



Original Article

Chronic subdural hematoma in patients over 65 years old: Results of using a postoperative cognitive evaluation to determine whether to permit return to driving

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ABSTRACT

Background: Chronic subdural hematoma (CSDH) is usually associated with good recovery with burr hole irrigation and postoperative drainage under local anesthesia. In Japan, traffic accidents by the elderly drivers over 65 years old are severely increasing, and there is no consensus on whether or not to return to driving after CSDH treatment. We perform a postoperative cognitive assessment. We retrospectively investigated the return-to-driving rate and associated factors.

Methods: Of the 45 patients over 65 y.o. and who had usually driven, 30 patients wished to drive again. We performed tests composed of Mini-Mental State Examination (MMSE), line cancellation and line bisection task, Kohs block design test, trail making test (TMT)-A and B, Kana-hiroi test, Rey-Osterrieth complex figure test, and behavioral assessment of the dysexecutive syndrome, in order. When all tests' scores were better than the cutoff values, we let patients drive again. When some of the scores were worse than the cutoff values, we reevaluated the patients at the outpatient every month. If the patients' scores could not improve at the outpatient, we recommended them to stop driving.

Results: Nineteen of 30 patients could return to driving. Worse MMSE, Kohs block design test, TMT-A, TMT-B scores, higher age, dementia, or consciousness disturbance as chief complaints were associated with driving disability.

Conclusion: CSDH is known as treatable dementia. However, we should perform an objective cognitive assessment before discharge because only 63% of the patients over 65 y.o. who wished to drive could return to driving.

Keywords: Chronic subdural hematoma, Cognitive assessment, Dementia, Elderly, Higher brain dysfunction

INTRODUCTION

Chronic subdural hematoma (CSDH) is one of the most common diseases seen by neurosurgeons. It is usually associated with good recovery with burr hole irrigation and postoperative drainage

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under local anesthesia.^[1,7,23] This simple procedure elicits a satisfactory therapeutic effect, and CSDH is so-called “treatable or reversible dementia.”^[6] However, in Japan, traffic accidents by elderly drivers over 65 years old are severely increasing. The ratio of the elderly, defined as over 65 years old, in Japan is 28.7%.^[24] The ratio is around 40% in the rural area, while driving is needed because there is a lack of public transport services. As the number of elderly drivers is increasing, the ratio of fatal traffic accidents, mainly due to the elderly driver’s operation error, is increasing over 15%.^[2,37] In general, early discharge from the hospital is often encouraged for CSDH patients. However, there is no consensus on whether or not to return to driving, and it is left up to each doctor or patient.

We work in a rural area in Japan with 37% of elderly population. We should prevent traffic accidents by elderly CSDH patients from happening after discharge. We have a few medical staff and many elderly patients, and the hospitalization term is short in CSDH patients. Therefore, we perform a simple cognitive assessment during hospitalization for elderly CSDH patients who want to drive after discharge. We retrospectively investigated the return-to-driving rate after CSDH treatment at our hospital and what factors were associated with return-to-driving. This is a unique investigation on the association between elderly CSDH patients’ cognitive function and return-to-driving rate.

MATERIALS AND METHODS

Study population

This retrospective study included 121 consecutive CSDH patients treated between 2017 and 2020 in our hospital. We usually performed burr hole, irrigation, and drainage surgery under local anesthesia. However, we sometimes used neuroendoscopy and suction cannula to penetrate the septum in the hematoma cavity so that the CSDH was not divided into compartments by the septum and that efflux of the hematoma could be achieved.^[13] The drainage tube was removed within 2 days after the operation. All of the patients took the Japanese herbal Kampo medicine Goreisan postoperatively, which acts as a hydragogue by inhibiting aquaporin expression and could prevent CSDH recurrence.^[10,14,21] Physical, occupational, and speech therapies were started the day after surgery, and cognitive assessment was performed in parallel with rehabilitation. We discharged the patients around 1 week.

Our hospital’s research ethics committee approved the study, and we gained written informed consent for this study from all of the patients, the legally authorized representative of the patients, or the next of kin of the deceased patients. All methods were carried out in accordance with relevant guidelines and regulations (Declaration of Helsinki). All

personal patient information were deleted from the database for this study to protect patient privacy.

