

Anesthetic care during awake craniotomy in a pediatric patients

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Key points

Optimal assessment of eloquent cortex function during a craniotomy often requires an awake and cooperative patient, making the anesthetic for these procedures challenging.

Abstract

Cortical mapping has demonstrated a wide variability in the location of areas controlling speech, memory, motor and sensory function. These regions of the cortex, often referred to as eloquent cortex, can be near areas of epileptic foci or pathologic lesions, making the surgical resection of these lesions difficult. Optimal assessment of eloquent cortex function during a craniotomy often requires an awake and cooperative patient, making the anesthetic for these procedures challenging. We present a 13-year-old girl who required an awake craniotomy during tumor resection. Previous reports regarding the performance of an awake craniotomy in pediatric-aged patients are reviewed.

Keywords: pediatric; awake craniotomy

Introduction

Despite advances in surgical technique and neurophysiologic monitoring, lesions near the cortical areas responsible for language function may require an awake and cooperative patient to definitively identify the limits of the resection.^{1,2} Such techniques allow for the possibility of total resection of the lesion with preservation of language function. Given the requirements for an awake and yet cooperative patient, such procedures are more commonplace in adults than

children.³⁻⁵ However, with appropriate preoperative preparation, patient selection, and perioperative care, these procedures can be performed in a select group of pediatric patients.^{6,7} During these procedures, the demands for anesthetic care include the provision of general anesthesia or deep sedation during craniotomy and exposure of the brain with prompt awakening to allow for intraoperative mapping of language function. Additional requirements during the awake portion of the procedure include the use of sedative and analgesic agents that will have limited effects on hemodynamic and respiratory function. We present a 13-year-old girl who required an awake craniotomy during tumor resection. Previous reports regarding the performance of an awake craniotomy in pediatric-aged patients are reviewed and suggestions for perioperative management provided.

Case report

Institutional Review Board approval is not required at Nationwide Children's Hospital (Columbus, Ohio) for the presentation of single case reports. A previously healthy, 13-year-old, 44.5 kilogram adolescent presented to the emergency department, two months prior to her arrival in our surgical unit, with new-onset seizure activity. The patient had been well until seven

weeks prior to admission when she had a witnessed generalized tonic-clonic seizure while sleeping. Initial work-up, including an electroencephalogram (EEG), demonstrated epileptogenic discharges in the left mid-temporal region. Further workup with dual-imaging brain magnetic resonance imaging (MRI) revealed a mass lesion centered at the left temporoparietal junction suggestive of a neoplastic process (figure 1).

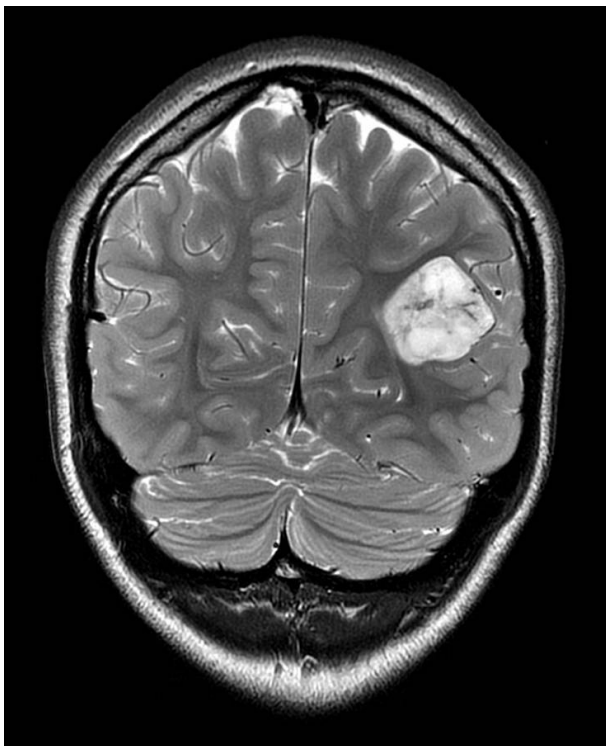


Figure 1. Magnetic resonance imaging scan of patient showing a well-circumscribed subcortical white matter mass in the left angular gyrus.

