



Case Report

Complete Recovery Following Electroacupuncture Therapy in Refractory Unilateral Sensorineural Hearing Loss



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Abstract

Role of electroacupuncture (EA) in refractory unilateral sensorineural hearing loss (SNHL) remains unclear but might be promising for the Meniere's disease. Two cases of unilateral SNHL who were unresponsive to conventional treatment of sudden SNHL showed complete recovery after receiving EA therapy. The first case was a 46-year-old woman who received EA in the seventh month after the acute onset of sudden right hearing loss and tinnitus. She had mild-to-moderate degree of SNHL at high frequencies in the right ear with episodic vertigo. The second case was a 55-year-old woman who received EA in the sixth year after developing sudden SNHL in the right ear. Before the EA began, her pure tone average of the affected ear was 45 dB and the phonetically balanced score was 88%. The regimen for both patients included 12 sessions of EA over four weeks at the main acupoints (Tinggong (SI 19), Ermen (TE 21), Qimai (TE 18) and Yifeng (TE 17) on the affected ear and the adjuvant acupoints (Zhongzhu (TE 3), Hegu (LI 4), Qihai (CV 6), Guanyuan (CV 4), Taixi (KI 3), and Taichong (LIV 3)). Both patients regained their normal hearing thresholds three weeks after the first EA. No adverse events were observed. Hence, EA may be a useful additional therapy in unilateral SNHL, even at the late phase when other treatments have failed because the possibility of Meniere's disease cannot be excluded.

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1. Introduction

Sudden sensorineural hearing loss (SNHL) is an inner ear condition which is described as an acute unilateral hearing loss (a drop of ≥ 30 dB in ≥ 3 contiguous audiometric frequencies) within three days accompanied by tinnitus and occasional vertigo. Approximately 76% of cases have no identifiable cause [1,2]. The rate of spontaneous recovery without any treatment has been reported to range from 30% to 60%. Most idiopathic sudden SNHL cases usually resolve within two weeks after the first presentation of symptoms. However, in cases where the patient is older, has suffered severe to profound hearing loss prior to treatment, or has a long history of poorly controlled cardiovascular disease, the recovery rate falls to 5% upto 15% [2,3]. Sudden SNHL can be the first presentation of Meniere's disease (MD) if the SNHL and vertigo last longer than months.

Because the etiology of unilateral SNHL remains unclear, there has been no definitive treatment. However, several possible causes have been suggested, for example, auto-immune disease, vascular compromise, viral infection, and disruption of the cochlear membranes [4]. Based on these hypotheses, a number of therapeutic strategies have been used especially within 6 weeks after the initial onset for better prognosis. Conventional therapy of unilateral sudden SNHL comprises rest, systemic corticosteroids such as prednisolone 1 mg/kg/day, vasodilators (e.g. betahistines), and methylcobalamin for at least a two-week period. Additional treatments such as hyperbaric oxygenation and intratympanic corticosteroids injection can be provided if available [5,6]. Despite receiving the appropriate therapy, many patients do not regain their hearing, leading to a refractory phase which significantly affects their quality of life [7]. Therapeutic options, including electroacupuncture (EA), have been introduced as adjunctive when other treatment modalities have failed [8].

EA has already been approved by the World Health Organization for treatment of certain diseases and conditions such as headache, primary dysmenorrhea, low back pain, and hypertension. But for some conditions such as hearing loss, tinnitus, and MD, although some therapeutic effects of acupuncture have been reported, further proof is needed [9]. According to acupuncture theory, syndrome differentiation of deafness (and tinnitus) can be divided into two types: "excess" type (i.e., fire preponderance in the liver and gall bladder and invasion of exogenous pathogenic wind) and "deficiency" type (hypofunction of the kidney and liver). Acupuncture's primary purpose is to regulate the circulation of qi (vital energy) in the meridians nearby the affected ear and also the meridians of the hands and feet that travel to the ear region and by that regulation to clear away the pathogenic fire from the liver and gall bladder, to expel pathogenic wind, and to reinforce the essential qi of the kidney, with respect to syndrome differentiation [10].

