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Original Article

Audiological and Otologic Characteristics of Patients with Musical Hallucinations

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BACKGROUND: Musical hallucinations have a great impact on a patient's life, but because of the rare frequency of occurrence and multiple causes, not enough research has been conducted on this topic yet, especially in Korea. Many patients with musical hallucinations have audiological and otologic problems. This study investigated the clinical manifestations of musical hallucinations in patients.

METHODS: The authors retrospectively analyzed clinical data from patients with musical hallucinations who visited the outpatient clinic of the Department of Otorhinolaryngology at Severance Hospital, Seoul, Republic of Korea, for 7 years, from January 1, 2015, to December 31, 2021.

RESULTS: Seven of 9 patients were female, the average age was 67.1 (52–89) years, and post-lingual hearing loss was diagnosed in all patients. They listened to songs 1–3 over and over again for 5.4 (±6.1) years. Four patients had chronic otitis media or underwent tympanomastoidectomy surgery because of chronic otitis media. Audiological rehabilitation was performed, including cochlear implantation surgery, in one patient.

CONCLUSION: In most cases, patients with musical hallucinations had audiological and otologic symptoms. Therefore, when patients complaining of musical hallucinations visit the hospital, it is essential to perform an audiological and otologic evaluation, and treatment for their symptoms should be considered.

KEYWORDS: Auditory hallucination, hearing loss, musical hallucination

INTRODUCTION

Hallucination is a phenomenon in which a sense is perceived without an external stimulus, and it can occur in any kind of sense. Auditory hallucinations refer to the perception of sounds without any external auditory stimuli being present.[1] These hallucinations are often linked to psychiatric disorders or neurodegenerative conditions and can manifest under various organic or emotional circumstances. Auditory hallucinations and subjective tinnitus are terms that have been similarly defined and used in the field of psychiatry and otolaryngology. However, the categories to which they are actually applied are different, and there is a trend to distinguish and use them according to the perceived sound quality and disease underlying the symptoms. Tinnitus is usually a meaningless basic sound such as a buzzing, ringing, or sizzling sound, but auditory hallucinations are often composed of melodies learned or experienced by the patient, such as hymns, nursery rhymes, and songs.[2] Patients with tinnitus tended to be more aware of their symptoms in a quiet environment, but no changes were observed in patients experiencing auditory hallucinations.[3] Because 65–80% of patients with tinnitus report changes in strength or frequency of symptoms during contractions of neck muscles,[4] this type of somatic stimulation might be beneficial in distinguishing the symptoms between these 2 conditions.

Musical hallucinations are a form of auditory hallucination where individuals perceive continuous or intermittent musical tones and melodies without any external acoustic stimuli.[5-7] This rare condition was initially documented by Ballinger in 1846, and it has since been reported worldwide with fewer than 500 cases.[8] In many reported cases, sounds heard by musical hallucination patients have been found to have personal meaning to the patient.[9] The precise prevalence of musical hallucinations remains unclear, and some patients with tinnitus commonly encountered by otolaryngologists have musical hallucinations rather than tinnitus. Musical hallucinations can be broadly classified into 2 types according to their etiological factors. Musical hallucinations that occur without

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any pathological abnormality, except for hearing loss, are called idiopathic musical hallucinations; if there is a related abnormality, they are termed symptomatic musical hallucinations.[10]

The etiology of musical hallucinations has not yet been elucidated. Numerous studies have classified them into 5 categories: those related to auditory deprivation, focal cerebral lesions, psychiatric disorders, epilepsy, and causes linked to pharmaceutical or metabolic toxicity. Additionally, factors such as advanced age, female gender, and social isolation have been noted as significant contributors to the development of musical hallucinations.[11,12]

A significant number of patients with musical hallucinations have auditory problems, including hearing loss. However, since research on auditory hallucinations has been mainly conducted in the psychiatric field, most reports are limited to this area, and studies on the auditory characteristics of patients with musical hallucinations are still lacking. This study aimed to analyze auditory test results and the clinical characteristics of patients with musical hallucinations.

SUBJECTS AND METHODS

Subjects

From January 1, 2015, to December 31, 2021, the authors analyzed the medical records of patients with musical hallucinations who visited the otolaryngology department of 2 general hospitals. After screening for patients with auditory hallucinations (disease code R44.0) according to the Korean Standard Classification of Diseases (www.koicd.kr) among patients who visited the 2 hospitals, the authors targeted patients who presented with symptoms corresponding to musical hallucinations by checking the medical records of individual patients who underwent an auditory examination. Patients were excluded from the study if there was an insufficient description of the clinical features of musical hallucinations in the medical records, and patients with previously diagnosed psychiatric diseases or organic acute lesions of the brain, except for mild depression or sleep disturbance, were excluded. Furthermore, patients under the age of 18 years were excluded (Figure 1).

