The Journal of Laryngology & Otology (2012), **126**, 615–618.

doi:10.1017/S0022215112000242

CLINICAL RECORD

Musical hallucination following whiplash injury: case report and literature review

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Abstract

Introduction: A musical hallucination is defined as a form of auditory hallucination characterised by the perception of music in the absence of external acoustic stimuli. It is infrequently cited in the literature, although population studies suggest a greater prevalence. The aetiology of this unusual disorder remains unclear.

Case report: A 70-year-old man with acquired hearing loss suffered a whiplash injury in a low-speed road traffic accident, and subsequently presented with bilateral 'tinnitus.' On closer questioning, he described hearing orchestral music. There was no evidence of psychosis, delirium or intoxication, and the patient was managed expectantly.

Conclusion: This patient represents the first published case of musical hallucination precipitated by whiplash injury. We explore the possible pathophysiological underpinnings of musical hallucination and highlight the need for a greater awareness of this disorder. A management strategy is suggested.

Key words: Hallucinations, Auditory; Music; Deafness; Cognition Disorders; Whiplash Injuries

Introduction

Auditory hallucinations are auditory perceptions which occur in the absence of external stimuli.[1] They may be elementary (e.g. buzzing or ringing) or complex (e.g. voices or music).

Musical hallucination describes an auditory hallucination comprising music, musical sounds or songs. Subjects usually describe hearing familiar tunes which are often intractable.[2] Reports of isolated musical hallucination are infrequent. A heterogeneous aetiology has been suggested, with cases described variably in adults with hearing impairment, central neurological system (CNS) disorders and/or psychiatric illness.[3] There is currently no standardised approach to the investigation of musical hallucination, and this has limited the ability of researchers to draw broad conclusions from the disparate case studies reported to date.[4]

Here, we describe a case of musical hallucination in a hearing-impaired man which was precipitated by a whiplash injury. To our best knowledge, this patient represents the first reported case of this phenomenon.

Case report

A 70-year-old male taxi-driver was referred with a history of sudden-onset, bilateral 'tinnitus' which began soon after a hyperextension neck injury during a low-speed road traffic accident. He had not suffered a head injury or loss of consciousness, but had been diagnosed by the emergency medicine physicians with whiplash, manifest by complaints of severe neck and shoulder pains.

This 'tinnitus' was disclosed as taking the form of orchestral music that was familiar to the patient (e.g. 'Chorus of the Hebrew Slaves' from the opera *Nabucco* by Verdi). The music was vividly experienced and not lateralised to either ear or head-space side, and the patient soon became aware of the hallucinatory nature of his perceptions. He described being able to change the orchestral piece on occasion by subvocalisation.

The patient was a hearing aid user with moderately severe, bilateral, sensorineural hearing loss (Figure 1), having previously worked as a mechanical engineer. He also suffered from tablet-controlled diabetes mellitus and had sustained a myocardial infarction three years prior to presentation.

Clinical examination did not elicit focal neurological signs or evidence of psychiatric illness, although the patient had become anxious and fearful of driving since his accident. There was no previous history of mental illness or psychiatric admission, nor any family history of such illness.

As the musical hallucinations did not cause significant distress, the patient was managed by being counselled about the benign nature of his symptoms and reassured that they did not represent a more significant mental illness.

Discussion

Musical hallucinations have been described from three broad perspectives: audiological, neurological and psychiatric, with aetiological explanations often biased towards a single mechanism. Few papers have systematically analysed the contributions of all three factors in any given case,[5] and it remains unclear as to what degree each factor may contribute to the musical hallucination phenomenon.[5,6]

Peripheral causes

Acquired deafness is the most common factor associated with isolated musical hallucination, and cases predominately

