Transtemporal Supralabyrinthine (Middle Cranial Fossa) Vestibular Neurectomy: A Review of the Last 100 Cases

ABSTRACT—The outcome of 100 consecutive transtemporal supralabyrinthine vestibular neurectomies performed between 1982 and 1992 was analyzed retrospectively and compared with that of the first 100 operations (1969 to 1975) in order to analyze the effects of the learning curve on immediate postoperative complications. A total sensorineural hearing loss, which occurred in 2% of the cases initially, could be totally avoided by (1) opening the tegmen tympani for better identification of the superior ampulla and (2) preserving the saccular branch of the inferior division of the vestibular nerve when the identification of the cochlear nerve was difficult because of a narrow anatomic space. As in the first series of patients, no immediate or delayed total loss of facial function was observed. However, a slightly higher number of delayed, temporary facial weaknesses (7% vs 3%) were recorded. The impairment of facial function was limited mostly to an asymmetric eyelid closure, unnoticed by the majority of the patients, which disappeared within 10 days. The number of postoperative temporary CSF leaks (through the wound or nose) resolving spontaneously remained the same (12%). There was no instance of postoperative meningitis. Due to the minimal dural elevation involved in transtemporal, supralabyrinthine vestibular neurectomy, no temporal lobe complications (particularly seizures) have been observed. In patients over 65 years of age, the operation lasted, on average, 10 minutes longer and the hospitalization was 3 days longer. There was no difference in the duration of the acute subjective vertigo (3 days) in patients younger than 65 versus older patients. Transtemporal, supralabyrinthine vestibular neurectomy offers an effective cure for disabling vertigo while preserving hearing in Menière's disease. The complications are acceptable even in patients over 65 years of age if the operation is carried out with limited elevation of the middle cranial fossa dura by a sufficiently trained and experienced skull base surgeon. (*Skull Base Surgery*, 6(4):221–225, 1996)

Control of vertigo while preserving hearing is the major goal in treating disabling Menière's disease. Through the years, selective vestibular nerve section has proven to be the best way to achieve this goal. Differences of opinion concern only the best approach (middle cranial fossa or posterior fossa) and the extent of nerve resection (neurotomy or neurectomy). Since 1969, our preference has been the transtemporal supralabyrinthine vestibular neu-

rectomy (TSVN), which is a modification of the middle cranial fossa approach proposed by William House in 1961.¹ The surgical technique, complications, and long-term results of TSVN have been reported in previous publications.^{2–4} The purpose of this paper is to review a recent series of 100 consecutive patients and to analyze the effects of the learning curve on the surgical technique and postoperative complications.

MATERIAL AND METHODS

The outcome of 100 consecutive operations performed between January 1982 and January 1991 was analyzed retrospectively on the basis of the clinical documentation (case history, vestibular test, audiometry) of the ENT Department of the University Hospital of Zurich. The age distribution of the patients varied from 20 to 73 years (average, 48 years) (Table 1). There were 43 females and 57 males; 10 patients were 65 years or older. Of all patients, 87% presented with unilateral and 13% with bilateral symptoms. The left ear was involved in 53% and the right ear in 47% of the unilateral cases. The duration of disabling vertigo (Table 2) was, on average, 7 years (range, 0.5 to 10 years). The degree of disablement according to the AAOO rules was moderate in 28%, severe in 36%, and total in 36% of the patients.

Surgical Technique

All patients underwent TSVN. The surgery and the anesthesia were carried out by the same surgeon and anesthetist. The surgical steps of TSVN have been described in detail previously.² The main features of the operation are: (1) preauriculotemporal skin incision, (2) minimal (2 × 4 cm) temporal craniotomy, (3) minimal (less than 1 cm) elevation of the middle cranial fossa dura, (4) identification of the blue line of the superior semicircular canal and the exposure of the meatal plane through the temporal bone without identification of the middle meningeal artery, (5) exposure of the internal auditory meatus by drilling away the bone between superior ampulla and the tympanic segment of the facial nerve after opening of the tegmen tympani, (6) identification of the superior vestibular nerve and labyrinthine facial nerve at the meatal fundus, (7) removal of the meatal segment of the vestibular nerve including Scarpa's ganglion (*complete neurectomy*) or removal of an intrameatal segment of the vestibular nerve with preservation of the ramus sacculi (*incomplete neurectomy*), (8) sealing of the internal auditory meatus with a free muscle graft and fibrin glue, (9) reconstruction of the tegmen tympani with part of the craniotomy flap, (10) suspension of the middle fossa dura from the temporalis muscle, repositioning of the craniotomy flap, and reconstruction of the temporalis

