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Case Report

Neuronavigation-guided intubated wake-up craniotomy for a patient with a brain astrocytoma

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Abstract

Computer-assisted neuronavigation (an image-guided technique that facilitates brain tumor surgery) reduces the risk of neurological morbidity. Postoperative neurological dysfunction is also minimized by performing intraoperative neurological testing during awake craniotomy with proper surgical resection of a brain tumor. However, when the patient's airway is not secured, an awake craniotomy can be hazardous if emergent intubation is necessary. The present report describes a young man with a brain tumor who underwent neuronavigation-guided wake-up craniotomy and surgical resection of an astrocytoma. The patient was intubated throughout the course of the procedure, during which modified intraoperative neurological tests were performed for cortical mapping. The patient recovered well after the operation and without any neurological deficits.

Keywords: airway maintenance; awake craniotomy; emergent intubation; neuronavigation

1. Introduction

For many years, computer-assisted neuronavigation has been used for brain tumor surgery and for the management of other pathological conditions of the brain. Neuronavigation technology facilitates brain surgery and is believed to reduce the risk of post-surgical neurological morbidity.[1] Awake craniotomy has also been used for several years for epilepsy surgery and for resecting tumors located in the eloquent cortex.[2] To minimize postoperative neurological dysfunction, intraoperative neurological testing can be performed during awake craniotomy, followed by proper surgical resection. Several anesthetic techniques for awake craniotomy have been described.[3–7] For optimal lesion localization during neuronavigation-guided brain surgery, the patient's head should be secured with a Mayfield clamp. However, maintaining the airway may be difficult with this procedure if emergent intubation is necessary during the course of the surgery. The present report describes a patient who underwent neuronavigation-guided wake-up craniotomy for the resection of a tumor that was near Wernicke's area. For safety considerations, the patient was intubated throughout the entire procedure. Wake-up neurological tests were modified for this intubated patient.

2. Case report

A 27-year-old male went to a local hospital due to a seizure associated with loss of consciousness. Brain computerized tomography was performed, revealing an ill-defined mass over the left temporal lobe with perifocal edema. The patient was

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then transferred to our hospital for further treatment. On admission, his neurological examination showed no other neurological deficits, except for a mild decrease in the muscle power of the four limbs. Magnetic resonance imaging (MRI) was performed. An axial tractogram revealed medial deviation of the white matter tract in the left temporal lobe (Fig. 1). Axial T2-weighted MRI revealed an infiltrative tumor in the left temporoparietal lobe with perifocal edema (Fig. 2). After adequate explanatory preoperative communication with the patient, we performed navigation-guided brain tumor surgery with intraoperative wake-up testing. After the induction of general anesthesia, the patient was placed in the supine position with his head turned to the right and fixed with a Mayfield clamp. The asleep-awake-asleep anesthetic technique combined with intubation was selected for this patient. To reduce the tracheal reflex, xylocaine (5 cc of a 2% solution) by inhalation with nebulizers was administered for 10 minutes preoperatively and for 5 minutes preceding the wake-up procedure.

A left temporoparietal craniotomy was performed. When the tumor was exposed, the anesthetic was stopped and the patient was allowed to awaken so that brain mapping could be performed. An Ojemann stimulator (Radionics Inc., Burlington, MA, USA) was used for bipolar cortical stimulation. He underwent neurological tests, which included finger counting, performing calculations, answering questions, and writing. The Beuson-Geschwind classification of aphasia,[8] Ojemanu Mira intraoperative cortical stimulation mapping,[9] and the modified Boston Diagnostic Aphasia Examination[10] were administered to evaluate his language function. The patient was asked repeatedly to count his fingers from 1 to 10 and to identify objects by pointing to the printed words or photographs of the objects. To evaluate his reading ability, he