2. Case presentation

2.1. Case 1

A 46-year-old woman presented with episodic vertigo and tinnitus in the right ear which had begun nearly

seven months ago. On her first visit at the otolaryngology clinic, she complained of sudden right tinnitus and slight dizziness for the previous three days. The initial audiogram showed mild-to-moderate SNHL at high frequencies in the right ear and normal hearing in the left ear. A complete physical and otoscopic examination identified no abnormalities. Results of laboratory tests, including complete blood count, lipid profiles, and fibrinogen level, were normal. Blood tests, including the venereal disease research laboratory (VDRL) test and the *Treponema pallidum* hemagglutination (TPHA) test, were non-reactive and negative.

She had been treated with systemic corticosteroids (a high dose of oral prednisolone) for 14 days and betahistines for one month but showed no improvement. She gradually developed five episodes of vertigo over the previous six months. Each episode of vertigo lasted 5 to 20 minutes. No other neurological deficits were detected. Her auditory brainstem response showed a normal retrocochlear pathway bilaterally. Her follow-up audiograms remained unchanged from the beginning (Fig. 2A). She complained that the tinnitus of the right ear was persistent but seemed to worsen at bedtime.

The initial EA therapy was performed six months after completion of the standard treatment. The acupuncture protocol used a formula consisting of 14 acupuncture points per session. The main acupoints were Tinggong (SI 19), Ermen (TE 21), Qimai (TE 18) and Yifeng (TE 17) on the right side. The adjuvant acupoints were Zhongzhu (TE 3), Hegu (LI 4), Qihai (CV 6), Guanyuan (CV 4), Taixi (KI 3), and Taichong (LIV 3) (Fig. 1 and Table 1). Needles were used to conduct an electrical current through the selected points and were inserted superficially (not more than approximately 0.5 inches in depth). With this technique, an elicitation of needle sensation (so-called de qi) during the insertion of the needles is normally not anticipated. Afterward, pairs of electrodes were connected between SI 19 and TE 21, TE 18 and TE 17, CV 6 and CV 4, TE 3 and LI 4 (ipsilateral), as well as KI 3 and LIV 3 (ipsilateral). A 2-Hertz (Hz) electrical stimulation was applied to each pair of needles and was then increased until it reached the maximum toleration level of the patient. Each pair of acupoints was simultaneously stimulated for 20 minutes during each treatment. The patients were treated three times a week (Monday, Wednesday, and Friday) for four weeks, a total of 12 treatments.

Three weeks after receiving the first EA treatment, she noticed her tinnitus had disappeared. A follow-up audiogram showed improvement of hearing thresholds, especially at the frequencies of 4,000 and 6,000 Hz (Fig. 2B). One month after treatment, she had regained normal hearing in the right ear (Fig. 2C). No recurrence of vertigo was reported. There were no adverse events related to the EA therapy. Verbal follow-ups via telephone were repeated annually. The patient mentioned that she did not experience tinnitus or vertigo again despite no further treatment. Five years after EA, the audiogram showed normal hearing thresholds at high and mid frequencies of the right ear; however, a slight drop of 30 dB at 250 Hz was noted.