Table 1. Transtemporal Supralabyrinthine Vestibular Neurectomy

Age (years)	n = %
20-39	24
40-64	66
65-73	10

n = 100; average: 48 years

Table 2. Transtemporal Supralabyrinthine Vestibular Neurectomy

Duration of Disabling Vertigo (years)	%
0.5-1	5
2-5	49
6-10	31
10	15

n = 100; average: 7 years; degree of disablement: moderate 28%, severe 36%, total 36%

muscle, and (11) introduction of a suction drain and wound closure.

Systematic facial nerve monitoring (NIM—2), introduced in 1988, has proven extremely valuable in detecting inadvertent manipulations of the facial nerve. The intraoperative medication consisted of antibiotic cover (Rocephin 2 g/die) and Dexamethasone (Decadron 4 mg/die). The average duration of surgery was 123 minutes (range, 70 to 180 minutes). The hospitalization lasted an average of 10 days (range, 7 to 26 days) (Table 3).

RESULTS

Postoperative Sequelae

Vertigo

The subjective immediate postoperative vertigo was slight in 10%, moderate in 64%, and severe in 26% of patients. The average duration of the acute postoperative vertigo was 3 ± 1.5 days (range, 1 to 9 days). No correlation was found between the preoperative caloric response (Table 4) and the postoperative degree of subjective vertigo. The clearly visible postoperative nystagmus to the nonoperated side rapidly decreased after the first 3 postoperative days. Oscillopsia was a general complaint during the first postoperative week but practically disappeared at discharge from the hospital. All patients were able to walk on their own when leaving the hospital.

Hearing

The preoperative air conduction (AC) hearing level for average of speech frequencies (0.5, 1, 2, and 4 kHz) is shown in Table 5. The majority (76%) of patients presented with an air conduction level of more than 40 dB in

Table 3. Transtemporal Supralabyrinthine Vestibular Neurectomy

Hospitalization (days)	%
1-7	18
8-11	69
12-14	9
14	4

n = 100; average = 10 days

Table 4. Transtemporal Supralabyrinthine Vestibular Neurectomy

<i>Preoperative Caloric Response (% of contralateral ear)</i>	<i>n = %</i>
0–25	17
26–50	33
51–75	23
76–100	27

n = 100

Table 6. Transtemporal Supralabyrinthine Vestibular Neurectomy

<i>Postoperative Hearing (1 to 3 months)</i>	<i>n = %</i>
Better (+ 10 dB)	15
Unchanged ($\pm$ 10 dB)	58
Worse (–10 dB)	27
Total deafness	0

n = 100

the speech frequency range. A postoperative pure tone audiogram was performed 1 to 3 months following surgery (Table 6), at which time 58% of patients had an unchanged ($\pm$ 10 dB), 15% an improved, and 27% an impaired AC level. On average, the AC level was decreased for all patients by 4.3 dB. There was no instance of total sensorineural hearing loss.

Facial Function

No patient exhibited an immediate or delayed total loss of facial function. Seven patients presented with a minimal facial weakness, which appeared after a delay of 3 to 7 days. The impairment of facial function was limited mostly to an asymmetric eyelid closure, which remained unnoticed by four of the seven patients and disappeared, on average, after 10 days.

CSF Leak

Twelve patients had a temporary CSF leak, all of which resolved without treatment at the time of discharge from the hospital. The CSF leak occurred in three patients through the wound and in nine patients through the nose. The outflow of CSF was limited to a few drops which appeared during physical exertion or bending forward.

Complications

The postoperative complications were limited to: diffuse headache (8%), swelling of the wound (2%), and localized hematoma (2%). None of these complications required a specific treatment. There was no instance of postoperative meningitis.

