Performances in a Picture Description Task in Japanese Patients with Alzheimer's Disease and with Mild Cognitive Impairment

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Background & Objectives: To determine the earliest changes in language function in participants with Alzheimer's disease, performances in various language tests were compared between patients with amnestic mild cognitive impairment (MCI) or with mild Alzheimer's disease (AD) and healthy elderly individuals. ***Methods:*** Language function was studied in patients with amnestic MCI (n = 20) and with mild AD (n = 27) and was compared with normal cognition in elderly individuals (NC, n = 20) using the Communicative Abilities in Daily Living (CADL), a confrontation naming test, and the Boston Cookie-Theft picture description task. The analysis for the picture description task was divided into two aspects: syntactic and semantic. ***Results:*** 1) In the CADL and confrontation naming tests, the mild AD group performed worse than did the NC and MCI groups. However, there was no significant difference between the NC and MCI groups. 2) In the Cookie-Theft picture description task, performances of the MCI and AD groups were non-informative, inefficient and empty in semantic aspect compared to the NC group. However, no differences were observed between the three groups on syntactic aspect. ***Discussion & Conclusion:*** The picture description task is useful for detecting subtle language deficits in patients with amnestic MCI. This study demonstrated that the picture description task can sensitively detect complex integrated communication abilities, although it is very quick and simple to administer. (***Korean Journal of Communication Disorders*** 2009;14;326-337)

Key Words: Alzheimer's disease, amnestic mild cognitive impairment, language disorders, Communicative Abilities in Daily Living, confrontation naming, Cookie-Theft picture description, discourse

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Ⅰ. Introduction

Discourse research is currently one of the richest areas of findings in neuropsychology and neurolinguistics for eliciting diagnostic clues about the intricate interactions between brain, cognition, and language. Discourse provides a window into the flow or misflow of information that may occur in early Alzheimer's disease (AD) as the speaker translates thoughts into language (Chapman et al., 2002). Verbal picture description is one of the most used discourse tasks, and is sensitive to language deficits in patients with early AD (Croisile et al., 1996). The language of patients with AD is globally non-informative and characterized by selective impairments in lexical-semantic processing compared to the relative sparing of syntactic and phonological aspects (Carlomagno et al., 2005; Croisile et al., 1996; Giles, Patterson & Hodges, 1996; Glosser & Deser, 1991; Groves-Wright et al., 2004; Hier, Hagenlocker & Shindler, 1985; Tomoeda et al., 1996; Vuorinen, Laine & Rinne, 2000). Studies on discourse in Japanese-speaking patients with AD have also demonstrated that the amount of information and efficiency of description were the most sensitive features for discriminating between cognition-matched normal individuals and those with AD (Sakuma et al., 1989; Shimada et al., 1998).

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However, very few studies have examined discourse in patients with mild cognitive impairment (MCI) or with minimal AD and the results are inconsistent. Forbes-McKay & Venneri (2005) reported that subtle language deficits were found even with minimal stage of AD and discourse was already non-informative, inefficient, and empty. However, in the study of Bschor, Kühl & Reischies (2001) no difference was found in discourse function between subjects with MCI and without cognitive impairment.

MCI is an intermediate state between normal cognition and dementia, and has become increasingly well defined and extensively studied as the prodrome and predictor of dementia (Farias et al., 2006). MCI appears to represent a transition between normal aging and early dementia, since in clinical settings patients with MCI show rates of conversion to dementia of about 12 % per year (Petersen et al., 2001). Many researchers speak to the importance of trying to identify cognitive impairments as its earliest stage, because early identification may lead to prevention of dementia. Patients with MCI present with memory complaints of unknown etiology and perform below the norms for age and educationon neuropsychological memory tests, but have relatively normal general cognitive function, maintain activities of daily living, and do not have dementia (Petersen et al., 1999). These criteria require that the general cognitive function is preserved, but the presence of mild deficits in other cognitive domains is not specifically excluded. In fact, the possibility that patients with MCI may have dysfunction of multiple cognitive domains has been clearly recognized (Cuetos et al., 2007; Ribeiro, de Mendonca & Guerreiro, 2006). Ribeiro, de Mendonca & Guerreiro (2006) suggested that patients with MCI frequently had deficits in cognitive domains beyond memory. Their findings documented as much as 68.7 % of the patients had deficits in temporal orientation, 30.2 % had deficits in semantic fluency, 33.7 % in the Token test, 23.4 % in calculation, and 23.9 % in motor initiative. However, the precise concept and character of MCI in various clinical settings remain controversial (Petersen, 2004). MCI is heterogeneous group, and the term of 'MCI' can be used quite loosely, which tends to confuse the underlying concept. In fact, the clinical criteria for diagnosis of MCI vary considerably from one study to another (Portet et al., 2006). Therefore, the present study included only patients with amnestic MCI, defined on the basis of the tests generally used for the early diagnosis of AD.

