Musical hallucinations in elderly patients with visuospatial impairment: two case reports

Chiara Luppi,[1] Francesca Santagata,[1] Margherita Marchetti,[1] Giuliana Bottignole,[1] Pasqualina Sapone,[1] Massimiliano Massaia,[1] Giancarlo Isaia[2]

[1]Department of Geriatrics, AOU Città della salute e della Scienza di Torino; [2]Unit of Geriatrics and Metabolic Bone Disease, Molinette Hospital and School of Geriatric Medicine, University of Torino, Italy

Abstract

Musical hallucinations are an uncommon type of auditory hallucinations, they widely occur in elderly. Our group analyzed medical history, pharmacological therapy, neuropsychological pattern, audiometric testing, electroencephalogram, cerebral magnetic resonance and cerebral fludeoxyglucose-positron emission tomography (FDG-PET) of two patients. FDG-PET showed in both patients hypometabolism pronounced in posterior regions. In particular the medial-inferior temporal cortex and the occipital associative areas were affected. Moreover, neuropsychological pattern suggested a visuospatial-executive deficit, conformed to the occipital involvement. Our reported cases might suggest that musical hallucinations have been arisen from a combination of peripheral and central dysfunction. A further explanation might be that musical hallucinations result from multiple white matter lacunar lesions due to small vascular events. A question is whether musical hallucinations might be primarily associated with occipital areas hypometabolism and visuospatial alterations typically associated with Levy body dementia (LBD).

Introduction

Musical hallucinations are a particular and uncommon type of auditory hallucinations, in which the patient perceives instrumental sounds, melodies or songs.

Auditory hallucinations are mostly restricted to patients suffering from schizophrenia.[1]

However, there is a growing body of evidence to suggest that musical hallucinations widely occur in older persons, with a female predominance, no history of psychiatric disease and a frequent association to acquired hearing loss. In the literature reviewed, it also seems that there is a high correlation between hearing loss and cognitive impairment, mainly described in the memory components and executive function.[2]

Depression is also present in almost one third of the cases.[3]

Musical hallucinations are generally described as stereotyped and often familiar motifs, including religious, childhood and popular songs, continually repeated. Despite their music content, these hallucinations can be very disabling.

The biological basis of this phenomenon remains largely unknown. Since a history of acquired hearing impairment is often present, one of the most convincing hypotheses is that musical hallucinations are due to sensory deprivation.[4]

Drug-induced musical hallucinations have been also analyzed. Antihypertensive treatments, metoprolol, misuse of ergot alkaloids, salicylate, tramadol hydrochloride, morphine and a combination of benzodiazepine have been supposed to be the trigger.[5]

Musical hallucinations have been observed also in focal brain disease, epilepsy and general brain atrophy, but those alone have never been described as sufficient causes.[6]

We present two cases of musical hallucinations in outpatients with visuospatial impairment, with a detailed neuropsychological assessment; a brain fludeoxyglucose-positron emission tomography (FDG-PET) showed the involvement of medial temporal regions and occipital associative areas.

Case Reports

T.D. 81-year old (patient #1) and B.I. 78-year old (patient #2) are right-handed women with no previous history of dementia or psychiatric pathology that were sent by their family doctor for auditory hallucinations symptoms.

Both report to hear instrumental music as played by an orchestra with a predominance of violins. Patient #1 reported that her hallucinations consisted of folk-song melodies that she could repeat, as they had been real; sometimes she heard choirs. Patient #2 complained that her hallucinations had presented as the same repetitive music at the onset; otherwise she had been hearing different songs since few weeks, sung by choirs. In both patients, hallucinations were constantly heard in both ears during the day but their intensity increased at night and when surrounding noise level was low. They could not been interrupted and interfered with their sleep causing disturb.

T.D. was retired before coming to our attention. She had elementary education and after she worked as chef.

In her medical history she had been treated for carotid artery disease (left carotid artery stenting in 2001) and breast fibro adenomas. She had heart bypass surgery and now she's taking statins and antiplatelets. She also had hypertension and hypothyroidism, which were treated with diuretics and levotiroxin. There was no relevant family history for psychosis or dementia, but there was high familiar cardiovascular risk.

Before sending the patient to our attention, the family doctor tried to treat the musical hallucinations with neuroleptics (promazine, haloperidol and quetiapine) without any benefits.

B.I. was also retired before coming to our attention and she had elementary education. She worked her entire life as beautician in a beauty center.

She has diabetes mellitus treated with insulin from 17 years and minimal eyes impairment; she had been treated for carotid artery disease (right carotid endarterectomy in 2013). Apart from insulin, her routine therapy consists only in antiplatelets.

