Analyses of the Impact of Olfactory, Hearing and Visual Impairments on Alzheimer's Disease

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ABSTRACT
Alzheimer's disease is a neurodegenerative disease, and the incidence of this disease is increasing with aging, so Alzheimer's disease has attracted more and more attention in society. The main problem for patients is the decline of cognitive and memory function. The occurrence of the disease is related to many factors, and the specific etiology is not completely clear. But the decline of cognitive and memory function can be explored from human senses, smell, vision and hearing impairments. Patients with cognitive impairment and memory impairment were analyzed in this paper. The results show that the decline of olfactory function and visual, auditory function will have different effects on Alzheimer's disease. This paper also proposes that the decline of smell function has a greater impact on Alzheimer's disease.

Keywords: *olfactory function, Alzheimer's disease, dementia, cognitive memory impairment, cognitive memory function*

1. INTRODUCTION

There are many olfactory centers in the brain area that are very complex. These areas include cortical and subcortical pathways, such as the Orbitofrontal cortex, piriform lobe and entorhinal cortex, hypothalamus, olfactory bulb and amygdala [1]. The neglect of olfactory dysfunction can be seen in a report the older people in the United States received help for hearing and vision impairments without being tested for olfactory dysfunction. But in clinical settings smell is also becoming increasingly important in the environment, as impairment of smell represents the leading non-invasive biomarker for predicting dementia during aging [2].

The hippocampus area in the brain is directly related to memory function, and another area that controls smell is partially connected to the limbic system responsible for emotion, memory and behavior, so when we smell a certain smell, it will also trigger a certain smell. Feelings and moods such as: coffee smells comforting or refreshing, lavender smells relaxing or sleepy. Relaxing scents reduce heart rate and skin conductance, while irritating scents have the opposite effect under the same conditions [3]. It is also generally believed that blindness and deafness have a high probability of reducing memory, but the onset of blindness or deafness can create serious social and personal impairments that can severely disrupt a person's life [4]. For example, hearing and visual sensory impairments in older adults may lead to cognitive decline and an increased risk of pathological impairments including dementia [5]. Therefore, hearing and vision cannot directly affect people's memories.

The paper aims to alyze the impact of Olfactory, Hearing and Visual Impairments on Alzheimer's Disease. This paper is divided into four parts. The first part analyzes the importance of smell and the relationship between depression and olfactory function. The second part analyzes the relationship between olfactory disturbance and Parkinson's disease and dementia and how olfactory function can be affected by other factors. The third part analyzes the relationship between visual impairment and Alzheimer's disease and the benefits of using retinal scan detection. The fourth part analyzes the importance of hearing and the dementia and various social problems caused by hearing impairment. This article can make people pay more attention to the decline of sensory ability, and hope that people can prevent Alzheimer's disease to some extent by detecting olfactory, visual and auditory dysfunction.

2. SMELL — A UBIQUITOUS SENSE

From the perspective of human evolution, the sense of smell is arguably the oldest human sense. Different

species, begin to regulate the interaction between the organism and the surrounding environment after birth [6]. From birth to youth and even adulthood, the sense of smell changes with the mother's odor, whether from social interaction or nutrition. For example, the odor emanating from the mammary gland area can trigger an appetite response in the newborn if the mother eats and chews during feeding. Pre-emptive practices can lead to dietary shifts at weaning, mother odor, and even mood regulation in children. Most studies on the primary olfactory cortex have focused on the piriform cortex, but most of the research has been done in rodents and there is little literature relevant to humans. Few people have studied other major olfactory structures, such as the anterior olfactory tubercle and olfactory nucleus, which form an intricate network that connects smell to other brain regions, such as those associated with memory, as well as those used for emotional processing and other sensory multisensory integration [7].

In daily life, smell is produced all the time, and smell is an "invisible" feeling that affects all aspects of daily life, whether it is from health nutrition or memory. Without smell, the fun of eating, eating habits and weight will be deeply affected. If the human sense of smell malfunctions, many people experience depression, anxiety and memory loss. This evidence can be explained anatomically because some parts of the brain are also involved in olfactory processing associated with these neurodegenerative diseases. Depressed patients have decreased olfactory acuity, especially compared to healthy subjects. Data supporting a link between smell and depression reports that patients with this disorder may also have odor recognition dysfunction [8].

