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The connection between MCI and Alzheimer disease: neurocognitive clues

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Background/aim: Mild cognitive impairment (MCI) is defined as a pathological stage between 'healthy aging' and 'dementia'. In this study, cases of MCI were compared with early-stage Alzheimer disease (AD) and age-related cognitive decline (ARCD) in terms of cognitive profiles in order to find a connection between MCI and AD.

Materials and methods: Patients who were comparable in terms of age and sex and who met the criteria of MCI, ARCD, or early-stage AD were included in the study retrospectively. Wechsler memory scale, executive function, visuospatial, language, and memory tests were applied to all subjects. Additionally, all patients completed a mini-mental state examination test, geriatric depression scale, and activities of daily living scale.

Results: Complex attention tests and long-term memory tests were more impaired in MCI patients when compared with ARCD. However, there were no significant differences between the MCI and ARCD cases in activities of daily living. Memory and executive functions were more deteriorated in patients with AD in comparison to MCI.

Conclusion: During the follow-up period of ARCD, impairment in orientation, complex attention, and long-term memory should suggest the diagnosis of MCI. When personal information and executive functions are affected in MCI, AD should be carefully considered.

Key words: Dementia, MCI, cognitive tests, forgetfulness

1. Introduction

Mild cognitive impairment (MCI) is a partial decline in cognitive functions in which activities of daily living are not affected; it is considered to be a period prior to the development of dementia (1). Several studies indicated that individuals over the age of 60 have an increased risk for developing dementia, at about 1%–2% for each year. However, this rate is 10%–15% for MCI patients (2). Age-related cognitive decline (ARCD) is a nonpathological decline in memory associated with normal aging (3). Early diagnosis and discrimination of MCI from ARCD is important for the patient's quality of life. Although the mini-mental state examination (MMSE) test is successfully used in the diagnosis of dementia, it may fail to diagnose MCI. Therefore, there is a need for the use of additional cognitive tests (4). In this study, the cognitive profile, activities of daily living (ADL) scale, and depression scores of MCI patients were compared with early-stage of (Alzheimer disease) AD and ARCD groups to determine the differences.

2. Materials and methods

A total of 126 subjects were included in the study. All patients had had routine blood tests, brain scans (computed tomography or magnetic resonance imaging), and a cognitive test battery. Subjects who were similar in age, sex, and educational level were grouped as follows: 38 patients were diagnosed with MCI according to the Petersen criteria (5), 56 were diagnosed with early-stage AD, and 32 were diagnosed with ARCD according to DSM-IV and NINCDS-ADRDA criteria (6). Secondary dementia and psychiatric diseases were excluded.

2.1. Contents of cognitive tests

2.1.1. Memory

All of the patients completed the following parts of the Wecshler memory scale (WMS): WMS-1, current and personal information; WMS-2, orientation; WMS-4, story tracking; WMS-5, backward and forward digit span; WMS-6, short-term and long-term memory. Executive functions were evaluated with clock drawing, proverb interpretation, Luria drawings, category fluency, and Stroop test (7,8).

2.1.2. Visuospatial functions

Visuospatial functions were evaluated with Benton facial recognition, line orientation, and copying. Language function was evaluated with the Boston naming test (9).

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2.1.3. Depression

Depression was evaluated by a geriatric depression scale (10).

2.1.4. Activities of daily living

Daily life activities were examined with an ADL scale (11).

2.2. Statistical analysis

For statistical analysis, SPSS 15.0 was used. To compare the nonparametric variables of the three groups, the Kruskal–Wallis test and Levene test were used. The Mann–Whitney U test was used for parametric variables such as cognitive tests, ADL, and geriatric depression scores of each group. $P < 0.05$ was considered statistically significant.

3. Results

The mean age, female/male ratio, and mean years in education in the MCI, AD, and ARCD groups were 71.5 ± 7 years, 23/15, and 9.6 ± 12.4 years; 74 ± 6 years, 37/19, and 7.2 ± 5 years; and 70.9 ± 8 years, 19/13, and 8.8 ± 5 years, respectively. There were no statistically differences in demographic data between the groups ($P = 0.17$, 0.82, and 0.09).

When comparing ARCD and MCI cases, there was no significant difference among the parameters of personal and current information, forward digit span, short-term visual memory, and language functions. Although MMSE scores between the two groups did not differ, tests that required more attention were found to be significantly different (Table 1). Several test parameters including MMSE test and ADL test were significantly different between patients with early-stage AD and MCI (Table 2). There were no significant differences in depression scores among the groups.

Table 1. The comparison of neurocognitive test parameters between mild cognitive impairment (MCI) and age-related cognitive decline (ARCD).