Table 5. Transtemporal Supralabyrinthine Vestibular Neurectomy

<i>Preoperative Hearing Loss</i>	<i>n = %</i>
Operated Ear	
0–20	4
21–40	20
41	76
Contralateral Ear	
0–20	69
21	31

n = 100; all patients with tinnitus

DISCUSSION

The difference between the postoperative sequelae and complications found in the first and in the last 100 cases is shown in Table 7. Experience has permitted the avoidance of total sensorineural hearing loss. Two factors have contributed to this progress:

1. The inadvertent opening of the superior ampulla while drilling away the bone overhang between this structure and the tympanic segment of the facial nerve was one of the causes of total deafness in our initial series of TSVN. Opening the tegmen tympani for identification of the malleus, incus, and tympanic segment of the facial nerve before removing the bone covering the internal auditory meatus has avoided this problem because of the clear identification of the necessary landmarks.
2. Another possible cause for total deafness in the initial series of cases was attributed to damage of the cochlear blood supply, particularly of the vestibulocochlear artery during separation of the ramus sacculi from the cochlear nerve in a narrow meatal fundus. We have tried to avoid this problem by preserving the saccular branch of the inferior division of the vestibular nerve (incomplete TSVN) when the identification of the cochlear nerve was difficult (narrow internal auditory meatus, posterior position of the facial nerve).

Table 7. Transtemporal Supralabyrinthine Vestibular Neurectomy

<i>Complication</i>	<i>First 100 Cases (1969–1975)</i>	<i>Last 100 Cases (1981–1991)</i>
Total deafness	3%	0%
Facial paralysis	0	0
Temporary delayed facial palsy	3%	7%
Temporary CSF leak	6%	12%
Meningitis	0	0

Table 8 shows the effect of the incomplete TSVN on the postoperative AC level. The 47 patients with preservation of the ramus sacculi presented an average postoperative improvement of 2.2 dB, whereas the 53 patients with total vestibular neurectomy had an average postoperative loss of 11.5 dB. The positive effect of an incomplete TSVN on postoperative hearing may be attributed to the better preservation of the cochlear blood supply. No difference was found in the rate of delayed temporary facial palsy with or without preservation of the ramus sacculi. This means that a delayed postoperative facial weakness must be related to the "devascularization" of the distal meatal segment of the facial nerve induced by the complete excision of the superior vestibular nerve. The extensive vascular network surrounding Scarpa's ganglion is indeed closely related to the vessels supplying the facial nerve.⁵ A direct surgical trauma to the facial nerve was unlikely to be the cause of a delayed palsy because the intraoperative monitoring of facial function gave no acoustic indication for such a lesion. The "devascularization effect" on the meatal segment of the facial nerve is an interesting phenomenon because it may also explain the occurrence of delayed and, in some instances, even total facial palsies after an otherwise "atraumatic" removal of an intrameatal tumor (hemangioma, meningioma, acoustic neuroma). At any rate, the devascularization effect does not reduce or prevent temporary, delayed facial dysfunction after TSVN, even with the surgeon's increasing experience. The fact that the number of patients with delayed, temporary facial weakness was higher in the last 100 operations is probably due to the better attention paid to minimal changes in postoperative eyelid closure.

As with temporary, delayed facial palsy, the number of temporary CSF leaks has increased from 6% of the first to 12% of the last 100 cases. This is not a real increase because in the former series only the CSF leaks noticed by the patients were recorded, whereas in the later series the patients were asked to report any drop of clear fluid falling from their nose in the postoperative period. A postoperative transient CSF leak after TSNS has to be expected because it is impossible to close tightly the internal auditory canal with a free muscle graft without exerting undue compression on its neural content. At any

rate, CSF leaks through the middle cranial fossa are less dangerous than those occurring in the posterior fossa because they subside spontaneously within 10 days without need of intralumbar drainage.

Table 9 shows the outcome of surgery for patients older and younger than 65 years of age. In the older age group the operation lasted on average 10 minutes longer and the hospitalization required 3 more days. There was no difference in the duration of the acute subjective vertigo (3 days) in both groups of patients. It must be stressed that no seizures and no temporary, delayed facial palsies were seen in the older group of patients. The absence of complications after TSVN in older patients is certainly due to the minimal dural elevation used for the exposure of the internal auditory meatus.

CONCLUSION

In conclusion, the results obtained in a recent series of 100 consecutive patients demonstrates that middle cranial fossa vestibular neurectomy can be performed consistently without loss of hearing and that it is a safe surgical procedure even in older patients. The complication rate in this series of TSVN (Table 9) is lower than reported for posterior fossa neurectomy.⁶ The advantage of the middle fossa neurectomy over posterior fossa neurectomy is the ability to take advantage of the natural division between the cochlear and vestibular nerves in the distal part of the internal auditory canal.