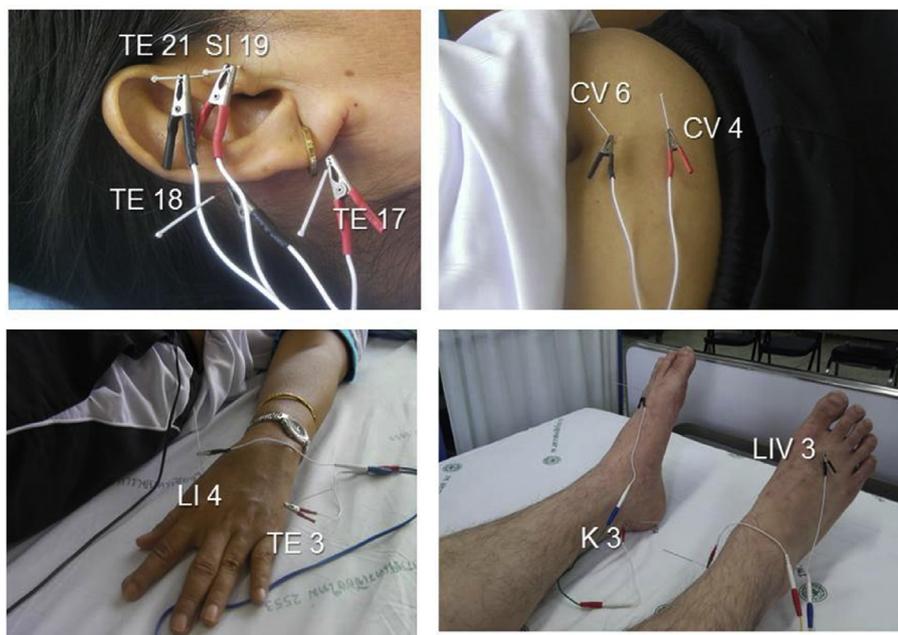


Figure 1 The main acupoints used in acupuncture treatment were Tinggong (SI 19), Ermen (TE 21), Qimai (TE 18) and Yifeng (TE 17) on the affected ear, and the adjuvant acupoints were Zhongzhu (TE 3), Hegu (LI 4), Qihai (CV 6), Guanyuan (CV 4), Taixi (KI 3), and Taichong (LIV 3).

2.2. Case 2

A 55-year-old woman presented with sudden hearing loss in the right ear which had occurred about six years ago. She came to the otolaryngology clinic on the seventh day of her symptoms and received a tapered course of high-dose oral prednisolone for two weeks plus betahistines and methylcobalamin for one month. After one month of medical treatment, she still had persistent high-tone tinnitus in the right ear and her hearing deficit had not improved. She did not experience any vertigo, only a slight dizziness during the first few days. She had underlying hypertension which was well controlled. Her initial audiogram showed a moderate degree of SNHL in the right ear and a slight drop of pure tone air conduction at 6,000 and 8,000 Hz in the left ear. A complete physical and otoscopic examination found no abnormality. Results of blood tests, including a complete blood count, lipid profiles, and fibrinogen level, were within normal limits. Blood tests for VDRL and TPHA were nonreactive and negative. An auditory brainstem response performed in the sixth month showed normal retrocochlear pathways on both sides. She was then recommended to undergo annual audiometry follow-ups.

Since then, her annual audiograms had remained mostly unchanged from the initial levels. The right ear high-tone tinnitus persisted, and no episodes of vertigo during the past six years were mentioned. Before receiving the EA therapy, the audiometry was performed again (Fig. 3A). The pure tone average (PTA) of the right ear was 45 dB, and PTA of the left ear was 21.25 dB. The phonetically balanced (PB) score of the right ear was 88%, and the PB of the left ear was 100%. The EA course, main acupoints, adjuvant

acupoints, and electrical stimulation were performed in the same manner as the aforementioned case.

One week after receiving the first EA, the patient noticed that her tinnitus had markedly decreased, but she was not sure whether her hearing had improved. An audiogram showed improvement of hearing thresholds: the PTA of the right ear was 23.75 dB, and the PB score was 96% (Fig. 3B).

Three weeks after that test, she reported that her hearing was improved. The right ear tinnitus had disappeared. The PTA of the right ear was 18.75 dB, and the PB score was 100% (Fig. 3C). No adverse events from the EA therapy were observed. One month later, she did not complain of her hearing problem at all during the verbal communication. Unfortunately since then, she was lost to follow-up.