Given the location of the lesion, a functional MRI (fMRI) was obtained which again demonstrated a three centimeter, well-circumscribed subcortical white matter mass in the left angular gyrus. The fMRI indicated that nearly 100% of the patient's language localization was located on the left with Wernicke's area inferior to and abutting the inferior surface of the tumor. Sixty percent of Broca's area was also noted to be left-sided with significant activation in the left inferior frontal gyrus. There was a robust area of motor cortex located just anterior and superior to the tumor. Given the

radiographic findings, and the associated seizure activity, it was determined that surgical resection of the tumor was indicated. However, there were significant concerns about the tumor location and the proximity to receptive language centers. Following neuropsychological, neurosurgical and neurology evaluations, the patient was deemed to be an appropriate candidate for a left temporal parietal, awake craniotomy with intraoperative electrocorticography (ECoG) and functional language mapping.

As noted, the patient was a previously healthy young lady with no prior surgical history. She had a documented medication allergy to penicillin. Her only preoperative medication was oral levetiracetam (Keppra) 500 mg twice daily, which had been started three weeks prior to the planned surgical procedure. A type and screen, as well as preoperative labs were obtained with the following results: sodium 140 mEq/L, potassium 4.2 mEq/L, prothrombin time 13.5 seconds, International Normalized Ratio (INR) 1.03, and partial thromboplastin time 32 seconds. The hemoglobin and hematocrit were 12.8 gm/dL and 39.4% respectively with a platelet count of 246,000/mm³. The patient was held *nil per os* for 8 hours except for her routine morning dose of levetiracetam. On the morning of surgery, the patient had a negative urine pregnancy screen. Baseline vital signs were obtained prior to transport to the operating room with a heart rate (HR) of 77 beats/minute (bpm), blood pressure (BP) 129/70 mmHg, respiratory rate of 20 breaths/min, oxygen saturation of 100%, and temperature of 97.8°C. Physical examination was unremarkable and the patient's airway was deemed to be a Mallampati I on evaluation. The patient denied any history of snoring or obstructive sleep apnea symptoms. After transport to the operating room, the patient was made familiar with the operating room layout and equipment, the nursing staff present in the room, and the sounds she would hear while she was awake during the case. While awake, the patient was positioned supine on the operating table with a roll

placed under her left shoulder and her head turned to the right in a manner that was comfortable to her. The table was turned 90° away from the anesthesia providers. Standard American Society of Anesthesiologists monitors were placed and an inhalation induction was initiated with incremental increases of sevoflurane in 70% nitrous oxide and 30% oxygen. After the patient had reached an appropriate depth of anesthesia, an 18 gauge peripheral intravenous (IV) cannula was placed in the left hand followed by the administration of propofol (1.5 mg/kg) to facilitate placement of a 2.5 Air-Q laryngeal mask airway (LMA, Trudell Medical, London, Ontario, Canada). A 16 gauge peripheral IV cannula was placed in the right forearm and a 20 gauge IV cannula was placed in the left radial artery. Maintenance infusions of propofol (150 µg/kg/min), remifentanyl (0.05 µg/kg/min), and dexmedetomidine (0.3 µg/kg/hr) were started. The nitrous oxide and sevoflurane were discontinued and the patient was allowed to spontaneously breathe 50% oxygen in air. Maintenance intravenous fluids included 0.9% normal saline and a Foley catheter was inserted. Dexamethasone (0.5 mg/kg), intravenous acetaminophen (15 mg/kg), ondansetron (4 mg), furosemide (10 mg), and mannitol (0.5 gm/kg) were administered. Prior to the placement of local anesthesia to the scalp, a 1 µg/kg bolus of remifentanyl was administered and the remifentanyl infusion was increased to 0.1 µg/kg/min. Lidocaine 1% with 1:200,000 epinephrine was injected subcutaneously by the surgeon at the sites of Mayfield pin placement. Bupivacaine 0.125% with 1:400,000 epinephrine was then infiltrated into the skin, galea, and periosteum by the surgeon along the planned incision line. The placement of Mayfield pins and local infiltration was well tolerated without patient response or change in the hemodynamic status. The propofol infusion was decreased to 130 µg/kg/min and the remifentanyl infusion was decreased to 0.05 µg/kg/min.

