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The Cambridge Behavioral Inventory: Validation and Application in a Memory Clinic

Yasuhiro Nagahama, MD, PhD, Tomoko Okina, MA, Norio Suzuki, and Minoru Matsuda, MD, PhD

ABSTRACT

The authors examined the validity of the Cambridge Behavioral Inventory (CBI), a questionnaire investigating broad neuropsychiatric symptoms and everyday functional ability in dementia. Test-retest reliability of the CBI was acceptable. Cross-validation with the Neuropsychiatric Inventory showed good concurrent validity of the CBI. The CBI reliably demonstrated that disinhibition, stereotypic behavior, elation, anxiety, poor self-care, and changes in eating habits occurred more commonly in patients with frontotemporal lobar degeneration than those with Alzheimer’s disease. The authors concluded that the CBI is a reliable informant-based assessment of neuropsychiatric symptoms and everyday functioning and may be a suitable tool for use in general clinical practice settings. (J Geriatr Psychiatry Neurol 2006;19:220-225)

Keywords: dementia; assessment; psychiatric symptoms; activities of daily living

Neuropsychiatric disturbances are frequent and are often the most disabling and disturbing symptoms to dementia patients and their caregivers. Alzheimer’s disease (AD) is accompanied by apathy, dysphoria, delusions, and agitation; frontotemporal lobar degeneration (FTLD) is accompanied by disinhibition, euphoria, and stereotypic behavior. These conditions raise the costs of caring for and are a major cause of the institutionalization of patients. Some symptoms have prognostic significance. For example, delusions are associated with poor prognosis in AD. The neuropsychiatric symptoms in dementing disease are often treatable with psychotropic medications. Thus, assessment of neuropsychiatric symptoms in patients with dementia syndromes is critical to providing appropriate management to dementia patients and caregivers.

A number of behavioral symptom rating scales are available for use in clinical research involving dementia patients. The principal tools currently in use include the BEHAVE-AD, the Alzheimer’s Disease Assessment Scale, the Neurobehavior Rating Scale, the Columbia University Scale for Psychopathology in Alzheimer’s Disease, Dementia Signs and Symptoms Scale, and the Neuropsychiatric Inventory (NPI). Most of these scales rely on a caregiver-informant interview but differ in item content: Some scales focus on psychiatric symptoms, some include cognitive and psychiatric symptoms, and some assess ability to perform activities of daily living (ADL). Although a structured or semistructured interview is the format most commonly used on these scales, the time required to complete the interview—typically 15 minutes or longer—makes their use in general practice settings impractical.

The Cambridge Behavioral Inventory (CBI) was developed to assess a wide range of neuropsychiatric changes in AD and FTLD and to evaluate which features reliably distinguish them. It incorporates questions related to symptoms reported in previous studies of FTLD, components from the NPI, and specific questions related to...
stereotypic or ritualistic behavior that other researchers had found to be very common in FTLD. The original version of the CBI was a self-administered questionnaire that contained 39 questions investigating a broad range of neuropsychiatric changes such as stereotypic behavior, changes in food preference, mood changes, and executive dysfunction. Bozeat et al. reported that the questionnaire disclosed striking differences between patients with FTLD and AD, but that only stereotypic behavior, changes in eating habits, disinhibition, and features of poor social awareness reliably separated the groups. Now the CBI has been extended to 77 questions that cover memory, orientation, attention, instrumental ADL, and fundamental ADL, plus more detailed emotional/behavioral symptoms than the original version involved. Thus, the revised CBI can be used to investigate broad neuropsychiatric domains and everyday functioning in a variety of dementia syndromes.

The first aim of this study was to establish the validity and reliability of the revised CBI as an instrument to assess patient condition in general clinical practice settings. The second aim was to examine the prevalence and profile of behavioral changes in AD and FTLD using the CBI. The final aim of this study was to demonstrate differences in everyday functional ability and neuropsychiatric symptoms between AD and FTLD using the CBI.

METHODS

The CBI is a 77-item, self-administered questionnaire. The questions cover broad aspects of everyday functioning and neuropsychiatric symptoms, including memory, orientation and attention, everyday skills, self-care, mood (depression, anxiety, irritability, elation), beliefs (delusion, hallucination), challenging behavior, disinhibition, eating habits, stereotypic and motor behaviors, and motivation (apathy). Caregivers were asked to rate the frequency of a behavior on a scale of 0 to 4, based on the patient’s behavior over the previous month. The scores were determined as follows: 0, no change; 1, occasional occurrence (a few times per month); 2, often a problem (a few times per week); 3, frequently a problem (daily); and 4, a severe problem (constantly). The questionnaire was scored by totaling the ratings for all the questions relating to each functional domain (subscale). According to the preliminary results of the factor analysis, question 22 in self-care (“Has difficulties traveling to places by self”) was included as an everyday skill.