The main purposes of this study were to identify the characteristic impairments of language in patients with mild AD and with amnestic MCI, compared with cognition-matched normal individuals, using the CADL, a confrontation naming test, and the Boston Cookie-Theft picture description task. The CADL was designed to provide a quick and valid assessment of communication skills in everyday activities by simulating daily life activities and is useful for estimating the patient's effectiveness in daily life (Fromm & Holland, 1989). The version of the CADL-Japanese includes the normative data of patients with dementia. Especially, CADL is a useful tool to evaluate patients with AD, because the demands on memory are small compared to overall aphasic tests. And, various studies of language disorders in patients with mild AD have focused on the 'anomic' features (Carlomagno et al., 2005). However, these tests are neither necessary for the diagnosis of MCI nor useful in identifying minimal AD (Testa et al., 2004). Therefore, we expected that language deficits would be more readily identified in the picture description task including complex cognitive processes, rather than the CADL and confrontation naming test.

Ⅱ. Methods

1. Subjects

Twenty-seven patients with mild AD and twenty patients with amnestic MCI were recruited from patients examined at Tohoku University Hospital

and clinics for cognitive impairment, and twenty healthy volunteers were recruited from the community. Because language changes associated with aging follow various patterns depending on sex and education level (Ardila & Rosselli, 1996), we matched the sex and education level of subjects as well as age between the three groups. All subjects were right-handed and non-institutionalized, and all were Japanese-speaking. All patients were examined comprehensively by behavioral neurologists. Standard neuropsychological examinations, routine laboratory tests, electroencephalography, and cranial magnetic resonance imaging were performed to exclude patients with causes of cognitive impairment other than AD, including cerebrovascular diseases, frontotemporal degeneration, dementia with Lewy bodies, progressive supranuclear palsy, and corticobasal degeneration. The patients with AD met the clinical criteria of the NINCDS-ADRDA (National Institute for Neurological and Communicative Disorders and Stroke – Alzheimer's Disease and Related Disorders Association) for the diagnosis of probable AD (McKhann et al., 1984). Mild AD was defined as a score greater than or equal to 18 on the Mini-Mental Stare Examination (MMSE) and rating of 0.5 or 1 on the Clinical Dementia Rating (CDR) (Morris, 1993). The patients with MCI met the 1999 criteria for amnestic MCI (Petersen et al., 1999). The rating scale for operational criteria includes the following: Memory complaint corroborated by an informant (0.5 for CDR memory score), progressive onset, memory impairment relative to healthy age-matched people (below 1.5 standard deviations on the logical memory score of the Japanese version of Wechsler Memory Scale-Revised (Sugishita, 2001)), typical general cognitive function (24 or more on the MMSE), largely intact activities of daily living (0 or 0.5 for any CDR score), no clinical dementia, and exclusion of other disorders that may cause cognitive impairment by adequate tests, including neuroimaging, as described above.

2. Language Tasks

2.1. Communicative Abilities in Daily Living (CADL)

We used the shortened version of the CADL-Japanese in this study (Watamori et al., 1990) which has five levels of scores. The CADL was administered to patients with mild AD and with amnestic MCI. In the normative data on the CADL-Japanese version, the scores of all normal subjects were within the range of the highest level. Therefore, we did not administrate CADL to elderly individuals with normal cognition (NC).

2.2. Confrontation naming test

We used the naming test called the Test of Lexical Processing in Aphasia (TLPA) in Japanese (Fujita et al., 2000) which comprise 90 black and white line drawings of familiar objects, animals, plants, places, and 10 color cards. The score is the number of correct responses. The TLPA was administered to all subjects including the elderly individuals with NC.

2.3. Picture description task: The Boston Cookie-Theft picture

The Boston Cookie-Theft picture (Goodglass & Kaplan, 1983) was used to obtain information about the patient's ability to make sense of a visual situation and to formulate and produce cohesive and topically relevant narratives (Brookshire, 2003).

