Is outpatient brain tumor surgery feasible in India?

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ABSTRACT
The current trend in all fields of surgery is towards less invasive procedures with shorter hospital stays. The reasons for this change include convenience to patients, optimal resource utilization, and cost saving. Technological advances in neurosurgery, aided by improvements in anesthesia, have resulted in surgery that is faster, simpler, and safer with excellent perioperative recovery. As a result of improved outcomes, some centers are performing brain tumor surgery on an outpatient basis, wherein patients arrive at the hospital the morning of their procedure and leave the hospital the same evening, thus avoiding an overnight stay in the hospital. In addition to the medical benefits of the outpatient procedure, its impact on patient satisfaction is substantial. The economic benefits are extremely favorable for the patient, physician, as well as the hospital. In high volume centers, a day surgery program can exist alongside those for elective and emergency surgeries, providing another pathway for patient care. However, due to skepticism surrounding the medicolegal aspects, and how radical the concept at first sounds, these procedures have not gained widespread popularity. We provide an overview of outpatient brain tumor surgery in the western world, discussing the socioeconomic, medicolegal, and ethical issues related to its adaptability in a developing nation.

Key words: Ambulatory surgery; awake craniotomy; brain biopsy; brain tumor; craniotomy; day surgery; outpatient neurosurgery

Introduction
Neurosurgery had significantly evolved by the turn of the century, 16 years ago. The availability of better operative tools, enhanced visualization techniques, and safer anesthesia capabilities have improved patient outcomes. Patients are more intimately involved in the decision making of their care and take responsibility in the process of recovery. Surgical outcomes are now focused on quality of life and preservation of neurological function, rather than simply on survival and surgeons’ interpretation of operative results.

With the advent of awake craniotomy and widespread use of electrophysiological monitoring, brain tumor surgery has become safer, and the postoperative recovery quicker. This has resulted in fewer postoperative complications and patients being discharged earlier.

This evolution has also brought forward the realization that prolonged hospital stay predisposes patients to nosocomial infections and thromboembolic complications, and the overall opinion that patients do better at home than they do in the hospital. This prompted the senior author to study the safety and efficacy of brain tumor surgery performed in the ambulatory setting starting 20 years ago; the details of his experience and personal statistics are tabulated as part of Table 1. Outpatient/ambulatory or day case surgery is defined as a patient arriving at the hospital the morning of their procedure,
Immediate Complications of Brain Tumor Surgery

The primary goal of surgery is safety and efficacy. Smaller incisions, precise microneurosurgical techniques, a move toward more aggressive resection of intra-axial tumors, and meticulous hemostasis have led to fewer complications, decreased postoperative pain, earlier mobilization, and decrease in hospital stay. Despite these advances, adverse events do occur—the common ones being hemorrhage, seizures, edema, new neurological deficits, cerebrospinal fluid leak, and wound infection. Taylor et al.,[20] have shown that most intracranial hematomas occur within the first 6 hours of craniotomy or stereotactic biopsy. In 2305 patients undergoing freehand or stereotactic biopsy, elective or emergency craniotomy, or posterior fossa surgery, 50 (2.2%) developed a hematoma. Clinical deterioration as a result of postoperative hematoma occurred within 6 hours of surgery in 44 patients and more than 24 hours after surgery in only 6 patients. The first group likely represents continued active bleeding at the operative site and, the second, patients in whom active bleeding is likely to have come to a halt—their clinical deterioration may represent swelling and edema formation around the hematoma. The DSU protocol requires a computed tomography (CT) scan done in all patients at 4 hours after surgery and conversion to an inpatient status if there is significant hemorrhage or edema, even if the patient is clinically well. Nonetheless, all neurosurgeons have encountered a delayed postoperative hemorrhage, after a clean CT scan at discharge, at least once in their life. Whether these anecdotal experiences warrant regular prolonged hospital stay is a matter of debate. Risk factors for hemorrhage include hypertension, coagulopathies and being discharged the same evening usually before 9:00 PM, avoiding an overnight hospital stay.