3. Discussion

Various therapeutic options have been proposed to enhance the prognosis of sudden unilateral SNHL patients, including EA. There are insufficient data to fully evaluate the role of acupuncture treatment for acute or refractory unilateral SNHL, although it is interesting that our patients showed a complete recovery after receiving EA despite the late-onset of administration. Our first hypothesis was that the patients' actual condition might be endolymphatic hydrops or probable MD as the first sign was presented as the unilateral sudden sensorineural hearing deficit. The second hypothesis concerned the key acupoints selection and the appropriate delivery schedule.

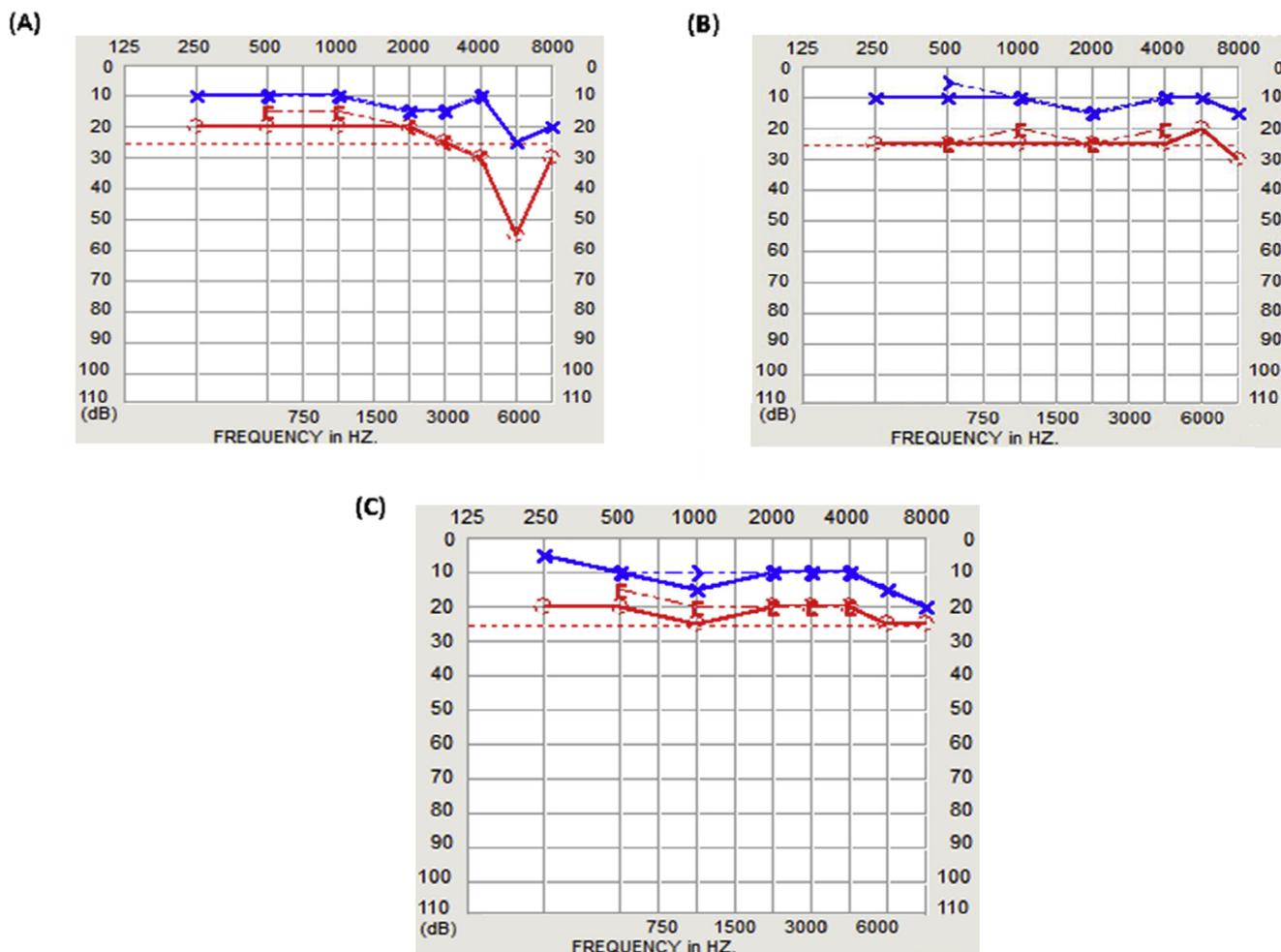


Figure 2 Audiometric evaluations of case 1 were as follows: (A) Initial audiogram revealed unilateral mild-to-moderate SNHL at high frequencies in the right ear and normal hearing in the left ear. (B) After receiving EA for three weeks, audiogram showed a remarkable hearing improvement of the right ear, especially at the frequency 6,000 Hz. (C) After completion of the 4-week course of EA therapy, patient regained normal hearing. Blue lines represented the left ear and the red lines represented the right ear. The air-conduction thresholds were plotted and connected with a continuous line while a dotted line demonstrated the bone-conduction thresholds.

The signs and symptoms of the first patient met the criteria for 'probable MD' [11]. It is difficult to exclude the possibility of MD in the second case as well. Sudden SNHL could be the first presentation of MD if time follows. Härkönen et al. [7] found that during an 8-year follow-up of 217 sudden idiopathic SNHL patients, seven of the patients developed MD. Some of them did not have vertigo but had mild dizziness during the acute phase. Similar to idiopathic sudden SNHL, the