The patient was then prepped and draped for a left craniotomy. The patient was kept supine with a roll under the left shoulder and the head turned to the right. The drapes were placed in a manner so as to allow for unobstructed access to the patient's airway and an open field of view for the patient during the awake period of the procedure. Prior to incision, clindamycin (10 mg/kg) was administered for surgical site infection prophylaxis. Following skin incision and left temporo-parietal craniotomy, the bone flap was turned to expose the dura overlying the cortex and tumor. Lidocaine 1% with 1:200,000 epinephrine was then injected into the dura prior to incision. ECoG monitoring was then performed with the patient anesthetized. At the conclusion of ECoG monitoring, the propofol and remifentanyl infusions were discontinued, the dexmedetomidine infusion was decreased to 0.2 µg/kg/hr. The LMA was removed with the patient anesthetized, but spontaneously breathing. A nasal cannula with end-tidal CO₂ monitoring was applied. After 20 minutes, the patient was arousable, appropriately answering neuropsychology speech questions, and was pain free. During ECoG grid stimulation for delineation of eloquent cortex, seizure activity was noted and the decision was made by the neurologist to administer a loading dose of fos-phenytoin (20 mg/kg). Following fos-phenytoin administration, the patient became more somnolent and the dexmedetomidine infusion was discontinued to allow for neuropsychological testing. The testing to identify areas of eloquent cortex and speech/language involvement continued for approximately one hour. Despite the increased drowsiness following the administration of fos-phenytoin, the patient remained capable of reciting from rote memory (the alphabet) and speech localization was identified by stimulation of the area that caused speech arrest. This process resulted in the identification of a path to the tumor which avoided the eloquent cortex. Once this surgical path had been identified, a bolus dose of propofol (3 mg/kg) was administered to reinstate

general anesthesia and the Air-Q LMA was reinserted into the oropharynx. An oral endotracheal tube (ETT) was placed into the patient's trachea through the Air-Q LMA via a fiberoptic bronchoscope. After the ETT position was confirmed, neuromuscular blockade was initiated with rocuronium, the LMA cuff was deflated, and maintenance anesthesia was continued with remifentanyl and desflurane in 50% oxygen and air. A gross total excision of the tumor was then performed. During closure of the skin, desflurane was discontinued and hydromorphone (0.2 mg) was administered. Residual neuromuscular blockade was reversed with glycopyrrolate and neostigmine, and the patient's trachea was extubated. The patient was transported to the post-anesthesia care unit (PACU). In PACU, the patient was noted to have intact speech and language comprehension. Throughout the 8 hour surgical procedure, the patient received a total of 2600 mL of 0.9% normal saline and 500 mL of 5% albumin. The estimated blood was 300 mL and the patient's total urine output was 2650 mL. The patient's postoperative course was uneventful. She was continued on dexamethasone (4 mg) for six doses and her home dose of levetiracetam was resumed. The patient was discharged home on postoperative day number 2. The final tumor pathology was identified as juvenile pilocytic astrocytoma, grade 1. On the last follow-up at 5 months, the patient does not have any speech deficits and no recurrence of tumor has been noted.

Discussion

The surgical resection of seizure foci and brain tumors located in close proximity to eloquent cortex has the potential to cause significant neurological deficits. In the appropriate patient population, performance of an awake craniotomy can allow for intraoperative cortical mapping of functional brain tissue to reduce the surgical risk of devastating neurologic dysfunction. During the process of cortical mapping, direct stimulation of the speech and language cortex results in slowing, slurring or inhibition of the patient's speech, while stimulation