While this has been routinely performed for spinal procedures since the 1980s, its introduction to intracranial surgery has not been far-reaching, obviously, primarily due to concerns of safety. Neurosurgical complications outside of a controlled environment of the hospital can be devastating.[18] Despite this knowledge, is there a justified role in performing outpatient brain tumor surgery?

In this review, we analyze the results of intracranial procedures performed via a day surgery unit (DSU) protocol. We also study the impact it has on patient satisfaction and outcome. We review its economic benefits on exponential health care costs and try and gain a sense of understanding of whether or not this protocol would be possible to emulate in India.

To our knowledge, there are no centers performing outpatient brain tumor surgery in India. This article addresses the possibility of doing so by reviewing outcomes and establishing a protocol, as well as discussing the hurdles that might have to be overcome into making this a successful initiative. This would hopefully stimulate the use of this very patient-friendly and resource-friendly procedure.

### Immediate Complications of Brain Tumor Surgery

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and hematological abnormalities, intraoperative hypertension and blood loss, and deficiencies in hemostasis. These patients are selected for an outpatient protocol on an individualized basis.

Postoperative edema peaks around the second or third day and occurs in <10% of the patients. Whether there is clear value in observing these patients through the period of swelling is not clearly established. Sughrue et al. successfully discharged 68% of all their brain tumor patients on day 1 or 2; 17% of cases had infratentorial lesions. Patients with infratentorial tumors are excluded from the DSU protocol. However, none of their readmissions were due to postoperative swelling. The overall rate of readmission for postoperative complications was 4.2%, compared with 4% for patients discharged on or after postoperative day 3, which was the standard discharge time for the authors.

There is no level 1 evidence to suggest that antiepileptic treatment administered prophylactically is effective in preventing post-craniotomy seizures. The incidence of postoperative seizures varies from 2–10%, most of which occur in the immediate postoperative period. Again, whether there is any additional benefit of observing patients for a seizure beyond 6 hours is circumspect.

**Rationale for Outpatient Brain Tumor Surgery**

The privacy of one’s own home on the first postoperative day allows for overnight observation and assistance by family members and friends without disturbance by other inpatients and without the possibility of hospital-based complications. While this is a luxury in first world countries, in India, where most poor patients have deplorable conditions at home and they travel long distances to live in motels or guesthouses, the comfort of a general bed in the hospital may provide more gratification and security.

Avoidance of an overnight hospital stay often alleviates the psychological impact of brain tumor diagnosis and treatment, and high patient satisfaction is demonstrated following an outpatient craniotomy. Compared with standard hospital experiences, the other potential benefits include decreased health care costs, less exposure to nosocomial infections, less risk of thromboembolism, limited use of extensive postoperative care, and less risk of iatrogenic complications from medical errors, a phenomenon becoming more widely recognized as a relatively common occurrence in hospitals. Patients have reported that having brain surgery done as an outpatients made their disease seem less serious, which contributed to their emotional well-being and aided in the recovery process. With more current data emerging on the benefits of early discharge, not only to the patient but also to the health care providers and hospitals, this procedure will gain further significance and importance.

Despite established safety of the procedure, the protocol has not gained widespread popularity among surgeons. Presumably, they still believe that delayed neurological worsening after 6 hours occurs at a high enough frequency to warrant closer observation in a hospital. In a survey of the members of the American Association of Neurological Surgeons and the Congress of Neurological surgeons, only 6% performed outpatient image-guided brain biopsy, even though the majority agreed that discharge on the same day would be safe and reasonable. Such a survey needs to be conducted among Indian neurosurgeons to learn about their views on whether such a protocol would be feasible. Reluctance to an early discharge also probably exists in institutes that conduct brain tumor trials because protocols require a magnetic resonance imaging (MRI) to be done in the first 24–48 hours.

**Patient selection and protocol for outpatient brain tumor surgery**

Choosing the correct candidate is of paramount importance for the success of this protocol. This decision is made preoperatively in consultation with the patient and their family. It involves a detailed education of the procedure, the expected complications, and discussion of the flexibility of conversion to an inpatient state anytime the patient is not ready to go home. A meeting with the anesthetist and the nurse practitioner along with provision of a pamphlet describing the steps of the procedure further alleviates patient concerns. While such a detailed discussion may be possible in a Private hospital setting, and anesthesia evaluation is routinely done on an outpatient basis in public hospitals, these cases are more often designated as urgent “add ons.” Thus, the patient may already be an inpatient if his ailment has been newly diagnosed in the emergency. In addition, fitness for surgery is most often assessed after admission to the hospital because consults to all services are promptly and easily obtained; necessary investigations are performed once the patient is admitted.

