ISSN 1009 - 3095 *Journal of Zhejiang University(SCIENCE)* V.2, No.1, P.111 - 113, Jan. - Mar., 2001
http://www.chinainfo.gov.cn/periodical; http://www.zju.edu.cn;
http://lib.zju.edu.cn/English; http://www.zjupress.com

RELATIONSHIP BETWEEN THE SIZE OF PONTOCEREBELLAR ANGLE TUMOR AND AUDIOLOGY

TANG Jian-guo(汤建国), CAI Yi(蔡 艺)

(*Department of Otorhinolaryngology, Sir Run Run Shaw Hospital, Medical College, Zhejiang University, Hangzhou 310016, China*)

Received Mar.28, 2000; revision accepted Aug.18, 2000

Abstract: Objective: To study the relationship between the size of pontocerebellar angle tumor and audiology. Methods: Retrospective analysis of accoustically evoked brainstem response (ABR) waveforms and pure tone threshold in 27 subjects with tumor of pontocerebellar angle. Results: ABR wave forms and pure tone threshold were significantly affected statistically by the size of tumors, especially those tumor larger than 3 cm in diameter. Conclusion: The primary symptom of the patient was unilateral hearing loss. Early discovery of the lesion is important and ABR is a sensitive tool for early diagnose of the tumor.

Key words: pontocerebellar angle tumor, size of tumor, audiology, ABR
Document code: A **CLC number**: R764

INTRODUCTION

There are some reports on the relationship between the size of pontocerebellar angle tumors and audiology. This paper presents 27 cases (28 ears).

MATERIALS AND METHODS

This study Of 28 – 55 years old (9 male and 18 female) patients (28 ears, one patient suffered from bilateral acoustic neuroma) with pontocerebellar angle and apico-petrosa tumors was conducted in Aug., 1995 to Oct., 1999. The course of the disease ranged from 15 days to 14 years, mean of two and half years. The main complaints were hearing loss in 26 cases, tinnitus in 20, paresthesia of face in 15, vertigo in 10, abnormal gait in 8 and headache in 3. Magnetic resonance image examination of the 27 patients showed they were suffering from pontocerebellar angle tumors with diameter of 1 – 7 cm, mean of 4 cm.

Audiological tests of the patients were done in a sound proof and electromagnetically shielded room. Amplaid 460 audiometer was used for pure tone threshold test and biologic electric response audiometer for ABR testing wherein the sound stimulus was a 10/sec repetitive frequency click from a TDH-39 overhead earphone. The responses were recorded with an AA6 differential amplifier. The input filters were set at 32 Hz and 3200 Hz and the sweep time of the averager was 20 msec, displayed in 1024 addresses. Random ABR response waves were obtained. The active electrode was placed on the forehead near the hair, the reference electrode on the ipislateral mastoid, and the ground electrode on another mastoid.

Surgical procedure employed was middle fossa approach with surgical microscope. During the operation, we measured the size of the tumor, with the tumor's intracranial maximum diameter taken as its diameter. The patients were divided into tumor $\leqslant$ 3 cm and tumor > 3 cm groups for statistical analysis of the relationship between the tumor size and corresponding audiology.

RESULTS

1. Pure tone threshold

The pure tone audiogram of 27 patients (28 ears) indicated sensorineural deafness. The language frequency (0.5, 1, and 2 kHz) average pure tone threshold was 69 dB HL(n = 28), and, that for 3, 4 and 8 kHz was 84 dB HL (n = 18). The audiogram manifested: high-frequency attenuated type (18 ears, 66%), and flat type (10 ears, 14%) cases.

2. ABR

The ABR was abnormal in all 27 patients (28 ears). No wave-Ⅲ of ABR was found in 11 cases (11 ears, 39.1%); no wave-V, 3 cases (3 ears, 10.7%); and abnormal increase of inter peak latency (IPL) of ABR waves was found in wave Ⅰ-Ⅲ IPL, 17 cases (17 ears, 60.7%); in wave Ⅰ-Ⅴ IPL, 24 cases (24 ears, 85.7%); and in wave Ⅲ-Ⅴ IPL of contra-lateral ear, 18 cases (18 ears, 64.3%, the diameter of the tumors was larger than 3 cm). In wave I-V IPL in both lateral ears (4 patients, 14.8%, the tumors were also larger than 3 cm). There was over-lapping in the test results. The total positive rate was 100%. In our audiological laboratory, normal data of IPL was indicated when the intensity of the click was 80 dB HL, the mean of wave Ⅰ-Ⅲ IPL was 1.65 msec ($n = 25$), if > 2.16 msec, abnormal; the mean of Ⅰ-Ⅴ IPL was 4.28 msec ($n = 25$), if > 4.62 msec, abnormal; the mean of wave III-V IPL was 2.12 msec ($n = 23$), if > 2.30 msec, abnormal.

3. The tumor size and pathology diagnosis

The tumor diameter measured during the operation was 2 to 7 cm; it was ≤ 3 cm in ten patients (37%, only one was less than 2 cm), and it was > 3 cm in seventeen patients (63%). Histological examination revealed schwannoma in fourteen patients (51.85%), acoustic neuroma in six patients (22.22%), and meningioma in seven patients (25.93%).

4. Statistical analysis

The statistical analysis used t-tests. Statistical significance was determined to be at $P < 0.05$. Hearing loss was significantly severe in the group with tumor diameter > 3cm compared to the group with tumor diameter ≤ 3cm, $P < 0.05$ or $P < 0.01$. see Table 1 and Table 2.