of the sensory or motor cortex manifests as increased sensation or movement in the associated body part.⁸ This process of electrocortical stimulation delineates a functional map of the brain surface, allowing for tumor excision via a surgical pathway that avoids or minimizes transgression through or resection of eloquent cortical tissue. Furthermore, the addition of intraoperative neurophysiological monitoring with ECoG can localize the epileptogenic tissue and ensure the resection of the entire epileptogenic zone.⁹ The successful completion of intraoperative neurophysiologic monitoring requires an awake, calm and cooperative patient. The provision of an anesthetic that affords analgesia, anxiolysis and sedation without causing respiratory depression can be challenging, especially in the pediatric population. Although several case reports have been published on the subject of anesthetic care for awake craniotomy in the adult population, there are limited data in children with reports of such a procedure in only 9 other pediatric patients (table 1).^{6,7,10-12} The anesthetic method commonly administered for an awake craniotomy has often been referred to as the "asleep-awake-asleep" method. This is a description of the usual sequence of events which includes anesthetic induction with maintenance anesthesia to allow for craniotomy and dural exposure followed by an awake period to allow for intraoperative mapping of language and motor centers. Once this is accomplished, general anesthesia is reinstated to allow for tumor resection and surgical closure. This technique has the potential for several complications including airway obstruction, hypoxemia and hypoventilation, intraoperative seizures, poor cooperation and agitation, nausea and vomiting, and uncontrolled pain.¹³ As such, appropriate planning is mandatory to allow the success of such procedures. In general, these procedures combine the usual challenges of craniotomy with the more difficult task of allowing a patient to awaken intraoperatively and cooperate with intraoperative mapping. Proper patient selection and preparation is paramount to a successful anesthetic

Table 1. Previous reports of awake craniotomy in the pediatric patient

*LMA= Laryngeal mask airway; NC= nasal cannula; NPA = nasopharyngeal airway

**Remifentanyl, alfentanil, and propofol are listed in µg/kg/min while dexmedetomidine is listed in µg/kg/hr.

Reference	Demographics	Patient Status	Airway Device*	Inhalational Agent	Intravenous agents**	Outcome
Tobias JD et al. ⁶	12 year old, 42 kg boy	Asleep	NC	100% O ₂	Propofol 100-200	Successful intraoperative neurological testing and mapping with tumor resection.
		Awake	NC	100% O ₂	None	
		Asleep	NC	100% O ₂	Propofol 100-200	
Ard J et al. ⁷	12 year old, 52 kg girl	Asleep	LMA	N ₂ O/O ₂ (60/40) Sevoflurane (0.3-0.7%)	Dexmedetomidine 0.2-0.5 Remifentanyl 0.1	Successful intraoperative neurological mapping and testing.
		Awake	NC	100% O ₂	Dexmedetomidine 0.1 Remifentanyl 0.1	
		Asleep	LMA	N ₂ O/O ₂ /sevoflurane	Remifentanyl 0.1	
	12 year old, 45 kg girl	Asleep	LMA	N ₂ O/O ₂ (60/40) Sevoflurane (0.7-1.5%)	Dexmedetomidine 0.5 µg/kg → 0.15-0.3	Successful intraoperative neurological testing.
		Awake	NC	100% O ₂	Dexmedetomidine 0.15-0.3	
		Asleep	LMA	100% O ₂	Dexmedetomidine 0.15-0.3	
Hagberg CA et al. ¹⁰	11 year old girl	Asleep	LMA	N ₂ O/O ₂ (50/50)	Propofol 100-180 Alfentanil 0.5-0.75	Successful intraoperative neurological testing, no postoperative recall.
		Awake	NC	100% O ₂	Alfentanil 0.5	
		Asleep	NC	N ₂ O/O ₂ (50/50)	Propofol 100-180 Alfentanil 0.75	
	12 year old girl	Asleep	LMA	N ₂ O/O ₂ (50/50)	Propofol 100-180 Alfentanil 0.5-0.75	Successful intraoperative neurological testing, no postoperative recall.
		Awake	NC	100% O ₂	Alfentanil 0.5	
		Asleep	NC	100% O ₂	Propofol 100-180 Alfentanil 0.5-0.75	
	16 year old girl	Asleep	LMA	N ₂ O/O ₂ (50/50)	Propofol 100-180 Alfentanil 0.5-0.75	Successful intraoperative neurological testing, no postoperative recall.
		Awake	NC	100% O ₂	Alfentanil 0.5	
		Asleep	LMA	100% O ₂	Propofol 100-180 Alfentanil 0.5-0.75	
Klimek M et al. ¹¹	9 year old, 32 kg boy	Entire case	NC	100% O ₂	Propofol 42-78	Successful intraoperative neurological testing, minimal postoperative recall
Everett L et al. ¹²	16 year old, 55 kg girl	Asleep	NPA	Unknown	Dexmedetomidine 0.2-0.4 Propofol 150-200	Successful intraoperative neurological testing.
		Awake	NPA		Dexmedetomidine 0.1	
	16 year old, 65 kg boy	Asleep	NC	Unknown	Dexmedetomidine 0.35-0.7	Successful intraoperative neurological testing.
		Awake	NC		Dexmedetomidine 0.2-0.3 Propofol 50-200	
		Asleep			Dexmedetomidine 0.1 Dexmedetomidine 0.5-0.7	