Preservation of the saccular branch of the inferior division of the vestibular nerve is recommended when a narrow meatal fundus prevents clear identification of the plane of cleavage between the cochlear and vestibular nerves, and preservation of the saccular nerve does not jeopardize the results. Silverstein and Makimoto have indicated that superior vestibular and singular nerve section may have a positive effect on the clinical course of Meniere's disease.⁷ This was also demonstrated in a recent long-term evaluation of patients who underwent bilateral TSVN with preservation of the saccular nerve on one side.⁸ These patients were able to maintain nearly normal balance, and their hearing was preserved, as well.

It has been argued that the surgical approach through

Table 8. Total versus Incomplete Transtemporal Supralabyrinthine Vestibular Neurectomy

<i>Investigated Parameters</i>	<i>Total Vest. Neurectomy (n = 53)</i>	<i>Preservation of R. Sacculi (n = 47)</i>
Average duration of surgery	120 min	127 min
Narrow IAM	17%	36%
Postoperative vertigo	3.2 (days)	3.1 (days)
Postoperative hearing	-11.5 dB	+2.2 dB
Delayed, temporary facial paresis	6.2%	8%

Table 9. Influence of Age on the Outcome of Transtemporal Supralabyrinthine Vestibular Neurectomy

	<i>Age of Patients</i>	
	<i>65 yrs n = 10</i>	<i>64 yrs n = 90</i>
Duration of surgery (x)	133 min	122 min
Hospitalization (x)	15 days	12 days
Duration of acute postoperative vertigo (x)	3 days	3 days
Temporary, delayed facial weakness	0%	8%
Seizures	0%	0%

the middle fossa is technically more difficult than from the posterior fossa.⁶ There is no question that for an “otologist” performing occasional middle cranial fossa surgery, it is easier to use a more familiar posterior approach for vestibular neurectomy. However, a “skull base surgeon” has to be equally proficient in posterior and middle fossa surgery because of the continuous confrontation with trauma, tumors, and cholesteatoma involving the labyrinthine segment of the facial nerve. For a skull base surgeon, TSVN should not be more difficult than a stapedotomy for a well-trained otologist.

Middle cranial fossa vestibular neurectomy offers effective relief of disabling vertigo while preserving hearing in Meniere’s disease. The complications are acceptable if the operation is performed by a surgeon having a sufficient number of patients to maintain adequate expertise.

REFERENCES

1. House WF: Surgical exposure of the internal auditory canal and its contents through the middle cranial fossa. *Laryngoscope* 71: 1363, 1961
2. Fisch U, Mattox D: *Microsurgery of the Skull Base*. New York: Thieme Publishing, 1988
3. Fisch U, Chen JM: Middle cranial fossa vestibular neurectomy. In Brackmann, Shelton, Arriaga (eds): *Otologic Surgery*. Philadelphia: W.B. Saunders Co., 1994
4. Kronenberg J, Fisch U, Dillier N: Long-term evaluation of hearing after transtemporal supralabyrinthine vestibular neurectomy. In Nadol JB Jr (ed): *Proceedings of the 2nd International Symposium on Menière’s Disease*. Kugler & Ghedini, 1988, pp 481–488
5. Fisch U: The surgical anatomy of the so-called internal auditory artery. Tenth Nobel Symposium. Stockholm: Almquist & Wiksell, 1968, pp 121–126
6. Silverstein H, Wanamaker H, Flanzer J, Rosenberg S: Vestibular neurectomy in the United States, 1990. *Am J Otol* 13:2330, 1992
7. Silverstein H, Makimoto K: Superior vestibular and “singular nerve” section—animal and clinical studies. *Laryngoscope* 9: 1414–1432, 1973
8. Böhmer A, Fisch U: Bilateral vestibular neurectomy for treatment of vertigo. *Otolaryngol Head Neck Surg*, 1993
9. Fisch U: Excision of Scarpa’s ganglion. *Arch Otolaryngol* 97:147–149, 1973
10. Glasscock ME, Thedinger BA, Cueva RA, Jackson CG: An analysis of the retrolabyrinthine vs the retrosigmoid vestibular nerve section. *Otolaryngol Head Neck Surg* 104:88–95, 1991
11. McElveen JT, Shelton C, Hitselberger WE, Brackmann DE: Retrolabyrinthine vestibular neurectomy: a reevaluation. *Laryngoscope* 98:502–506, 1988

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