

Is it necessary to differentiate tinnitus from auditory hallucination in schizophrenic patients?

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Abstract

Although the definitions of subjective tinnitus and auditory hallucination are very similar, the origins and underlying causes of each symptom clearly differ. This study examined whether the differentiation of tinnitus from auditory hallucination is necessary for the proper management of these symptoms in schizophrenic patients. We investigated the characteristics of auditory hallucinations in 15 schizophrenic patients, and measured their pure-tone hearing levels and auditory brainstem responses (ABR). The average hearing level was 20.6 ± 16.2 dB, with a mild decrease at high frequencies. We classified the patients into three groups: pure hallucination, tinnitus, and hallucination plus tinnitus. Eight patients (53.3 per cent) complained of pure hallucination and only one of them had a mild hearing loss. Hearing deficits were observed in six of seven tinnitus patients. Abnormal findings of ABR were found only in the pure-hallucination group. The results suggest that tinnitus should be differentiated from auditory hallucination in the evaluation of schizophrenic patients.

Key words: Auditory Perception; Psychotic Disorders; Hearing Loss

Introduction

Hallucinations are perceptions without a corresponding external stimulus, and can involve any of the senses. Auditory hallucinations occur in a range of organic and emotional states, including neurological conditions, hearing loss and deafness, and psychiatric conditions, such as schizophrenia and bipolar disorder.¹ Subjective tinnitus is referred to as the false perception of sound in the absence of an acoustic stimulus;² therefore, we cannot provide a conceptual basis to separate them. According to Stevenson,³ however, hallucination should be restricted to hallucinatory experiences associated with psychiatric disorders, and Gordon⁴ suggested that the only common denominator of auditory or musical hallucination is the ear. Although the definitions of subjective tinnitus and auditory hallucination are very similar, the origins and underlying causes of each symptom are thought to clearly differ.

Auditory hallucination is one of the major symptoms in the diagnosis of schizophrenia and is an important factor used to evaluate the clinical status of the disease. Moreover, its existence or severity has a great influence on determining the dosage, species, and duration of psychotropic drugs.

We investigated auditory function and the

characteristics of auditory hallucinations of schizophrenic patients in order to elucidate whether it is necessary to differentiate tinnitus from auditory hallucination for the proper management of these symptoms in schizophrenic patients.

Material and methods

Fifteen schizophrenic in-patients (seven males and eight females) participated in this study on an informed-consent basis. Their median age was 40 years (range 26–59) and the median duration of illness was 14.5 years (range 1–42). One of the patients had never been admitted to hospital before and had never received neuroleptic treatment. The same psychiatric specialist interviewed them to investigate the characteristics of their auditory hallucinations.

Hallucinatory intensity (HI) was scored by asking the patients to rate the intensity from 1 (faintest sound) to 10 (loudest sound). They were asked to record their hallucinatory frequency (HF) on a scale of 1 (rarely) to 5 (always).

According to the sound characteristics of the hallucination, we classified them into three groups: pure hallucination (H), tinnitus (T), and hallucination plus tinnitus (H/T). The H-group patients complained of hearing vocal hallucinations,

TABLE I

CLINICAL CHARACTERISTICS AND AUDIOMETRIC RESULTS FOR 15 HALLUCINATING SCHIZOPHRENIC PATIENTS

Patient number	Sex	Age	H, T or H/T	HI	HF	5f-PTA (dB)		ABR	Related otological status
						(R)	(L)		
1	M	40	H	5	1	19	25	nl	-
2	M	39	H	2	1	9	29	nl	High-tone loss (L)
3	M	26	H	4	4	3	2	nl	-
4	F	33	H	4	2	4	4	Prolonged	-
5	F	40	H	1	1	16	14	nl	-
6	F	31	H	6	4	5	2	Wave I (-)	-
7	F	55	H	9	5	12	18	nl	-
8	M	35	H	8	5	17	18	Prolonged	-
9	M	59	H/T	8	4	28	25	nl	High-tone loss (B)
10	F	59	H/T	5	4	59	35	nl	SNHL (B)
11	F	33	H/T	3	1	27	7	nl	Ménière's disease (R)
12	M	33	T	1	1	3	2	nl	-
13	M	44	T	5	2	32	32	nl	SNHL (B), patulous eustachian tube (L)
14	F	58	T	3	1	43	37	nl	SNHL (B)
15	F	47	T	4	2	62	28	nl	Cholesteatoma (R)

