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Coexistent Acquired Hearing Loss and Right Fronto-Parietal Meningioma as Causes of Musical Hallucinations

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Although etiological theories on musical hallucinations tend to focus on single factors, this article reports the case of a patient with coexistent factors that might be relevant in aberrant musical listening. A 61-year-old woman with symptoms of anxiety was examined in an outpatient psychiatric center. During the examination, musical hallucinations were explored. Severe hearing loss, including loss in her right ear and mild loss in her left ear, was found. The magnetic resonance scan exhibited a right-sided fronto-parietal meningioma. In lieu of the presenting clinical picture, where the presence of simple partial seizures was considered a possibility, carbamazepine treatment and later a low-dose risperidone add-on medication were introduced. This report emphasizes the importance of assessing the interactive potential of coexistent pathogenetic factors. Such factors might take an active presence, especially when considered in the context of evaluating musical hallucinations.

Keywords: musical hallucinations; meningioma; hearing loss; epilepsy

Musical hallucination is defined as a type of auditory hallucination characterized by the perception of music in the absence of sound input. Musical hallucinosis is understood to be a disorder of complex sound processing. Musical hallucinations have been reported from a variety of perspectives, including those of audiology, neurology, and psychiatry (Stewart, von Kriegstein, Warren, & Griffiths, 2006). Former findings (Stewart et al., 2006) have reported that musical hallucinations are more common in women than in men. Musical hallucinations can be associated with aging (usually present in patients who are middle-age to older adults) and can be the result of acquired deafness. These distinct hallucinations can also be related to brain diseases (epilepsy, tumor, stroke, meningitis, neurosyphilis, degenerative disorders), psychiatric disorders (schizophrenia, obsessive-compulsive disorder, bipolar affective disorder, alcohol withdrawal), and toxic states (alcohol) or the result of a combination of drugs such as clomipramine, salicylate, oxycodone, pentoxifylline, propranolol, or benzodiazepines (Stewart et al., 2006; Tomar & Cheung, 2007). Cases of musical hallucinations where a single neurological mechanism is the cause are reported less commonly than the cases where deafness or hearing loss play an active role (Berrios, 1990). Tumors involving the temporal lobe, parietal lobes, and the brainstem have been associated with musical hallucinations (Keshavan, Kahn, & Brar, 1988; Scott, 1979).

In 1988, Keshavan and his colleagues reported the case of a patient who developed musical hallucinations following removal of right frontal meningioma. Berrios (1990), in an elegant clinical study of 46 participants, emphasized an abnormality of the right

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hemisphere, which was notably more commonly affected than the left hemisphere. It is understood that the cases associated with an epileptic foci present the phenomenology of hallucinations that may include experiential features (Stewart et al., 2006).

It is interesting to view this phenomenon from a historical perspective. The well-known composer Robert Schumann suffered from musical hallucinations. They were part of his bipolar symptomology. In 1854, Schumann reportedly experienced a simple pitch (note A), which eventually served as a basis for his composing processes. The A evolved into a magnificent music masterpiece when it was said to be gradually incorporated into his violin concerto (Stewart et al., 2006). Although etiological theories on musical hallucinations tend to focus on single factors, in contrast to this, we encourage the necessary and important syntheses of integration in the practice of medicine. The presenting report of a case of a patient with coexistent factors may have significant relevance to aberrant musical listening.

Case Report

A 61-year-old woman with symptoms of anxiety related to conflicts with her family was examined in an outpatient psychiatric clinic. The patient was divorced. She had two children: a son and a daughter. She worked as a nurse, and at the time of referral lived only with her son. She reported persistent conflicts with him and relayed that the source of their frequent tension was due to the fact that although her son was 30 years old, he was not willing to work with regularity, and this had resulted in financial problems. She had no former psychiatric or neurological problems prior to the time of referral.

She had had a successful operative procedure that was the result of colon carcinoma 8 years prior. During her oncological control trials, her results were always normal. During the psychiatric exploration, she mentioned that occasionally she "heard music in her head." Such musical hallucinations had an acute onset 3 months before her psychiatric examination. Most of the time, the "music" she referred to included popular songs, which she referred to as "voices" with no referential thinking—meaning that the voices were not associated with a specific tune. Such an experience lasted for about 4 minutes, and sometimes the tempo of the music would gradually increase. She heard the music not only in one of her ears but throughout her entire head without lateralization. The nature of the experience was interpreted by the examiner as "experiential." The patient reported that she had "felt" the music in her body and that it "tuned everything out" around her. There were times when she described the music as awakening her during the night, and she would hear the music from the moment of waking up and at other times throughout significant periods or moments.