Table 2. Perioperative care for awake craniotomy

1. Preoperative care

- a. Appropriate patient evaluation, selection and education
- b. Planning and communication among surgical, neurology, anesthesia, and nursing service
- c. Continue routine medications including anticonvulsants
- d. Document therapeutic levels of anticonvulsant medications
- e. Standard preoperative evaluation
 - i. History of obstructive sleep apnea symptoms, snoring
 - ii. Mallampati classification

2. Intraoperative care

- f. Routine American Society of Anesthesiologists' monitoring
- g. Two peripheral intravenous cannulae + arterial cannula
- h. Foley catheter
- i. Inhalation or intravenous induction
- j. Laryngeal mask airway (Asleep-Awake-Asleep technique)
- k. Maintenance anesthesia: propofol, remifentanyl, and dexmedetomidine
- l. Acetaminophen, dexamethasone, ondansetron
- m. Antibiotic prophylaxis for surgical site infection prophylaxis
- n. Intraoperative redosing of anticonvulsants as needed
- o. Local infiltration of scalp and pin sites ± regional anesthesia of the scalp
- p. Local infiltration of the dura after craniotomy
- q. Mannitol and furosemide to provide brain relaxation
- r. Spontaneous ventilation if brain relaxation adequate
- s. Discontinue remifentanyl and propofol – removal of LMA
- t. Continue dexmedetomidine during awake portion
- u. End-tidal carbon dioxide monitoring from nasal cannula
- v. Intraoperative mapping of language and motor function
- w. Reinitiation of general anesthesia with propofol
- x. Placement of LMA – conduit for fiberoptic guided endotracheal intubation
- y. General anesthesia with controlled ventilation during tumor resection and closure of craniotomy

of seizures, and the degree of hemorrhagic risk associated with the type of lesion and proposed surgical procedure needs to be delineated.^{13,14}

During the preoperative evaluation, the patient should be counseled on the intraoperative speech and language testing, the expected operating room sounds, layout and personnel, and the positioning during the procedure. On the day of surgery, the patient should be comfortably positioned on the operating table. It should be ensured that their field of vision is unobstructed by the surgical drapes upon awakening during the procedure. During the awake portion of the procedure, all attention should be focused on the patient and operating room noise kept to a minimum.

One of the key components of the anesthetic care is the use of agents which provide effective anesthesia and analgesia, yet allow for rapid awakening when necessary. In the majority of the reported cases, this has included the use of propofol with either remifentanyl or alfentanil. The other key aspect of the anesthetic agent chosen is limited effects on respiratory function. We chose remifentanyl as its effects dissipate rapidly upon discontinuation thereby leaving little chance of residual respiratory depression following its discontinuation. During the awake aspect of the procedure, we and others have used dexmedetomidine given its ability to provide sedation and anxiolysis with limited effect on respiratory function.^{15,16} When choosing the anesthetic agents for use during an awake craniotomy, one must also consider their impact on intraoperative neurophysiological monitoring including EcOG and cortical stimulation, as well as the motor and language mapping during the awake portion of the procedure. Several studies suggest that propofol has potent anticonvulsant properties and may suppress epileptiform activity, both of which are concerning in the setting of intraoperative EcOG monitoring.¹⁷⁻²⁰ However, multiple reports have demonstrated that, when discontinued 15 to 20 minutes prior to electrophysiological studies, propofol does not interfere