METHODS

Basic tympanic membrane examination, otologic physical examination, pure tone and speech audiometry tests were performed.

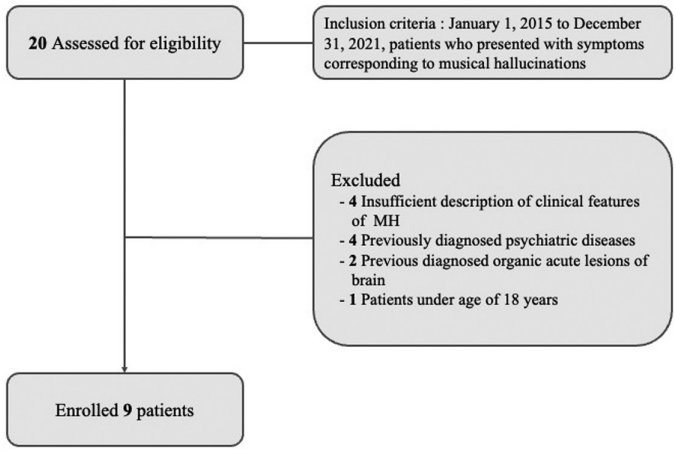

Figure 1. Flowchart of patient selection and enrollment.

Additional audio examinations were performed based on the patient's complaints. The threshold of pure-tone audiometry was averaged using the weighted 3-frequency average = (0.5 kHz + 1 kHz + 1 kHz + 2 kHz)/4).[13] This study was reviewed and approved by the institutional review boards of Severance Hospital (no. 2022-0394-001, Date: June 30, 2022). Due to the retrospective design of the study, the requirement for informed consent was waived. This study was conducted in accordance with the principles of the Declaration of Helsinki.

RESULTS

This study involved 9 patients, of whom 7 were female. The average age was 67.1 years, ranging from 52 to 89 years. To differentiate the etiology, blood tests including liver function, renal function, and serum electrolytes were performed in all patients, and all were within the normal range. All subjects included in this study were consulting a psychiatrist, and there were no patients with mental illness or a family history of mental illness, except for one patient who had a history of treatment for mild anxiety disorder before the onset of musical hallucinations.

All patients complained of hearing loss acquired hearing loss after becoming adults. Four patients used hearing aids. Four patients had a history of chronic otitis media, and 3 of them had undergone surgery. One patient developed tinnitus and musical hallucinations simultaneously after an upper respiratory tract infection, and one patient had chronic otitis media in the left ear, with musical hallucinations beginning after tympanostomy. The number of songs heard was 1-3, and the songs were heard repeatedly. The types included hymns, nursery rhymes, and songs (Table 1).

All patients showed sensorineural or mixed hearing loss in the hearing test results. The average threshold of pure-tone audiometry for the right ear was 61.4 (±29.7) dB HL (Figure 2) and that for the left ear was 57.6 (±22.6) dB HL (Figure 3). The average duration of hearing loss before the onset of musical hallucinations was 5.4 (±6.1) years. Hearing rehabilitation treatment, including a hearing aid, was prescribed for each case of hearing loss, and cochlear implantation was performed on one patient with total deafness. The 3 patients who were recommended drug treatment by the Department of Psychiatry showed improvement in their symptoms after drug administration. Although there were no objective or quantifiable measures available

MAIN POINTS

- Patients with musical hallucinations commonly exhibit underlying hearing impairment, highlighting the necessity of audiological assessment.
- Among the patients studied, chronic otitis media and prior otologic surgery were frequently observed, suggesting a possible link between auditory pathology and musical hallucinations.
- Hearing rehabilitation, including cochlear implantation and hearing aids, led to subjective symptom improvement in a majority of cases, emphasizing their potential role in symptom management.
- The study underscores the importance of differentiating musical hallucinations from tinnitus, as they may have distinct clinical implications and treatment considerations.
- Further research with larger cohorts is required to establish standardized diagnostic and treatment guidelines for musical hallucinations.

