Eur Arch Otorhinolaryngol (2006) 263: 552–555
DOI 10.1007/s00405-006-0008-z

MISCELLANEOUS

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Could vestibular evoked myogenic potentials (VEMPs) also be useful in the diagnosis of perilymphatic fistula?

Received: 28 January 2005 / Accepted: 13 September 2005 / Published online: 16 February 2006

Abstract The role of vestibular evoked myogenic potentials (VEMPs) is at this time indisputable in the study of vestibular disorders. Furthermore, VEMPs are widely accepted as a diagnostic tool when a superior semicircular canal dehiscence (SCD) is suspected, presenting in such cases a lowering of threshold values able to raise a recordable response due to increased inner ear immittance. According to the same principle, the possibility of another kind of alteration having the same effect on the inner ear might be considered when high-resolution computed tomography has excluded the presence of an SCD. In this paper four cases are described in which high-resolution computed tomography showed normal features without any labyrinthine dehiscence and VEMP threshold values were lowered; the appropriateness of suspecting a perilymphatic fistula in such cases and resorting to VEMPs in detecting a perilymphatic fistula is discussed.

Keywords Perilymphatic fistula · Vestibular evoked myogenic potentials · Superior semicircular canal dehiscence

Introduction

In the last few years, vestibular evoked myogenic potentials (VEMPs) have definitely proved to be a useful, reliable and easily applicable tool for the study of vestibular function [1].

More recently, their particular characteristics, mainly consisting of the response to a saccular stimulation which can also be obtained by means of acoustic stimuli, have suggested using VEMPs in investigating possible bony vestibular dehiscences usually located in the superior semicircular canal (SCD) [2–4]): it is generally accepted that the increase of the inner ear immittance provoked by the lack of part of the bony capsular wall may be responsible for lowering of threshold values able to raise a recordable response [2].

In our series on SCD, which will be reported elsewhere, this common finding is present.

On the other hand, a more or less considerable lowering of threshold values at VEMPs was also found in cases in which an accurate high-resolution computed tomography study made it possible to exclude the presence of an SCD: the preliminary report and analysis of these cases seemed to be of some interest in the attempt to reach a better understanding of the mechanics of bony dehiscences and perilymphatic fistulae.

Patients and methods

The study of VEMPs has been included in our routine otoneurological investigations since September 2002. Our method consists of applying a logon of 500 Hz lasting 2 ms with a repetition frequency of 4 Hz for 100 times. A stimulus intensity of at least 120 dB has been considered necessary to obtain a normal response according to Valli et al. [5]. All cases responding to stimuli of a lower intensity and/or showing an asymmetry in the response of both sides were submitted to high-resolution computed tomography in order to detect the possible presence of an SCD, which was found in 11 cases. A negative computed tomography response was obtained in four cases, all complaining of vertigo as the most important symptom and presenting a history of trauma. The following detailed description concerns these latter cases.

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Case 1

A 32-year-old male complaining of Ménière-like symptoms localized in the left ear was referred to our observation, in September 2002. He had a history of underwater sports practice (hockey). This pathological condition had already been treated elsewhere as Ménière disease. Corticosteroid therapy proved effective in resolving the first vertiginous attack, which was observed, and the patient was subsequently discharged. A second crisis occurred in November 2002. Glycerol test, as well as magnetic resonance imaging and high-resolution computed tomography, was negative. VEMPs on the left side were evocable by a 130 dB SPL stimulus in the intercritic period, whereas the intensity able to raise a response decreased to 110 dB SPL during the acute attack (Fig. 1). This led to an exploratory tympanotomy which disclosed the evidence of a perilymphatic fistula in the oval window area (Fig. 2). A packing with Gelfoam® was made on both windows. At the postoperative control no symptoms were observed and VEMPs returned to normal response (130 dB SPL) within 3 months (Fig. 3). An 18-month follow-up did not reveal any recurrence.