In studies showing a potential link between depression and a sense of smell disorder, Pollatos and colleagues explored the relationship between depressive symptoms and olfactory function in subjects. There was a significant negative correlation between olfactory sensitivity and depressive symptoms, while olfactory discrimination was not related to depressive symptoms, which was described by the authors in the literature. The reason may be due to functional bias in brain structures [9].

Ramakers and colleagues believe that potential AD can be manifested in symptoms of anxiety, excitement and irritability [10]. Furthermore, anxiety in amnestic mild cognitive impairment (AMCI) increases the odds of transforming Alzheimer's disease (AD) beyond depression, memory loss, or neuroimaging markers of Alzheimer's disease (AD), the effects of atrophy [11]. Therefore, depression due to anosmia may be one of the risk factors for the development of Alzheimer's disease. In a word, through various experimental observations, an in-depth understanding of how olfactory function regulates and perceives odor in human life will greatly improve people's health.

3. THE EFFECTS OF OLFACTORY DISTURBANCE

To stop the global spread of the disease, much research in the past years has focused on non-invasive biomarkers such as senses, vision, hearing and smell [12]. Olfactory performance peaks at age 40 [13], and then gradually decreases with age. Furthermore, in different neurodegenerative diseases, such as Parkinson's disease and dementia in Alzheimer's disease (AD), olfactory decline is more severe than physical decline, and occurs in motor and cognitive impairments. Olfactory dysfunction can be used to detect early predictors of Parkinson's disease and dementia, which has been confirmed in a large number of studies [14].

There are many different tests available to judge anosmia, but the most common tests used to determine early AD and dementia include odor recognition, discrimination and threshold. In particular, it provides a more accurate assessment in diagnosing precursors to Alzheimer's disease. This can be explained by the following experiments. Olfactory information is continuously transmitted to the hippocampus. It projects from olfactory receptors to the olfactory bulb, to the primary olfactory cortex, to the inner the olfactory cortex (ERC). Olfactory dysfunction and atrophy in the ERC and hippocampus is one of the earliest pathological changes in the disease [15]. Hence it is shown that their execution requires more complex processing. Instead, odor thresholds are primarily associated with peripheral olfactory stimuli for olfactory perception in the neuroepithelium [16]and are influenced by changes in nasal anatomy.

Olfactory function may also be affected by other factors, such as smoking, chronic sinusitis. Trauma or viral infection may also trigger anosmia, which should be considered [17]. Quick, non-invasive, practical and self-testing are the advantages of psychophysical testing of olfactory function. In addition, they may enable patients to reduce other expensive tests, such as PET, especially when analyzed in conjunction with other tests [18]. To obtain reliable results, an important aspect to consider when performing odor recognition tasks is the different odors associated with different cultural backgrounds of people of different ages and from different regions [19] [20]. In addition to olfactory testing, sampling using an olfactory brush is a complementary procedure for assessing damage to neurodegenerative diseases and the integrity of the olfactory system. This multivariable method to study the olfactory system may provide useful supplementary results for the diagnosis of preclinical neurodegenerative diseases.

In conclusion, as with other senses, a comprehensive exploration of different aspects of smell will provide additional value for understanding the development and prevention of cognitive and memory defects, provide a

new direction for the treatment and application of Alzheimer's disease and dementia in the preclinical stage, and can be treated before the disease is irreversible.

4. EFFECTS OF VISUAL IMPAIRMENT

Patients performed significantly worse in tests of static spatial contrast sensitivity, visual memory, visual spatial structure, color, visual attention and motor shape [21]. Therefore, detection of these defects could play an important role in the early diagnosis of Alzheimer's disease in the asymptomatic stage. There are many retinal and non-retinal markers available to detect risk of pre-Alzheimer's disease. Some experiments reported that studies using optical coherence tomography (OCT) to analyze different eye structures reported retinal and optic nerve changes in patients with AD and MCI. Furthermore, Chiasseu and colleagues found that tau accumulation promotes impairment of anterograde axonal transport in vivo and identified this response as an early feature of neuronal dysfunction prior to retinal cell death in [22].