For the musical hallucinations she never received medications before coming to our center.

Remarkably similar cognitive and neuropsychological pattern was found in both patients, even if the degree of deficits was different: T.D. performed worse than B.I.

The *mini mental state examination*[7] showed mild cognitive impairment for T.D. while B.I. seemed to have normal scoring.

The neuropsychological profile of the patient #1 is characterized by difficulties in attention, in long-term visuospatial memory, in visual-per-

Correspondence: Francesca Santagata, Department of Medical Science - Geriatrics, Corso Bramante 88/90, 10126 Torino, Italy.
Tel.: +39.011.6335328 - Fax: +39.011.6636033.
E-mail: Santagata_francesca@libero.it

Key words: Musical hallucinations; vascular dementia; cognitive decline; elderly; visuospatial impairment.

Contributions: the authors contributed equally.

Conflict of interest: the authors declare no potential conflict of interest.

Received for publication: 19 September 2016.
Revision received: 14 December 2016.
Accepted for publication: 19 December 2016.

Geriatric Care 2016; 2:6288
doi:10.4081/gc.2016.6288

ceptual functions and praxis component. Specifically, she obtained a score at the inferior limits of normality in short-term numerical and verbal memory, but the visuospatial ability to repeat sequences was normal (Table 1).[8-16]

The long-term verbal memory was considered normal in the tests with textured material as the brief story presented and in delayed recall of material not related, while the immediate re-enactment could be considered at the lower limits of normality.

The attention was deficient in all its components; executive functions were normal.

The language was characterized by good phonemic fluency, instead a worst performance in the semantic component. Language comprehension was totally normal.

Visuospatial and perceptual functions were impaired; clinically relevant were the performances at *clock drawing test.*[15]

The tasks of praxia indicated visuopercettive disorder (in addition to the previously described visuospatial disorder) and deficits in apraxia ideo-motoria. The ability for logical reasoning was normal.

The performances of the patient #2 were globally better than patient #1. The B.I. cognitive profile was characterized by disorder of the visual-spatial, perceptual and praxis component; it was reported spatial planning disorder.

In particular, the performances for the memory were altogether normal: good short- and long-term performance, whether with textured material or unrelated words.

The attention appears normal, executive functions were normal, but she had marked difficulty in spatial planning emerged in the evidence of *Elithorn's perceptual maze test.*[9]

The language was characterized by good phonemic fluency, instead a worst performance in semantic component. Language understanding was globally normal.

The tasks of praxis showed disorder visuopercettive and visuospatial deficits in combination with the ideo-motor apraxia.

The ability of logical reasoning could be considered normal, with low score.

Since depression is often associated with musical hallucinations, neuropsychological assessment investigated also the presence of subclinical depressive symptoms with neuropsychiatric inventory (NPI).[17]

In both patients depression was detected and was characterized by continuous low mood

Table 1. Neuropsychological assessment of the two patients.

			Patient #1. T.D.			Patient #2. B.I.		
	Range	NV	RS	CS	ES	RS	CS	ES
Screening Test								
Mini Mental State Examination[7]	0-30	≥23.8	21	23.49		26	28.33	
Short-term Memory								
Digit numeric Span[8]	0-9	≥3.75	4	4.55	2	6	6.50	4
Digit word Span[9]	0-10	≥3	3	3.50	2	5	5.45	4
Corsi blocks Span[8]	0-9	≥3.5	5	5.75	4	3	3.75	1
Long-term Memory								
Short story - Babcock[9]								
Immediate recall	0-8		5.3			6.3		
Delayed recall (10')	0-8		5.5			6.6		
Total	0-16	≥4.75	10.8	11.85	3	12.9	13.85	4
15 Rey's words[10]								
Immediate recall	0-75	≥28.53	16	28.64	1	31	42.76	4
Delayed recall (15')	0-15	≥4.69	5	8.94	4	6	9.66	4
Rey figure delayed reproduction (10')[11]	0-36	≥9.47	0	0.00	0	6.5	15.00	4
Attention								
Attentive Matrices[9]	-	≥30	11	18.25	0	40	45.75	4
Trail Making Test[12]	-							
Trail Making Test A (sec.)	-	≤93	406	374.20	0	114	82.20	1
Trail Making Test B (sec.)	-	≤282	600	491.00	0	300	191.00	1
Trail Making Test B-A (sec.)	-	≤186	194	116.60	1	186	108.60	2
Executive function								
FAB - Frontal Assessment Battery[13]	0-18	≥13.5	16	17.88	4	15	16.74	4
Elithorn's Perceptual Maze Short Test[9]	0-16	≥7.75	9	10.9	2	3	4.65	0
Language								
Word fluency on phonemic cues[14]	-	≥17	25	34.10	4	30	39.10	4
Word fluency on semantic cues[9]	-	≥7.25	7	10.40	1	10	13.15	2
Token Test[9]	0-36	≥26.5	32	33.60	4	33.5	34.90	4
Visuo-spatial and perceptual function								
Clock's Drawing Test[15]	0-15	≥7.57	2		0	5		0
Constructional praxis								
Rey figure copying[11]	0-36	≥28.88	4	7.35	0	3.5	6.65	0
Drawing Copy Test[9]	0-14	≥8	9	10.05	2	13	13.95	4
Imitation facial expressions De Renzi[9]	0-20	≥17	20	20.00	4	20	20.00	4
Imitation gestures De Renzi[9]	0-20	≥16	15	15.30	0	15	15.25	0
Logical Reasoning and Intelligence								
Raven's colored progressive matrices P47[16]			21	28.20	2	18	23.84	2

