〈Regular Article〉

Current status and problems of driving in elderly with cognitive decline in Okayama.

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ABSTRACT　**Background**: Because cognitive decline increases the risk of traffic accidents, elderly people with dementia are prohibited from driving in Japan. However, criteria for determining whether patients with mild cognitive impairment (MCI) can continue driving have not been established. Car driving is an important tool for social and daily activities, especially for people living in suburbs who lack support with mobility from family members. Therefore, prohibiting driving could result in social isolation and severely impact the quality of life of elderly people. From April 2017, we established a specialized outpatient clinic to evaluate cognitive ability in the context of driving for elderly people who categorized as possible dementia by the National Public Safety Commission, and the people who suspected cognitive decline. Based on those data, we try to clarify the current situation about driving in cognitive declined elderly in Okayama, and discuss the relationship between driving and clinical characteristics of these people for future establishment of better criteria to prohibit driving among older adults with suspected cognitive impairment.

　Methods: From April 2017 to August 2021, we retrospectively examined the medical records of 61 patients (58 men; mean age, 80.5 ± 5.1 years) who visited our clinic for a cognitive evaluation in relation to driving. We compared clinical and neuropsychological characteristics between patients who continued driving and those who had stopped, with the goal of identifying criteria for determining the eligibility to drive.

　Results: We diagnosed 26.2% of the patients with dementia and 73.8% with MCI. Neuropsychological tests revealed that global cognitive impairment was typically not severe, although severe impairment was observed in several cognitive sub-categories in some patients, including attention, frontal lobe function, visuospatial processing, and executive function. We attempted to persuade all patients to give up driving; however, only 20 did so immediately after diagnosis. Of the remainder, 20 patients (19 males; mean age, 78.9 ± 4.4 years) continued

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to drive and were retested in our clinic every 6 months. In comparison with the patients who continued driving, those who gave up showed more severe impairment according to the Mini-Mental State Examination-Japanese version, Dementia Assessment Sheet in Community-based Integrated Care System, Clinical Dementia Rating, Frontal Assessment Battery, Trail Making Test-Japanese version, and Kohs Block Design Test.

Conclusions: Despite current legal criteria enable MCI patients to continue driving, our data indicated that they tend to return their driver's license when they have cognitive declines in multiple domains. It suggests that detailed cognitive assessment using multiple neuropsychological tests may help convince cognitively impaired patients to return their driver's licenses.

INTRODUCTION

Because Japan is a super-aging society, the number of elderly drivers is increasing. Among the most serious social problems in Japan is the increasing number of drivers with dementia, who are at higher risk of being involved in traffic accidents. It is necessary to reduce the risk of traffic accidents involving elderly people without reducing their quality of life (QOL).

Driving a car requires many cognitive functions including memory, visuospatial perception, the application of knowledge (of traffic laws), judgment, and attention. Individuals with impaired visuo-attentional and cognitive function exhibit delays in the recognition of environmental conditions and performance of appropriate actions. Therefore, elderly people who exhibit cognitive decline, and are thus at high risk for traffic accidents, should be encouraged to hand in their driver's license. Japan's Road Traffic Act of 1960 (Article 105) stipulates that the drivers' licenses of persons with dementia must be revoked. Subsequently, the revised Road Traffic Act of 2015 introduced cognitive function tests and courses for the elderly, in response to the risk posed by elderly people exhibiting cognitive decline. In addition, a driving test conducted in a real vehicle prior to taking the cognitive function test was mandated for persons 75 years of age or older with a history of violations on May 13, 2022. However, it is also important to maintain the QOL of elderly people who may have to give up driving. In suburban areas of Okayama (Japan), public transport services are poor such that car driving is essential for activities of daily living (ADL). Additionally, many households contain only elderly couples, i.e., lack young family members who can provide support. For such households, revocation of drivers' licenses without sufficient support may severely impact QOL and the ability to perform ADL. Local governments have made attempts to maintain the QOL and ability to perform ADL of people with dementia (and their caregivers) in this situation, including by issuing discount tickets for public transportation to elderly people who voluntarily hand in their drivers' licenses (e.g., the "Okayama Ai Card"); however, these measures have proven insufficient[1].

The Road Traffic Act defines dementia as "a condition in which memory and other cognitive functions are impaired to the extent that they interfere with daily life due to organic changes in the brain based on cerebrovascular disease, Alzheimer's disease, and other factors". However, the boundaries between normal, mild cognitive impairment (MCI), and dementia are not always clear, and there are no established guidelines or standards that can be

followed to revoke the driver's licenses of people exhibiting cognitive decline. Scientific research on cognitive decline in the context of driving ability is still insufficient. Clinicians have to make judgments on the basis of interviews, cognitive function tests, driving simulation tests, and driving ability in actual vehicles. Thus, we established a specialized clinic to assess the eligibility of elderly drivers in April 2017. Multidisciplinary evaluations are performed at the clinic and comprehensive support is provided to elderly people who have stopped driving, including medical examinations, notifications, and guidance.

