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Endoscopy of the posterior fossa and endoscopic dissection of acoustic neuroma

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The objective of this study was to evaluate the importance of endoscopes in eliminating the disadvantage of posterior fossa approach--that is, the lack of adequate visualization obtained of the lateral aspect of the internal acoustic canal (IAC).

Over a 10-year period 32 patients underwent removal of acoustic neuroma (AN) via a combined retrosigmoid retrolabyrinthine approach (CRSRL). Endoscopes were used at different stages of the operation, and their use was evaluated with regard to elimination of the disadvantages of the posterior fossa approach.

All patients in whom AN had been diagnosed underwent surgery. A standard combined retrosigmoid retrolabyrinthine approach was performed. Standard sinus endoscopes of 0, 30, and 70° were introduced into the cerebellopontine angle before debulking the tumor, and the IAC was inspected at the end of the operation. Neurovascular integrity as well as the relationship between AN and surrounding structures were evaluated. The IAC was inspected for residual tumor, and if any was found, endoscopic tumor dissection was performed.

Endoscopes have facilitated the understanding of the relationship between AN and neighboring neurovascular structures. The disadvantage of posterior fossa approach can be eliminated by using endoscopes.

In surgery in which the posterior fossa approach is performed, endoscopes can be used to make operations safer. In addition to allowing inspection of the fundus, it is possible to perform tumor dissection within the IAC by using the endoscopes.

Key Words * endoscopy * acoustic neuroma

Acoustic neuroma (AN) is the most frequent tumor of the cerebellopontine angle (CPA). In general, the tumor starts within the internal acoustic canal (IAC) and grows medially into the brainstem. Tinnitus and hearing loss are the most frequent symptoms. The superior vestibular nerve is the most common site of

origin. After the tumor enlarges to a certain extent (> 25 mm), symptoms related to involvement of other cranial nerves, such as the trigeminal and facial nerves, begin.[1,7]

The objectives of the surgical management are total excision of the tumor, preservation of the facial functions, conservation of hearing, and preservation of neighboring neurovascular structures.

There are several surgical approaches for removal of AN. There are advantages and disadvantages to each approach. The posterior fossa approach is one of the surgical techniques applied for the removal of acoustic tumor. However, inadequate visualization of lateral ends of the IAC or fundus is the major disadvantage of this technique because the IAC is located in an obtuse angle in relation to the petrous ridge, and further, the labyrinth contributes to this difficulty by blocking 2 or 3 mm of the lateral IAC. Therefore, removal of the posterior wall of the IAC is necessary for total excision of a tumor located within the lateral end of the IAC. Although the surgical landmarks have been defined to facilitate removal of the posterior wall of the IAC while sparing the labyrinth, failure to conserve hearing is not an uncommon outcome in the posterior fossa approach.[2,3]

For the purpose of this study, we tried to overcome the main disadvantages of the posterior fossa approach by using endoscopes as well. We present our results of endoscopic inspection and tumor dissection in AN surgery.

CLINICAL MATERIALS AND METHODS

Over a 10-year period, 32 patients who harbored CPA tumors underwent surgery via posterior fossa approach in which the combined retrosigmoid retrolabyrinthine technique was used. All operations were performed by the senior author (N.G.) and his team. Diagnosis of CPA tumor was based on patient history, complete otolaryngological examination, audiometric investigation, and radiological evaluation. Pure tone averages and speech discrimination scores were calculated by audiometry. Radiological assessment included computerized tomography scanning and/or magnetic resonance imaging studies. A diagnosis of AN was confirmed by postoperative pathological examination of the surgically excised specimens.

Intraoperative facial nerve monitoring was performed in 26 patients by using the Silverstein facial nerve monitor. During surgery, either inspection of the fundus for residual tumor or endoscopic tumor dissection within the IAC was performed whenever necessary. The endoscopes were standard 0, 30, and 70° sinus endoscopes (Karl Storz, Inc., Culver City, CA).

Description of Technique

The senior author (N.G.) performed all surgeries by using the combined retrosigmoid retrolabyrinthine technique as described by Silverstein, et al.[9]

Tumors were removed in the standard fashion, and the endoscopes were used to determine if residual tumor existed and to observe the integrity of the cochlear and facial nerves. When the tumor was located in both CPA and IAC, initial debulking of the tumor was performed in the CPA preceding the drilling of 4 to 5 mm of bone in the posterior lip of IAC under guidance of a surgical microscope. Subsequently, 0, 30, and 70° endoscopes were introduced into the CPA, and the IAC and related neurovascular structures were inspected. If a residual tumor was encountered within the IAC, in particular at its lateral end, the tumor was dissected under endoscopic view. Neuroendoscopic dissection could be performed until the IAC was free of tumor and the cochlear and facial nerves were left intact.

