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Case Report

Awake brain tumor resection during pregnancy: Decision making and technical nuances

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ABSTRACT

The co-occurrence of primary brain tumor and pregnancy poses unique challenges to the treating physician. If a rapidly growing lesion causes life-threatening mass effect, craniotomy for tumor debulking becomes urgent. The choice between awake craniotomy *versus* general anesthesia becomes complicated if the tumor is encroaching on eloquent brain because considerations pertinent to both patient safety and oncological outcome, in addition to fetal wellbeing, are involved. A 31-year-old female at 30 weeks gestation with twins presented to our hospital seeking awake craniotomy to resect a 7 × 6 × 5 cm left frontoparietal brain tumor with 7 mm left-to-right subfalcine herniation on imaging that led to word finding difficulty, dysfluency, right upper extremity paralysis, and right lower extremity weakness. She had twice undergone tumor debulking under general anesthesia during the same pregnancy at an outside hospital at 16 weeks and 28 weeks gestation. There were considerations both for and against awake brain tumor resection over surgery under general anesthesia. The decision-making process and the technical nuances related to awake brain tumor resection in this neurologically impaired patient are discussed. Awake craniotomy benefits the patient who harbors a tumor that encroaches on the eloquent brain by allowing a greater extent of resection while preserving the language and sensorimotor function. It can be successfully done in pregnant patients who are neurologically impaired. The patient should be motivated and well informed of the details of the process. A multidisciplinary and collaborative effort is also crucial.

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1. Introduction

The occurrence of brain tumors during pregnancy is rare but imposes multiple treatment dilemmas. The evidence regarding management of gravid patients with malignant brain tumors is limited. Neurosurgical intervention is typically delayed until after fetal delivery if the patient is neurologically stable; however, in cases of neurological instability, urgent brain tumor resection may be required before delivery [1,2]. We report a case in which the patient became neurologically unstable due to a rapidly progressing recurrent anaplastic astrocytoma during twin pregnancy. To the best of our knowledge, this is the second report of brain tumor resection via awake craniotomy during pregnancy [2]. Here we focus on the perioperative decision-making and technical considerations. Written informed consent for case publication was obtained from the patient.

2. Case report

A 31-year-old female with a twin pregnancy at 30 weeks gestation was transferred to our hospital seeking awake craniotomy for a more definitive brain tumor resection. She had twice undergone brain tumor resection under general anesthesia at an outside institution, at 16 and 28 weeks gestation, with the pathology consistent with World Health Organization grade III anaplastic astrocytoma. On neurological examination, she had word-finding difficulty, dysfluency, right upper extremity plegia and right lower extremity paresis. MRI showed a 7 × 6 × 5 cm (anterior–posterior × transverse × cranio–caudal) heterogeneously enhancing intra-axial mass within the left frontoparietal white matter (Fig. 1A), with the superior aspect of the mass abutting the pre- and post-central gyrus (Fig. 1B). Mass effect resulted in 7 mm left-to-right subfalcine herniation.

Our patient preferred awake surgery and seemed motivated. However, the decision between awake craniotomy and surgery under general anesthesia was not made until 3 days later when she showed improvement in language function, appeared calmer, more alert and cooperative.

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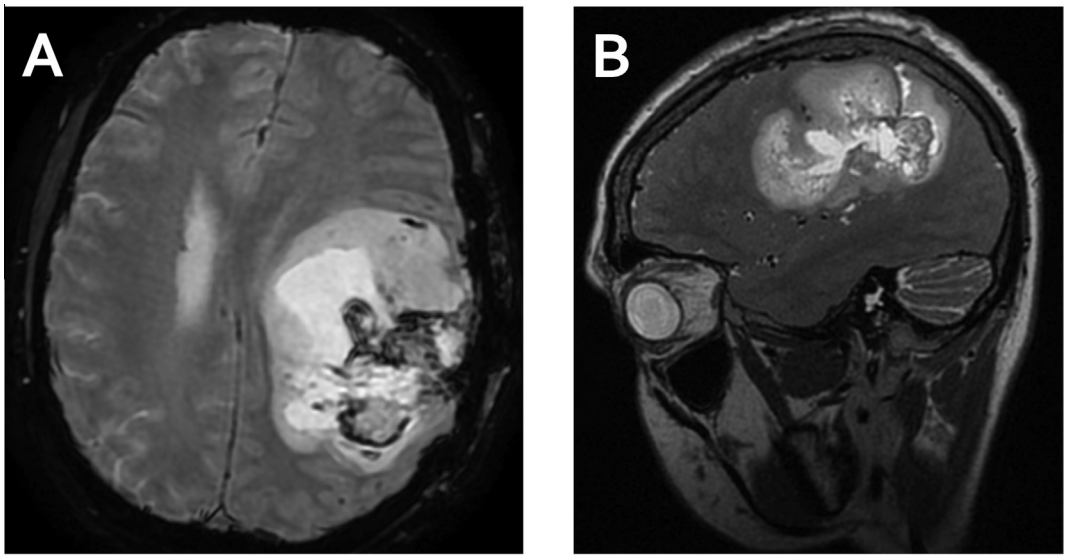

Fig. 1. T2-weighted MRI 3 days before the third craniotomy (at 30 weeks gestation of a twin pregnancy) showing a 7 × 6 × 5 cm (anterior–posterior × transverse × cranio–caudal) mass within the left frontoparietal region on axial view (A), with the superior aspect of the mass involving the pre- and post-central gyri on sagittal view (B). The mass effect resulted in a 7 mm left-to-right subfalcine herniation, with evidence of early uncal herniation.

