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Nerve origin of the acoustic neuroma

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Abstract

Two hundred and seventy-one Japanese patients who underwent surgical removal of neuroma from the cerebello-pontine angle using the translabyrinthine approach were retrospectively reviewed in order to investigate the nerve origin on an anatomical basis. In 269 out of the 271 cases, the origin of the neuromas was identified. Among these cases, 84.8 per cent of tumours originated from the inferior vestibular nerve (IVN), followed by the superior vestibular nerve (SVN) (8.9 per cent). Of the 5.6 per cent of tumours arising from the vestibular nerve, however, it could not be determined whether they originated from the SVN or IVN. Two cases of neuromas originating from the facial nerve were seen (0.7 per cent). No neuroma arose from the cochlear nerve.

Currently, the diagnosis of acoustic neuromas is best made with Gd-enhanced magnetic resonance imaging (MRI). However, our data indicate that the development of a functional test of the individual IVN can be useful for screening most cases of acoustic neuroma and in facilitating their early diagnosis.

Key words: Neuroma; Facial Nerve; Neuroma Acoustic; Temporal Bone; Surgical Procedures, Operative

Introduction

The acoustic neuroma is the most common cerebello-pontine angle (CPA) tumour and usually arises in the internal auditory canal (ICA).[1] Although the VIIth and VIIIth cranial nerves run in the IAC, they typically arise from the vestibular division of the VIIIth nerve rather than the acoustic division. The vestibular nerve has two divisions in the IAC: the superior and inferior vestibular nerves. The SVN innervates the lateral semi-circular canal and is responsible for the caloric response. Since a high incidence of decreased caloric response had been seen in patients with acoustic neuroma, this tumour has been thought to arise from the SVN.[2–4]

Recently, with the progress of diagnostic modalities, such as MRI, many small neuromas are being detected, and acoustic neuroma patients with normal caloric responses have often been seen in the otolaryngological clinic. Therefore, there has been some doubt as to whether most acoustic neuromas arise from the SVN.[5] In this manuscript, we report the nerve origin of acoustic neuromas from our own surgical experience.

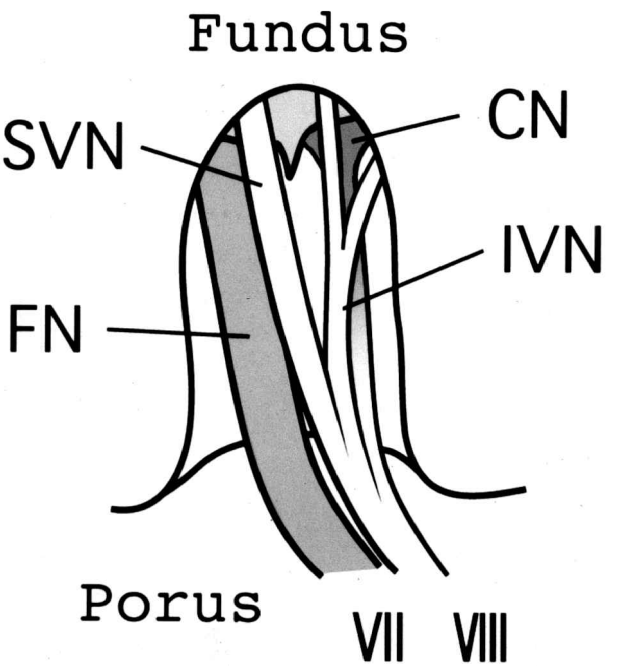

Fig. 1

Anatomical relation of the nerves in the right IAC, a view of the translabyrinthine approach. The SVN is situated left and the IVN is situated right. The transverse crest is situated between both nerves. The facial nerve (FN) and cochlear nerve (CN) are situated behind both vestibular nerves.

Materials and methods

From April 1987 to September 1998, 380 neuromas excluding neurofibromatosis, were surgically removed from the CPA. All patients were Japanese and the diagnosis of the neuroma was made by

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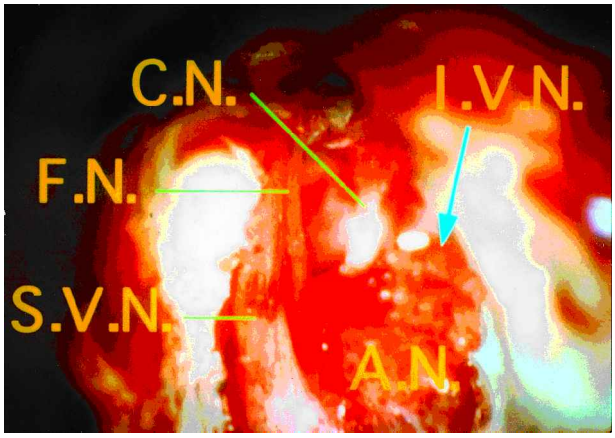

FIG. 2

Surgical review of the translabyrinthine approach for right acoustic neuroma. The SVN was thin but could be divided from the tumour. The IVN was atrophic and was torn out of the fundus during manipulation and lay on the tumour.

gadolinium-enhanced MRI prior to surgery except for a few cases that were diagnosed by enhanced computed tomography (CT). The size of the tumour was measured from these images as the degree of extension into the CPA.

Of these 380 cases, 271 underwent a translabyrinthine approach. Exploration of the IAC was performed by a single surgeon with the aid of a microscope and video monitor. All cases were histologically diagnosed as neuroma.