Accepted for publication 22 August 2011 First published online 19 April 2012

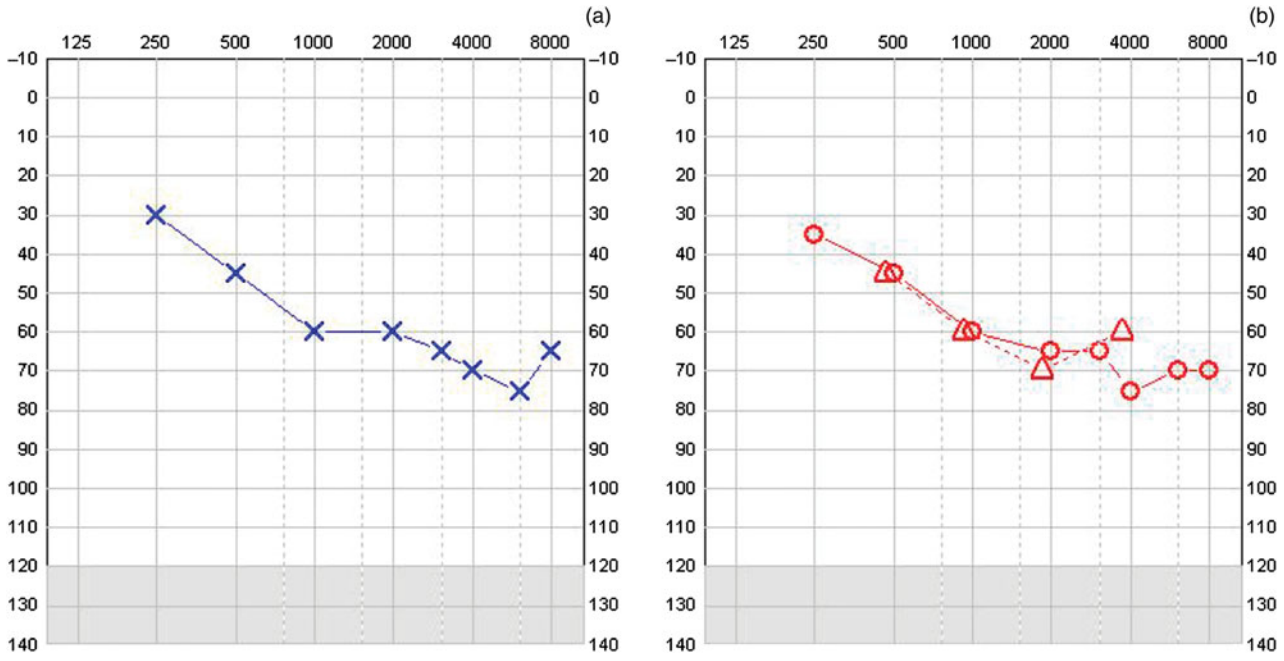

FIG. 1
The patient's pure tone audiograms prior to his whiplash injury: (a) left ear and (b) right ear.

comprise women of middle to old age with moderate to severe hearing impairment and social isolation.[2,5]

A population survey of 125 elderly, hearing-impaired patients established a 33 per cent prevalence for auditory hallucination but identified only one case of musical hallucination (0.125 per cent).[7]

Some authors have suggested a primary role for sensory deprivation in the generation of musical hallucination,[8] akin to the visual hallucinations of Charles Bonnet syndrome described in the visually impaired.[9] Others suggest that the ascending auditory pathway does not need to encode a true 'musical pattern' and that the central auditory pathway represents the substrate for musical hallucination, with the reduced signal-to-noise ratio of the auditory afferent fibres 'disinhibiting' the normal cortical pathways responsible for musical perception and imagery.[10] Indeed, functional imaging suggests that musical hallucination represents abnormal activation of the normal cortical pathways involved in music perception.[11] Given the small numbers of musical hallucination cases compared with the large size of the hearing-impaired population, which comprises one in seven of the UK population,[12] it is clear that additional factors are required to precipitate this phenomenon. These may involve dysfunction between the primary and association auditory cortices, which lowers the threshold of the system towards musical hallucination – a hypothesis supported by the over-representation of vascular risk factors and resultant leucoencephalopathy amongst the musical hallucination group.[5]

Central causes

Several cases of musical hallucination have been reported in patients with acute CNS pathology, after excluding cases of delirium, intoxication and psychosis. The character of musical hallucination in this group is more often described as transient and mono-aural to the ear contralateral to the CNS disease.[13,14]

Cases of intracerebral haemorrhage have been associated with the sudden onset of musical hallucination. Paquier has described unilateral musical hallucination following contralateral subarachnoid haemorrhage in a hearing-impaired patient.[15] Cerrato *et al.*[16] have reported bilateral musical hallucination following subcortical temporal lobe haemorrhage without previous hearing loss, suggesting disconnection between the primary auditory and association cortices as the responsible mechanism.

Brainstem lesions have also been reported as causative or contributory to musical hallucination.[5]

Other CNS disease processes reported to be associated include tumours, meningitis, epilepsy, neurosyphilis and drug toxicity.[4,17,18]

Psychiatric illness

Whilst the majority of patients presenting with isolated musical hallucination will not be suffering from psychiatric illness, it is important to be aware of this possibility.