Cognitive assessment

We postoperatively performed the simple cognitive assessment composed of seven tests, including Mini-Mental State Examination (MMSE), line cancellation and line bisection task, Kohs block design test, trail making test (TMT)-A and B, Kana-hiroi test, Rey-Osterrieth complex figure test, and behavioral assessment of the dysexecutive syndrome, in order. The cutoff values are shown in [Table 1]. The assessment’s structure is similar to the Japan Society for Higher Brain Dysfunction’s driving assessment (draft).^[8]

First, patients with MMSE score under 24/30 or unilateral spatial neglect evaluated by line cancellation and line bisection task were recommended to stop driving. Then, we performed other tests in order. When all tests’ scores were better than the cutoff values, we let patients drive again. When some of the scores were worse than the cutoff values, we reevaluated the patients at the outpatient every month, and if the patients’ cognitive function improved superior to the cutoff values, we let them drive again. If the patients’ scores could not improve at the outpatient, we recommend them to stop driving and to consult the police station if they wanted to drive.

Regarding patients who did not wish to drive, who were physically unable to drive due to comorbidities like fractures and wish to stop driving, or who were prohibited from driving by family members, the cognitive assessment was stopped as appropriate.

Outcome and variables

The outcome was whether the patient eventually could return to driving or not. We also investigated the age, sex, chief complaint, presence of hypertension, diabetes mellitus, and

Table 1: Cognitive assessment performed in our hospital.

Order	Neuropsychological examination	Cutoff values
1	Mini-Mental State Examination	24/30
2	Line cancellation and line bisection task	Present or not
3	Kohs block design test	IQ 80–90
4	Trail making test-A and B	A: within 120 s B: within 133 s
5	Kana-hiroi test	85% accuracy
6	Rey-Osterrieth complex figure test	Immediate recall: 28 points Delayed recall: 13 points
7	Behavioral assessment of the dysexecutive syndrome	2.3 points

IQ: Intelligence quotient

dyslipidemia that are now treated, atrial fibrillation, habitual smoking, and habitual alcohol consumption. Laboratory data, including levels of total protein, albumin, triglycerides, total cholesterol, high- and low-density lipoprotein cholesterol, white blood cell count, hemoglobin level, and lymphocyte count, were also investigated. These are related to nutrition status, and some are related to the neurosurgical diseases' outcomes.^[5,11,12] We also investigated radiological findings; laterality, hematoma thickness, hematoma density, midline shift, and temporal muscle thickness. Temporal muscle thickness is recently reported as a surrogate marker of nutrition status and predictor of sarcopenia.^[15-19,28,29,33] Raw scores of the cognitive assessment's tests and the timing of final judgment were also investigated.

Statistical analysis

To assess the association between the outcome and variables described above, we used the Mann-Whitney U-test, Fisher's exact test, or Pearson's Chi-square test adequately. Continuous variables were summarized as median (interquartile range). A two-tailed $P < 0.05$ was considered statistically significant. We conducted these calculations using SPSS software version 24.0.0. (IBM, New York, USA).

RESULTS

Clinical characteristics

All patients' surgical procedures were successfully completed, and all the symptoms were improved after surgery. Among

the 121 CSDH patients (median age 81, interquartile range 74–86, 41 women and 80 men), 10 patients were under 65 years old, and all passed the cognitive assessment. Among the 111 patients over 65 years old, 66 patients (59%) had already quit driving before admission. Among the 45 patients (41%) who had usually driven, 15 patients (33%) did not wish to drive or could not drive due to other comorbidities. Therefore, the rest of the 30 patients (67%) who wished to drive were assessed on driving ability [Figure 1].

Clinical characteristics of the 30 CSDH patients who wished to drive (8 women and 22 men) are summarized in [Table 2]. The median (interquartile range) age was 71 (69–76) years old. Nineteen patients had focal deficits, eight dementia or disturbance consciousness, and three headaches as chief complaints. Eleven patients had left CSDHs, nine right ones, and 10 bilateral ones. The median hematoma thickness was 25 (20–29) mm, and the median midline shift was 7.4 (3.4–9.6) mm. The hematoma density was high in 5 patients, iso in 16, low in 5, and mixed in 4.

After cognitive assessment, 19 patients could return to driving eventually, and 11 could not. Five patients could return to driving at discharge, eight after 1 month, three after 2 months, and three after 4 months. Six patients were judged as disable to drive at discharge, one after 1 month, and four after 2 months [Figure 1 and Table 2]. In the follow-up period ranging from 6 to 44 months after cognitive assessment, there have been no traffic accidents caused by the treated patients.

