Complications of the Translabyrinthine Approach for the Removal of Acoustic Neuromas

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Objective: To report the complications that occurred during a large series of surgical procedures for the removal of acoustic neuromas using the translabyrinthine approach.

Design: Retrospective analysis.

Setting: Neuro-otology practice with academic affiliation. Procedures were performed at either a university medical center or a community hospital in conjunction with a neurosurgery team.

Patients: A total of 258 patients (142 men, 116 women; mean age, 51 years) underwent the translabyrinthine approach during a 14-year period. All patients had a histologically proven diagnosis of acoustic neuroma.

Results: There were no deaths. There were 3 cases (1.1%) of neurovascular compromise. There were 20 cases (7.8%) of cerebrospinal fluid leak, 16 (80%) of which presented as rhinorrhea and 4 (20%) as incisional leaks. The leaks at the incision responded to conservative management, while rhinorrhea usually required more aggressive means of closure. Four patients (1.6%) were diagnosed as having bacterial meningitis. Complete gross tumor removal was not achieved in 4 patients (1.6%). Facial nerve function, as measured by the House-Brackmann system, was recorded in all patients at 1 year: 76% had a score of I or II; 18%, a score of III or IV; and 6%, a score of V or VI. Other complications included 3 cases of pneumonia, 1 case of severe gastric hemorrhage, and 1 case of wound infection.

Conclusions: The results of this series generally agree with those of other large series and demonstrate the safety and effectiveness of the translabyrinthine approach in excising acoustic neuromas.

PATIENTS AND METHODS

More than 400 patients with lesions of the cerebellopontine angle were referred to the senior author (R.J.W.) between the years 1982 and 1996. Of these, 258 were patients with acoustic neuromas who were operated on using the TLA. Patients with meningiomas or rare cerebellopontine angle tumors were excluded. Patients with acoustic neuromas as part of a neurofibromatosis syndrome were also excluded. Medical information was gathered by means of a review of a computerized acoustic neuroma database as well as hospital and office charts. All patients had office follow-up visits for at least 1 year, with direct assessment of facial nerve function and a postoperative imaging study performed at a minimum of 1 year. In most cases, patients were offered translabyrinthine surgery in cases in which their preoperative hearing or the size of their tumor allowed little chance at hearing preservation. Some patients were offered the choice of a hearing preservation attempt but opted for the TLA instead.

The tumors were grouped by size, as shown in the Figure. Tumor size was measured by computed tomography or magnetic resonance imaging as the largest extracanalicular diameter and ranked as follows: intracanalicular tumors had no extracanalicular extension; small tumors extended 1 to 15 mm, medium tumors 16 to 35 mm, and large tumors more than 35 mm into the cerebellopontine angle. The surgical technique that was used is similar to that described elsewhere.1,2 Salient points of this technique include packing the eustachian tube with muscle, obliterating the middle ear and mastoid cavity with abdominal fat, and, since 1986, intraoperative facial nerve monitoring.

MORTALITY

There were no deaths in this series (mortality rate, 0%).

NEUROLOGIC COMPLICATIONS (EXCLUDING FACIAL NERVE INJURIES)

There were 3 cases (1.1%) of neurovascular compromise in this series: 1 case was transient and 2 cases were permanent. The first occurred in a 54-year-old woman with a small tumor who developed cerebellar edema on postoperative day 3, causing severe ataxia that lasted longer than the expected postoperative dysequilibrium. The computed tomographic scan revealed no evidence of infarct. The patient was discharged after approxi-

mately 3 weeks in the hospital, with physical therapy arranged as an outpatient. Within 3 months the ataxia resolved completely.

The second case occurred in a 45-year-old man with a 4.5-cm tumor. After surgery, he developed an ipsilateral 10th cranial nerve paresis, resulting in severe aspiration during deglutition. He has since required gastrostomy tube placement for safe feeding.