pathophysiology of MD is not clearly understood. It is possible that MD is caused by endolymphatic hydrops, an excess production of endolymph, or a decreased absorption in the endolymphatic duct resulting in an enlarged labyrinth. Sudden releases of endolymph across the endolymphatic sac may cause episodic vertigo accompanying the unilateral hearing loss [12].

It is possible that the most important factor for success, especially for hearing improvement in these two cases, was identification of appropriate acupoints. In the first case, the hearing impairment was completely restored and cessation of vertigo was achieved by EA therapy. In the

second case, a complete recovery was observed even though the EA was performed six years after the initial onset of hearing loss.

The selection of acupuncture points in disease treatment can be divided into two main approaches: individualized and formula acupuncture. In individualized acupuncture, the selection is tailored corresponding to symptoms, signs, and differentiated diagnosis of each patient as described in traditional Chinese medicine theory. Formula acupuncture, on the other hand, includes a group of acupuncture points which are believed to provide therapeutic benefits for all patients without defining syndrome differentiation; thereby, the complicated diagnostic techniques used by highly skilled traditional Chinese medical professionals, such as pulse and tongue diagnoses, are not compulsory. Formula acupuncture was selected for this study because it consists of 14 acupuncture points which believed to be effective in rebalancing the body homeostasis and eliminating the pathological factors. The actions of each point used in this study are listed in Table 1.

Table 1 Locations, needling techniques, and actions of the selected acupoints according to traditional Chinese acupuncture theory [10].