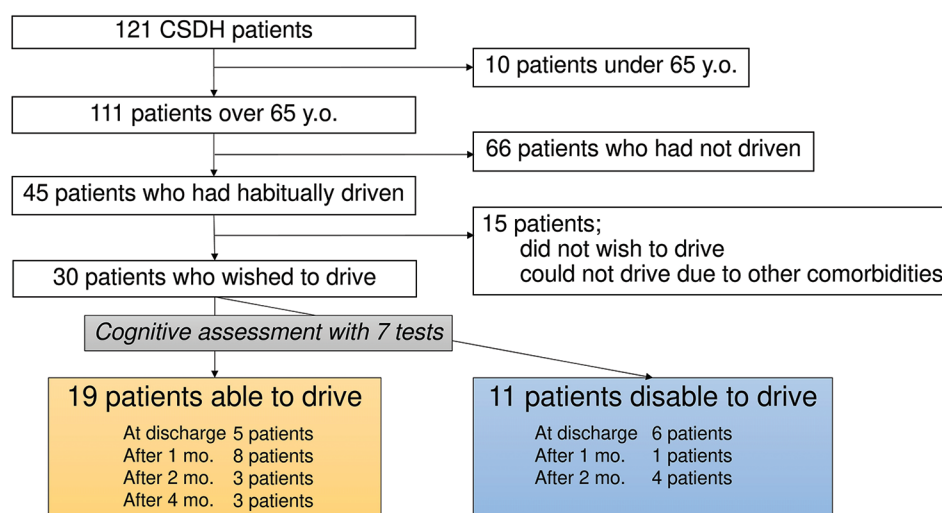


Figure 1: Among the 121 CSDH patients (median age 81, interquartile range 74–86, 41 women and 80 men), 10 patients were under 65 years old, and all passed the cognitive assessment. Among the 111 patients over 65 years old, 66 patients had already quit driving before admission. Among the 45 patients who had usually driven, 15 patients did not wish to drive or could not drive due to other comorbidities. Therefore, the rest of the 30 patients who wish to drive were assessed on driving ability. Then, 19 patients could return to driving eventually, and 11 could not. Five patients could return to driving at discharge, eight after 1 month, three after 2 months, and three after 4 months. Six patients were judged as disable to drive at discharge, one after 1 month, and four after 2 months.

Table 2: Patient characteristics and difference between those able and those disable to return driving.

Variables (median, interquartile range)	Able (n=19)	Disable (n=11)	P value†
Age (years)	70 (70–72)	76 (72–78)	0.064
Women: men (Women%)	5:14 (26%)	3:8 (27%)	0.954
Chief complaint			
Focal deficits	14 (74%)	5 (45%)	0.122
Dementia or disturbance of consciousness	3 (16%)	55 (45%)	0.077
Headache	2 (10%)	1 (9%)	0.841
Presence of the past history			
Hypertension	7 (37%)	11 (100%)	0.712
Diabetes mellitus	5 (26%)	0	Uncalc.
Dyslipidemia	2 (11%)	0	Uncalc.
Atrial fibrillation	1 (5%)	1 (9%)	0.999
Habitual smoking	7 (37%)	6 (54%)	0.454
Habitual alcohol consumption	8 (42%)	6 (54%)	0.707
Laboratory data			
Total protein (mg/dL)	7.0 (6.9–7.4)	7.0 (6.8–7.4)	0.767
Albumin (mg/dL)	4.4 (4.3–4.5)	4.3 (4.1–4.5)	0.216
Triglycerides (mg/dL)	117 (81–144)	93 (66–112)	0.250
Total cholesterol (mg/dL)	192 (165–214)	172 (167–202)	0.735
High-density lipoprotein cholesterol (mg/dL)	52.4 (46.4–65.2)	51.5 (46.6–63.8)	0.933
Low-density lipoprotein cholesterol (mg/dL)	122 (95–130)	110 (101–121)	0.735
White blood cell count (× 100/μL)	58 (50–68)	66 (51–74)	0.395
Hemoglobin (mg/dL)	13.8 (12.7–15.1)	14.3 (13.1–15.6)	0.497
Lymphocyte count (× 100/uL)	12 (10–18)	14 (12–16)	0.999
Radiological findings			
Laterality (left: right: bilateral)	5:6:8	6:3:2	0.252
Hematoma thickness (mm)	22 (20–28)	28 (21–29)	0.525
Hematoma density (high, iso, low, and mixed density)	4:10:3:2	1:6:2:2	0.817
Midline shift (mm)	7.4 (3.6–10.0)	5.6 (4.5–8.7)	0.767
Temporal muscle thickness (mm)	4.85 (3.23–5.50)	4.71 (3.90–5.44)	0.899
Cognitive assessment during hospitalization (number)‡			

(Contd...)