The third case occurred in a 72-year-old man with a medium-sized tumor. He had significant preoperative risk factors, such as hypertension, coronary artery disease, and deep venous thrombosis. After surgery, he suffered a cerebrovascular accident that left him obtunded for several days. He has gradually improved, but aphasia and motor deficits have remained despite extensive rehabilitation efforts.

CEREBROSPINAL FLUID (CSF) LEAKAGE

A CSF leak occurred in 20 patients (7.8%). The leaks presented as rhinorrhea 80% of the time, and at the incision site in the remainder. They were handled 3 different ways: (1) conservatively, with application of a pressure dressing and bed rest; (2) with lumbar drain placement; or (3) with surgical repair. As shown in Table 1, leaks at the incision site responded to conservative therapy, while rhinorrhea usually required more invasive measures to effect closure. The mean tumor size in patients with CSF leaks was 18.7 mm, as compared with 18.5 mm in patients without CSF leaks. This difference was not statistically significant.

MENINGITIS

Bacterial meningitis was indicated by the presence of the classic symptoms and confirmed by the findings on spi-
nal fluid analysis. Of the 4 patients (1.6%) diagnosed as having bacterial meningitis in this series, 2 had concomitant CSF leakage, which presented as rhinorrhea, and were treated with lumbar drainage. All cases of meningitis resolved with intravenous antibiotic therapy, without further sequelae.

Six patients (2.3%) had aseptic or chemical meningitis with moderate neck pain and headaches without fever. Analysis of CSF samples excluded a bacterial origin. The patients were treated symptomatically with a short course of oral steroids, and all symptoms eventually resolved.

**RESIDUAL TUMOR**

Complete gross tumor removal was achieved in all but 4 patients (1.6%). Of the patients with complete tumor removal, none had evidence of recurrence on computed tomographic or magnetic resonance imaging scans beyond 1 year.

**FACIAL NERVE FUNCTION**

Facial nerve function was graded according to the House-Brackmann scale in the immediate postoperative period and at 1 year. The 1-year evaluation does not take into account surgical correction; for instance, if a 12th to 7th cranial nerve anastomosis transforms a total paralysis to an incomplete paresis, it is still considered grade VI for the purpose of this study. Seventy-six percent of the patients had a grade I or II score at 1 year, while 18% had a score of III or IV and 6% had a score of V or VI. The results are summarized in Table 2. Not surprisingly, there is a significant correlation between tumor size and facial nerve outcome (as measured on the House-Brackmann scale), with larger tumors yielding worse outcomes. Table 2 illustrates this relationship, comparing final facial nerve outcome with tumor size (Pearson $r = 0.29$, $P < .001$).

Beginning in 1986, the facial nerve monitor was routinely used for acoustic tumors removed via the TLA. In all, of the 238 patients in our study, 233 were monitored and 23 patients were not. The size of the unmonitored group precludes a meaningful comparison between the groups.

**MISCELLANEOUS**

There were 3 cases of postoperative pneumonia. All resolved with intravenous antibiotic therapy, without the need for intubation. There was 1 case of gastric bleeding that was thought to be secondary to the postoperative steroid administration. The bleeding resolved without need for transfusion or surgery. While there were no hematomas at the harvest site for abdominal fat, there was 1 case of a stitch abscess that responded to local wound care.

<table>
<thead>
<tr>
<th>Tumor Size</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
<th>VI</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intracanalicular</td>
<td>11 (100)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>11</td>
</tr>
<tr>
<td>Small (1-15 mm)</td>
<td>81 (71.7)</td>
<td>13 (11.5)</td>
<td>10 (8.8)</td>
<td>5 (4.4)</td>
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<td>2 (1.8)</td>
<td>113</td>
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<tr>
<td>Medium (16-35 mm)</td>
<td>63 (60)</td>
<td>15 (14.3)</td>
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<td>Large (&gt;35 mm)</td>
<td>7 (24.1)</td>
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**COMMENT**