Table 1. Patient Demographics and Characteristics

Variables	Patients with MH (n = 9)
Age at diagnosis (years)	67.1 (±11.7)
Sex (male : female)	2 : 7
Characteristics of MH	
Laterality of MH (right : left : both)	1 : 4 : 4
Number of songs (1 : 2 : 3)	4 : 4 : 1
Otological symptom	
Hearing impairment	9 (100%)
Tinnitus	7 (77.8%)
Dizziness	1 (11.1%)
Otalgia	1 (11.1%)
Otorrhea	2 (22.2%)
Otological history	
COM	4 (44.4%)
Hearing aids	4 (44.4%)

COM, chronic otitis media; MH, musical hallucination.

to assess changes in musical hallucinations, subjective improvements were reported. During follow-up outpatient visits, 6 patients (including 2 patients who were also receiving psychiatric medication) expressed that their musical hallucinations had subjectively improved after hearing rehabilitation.

DISCUSSION

Musical hallucinations are rare, and related studies are often limited to patients with mental illnesses. There have been few reports on the auditory characteristics of musical hallucinations. This may be because patients do not often report their symptoms related to mental illness, and otolaryngologists do not ask patients with hearing loss and tinnitus for details of their auditory or musical hallucinations.

Although the etiology of musical hallucinations has not been elucidated, auditory defects, pharmacological factors, and focal brain lesions, as well as age over 60 years, female sex, and social isolation have been identified as key factor in the development of musical hallucinations.[11,12] Of the patients, 77.8% were female, with the average age of symptom onset being 67.1 years. All except 2 patients were over 60 years old.

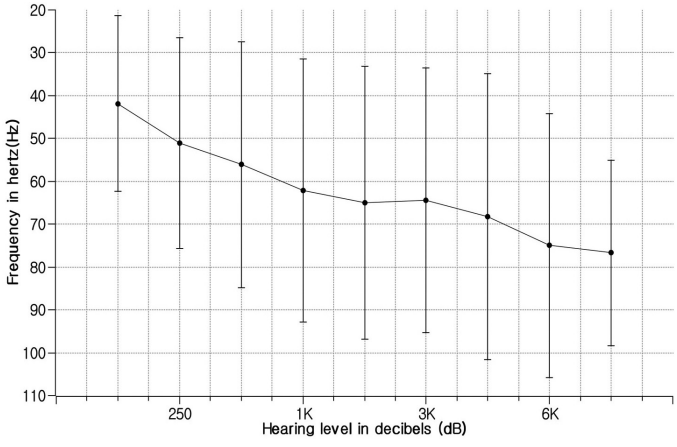

Figure 2. Pure-tone average of right ears before and after rehabilitation. The full lines indicate the average hearing thresholds of right ears, and the bars indicate ±1 SD.

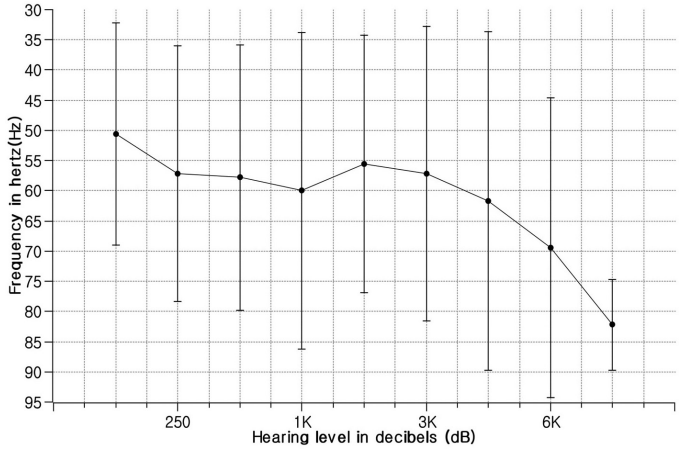

Figure 3. Pure-tone average of left ears before and after rehabilitation. The full lines indicate the average hearing thresholds of right ears, and the bars indicate ±1 SD.

Analyzing the reported cases, the type of music heard in musical hallucinations seems to have a personal meaning for each patient.[9] Musical auditory hallucinations often consist of melodies experienced by the patient before the symptoms occur, such as hymns or songs that were frequently heard. Unlike other forms of auditory hallucinations, musical hallucinations are often perceived as pleasant by most patients.[14]

