postsurgery, which did not show any evidence of tumor recurrence. He did not have postoperative radiation or chemotherapy.

Both patients expressed satisfaction with the awake craniotomy and the process of being discharged on the same day of surgery.

DISCUSSION

One of the fundamentals of elective brain tumor craniotomy is the stratification of patients between those requiring admission to the ICU postoperatively and those that do not. Admission into the ICU following brain tumor surgery allows for close monitoring, early detection of complications, and prompt intervention. Setting up and maintaining neuro-ICUs, however, are rare in developing countries and expensive,^[4,24,25] particularly so within the context of low-income economies^[34] where a fully functioning ICU seems to be an exception rather than the rule.^[35] There seems to be an increasing attempt at utilizing intermediate care units known as high dependency units or step down neurosurgical units rather than the ICU for the postoperative care of neurosurgical patients who are not a high risk for neurological deterioration and who are not in need for mechanical ventilation.^[24,36] The latter units have been shown

Table 1: Summary of outpatient craniotomy for brain tumors.

Author	Procedure	Successful discharge as planned (%)	Complications (%)	Comments and reasons for inpatient conversion
Bernstein 2001	Craniotomy (46 patients)	89	11	1 patient had hemiparesis, 1 had a seizure, 1 had an air-embolus, and 1 was a family request
Blanshard 2001	Craniotomy (15 patients)	88	6	1 patient had a seizure, 1 headache, and 1 nausea
Grundy 2008	Craniotomy (11 patients)	82	18	The patient had transient hemiparesis, 1 had a seizure, and 1 had intraprocedural hemorrhage after biopsy
Boulton 2008	Craniotomy (145 patients)	94	5	No patient suffered an adverse event with alteration in the outcome due to planned outpatient discharge
Purzner 2011	Craniotomy (249 patients)	93	7	1 patient had worsening neurological deficit, 1 headache, nausea, and 2 had seizures and a hemorrhage
Au 2006	Craniotomy under general anesthesia (46 patients)	86	11	Reasons for admission were seizure, aphasia, wound hemostasis, cognitive impairment, and new weakness

to be cost effective without compromising the care of patients particularly when incorporating neurocritical care specialists.^[24] Intermediate care units are generally not available in developing nations such as ours in Africa due to the resources needed to maintain such a unit as well as a separate ICU.

There are valid concerns regarding the potential development of neurologic and/or nonneurologic complications following elective craniotomies for brain tumors. Neurologic complications include development of new cranial nerve or motor deficits, language problems, aphasia, seizures, and deterioration in the level of consciousness. These complications are often secondary to intraoperative neural injury, intracranial hematoma (particularly in the tumor bed and from extra-axial hematomas), and brain swelling. The peak of the occurrence of postoperative neurologic complications has generally been alluded to occur within the first 6 h after surgery, particularly in cases of postoperative hematoma following supratentorial surgeries for brain tumors.^[30] Lonjaret *et al.* found in their series of 167 patients, that of the 26 patients that develop complications within the first 24 h, 85% of them developed their complication within the first 2-h postsurgery. Furthermore, often patients who required urgent CT scans, three (constituting 2% of the total study population) had developed a cerebral hematoma which, however, did not require evacuation.^[21] Based on the preceding arguments, there have been proposals that fundamentally agreed that discharging patients after elective craniotomy, from the ICU to the ward, would appear to be an acceptable policy. Such transfer was assumed safe once a patient had fully recovered for 6 h or more postoperation.^[10,30] Such a management algorithm can also help to make ICU beds more readily available for both elective and emergency procedures, thus improving efficiency (and bed utilization) in the setting of limited resources.

The understanding that most significant complications following craniotomy for brain tumors usually occur in the first 6-h postsurgery served as the key motivation not only to discharge patients from the ICU to a ward level setting but also allowed a change in practice toward an early discharge from the hospital. This essentially made it possible to prepare for patients being discharged as early as postoperative day 1 or 2.^[28]

Early success with this change in practice has moved brain surgery toward an already established process of outpatient procedures in other specialties/subspecialties.^[14-16,18,19] Taken together, it has been demonstrated that these measures can reduce hospital stay, thereby reducing the risk of nosocomial infections as well as being cost effective for both the patient and the system.

Aside concerns of immediate deterioration postoperatively, any prolonged hospitalization is usually prophylactic and often not therapeutic in, though it is acknowledged that a small percentage of patients may experience delayed deterioration from the hematoma. Such late complications may occur from extra-axial hemorrhage or bleeding into the resection site, cerebral edema, or electrolyte derangement. The big question, therefore, remains:

“should we continue to keep patients in the hospital mainly for precautionary reasons?”