Point	Location	Needle size and needling technique	Action
Tinggong (SI 19)	Between the tragus and the mandibular joint, in a depression formed when the mouth is slightly opened	Size 0.25 × 13 mm, puncture vertically	Benefits the ears, particularly indicated for deficiency type of deafness and tinnitus
Ermen (TE 21)	Anterior to and slightly superior to the condyloid process of the mandible, in a depression formed when the mouth is opened	Size 0.25 × 13 mm, puncture perpendicularly	Indicated as a local point for deafness and tinnitus
Qimai (TE 18)	Posterior to the ear, in a small depression on the mastoid bone, one third of the distance along a curved line drawn between Yifeng (TE 17) and Jiaosun (TE 20) following the line of the rim of the ear	Size 0.25 × 40 mm, puncture subcutaneously	Indicated as a local point for deafness and tinnitus
Yifeng (TE 17)	Posterior to the lobule of the ear, in the depression between the mandible and mastoid process	Size 0.25 × 40 mm, puncture perpendicularly	Expels pathogenic wind and benefits the ears and can be used in all ear problems of exterior and interior origin
Zhongzhu (TE 3)	In the posterior depression between the fourth and fifth metacarpophalangeal joint	Size 0.25 × 40 mm, puncture perpendicularly	Benefits the ears and subdues liver Yang
Hegu (LI 4)	On the dorsum of the hand, midway between the first and second metacarpal bones, approximately in the middle of the second metacarpal bone on the radial side	Size 0.25 × 40 mm, puncture perpendicularly	Expels pathogenic wind, regulates the ascending of clear qi and descending of turbid qi in the head
Qihai (CV 6)	On the anterior midline, 1.5 <i>cun</i> inferior to the umbilicus or 3.5 <i>cun</i> superior to the upper border of the pubic symphysis	Size 0.25 × 40 mm, puncture perpendicularly	Tonifies and regulates vital energy
Guanyuan (CV 4)		Size 0.25 × 40 mm, puncture perpendicularly	Tonifies the kidney and the essence
Taixi (KI 3)	In the depression between the prominence of the medial malleolus and the Achilles tendon.	Size 0.25 × 40 mm, puncture perpendicularly	Reinforces the essential qi of the kidney
Taichong (LIV 3)	On the dorsum of the foot, in the depression distal to the junction of the first and second metatarsal bones	Size 0.25 × 40 mm, puncture perpendicularly	Subdues liver Yang

The *cun* is a traditional Chinese unit of length equal to the width of a patient's thumb at the knuckle.

Various combinations of acupoints and different time schedules of acupuncture had been performed in MD cases [13,14]. EA had a positive effect for vertigo but not for hearing improvement. Our report, however, has shown otherwise. The main acupoints selected in most studies are Ting Gong (SI 19) and Feng Chi (GB 20). Correspondingly, the main acupoints, for example, SI 19, TE 21, TE 18, TE 17, and TE 3, were selected for our patients. The adjuvant acupoints were also crucial. We chose LI 4, CV 6, CV 4, KI 3, and LIV 3 because they are important points for balancing internal organ function, that is, they enhance oxygen and nutrient transport while reducing and eliminating waste products from the inner ear tissues.

Tension and anxiety are also considered important factors which can trigger an attack of MD. In addition, it is possible that EA may help by easing stress. It has been hypothesized that EA modifies the effect of

neurotransmitters on neural signaling, for example, the effect of opioids peptides and glutamates as well as activation of calcium ion channels [15].

Proposed EA treatment schedules also vary. The mean treatment frequency and duration that shows the best favorable outcome is daily acupuncture for approximately 10 to 15 days [14]. However, in these two cases, we performed EA on a less frequent schedule. We propose that three sessions of EA per week for four consecutive weeks might be sufficient and would also be more convenient for the patients.

A definitive recommendation regarding adjunctive EA for idiopathic unilateral SNHL patients has not yet been determined. The exact mechanism by which EA affects the inner ear is not clearly understood and should be studied further. However, the successful outcomes from 12 sessions of EA therapy over four weeks using the acupoints SI 19, TE