Our findings confirm the generally held notion that the TLA is a safe and effective method for excising acoustic neuromas. Most importantly, there were no deaths in this series. Other reports have placed the mortality rate at 1% to 5%.1,2,6-8 Usually, the cause of death is a severe neurovascular insult. In our study, there were 3 significant neurovascular complications, 2 of which led to permanent deficits. In one of the patients involved, the tumor was quite large (4.5 cm). While increased tumor size clearly yields higher complication rates in general, it should be noted that only 1 of our 27 patients with large tumors (>35 mm) had a neurovascular complication. This finding is in accordance with a recent study that demonstrated the safety of the TLA for large acoustic neuromas. In that study, tumors larger than 4.0 cm had a 4.8% neurovascular complication rate.4

Rates of CSF leakage have fallen dramatically with the refinement of surgical techniques. Previously reported rates of 20%9 have declined with the use of fat packing into the mastoid and obliteration of the eustachian tube and middle ear space. In our series, CSF leaks developed in 7.8% of patients after surgery. This rate is comparable to other recent series that have placed rates at 6% to 16%.2,10,11 Regarding the development and outcome of CSF leaks, several conclusions can be drawn. First, we found that tumor size did not influence the development of CSF leaks. This finding is in agreement with the observations noted in other reports.12 The mean tumor size (18.7 mm) in patients in whom leaks developed was nearly identical to that (18.5 mm) in patients in whom there was no evidence of CSF leakage. Factors such as delayed wound healing and episodes of increased intracranial pressure (as occurs with straining or vomiting) may play a more important role in the development of CSF leakage. In our series, we found that the site of CSF leakage greatly influences outcome. Leaks that occurred via the eustachian tube (rhinorrhea) were more likely to require invasive intervention than those that occurred via the incision. At our institution, CSF leaks are usually handled in a stepwise fashion. Management progresses from conservative measures, such as pressure dressing and bed rest, to lumbar drainage, and finally to surgical repair. Management plans are, of course, individualized according to the size and dura-

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**Table 2. Tumor Size and Final Facial Nerve Outcome by House-Brackmann Grade**

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tion of the leak. In this series, leaks at the incision site responded to simple pressure dressing and bedrest in all cases. Cerebrospinal fluid rhinorrhea was more problematic. Only 3 (19%) of 16 cases resolved with conservative measures. Five cases (31%) responded to lumbar drainage for several days, while 8 cases (50%) required operative repair. Based on these findings, it would seem prudent to attempt closure of CSF rhinorrhea with a lumbar drain as a first step, with the expectation that about 50% of the cases will require definitive closure in the operating room. Incisional leaks may usually be handled in a conservative manner.

Bacterial meningitis developed in 4 cases (1.6%). Two (50%) of the 4 cases developed in the presence of CSF rhinorrhea. These numbers are not large enough to draw statistical conclusions, but they are suggestive of a relationship and lend some urgency to the issue of quickly closing a CSF leak. Other authors have found no statistical association between CSF leakage and meningitis, and have concluded that both may be the result of a flawed technique or an extensive dissection.11

Data regarding facial nerve preservation are presented in Table 2. The majority of patients had normal or near normal function at 1 year, with 76% exhibiting grade 1 or II facial nerve function. These rates are comparable to those of other series.2 As shown in Table 2, there is a clear correlation between increasing tumor size and worsening facial nerve outcome. This is not surprising, as larger tumors tend to become more intimately involved with the facial nerve or significantly alter its anatomical course. These larger tumors are thus more difficult to extract without injury to the facial nerve. We believe that facial nerve monitoring has become the standard of care for the TLA to acoustic tumors. Because the vast majority of our patients had intraoperative facial nerve monitoring, comparisons of outcomes in unmonitored patients were meaningless in this series.

CONCLUSIONS

Our findings demonstrate the safety and effectiveness of the TLA for the removal of acoustic neuromas, particu-