She also complained of having ongoing headaches two or three times a week. The patient did not have tinnitus before or during the presence of musical hallucinations. She did have insight related to her hallucinations, and delusional elaboration was not presented. Her neurological examination was normal. Severe hearing loss in her right ear and mild hearing loss in her left ear was found. It became evident from her medical history that a sudden loss of hearing had happened 10 years before she was examined, but the patient had not sought otological examination or treatment at that time. During her recent presenting otological examination, intact tympanic membranes were registered. Her tympanometry has showed normal pressures. On her audiometry, however, severe mixed hearing loss was evident on the right side, while on the left side over 4000 Hz mild, neural hearing loss was detected. During the objective examination with brainstem-evoked response audiometry on the right side, the objective threshold of hearing was 50 dB, which was better than the subjective threshold. On the left ear, the objective and the subjective thresholds were equivalent. No retrocochlear lesions were detected. The results from our patient's otological examination did not clear the etiology of the acquired hearing loss. Further, the magnetic resonance (MR) scan exhibited a right-sided semi-lune fronto-parietal meningioma with a maximum diameter of 28 mm (Figure 1). The standard awake and 8-hour sleep EEG was normal. However, in light of the clinical picture, the presence of simple partial seizures were considered as one of the possibilities for her complaints, and carbamazepine treatment was introduced. According to neurosurgical consultation, risks of a surgical intervention were higher than the possible advantages presented. On a 3-week-long carbamazepine treatment (600 mg/day, therapeutic blood level was 10.2 mg/l), the frequency of musical hallucinations decreased from 6 times per day to a once a day. Risperidone 2 mg/day was combined with carbamazepine treatment, and the patient

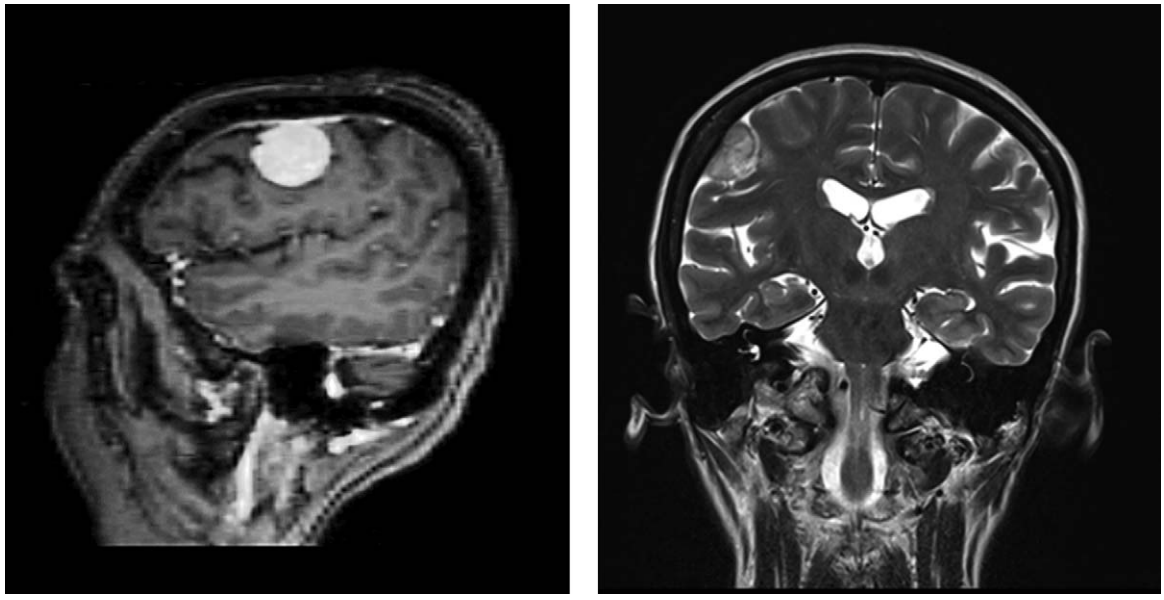

Figure 1. Coronal T2- and sagittal T1-weighted pictures revealed a right fronto-parietal meningioma with a maximal diameter of 2.8 cm. The tumor dislocated the right-sided frontal and parietal structures, especially the inferior frontal gyrus. The magnetic resonance imaging (MRI) examinations were performed on a 3-Tesla Siemens Trio MRI machine (Siemens AG, Erlangen, Germany). T2-weighted axial, FLASH 3D T1-weighted, and coronal T2-weighted and FLAIR sequences were made.

became symptom free after 2 weeks. During her 9-month-long follow-up, the patient remained symptom free; her repeated MR scans did not shown any changes concerning the size of the meningioma.