The inclusion and exclusion criteria for outpatient brain tumor cases are as follows:

**Inclusion criteria**

- Supratentorial tumor.
- Patient caregiver available.
- Patient staying relatively close to the hospital (i.e., no more than 1 hour away even in peak traffic).
Exclusion criteria

- Already an inpatient.
- Significant cardiorespiratory morbidity.
- Airway management concerns (e.g., sleep apnea).
- Uncontrolled seizures or poor neurological status.
- Long procedure expected (greater than 4 hours).
- Psychological unsuitability/patient preference.

These criteria limit the type of cases that can be done in the ambulatory setting. The majority of tumors are gliomas, metastasis, and meningiomas. Obviously, skull base meningiomas and transsphenoidal procedures are excluded. The age of the patient and the kind of anesthesia administered (local or general) do not feature in the decision for day care surgeries. The nature and location of the tumor (e.g., middle fossa floor tumors tend to be associated with more pain), the understanding and acceptability of the patient and the motivation of their caregiver help to determine if they would be candidates for outpatient brain tumor surgery. Increased intracranial pressure is not an exclusion for day surgery craniotomy. To reemphasize, not only a good patient selection criteria but a good discharge criteria are also equally important. The decision to discharge on the same day of surgery ought to be a mutual decision made by the patient and the physician, including both the surgeon and the anesthetist.

Key steps in the protocol

The important thing to note is that the protocol should be modified according to individualized institutions and patient cohorts.

- The patient is admitted to the DSU at 5:30 AM and undergoes a limited sequence magnetic resonance imaging (MRI) for the frameless navigation
- The use of arterial lines, urinary catheters, and central venous lines in the operating room is extremely rare in awake craniotomy cases. Most often, all intravenous access is through peripheral lines
- Prophylactic antibiotics and steroids are given prior to the skin incision. Anticonvulsants are administered only in the cases with prior seizures. Mannitol is almost never administered
- Electrocardiography and pulse oximetry monitoring is performed. The patient is positioned as desired with the head fixed in a Sugita head rest and the procedure is performed under the appropriate anesthesia for the given case (local or general). Microneurosurgical technique is used in every case
- Electrophysiological monitoring/cortical mapping is carried out during the procedure
- After surgery, the patient is monitored in the postoperative anesthetic care unit for 2 hours and then transferred to a DSU for an additional 4 hours at the least
- A computed tomographic (CT) scan is performed 4 hours after surgery and a physician assesses the neurological status, fitness for discharge, and adequate control of pain and nausea [Figures 1 and 2]
- Patients are most often discharged 6 hours postoperatively with very clear and strict instructions to return if any new signs or symptoms develop
- Patients who do not fulfill any of the above criteria, or the CT scan demonstrates undue hemorrhage or edema, are admitted to the ward for overnight monitoring
- Patients are followed-up in the clinic at about two weeks, documenting their experiences of the procedure, and appropriate referrals are made (e.g., neuro-oncology, radiation oncology, imaging, etc.).

Supportive care

Nurses play a vital role in facilitating a shift in outpatient neurosurgery toward a more patient-care focused environment. By providing information and education to patients and families, nurses have an enormous potential to improve satisfaction and outcomes for patients undergoing these procedures. Thoroughly preparing patients for their surgery and helping them manage their care postoperatively are the key steps in decreasing complications and readmission. The nurse also takes over the role of the counselor and addresses all the concerns of the patient. This role requires constant and repetitive explaining, interpreting the patient’s questions, and reinforcing the facts of the procedure to the patient to have a successful outcome. However, this involves training of additional staff in an already resource-starved environment.

