THE TRANSPETROSAL/TRANSTENTORIAL APPROACH: AN ALTERNATE APPROACH FOR THE PLACEMENT OF AN AUDITORY BRAINSTEM IMPLANT (ABI)

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Abstract

Educational Objective: At the conclusion of this presentation, the participants should demonstrate an additional surgical approach for placement of an auditory brainstem implant.
Objectives: 1) Compare the novel transpetrosal/transtentorial (TPTT) surgical approach to the translabyrinthine (TL) and retrosigmoid (RS) approaches for the placement of an auditory brainstem implant (ABI); and 2) discuss when the TPTT route may be the optimal option in patients with neurofibromatosis type 2 (NF2), particularly if patients have numerous concurrent intracranial tumors (i.e., those of the jugular foramen) and/or a single functional venous outflow tract.
Study Design: Retrospective case report.
Methods: In a 30 year old Caucasian female with NF2, prior bilateral posterior fossa surgical approaches, and a single functioning venous outflow tract, a right sided TPTT surgical approach was used to resect a residual/recurrent vestibular schwannoma and for placement of an ABI. As the patient also had tumors of the jugular foramen, the TPTT surgical route allowed the avoidance of not only catastrophic thrombosis of the only venous outflow tract but also avoidance of additional cranial nerve injury, of significant importance in a patient with concurrent, ipsilateral complete facial paralysis and blindness.
Results: The patient underwent tumor resection and ABI placement without complication with good intraoperative eABR findings. Postoperative CT scan imaging confirmed good placement in the lateral recess of the fourth ventricle.
Conclusions: While the TL and RS approaches remain the workhorse approaches for placement of the ABI, the TPTT approach may be an option for tumor resection and ABI placement in patients suffering from the devastating effects of hearing loss of NF2 while avoiding injury to the lateral sinus or lower cranial nerves.

Introduction

Auditory brainstem implants (ABI) have been in use since 1979[1]. While they were initially approved for use in adults with neurofibromatosis type 2 (NF2), they have since been used in the pediatric population and for expanded indications, including labyrinthitis ossificans, temporal bone fractures, cochlear nerve aplasia, or other cases in which cochlear implants or standard hearing amplification devices that would not function adequately.
While the translabyrinthine (TL) approach was the first approach described for the placement of an ABI, the retrosigmoid (RS) approach has also been used for both adult and pediatric implants in both tumor and non-tumor cases[2]. We present the first known case of the transpetrosal/transtentorial (TP/TT) approach for placement of an ABI (a variant of an extended middle cranial fossa, or eMCF, dissection). This surgical route was chosen for 2 major reasons: 1) to avoid injury to the only remaining venous outflow tract (the right sigmoid sinus) 2) to access the lateral recess of the fourth ventricle for placement of an ABI in a patient with lower cranial nerve tumors.

Methods and Materials

This is a case report of a single patient undergoing the TP/TT approach for not only resection of a recurrent or residual vestibular schwannoma but also for ABI placement. The patient is a 31 year old Caucasian female with a history of NF2 who has undergone numerous intracranial procedures for meningiomas and internal auditory canal/cerebellopontine angle (IAC/CPA) tumors by other surgeons. She presented for removal of a nonfunctional cochlear implant (CI) followed by an magnetic resonance imaging (MRI) scan (Figure 1). The scan revealed a right CPA tumor and lower cranial nerve lesions. In addition, the right sigmoid sinus was the only functional venous outflow tract. Preoperatively, the patient was blind and profoundly deaf. Her facial function was House-Brackmann grade VI on the right. Her only means of communication was through finger spelling. The patient desired to proceed with a right TP/TT approach to remove the tumor and place the ABI.

Results

The patient underwent the right TP/TT IAC/CPA tumor resection with external auditory canal (EAC) closure, Eustachian tube obliteration, abdominal fat graft followed by placement of an ABI without complication. The magnet was removed from the ABI to allow postoperative MRI scans. Intraoperatively, the electric auditory brainstem response (EABR) was considered good; no repositioning of the ABI paddle was performed after the initial placement. Two months after surgery, the patient could hear the television, her own voice, her children's voices, and environmental sounds (e.g., running water). Her family member stated that there were no apparent complaints about the device other than with issues of retention at the site due to the lack of a magnet being present. The patient will be monitored with MRI scans every 6 months for continued growth of her other lesions and possible contralateral ABI placement.

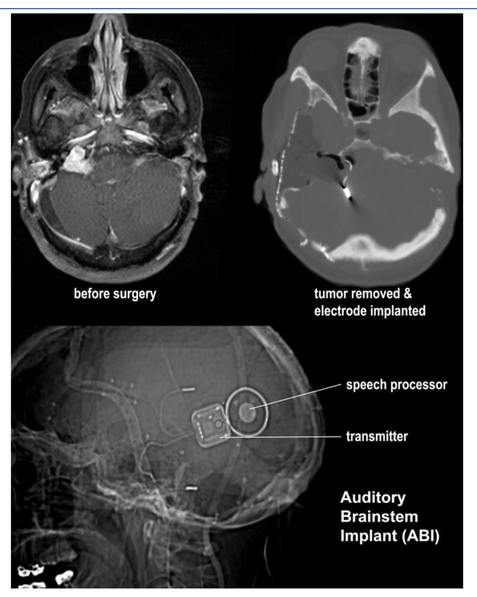

FIGURE 1: A. UPPER LEFT-HAND CORNER: IMAGE OF LOWER JUGULAR FORAMEN TUMOR ON MRI WITH GAD. B. UPPER RIGHT-HAND CORNER: IMAGE OF AXIAL NONCONTRAST CT SCAN SHOWING PLACEMENT OF ABI PADDLE IN LATERAL RECESS OF FOURTH VENTRICLE. C: INFERIOR IMAGE OF LATERAL CT SCANOGRAM SHOWING ABI RECEIVER STIMULATOR.

Discussion

ABIs are potentially a significant life altering event for patients. While they do not function as well as CIs nor typically provide open-set recognition (except in subset populations), they do allow the recipients to recognize environmental sounds and can enhance lip-reading skills. While this patient was both deaf and blind and could not lip-read, her improvement in her quality of life is substantial. She has significant sound awareness and is able to hear her own children for the first time in many years.
The traditional routes of ABI placement are the TL and RS approaches. While these approaches typically allow concurrent tumor resection and ABI placement, in this particular patient, who had only 1 functional sigmoid sinus and lower cranial nerve tumors, the TP/TT route allowed us to safely remove tumor, avoid sigmoid sinus injury, and place the ABI paddle into the lateral recess of the fourth ventricle.
The eMCF approach has been used not only for vestibular schwannoma surgery, but also in other pathologies of the lateral skull base and anterior and posterior fossa, including meningiomas, schwannomas of other cranial nerves, and brainstem cavernomas[3,4]. While others have described the eMCF approach for placement of an ABI in cadaveric specimens[5], this is the first description of this TP/TT or eMCF approach in a patient.

Conclusions

The TP/TT (or eMCF) approach for tumor resection and ABI placement is one additional approach that may be used by the neurotology/neurosurgery team in the management of patients with NF2 from both a tumor perspective as well as a rehabilitative perspective. Future studies at our institution will continue to further define when this approach is most applicable as well as the potential challenges and pitfalls.

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