Discussion

Musical hallucinations are found at the crossroads of otological, neurological, and psychiatric practice but are not always explored fully in terms of integrating medical practice domains. There are basic theories formerly reported regarding the pathogenesis of musical hallucinations (Wodarz, Becker, & Deckert, 1995). The first is the perceptual release theory, which is based on the pathogenetic role of sensory impairment. This is similar to the Charles-Bonnet syndrome found among patients with blindness (Patel, Keshavan, & Martin, 1987). Past cases evolving from tinnitus suggest a possible basis in the cochlea, which has been proposed by Gordon (1997), and have served as a universal explanation of musical hallucinations.

According to another major pathogenetic concept, the dissociation of circuits in the association cortex is emphasized (Wodarz et al., 1995). Music perception requires the involvement of various components including melody, lyric, pitch, rhythm, harmony, and timbre. A complex neural network plays an active role in the composition of these varying components (Platel et al., 1997). Although there is no single cortical representation for these abilities, there is some evidence of association with the right hemisphere derived from Amytal tests, from intraoperative cortical stimulation studies, and through analyses of the mechanism of musicogenic reflex epilepsy. Some components of the music (e.g., timbre) have been definitely confined to the right frontal gyri. Pitch is understood to be represented in both hemispheres, while rhythm perception seems to be located in the left insula and Broca's areas (Platel et al., 1997).

In the present case, the perception of complex-patterned sequences and the consistency with previous listening experience suggest the involvement of central mechanisms beside the sensory deprivation component due to hearing loss. As Griffits (2000) postulated, hearing loss can lead to an inappropriate activation of cortical networks, which are usually involved in perception and imagery, while the coexistence of a right fronto-parietal tumor, as in the case of the presenting patient, was possibly responsible for epileptic activity, as it dislocated fronto-temporal structures involved in musical imagery.

The change of the tempo of musical hallucinations, which we observed in the case of our patient, was published previously (Satoh, Kokubo, & Kuzuhara, 2007), and recently this phenomenon was interpreted as a product of an abnormal musical pacemaker possibly existing in the temporal lobe (Biran, & Steiner, 2006). From a therapeutic perspective, it is important to mention that, as in the presented case, carbamazepine has been reported earlier to be effective in a number of cases in patients presenting with musical hallucinations (Gertz, Gohringer, & Schmmelpfennig, 1996; Terao & Tani, 1998).

The current case emphasizes the importance of the interacting roles of coexistent pathogenetic factors (hearing loss, damage of the music-processing brain regions, older age, female sex) and their possible significance as a contributing background factor in musical hallucinations. The role of parallel coexistent factors in musical hallucinations are in agreement with a recent case report where musical hallucinations appeared in a patient who underwent a left temporal lobectomy and hallucinations appeared 6 months postoperatively after development of hearing loss due to antibiotic treatment (Williams, Tremont, & Blum, 2008).

Summary

We consider two mechanisms for musical hallucinations in this case:

1. *Epileptic seizures*. Musical aura in epilepsy is a rare but well-described phenomenon. This can consist of familiar or unfamiliar music. Similar to the presenting patient, musical aura can show increasing intensity (Florindo et al., 2006). Conversely, it cannot be proven that there is an epileptic origin in this case because the patient's EEG was normal, even during an 8-hour sleep; she never experienced generalized tonic-clonic or any other seizure types.
2. *The hallucinations result from coexistent pathogenic factors*. Not only was the auditory input damaged but also the right-sided fronto-parietal regions were under pressure from the tumor. These regions—including the dislocated inferior frontal gyrus—are thought to be the main contributing factors of music perception network.

It is recommended that future research focus on cases of musical hallucinations with a broadened perspective on the influence of various etiologies. This may help to clarify the background of this unique phenomenon.

Declaration of Conflicting Interests

The author(s) declared that there are no conflicts of interests with respect to their authorship or the publication of this article.

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