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Review

Considering the senses in the diagnosis and management of dementia

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ABSTRACT

Associations between dementia and impairments in hearing, vision, olfaction and (to a lesser degree) taste have been identified. Hearing impairment has been shown to precede cognitive decline, but it is not clear if the hearing loss is an early marker of dementia or a modifiable risk factor. Olfactory impairment is seen in many neurodegenerative conditions, but it has been shown that those with dementia have particular difficulties with the recognition and identification of odours rather than the detection, suggesting a link to impairment of higher cognitive function. Olfactory impairment has been shown to be predictive of conversion from mild cognitive impairment to Alzheimer's disease with 85.2% sensitivity.

As cognitive function deteriorates, the world is experienced at a sensory level, with reduced ability to integrate the sensory experiences to understand the context. Thus, people with dementia are very sensitive to sensory experiences and their environment needs to be managed carefully to make it understandable, comfortable, and (if possible) therapeutic. Light can be used to stabilise the circadian rhythm, which may be disturbed in dementia. Music therapy, aromatherapy, massage and multisensory stimulation are recommended by NICE for the management of behavioural and psychological symptoms of dementia (BPSD), although the mechanisms behind such interventions are poorly understood and evidence is limited. Sensory considerations are likely to play a greater role in dementia care in the future, with the development of purpose-built dementia care facilities and the focus on non-pharmacological management strategies for BPSD.

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Abbreviations: NICE, National Institute for Health and Care Excellence; BPSD, behavioral and psychological symptoms of dementia; MMSE, mini mental state examination; AD, Alzheimer's disease; PD, Parkinson's disease; UPSIT, University of Pennsylvania smell identification test; MCI, mild cognitive impairment; OR, odds ratio; DLB, dementia with Lewy bodies; AMD, age-related macular degeneration; CBS, Charles-Bonnet syndrome; ADL(s), activities of daily living; CGI, Clinical Global Impression of Change.

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1. Introduction

Hearing loss and other sensory deficits, such as olfactory and visual disturbances have been linked with cognitive decline and the onset of dementia. It is unclear whether hearing loss and other sensory deficits are risk factors for the development of dementia, early stages or part of a continuum of age-related degeneration [1]. Studies have suggested that hearing loss can be an early sign of dementia onset and suggested that hearing studies should be incorporated in routine dementia screening. In the first part of this review we summarise the evidence providing links between hearing loss and other sensory impairments with cognitive dysfunction and onset of dementia. In the second part we examine the management of behavioural and psychological symptoms of dementia using a sensory framework.

2. Hearing impairment and dementia

Early studies have found a correlation between hearing loss and dementia in elderly populations [2,3]. Uhlmann et al. found an association between hearing impairment and dementia in a case–control study, the severity of hearing impairment was linked with the relative odds of incidence of dementia [4]. Moreover, findings from a prospective cohort study have suggested that central auditory dysfunction may precede the onset of dementia for many years and could be used as an early risk marker for dementia [5,6]. Lin et al. have confirmed the association between hearing loss and dementia in prospective cohort study [7]. They have concluded that future research needs to clarify whether hearing loss is an early stage of dementia or a modifiable factor that can affect the risk of developing dementia [7]. In a cross-sectional cohort, Lin et al. found that a hearing loss of 25 dB correlated with cognitive loss equivalent to an extra 6.8 years of age [8]. Cohort studies in Japanese and Italian elderly populations have highlighted a correlation between auditory function and performance on MMSE score, suggesting that hearing impairment is associated with cognitive dysfunction [9,10].

2.1. Hearing loss and cognitive testing performance

It has been suggested that hearing loss may impair the performance on cognitive tests without an underlying cognitive decline. However, a study by Uhlmann et al. showed that hearing-impaired patients with dementia scored lower on both written and standard MMSE tests, when compared with hearing-unimpaired patients, suggesting that cognitive dysfunction in hearing-impaired patients is not just an artefact of the testing procedure [11].

2.2. Underlying mechanisms

A common mechanism of hearing impairment and the development of age-related cognitive decline and dementia has been proposed, involving mitochondrial dysfunction and increased oxidative stress. Treatment strategies like caloric restriction and their underlining biological mechanisms, such as up-regulation of sirtuins, have been involved in delaying the onset of age-related cognitive decline, as well as age-related hearing loss [12,13].

3. Other sensory impairments and dementia

3.1. Olfactory impairment

A meta-analysis by Mesholam et al. has found an association between olfactory impairment and Alzheimer's disease (AD), as well as Parkinson's disease (PD) [14]. In this study, there were no differences between the diseases, suggesting that olfactory impairment may just be a marker for any of the neurodegenerative conditions. On the other hand, in a meta-analysis of 81 published studies, Rahayel et al. found that olfactory impairments are present both in AD and PD patients, but AD patients perform worse in odour identification and odour recognition tasks, while PD patients perform worse in odour detection tests. Such data suggests that AD patients are impaired in higher-level olfactory cognition tests, while PD patients are more impaired in lower-level perceptual tests [15]. Moreover, olfactory impairment, especially severe anosmia, has been linked with the risk of developing dementia in PD [16]. Yet, in a prospective cohort study, Swan et al. showed that olfactory impairment may also predict specific decline of verbal memory in non-demented elderly [17]. Olfactory impairment in the elderly was further found to correlate with neurocognitive tests of immediate and delayed recall, category fluency and naming objects as well as with MRI hippocampal volumes [18]. Olfactory impairment, using the University of Pennsylvania smell identification test (UPSIT), along with measures of verbal memory, functional activities scale, MRI hippocampal volumes and MRI entorhinal cortex volumes have been part of the combination of early markers in a study predicting the conversion of mild-cognitive impairment (MCI) to AD with 85.2% sensitivity [19].

Djordjevic et al. showed in a cohort study that patients with MCI have deficits in all domains of olfactory function, i.e. detection threshold, discrimination and identification, and those functions deteriorate further with the progression to AD [20]. In a five year prospective cohort study, Schubert et al. noted that olfactory impairment at baseline can predict onset of cognitive decline, measured by MMSE, with an odds-ratio (OR) of 6.6 [21]. Similarly, Conti et al. found that, in a two year longitudinal cohort study, olfactory deficits in MCI subjects may be associated with an increased risk of conversion to AD, with an OR of 5.1 [22], while Sohrabi et al. showed that in a three year prospective follow up study olfactory impairment can predict cognitive decline in elderly individuals [23]. Seligman et al. showed that olfactory impairment in demented patients correlated with the levels of apathy [24]. Finally, anosmia in dementia has been strongly associated with dementia with Lewy bodies (DLB), and it has been suggested that olfactory function tests may be used for the identification of patients with DLB [25–27].

3.2. Taste

Apart from the olfactory impairment, limited evidence indicates a link between taste impairment and dementia. A cohort study by Lang et al. found a correlation between the severity of dementia and taste impairment which was especially prominent in PD patients, even after controlling for confounding effects of age, smoking and alcohol consumption [28]. In a cohort study by Steinbach et al. taste impairment was associated with MCI and AD patients when