Case 2

A 41-year-old female came to our observation in March 2003 for recurrent vertigo, which was reported as having started after a head trauma 9 years before. Since then, the patient has suffered recurring vertiginous attacks and fullness in the left ear, without clinical evidence of vestibular impairment. During 2003, a worsening of symptoms consisted of positional vertigo. Vestibular symptoms were also elicited by chewing and by sounds of high intensity (Tullio phenomenon). Magnetic resonance imaging and high-resolution computed tomography proved negative, whereas VEMPs showed a response for a 110 dB SPL stimulus on the left side. An exploratory tympanotomy was thus performed in November 2003 and a perilymphatic fistula was detected in the oval window area and was sealed with Gelfoam. Despite prolonged bed rest, symptoms recurred after 1 month, thus leading to revision surgery with covering of the fistula area with autologous perichondrium. A completely satisfactory recovery was not achieved, and the patient is now scheduled for a further revision procedure.

Case 3

A 44-year-old male complaining of a sudden sensorineural hearing loss with tinnitus and without vertigo that occurred after diving in December 2002 was referred. During VEMP recording a vertiginous attack was elicited, and the response was raised by a stimulus intensity of 110 dB SPL. A recovery was achieved by absolute rest, which was followed by the return of a normal VEMP response. The patient is symptom-free after a 16-month follow-up.

Case 4

A 43-year-old female was referred to our observation in January 2003 complaining of dizziness and positional vertigo and reporting a history of head trauma in 1984. Hearing loss and tinnitus were absent. Magnetic resonance imaging and high-resolution computed tomography were negative. A routine VEMP study was performed showing a lowered threshold (100 dB SPL) on the right side. A transient subjective recovery was accompanied by a normalization of the VEMP threshold (130 dB SPL). In the following period, another crisis was concomitant with a recurrent lowering in the VEMP threshold (100 dB SPL). An exploratory tympanotomy did not reveal any fistula. The patient has not complained of other acute crises and at the moment is scheduled for an autonomic system test.

Discussion

In the reported cases, the finding of VEMP responses to stimuli of lower intensity than normal should not be considered as an individual variant because the asymmetry between both sides of the same patient suggests that this possibility should be excluded. A possible

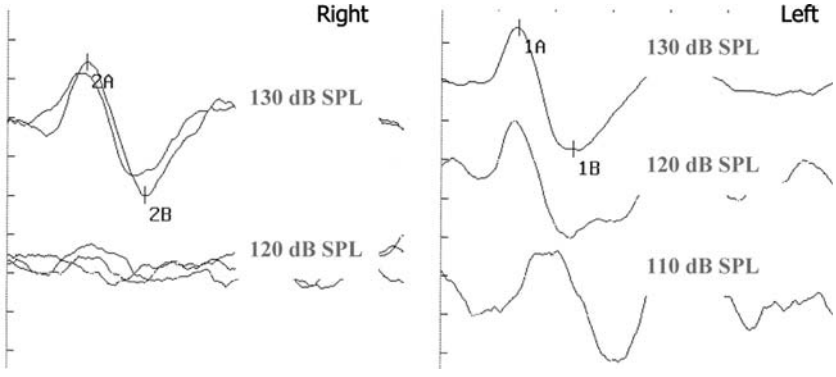

Fig. 1 Case 1. Preoperative bilateral VEMPs with lowered threshold on the left side (the upper trace is recorded with a halved level of amplification). The recording was made in concurrence with an exacerbation of the symptomatology

