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CASE REPORT

Auricular Acupuncture Effect on Facial Contraction via Middle Ear Muscles Reflexes

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Importance: Auricular acupuncture (AA) regulates the function of systems or organs by stimulating specific regions of the body via efferent pathways in the central areas through the auricle. This case aims to investigate the causes of facial contractions observed during AA.

Case presentation: A female patient, diagnosed with depression and refusing medication, was referred for AA. She presented to our clinic with a complaint of right-sided facial contraction triggered by high-intensity sound during AA.

Conclusions and Relevance: After evaluation, a decrease in acoustic reflex thresholds of 0.5 and 1 kHz, along with right-sided facial contractions at the same sound frequencies, were detected. This case offers a new perspective on the neural pathways and connections through the auricle.

Keywords: Auricular acupuncture, Audiology, Acoustic reflex, Facial muscles, Case report

INTRODUCTION

Recent clinical and basic research has largely validated the efficacy of auricular acupuncture in treating acute and chronic pain and anxiety-related disorders. However, its effectiveness in managing irritable bowel syndrome, obesity, smoking cessation, alcohol withdrawal, and other substance abuse disorders remains inconclusive [1]. Although auricular acupuncture, also used for treating depression, shows promise as a non-pharmacological approach to symptom reduction, its underlying mechanisms and clinical efficacy are not fully understood, necessitating further research [2]. This case report aims to enhance the understanding of the neural connections and mechanisms of auricular acupuncture by detailing the findings of a patient who reported sensitivity to loud sounds during treatment at the audiology clinic.

The symptoms described in this case are noteworthy, as no similar cases or studies have been identified in the literature.

CASE PRESENTATION

This report followed the case report guidelines. On January 25, 2024, a 39-year-old female patient referred for auricular acupuncture with an "inability to cope with stress and depression?" and a history of acute otitis media, presented to the audiology clinic. She reported right-sided facial contraction triggered by loud noise one day after starting acupuncture. The patient's audiological history revealed no factors associated with hearing loss, such as exposure to loud noise, neurological or systemic diseases, or ototoxic drug use (Table 1).

Hualong acupuncture needles, measuring 0.22 × 1.5 mm, were applied by the acupuncturist to points CO1, LO1, LO2, and LO3, following the World Federation of Acupuncture-Moxibustion Association guidelines (Fig. 1) [3,4]. The needles were replaced twice weekly. Tympanometry and acoustic reflex testing were conducted using an Interacoustics® Titan Handheld device (Denmark) on a patient with a normal otoscopic examination. Pure tone audiometry was performed with an Interacoustics® AC40 clinical audiometer (Denmark), revealing bilateral hearing within normal limits (Table 1) [5].

Audiological evaluation began with immittance tests, revealing bilateral tympanograms within normal limits [6]. Immittance tests were repeated at intervals of no more than 10 days during acupuncture treatment, with results summarized in Table 2. Acoustic reflex thresholds were below normal values at 0.5 and 1 kHz [7], representing the only difference compared to the patient's previous audiological tests conducted before acupuncture treatment. Specifically, a decrease in thresholds at 0.5 and 1 kHz was noted (Table 2). Additionally, facial contractions were observed simultaneously with stimuli at these frequencies

Table 1. Audiological findings before and after starting acupuncture treatment

	Pre-acupuncture (18 July 2023)		During acupuncture (26 January 2024)	
	Right ear	Left ear	Right ear	Left ear
Audiometric measurement				
Pure tone avarage -PTA (dB)				
Air	9	11	10	10
Bone	8	11	10	10
Speech reception threshold -SRT (dB)	10	15	15	15
Speech discrimination score -SDS (%)	96 (55 dB)	92 (55 dB)	96 (55 dB)	96 (60 dB)
Uncomfortable loudness levels -UCL (dB)	110^{+}	110^{+}	90*	110^{+}
Tympanometric measurement				
Middle ear measurement (daPa)	78	92	62	87
Compliance (cc)	0.9	1.2	0.9	1.1
Gradient	1.1	1.0	1.0	1.2
Type	A	A	A	A
Acoustic reflex decay				
500 Hz	Negative	Negative	Negative	Negative
1,000 Hz	Negative	Negative	Negative	Negative

*Expressed that the case was uncomfortable.