The purpose of this study is to clarify the current situation and problems regarding elderly drivers in Okayama, and to explore evaluation for future establishment of better criteria that could be applied to assess the eligibility to drive of patients with dementia or MCI.

MATERIALS (SUBJECTS) AND METHODS

We enrolled 61 patients (58 males, mean age 80.5 ± 5.1 years, cumulative number of visits is 109 times) who visited our clinic from April 2017 to August 2021. Information from medical records was retrospectively reviewed. Patients were interviewed regarding the reason for their visit, current medical history, underlying medical conditions, and the number of people living with them. Neuropsychological tests (the Mini-Mental State Examination-Japanese version [MMSE-J], Dementia Assessment Sheet in Community-based Integrated Care System [DASC-21], Clinical Dementia Rating [CDR], Kohs Block Design Test, Frontal Assessment Battery-Japanese version [FAB-J], and Trail Making Test-Japanese version [TMT-J; A and B]), electrocardiogram, electroencephalogram, brain magnetic resonance imaging(MRI), and N-isopropyl-p-(123)I iodoamphetamine single photon emission computed tomography (IMP-SPECT) using three-dimensional stereotactic surface projections (3D-SSP)[123]I-IMP SPECT 3D-SSP] were performed. For the clinical diagnosis of dementia, the Diagnostic and Statistical Manual of Mental Disorders, 5th ed. (DSM-V)[2] and the International Classification of Diseases, 10th revision (ICD- 10)[3] were used for the clinical diagnosis of dementia, and the criteria defined by Petersen were used for the clinical diagnosis of MCI[4]. Furthermore, as of August 2021, all patients were interviewed by telephone regarding whether they had returned their driver's license or continued to drive. And we compared the clinical characteristics and neuropsychological test results of a group of patients who were still driving as of August 2021 (n = 20) and a group of patients who had given up their driving license (n = 29). Group comparison was made by using the unpaired t-test, and $p < 0.05$ was taken to indicate statistical significance.

This clinical study was approved by the Ethics Committee of Kawasaki Medical School and its affiliated hospitals (Approval No. 5418).

RESULTS

Out of all 61 patients, 60% of the households were either single or consisted only of elderly couples. Regarding of the cause for visiting our clinic, 75% of the patients were ordered by the National Public Safety Commission because they were classified as possible dementia (Category 1). The remaining 25% of patients came to the clinic because of their concerns about driving. In addition, approximately 30% of the patients had been involved in a traffic accident prior to coming to the clinic. Regarding comorbid diseases, hypertension, diabetes, and other diseases were present in 34.4 %, 23.0 %, and 75.4 % of the patients, respectively. In addition, 21.3 % of the patients were already taking medication for dementia. The mean neuropsychological test scores were as follows: MMSE-J 21.6 ± 3.6, DASC-21 28.5 ± 6.9, CDR 0.6 ± 0.2, Kohs Block Design Test IQ 63.8 ± 12.6, FAB-J 10.9 ±

2.8, TMT-J A 102.1 ± 43.9 s and TMT-J B 261 ± 81.9 s. These data indicate that while general cognitive function was relatively maintained, attention, frontal lobe function, visual information processing, and executive function were impaired. The electrocardiogram and electroencephalogram were abnormal in 44.2 % (n = 43) and 6.7 % (n = 30), respectively. Brain MRI (n = 51) showed brain atrophy suspected of Alzheimer's disease (AD) in 25.5%, previous history of stroke or cerebral contusion in 60.8%, brain atrophy in 7.8%, and no abnormalities in 7.8%. ^{123}I-IMP SPECT 3D-SSP (n = 37) showed decreased blood flow in the posterior cingulate gyrus and parietal cortex, which are considered characteristic of AD, in 37.8%. From these results, 26.2% were diagnosed with dementia (AD 6.5%, vascular dementia 6.5%, other dementias13.2%) and 73.8% were diagnosed with MCI. All of the patients were advised to return their driver's licenses because of cognitive decline that could interfere with safe driving even if they did not have dementia, but they insisted that they wanted to continue driving because it was essential for their daily lives. Only 20 patients gave up driving immediately after diagnosis and additional 9 patients stopped driving by August 2021; the remaining 20 (19 males, mean age 78.9 ± 4.4 years) were continue driving with follow up cognitive evaluation every 6 months as MCI. Although 12 patients were lost followed up, there was no patients with dementia continued to driving.