Patients usually have concerns related to the fear of surgery, complications, and levels of recovery. At discharge, they want to know about their medications, how to recognize complications, and what preventive measures they could take to avoid them. A dedicated nurse/nurse practitioner

Figure 1: (a) Enhanced axial magnetic resonance imaging of a 67-year-old female patient with a recurrent left temporal glioblastoma who underwent an awake craniotomy. (b) Computed tomography done 4 hours postoperatively after awake craniotomy and 2 hours prior to discharge from the day surgery unit
Methods utilized to facilitate safety and efficiency of domiciliary care

Patients with massive tumors and those undergoing lobectomy were excluded from the study. Discharge was allowed provided all patients were seen by the surgeon before discharge to ensure that there was no neurological deterioration and also to not report. Patients were given a prescription for analgesia and a steroid taper, along with written instructions for pain control, medications for pain, nausea, and brain edema. They are advised on how to identify a seizure, a new onset neurological deficit, and given the contact number of a nurse who will either address further concerns at home or facilitate their return to the emergency, if deemed necessary, or even if a doubt is expressed by the patient or his/her relatives. Contact information for the neurosurgeon on call is also given to the family. This education is provided to all the patient’s relatives irrespective of the nature of the tumor because there is no additional personal home care provided by medical personnel. Only in the initial two studies on outpatient craniotomy and brain biopsy did a home care nurse visit the patients on the evening of the biopsy, whereas in another, a nurse routinely called the patients’ home to monitor their progress. There are no technical adjuncts in providing home care as well. If the operating team feels that the patient cannot be managed at home by their personal caregiver then they are admitted to the hospital. Table 1 describes the few prospectively conducted trials on outcomes implementing the outpatient brain tumor craniotomy/biopsy protocol; and, Table 2 summarizes the various methods used to facilitate the safety and efficiency of care at home.

Table 2: Summary of methods used to facilitate safety and efficiency of domiciliary care

<table>
<thead>
<tr>
<th>Author</th>
<th>Methods utilized to facilitate safety and efficiency of domiciliary care</th>
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<tr>
<td>Bernstein et al. (2001)</td>
<td>At discharge, the loved ones were reminded of the negative signs to be aware of and given the surgeon’s pager number and home number. A home care nurse visited the patient at home at 11 pm that evening and at 8 am the following morning.</td>
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<td>Blanshard et al. (2001)</td>
<td>All patients were seen by the surgeon before discharge to ensure that there was no neurological deterioration and also to assess their “home readiness.” No additional methods to monitor safety at home have been documented in this study.</td>
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<td>Kaakaji et al. (2001)</td>
<td>The authors state that in the absence of intraoperative hemorrhage, new postoperative deficit, or complications demonstrated on radiography, patients may be discharged from the hospital to adequate home monitoring at the end of this observation period. However, details of care at home have not been mentioned.</td>
</tr>
<tr>
<td>Bharadwaj &amp; Bernstein (2002)</td>
<td>Patients participated in discussions of their quick section diagnosis before discharge. A home care nurse visited all patients at home in the evening after the biopsy.</td>
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<tr>
<td>Grundy et al. (2008)</td>
<td>Patients with massive tumors and those undergoing lobectomy were excluded from the study. Discharge was allowed provided the patient was fully mobile with unchanged neurological condition, had eaten well, and passed urine, had a good postoperative analgesia and had no identifiable significant pathology on the postoperative scan. The clinical nurse specialist contacted patients on the phone after discharge to monitor their progress at home.</td>
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<tr>
<td>Boulton &amp; Bernstein (2008)</td>
<td>Patients were provided with information pamphlets and contact information of the neuro-oncology nurse practitioner. Explicit instructions were imparted to enable the patient to return to the emergency room if he/she experienced any clinical deterioration, decreased level of consciousness, weakness, or seizures.</td>
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<tr>
<td>Purzner et al. (2011)</td>
<td>Patients were educated on the expected course of events and potential complications. The neurosurgeon and anesthetics provided discharge instructions. Additional information pamphlet and contact information was provided for further concerns.</td>
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<tr>
<td>Park et al. (2011)</td>
<td>Not reported.</td>
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<tr>
<td>Au et al. (2016)</td>
<td>Patients were given a prescription for analgesia and a steroid taper, along with written instructions for pain control, possible adverse symptoms, and follow-up. The patient and family members were instructed to present to the emergency department if any clinical deterioration occurs, including a decreased level of consciousness, seizure, or new/worsened neurological deficit.</td>
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Surgical Outcomes

While the initial cases were all performed under local anesthesia as awake craniotomies, the Toronto group...
recently showed that general anesthesia does not preclude day surgery procedures [Figure 3].