The nerve origin of the neuroma was carefully determined based on its anatomical relationship (Figure 1). The fundus of the IAC was fully opened and the transverse crest (falciform crest) was identified. Both of the vestibular nerves were identified, and then traced medially. In the case of neuromas arising from the IVN, the SVN was compressed superiorly and usually became flattened. The SVN could often be divided from the neuroma surface, whereas the IVN could not be divided because it was involved with the tumour (Figure 2). In the case of a tumour arising from the SVN or other nerves, the same strategy could be applied to detect the origin of neuroma.

Results

The results are summarized in the Tables. In over 99 per cent of neuromas, their nerve origins were identified, however, the fundus of the IAC was filled with tumour in two cases, and the origin of the neuroma could not identified (Table I).

TABLE II

NERVE ORIGIN OF THE NEUROMA OF IDENTIFIED NERVE ORIGIN IN CPA (N = 269)

Vestibular nerve	267 (99.3%)
inferior vestibular nerve	228 (84.8%)
superior vestibular nerve	24 (8.9%)
undefined (vestibular nerve)	15 (5.6%)
Facial nerve	2 (0.7%)
	(cases)

Eighty-five per cent of neuromas arose from the IVN. However, no distinction between the two divisions of the inferior vestibular nerve, the singular nerve (which innervates the posterior semi-circular canal) and the saccular nerve (which innervates the sacculus) could be made. The origin of 15 neuromas could not be differentiated from either the SVN or IVN, because the neuroma extended to either side of the transverse crest. However, they were thought to arise from the vestibular nerve since both the facial and cochlear nerve could be divided from the tumours. Neuromas originated from the facial nerve in two cases (0.7 per cent), however, no neuroma arose from the cochlear nerve (Table II).

Discussion

Reports on the difference between the superior and inferior divisions are relatively rare. Clemis *et al.* reported five cases arising from the IVN and they suggested that only 50 per cent of vestibular schwannomas originated from the SVN.[5] Prior to their report, Ylikoski *et al.* reported eight out of 21 neuromas originated in the IVN whereas only two originated in the SVN. In six cases, the nerve origin was probably the vestibular nerve, in two cases the cochlear nerve, while in three cases the nerve origin could not be determined.[6] Neely specified the nerve which was invaded by the neuroma in the fundus of the IAC. The SVN was invaded in seven cases and the cochlear nerve in five cases. However, the IVN was infiltrated by a tumour in 16 cases.[7] These two reports were based on findings of the translabyrinthine approach.

Recent studies suggested relative high frequencies for the tumour of the IVN origin. Okada *et al.* reported 147 acoustic neuroma cases which underwent a middle cranial fossa approach and the nerve origin was identified in 22 cases. Neuromas originated in the IVN in 16 cases whereas neuromas originated in the SVN in six cases.[8] Cohen *et al.* reported the nerve origin of 128 neuromas performed by a suboccipital/retrosigmoid approach except for one middle cranial fossa procedure. Fifty-eight neuromas arose from the IVN and 70

TABLE I

NUMBER OF THE NEUROMAS IN EACH SIZE (N = 271)

Extension of the CPA	Intracanalicular	Less than 1 cm	Less than 2 cm	2 cm or greater	Total
Identified neuroma	11	41	66	151	269
Unidentified neuroma	0	0	0	2	2
					(cases)

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arose from the SVN.[9] Slattery *et al.* reported that 48.3 per cent of acoustic neuromas arose from the IVN whereas 43.9 per cent arose from the SVN among 151 consecutive middle fossa approaches.[10] Frommeld *et al.* reported 67 per cent of acoustic neuromas arose from the inferior vestibular nerve out of 67 cases.[11] However, these surgical methods were not performed by the translabyrinthine approach alone.

In this report, we have dealt only with the cases undergoing the translabyrinthine approach in sufficient numbers. As compared to the sub-occipital or middle cranial fossa approach, the IAC can be fully opened and the surgical field visualized sufficiently in both the fundus and the CPA.[12,13] The characteristics of nerves in the IAC have been variously investigated.[12,14,15] Concerning their positions, each of the four nerves could be most easily divided in the lateral part of the IAC.[12,15] The translabyrinthine approach usually allows the surgeon to observe where the nerves run into individual holes within the fundus. In our opinion, the nerve origin of the tumour can only be accurately determined from the fundus. As a result, the nerve origin of the neuroma could be distinguished in 99 per cent of cases. Therefore, the present data are reliable, despite the fact that such results have never been reported. This survey of acoustic neuromas was conducted only on Japanese people, and the presence of certain population differences cannot be ruled out.

Acoustic neuromas tend to arise in the IVN, leading to diagnostic problems. Although Gd-enhanced MRI is very useful in the diagnosis of acoustic neuromas, its expense means that this procedure cannot be performed on all patients with hearing loss or dizziness.[16] From our experience and a previous report, some acoustic neuromas were not detected at first but found later by MRI.[17] In addition, the adverse effect of gadolinium has been variously reported.[18–20] We also experienced three patients who suffered adverse effects of gadolinium.

Functional testing, such as a caloric test and auditory brainstem response (ABR), is also done when such a tumour is suspected.[17,21,22] However, these tests are not examinations of the IVN, so they do not directly reflect damage to this nerve in most cases. Functional tests for unilateral IVN, such as vestibular evoked myogenic potential, have been reported, however, it is not sensitive enough for the early detection of an acoustic neuroma.[23] Therefore, an appropriate test for IVN function would be ideal for screening and treatment in most cases of acoustic neuromas.[24]

Conclusion

Over 80 per cent of the acoustic neuromas arose from the inferior vestibular nerve in our experience. The reason for such a clear difference was unknown and population differences should be borne in mind. Therefore the investigation of differences between the superior and inferior vestibular nerve from various aspects will shed light on the pathogenesis of neuromas.

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