There are several hypotheses regarding the process by which these hallucinations are induced, ranging from psychoanalytic interpretations to neurobiological mechanisms.[15] It has been hypothesized that sensory organ abnormalities are significantly involved in the onset of these symptoms. Hallucinations are thought to be caused by the inability to distinguish between external stimuli that actually exist and stimuli generated from within. In other words, hallucinations occur by distortion of ambiguous stimuli because of an abnormality in the brain's ability to cancel insignificant sensory stimuli.[16] Reports indicate that patients with hearing loss experience auditory hallucinations more frequently compared to the general population,[15] and studies have reported that hearing loss itself is a risk factor for mental disorders.[17] Consequently, several studies have highlighted a connection between hearing impairment and musical hallucinations.[18,19] In this study, all patients with musical hallucinations were also found to have hearing loss. In the case of hearing loss, the ability to distinguish between internal and external stimuli is reduced because of a decrease in external auditory stimuli, and this is thought to make experiencing musical hallucinations easier. This phenomenon can be attributed to the disinhibition of auditory memory circuits caused by sensory deprivation, and there is a high possibility of misinterpreting the experience of unfamiliar or incomplete stimuli due to decreased sensory function.[20] Keshavan[21] proposed that musical hallucinations stem from a memory structure conceptualized as parasitic memory. Essentially, musical hallucinations are believed to result from sensory deficits, akin to those seen in patients with Charles Bonnet syndrome or phantom limb. However, the exact mechanism behind the spontaneous release of these memory traces without specific brain stimuli remains unknown. Psychiatric comorbidities have also been

linked to the development of musical hallucinations. In this study, 2 patients who reported improvement after hearing rehabilitation were concurrently receiving psychiatric medication. Previous studies have suggested that musical hallucinations may be associated with underlying psychiatric conditions such as depression, schizophrenia, or obsessive-compulsive disorder, and pharmacological interventions targeting these conditions may influence symptom severity. Further research is needed to explore the interaction between psychiatric comorbidities and the effects of hearing rehabilitation on musical hallucinations.

Musical hallucinations in some patients improve with cochlear implant surgery.[22] It is hypothesized that musical hallucinations are due to sensory deficits in the auditory cortex, and cochlear implantation surgery is presumed to restore auditory stimulation in the auditory cortex and improve overall symptoms of musical hallucinations. In contrast, a case of musical hallucinations after cochlear implant surgery indicates that the insertion of electrodes during cochlear implant surgery can destroy the residual structures in the cochlea, suggesting a link between the destruction of the inhibitory neural feedback mechanism derived from cochlear hair cells and the occurrence of musical hallucinations.[23] In this study, one patient underwent cochlear implantation, and 8 patients were fitted with hearing aids. During follow-up, 6 patients reported subjective improvement in their musical hallucinations. This finding supports the hypothesis that enhancing auditory input through hearing rehabilitation may help alleviate musical hallucinations by restoring external auditory stimulation. However, given the subjective nature of these improvements, further studies with objective assessments are needed to establish the efficacy of hearing rehabilitation in managing musical hallucinations.

While standardized treatment guidelines for musical hallucinations have not yet been established, several case reports have explored various therapeutic approaches.[10] If the root cause is identified, treatment for the cause is implemented. However, treatment is not necessary for all patients, as musical hallucinations can be highly subjective, and the extent of their impact on daily life varies among individuals. A safe treatment option for patients and an initial consideration is to provide digital hearing aids to improve hearing.[24] This is done because, in many cases, hearing loss and musical hallucinations are related. If hearing aid treatment is unsuccessful and the underlying cause is difficult to identify, pharmacological treatments such as antipsychotic drugs (olanzapine and quetiapine), carbamazepine, and donepezil may be considered.[25] Furthermore, the therapeutic efficacy of repetitive transcranial magnetic stimulation (rTMS) has been documented in patients suffering from auditory hallucinations and tinnitus,[26,27] suggesting that it may become a viable option in the future.

A limitation of this study is that it involved few cases, and sufficient analysis of auditory and otologic diseases has not been performed. Since people with musical hallucinations show normal psychiatric function, except for the symptoms of musical hallucinations, there are not many cases of active treatment in mental health medicine. This study showed that active treatment for auditory or otologic diseases can help improve symptoms of musical hallucinations. It is significant in that it showed that positive results can be expected in the treatment of this disease through active intervention by an otolaryngologist.

CONCLUSION

Musical hallucinations have a large impact on the life of patients; however, because of their rare occurrence, studies on auditory characteristics are still lacking. In conclusion, all patients with musical hallucinations in this study exhibited hearing loss. This finding underscores the importance of otologic evaluation and hearing rehabilitation in the management of musical hallucinations. Although further research with larger cohorts is necessary to establish standardized treatment guidelines, the results suggest that improving hearing function may be a key factor in alleviating musical hallucinations.

Data Availability Statement: The datasets used and analyzed during the current study are available from the corresponding author upon reasonable request.

Ethics Committee Approval: This study was approved by the Institutional Review Board of Severance Hospital (Approval No: 2022-0394-001; Date: Jan 30, 2022).

Informed Consent: N/A.

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Declaration of Interests: The authors have no conflict of interest to declare.

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