H = hallucination, T = tinnitus, H/T = perception of both, HI = intensity of hallucination (1–10), HF = frequency of hallucination (1–5), 5f-PTA = 5 frequency-pure-tone average hearing threshold = $(0.5+1+2+4+8 \text{ kHz})/5$, bold numbers = abnormal hearing level, ABR = auditory brainstem response test, nl = within the normal range, prolonged = abnormal prolongation of interpeak latencies, SNHL = sensorineural hearing loss, L = left R = right, B = both.

such as conversation, crowd noises, and dictation. Non-vocal (e.g. ringing, buzzing, cricket-like, hissing), meaningless sounds were classified as tinnitus.

In order to evaluate their hearing level, pure-tone audiometry was performed, and to examine the integrity of the central auditory pathway, an auditory brainstem response (ABR) test was given. Pure-tone hearing thresholds were measured at 0.5, 1, 2, 4, and 8 kHz, and the pure-tone average threshold of these five frequencies (5f-PTA) was calculated. A 90-dB rarefying click sound was used in the ABR test (Bio-Logic Co., Navigator SE, USA), with a duration of 100 μ sec and a frequency of 11.3 clicks/sec. White noise at an intensity of 50 dB was played in the contralateral ear as a masking sound. We defined abnormal findings of ABR as the absence of the I, III, or V wave, or prolonged interpeak latencies (I-III, III-V, or I-V) beyond the normal criteria for our device.

Results

Eight (53.3 per cent) of the 15 patients studied described pure vocal hallucinations, (Table I) such as voices arguing, calling, blaming, or insulting, or the voice of an acquaintance or that of God. Four patients (26.7 per cent) heard ringing, buzzing, or hissing sounds. Patient 13 complained of a hissing sound and a pure-tone-like sound when he swallowed. Three patients (20 per cent) belonged to the H/T group; they perceived a voice plus mosquito-like tinnitus, a voice with a hissing sound, and a voice with musical or mosquito-like tinnitus, respectively. Patient 9 noted that his tinnitus increased after drinking alcohol.

The mean HI of the participants was 4.5 ± 2.5 (mean \pm SD, range 1–9); the mean HF was 2.5 ± 1.6 (range 1–4). In the pure hallucination group, the mean HI was 4.9 ± 2.7 and the mean HF was 2.9 ± 1.8 ; in the hallucination plus tinnitus group, the respective values were 5.3 ± 2.5 and 3.0 ± 1.7 , and in the tinnitus group they were 3.2 ± 1.7 and 1.5 ± 0.6 .

The intensity and frequency were greatest in the H/T group, and smallest in the tinnitus group.

The participants' mean pure-tone hearing thresholds were 16.8 ± 13.7 , 15.0 ± 13.8 , 17.2 ± 15.5 , 24.0 ± 19.5 , and 29.8 ± 27.7 dB at 0.5, 1, 2, 4, and 8 kHz, respectively (Figure 1). The mean 5f-PTA was 20.6 ± 16.2 dB. Only one patient in the pure hallucination group had a mild hearing loss, and it was in the high frequency range. By contrast, all the members of the hallucination plus tinnitus group had hearing deficits. Patient 11 had a hearing loss in the low-tone area, vocal and mosquito-like tinnitus, and symptoms of vertigo and ear-fullness, indicating that she was suffering from Ménière's disease. On electrocochleography, her right ear scored a 0.54 SP/AP (summating/action potential) ratio. Three patients in the tinnitus group had hearing loss, which was the sensorineural type in two cases. A cholesteatoma with a 45-dB A-B (air-bone conduction) gap was found in Patient 15. Patient 13 had symptoms of a patulous eustachian tube, which was confirmed by tympanometric tests evaluating his eustachian tube function.