The group of patients who ultimately returned their driver's license as of August 2021 (n = 29) had significantly lower mean scores on the MMSE-J, DASC-21, CDR, FAB-J, TMT-J, and Kohs Block Design Test than the group of MCI patients who continued driving (n = 20) (Table 1).

DISCUSSION

Our study revealed that 70% of people who categorized as possible dementia by the National Public Safety Commission remained MCI level and legally continued driving. However, the question remains whether people with MCI can really drive safely. A comparison of patients who continued driving with patients who n up driving revealed that patients who given up driving showed decreased scores on average in multiple domains. It suggests patients with cognitive declines in multiple domains were more likely to give up driving. Detailed neuropsychological testing might help to detect those with compromised driving aptitude and guide

Table 1. Clinical information and neuropsychological testing of a group of patients who continued driving and a group of patients who returned their driver's licenses. Mean ± SD.

	continued driving (n = 20)	returned the driver's license (n = 29)	p
Age	78.9 ± 4.4	79.7 ± 4.6	n.s
education (y.)	11.6 ± 2.4	11.1 ± 2.3	n.s
Households with only single or elderly couples (%)	65.0	69.0	n.s
the first category (%)	85.0	62.1	n.s
diagnosis: MCI (%)	95.0	37.9	< 0.01
MMSE-J	22.8 ± 3.2	20.3 ± 3.9	< 0.01
DASC-21	26.4 ± 6.0	31.8 ± 6.4	< 0.01
Kohs IQ	65.6 ± 13.5	57.2 ± 19.7	0.02
CDR	0.5 ± 0.1	0.6 ± 0.2	0.03
FAB	11.7 ± 2.8	10.2 ± 2.4	< 0.01
TMT-J A (s): except time out (time out patient rate; %)	87.6 ± 33.1 (0)	117.0 ± 64.6 (13.8)	< 0.01
TMT-J B (s): except time out (time out patient rate; %)	211.8 ± 68.5 (50)	249.0 ± 98.9 (51.7)	0.03

them to give up driving early.

This view is consistent with the previous findings exploring the relationship between cognitive decline and driving. A recent review indicated that drivers with a CDR score of 1 and MMSE score ≤ 24/30 should either stop driving or undergo further driving evaluations[5]. Tests of processing speed and cognitive flexibility (i.e., the Wechsler Adult Intelligence Scale 3rd edition), computational tasks, digit span backward, and the Trail Making Test have been used to assess drivers aged > 70 years. The Trail Making Test is considered the most sensitive test for predicting driving aptitude in this population[6]. However, the criteria and cutoffs applied to determine suitability to drive vary among reports. Thus, there is insufficient evidence to mandate immediate cessation of driving by MCI patients.

Because there are many "near-miss" cases for every actual traffic accident, it is essential to accurately assess the ability of drivers to appropriately respond to situations that may arise when driving. But it is difficult to evaluate the skills important for accident prevention, such as appropriate responses to various sudden environmental changes and events.

The decision regarding whether an individual would be capable to drive safely must be made on the basis of medical opinion, but there was considerable dissociation between medical diagnose and legal categorization by National Public Safety Commission and specificity of current screening system is not high. Considering the impact of giving up driving on social activity and overall QOL, more accurate screening system would be needed.

In recent years, with developments in science and technology, autonomous vehicles and driver assists have been developed. This technical evolution may enable to prevent social isolation without decrease safety. In addition, on May 13, 2022, it became mandatory for persons over 75 years of age with a history of violations to drive in an actual vehicle before taking a cognitive function test. Thus, the law is gradually improving.

On the other hand, since it is inevitable that cognitive decline by aging, most of elderly people must consider how long they should continue to drive, and how they will maintain their standard of living after given up their license. They hope to be able to return their driver's license at a good time that is both safety and socially acceptable.

CONCLUSIONS

Under the consensus that elderly people who exhibit cognitive decline are high risk for traffic accidents and should be encouraged to hand in their driver's license early, the cognitive function screening tests have been adopted by the Public Safety Commission. This is useful as a screening test, but false positives also exist. Actually, 75% of the patients who were classified as having possible dementia (Category 1) by the National Public Safety Commission were MCI and could legally continue to drive under careful cognitive follow up. Further study with multidomain neuropsychological batteries combined with long-term follow up to detecting "real" at-risk people would be needed to establish better criteria for safety driving. Ensuring mobility and maintaining safety are issues that must be addressed in our whole society.

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