Table 2: (Continued).

Variables (median, interquartile range)	Able (n=19)	Disable (n=11)	P value†
Mini-Mental State Examination	28 (25–30)	22 (19–24)	< 0.001*
Line cancellation and line bisection task (presence of unilateral spatial neglect)	0	1 (n=8)	Uncalc.
Kohs block design test	77.6 (70.0–80.2)	56.8 (54.9–65.9) (n=7)	0.051
Trail making test-A (s)	121 (97–137)	151 (136–178) (n=7)	0.046*
Trail making test-B (s)	166 (153–224)	257 (228–354) (n=7)	0.087
Kana-hiroi test (%)	71 (59–93)	58 (29–65) (n=7)	0.166
Rey-Osterrieth complex figure test (immediate recall)	34 (33–35)	34 (27–35) (n=6)	0.579
Rey-Osterrieth complex figure test (delayed recall)	19 (11–23)	11 (9–17) (n=6)	0.213
Behavioral assessment of the dysexecutive syndrome	2 (1–3)	1.5 (1–2) (n=4)	0.521
Final judgment timing			0.190
At discharge	5 (26%)	6 (55%)	
1 month	8 (42%)	1 (9%)	
2 months	3 (16%)	4 (36%)	
4 months	3 (16%)	0	

Results are described as median (interquartile range). Uncalc.: Uncalculated. * $P < 0.05$ by Mann-Whitney U-test, Fisher's exact test, or Pearson's Chi-square test. †Mann-Whitney U-test, Fisher's exact test, or Pearson's Chi-square test was performed. ‡There were missing values because some patients had severe dementia and could not be evaluated

Relationship between outcome and variables

We performed the Mann-Whitney U-test, Fisher's exact test, and Pearson's Chi-square test. Lower MMSE score and worse TMT-A score were significantly related to driving disability ($P < 0.001$, $P = 0.046$, each). Higher age, dementia or disturbance of consciousness as chief complaints, and worse Kohs block design test and TMT-B scores were also associated with driving disability, though they were not statistically significant ($P = 0.064$, 0.077 , 0.051 , and 0.087 , respectively) [Table 2].

DISCUSSION

We herein report 111 CSDH patients over 65 years old, and 45 of 111 patients had usually driven. Eventually, only 19 patients

could return to driving, and 15 or 11 patients did not wish to drive or could not return to driving. Higher age, dementia or disturbance of consciousness as chief complaints, lower MMSE, worse Kohs block design test, and TMT-A and B scores were associated with driving disability. This is the first report on whether elderly CSDH patients could return to driving or not in Japan. CSDH is known as treatable dementia. However, our results suggest that we should perform an objective cognitive assessment before discharge because only 63% of the patients could return to driving.

Road traffic laws in Japan

In the road traffic law, dementia is a disease specified as a requirement for restricting driving licenses from 2002. "Dementia" in this context is defined as "dementia with no hope of cure," and it is ambiguous whether CSDH is included or not. Furthermore, as for the higher brain dysfunction, it is stated that "the license shall be revoked in accordance with the provisions on dementia," and the criteria are still vague.^[26]

In this unclear and complex context, when CSDH patients consult the police officers, they must let doctors make medical certificates describing whether or not the cognitive function is expected to recover within 6 months. If the patient submits a medical certificate stating that they are expected to recover, the police will evaluate cognitive and driving functions and make a final decision after 6 months.^[37] Patients' quality of life lowered by being banned from driving for these 6 months. Furthermore, the predefined medical certificate form provided by the police office has many uncertainties and can be difficult to determine by doctors.^[20] Easily allowing or prohibiting driving or leaving all decisions to the police officer will degrade the patient's quality of life and may even lead to doctors being held accountable. Therefore, we try to perform our cognitive assessment in this rural area and maintain the patient's quality of life and fulfill our medical staff's responsibilities.