Particularly, the ocular structural changes and the accumulation of amyloid deposits that cause visual impairment in the early stage of AD may also change the composition of tears. Compared with healthy controls, AD subjects had significantly increased protein in tears [23]. While a retinal scan test can detect early neurodegenerative disease information, it requires medical help and is more difficult to obtain than a smell test in older people. In addition, tear biomarker diagnostics may become more widely accepted and used in the population, but there are few studies on tear and there are no approved and marketed products on the market.

5. EFFECTS OF HEARING IMPAIRMENT

Hearing loss is most pronounced and predominant in human aging, and it is estimated that approximately one-third of those affected are aged 65 years or older. Over 20% of respondents over the age of 60 had hearing problems, and over 30% of those over the age of 70 [24]. Older adults with hearing impairment have difficulty in decoding sounds and discriminating language from background noise as they age, leading to social isolation or depression, and It may even change the integrity of the cognitive process. Mild, moderate and severe hearing loss can correspondingly increase the risk of dementia by two, three or five times, which has been confirmed in some studies. It is suggested that there are several mechanisms of a causal relationship between hearing loss and dementia. They are sensory degradation or deprivation, allocation or consumption of cognitive resources, and social isolation or depression [25]. Furthermore, this deficit appears to be stronger in concurrent multisensory disorders, such as in the auditory and visual domains [26]. Auditory performance can be tested by a variety of measures such as auditory perception concussion, auditory language learning test and central auditory test.

In general, hearing loss alters the input of external sounds, which in turn alters the information of external stimulus, leading to a decrease in the overall awareness of time and space in the hearing-impaired individual. Together, these experimental results show that hearing loss may contribute to dementia and AD. However, further research is needed to address the key mechanistic links between auditory dysfunction and dementia/AD, thereby enabling the detection of hearing as one of the important predictive markers of early cognitive decline.

6. DISCUSSION

A growing body of data from different studies suggests that olfactory acuity, along with varying levels of hearing and vision detection, may help detect neuronal changes in intellectual and cognitive decline early, leading to more direct interventions that may be available long before cognitive impairment sets in. Multiple studies have shown that reduced olfactory function is an important predictor of cognitive decline and markers of neurodegeneration in non-demented elderly people. The sequential association between cognitive deficits and olfactory dysfunction has not been fully resolved. Tauopathy extensibility in limbic brain regions may first affect olfactory transmission and then cognitive processing. These observations provide further evidence for the association between smell and cognition and help identify subjects at higher risk of dementia through olfactory tests.

Since many patients with the disease experience symptoms of visual impairment, a growing body of research is also investigating whether the visual sensory system can represent or accurately identify early biological agents of dementia and cognitive decline. The central nervous system and retina share features in exhibiting the pathophysiological link between cognitive impairment and visual impairment. Furthermore, the accumulation of Alzheimer's disease markers in pre-dementia visual structures was revealed in advanced imaging techniques.

Overall, if sensory function is used as a reliable way to assess and identify risk for dementia, it will enrich a range of step-by-step screening protocols in clinical practice. In many countries, people are regularly checked for other chronic diseases (e.g., diabetes and hypertension), and odor testing is a convenient and simple way to monitor olfactory performance during aging and to be informed of risk for neuropathology. Odor testing is a potentially important non-invasive diagnostic measure which can inform patients, families and help physicians intervene. In addition, the

implementation of the smell test aims to improve preventive methods for cognitive and brain health. In the future, it is hoped that smell testing could become part of a personalized health plan that improves quality of life in the long term.

7. CONCLUSION

All in all, the impairment of smell, hearing and vision will have varying degrees of impact on cognitive impairment, intellectual disability and memory impairment, slowly evolving into Alzheimer's disease. Olfactory dysfunction is caused by ERC and hippocampal atrophy, which subsequently leads to cognitive impairment. Thinning of the retinal nerve fiber layer (RNFL), degeneration of the retinal ganglion cell layer (GCF), and changes in choroidal thickness and blood vessels can lead to visual impairment, which in turn affects cognitive function. Impairment of the central auditory nervous system can lead to hearing impairment, which can lead to depression, social isolation and slow development into cognitive impairment. Cognitive impairment is an important feature of Alzheimer's disease. The limitation of this paper is that there are few practical cases combined with analysis. The causes of Alzheimer's disease are very complex, so future studies will start with more factors and more cases to conduct in-depth data analysis.

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