Eur Arch Psychiatr Neurol Sci (1988) 237:343–246

European Archives of Psychiatry and Neurological Sciences

False-Negative Brainstem Auditory Evoked Potential Recordings in a Case of Multiple Acoustic Neuroma

U. W. Buettner[1], A. Thron[2], S. Elies[3], and E. Grote[4]

[1]Departments of Neurology, [2]Neuroradiology, [3]ENT, and Neurosurgery, [4]University Hospital Tübingen, Liebermeisterstrasse 18–20, D-7400 Tübingen 1, Federal Republic of Germany

Summary. A case history is reported to demonstrate that electrophysiological testing (brainstem auditory evoked potentials, BAEP and stapedius reflex) may fail in the search for cerebello-pontine angle tumours. The clinical history began with repeated episodes indicating a disorder of the vestibular system. Repeated testing of BAEP exhibited normal curves before and after surgery on the right side. This case serves as a reminder that normal BAEP do not necessarily exclude the presence of an acoustic neuroma developing in the immediate vicinity of the vestibular nerve.

Key words: Acoustic neuroma – BAEP – Air meatography

Introduction

It is widely assumed that brainstem auditory evoked potentials (BAEP) are especially important for the early diagnosis of acoustic neuroma. Several authors have stressed the high percentage of 85% to 100% abnormal BAEP in cerebello-pontine angle tumours (Bockenheimer et al. 1984; Bonafé et al. 1985; Clemis and McGee 1979; Clemis and Mitchell 1977; Eggermont and Don 1986; Eggermont et al. 1980; Hart et al. 1983; Maurer et al. 1982; Robinson and Rudge 1983; Selters and Brackmann 1977; Thomsen et al. 1982). This has led to the widely accepted assumption that normal BAEP in a patient with complaints clinically indicating an acoustic neuroma exclude this diagnosis. This is not correct in all cases as demonstrated by the present case history, and discussion on the limits of the method.

Methods

The BAEP were recorded simultaneously from both mastoids against a C_Z reference electrode (platinum needles, DISA 25 C 04) following rarefaction click stimulation with pulses of 100 μs delivered monaurally over shielded earphones 70 dB SL at 11.9 c/s. The bandpass of the recording system was set at 100 Hz to 3 kHz. The resolution of the averager was 1024 data points. Normal values for latencies, inter-peak latencies (IPL), side differences and the amplitude relation IV/V versus I were derived from our own control group (Buettner et al. 1983, see Table 1).

The CT scans were performed on a third generation scanner (Somatom DRH, Siemens AG, Erlangen) with a 512 × 512 matrix. For air-CT-cisternography, 3 ml air was introduced and both cerebello-pontine angles were examined successively. Slice thickness was 2 mm.

Magnetic resonance imaging (MRI) was performed using a superconducting system operating at 1.5 T field strength (Magnetom, Siemens AG, Erlangen) using a head coil of 30 cm diameter. Following spin echo sequences for T_1-(400 ms TR, 30 ms TE) and T_2-weighted images (1600 ms TR, 120 ms TE), an additional study was done after injection of paramagnetic MRI-contrast medium (gadolinium DPTA, Schering AG, Berlin). Slice thickness was 8 mm.

Case Report

A 29-year-old male presented with a 5-year progressive gait ataxia and episodic vertigo attacks for 2 months before admission. Neurological investigations revealed gaze nystagmus, ataxia of stance and gait. Hearing was only slightly affected on the right side according to audiometry (Fig. 1). Caloric testing showed a loss of excitability on the right and the stapedius reflex was normal. The CT scans at bone window setting and plain x-ray films in Stenvers projection demonstrated bilateral widening of the internal acoustic canals. Plain and enhanced CT scans did not reveal any tumour, but T_1-weighted MRI showed a soft tissue signal within the left internal acoustic canal, suspicious of neuroma. Only air-CT-cisternography (Fig. 2) showed bilateral, for the most part intra-canalicular tumours. The MRI showed a large neuroma on the left side.

