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Audio-vestibular findings in meningioma of the cerebello-pontine angle: a retrospective review

DAVID M. BAGULEY*, GRAHAM J. BEYNON*, PHILIP L. GREY†**, DAVID G. HARDY‡,
DAVID A. MOFFAT†

Abstract

The aim of this study was the determination of the incidence of symptoms of audio-vestibular dysfunction and of abnormalities on audio-vestibular testing in patients found to have a unilateral meningioma of the cerebello-pontine angle (CPA). The case notes of 25 patients diagnosed with unilateral, sporadic and histologically proven CPA meningioma were retrospectively reviewed. The age range of this series was 31–71 years, with a mean age of 50 years. Two patients were male (eight per cent) and 23 were female (92 per cent). The mean length of history was 44.7 months. The distribution of tumour size was skewed toward larger tumours, with 15 cases (60 per cent) having tumours with a maximum diameter greater than 3.5 cm on imaging. Pure tone audiometry was normal in five cases (20 per cent), and no patients exhibited the high frequency sensorineural hearing loss that is characteristic of vestibular schwannoma. Speech audiometry was normal in 50 per cent of cases. Caloric testing was abnormal in 77 per cent of the 18 cases tested, whilst auditory brainstem responses (ABR) were abnormal in 100 per cent of the 18 cases who had sufficient hearing for this test to be possible. The presence of normal audiometry in patients with a proven CPA lesion indicates that, if in a protocol for investigation, asymmetry of hearing is mandatory then some pathology will be missed. Any suspicion of a CPA lesion warrants investigation even in the absence of hearing loss.

The investigation of choice for the identification of CPA lesions has become magnetic resonance imaging (MRI). If this technique is not available then this study indicates that ABR is a suitable and sensitive investigation. It should be borne in mind however that the data in this study has been derived from a series of predominantly large tumours, and the sensitivity of ABR to smaller CPA meningiomata may fall, as is the case for vestibular schwannoma.

Key words: Meningioma; Cerebellopontine angle; Audiology; Diagnosis

Introduction

Meningioma is the second most common space occupying lesion found in the cerebello-pontine angle (CPA) comprising 10 per cent of the total (Jackler and Lalwani, 1992). These lesions arise from cap cells located in clusters around the tips of arachnoid villi, which in the CPA are found in the internal auditory canal, jugular foramen and in the region of the porus acousticus (Glasscock *et al.*, 1994). A higher incidence in women than men in the ratio 5:2.3 has been reported (Hart and Lillehei, 1995).

A small number of previous studies have considered audiological findings in CPA meningioma (Table I). In studies both by Laird *et al.* (1985) and by Granick *et al.* (1985) only six patients underwent sophisticated audiological testing. Abnormalities were found on audio-vestibular testing, but no conclusions were drawn from such small series. Aiba *et al.* (1992) reported upon 18 cases of CPA meningioma of whom 10 underwent ABR (with abnormal findings in 80 per cent) and 12 caloric testing (with abnormal findings in 75 per cent). Aiba *et al.* did not, however, detail pure tone audiometric findings or speech audiometry findings. Prasher *et al.* (1992) considered the differentiation of acoustic neuroma from other cerebello-pontine angle lesions, and in doing so analysed the audiological test findings of a group of 35 lesions which included nine meningiomata. The study concluded that such differentiation was possible, but the disparate nature of lesions in the analysed group, which included brainstem glioma, epidermoid cyst and glomus jugulare meant that little could be said about meningioma as a discrete group of lesions.