During direct endoscopic dissection, the surgeon needs to wear sterile eye glasses so that he or she does not contaminate the endoscopes as well as the surgical field with naked eye. Sterile eye glasses do not need to be worn when the surgeon performs endoscopic dissection by looking at a monitor.

RESULTS

The patients were 12 men and 20 women whose ages ranged from 20 to 63 years. Preoperatively all patients complained of hearing loss. There was tinnitus in 31 (96.9%), dizziness in 27 (84.4%), vertigo in 10 (31.3%), and horizontal-rotary type nystagmus in eight patients (25%). Excision of the tumor was performed in all patients except in one patient with neurofibromatosis type II who presented with multiple site involvement throughout the central nervous system.

Utilizing 0, 30, and 70° of endoscopes, the IAC and CPA were inspected, and in eight patients endoscopic tumor dissection was made within the IAC.

Postoperatively, Grades II, III, and IV facial weaknesses were documented in six, two and one patients, respectively. In the other patients Grade I facial function was demonstrated. In cases in which endoscopic tumor dissection was not performed, in spite of observing intact cochlear nerves at the end of the operation, hearing preservation could not be achieved except in one. In patients in whom endoscopic dissection was performed, hearing preservation was achieved in only four, although intact cochlear nerves were observed when surgery was complete.

Postoperatively, cerebrospinal fluid leakage was noted in one patient who received local care and revision of the wound sites and lumbar spinal drainage was performed as well.

DISCUSSION

Although it is a benign tumor, AN is an entity that necessitates surgical removal. If the tumor settles within the IAC and/or CPA, some disadvantages may arise that unfavorably affect the operative procedure performed via posterior fossa approach.

The CPA is a place rich in neural and vascular structures, and therefore, it presents a challenge to performing functional operations. Improvement of the surgical techniques and instrumentation are essential to perform functional operations and to minimize the complications. What we understand from the term "functional" in AN surgery is that it is necessary to preserve hearing, facial functions, and related neurovascular integrity while completely removing the tumor.

Indeed, in this pilot study we have not referred to hearing results of the endoscopic AN surgery. In this study we mainly deal with the importance of using endoscopes in surgery performed via the posterior fossa approach, as well as eliminating the disadvantages of the concerned otoneurosurgical procedure.

Selection of the surgical approach for removal of AN depends on the size and location of the tumor, medical and hearing status of the patient, as well as preference of the surgeon. In a patient with serviceable hearing, the middle fossa approach is considered an appropriate approach for resection of tumors localized to IAC and, in particular, for those localized at the lateral aspect of the IAC. However, the inferior half of the fundus cannot be viewed fully when the middle fossa approach is used, which may potentially lead to recurrences, particularly if the tumor arises from the inferior vestibular nerve. Use of posterior fossa approach is mostly preferred for large tumors of the CPA with less extension to IAC because it allows for hearing preservation in most of the cases.

In combined retrosigmoid retrolabyrinthine approach, lack of the adequate visualization of the lateral aspect of IAC or fundus limits the assessment of the relationship between the tumor and facial and cochlear nerves within the IAC; furthermore unless the labyrinth is violated, 2 to 3 mm of the fundus cannot be exposed in the vast majority of the cases. Therefore, the likelihood of leaving some residual tumor within the IAC is higher due to limitation of the view.[4] For this reason, the majority of the surgeons recommend either translabyrinthine or middle fossa approaches for tumors settled laterally within the IAC. However, when the posterior fossa approach is performed, the endoscopes can be used to inspect the lateral end of IAC or fundus for residual tumor tissue.

Utilization of the endoscopes during otoneurosurgical procedures has facilitated both visualization of and reaching the sites that otherwise prohibit visualization when using an operative microscope. Standard sinus endoscopes of 30 and 70° can be used for both inspection and tumor dissection within the IAC. In addition, early identification of the relationship between the tumor and neighboring neurovascular structures is possible when using 0, 30 and 70° endoscopes as well (Fig. 1).

Fig. 1. Endoscopic views. Left: Inspection of the posterior fossa through 0° endoscope. Right: View through 30° endoscope after drilling approximately 4 mm of the posterior lip of IAC. Note the small tumor (T) and its relation with the vestibular (V) and cochlear (C) nerves. F = cerebellar flocculus; 5, 8, 9, 10, 11 = fifth, eighth, ninth, 10th, 11th cranial nerves.

That is, early in the operation, the surgeon can strategize how to dissect the tumor while preserving the related neurovascular structures. According to McKennan,[6] neuroendoscopy has the advantages of providing: documentation of complete tumor excision; a lateral view of facial and cochlear nerves; a better view of the mastoid air cells that need obliteration; and excision of all vestibular neurons in cases with neurofibromatosis type II. The advantages of the endoscopes are summarized in the Table 1.