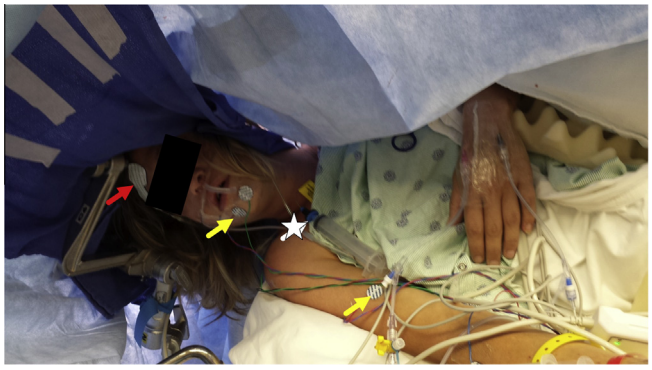

Fig. 2. Intraoperative photograph showing the patient positioned in right semilateral position with the head pinned in Mayfield frame. She had a cerebral oximeter probe placed on the right forehead (red arrow), epidural catheter placed before positioning (white star) and leads for sensorimotor neuromonitoring (yellow arrows).

On hospital day 3, our patient was brought to the operating room to undergo awake brain tumor resection with intraoperative language and sensorimotor stimulation mapping. A lumbar epidural catheter was first placed but not tested in order to preserve the sensorimotor function for mapping. The patient was positioned right semilateral with the head fixed in Mayfield frame (Fig. 2). The obstetric team performed continuous fetal monitoring. The process to remove the head frame and reposition the patient was rehearsed in case of urgent need to proceed with cesarean section. Propofol (25–60 mcg/kg/minute) and remifentanil (0.04–0.14 mcg/kg/minute) infusions were started to facilitate the opening phase of craniotomy and stopped when the surgeon was ready for awake mapping. Other sedative or analgesic medications were not given. The surgical analgesia was achieved using local anesthetic infiltration with a 1:1 mixture of 0.5% lidocaine and 0.25% bupivacaine. Detailed language and sensorimotor testing were satisfactorily conducted. Repeated subcortical motor stimulation mapping was used and resection was stopped when the corticospinal tract and anatomic Broca's area were encountered, based on the clearly evoked forearm, leg and face movements and speech hesitation during object naming, respectively. Propofol and remifentanil infusions were restarted for surgical closure. The fetal monitoring was unremarkable throughout the case.

Our patient experienced significant neurologic improvement on postoperative day 1. She became more fluent with intact naming and comprehension, but with impaired repetition. The strength of the right arm and leg returned to baseline except for a weak hand grip. Postoperative MRI showed extensive debulking with some residual disease at the perirolandic region and deep frontal and parietal white matter (Fig. 3). The twin babies were uneventfully delivered on postoperative day 4 under spinal anesthesia.

She was discharged to a skilled nursing facility and received a partial course of external beam radiotherapy and chemotherapy. She is currently (12 months after awake brain tumor resection) receiving hospice care. She stopped walking only recently due to the progressively worsening right leg weakness. Her speech is comprehensible but slurred.

3. Discussion

3.1. Awake craniotomy versus craniotomy under general anesthesia: The decision-making process

For gliomas, maximal safe resection is recommended as resection is superior to biopsy and the greater the extent of resection, better the outcome [3]. Awake craniotomy has evolved into the standard of care for tumors adjacent to eloquent brain in order to maximize resection without compromising important neurologic functions using intraoperative stimulation mapping [4,5]. The recent reports suggest that awake craniotomy is associated with shorter hospital stay, fewer late neurologic deficits, and improved survival [6].

At our institution, we typically use propofol, remifentanil, and/or dexmedetomidine in low infusion rates only for the opening and closing phases. Local anesthetic infiltration serves as the mainstay of analgesia. Therefore, fetal exposure to inhaled anesthetics is avoided and the exposure to intravenous agents is presumably reduced.