The subjects were shown the Boston Cookie-Theft picture, and asked to "report everything happening in the picture." The report was recorded on tape and later transcribed. All data was transcribed by two researchers, the inter-judge reliability (ratio of agreement) was 97.3 %. The analysis procedure (Appendix) was consistent with prior studies for brain-damaged individuals (Groves-Wright et al., 2004; Hier, Hagenlocker & Shindler, 1985). The analysis is divided into two aspects, syntactic and semantic. Syntactic aspects were measured by total number of sentences, total number of phrases, and number of phrases per

sentence. Semantic aspects were measured by the number of main concepts (mother, washing dishes, the boy or the children, falling down, the girl or the sister, stealing or taking cookies, the water running onto the floor, and the inattention of the mother), narrative efficiency (adequate description and sequencing of events, narrative conciseness, and relevance of information to the image stimulus), and information units (water, kitchen, washing, stool, get, fall down, sink, and is on).

2.4. Analyses

We used the SPSS 11.0 version for all statistical analyses. To compare the age and education level between the three groups (NC, amnestic MCI, and mild AD), one-way analyses of variance (ANOVA) were employed. And, in the MMSE and other language test scores, the Kruskal-Wallis ANOVA (nonparametric test) was used to compare these test scores between the three groups, and post hoc Mann-Whitney U tests with Bonferroni adjustment were applied when needed. The Mann-Whitney U test was also used to compare in the CADL in the amnestic MCI and mild AD groups. Significance was set at $p < .05$.

Ⅲ. Results

1. Demographic data of the three groups

No differences were observed between the three groups in age ($F_{(2, 64)} = 1.944$, $p = .151$), education ($F_{(2, 64)} = 2.165$, $p = .123$), and sex ($\chi^2 = 2.244$, $p = .326$). The MMSE showed significant differences between the groups by the post hoc test, with the NC group scoring best followed by the MCI group and the mild AD group. And the scores of MCI and AD groups were different from each other ($p < .001$) (Table 1).

Table 1. Demographic data of the three groups

	Mean (±SD)[a]		
	NC[b]	amnestic MCI[c]	mild AD[d]
N[e] (male/female)	20 (10/10)	20 (9/11)	27 (8/19)
Age (yrs)	75.8 (±5.3)	77.2 (±5.8)	79.1 (±4.8)
Education (yrs)	10.5 (±1.8)	9.8 (±1.9)	9.3 (±1.6)
MMSE[f]	27.8 (±1.9)	25.2 (±1.5)*,g)	20.4 (±2.1)*,g),h)

[a] SD: standard deviation, [b] NC: normal cognition,
[c] MCI: mild cognitive impairment,
[d] AD: Alzheimer's disease, [e] N: number,
[f] MMSE=Mini-Mental State Examination,
[g] Significantly different from NC,
[h] Significantly different from MCI
* $p < .05$

2. Language tasks

2.1. CADL

The CADL score was significantly lower in the mild AD group than in the amnestic MCI group ($U = 143.5$, $p = .001$) (Table 2). Most MCI patients (19/20) were within the range of the highest CADL level (level 5).

2.2. Confrontation naming test

The confrontation naming test scores were significantly different by post-hoc analysis, with the mild AD group showing worse performance than the NC and amnestic MCI groups ($U = 61.5$, $p < .001$; $U = 92.5$, $p < .001$, respectively) (Table 2). There was no significant difference between the NC and MCI groups ($U = 149.5$, $p = .174$).

Table 2. Results of the CADL and confrontation naming test

	Mean (±SD)[a]		
	NC[b]	amnestic MCI[c]	mild AD[d]
CADL[e]	5.0 (±0)	4.95 (±0.22)	4.48 (±0.51)*,f)
Confrontation naming test	97 (±2.2)	95.3 (±8.6)	86.5 (±8.6)*,f),g)

[a] SD: standard deviation, [b] NC: normal cognition,
[c] MCI: mild cognitive impairment,
[d] AD: Alzheimer's disease,
[e] CADL: communicative abilities in daily living,
[f] Significantly different from NC,
[g] Significantly different from MCI
* $p < .05$

2.3. The Boston Cookie-Theft picture description task

All indices of the syntactic aspect, total number of sentences, total number of phrases, and number of phrases per sentence, were comparable between the three groups, but all indices of the semantic aspect, number of main concepts, narrative efficiency, and information units, were significantly different by the post-hoc test, with the amnestic MCI and with mild AD groups showing worse performance than the NC group (main concepts: $U = 94.0$, $p = .004$; $U = 48.5$, $p < .001$, narrative efficiency: $U = 44.5$, $p < .001$; $U = 43.0$, $p < .001$, information units: $U = 90.5$, $p = .002$; $U = 104.0$, $p < .001$, respectively), but no significant difference between the amnestic MCI and mild AD groups (Table 3).