From the Departments of Audiology*, Otolaryngology†, and Neurosurgery‡, Addenbrooke's Hospital, Cambridge, UK, and the ENT Department**, Sir Charles Gairdner Hospital, Nedlands, WA, Australia.
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TABLE I
INCIDENCE OF ABNORMALITY ON AUDIOLOGICAL TESTING IN PREVIOUS STUDIES OF CPA MENINGIOMA

Study	Year	Audiometry	Speech audiometry	Calories	ABR
Laird *et al.*	1985	7/15 (47%)	8/14 (57%)	9/10 (90%)	6/6 (100%)
Granick *et al.*	1985	6/23 (26%)	Not tested	19/20 (95%)	6/6 (100%)
Aiba *et al.*	1992	Not reported	Not tested	9/12 (75%)	8/10 (80%)
Hart and Lillehei	1995	4/8 (50%)	4/8 (50%)	6/7 (86%)	5/7 (71%)

A recent study by Hart and Lillehei (1995) looked in more detail at audiological findings in posterior fossa meningioma. Of the eight cases presented, 50 per cent had a hearing loss on audiometry, and 50 per cent had abnormal speech discrimination scores. ABR was undertaken in seven cases, and was abnormal in five (71 per cent) and calorics were abnormal in six of the seven patients tested (86 per cent). This paper considered audio-vestibular testing a useful adjunct to radiological investigation in diagnosis.

Thus, it is indicated in the literature that abnormalities on audio-vestibular testing are found in CPA meningiomata, though in the studies undertaken only a proportion of the series underwent comprehensive testing, and it is not clear how these patients were selected. The possibility remains that those patients tested are not representative of the series as a whole.

The present study considers the audio-vestibular symptoms and findings in a group of 25 patients with histologically proven unilateral meningioma of the cerebello-pontine angle in order to consider how these lesions might be effectively diagnosed and how audiological and vestibular investigation can contribute to this process.

Method

A retrospective analysis of the presence of audiological symptoms and test findings in a series of 25 patients with histologically proven unilateral CPA meningioma was undertaken. Tumours were classified as CPA meningioma when they arose from the posterior surface of the temporal bone and the bulk of the tumour was located within the CPA (Glasscock *et al.*, 1994).

Of these cases two (eight per cent) were male and 23 (92 per cent) female. The mean age at operation was 50 years, with a range of 31–71 years and a standard deviation of 10.6 years. The patients in this series comprise those cases of CPA meningioma identified at Addenbrooke's Hospital, Cambridge University Teaching Hospitals Trust in the years 1987 to 1995. The principal presenting symptom of these patients was recorded, being defined as that which has caused them to seek a specialist opinion. The presence of other symptoms on careful questioning was also recorded.

A battery of audiological and vestibular tests were undertaken in each case, beginning with pure tone audiometry (air and bone conduction, at frequencies 250 Hz, 500 Hz, 1000 Hz, 2000 Hz, 4000 Hz, 8000 Hz). A classification of audiometric results was utilized wherein an audiogram was described as normal (500 Hz–4000 Hz average <20 dB), high frequency, low frequency where a hearing loss was seen in those areas, or flat where a significant hearing loss was present broadly equal across the frequency range. A category of cup shape was used where a loss was seen in both the low and high frequencies but markedly better thresholds present at 1 kHz. This classification system was intended as descriptive rather than rigorously analytical. Speech audiometry was performed in quiet using Boothroyd word lists (Boothroyd, 1968), scoring by phonemes correctly repeated at a number of suprathreshold intensities. Caloric testing was undertaken utilizing bithermal water stimulation (Fitzgerald and Hallpike, 1942; Luxon, 1995) (44 and 30 °C for 40 seconds) with response determined by direct observation and more recently by electronystagmographic recording (ICS Chartr system, duration of stimulus reduced to 30 seconds). An abnormal response, indicating significant hypofunction was defined as a canal paresis greater than 20 per cent. Auditory brainstem responses were recorded by a Biologic Navigator system, using click stimuli at 90 dBnHL, the rate of presentation being 19.1 per second. Filters were set at 3000 Hz (low pass) and 100 Hz (high pass), and recordings made over a 10 millisecond timebase. Recordings were judged to be abnormal if they exceeded the norms for this procedure at Addenbrooke's, those being JI-JV interpeak latency of 4.38 (± 2 standard deviations from mean). The audiological test battery was performed before a definitive diagnosis had been made, and so interpretation of results was not influenced by expectation.