Three patients in the pure hallucination group showed abnormal ABR recordings, two patients with prolonged III-V and I-V interpeak latencies and one with absent wave I; their pure-tone hearing levels were within normal range. There was no abnormal ABR findings observed in the tinnitus or the hallucination plus tinnitus groups.

Discussion

Although their respective definitions do not enable us to separate subjective tinnitus from auditory hallucination, the characteristics and content of the sounds heard and the diseases underlying these symptoms clearly differ; in fact, these symptoms are referred to separately in otology and psychiatry, respectively. In a recent report, Korean patients most frequently described subjective tinnitus as a pure-tone-like, modified sine wave-like, or

mosquito-like sound.⁵ Others have reported ringing (37.5 per cent), buzzing (11.2 per cent), a cricket-like noise (8.5 per cent), hissing (7.8 per cent), whistling (6.6 per cent), and humming (5.3 per cent) noises.² The sound of tinnitus is meaningless and does not contain human voices.

There have been some helpful comments on the differences between the two symptoms. Both subjective tinnitus and auditory hallucination are most common at bedtime, but the patients with genuine tinnitus can state the time when they notice their symptom more clearly. Moreover, covering the ear with the palm un masks tinnitus, while this manoeuvre has no effect on auditory hallucination.⁶

In our study, the hallucination plus tinnitus group had the highest HI and HF. The superimposition of two different types of sounds must have sounded more annoying than a single auditory stimulus, also suggesting that the two types of sound that patients in the H/T group were hearing had different natures and they did not blend with each other.

In earlier studies, schizophrenic patients showed no appreciable difference in auditory acuity, as compared to control subjects; however, Mathew *et al.*⁷ reported that the acuity at frequencies above 1 kHz was poorer in schizophrenic patients. In our study, the mean hearing level decreased slightly at high frequencies, but only one patient in the H group had mild hearing loss. Most patients with a hearing deficit belonged to the T or H/T groups. This suggests that hearing loss in schizophrenic patients is related to tinnitus, not to their psychosis or their hallucinations. Overall, 55–90 per cent of tinnitus is accompanied by hearing loss, most frequently the sensorineural type, and only 10–18 per cent presents with normal hearing.^{8,9} In our study, the tinnitus and hallucination plus tinnitus groups seemed to have older subjects than the hallucination group, indicating higher possibility of presbycusis. It would need a further study to investigate prevalence of hearing loss in hallucinating schizophrenia and for the study of an accurate prevalence, we strongly suggest that patients with tinnitus should be separated from the study population.

Lindstrom *et al.*¹⁰ observed abnormal ABR findings in nine out of 10 hallucinating schizophrenic patients. They could not ascribe the ABR pathology to peripheral hearing impairment, and it was not related to sex or age; it might, however, be associated with the disease itself. They also suggested that the causes of abnormal ABR might be a dysfunction of the brainstem and limbic mechanisms, resulting from subcortical dopaminergic dysfunction and the encephalitic lesions usually found in the brainstem of schizophrenics. Our results support their observations in that three abnormal ABR cases were found in the pure hallucination group, whose peripheral hearing was normal. We think that schizophrenia itself might have an impact on central auditory pathway, resulting in prolonged neural conduction.