A sequence of four BAEP recordings (three before, one 17 days after surgery; Fig. 4) demonstrated essentially normal waves on the right side with respect to latencies and amplitudes of all components. On the left, the IPL I–III (2.4 ms) was at the upper limit of normal and 0.3 ms longer than on the right side. This did not constitute an abnormal finding according to our criteria. The same was true for the IPL I–V side difference which was also normal. The contralateral recordings (not

Offprint requests to: U. W. Buettner

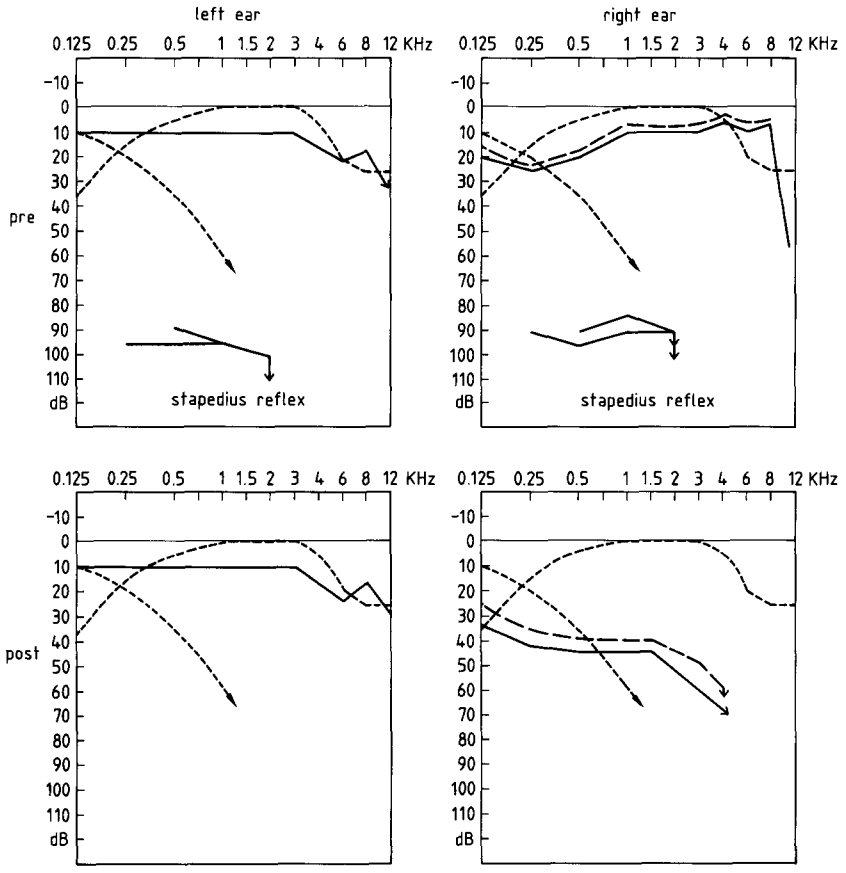

Fig. 1. Audiometry before and following surgery. Before surgery, the stapedius reflex was normal, audiometry showing a low-tone deficit of 20 dB on the right side, normal values before and following surgery on the left side. Following surgery, there was a pancochlear loss of 40 dB on the right side