Tumour size was determined by measurement of the maximum diameter in a line parallel to the posterior face of the temporal bone as seen on the definitive radiology of the day.

Results

The average length of history of these patients was 44.7 months with a range of eight to 120 months. The distribution of tumour size was skewed towards larger tumours, with 15 (60 per cent) having a maximum diameter on MRI greater than 3.5 cm. Tumour size is illustrated in Figure 1.

Of this series 10 patients (40 per cent) were found to have a principal presenting symptom of progressive hearing loss, two (eight per cent) of tinnitus and five (20 per cent) of imbalance (Figure 2). On questioning 21 patients (84 per cent) were found to have a hearing loss, 14 (56 per cent) had tinnitus and 19 (76 per cent) experienced imbalance (Figure 3). Headaches were reported in 16 cases (64 per cent)

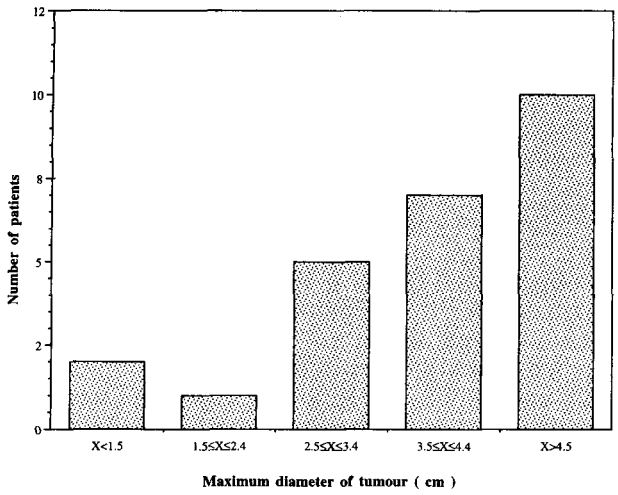

FIG. 1
Tumour size.

and facial weakness in nine cases (36 per cent). Pure tone audiometry (Figure 4) was normal in five patients (20 per cent of the 25 tested), indicative of a low frequency loss in three patients (12 per cent), flat in nine patients (36 per cent) and a profound hearing loss was found in five (20 per cent). A cup-shaped hearing loss (normal at the low and high frequency extremes of the audiogram, but with a moderate/severe loss in the mid frequencies) was present in three cases (12 per cent). No patients exhibited a high frequency hearing loss.

Speech audiometry indicated discrimination scores of greater than 90 per cent in 10 cases (53 per cent of the 19 tested: five patients had a profound hearing loss and thus could not be tested), and thus abnormal speech discrimination was observed in 10 cases. Reduction of the caloric response (>20 per cent) was noted in three cases (16.7 per cent of 18 tested) and absence in nine (50 per cent). ABR recordings ipsilateral to the tumour were not possible in the five cases with profound hearing loss, but indicated a significant JI-JV delay in 11 (48 per cent of 23) cases and a lack of consistent response in seven cases (30 per cent of 23): in two cases this investigation was not performed.

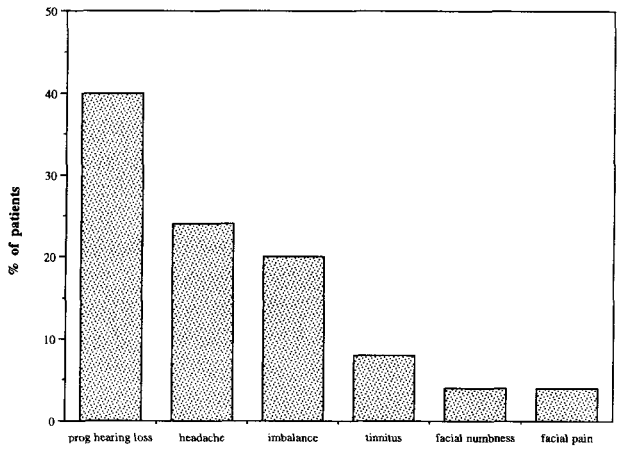

FIG. 2
Principal presenting symptom of CPA meningioma (n = 25)

