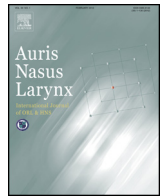




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Taste detection and recognition thresholds in Japanese patients with Alzheimer-type dementia

Takao Ogawa^{a,*}, Naoya Irikawa^a, Daijiro Yanagisawa^b, Akihiko Shiino^c,
Ikuo Tooyama^b, Takeshi Shimizu^a

^a Department of Otorhinolaryngology, Shiga University of Medical Science, Otsu, Shiga, Japan

^b Department of Molecular Neuroscience Research Center, Shiga University of Medical Science, Otsu, Shiga, Japan

^c Department of Biomedical MR Science Center, Shiga University of Medical Science, Otsu, Shiga, Japan

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ABSTRACT

Objective: Alzheimer-type dementia (AD) is pathologically characterized by massive neuronal loss in the brain, and the taste cortex is thought to be affected. However, there are only a few reports regarding the gustatory function of AD patients, and the conclusions of this research are inconsistent.

Methods: This prospective study enrolled 22 consecutive patients with mild to moderately severe Alzheimer-type dementia (AD) with mean age of 84.0 years, and 49 elderly volunteers without dementia with mean age of 71.0 years as control subjects. The control subjects were divided into two groups according to age: a younger group ($N = 28$, mean age: 68.5) and an older group ($N = 21$, mean age: 83.0). The gustatory function was investigated using the filter paper disc method (FPD) and electrogustometry (EGM).

Results: The gustatory function as measured by the FPD was significantly impaired in patients with AD as compared with age-matched control subjects; no such difference was found between the younger and the older control groups. On the other hand, as for the EGM thresholds, there were no differences between the AD patient group and the age-matched controls.

Conclusion: The FPD method demonstrated decreased gustatory function in AD patients beyond that of aging. On the other hand, EGM thresholds did not differ between the AD patient group and the age-matched controls. These results suggest that failure of taste processing in the brain, but not taste transmission in the peripheral taste system, occurs in patients with AD.

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1. Introduction

Alzheimer-type dementia (AD) is one of the most frequent neurodegenerative disorders in adults aged 65 years and older, and the annual incidence of Alzheimer's disease increases after 65 years of age by approximately 0.18–3.8% during the

following 20 years [1]. With the population of older adults increasing, the number of cases with AD will increase worldwide. AD is characterized clinically by progressive memory loss and pathologically by massive neuronal loss in the brain, including losses in the orbitofrontal cortex and limbic cortex. Afferent taste stimuli run through the limbic cortex, including the thalamus, the opercular cortex, the insular cortex, the amygdalae and the hippocampus, and then reach the orbitofrontal cortex. Thus, the taste cortex is thought to be affected in AD patients. However, there are only a few reports regarding the gustatory function of AD patients, and the

* Corresponding author at: Department of Otorhinolaryngology, Shiga University of Medical Science, Seta-tsukinowa, Otsu, Shiga 520-2192, Japan. Tel.: +81 77 548 2261; fax: +81 77 548 2783.

E-mail address: takao971@belle.shiga-med.ac.jp (T. Ogawa).

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conclusions of these reports are inconsistent. It is thought that a decrease of gustatory function in AD patients may not be so severe and that the methods for assessing the gustatory function vary from study to study. It has been reported that most patients with AD have an eating disturbance and furthermore, that half of these occur in the early stages of AD [2]. A better understanding of the gustatory function of AD patients may promote good health through an increased understanding of changes in their eating behaviors.

The filter paper disc method (FPD) and electrogustometry (EGM) are widely used in clinical settings in Japan for assessing gustatory function in detail. In the present study, the gustatory function of AD patients in Japan was investigated using these methods. In addition, gustatory changes during the elderly stages of life were also investigated.