Musical hallucination needs to be differentiated from musical pseudo-hallucination and musical obsession. Musical pseudo-hallucinations are the experience of sounds in subjective head-space in the absence of external stimuli, but without these sounds having 'the full force or impact of a real perception'. Musical obsession describes the compulsive thought of music despite efforts to resist it, which is present together with preservation of insight into the self-generated origin of such thought.[19]

Studies do however suggest an increased prevalence of musical hallucination in certain psychiatric populations, notably those with schizophrenia or obsessive compulsive disorder. Estimates suggest a 16 per cent lifetime risk of musical hallucination amongst schizophrenics[20] and a possible 30 per cent prevalence in obsessive compulsive disorder patients.[21] Therefore, it would be prudent to make a preliminary assessment for psychotic illness when evaluating a patient with musical hallucination, as the neurobiological

https://doi.org/10.1017/S0022215112000242 Published online by Cambridge University Press

underpinnings, and thus treatment, of these hallucinations may be qualitatively different from those of other cases described in this report. A population prevalence study of 3678 psychiatric inpatients from a district general hospital gave a prevalence of 0.16 per cent,[22] similar to that in an elderly hearing impaired cohort studied by Cole *et al.*[7]

A closer analysis of three cases of musical hallucination in non-psychotic patients with anxiety or obsessive compulsive disorder symptoms suggests that a combination of psychopathology, hearing impairment and advanced age may be important for musical hallucination generation.[23]

Present case: a novel trigger

Our patient's risk factors of hearing impairment and atherosclerosis are consistent with those in previously published reports. However, our patient's musical hallucinations were triggered by whiplash injury, a previously unreported phenomenon.

A review of oto-vestibular symptoms following whiplash injury has suggested an incidence of 10 per cent, although some may be open to exaggeration,[24] and other researchers have found significantly lower rates amongst patients with low-grade whiplash injuries.[25] High frequency hearing loss is the most common type associated, although individuals may report poor speech discrimination, without changes seen in the pure tone audiogram, which may require a 'speech-in-noise' test for confirmation.[26]

The underlying mechanisms linking injury and symptoms have been speculated to be: transient labyrinthine ischaemia following vertebral artery compression; direct labyrinthine or brainstem concussion; or even the unmasking of a pre-existing hearing difficulty by the psychological impact of the injury.[24]

- **Musical hallucination describes vivid perception of music without external stimuli**
- **Most cases are persistent and associated with hearing impairment, without psychiatric illness, but sometimes triggered by central dysfunction**
- **Transient, mono-aural hallucination may represent acute central pathology and warrant neuro-imaging**
- **Whiplash injury may cause psychopathology and unmask pre-existing hearing disorder**

Our patient developed situational anxiety for driving, and we speculate that the neurobiological changes manifest by this psychopathology may have been involved in triggering his musical hallucinations.

Treatment

No systematic studies have been performed to determine the best treatment for musical hallucination. Given the role of sensory deprivation, some have found auditory amplification useful to alleviate musical hallucination morbidity.[10] Some success has been reported with the use of carbamazepine (in two cases),[27] gabapentin (in one),[28] antipsychotic medication[4] and anti-cholinesterase inhibitors;[29] however, no general recommendations on pharmacological treatment can be made. Our patient did not find his musical hallucinations particularly distressing, although he was intrigued by the phenomenon, and was happy to be managed with reassurance alone.

Conclusion

We suggest that the previously cited distinction between peripheral audiological, central neurological and psychiatric causation of musical hallucination is somewhat artificial. The auditory perceptual system ought to be evaluated systematically through audiometric, neurological and psychological assessment. Dysfunction in higher order cognitive processing, as manifest by frequently subtle psychopathology, may act to trigger the disorder. The patient's social and drug histories are also important. It is likely that reported cases of musical hallucination represent the top of a clinical 'iceberg' of community prevalence, with the great majority of patients not presenting, either because they are not sufficiently troubled by their symptoms or because they fear a diagnosis of mental illness. For those who are distressed by their musical hallucinations, audiological aiding and reassurance would be reasonable first-line interventions.

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https://doi.org/10.1017/S0022215112000242 Published online by Cambridge University Press

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Mr Y M Bhatt takes responsibility for the integrity of the content of the paper
Competing interests: None declared