In Japan, "memory and judgment function tests" are conducted every 3 years for elderly drivers over 75 years old by the National Police Agency, but not for those under 75 years old.^[37] The test by the National Police Agency consists of five cognitive tests; (1) checking temporal orientation, including year, date, and time, (2) a 16-picture naming test according to some hints, (3) circling a specific number from a random number sequence, (4) recalling the 16 objects in the test (2) with/without hints, and (5) clock drawing test.^[27] This test is used to evaluate the "drivers' memory and judgment." It is unlikely to examine higher brain function, and it also clearly states that it is not meant to be a medical diagnosis of dementia. Therefore, we performed our test similar to the Japan Society for Higher Brain Dysfunction^[8] to examine higher brain function relatively precisely.

CSDH and cognitive function

From the Japanese epidemiological study on CSDH, the overall incidence of CSDH was 20.6/100,000/year in all age groups, and the mean \pm standard deviation of age was 71.2 \pm 12.8 years old. Furthermore, the incidence was 80.1/100,000/year in people over 65 years of age.^[9] As the aging population in Japan, the CSDH incidence and onset age will be increased,^[35] and the return-to-driving problem will be further important.

Some report describes that treatable dementia accounts for 8%, and CSDH is 0.4% of all the dementia outpatients.^[34] The term "treatable dementia" is becoming more common, and neurosurgeons, of course, know from experience that cognitive function can improve after surgery. However, there are few detailed studies on CSDH and cognitive function. The most important study is Ishikawa's report on the detailed surgical effect for CSDH regarding neuropsychiatric function in 2002.^[6] He demonstrated that approximately two-thirds of the 26 patients with CSDH were suspected of having dementia on admission and that surgery improved the neuropsychiatric symptoms in 50% of patients, evaluated by MMSE, Hasegawa Dementia Scale-Revised, and activities of daily living scale. In his report, patients aged under 74 years old and with MMSE score over 10/30 tended to improve their neuropsychiatric functions. Other studies also showed that younger age is related to cognitive function improvement.^[30,36] Our results were similar in the sense that the better the preoperative condition and the younger the age, the better the postoperative function. However, on the PubMed database, there are no further studies on cognitive, neuropsychiatric function, and CSDH. Therefore, we believe that our study is important as an extension of Ishikawa's study, focusing on driving ability.

Cognitive assessment

A composite cognitive battery is likely to be better than testing single cognitive domains in assessing fitness to drive in patients with dementia.^[20,32] In the seven tests of our cognitive assessment, MMSE, Kohs block design test, and TMT-A and B scores were associated with return-to-driving ability compared to other tests.

MMSE is a typical test for dementia, not to mention its importance to whether or not one can drive.

Kohs block design test is an intelligence quotient test with creating 17 different patterns by combining wooden cubes of 3 cm on a side. Kohs block design test is thought to reflect spatial cognitive ability.^[31] Our results suggest that Kohs block design test can be a useful test for cognitive assessment, similar to the previous report.^[4]

TMT requires tracing numbers and alphabets (hiragana in the Japanese version) alternately in ascending order, so it requires

various abilities such as recognition of numbers and letters, mental flexibility, attention span, visual search, visual motility, and coordination of hand movement and vision.^[22] TMT-A represents right hemisphere cortical functions, including visual exploration, spatial discrimination, and attention, while TMT-B represents left hemisphere cortical function, including language processing.^[25] Regarding cognitive assessment, TMT-B is widely used as a simple test to assess attention diversion and allocation, and executive function.^[3] Our results also suggest that TMT-A and B can be useful tests similar to the previous report.^[22]

Our cognitive assessment consists of seven tests, but these results suggest that our cognitive assessment for CSDH can be simplified into 3–5 tests, including MMSE, Kohs block design test, and TMT, leading to saving the medical and time resources. Further studies are desired.

Limitations

First, the sample size was small, and we performed only univariate analysis. We should continue to study with large samples and perform multivariate analysis. Second, we should have investigated the patients' psychological status after the judgment of driving disability because driving is needed in this rural area. The patients and their families' burden might have become severe. Third, the cutoff values and the number of tests should be reconsidered. Our cognitive assessment is relatively simple and could be performed by a few medical staff in the short-term hospitalization. However, overestimating and restricting driving could lead to patient frustration and worsen the quality of lives, while underestimating might lead to causing accidents. Fourth, it is unclear whether the cognitive function deteriorated due to CSDH itself or whether it had already got worse preoperatively.

CONCLUSION

CSDH is known as treatable dementia. However, we should perform an objective cognitive assessment before discharge because only 63% of the patients who wished to drive could return to driving.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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