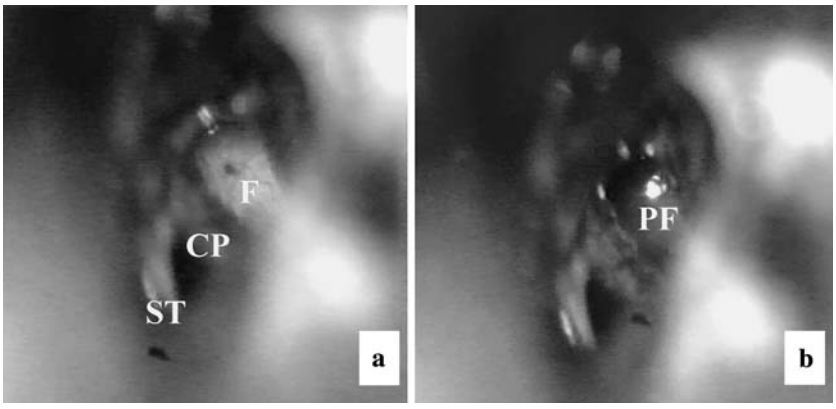

Fig. 2 Case 1. Intraoperative view of the left ear: **a** footplate before suction, **b** perilymphatic fluid (in correspondence with the sparkling area) on the footplate after suction and ipsilateral rotation of the head. *F* footplate, *PF* perilymphatic fluid covering the footplate area, *CP* crus posterior, *ST* stapedial tendon

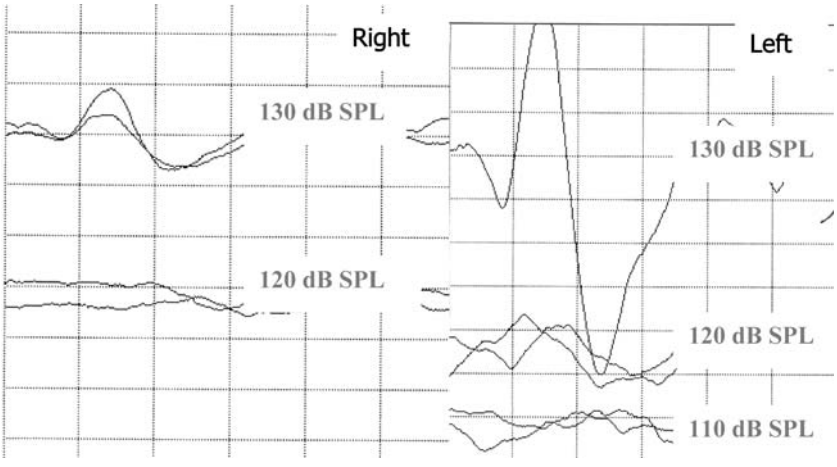

Fig. 3 Case 1. Postoperative VEMPs after recovery (at 3 months). The threshold level is the same on both sides, but the amplitude is higher on the left side

explanation for the threshold lowering of VEMPs in the presence of a labyrinthine fistula may, in our opinion, be found in the increased inner ear immittance, as well as in ''classic'' cases of SCD. In the latter, it is considered that the presence of a third mobile window [6] in the inner ear allows an increase of pressure variations in the membranous labyrinth after a sound stimulation, thus justifying the enlarged sound-induced VEMPs in such patients [2]. The same effect, even if possibly less pronounced due to the absence of a real ''third window'', could be produced by a fistula which is likely to be able to reduce inner ear impedance. Another additional explanation for the presence of altered threshold values in such cases could theoretically be found by considering a possible degree of failure of the protective action of the middle ear muscles, which could reasonably be less effective in a not-closed system.

The variations in threshold values in the same patient under different circumstances might be attributable to different mechanical conditions depending on a more or less pronounced perilymphatic loss, or perhaps on a sort of ''valve'' effect of the fistula; indeed, the better detectability of this kind of alteration in concurrence with a crisis, which was well recorded in at least one of the cases, may be a subject deserving further studies in order to be explained more satisfactorily. As for the cases in which direct evidence was not available, in the explored case it could be argued that a fistula located in another area, possibly not reachable by means of a simple tympanotomy, may not be excluded, while the case which recovered after conservative therapy and consequently normalised the VEMP response could in our opinion represent indirect evidence of a self-repaired fistula [7, 8]. In conclusion, despite the still low number of cases and the short follow-up due to their recent occurrence, in our opinion these preliminary findings seem to be of some use in order to highlight the possible application of the study of VEMPs to any case in which the presence of a perilymphatic fistula is suspected: to our knowledge, such an application has not yet been considered in literature. If our data are confirmed by a more representative series, this could provide a reliable tool for a more accurate diagnostic approach to a pathological condition substantially characterized by the absence of a peculiar symptomatology [9–11].

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