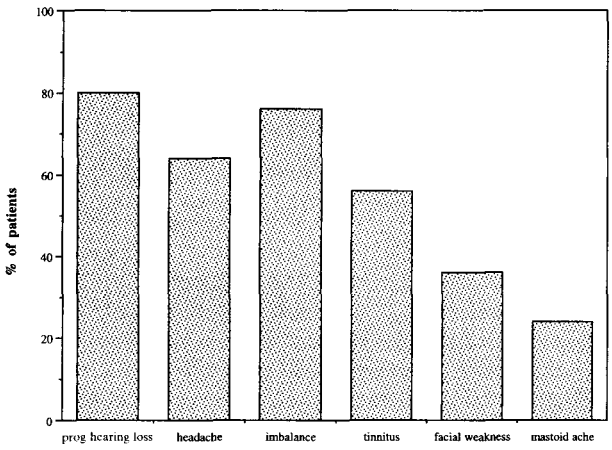

FIG. 3
Incidence of symptoms in CPA meningioma (n = 25).

The pattern of results on audiometry, speech audiometry, ABR and caloric testing with tumours of various sizes is seen in Table II. A comparison of tumour size was performed for those patients with normal audiometry versus those with abnormal audiometry; a similar comparison was performed for caloric testing. No significant relationship between tumour size (maximum diameter) and the presence of abnormality on testing was observed (the Mann-Whitney U Test gave tied p values >0.05 for audiometry, speech audiometry and caloric testing). No statistical analysis was performed for the ABR results as all recordings were abnormal.

Discussion

Cerebello-pontine angle syndrome refers to the constellation of symptoms and signs that are indicative of an expanding lesion in the CPA. Bartels and Arrington (1994) have described the typical course of CPA syndrome as hearing loss, balance disturbance, altered facial sensation, facial pain, and later nystagmus, impaired co-ordination, facial palsy, swallowing difficulty, impaired vision and eventually long tract signs. There are a large number of lesions

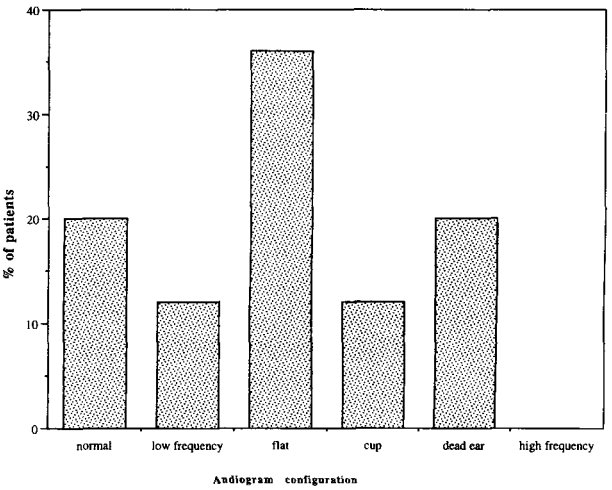

FIG. 4
Pure tone audiometry.