Since 1991, the senior author has routinely performed awake craniotomy for intra-axial brain tumors with low complication rates and minimum resource utilization [9,10,12,21]. In 1996, a pilot study was initiated at the senior author’s hospital in Toronto to assess the feasibility of performing craniotomy for tumor resection as an outpatient procedure. [13] The results of this study were reported in 2001. Forty-one of the 46 (89%) patients successfully completed the protocol. Four patients were converted to inpatients because of: (1) Hemiparesis which ultimately resolved; (2) air-embolus with no permanent sequelae; (3) intraoperative seizure requiring conversion to general anesthetic; (4) request by a family member who was not present at the initial preoperative discussion. Participating in the study disadvantaged no patient. This protocol was later adopted at one center in the United Kingdom after a team came to Toronto to observe the procedure.[30]

This was followed by a larger study sample of 117 patients who underwent brain biopsies and 145 patients who underwent a craniotomy.[17] While most were successfully discharged from the DSU, 7% of the brain biopsy patients and 6% of patients who underwent an awake craniotomy had to be admitted. The reasons for the inpatient conversion included hemorrhage with worsening neurological deficits, headache, seizures, and family anxiety. While all of these conversions took place at the time of the afternoon assessment, 3 other patients were readmitted after being discharged to the protocol of domiciliary care; 2 for headache and 1 for a seizure the next day. Outpatient image-guided biopsies have shown a similar success and safety profile. Of the 76 patients, 98% were discharged to their respective homes with none experiencing an adverse outcome because of their outpatient status.[15] The authors argued that this approach was cost-effective and saved approximately $1000 per patient (in 2002) in comparison with treatment that involved an overnight stay. Kaakaji et al.,[32] too performed outpatient brain tumor biopsies and their success rate was 82%.

In another prospective study of 401 patients conducted by the same group reported by Purzner et al.,[16] in 2011, of the 249 patients who underwent a craniotomy, 93% were successfully discharged from the DSU, 5% were admitted from the DSU, and 2% were discharged and later readmitted. Of the 152 patients who underwent a brain biopsy, 94.1% were successfully discharged from the DSU, 4.6% were admitted from the DSU, and 1.3% were discharged and later readmitted. No patients experienced a negative outcome as a result of their early discharge.

Grundy et al.,[30] reported a day case series of 27/30 biopsy and 9/11 craniotomy patients who were discharged 6 hours postoperatively. One patient who had undergone a biopsy was admitted due to an intra-procedural hemorrhage and increasing headache in the postoperative period, but with a normal CT scan; and, a patient who had undergone a craniotomy had transient worsening of lower limb paresis, requiring an overnight admission. The three other overnight admissions were based on the patient’s preference. One patient, after having undergone a biopsy, was readmitted 30 hours postoperatively with a seizure and was discharged the following day. No patients suffered an adverse outcome.

Outpatient brain tumor cases have also been performed under general anesthesia. Au et al.,[14] showed that of a series of 44 operations done under general anesthesia, but targeted for day surgery, 38 (86%) were successfully discharged the same evening. Of the cases requiring conversion to inpatient admission, 1 was admitted for ongoing difficulties with wound hemostasis, 1 for new cognitive impairment, 2 for new or worsened weakness, and 1 for new onset of seizure. One patient was discharged from DSU but required readmission on the first postoperative day for new onset aphasia, with no adverse findings on CT.