with electrocorticography and cortical stimulation.^{14,17,21} Furthermore, the use of propofol during the asleep periods of the procedure may be beneficial in the prevention of intraoperative seizures, particularly generalized seizures, which may lead to an obtunded patient from either the postictal state or the pharmacologic treatment for cessation of the seizure activity.¹⁷ The use of a short-acting opioid, such as remifentanyl or alfentanil, as an adjunct anesthetic to propofol during the asleep portions of the procedure is ideal for neuromonitoring and rapid awakening. In our patient, we chose to use remifentanyl due to its favorable pharmacokinetic profile. Remifentanyl is an ultra-short acting opioid that can be easily titrated to effect, has minimal change in pharmacokinetic parameters despite extremes of age or hepatic function, and demonstrates a very short context-sensitive half-life, which is unaffected by the duration of the infusion.^{14,22} Furthermore, when used during epilepsy surgery, remifentanyl can enhance intraoperative ECoG monitoring. During ECoG monitoring, Wass et al demonstrated a significant increase in epileptiform activity with remifentanyl administration, such that localization of the epileptogenic zone was facilitated by suppression of electrical activity in the surrounding non-epileptogenic brain tissue.²²

Dexmedetomidine, a highly selective α_2 -adrenergic agonist with centrally-mediated sympatholytic effects, is routinely used for sedation in the intensive care setting and has been reported in four pediatric patients undergoing an awake craniotomy.^{7,12,23-26} In addition to the benefit of sedation with limited respiratory depression, dexmedetomidine has also been shown to reduce both intraoperative and postoperative anesthetic and analgesic requirements, minimize opioid induced muscle rigidity, and have hemodynamic stabilizing effects.^{14,27-30} Unlike the effects of remifentanyl and propofol, the effects of which have been documented on ECoG, EEG and cortical stimulation testing, the effects of dexmedetomidine on such neurophysiological testing

has not been well delineated. Prior studies on the effects of dexmedetomidine sedation on EEG activity in healthy adults has demonstrated that dexmedetomidine produces a state of sedation similar to natural stage II sleep with an easily arousable patient and minimal effects of the EEG.²⁹⁻³¹ Furthermore, in animal studies, the effects of dexmedetomidine on the seizure threshold are conflicting.³²⁻³⁴ Whittington et al demonstrated that, in rats, dexmedetomidine increases the cocaine-induced seizure threshold; however, Miyazaki et al have shown a reduced seizure threshold in cats receiving dexmedetomidine with enflurane anesthesia.^{32,33} In adults with medically refractory seizures, dexmedetomidine did not reduce EEG seizure focus activity and was thought to be a suitable anesthetic agent during seizure foci surgery.³⁴ The data regarding the ECoG effects of dexmedetomidine are even more limited. Oda et al. demonstrated that, in patients undergoing temporal lobe epilepsy surgery under sevoflurane anesthesia, the addition of dexmedetomidine slowed the frequency, but did not affect the spike activity on ECoG monitoring.³⁵

In our patient, we elected to use dexmedetomidine as an adjunct agent to propofol and remifentanyl during the asleep portions of the procedure due its ability to decrease the requirements for both opioids and propofol. During the awake portion of the procedure, the dexmedetomidine infusion was continued at a lower dose to maintain anxiolysis with limited risk of respiratory depression and avoid the potential for over-sedation during language and motor cortex mapping. This approach produced a comfortable and easily arousable patient, while still allowing for adequate ECoG mapping, cortical stimulation, and language and motor cortex mapping.