NV, normative value; RS, raw score; CS, corrected score; ES, equivalent score. ES=0 pathological performance; ES=1 inferior limits of normality (borderline); ES=2 limits of normality with low score; ES=3 normal performance; ES=4 superior limits of normality.

and sadness, feeling tearful and hopeless about future.

The disorders of constructive praxis were similar in both patients. Deficit in copy tests traditionally are associated with parieto-occipital lesions and the impairment of ideomotor praxia is associated with parietal lesions, sometimes with involvement of the thalamus and basal ganglia.

Worst performances in semantic component of language tests were also comparable in the two patients. This difficulty is usually associated with temporal lesions. To evaluate these anatomical correlations the patients went to detailed radiological study.

Cerebral magnetic resonance findings showed generalized brain atrophy and multiple white matter lacunar lesions affecting above all the cerebellum; T.D. brain imaging in particular revealed bilateral enlargement of the temporal horn.

Furthermore cerebral FDG-PET showed heterogeneous cortical metabolism. In both patients hypometabolism was more pronounced in posterior regions. In particular the medial-inferior temporal cortex and the occipital associative areas were affected. Interestingly in both patients occipital associative areas involved were homolateral to previous carotid surgery (Figures 1 and 2).

Electroencephalograms (EEGs) were unremarkable.

In addition the presence of acquired hearing impairment was evaluated, because it might be associated to musical hallucinations. Both patients reported a gradual and progressive hearing loss. Audiometric testing revealed bilateral mild-moderate sensorineural and conducting hearing impairment.

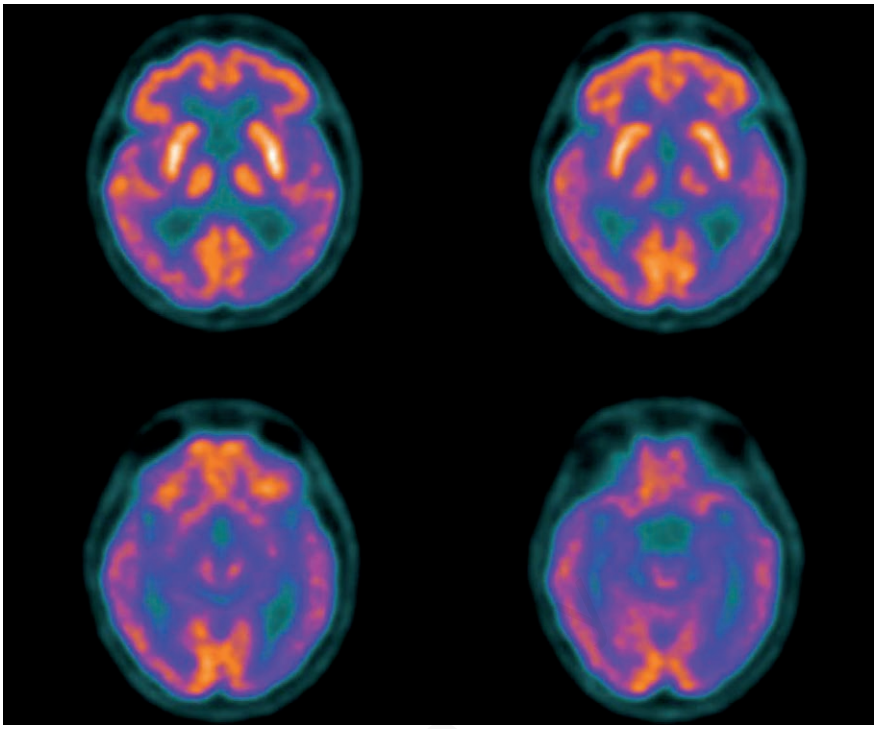

Figure 1. Fludeoxyglucose (FDG)-positron emission tomography of patient #1. Cortical distribution of FDG uneven and reduced in the rear middle portions. Low concentration in the left-down portions of the temporal cortex, and in the associative areas of the occipital cortex.