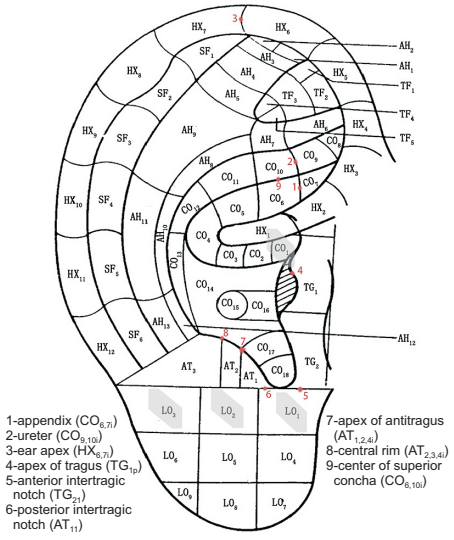

Fig. 1. Auricular acupuncture points as defined by the World Federation of Acupuncture-Moxibustion Societies [4].

(Supplementary Video 1). On January 26, 2024, the patient was referred for electroneurography and radiological evaluation declined these procedures. By March 12, 2024, the patient reported no improvement in symptoms (Supplementary Video 2). At her request, acupuncture treatment was discontinued on May 11, 2024. Acoustic reflex thresholds recorded on that day and 1 month later are presented in Table 2. A final video recorded on June 11, 2024, showed persistent facial contractions and stapes reflex thresholds remaining below 80 dB sound pressure level (SPL) (Supplementary Video 3). Subsequent attempts to contact the patient for follow-up audiological assessments were unsuccessful, as she declined further evaluation.

DISCUSSION

Acupuncture shows promise as a non-pharmacological treatment for reducing depressive symptoms and might serve as an alternative or complementary approach to pharmacological therapies for improved outcomes [2]. Auricular acupuncture, in particular, is recognized as a method for depression treatment, given that the vagus nerve—the only peripheral branch involved in depression therapy—passes through the ear. In addition to the vagus nerve, the auricle is innervated by cranial and spinal nerves, including the trigeminal nerve (auriculotemporal branch), the occipital nerve, and the great auricular nerve (GAN) [8]. The anterior branch of the GAN connects with the marginal mandibular branch of the facial nerve on its deep surface, while its posterior branch has notable connections with the lesser occipital nerve, the peripheral branch of the vagus nerve, and the postauricular branch of the facial nerve [3]. These neural connections align with the acupuncture points of the patient's auricle, innervated by the GAN and the trigeminal nerve (auriculotemporal branch). In this case, the involuntary facial contractions observed during high-intensity acoustic stimuli might result from electrical via acupuncture needles, potentially sensitizing these nerves.

The stapedial and tensor tympani muscles in the middle

Table 2. Acoustic reflex thresholds before, during and after acupuncture treatment

	Date (d/m/y)	Right IL reflex (dB SPL)				Left IL refleks (dB SPL)			
		0.5 kHz	1 kHz	2 kHz	4 kHz	0.5 kHz	1 kHz	2 kHz	4 kHz
Pre-acupuncture	18.07.2023	85	80	85	85	80	80	85	85
During acupuncture	26.01.2024	75	70	85	85	85	80	85	85
	1.02.2024	75	70	85	85	80	80	80	85
	7.02.2024	75	70	85	85	80	80	85	85
	7.03.2024	75	70	85	85	80	80	85	85
	12.03.2024	75	75	85	85	80	80	85	85
	21.03.2024	75	70	85	85	80	80	85	85
	11.04.2024	75	70	85	85	85	85	80	80
Post-acupuncture	11.05.2024	75	75	85	80	85	85	85	85
	11.06.2024	75	70	85	85	85	80	80	85

d = day; m = month; y = year; IL = ipsilateral; dB = decibell; SPL = sound pressure level; kHz = kiloHertz.