The leap to perform outpatient craniotomies for brain tumors has been mainly championed by the Toronto group of Bernstein is the most senior author of the paper and has been the champion of the procedure not the first author of the paper.^[11] (Table 1 summarizes the outpatient craniotomy for brain tumors excluding biopsies). From an initial pilot experience with 46 patients,^[5] this group has progressed to a more recent report of 136 craniotomies which were successfully scheduled and completed as an outpatient awake craniotomy.^[7] Another study yielded a 92.8% success rate in a cohort of 249 patients who underwent an outpatient craniotomy.^[23]

A more recent report included 44 further cases, which were conducted under a day surgery protocol. In this study, craniotomy for brain tumor was done under general anesthesia and successfully completed in 38/44 patients (86%).^[11] These reports validate the fact that neither size and location of the tumor nor anesthesia technique (awake or general) are limitations to the ability to perform craniotomy as an outpatient procedure. Supportive arguments for the consideration of brain tumor biopsies and craniotomies being performed as outpatient procedures were put forward by Grundy *et al.* who adapted some of the criteria from the Toronto group but tailored them to their practice and system.^[17] Indeed, outpatient craniotomy has also been successfully deployed in the care of brain aneurysms.^[16]

Our initial experience reported here is, to the best of our knowledge, the first to be documented in any low- or medium-income economy such as sub-Saharan Africa. We elected to perform surgery in our patients employing awake procedures, though our resections were done without intraoperative brain mapping. Such added high-performance technology can be utilized in more “customized” hospital settings, which are more readily available in developed countries. We are aware that while intraoperative brain mapping further maximizes the advantages of awake craniotomy, its other conveniences include avoidance of the negative effects of general anesthesia; shorter hospital stay favoring same day discharge, which was our goal.^[9,27] Further steps may be taken, if the resource allocation will allow us to do so.

The reports from the Toronto and Southampton groups have involved a substantial number of patients; yet, these studies have failed to expose any significant difference in complication rates in their outpatient craniotomy cohort compared with those patients who were admitted to the inpatient ward,^[7,17,23] thus emphasizing the safety in carefully selected patients as ours.

None of the two patients in our present report required readmission or developed a new neurologic deficit. This is important when you consider that high mortality rates have been reported in neurosurgical procedures in studies from across Africa.^[6] It is also known that, in sub-Saharan Africa, surgery is often seen as a therapy of last resort, which is largely due to the perception that surgical patients have poor outcomes.^[8] Thus, safely performed,

cost-effective outpatient brain tumor surgeries can contribute to restore confidence in the local patient population, and overtime possibly reduces the rate of delayed presentations. There is also the predictable advantage that outpatient craniotomy for brain tumors can increase the throughput of patients and reduce cancellation of surgeries^[1] particularly in a system that is challenged with a paucity of neurosurgical and anesthesia manpower coverage as well as limitations in operating times.^[13,26]

Some of the other arguments put forward in favor of outpatient craniotomy for brain tumor include (i) avoidance of overnight hospital stay (=cost reduction) and (ii) the comfort of enjoying one's privacy at home.^[28,32] Indeed, outpatient craniotomy has been noted to reduce the cost of surgery and impact the total hospital cost of care.^[17,33] This may be attractive to low- and middle-income economies such as ours, where health-care payment is mainly out of pocket with very low percentage of the population supported by any form of health-care insurance (often not covering neurosurgical fees). In our experience, the difference in the cost of care for a brain tumor patient was operated under general anesthesia, admitted into the ICU for 24 h, and discharged from the hospital after 5–7 days (common praxis at our institution), and the cost of doing the procedure under awake craniotomy without brain mapping as an outpatient procedure is about \$500. The impact of the cost differential is appreciated when considered in the context of the minimum wage for the country, which is about \$50 per month and the fact that a significant percentage of the population lives below the poverty line, defined as living on <\$1.90/day.^[2] This is aside the indirect cost of loss of income by family members.

Enjoying the comfort of home during postsurgical care certainly depends on the access to proper infrastructure and reliable community services; its relevance becomes more apparent in low-income economies where the living conditions may not be suitable or convenient for this type of postoperative care.^[32] It may thus be part of the selection criteria, as indeed it was for our decision-making. We also had to ensure that the caregiver/family has sufficient means of private transportation to/from the hospital. This matters greatly in our environment because emergency transport services such as ambulances and paramedics are largely absent which may narrow the spectrum of patients that can be offered outpatient procedures. It is also of great importance to note that patients, including the ones we have presented, have reported high levels of satisfaction with their outpatient craniotomy, despite concerns from previous studies relating to perioperative pain control and postoperative care.^[20]

CONCLUSION

We have discussed the practicality, safety, and cost-effectiveness of awake outpatient craniotomy for brain tumors in two carefully selected patients, in a resource-challenged environment. Further prospective studies in similar settings but involving larger groups of patients are warranted and encouraged.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patients have given their consent for their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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Commentary

This two-case study describes the complex reality of oncology patients requiring neurosurgical intervention in a sub-Saharan, resource-restrained environment. The authors have delicately proposed a patient-focused, cost-effective surgical approach aimed at reducing post-operative inpatient care while providing optimal neurological outcome and sustained quality of life.

A potential landmark in neurosurgical care. Prospective studies with large-scale settings are encouraged and warranted.

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