2. Material and methods

2.1. Subjects (Table 1)

This prospective study included 22 consecutive patients with AD, mean age 84.0 ± 5.96 years, and 49 elderly volunteers without dementia, mean age 71.0 ± 8.3 years, as controls. Clinical characteristics of these subjects are shown in Table 1. Patients with AD were recruited from a nursing home, “Ohmi Furusato En”, in Hikone City, Shiga Prefecture, Japan. AD was diagnosed with the use of the DSM-IV TR criteria by two neurologists. A brief cognitive assessment using the Mini-Mental Status Examination (MMSE) was also performed. Patients scoring less than 10 on the MMSE were excluded from this study in order to avoid the possibility of unreliable answers concerning gustatory tests. Elderly volunteers (mean age: 71.0 ± 8.3 years, 60–93 years, 13 males and 36 females) without dementia were included as controls; these subjects were divided into two groups according to age: the younger group ($N = 28$, mean age: 68.5 ± 3.43 years, 60–73 years, 8 males and 20 females) and the older group ($N = 21$, mean age: 83.0 ± 5.74 years, 74–93 years, 5 males and 16 females). All subjects had a good nutritional status. The drug use was examined by the drug questionnaire or the chart review. The drug use of each group was shown in Table 2. The rate of current drug use was 71.4%, 85.7% and 100% in the younger group, the older group and the AD group, respectively. All AD patients were taking anti-Alzheimer drugs.

All subjects were screened to exclude those with relevant co-morbidities that can affect gustatory function (e.g. head

Table 2

The drug use of each group.

	Control subjects ($N = 49$)		AD ($N = 22$)
	Younger ($N = 28$)	Older ($N = 21$)	
The rate of drug use (%)	71.4%	85.7%	100%
Antihypertensive drugs (N)	8	10	14
Hypoglycemic drugs (N)	4	4	2
Stomach medicines (N)	3	2	5
Antihyperlipidemic drugs (N)	2	2	0
Antiarrhythmic drugs (N)	0	0	2
Anti-Alzheimer drugs (N)	0	0	22
Other drugs (N)	5	5	8

traumas, strokes, thyroid deficiencies, liver dysfunction, renal dysfunction). The present study was conducted according to the guidelines of the Declaration of Helsinki and the study protocol was approved by the Ethics Committee of Shiga University of Medical Science. Informed consent was obtained from the subject, or from the legally authorized representative if appropriate.

2.2. Gustatory function tests

Gustatory function tests were conducted by three trained examiners using the FPD and EGM. A test kit (Taste Disk[®], Sanwa Kagaku, Nagoya, Japan) was used for the FPD, and the EGM device used was the TR-06 (Rion Co., Ltd., Tokyo, Japan) [3]. These two types of tests are routinely used for the evaluation of dysgeusia in clinical settings in Japan. Taste stimuli were provided on the lateral side 2 cm from the tip for the anterior stimulus, and at the lateral side of the circumvallate papillae for the posterior stimulus. Each AD patient was able to understand the instruction and to perform the requested tasks properly.

Four basic tastes (sweet, sucrose; salty, sodium chloride; sour, tartaric acid; and bitter, quinine hydrochloride) were assessed by the FPD. Each test substance was applied at 5 concentration grades, with grade 1 being the lowest and grade 5 the highest, as follows: 8.8, 74, 292, 584, and 2336 mM for sucrose; 51.4, 214, 856, 1714, and 3420 mM for sodium chloride; 1.3, 13.3, 133, 266, and 532 mM for tartaric acid; and 0.025, 0.5, 2.5, 12.5, and 100 mM for quinine hydrochloride. Filter paper discs measuring 5 mm in diameter were soaked in each solution and then one disc was placed on the anterior or posterior part of the left tongue. Before each taste administration, the subject's mouth was rinsed with water. The test was started from the lowest concentration level (grade 1) and then proceeded from grade 2 to grade 5. A forced choice was made from six possible answers: sweet, salty, sour, bitter, unidentifiable taste, or no taste. The lowest concentration level at which a subject correctly answered was recorded as the recognition threshold. If use of the highest concentration (grade 5) did not yield a correct answer, the recognition threshold was graded as 6. The lowest concentration at which a subject detected any taste was recorded as the detection threshold. If no taste was

Table 1

Clinical characteristics of control subjects and AD patients.

	Control subjects ($N = 49$)		AD ($N = 22$)
	Younger ($N = 28$)	Older ($N = 21$)	
Age (mean age \pm SD)	68.5 ± 3.4	83.0 ± 5.7	84.0 ± 5.9
Male:female	8:28	5:16	4:19
Smoker (N)	2	0	3
MMSE score	–	–	17.5 ± 3.8

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