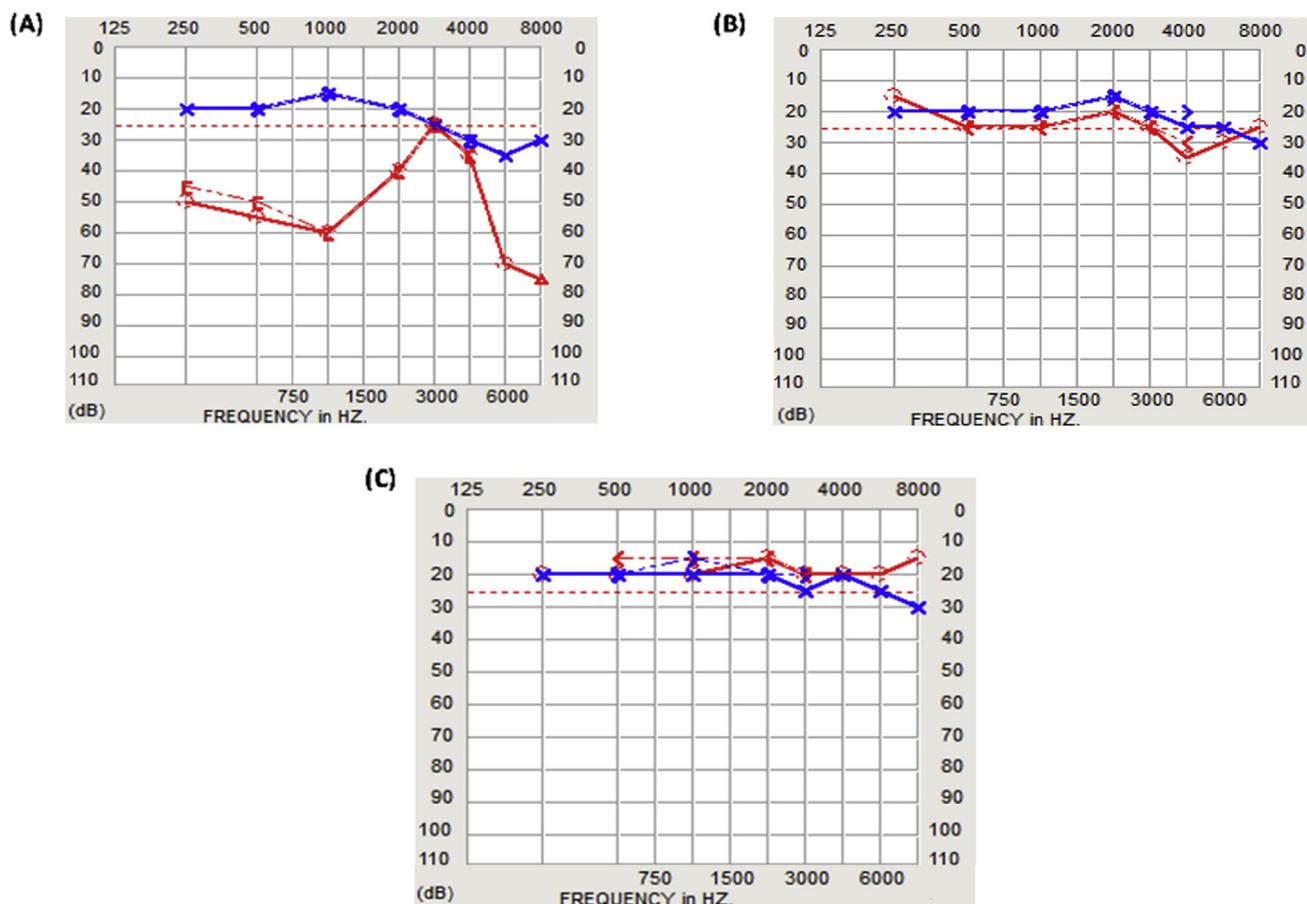


Figure 3 Audiometric evaluations of case 2 were as follows: (A) audiogram before EA showed a moderate degree of SNHL in the right ear. (B) An improvement of PTA of the right ear was seen after one week of EA therapy. (C) After completion of the 4-week course of EA, normal hearing was observed in the right ear. Blue lines represented the left ear and the red lines represented the right ear. The air-conduction thresholds were plotted and connected with a continuous line while a dotted line demonstrated the bone-conduction thresholds.

21, TE 18, TE 17, TE 3, LI 4, CV 6, CV 4, KI 3, and LIV 3 as described in this report may be a useful additional option when other treatments have failed, even at the late phase because unilateral SNHL may be a first sign of the development of MD.

Disclosure statement

The authors declare that they have no conflict of interest and no financial interests related to the material of this manuscript.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jams.2019.04.003>.

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