Nonetheless, there were considerations that made us cautious about awake craniotomy for this patient. If fetal distress occurred during awake craniotomy, emergent cesarean section would

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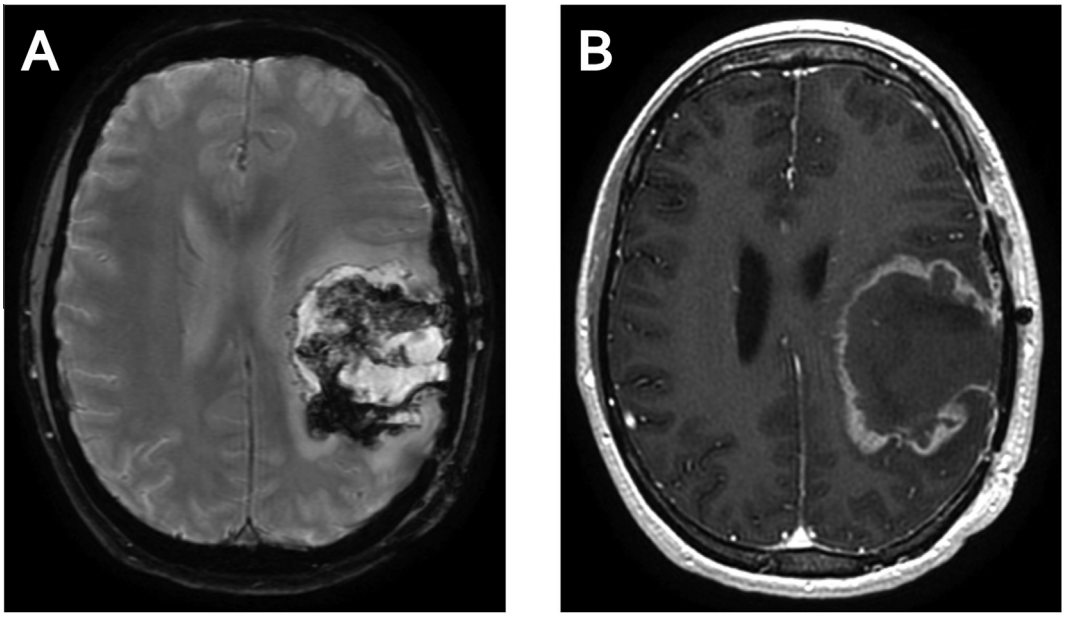

Fig. 3. MRI 8 days after the awake craniotomy. Axial T2-weighted images showing a left frontoparietal resection cavity with expected postsurgical changes, including blood products (A). Axial post-contrast T1-weighted images showing a rim of enhancement within the resection cavity (B). As a contrasted scan was not obtained prior to surgical resection (due to pregnancy) and unavailable for comparison, it was unclear whether the enhancement represented residual tumor or postoperative changes.

require either epidural or general anesthesia. There was a chance that the epidural catheter might not provide adequate anesthesia for cesarean delivery. If a conversion to general anesthesia was needed, risks associated with emergent head frame removal, patient repositioning, anesthesia induction and endotracheal intubation could be dramatic. Even if the twin fetuses were doing well, there were other considerations, including intractable seizure, aspiration, or psychological intolerance, which had the potential to prompt a conversion to general anesthesia.

Therefore, the risks and benefits associated with both awake craniotomy and general anesthesia need to be carefully weighed. The decision should be made with a multidisciplinary approach involving surgeon, anesthesiologist, and obstetrician. The patient also plays a critical component in the decision-making process as their motivation and participation are the key for successful intraoperative stimulation mapping.

3.2. Awake brain tumor resection: Anesthetic technical nuances

The anesthetic goal of awake craniotomy is to ensure an awake, comfortable, pain free, and engaged patient during the awake mapping and/or resection phase while providing the needed sedation and analgesia during the opening and closing phases. Various anesthetic techniques have been described with the difference centering on the management during the opening phase that ranges from keeping the patient awake or sedated, to having the patient intubated with an endotracheal tube, or instrumented with a laryngeal mask airway. We typically keep the patient sedated, drowsy but arousable to verbal commands during the opening and closing phases in our institution [4].

Adequate preoperative preparation is crucial for awake craniotomy. This allows an opportunity to explain to the patient the overall process, what they should expect to see and hear, and what aspects could be potentially bothersome including the sensation of having a bladder catheter, itching, pain, noise of drilling bone, and discomfort from being in the same position for an extended duration.

Our pregnant patient was positioned semilateral so aorto-caval compression was mitigated. We employed continuous fetal heart rate and contraction monitoring throughout the procedure. The arterial pressure and heart rate goals were within 15% of baseline in an effort to maintain uterine and fetal perfusion. Phenylephrine was used as the primary vasopressor, with ephedrine and glycopyrrolate available if needed to maintain maternal heart rate. Mannitol can accumulate in the fetus leading to hyperosmolality with decreased fetal lung fluid and urine production, but doses up to 0.5 g/kg have been reported with good outcomes [7]. Cross-matched blood was in the room as well as an obstetrician in the event an urgent cesarean delivery was needed. Neonatology was also aware of the case and had a newborn isolette with neonatal resuscitation equipment readily available.

4. Conclusion

Awake brain tumor resection has its unique advantages and should be considered when indicated, even in patients who are pregnant. The patient should be involved in perioperative planning and the associated risks and benefits should be carefully weighed via a multidisciplinary approach during the decision-making process. Various anesthetic techniques have been described for awake craniotomy in general, and we describe the technical details used in our twin-gestating patient.

Conflicts of Interest/Disclosures

The authors declare that they have no financial or other conflicts of interest in relation to this research and its publication.

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