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TABLE II
AUDIOLOGICAL AND VESTIBULAR TEST FINDINGS AND TUMOUR SIZE

	Tumour size	<1.5 cm	1.5–2.4 cm	2.5–3.4 cm	3.5–4.4 cm	>4.5 cm	Total
Pure tone audiometry	Normal			2		3	5
	Abnormal	2	1	3	7	7	20
Speech audiometry	Normal (>90%)	1		4	4	1	10
	Abnormal (<90%)	1	1	1	2	3	10
ABR	Normal						0
	Abnormal	2		5	5	6	18
Calorics	Normal	2		2	1	1	6
	Abnormal		1	3	4	4	12

in the CPA that may give rise to CPA syndrome, of which vestibular schwannoma is the most common accounting for 80–90 per cent. The present series of patients demonstrates that meningiomata of the CPA present with the familiar symptoms of CPA syndrome and as such are not immediately distinguishable on clinical grounds from vestibular schwannoma. Sekhar and Janetta (1984) noted that in a series of 22 patients with CPA meningioma 73 per cent experienced fifth nerve signs and that this was higher than the incidence of hearing loss (three of 28 cases, 11 per cent), but this finding has not been corroborated by the present study. The reasons for this difference are not clear, but perhaps are simply indicative of the variable presentation of this pathology.

The incidence of patients with normal audiometry (20 per cent) differs markedly from that in our series of vestibular schwannoma (1.9 per cent, n = 361) and is worthy of note. In this meningioma series there were mainly large tumours, and findings on ABR were abnormal in all patients in whom this investigation was feasible. The coincident finding of normal audiometry and abnormal ABR in 20 per cent of cases indicates that ABR is more sensitive to distension or compression of the VIIIth nerve than audiometric thresholds.

The criteria for investigation of patients for lesions of the CPA in some centres include the presence of asymmetry of audiometric thresholds (Fisher *et al.*, 1994). The Cambridge series of patients with CPA meningioma indicates that if such asymmetry is mandatory before investigation is undertaken then a significant number of patients with CPA meningioma will not be selected for such investigation despite large tumours.

The authors of the present study feel that the appropriate investigation for suspected lesions of the CPA is MRI scanning (Baguley, 1995; Moffat *et al.*, 1995). It is appreciated, however, that this is not readily available in some centres and ABR is utilized as a screen. The findings in this series indicate that ABR is sensitive to the presence of large CPA meningioma even when audiometry is normal. It should not be assumed however that ABR will be appropriately sensitive to small lesions, and if this is not the case then ABR screening will miss patients with CPA meningioma that are not yet impinging upon the auditory pathway. Selesnick *et al.* (1993) have noted that the sensitivity of ABR to the presence of small vestibular schwannomas is markedly less than that for larger tumours.

This study was a retrospective review of the medical case notes of patients found to have a rare pathology and during the timeframe of the study there were several major changes in diagnostic practice. The most dramatic of these was the introduction of MRI, replacing CT as the usual radiological investigation for patients suspected of a CPA lesion, whilst another was the application of ENG to quantify responses on caloric testing. These changes are illustrative of the development in our specialty, but have had a consequence for the scientific analysis contained in this study in that the changes have meant that only a proportion of the series had investigations, such as MRI and ENG, that are sensitive to minor abnormalities and accurate in identifying tumour location. Thus analysis of the signs, symptoms and test results found in CPA meningioma with reference to tumour morphology and location has not been possible due to the small number with suitable data in the series. A recent analysis of such data from a series of patients with vestibular schwannoma seen in the Cambridge unit has suggested that morphological analysis of CPA lesions may clarify why patients present with particular symptom profiles, and it is our intention to apply this work to CPA meningioma as soon as patient numbers allow.

Conclusion

Abnormalities are found on audio-vestibular testing in the majority of cases of CPA meningioma. There are a significant proportion of cases, however, that appear normal on audiometric testing. The lack of asymmetry in hearing thresholds should not preclude investigation if the clinician has any suspicion of a CPA lesion, even if this is based upon clinical acumen alone.

Acknowledgement

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Address for correspondence:
David M. Baguley, M.Sc., M.B.A.,
Department of Audiology (94),
Addenbrooke's Hospital,
Hills Road,
Cambridge CB2 2QQ.

Fax: 01223 217559
e-mail: dmb29@cam.ac.uk