A therapeutic radiosurgery procedure usually follows a separate diagnostic stereotactic procedure after days or weeks. Park et al.,[33] conducted a prospective study to define the clinical reliability, safety, and cost implications of same-day diagnostic stereotactic biopsy and therapeutic radiosurgery. The intraoperative diagnosis correlated with the final histopathological diagnosis in 96% of the patients with no biopsy-related morbidity. The mean total

Figure 3: (a) Preoperative magnetic resonance imaging of a 44-year-old man with a large right frontal recurrent anaplastic oligodendroglioma excised under general anesthesia. (b) Computed tomography done 4 hours postoperatively and 2 hours prior to discharge from the day surgery unit.
costs of same-day patients were significantly lower than the costs of patients who had a two-stage procedure (USD $9077.00 ± $2366.00 vs. $11284.00± $3025.00; P = 0.008).

To summarize the senior author’s experience since 1991, when he started awake craniotomies, 1930 supratentorial intra-axial brain tumors have been resected including 775 craniotomies under general anesthesia and 1155 awake craniotomies. Of the 1930 cases, 522 (27%) were outpatient craniotomies. In addition, 163 of 475 (34%) image-guided biopsies conducted during that time period were outpatient procedures. The median length of stay for general anesthesia craniotomy was 2 days, for awake craniotomy 1 day, and for outpatient craniotomy 0 days. The outpatient craniotomy group were not all awake craniotomies and 87 (17%) were operated under general anesthesia; hence, general anesthesia is not a contraindication to outpatient surgery. Of the 522 patients in the outpatient protocol, 48 (9%) were converted to inpatients. These outcomes should empower other centers to adopt this protocol.

Socioeconomic Issues

Beyond low and middle-income countries, there are regions within high-income countries that also struggle to deliver health care. In India, health care has two sectors, the private sector where patients or insurance companies pay, and the public sector where the government or municipal hospitals subsidize health care to a great extent for financially challenged patients. There are some institutes operated by charitable trusts that offer completely free neurosurgical services and do not even have a billing department. In some respects, this is similar to the Canadian system where the hospital becomes the payer. Unfortunately, only 21.6 crore (216 million) people, or 17% of the total population, were covered by health insurance at the end of March 2014.

India’s public financing for health care is < 1% of the world’s total health expenditure, even though it is home to over 16% of the world’s population, according to an estimate by the World Bank. Families meet almost 70–80% of their health expenses out of their own pockets, placing considerable financial burden on poor households, often pushing them deeper into poverty.

As outpatient craniotomy has shown to significantly reduce cost, it would work best in public hospitals that have a high influx of patients. This can serve as an alternate pathway to improve patient flow where the demand for inpatient beds is always very high. Protocol implementation and strict adherence can be efficient in achieving a goal, especially in large institutions where multiple providers work together as a team. However, in its initializing stages, it requires time and patience. Additional personnel are required to run an appropriate outpatient clinic for pre and postoperative patient management. Due to a large number of patients being uneducated, this is even more challenging. Patients tend to become uncomfortable if they do not see the surgical team regularly in the postoperative period. Therefore, the health care team and the caregiver of the patient must have a low threshold for the conversion of the patient's status to an inpatient one. A streamlined readmission process must be in place to allow patients a quick return to the hospital so that they can be managed appropriately. Early discharge should be a consequence of good patient care and not a primary end point.

In the private sector, some insurance companies do not pay unless patients are admitted overnight. As the occupancy in private hospitals is only about 70–80%, they tend to lose revenue if patients are discharged early. Insurance reimbursements to hospitals for procedures performed are substantially higher in cases that include an approved overnight stay. Although this fact in itself should not justify overnight stays, it should be recognized that private hospitals rely on certain procedures for financial stability and could be burdened further while accepting a higher level of liability for outpatient protocols. Doctors also are reluctant to send home “paying” patients early for a myriad of reasons, with the primary one being safety and the fact that most family doctors will refuse to deal with complications. A good way to initiate this protocol would be to start with early discharge within 1–2 days and then determine whether this could be replicated in the outpatient setting.