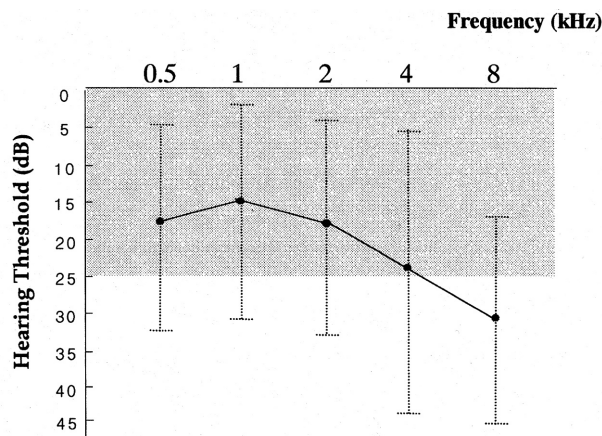


FIG. 1

Mean and standard deviation of the pure-tone hearing thresholds of hallucinating schizophrenic patients ($n = 15$). A mild decrease in hearing is observed at high frequencies.

Relation between tinnitus and psychosis

Houston *et al.*¹¹ reported a patient with a long-term hearing loss who started to hear a tinnitus; this changed into a voice and laughing, and then led him to suffer from 'illusion of thought-insertion'. They suggested that tinnitus might cause delusion, illusion, and neurosis. TARRIER¹² stated that 'a chronic hearing loss could provoke psychiatric problems as a chronic intractable pain does, and also startlingly big sounds from car-horns or from TV could contribute to recurrence of schizophrenia.'

The transformation of single auditory sensations, such as tinnitus, into music and then into voices could occur under certain psychological or biochemical conditions. MARNEROS *et al.*¹³ reported a patient suffering from otosclerosis, with unilateral auditory hallucinations and other psychotic symptoms that disappeared after surgery for otosclerosis. In this case, the tinnitus was transformed into music, and four months later, the music changed into imperative voices. On both occasions, the transformation occurred during a period of alcohol withdrawal. Interestingly, our Patient 9, who complained of an insulting voice and mosquito-like tinnitus, stated that drinking alcohol exacerbated his tinnitus.

Although it is not certain that some psychotropic drugs may trigger endolymphatic hydrops via drug-induced weight loss, dehydration, fluid imbalance, hypotension, etc, the main tenet of this theory – perilymphatic hypotonia induces hydrops – has been suggested.^{14,15} In our study, Patient 11, who had symptoms compatible with Ménière's disease, needed an otological diagnostic work-up. Her tinnitus and hallucinations were improved by treatment with a low-salt diet and the administration of anti-vertiginous drugs and low-dose diuretics.

The separation of tinnitus from psychotic symptoms, and its adequate treatment, are crucial given that we have found supporting evidence in previous reports for the disappearance of auditory hallucinations on the restoration of hearing, and the alleviation of hallucinatory symptoms after the use of hearing aids.^{16,17}

Conclusion

Auditory hallucination and subjective tinnitus are irritating symptoms that result in a psychological burden and handicap patients' daily lives. It will be even more problematic if we let the severity of these symptoms influence our judgment of the status of a patient's psychosis, without differentiating between the two symptoms. In conclusion, this study suggests that an otological and audiological evaluation and management should be provided regularly and continuously to patients with hallucinating schizophrenia after the first evaluation and there should be a long monitoring period of the symptoms thereafter. The application of tinnitus-maskers or hearing aids should be more intensively considered in patients with tinnitus. The detection, separation and intervention of tinnitus would reduce a psychological burden from those patients and might have a preventive effect on the deterioration of psychosis associated with hidden tinnitus and related hearing loss.

- **This paper examines the relationship between auditory hallucinations and tinnitus in schizophrenic patients**
- **Fifteen schizophrenic patients were investigated using pure-tone audiometry and auditory brainstem responses and subdivided into those who suffer from pure hallucinations, tinnitus and a mixture of the two**
- **The results suggest that it is important that tinnitus should be differentiated from auditory hallucination in schizophrenic patients and that as well as auditory evaluation, symptom characteristics are important**

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