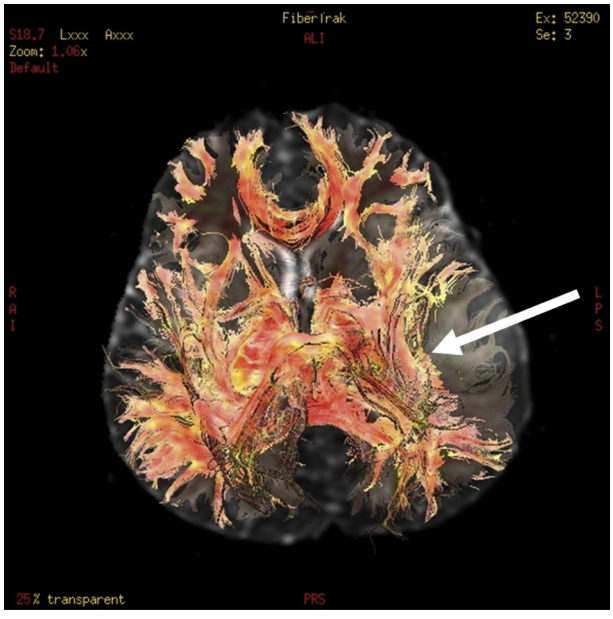

Fig. 1. Axial tractogram reveals a tumor in the left temporal lobe. The tumor is deviating the white matter tract medially (arrow).

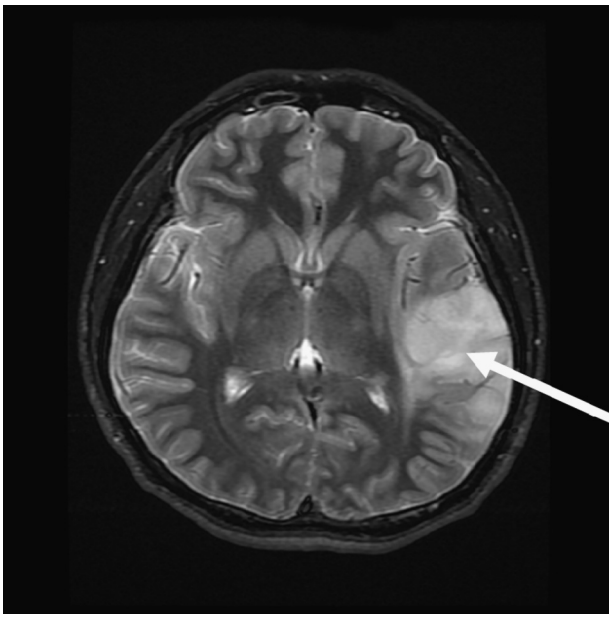

Fig. 2. Axial T2-weighted magnetic resonance image(MRI) shows a round hyperintense tumor with perifocal edema in the left temporal lobe (arrow).

answered specific questions by selecting from a group of cards that displayed a printed question with the correct response. To evaluate his writing ability, he was requested to write specific sentences with a pen. As the final test, he was asked to perform calculations so that global integration of his language function could be evaluated.

After successfully mapping his cortical function, tumor excision was then performed by employing neuronavigation (for anatomical localization) and wake-up direct cortical Ojemen stimulation (for precise functional localization). When the tumor resection was complete, general anesthesia was re-introduced. The patient recovered well after surgery without any new onset of neurological deficiency. The final pathology report indicated an anaplastic astrocytoma. Postoperative MRI showed adequate resection of the tumor (Fig. 3). After surgery, the patient was referred to the Radiooncology for adjuvant radiotherapy.

3. Discussion

In 1889, Zernow[11] developed the first stereotactic frame for intracranial navigation. Since then, the technique has undergone a dramatic degree of modification. Current neuronavigation techniques allow very precise anatomical localization of brain lesions and serve as effective therapeutic modalities for brain tumor removal. This approach results in a greater degree of tumor resection and in increased survival time.[12] In 1999, Gumprecht et al[1] described using the BrainLab Neuronavigation System (which has a target-localizing accuracy of 4 ± 1.4 mm) in 131 cases of brain surgery. These investigators concluded that the neuronavigation system was remarkably helpful and user-friendly for neurosurgical interventions. In 2004, Kurimoto et al[13] retrospectively