Medicolegal Issues

Outpatient craniotomy may increase the risk of litigation, deterring neurosurgeons from performing the procedure. Some anesthetists may not start craniotomy cases without an arterial and a central line for potential medicolegal liability concerns. Patients may assert that the discomfort caused from being away from the hospital after a major surgery may be more emotionally challenging and frustrating than the one, the surgeon had described. Postoperative bleeding is a rare event, but if it occurs, it should not happen at home. The education of a responsible adult living with the patient is certainly helpful; however, it does not preclude litigation by a patient who becomes disabled as a result of the complication that is not treated in time. A single case of litigation over an early postoperative complication has the
Ethical Issues

Ethical conflicts can arise between a neurosurgeon’s desire to explore different applications of brain tumor surgery and the maintenance of patient safety and comfort. Innovative patient care sometimes involves uncertainty about the risks and benefits, and outcome data are not always available.[37] In many developing or low-income countries, there is a significant unmet burden of surgical disease.[38] Although neurosurgery is typically considered a more resource-intensive specialty, in the case of awake craniotomy for brain tumors, many barriers are inherently avoided, making it an attractive and feasible procedure in settings where the availability and cost of intensive care unit beds, ventilators, and patient fees are prohibitive.[39] In addition to serving as a resource-sparing tool, outpatient craniotomy has been shown by qualitative research to be associated with a high rate of patient satisfaction.[39] Although data from these studies have been derived from high-income countries, it may be reasonable to extrapolate them to individuals in India.

Clinical research is usually conducted to answer the question of whether a new treatment is better than the standard one.[40] Unfortunately, while these data exist for spine (both cervical and lumbar) surgery,[41,42] there are no definitive data that outpatient brain tumor resection is better or worse for patients. While there are no randomized controlled trials demonstrating that outpatient craniotomy is superior to inpatient surgery in terms of outcome, many different studies have determined it to be safe, well-tolerated, and efficient.[13-15,17,26]

Nonetheless, in an evidence-based medical culture, the lack of data does raise questions regarding the ethics of advocating the use of outpatient brain tumor surgery, and hence, it is not possible to provide entirely unbiased recommendations to patients.[43] However, there are recent data that suggest that cancer patients may live longer if they undergo surgery avoiding the use of volatile agents (i.e., general anesthesia).[44]

Another important ethical issue is whether neurosurgeons under or over select patients for awake brain surgery based on personal preference.[45] We use the analogy of awake craniotomy here because those patients are most suited for an early discharge. The other question to answer is if it is ethical that selected patients be routinely subjected to outpatient brain tumor surgery, where most surgeons and patients feel safe and comfortable in an inpatient environment for a few days after a major intracranial surgery. Following a strict inclusion and exclusion criteria significantly reduces the risk of a discharge on the same day as surgery. While a standard of care for deciding when to perform outpatient brain tumor surgery does not exist, the persona of neurosurgeons as individuals is a difficult obstacle to overcome.

On the other hand, doctor and patient preference may not be aligned. Although medicine is supposed to be patient-centric, surgeons can strongly influence decision-making. Patients unwilling to undergo outpatient craniotomy should be managed as inpatients, and surgeons uncomfortable with this concept should stick to what works best for them or refer patients to colleagues who perform this if they feel it might make a difference to the patient.

Although a strong argument can be made for performing outpatient craniotomy, to do so effectively, some patients will have to form part of the neurosurgeons’ and anesthetists’ learning curve.

Conclusions

Performing brain tumor resection as an outpatient procedure, at first may appear to be dangerous, perhaps even a cavalier endeavor. It is not advised that every surgeon adopt this procedure, nor is it suggested that this should represent the standard of surgical care for a patient with an intra-axial brain tumor. However, this approach may represent an important step in the minimally invasive revolution of modern surgery, facilitating a health care system, which is user friendly and
more efficient without compromising patient care. Not only is there no excess morbidity resulting from an early discharge after surgery compared to inpatient admission, same-day discharges, in all likelihood, also reduce the exposure of patients to nosocomial infections, thromboembolic complications, and medical errors, and decrease the incidence of case cancellation due to lack of inpatient bed availability, thus improving patient flow. The procedure is less resource intensive and may be of added value in the developing world. Several studies have clearly established its safety and efficacy over a 20-year period. However, until its superiority is proven in randomized trials, the best clinical judgment will have to be practiced.

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Conflicts of interest
There are no conflicts of interest.

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