Ⅳ. Discussion and Conclusion

Our main purpose was to identify the language impairment characteristic of spontaneous speech in patients with amnestic MCI and with mild AD, and to identify the features that differentiate patients with amnestic MCI from elderly individuals with NC. As we hypothesized, language deficits were more readily identified by the picture description task rather than the functional language tests such as the CADL and the confrontation naming test.

1. CADL and confrontation naming in patients with amnestic MCI and with mild AD

The CADL and the confrontation naming test detected reduce performance only in the mild AD group. There was no significant difference between the amnestic MCI and NC groups. These results suggest that these functional language tests cannot detect subtle language impairment in patients with amnestic MCI, although these tests have been widely used for assessing language deficits in patients with advanced AD as well as very early AD and MCI. In the study of comparison of CADL performance between patients with AD and normal elderly individuals, Fromm & Holland (1989) demonstrated that language communicative ability was impaired in patients with mild and moderate AD. Our findings support the findings for patients with mild AD, but most patients with amnestic MCI (95 %) achieved the highest level on the CADL. This result suggests that impairment of functional communication in activities of daily living in patients with amnestic MCI cannot be detected by the CADL. Like previous studies (Bayles & Tomoeda, 1983; Kirschner, Webb & Kelly, 1984; Shuttleworth & Huber, 1988), the present study demonstrated that confrontation

Table 3. Results of the Boston Cookie-Theft picture description task

		Mean (±SD)[a]		
		NC[b]	amnestic MCI[c]	mild AD[d]
Syntactic aspects	Total number of sentences	7.8 (± 3.4)	7.1 (± 5.3)	7.4 (± 3.8)
	Total number of phrases	37.4 (±16.8)	33.1 (±16.5)	31.0 (±16.2)
	Number of phrases per sentence	5.0 (± 1.7)	5.6 (± 2.5)	4.5 (± 1.8)
Semantic aspects	Number of main concepts	6.5 (± 1.0)	4.9 (± 2.0)[*,e]	3.9 (± 1.7)[*,e]
	Narrative efficiency	2.5 (± 0.6)	1.3 (± 0.7)[*,e]	1.0 (± 0.7)[*,e]
	Information units	5.5 (± 1.1)	4.2 (± 1.4)[*,e]	3.9 (± 1.5)[*,e]

[a] SD: standard deviation, [b] NC: normal cognition, [c] MCI: mild cognitive impairment, [d] AD: Alzheimer's disease,
[e] Significantly different from NC
[*] $p < .05$

naming is defective in patients with mild AD. On the other hand, confrontation naming in patients with amnestic MCI was comparable to that of normal individuals. This suggests that the naming test cannot detect subtle language deficits in patients with amnestic MCI, as found in previous studies (Bschor, Kühl & Reischies, 2001; Giles, Patterson & Hodges, 1996). Chapman et al. (2002) suggested that the language deficit in patient with AD is more obvious in language tasks including complex cognitive processes. In fact, some researchers demonstrated that language deficits, especially in verbal fluency task and written language tasks, appeared even in patients with MCI (Fillenbaum et al., 2005; Garrard et al., 2005). Especially, verbal fluency task is known to be the most sensitive task for discriminating minimal AD or MCI from normal cognition elderly individuals (Henry, Crawford & Phillips, 2004). The verbal fluency task, in which subjects are required to produce words of a given category, involves complex cognitive processes including a linguistic component as well as several other cognitive processes, such as attention, working memory, and ability to generate visual images (Chertkow & Bub, 1990). The involvement of these multiple processes makes it difficult to interpret the impaired verbal fluency in dementia straightforwardly as a breakdown of semantic memory (Adlam et al., 2006). That is, the high sensitivity of this task for cognitive impairment is most probably due to the diversity of the cognitive domains involved.

2. Picture description in patients with amnestic MCI and with mild AD

The Boston Cookie-Theft picture description task detected no differences in the indices of the syntactic aspect, whereas significant differences were present in the indices of the semantic aspect between the three groups. Patients with amnestic MCI and with mild AD were comparably affected in the semantic aspect, as the output of patients with both amnestic MCI and mild AD was non-informative and inefficient. This finding supports our hypothesis that language deficits in amnestic MCI would be more readily identified by the picture description task. Patients with AD have less severe difficulties in syntax than in semantics (Hier, Hagenlocker & Shindler, 1985). The linguistic deficit of patients with AD is initially at the lexical-semantic level and later at the phonological and syntax levels (Honer et al., 1988). Therefore, semantic deficits are likely to be present even in the prodromal or mild stage of AD and syntactic deficits, even milder, finally appear in the advanced stage.