Discussion

Cases presented by our patients conformed closely to almost stereotyped pattern musical hallucinations consisting of folk- song music played by an orchestra and sang by a choir.

There's still disagreement about the possible anatomical substrate of the phenomenon. Within this context our reported cases might suggest that musical hallucinations have been arisen from sensory distortions due to a combination of peripheral and central dysfunction.[18] A further explanation might be that musical hallucinations result from multiple white matter lacunar lesions due to small vascular events.[19]

Brain atrophy and lacunar lesions might worsen these *sensory deprivation*. In support, our patients suffer from neurosensorial-conductive hearing impairment. No EEG alterations, therefore, have been detected.

In contrast to most published cases our patients' hallucinations were unfamiliar to them. This observation might support a model

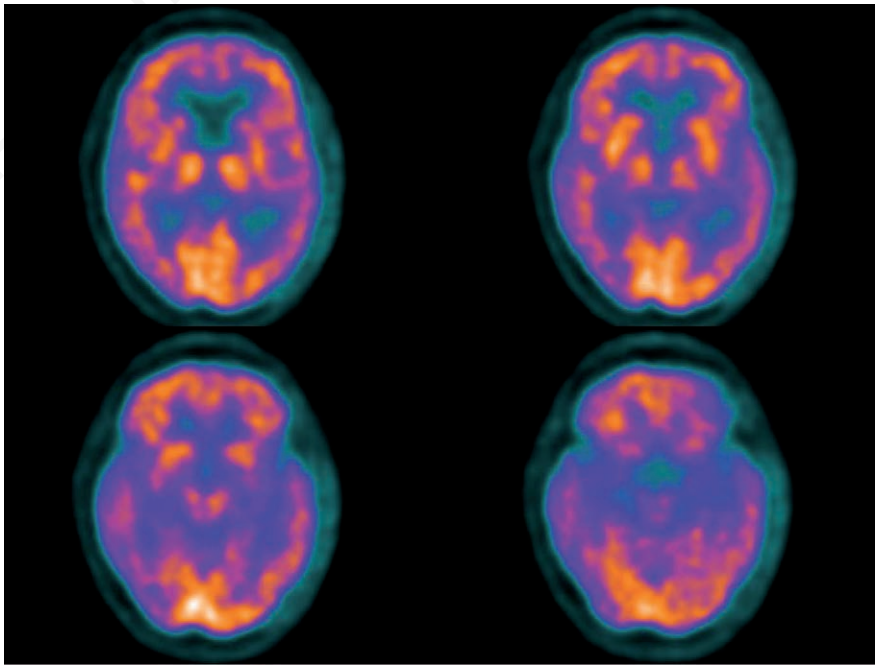

Figure 2. Fludeoxyglucose (FDG)-positron emission tomography of patient #2. Bilateral low concentration of FDG in the mesial temporal cortex and in parietal cortical, especially in cranial portions. In right side where the parietal deficit is more evident it detects involvement of the associative occipital cortex. Accentuation of the interhemispheric fissure.

in which musical hallucinations are based on musical experience but not necessarily reproduced entirely from musical memory.[20]

The complex music and their definite tonality, large scale structure and timbre are consistent with an origin in higher-order auditory areas in the antero-medial temporal or frontal lobes.[21] In both our patients medial-inferior temporal cortex and the occipital associative areas were affected.

It is also remarkable that occipital associative areas impairment was homolateral to previous carotid disease surgery, our patients have undergone to. To the best of our knowledge, no data on musical hallucinations associated to this brain imaging findings have been reported in scientific literature. Neither data are available on the effects of carotid artery surgery on occipital areas functioning. Moreover, in both patients neuropsychological pattern suggested a visuospatial-executive deficit, consistent to the occipital involvement.

The anatomical features and the neuropsychological assessment of the two patients could suggest a form of Levy body dementia, but the criteria to diagnose this pathology are not satisfied at the moment.[22]

Both patients were treated with citalopram in order to reduce the depressive symptoms. Recently completed randomized controlled trial[23] on novel or repositioned drugs (mibampator, dextromethorphan/quinidine, cannabinoids, and citalopram) showed some promise in treating agitation in Alzheimer's disease, but still with safety concerns.