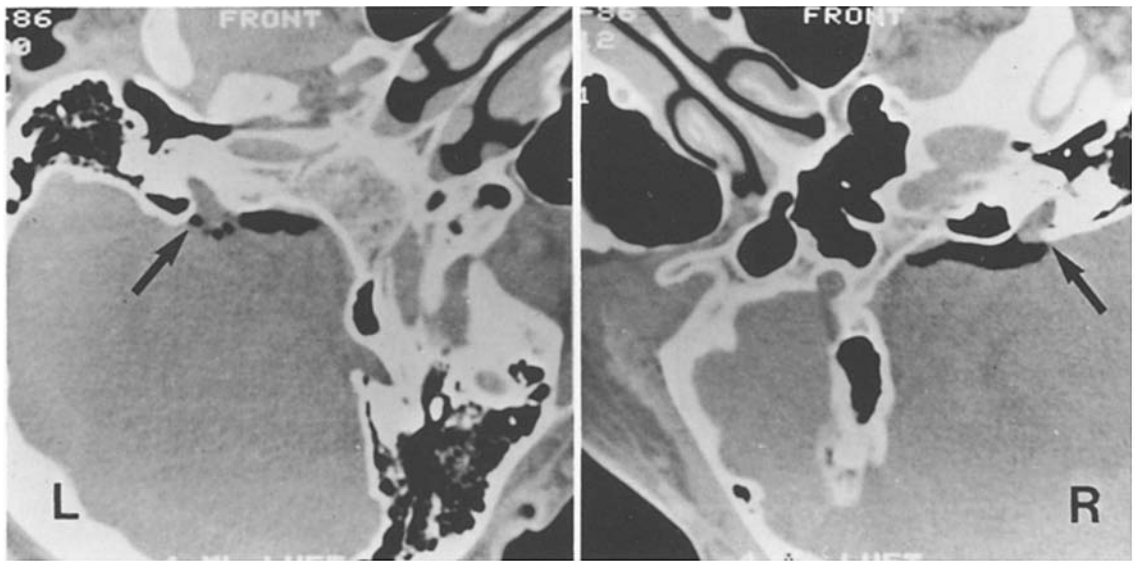

Fig. 2. Bilateral, for the most part intra-canalicular acoustic neuroma as demonstrated by air-CT-cisternography *(arrows)*

shown in Fig. 4) did not reveal any additional information in this case. The patient had the tumour on the right removed surgically. Histology of the $9 \times 7 \times 6$ mm tumour specimen revealed a neuroma type A following Antoni. Post-operative hearing loss consisted of a 40 dB pancochlear deficit, the BAEP were completely normal. Post-operative recording exhibited larger potentials and an earlier peak I.

Discussion

This report does not dispute the importance of BAEP for early diagnosis of cerebello-pontine angle tumours. It is recognized that BAEP are very important in early

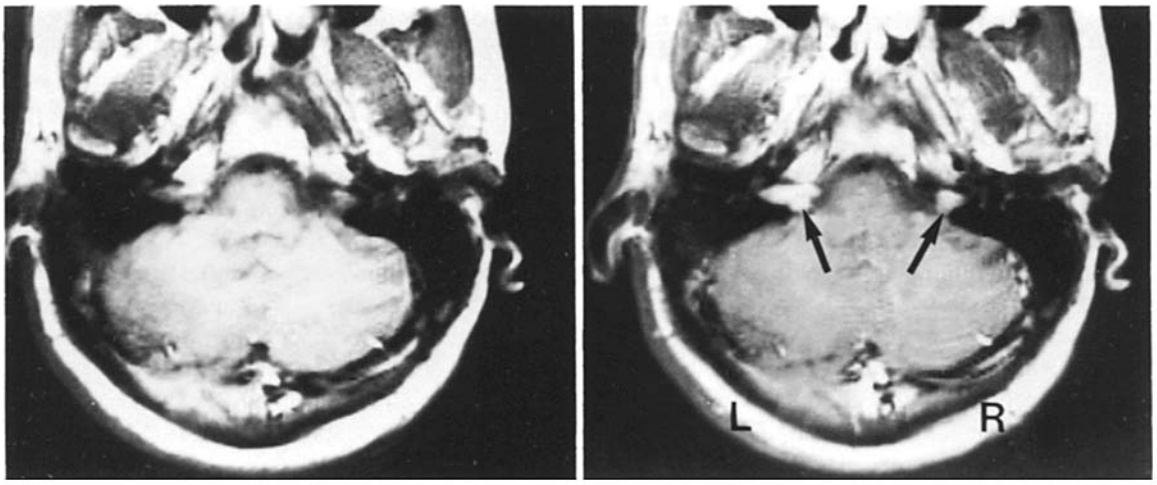

Fig. 3. Magnetic resonance imaging of bilateral acoustic neuroma. The tumours were best shown on gadolinium-enhanced T_1-weighted images on the right (*arrows;* 400 ms TR, 30 ms TE). For comparison, the unenhanced scan on the left