TABLE 1
THE ADVANTAGES OF USING ENDOSCOPES IN POSTERIOR FOSSA ACOUSTIC TUMOR REMOVAL

- 1) drilling less bone in the posterior portion of IAC (<4–5 mm)
- 2) inspection of neurovascular contents of IAC & their relation w/ the tumor
- 3) inspection of proximity of the jugular bulb to IAC
- 4) inspection of fundus for residual tumor following resection
- 5) inspection of IAC for integrity of the cochlear & facial nerves after tumor removal
- 6) inspection of drilled-out portion of the petrous bone for open air cells that might need sealing

To obtain a view of the lateral aspect of the IAC via posterior fossa approach, excessive drilling of the IAC is necessary, which is not possible in procedures in which hearing preservation is attempted because of the limitation of the posterior semicircular canal. In the past, we utilized mirrors to inspect the lateral aspect of the IAC for residual tumor in the posterior fossa approach. In addition, when a tumor was encountered within the IAC, we drilled the posterior portion of IAC so that we could remove the tumor completely, which is not good when hearing preservation is attempted. However, excessive drilling of bone is not necessary when endoscopes are used. Only 4 to 5 mm of drilling at the posterior IAC is required. Rosenberg, et al.,[8] also pointed out that the use of endoscopes obviates the need for excessive drilling. Briefly, the surgeon does not need a microscope and can see the whole IAC directly through endoscopes after standard posterior fossa exposure; a tumor within the IAC can be subsequently dissected under direct endoscopic view (Fig. 2 left). Moreover, after completion of tumor removal the endoscope can be used to inspect the IAC for residual tumor (Fig. 2).

Fig. 2. Endoscopic views. Left: View through 30° endoscope during endoscopic tumor (T) dissection with its superior vestibular nerve (V) attachment. The facial nerve (F) is clearly observed, and the meatal portion of the cochlear nerve (C) is masked by the tumor. Right: View through 70° endoscope after completion of tumor removal. Note the remnant of the superior vestibular nerve (SV). The facial, inferior vestibular (IV), and cochlear nerves are intact. The fundus is free of tumor.

We performed endoscopic tumor dissection within the IAC and observed that tumors in this site can be removed safely in a controlled manner with visualization of the cochlear and facial nerves and their relationship with the tumor under direct endoscopic view. The results of other studies support our contention that the use of endoscopy makes the operation safer and facilitates the inspection of the

fundus.[5] However, the other studies are not used to address endoscopic tumor dissection. To the best of our knowledge, ours is the first report in the literature that refers to endoscopic AN resection.

Endoscopic dissection of the tumor within the IAC can be performed either under direct endoscopic view or by watching the endoscopic view on a monitor. The drawback here is the difficulty in manipulation the instrument under endoscopic view if the surgeon is not skilled in the use of endoscopes.

In conclusion, utilization of the endoscopes in otoneurosurgical procedures is a new concept with promising results. Endoscopy can make the operation safer and eliminate the disadvantages inherent in the posterior fossa approach, which are the lack of visualization of fundus and gaining access to lateral IAC under direct vision. Standard sinus endoscopes of 0, 30, and 70° are useful for the evaluation of the relationship between the AN and neighboring neurovascular structures even in the early stages of the operation.

References

1. Brackmann DE, Green JD: Cerebellopontine angle tumors, in Bailey BJ (ed): **Head and Neck Surgery-Otolaryngology**. Philadelphia: JB Lippincott, 1993, Vol 2, pp 1803-1819
2. Domb GH, Chole RA: Anatomical studies of the posterior petrous apex with regard to hearing preservation in acoustic neuroma removal. **Laryngoscope** **90**:1969-1976, 1980
3. Geurkink NA: Surgical anatomy of the temporal bone posterior to the internal auditory canal: an operative approach. **Laryngoscope** **87**:975-986, 1977
4. Jackler RK, Pitts LH: Selection of surgical approach to acoustic neuroma. **Otolaryngol Clin North Am** **25**:361-387,1992
5. Magnan J, Chays A, Lepetre C, et al: Surgical perspectives of endoscopy of the cerebellopontine angle. **Am J Otol** **15**:366-370, 1994
6. McKennan KX: Endoscopy of the internal auditory canal during hearing conservation acoustic tumor surgery. **Am J Otol** **14**:259-262, 1993
7. Roland PS, Glasscock ME: Acoustic neuroma, in Paparella MM (ed): **Otolaryngology**, ed 3. Philadelphia: WB Saunders, 1991, Vol 2, pp 1775-1787
8. Rosenberg SI, Silverstein H, Willcox TO, et al: Endoscopy in otology and neurotology. **Am J Otol** **15**:168-172, 1994
9. Silverstein H, Norrell H, Smouha E, et al: Combined retrolab-retrosigmoid vestibular neurectomy. An evolution in approach. **Am J Otol** **10**:166-169, 1989

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