In the subsequent visits we saw some benefits from the therapy, T.D. reported better mood and reduced sleeping disorder and B.I. describe herself as more hopeful for the future and less anxious, moreover we observed a minimal reduction of her complaining for the musical hallucinations, reported also by her family.

After few mouths, during the follow-up visits, T.D. increased the behavioral disturb, which were evaluated with NPI. In order to control these symptoms the patient is now treated with low dosage of haloperidol.

Conclusions

A crucial question is whether musical hallucinations might be primarily associated with occipital areas hypometabolism and visuospatial alterations or might be just an epiphenomenon of the occipital areas involvement typically associated with LBD. Understand the physiopathology connected to this uncommon clinical manifestation is important in order to find a therapeutic options for these patients. Further studies are needed to reach that goal.

References

1. Choong C, Hunter MD, Woodruff PW. Auditory hallucinations in those populations that do not suffer from schizophrenia. Curr Psychiatry Rep 2007;9:206-12.
2. Lagroscino G, Panza F. The role of hearing impairment in cognitive decline:need for the special sense assessment in evaluating cognition in older age. Neuroepidemiology 2016;46:290-1.
3. Fenton GW, McRae DA. Musical hallucinations in a deaf elderly woman. Br J Psychiatry 1989;155:401-3.
4. Evers S. Musical hallucinations. Curr Psychiatry Rep 2006;8:205-10.
5. Gordon AG. Drug-induced musical hallucinations. J Nerv Ment Dis 1998;186: 652-3.
6. Evers S, Ellger T. The clinical spectrum of musical hallucinations. J Neurol Sci 2004;227:55-65.
7. Measso G, Cavarzeran F, Zappalà G, et al. The mini-mental state examination: normative study of an Italian Random Sample. Dev Neuropsychol 1993;9:77-95.
8. Orsini A, Grossi D, Capitani E, et al. Verbal and spatial immediate memory span: normative data from 1355 adults and 1112 children. Ital J Neurol Sci 1987; 8:539-48.
9. Spinnler H, Tognoni G. Standardizzazione e taratura italiana di test neuropsicologici. Ital J Neurol Sci 1987;6:23-4.
10. Carlesimo GA, Caltagirone C, Gainotti G. The Mental Deterioration Battery: normative data, diagnostic reliability and qualitative analyses of cognitive impairment. The Group for the Standardization of the Mental Deterioration Battery. Eur Neurol 1996;36:378-84.
11. Cafarra P, Vezzadini G, Dieci F. Rey-Osterrieth complex figure: normative values in an Italian population sample. Neurol Sci 2002;22:443-7.
12. Giovagnoli AR, Del Pesce M, Mascheroni S, et al. Trail making test: normative values from 287 normal adult controls. Ital J Neurol Sci 1996;17:305-9.
13. Apollonio I, Leone M, Isella V, et al. The Frontal Assessment Battery (FAB): normative value in an Italian population simple. Neurol Sci 2005;26:108-16.
14. Novelli G, Papagno C, Capitani E, et al. Tre test clinici di ricerca e produzione lessicale. Taratura su soggetti normali. Archiv Psicol Neurol Psichiatr 1986;4: 477-506.
15. Cafarra P, Gardini S, Zonato F, et al. Italian norms for the freedman version of the Clock Darwing Test. J Clin Exp Neuropsychol 2011;33:982-8.
16. Basso A, Capitani E, Laicona M. Raven's coloured progressive marices: normative values on 305 adult normal controls. Funct Neurol 1987;2:189-94.
17. Cummings JL, Mega M, Gray K, et al. Neuropsychiatric Inventory. Neurology 1994;4:2308-14.
18. Griffiths TD. Musical hallucinosis in acquired deafness. Phenomenology and brain substrate. Brain 2000;123:2065-76.
19. Serby MJ, Hagiwara M, O'Connor L, et al. Musical hallucinations associated with pontine lacunar lesions. J Neuropsychiatry Clin Neurosci 2013;25: 153-56.
20. Warren JD, Schott GD. Musical hallucinations in a musician. J Neurol 2006;253: 1097-99.
21. Calabrò RS, Baglieri A, Ferlazzo E, et al. Neurofunctional assessment in a stroke patient with musical hallucinations. Neurocase 2012;18:514-20.
22. McKeith IG, Dickson DW, Lowe J, et al. Diagnosis and management of dementia with Lewy bodies: third report of the DLB Consortium. Neurology 2005;65:1863-72.
23. Panza F, Solfrizzi V, Serpia D, et al. Progresses in treating agitation: a major clinical challenge in Alzheimer's disease. Expert Opin Pharmacother 2015;16: 2581-8.