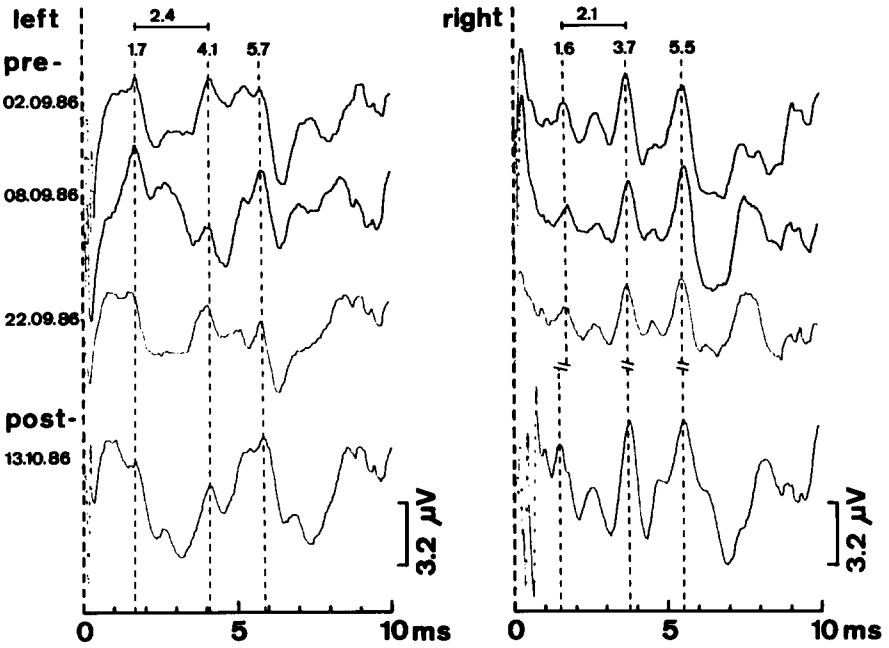

Fig. 4. Brain stem auditory evoked potentials (BAEP) before and following surgery on the right side. Three recording sessions before surgery documented the reproducibility of the BAEP at least with respect to latencies and inter-peak latencies. Although on the left the inter-peak latency I-III was at the uppermost limit of normal and by 0.3 ms longer than on the right side, it was not judged to be abnormal. The potentials on the right side were quite normal. Following surgery potentials on the left side were essentially unchanged, on the right side they exhibited even larger amplitudes. The peaks I, III, and V are indicated by latency values on either side

Table 1. Normal values of BAEP with averaged latencies and limits (3 SD) according to our control group (Buettner et al. 1983)

	I	II	III	IV	V
♀ < 40 years	1.5 (0.5)	2.6 (0.5)	3.5 (0.5)	4.7 (0.6)	5.3 (0.5)
♀ ≥ 40 years	1.5 (0.5)	2.6 (0.5)	3.6 (0.5)	4.6 (0.6)	5.5 (0.5)
♂ < 40 years	1.5 (0.5)	2.6 (0.5)	3.6 (0.5)	4.7 (0.6)	5.4 (0.5)
♂ ≥ 40 years	1.6 (0.5)	2.6 (0.5)	3.6 (0.5)	4.7 (0.5)	5.5 (0.6)

Inter-peak latencies (IPL)				Inter-peak side differences			
I–II	I–III	I–V	III–V	I–II	I–III	I–V	III–V
1.1 (0.4)	2.0 (0.4)	3.85 (0.6)	1.8 (0.5)	< 0.3	< 0.4	< 0.4 [ms]	< 0.4

Side differences of single peaks < 0.5 ms
Amplitude relation IV–V/I > 1.0

diagnosis because the method is sensitive, easily reproducible, non-invasive and cheap. The method may be even more sensitive and specific when certain modifications of the procedure, for example, narrow band click stimulation, are applied (Eggermont and Don 1986). Although most authors report the high sensitivity of BAEP, it is important to stress possible false-negative recordings in acoustic neuromas and the presumed reasons for them. The case reported illustrates this fact. The question why this is possible is tentatively addressed in the following.

Depending on location, speed of growth and size of the tumour, different types of abnormalities of BAEP have been described (Robinson and Rudge 1983; Maurer et al. 1982), although the overall correlation between type of abnormality and tumour size was poor. Eggermont and Don (1986) described a differentiation between large and small acoustic neuromas by additional use of narrow band click stimulation. This procedure seems to be promising, and deserves further studies.

It is self-evident that a tumour becomes symptomatic at a time specific for the individual tumour and that this holds for all methods which may be used to detect the tumour (imaging procedures and electrophysiological methods). In electrophysiological methods abnormalities can only be detected when information processing or transmission of the system tested are affected, so when the tumour is just beginning to grow or when only a neighbouring structure is affected no abnormality is detected.