Despite a thorough preoperative evaluation, careful patient selection, and a meticulous anesthetic technique, intraoperative complications can still arise. Agitation, intraoperative seizure activity, respiratory depression, airway obstruction, and vomiting are all potential

intraoperative concerns. To actively address each of these aspects, we tailored our anesthetic technique in an attempt to avoid these potential complications. In our patient, dexmedetomidine was specifically chosen to ameliorate the patient's anxiety during the awake portion of the procedure, yet allow for neuropsychological testing and an interactive, cooperative patient. The use of dexmedetomidine also afforded the benefit of a lower potential for respiratory depression and a reduction in adjunct anesthetic requirements. Furthermore, remifentanyl was specifically chosen as the opioid for infusion due to the medication's short duration of action and rapid elimination half-life. Dexamethasone, ondansetron, and propofol were chosen to prevent perioperative nausea and vomiting.^{36,37}

The development of intraoperative seizures can be particularly problematic in the setting of an awake craniotomy with a recent study demonstrating that approximately 12% of adults undergoing an awake craniotomy experience intraoperative seizure activity, resulting in 18% of those patients failing the awake procedure.³⁸ A preoperative discussion with the neurologist and plan for the of intraoperative seizures should be developed. The preoperative documentation of therapeutic anticonvulsant levels is suggested along with the preoperative administration of these agents on the day of surgery and their continuation intraoperatively. Although our patient had received her home regimen of levetiracetam on the morning of surgery, seizure activity occurred during cortical stimulation. Fos-phenytoin was administered intraoperatively to terminate the acute seizure episode along with ice-cold saline at the moment that seizure activity was identified by ECoG. Alternative agents for the rapid termination of intraoperative seizure activity may also include propofol or a benzodiazepine; however, these agents are more likely to result in significant sedation. Regardless of the agent used, these anticonvulsant medications, in combination with a post-

ictal state, can produce significant sedation requiring an alteration in the planned anesthetic management or delays in achieving intraoperative neurophysiological monitoring. The risk of a seizure from electrical stimulation of the cortex during mapping increases when the electrical stimulation is performed in the epileptogenic area adjacent to a lesion. In a patient known to have seizures preoperatively and therefore increased excitability of adjacent cortex, consideration should be made for an additional loading dose of an anticonvulsant preoperatively to obtain the benefit of suppression of intraoperative seizures. Preferably, this should be administered early enough to allow any sedating effects to be minimized during the awake portion of the procedure.

The potential for airway obstruction during the asleep portions of the procedure necessitates appropriate planning regarding patient positioning and placement of surgical drapes (figure 2).

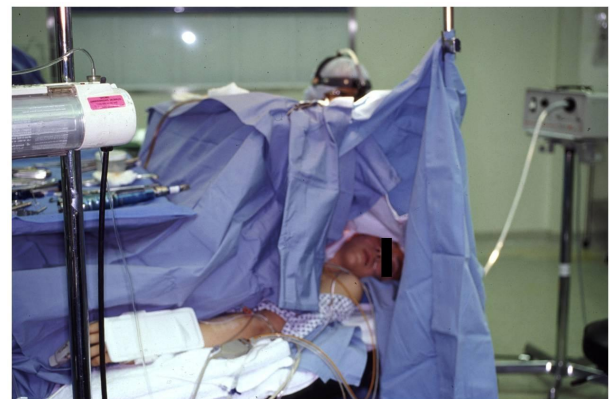


Figure 2. Image demonstrating appropriate patient positioning for awake craniotomy. The surgical drapes are positioned to permit visual contact with the patient's face. This provides not only ready access to the airway, but also allows for the patient to interact during the awake portion of the case.

This should be performed so as to allow visual contact with the patient's face. This not only allows ready access to the airway, but may serve to limit the feeling of claustrophobia during the awake portion of the

procedure. Although several case reports present the asleep-awake-asleep technique with a natural airway and spontaneous ventilation^{6,11,12}, we elected to use the Air-Q intubating LMA during the asleep portions. We specifically chose the Air-Q LMA due to the ease of endotracheal intubation with improved glottic views through the LMA using fiberoptic guidance when compared to other available LMA's.³⁹⁻⁴² In summary, we present the anesthetic management, preoperative evaluation and intraoperative considerations for an awake craniotomy in a 13-year-old patient. The use of an asleep-awake-asleep technique utilizing a combination of propofol, remifentanyl and dexmedetomidine with an Air-Q intubating LMA resulted in successful intraoperative ECoG, cortical stimulation, and eloquent cortex mapping in a comfortable and cooperative patient.

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