The ability to organize information at the supra-sentential level is impaired in AD despite only a slight deficit in lexical encoding of information (Glosser & Deser, 1991). This impairment is attributable to a cognitive deficit identified as 'weak central coherence,' and critically depends on the quality of general executive functioning (Feyereisen, Berrewaerts & Hupet, 2007). An unexpected finding of the present study was that the performances of the amnestic MCI group were comparable to those of the mild AD group, suggesting that the deficit of semantic level is readily identified in the earliest stage of the disease, and can be revealed by complex tasks such as the picture description task.

Complex language such as discourse requires setting a language plan, maintaining activation of the basic language operation that are going to be recruited for the lexical, phonological and essential grammatical and syntactical structure of any utterance, and monitoring the process of the speech. Therefore, the approach of network interactions between brain regions associated with language processing is needed. In the study related to these functional interactions, Horwitz & Braun (2004) demonstrated that left anterior and bilateral posterior perisylvian regions interact strongly with one another during spontaneous narrative production. And, Alexander (2006) suggested that prefrontal cortex and contralateral posterior neocelebellum drives a neural system that executes complex, time-constrained, attention-based

recruitment of procedures for language execution. However, neural basis of connected speech needs to be further investigated.

The picture description task is a useful tool to evaluate patients with AD for two reasons: the demands on memory are small, because the story content is displayed statically in front of the patient, and the task facilitates discourse analysis, because the target contents can be derived from the picture (Duong, Tardif & Ska, 2003). Additionally, the picture description task is simple and requires less than a few minutes, so is not a burden to the patient. Therefore, the picture description task is very suitable for detecting subtle language deficits in patients with amnestic MCI and with mild AD.

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〈Appendix〉

Syntactic aspects	Total number of sentences	
	Total number of phrases	
	Number of phrases per sentence	
Semantic aspects	Main concepts (maximum score 8) (Hier, Hagenlocker & Shindler, 1985)	- mother - washing dishes - the boy or the children - falling down - the girl or the sister - stealing or taking cookies - the water running onto the floor - the inattention of the mother
	Narrative efficiency (maximum score 3) (Groves-Wright et al., 2004)	- adequate description and sequencing of events - narrative conciseness - relevance of information to the image stimulus
	Information units (maximum score 8) (Groves-Wright et al., 2004)	water, kitchen, washing, stool, get, fall down, sink, is on

일본인 알츠하이머병 환자와 경도인지장애 환자의 그림설명하기 과제의 수행

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배경 및 목적: 알츠하이머병 가장 초기의 언어기능 손상의 특징을 알아보기 위해 알츠하이머병 전단계로 알려져 있는 건망형 경도인지장애(mild cognitive impairment: MCI, 이하 MCI) 환자와 경도 알츠하이머병(Alzheimer's disease: AD, 이하 AD) 환자들에게 언어 검사를 실시하여 이를 정상 고령자와 비교하였다. **방법:** 본 연구에서는 일본인을 대상으로 하였으며, MCI 환자 20명, 경도 AD 환자 27명, 정상고령자 20명이 참여하였다. 참여자들에게 대면이름대기 과제(Test of Lexical Processing in Aphasia (TLPA-Japanese))와 Communicative Abilities in Daily Living (CADL-Japanese), 그림설명하기 과제(The Boston Cookie-Theft picture)를 실시하였다. 그림설명하기 과제의 수행은 구문적/의미적으로 분석하였다. **결과:** 1) 대면이름과제와 CADL에서 경도 AD 환자들은 MCI 환자나 정상 고령자에 비해 유의미하게 수행이 낮은 반면, MCI 환자들은 정상 고령자와 유의한 차이가 없었다. 2) 그림설명하기 과제의 수행 결과 의미적인 측면에서 경도 AD와 MCI 환자는 정상 고령자에 비해 정보량이 부족하고, 비효율적이며, 공허한(empty) 내용의 언어를 사용하는 것으로 나타났다. 그러나 구문적인 측면에서는 경도 AD 환자를 포함한 3집단에 유의한 차이가 나타나지 않았다. **논의 및 결론:** 본 연구에서 MCI 환자의 미세한 언어 기능의 손상을 검출 할 수 있는 과제는 그림설명하기 과제(의미적 측면)뿐이었다. 그림설명하기 과제는 실시와 분석이 간단함에도 불구하고 다양한 의사소통 기능을 통합적으로 평가할 수 있는 유용한 과제임을 알 수 있다. 『**언어청각장애연구**』, **2009;14(3); 326-337.**

핵심어: 알츠하이머병, 경도인지장애, 언어장애, 대면이름대기, Communicative Abilities in Daily Living, Cookie-Theft picture description, 담화

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