This report is very unusual in that two acoustic neuromas with radiological signs of enlargement of the internal acoustic canal exhibited normal BAEP. Therefore, from theoretical reasons the side differences of the inter-peak latencies I–V are diagnostically not applicable. With respect to this finding, it is important to recognize that almost all of the so-called acoustic neuromas in reality stem from the vestibular part of the VIIIth nerve (Crowe and Hardy 1936; Henschen 1915). This agrees well with the finding that this patient's history began with vestibular symptoms and that caloric irrigation revealed an unresponsive horizontal canal on the right. Other tests used in the search for a cerebello-pontine angle tumour were similarly unrevealing (stapedius reflex, the routine CT scan (with and without enhancement) and audiometry). The audiometry was abnormal but instead of showing the typical high-tone deficit, it exhibited a 20 dB low-tone deficit only on the right, although the tumour was larger on the left. The definite diagnosis of two tumours in the cerebello-pontine angle was possible following air-CT-meatography and MRI using paramagnetic contrast enhancement (Figs. 2 and 3).

This report demonstrated that electrophysiological testing always needs critical interpretation, that normal electrophysiological findings cannot exclude processes in the vicinity of the system tested or in status nascendi and that clinical symptoms should have the leading role in indicating the diagnostic procedures.

As far as acoustic neuromas are concerned, air-CT-cisternography and gadolinium-enhanced MRI are very sensitive methods for the detection of even small, largely or totally intra-canalicular tumours. These methods should complement at an early stage the otherwise sensitive, non-invasive and comparably cheap procedures (audiometry, caloric testing and BAEP) in clinically suspicious cases and final preoperative imaging.

References

Bockenheimer S, Schmidt CL, Zöllner C (1984) Neuro-otological findings in patients with small acoustic neuromas. Arch Oto-Rhino-Laryngol 239:31–39

Bonafé A, Manelfe C, Clanet M, Fraysse B, Soulier MJ, de Kersaint Gilly A, Raphalen JP, Legent F, Massot M (1985) Correlations electrophysiologiques et tomodensitometriques dans l'exploration des neuronomes du VIII. J Neuroradiol 12:61–70

Buettner UW, Stöhr M, Koletzki E (1983) Brainstem evoked potential abnormalities in vascular malformations of the posterior fossa. J Neurol 229:247–254

Clemis JD, McGee Th (1979) Brainstem electric response audiometry in the differential diagnosis of acoustic tumors. Laryngoscope 89:31–41

Clemis JD, Mitchell C (1977) Electrocochleography and brainstem responses used in the diagnosis of acoustic tumours. J Otolaryngol 6:447–459

Crowe SJ, Hardy M (1936) Early asymptomatic acoustic tumor. Arch Surg 32:292–301

Eggermont JJ, Don M (1986) Mechanisms of central conduction time prolongation in brainstem auditory evoked potentials. Arch Neurol 43:116–120

Eggermont JJ, Don M, Brackmann DE (1980) Electrocochleography and auditory brainstem electric responses in patients with pontine angle tumors. Ann Otol Rhinol Laryngol 89 [Suppl 75]:1–19

Hart RG, Gardner DP, Howieson J (1983) Acoustic tumors: atypical features and recent diagnostic tests. Neurol 33: 211–221

Henschen F (1915) Zur Histologie und Pathogenese der Kleinhirnbrückenwinkeltumoren. Arch Psychiatr 56:21–122

Maurer K, Strümpel D, Wende S (1982) Acoustic tumour detection with early auditory evoked potentials and neuroradiological methods. J Neurol 227:177–185

Robinson K, Rudge P (1983) The differential diagnosis of cerebellar pontine angle lesions. J Neurol Sci 60:1–21

Selters WA, Brackmann DE (1977) Acoustic tumor detection with brainstem electric response audiometry. Arch Otolaryngol 103:181–187

Thomsen J, Terkildsen K, Osterhammel P (1982) Auditory brainstem responses in patients with acoustic neuromas. Acta Otolaryngol Suppl 386:20–22

Received December 29, 1987