Neurocognitive test	MCI (n = 38)	ARCD* (n = 32)	P*
Orientation	4.5 ± 0.7	4.8 ± 0.3	0.04
Backward digit span	7 ± 4.2	9.1 ± 4.4	0.03
Verbal long-term memory	12.4 ± 4.7	15.2 ± 4.5	0.008
Proverb interpretation	8.3 ± 1.3	8.9 ± 0.5	0.01
Category fluency	14.1 ± 4.9	17.9 ± 5.4	0.001
Verbal fluency	20.5 ± 13.9	26.7 ± 13.3	0.01
Stroop test	66.2 ± 21.6	54 ± 15	0.007
Visual long-term memory	5.4 ± 3.1	7.8 ± 3.8	0.01

* $P < 0.05$.

4. Discussion

MCI, defined in 1999, is a heterogeneous group and has two subtypes: single-domain and multiple-domain. The clinical course may vary. A large proportion of patients progress to AD, while a smaller group develops other types of dementia. Some MCI patients may remain stable, or their cognitive decline may be reversible. According to the Mayo Clinic Alzheimer's Research Center, the AD conversion rate is around 10%–15% per year (12). This rate was announced to be 6%–25% per year by the American Academy of Neurology (13). The development of cognitive deficits in AD occurs in three main phases. In the first stage, memory is affected. During this period, episodic memory impairment is the prior problem, which is caused by failure to record new information (14). The learning of new information is thus reduced. The next step of the impairment is the effect on daily life. In this early clinical stage, episodic memory as well as visuospatial perception, recognition, verbal fluency, and naming are significantly affected (15,16). Some studies point out that there is no cognitive difference between MCI patients and healthy controls (17). However, upon detailed neuropsychological assessment, MCI patients show learning and memory impairment compared to nondemented healthy subjects (18). The examination of long-term memory is especially suggested as the most important criterion to compare these groups (19). In our study, long-term memory was found significantly affected in the MCI group as compared to the ARCD group. Some studies found attention to be impaired in MCI (20). Ribeiro et al. also pointed out that language and verbal fluency are affected as well as memory and attention in MCI (21). Our study confirms these results.

Impairment in attention follows memory decline in AD (22). While simple attention is affected in late stages of AD, complex attention and distraction are affected in the early stages (23). Our study also emphasized that although there was no difference in simple attention between AD and MCI groups, complex attention parameters such as backward digit span and story tracking and interference in Stroop tests were significantly affected in the early-stage AD group.

In studies of patients with early-stage AD, the most important criterion is suggested to be delayed recall when comparing MCI with AD (24,25). In our study, both verbal and visual delayed recall were found significantly impaired in the AD group compared to the MCI group.

In studies mentioning executive functions, proverb interpretation and clock drawing are significantly impaired in early stages of AD while perseveration is reported in late stages (23,24,26). In our study, executive functions were found significantly impaired in the AD group as compared

Table 2. The comparison of neurocognitive test parameters between Alzheimer disease (AD) and mild cognitive impairment (MCI).

Neurocognitive test	AD (n = 56)	MCI (n = 38)	P*
Personal and current information	3.7 ± 1.4	4.9 ± 1	<0.0001
Orientation	3.2 ± 1.5	4.5 ± 0.7	<0.0001
Backward digit span	5.2 ± 4	7 ± 4.2	0.04
Story tracking	8.4 ± 4.8	13.4 ± 3.8	<0.0001
Long-term memory	6.3 ± 6	12.4 ± 4.7	<0.000
Proverb interpretation	6.8 ± 3.2	8.3 ± 1.3	0.03
Clock drawing	1.1 ± 1.1	1.8 ± 0.9	0.00
Luria drawing	5.2 ± 6	2.3 ± 3.2	0.02
Category fluency	10.9 ± 5.6	14.1 ± 4.9	0.002
Verbal fluency	4.7 ± 2.8	6.1 ± 2.2	0.001
Stroop test	81 ± 39.4	66.2 ± 21.6	0.009
Facial recognition	36.6 ± 8.1	39.9 ± 3.6	0.01
Copying	2.7 ± 1.3	3.3 ± 1	0.01
Short-term visual memory	6.3 ± 3.3	8.5 ± 3.1	0.001
Long-term visual memory	2.6 ± 2.6	5.4 ± 3.1	<0.0001
Mini-mental state examination test	22.5 ± 2.3	26.2 ± 1.2	0.001
Activities of daily living	16.2 ± 2.4	22 ± 1	<0.0001

* $P < 0.05$.

to the MCI group. Although our group consisted of early-stage AD patients, perseveration was found to be quite higher than expected.

Our results show that MCI can be neuropsychologically differentiated from normal aging and dementia. In elderly populations, the diagnosis of MCI should be established when complex attention, orientation, and long-term memory are disturbed. In MCI patients, impairments in ADL, personal information, and executive functions should be considered as an indicator of AD.

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