Table 1 The relationship between the size of tumor and pure tone hearing loss

Pure tone	Tumor diameter	
	≤3 cm	>3 cm
LF average threshold dB HL	55.45 ± 41.79	80.28 ± 40.82*
$X \pm SD$	(n = 10 ears 35.7%)	(n = 18 ears 64.3%)
3,4,8 kHz average threshold dB HL	63.00 ± 42.51	95.0 ± 29.56**
$X \pm SD$	(n = 10 ears 35.7%)	(n = 18 ears 64.3%)

Adopted t-check: $t_1 = 2.087$, $t_{(0.05,26)} = 2.056$; $t_2 = 2.810$, $t_{(0.01,26)} = 2.779$

* $P<0.05$, ** $P<0.01$, LF: language frequency (0.5, 1 and 2 kHz) of pure tone

Table 2 The relationship between the size of tumor and ABR interval of wave

Tumor diameter	Latency	
	Ⅰ-Ⅲ (msec) $X \pm SD$	Ⅰ-Ⅴ (msec) $X \pm SD$
≤3 cm	2.632 ± 0.429 (n = 10 ears 35.7%)	5.463 ± 0.663 (n = 10 ears 35.7%)
>3 cm	2.917 ± 0.449 (n = 7 ears 25%)	5.833 ± 0.572 (n = 15 ears 53.9%)**
Normal control	1.650 ± 0.253 (n = 25 ears 89.3%)	4.280 ± 0.332 (n = 25 ears 89.3%)

Adopted t-check: $t_1 = 2.168$, $t_{(0.05,15)} = 2.131$; $t_2 = 2.921$, $t_{(0.01,23)} = 2.807$

* $P<0.05$ ** $P<0.01$

DISCUSSION

Hearing loss is one of the symptoms in pontocerebellar angle tumors occurring in well over 95% of patients who complaint their hearing was getting worse and worse. As can be seen in this paper, all of the 27 patients had hearing loss (100%), which was confirmed by pure tone audiometry showing sensorineural hearing loss (SHL) in all of them. The hearing curve was mainly characterized by high-frequency drop in 18 cases (19 ears, 66.7%), which accorded with that reported in the literature, 66% (Jognson, 1997). Four theories for the cause of SHL in acoustic neuroma patients were suggested (Neely, 1981): (1) direct pressure on the cochlear nerve; (2) pressure on the blood vessels supplying the inner ear; (3) biochemical changes in the inner ear fluid and (4) blocked conduction of the remaining cochlear nerve fibers. In this study, bilateral sensorineural hearing loss occurred in one patient, who suffered from left pontocerebellar angle tumor with diameter of 5.6 cm; his ipsilateral (left) pure tone hearing threshold was 90 dB HL, and his contralateral (right) threshold was 55 dB HL. His bilateral I-III and I-V IPL increased abnormally also, maybe because of the large tumor's pressure on the accoustic nerve's bilateral path. Haralampiev and Ribaric (1991) pointed out that the contralateral brain stem response is affected by tumors greater than 20 mm, and statistically more often by neuroma (significance level 5%) than by other tumors.

ABR test is considered to be the most reliable electrophysiological examination for diagnosis of acoustic neuroma because of its high sensitivity; the false negative rate of ABR is less than 5% (Telian et al., 1989). Brackmann et al. (1993) emphasized that ABRs undoubtedy indicate acoustic neuroma; and that ABR with prolonged interpeak latencies is a useful tool for diagnosis of acoustic neuroma. Acoustic neuromas of at least 1 cm can be evidenced by positive ABR rate of 100% (Braokman et al. 1993). Wilson et al. (1992) reported that tumor size and I-V inter peak latency were important factors affecting ABR sensitivity and proportion; that the I-V IPL of ABR increases proportionally to tumor growth. In this paper, most of the tumors were larger than 3 cm in diameter, and ABR abnormal rate was 100%; there were no wave-III, 11 cases (11 ears, 39.1%), no wave-V 3 cases (3 ears, 10.7%), an abnormal increase in I-III IPL, 17 cases (17 ears, 60.7%), and in I-V IPL 24 cases (24 ears, 85.7%). Han Dongyi et al. (1995) reported 31 cases (32 ears) that ABR is abnormal, positive rate 100%. So we consider that if ABR is abnormal, MRI should be done for the patient with unilateral hearing loss or tinnitus. The I-III and I-V IPL of the < 3 cm tumor diameter group differed significantly from those of the > 3 cm tumor diameter group ($P < 0.05$ or $P < 0.01$, see Table 1 and Table 2), which showed that the larger the tumor, the severer its pressure and numbing effect on the auditory nerve. Kaga et al. reported (1997) a case of temporal bone pathology of the acoustic neuroma correlating with presence of electrocochleography and absence of auditory brainstem response. The cause of absence of ABR was that in the modiolus, the respective numbers of spiral ganglion cells and cochlear nerve fibers in each tube were decreased, so ABR was absent because of the blockage of the cochlear nerve proximal portion by the tumor. We suggest that if a pontocerebellar angle tumor was over 3 cm in diameter, ABR may be absent or wave-III or wave-V may be absent, because of the tumor pressure on the auditory nerve path and consequent blockage of nerve conduction. We consider that ABR is a very sensitive tool for diagnosing pontocerebellar angle tumor.

In this study, most of the tumors were larger than 3 cm in diameter (except for one case that was smaller than 2 cm in diameter), and were detected at a late or very late stage, which suggests the need for better awareness by both patients and their primary care providers. Certainly, early discovery of tumor is unquestionably very important.

CONCLUSIONS

As discussed above, we consider that the primary symptom of the patient with pontocerebellar angle tumors is unilateral hearing loss; and that it is important to diagnose the tumor early. Auditory tests should be done for every patient with unilateral hearing loss or tinnitus. ABR is a very sensitive tool for early diagnosis of pontocercbellar angle tumor.

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