ear form an efferent control system that affects sound transmission to the inner ear. The contraction of these muscles reduces sound transmission, providing a protective effect on cochlear cells [7]. The stapedial component of this system is commonly evaluated through the acoustic reflex threshold test during hearing assessments. Muscle contraction in response to auditory stimuli is mediated by neural activity in the brainstem, with each middle ear muscle (MEM) being innervated by distinct motoneuron pools on the same side of the brainstem. The tensor tympani motoneurons are associated with the trigeminal motor nucleus, while the stapedius motoneurons are associated with the facial motor nucleus. Both motoneuron pools receive input from the auditory nuclei, forming reflex circuits [9].

Although these circuits are anatomically separate, they are often considered together as part of the middle ear muscle reflex [6]. The ascending limb of this reflex is common to both muscles: auditory stimuli trigger action potentials from the spiral ganglion to the ventral cochlear nucleus (VCN), which then projects directly or indirectly to motoneurons controlling the or tensor tympani on the same side. The stapedius is innervated by the stapedial branch of the facial nerve, while the tensor tympani is innervated by the tensor tympani nerve, originating from the mandibular division of the trigeminal nerve [10]. These strong neural connections might explain the patient's symptoms of stapedial and tensor tympani muscle contraction. To evaluate the role of the acoustic reflex, it is essential to identify conditions under which MEM contraction occurs. In humans, the MEM reflex typically responds to pure tones at SPLs between 85 and 100 dB [7]. In this case, acoustic reflex thresholds at 0.5 and 1 kHz were observed to fall below 80 dB SPL, the frequencies at which facial contractions were reported (Table 2).

Despite initial suspicion of hyperacusis, the loudness discomfort level (LDL) test scores did not indicate pathology. The tensor tympani reflex can also be elicited by various stimuli, such as tactile stimulation of facial areas, electrical stimulation of the tongue, air puffs near the orbit, swallowing, and activation of certain facial, neck, or phonation muscles. This reflex often occurs as part of the startle response and might involve the auropalpebral reflex (APR). Facial nerve connections in the spinal trigeminal nucleus projecting to the trigeminal motor nucleus are crucial for APR [7]. These neural connections could underlie the patient's facial contractions during loud sounds, mimicking APR. The patient expressed discomfort during uncomfortable loudness level and LDL tests performed during audiometry.

However, facial contractions were not observed by the audiologist. Bilateral LDL measurements were 85, 80, 80, 80, 85, and 90 dB at 0.25, 0.5, 1, 2, and 4 kHz, respectively. Although these results do not suggest hyperacusis [10], APR was observed during high-intensity (≥ 85 dB SPL) acoustic stimuli at 0.5 and 1 kHz delivered to the right ear. The patient verbally expressed discomfort during the tests. Eustachian tube function tests were normal [11]. This case, unprecedented in the literature, highlights unique symptoms; however, study limitations arose as the patient did not attend follow-up visits and refused electroneurography and radiological evaluations.

CONCLUSIONS

The anatomical and physiological mechanisms underlying acupuncture remain insufficiently understood, despite its increasing popularity as an alternative medical treatment. This paper reviews the literature on the effects of auricular acupuncture on symptoms such as intolerance to loud sounds, facial contraction, and decreased acoustic reflex thresholds.

The findings provide preliminary data to guide further research into the interactions between auricular acupuncture

and the motor branches of the trigeminal and facial nerves, which influence the contraction of the stapes and tensor tympani muscles in response to auditory stimuli. These insights might contribute to the development of novel clinical testing methods for evaluating tensor tympani muscle contraction.

SUPPLEMENTARY MATERIAL

Supplementary data to this article can be found online at https://doi.org/10.51507/j.jams.2024.17.6.206.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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