The CBI was translated into Japanese with permission from the original author. The 110 caregivers providing behavioral information in this study were all family members of outpatients of the Memory Clinic, Shiga Medical Center, Japan. To serve as an informant, the caregiver must have lived with the patient or have, at the minimum, daily contact with the patient. The informants included 76 women and 34 men. Of these, 48 were spouses, 15 were sons, 23 were daughters, and 24 were daughters-in-law. The patients had a variety of dementia syndromes: 74 had probable AD; 5 had possible AD; 1 had mild cognitive impairment; 16 had FTLD; 6 had probable dementia with Lewy bodies (DLB); 1 had possible DLB; 3 had vascular dementia; and 4 had other dementias (traumatic brain injury, chronic hepatic encephalopathy, leukoencephalopathy, and progressive supranuclear palsy). All subjects were interviewed and received a comprehensive neurological examination prior to inclusion in the study. One hundred and five patients received the Mini-Mental State Examination (MMSE). All subjects underwent a head computed tomography (CT) scan or magnetic resonance imaging (MRI) scan.

Test-Retest Reliability

Test-retest reliability was established by asking 42 of the caregivers to complete a second questionnaire, 2 weeks after the first, without reference to the previously completed questionnaire. The patients were 25 probable AD, 2 possible AD, 7 FTLD, 2 probable DLB, 2 VD, and 4 other dementias. Spearman’s rank correlation coefficient was used to examine test-retest reliability.

Concurrent Validity

Concurrent validity was determined by comparing the scores on the relevant subscales of the CBI with the appropriate subscales of the NPI. Twenty-four caregivers participated in the concurrent validity study. Seventeen of the patients had probable AD, 2 had possible AD, 4 had probable DLB, and 1 had traumatic brain injury. The depression (questions 29 and 30), anxiety (questions 31 and 32), irritability (questions 33 and 34), elation (questions 35, 36, and 37), delusions (questions 38, 41, 42, and 43), hallucinations (questions 39, 40, and 44), challenging behavior, disinhibition, stereotypic and motor behaviors, and motivation subscales of the CBI were compared with the dysphoria, anxiety, irritability, euphoria, delusions, hallucinations, aggression, disinhibition, aberrant motor behavior, and apathy subscales of the NPI. Spearman’s rank correlation coefficients were calculated to determine concurrent validity between the CBI and the NPI.

Assessment of Neuropsychiatric Features in AD and FTLD Patients

We included 74 patients with probable AD, 16 patients with FTLD (11 frontotemporal dementia [FTD] and 5 with semantic dementia [SD]), and their caregivers in this analysis. Patients with probable AD fulfilled the
National Institute of Neurological and Communicative Diseases and Stroke/Alzheimer’s Disease and Related Disorders Association (NINCDS/ADRDA) criteria. Brain CT/MRI showed no abnormalities other than atrophy and/or mild periventricular intensity changes. Patients with FTD were diagnosed based on the clinical diagnostic criteria for FTD and SD. In brief, patients with FTD had predominant changes in personality and social behavior with evidence of either frontotemporal atrophy on CT/MRI or frontal hyperperfusion on HMPAO-SPECT (hexamethyl propylene-amine-oxime/single photon emission computed tomography). Patients with left-dominant SD presented with progressive loss of vocabulary affecting expressive and receptive language in the context of fluent speech production. Right-dominant SD presented with anosognosia or associative visual agnosia in their early stage. In all cases of SD, MRI showed focal atrophy involving the polar and inferolateral regions of the temporal lobe. Severity of cognitive dysfunction in the 71 AD, 10 FTD, and 4 SD patients was assessed using the MMSE.

The prevalence of individual symptoms of the CBI between patient groups was assessed using analyses of variance (ANOVA). The relationship of the CBI scores to dementia severity and age was calculated using Pearson’s correlation. In addition, we also examined the frequency of each symptom to explore which ones were significantly more common in each group. Following the original study, we decided to include scores of 2 or greater as a positive score. Based on this dichotomy, the frequency of functional domains in the CBI was determined; if an item in the subscale was positive, we interpreted the symptom cluster as positive. The difference of frequency distribution of the symptoms between the 2 patient groups was examined using the $\chi^2$ test.

RESULTS

Test-Retest Reliability
We found an overall high degree of reliability ($\rho = 0.907$, $P < .0001$). Concerning each subscale, the weakest correlation was for memory ($\rho = 0.773$, $P < .0001$), and the highest correlation was for self-care ($\rho = 0.913, P < .0001$).

Concurrent Validity
Table 1 presents the correlation of the CBI subscales with the NPI subscales. All correlations reached the 0.05 significance level, indicating that the CBI is not significantly different from the NPI in its quantification of neuropsychiatric symptoms. Almost all correlation coefficients exceeded 0.60, except anxiety and stereotypic and motor behaviors. Overall, the analysis demonstrates an acceptable level of concurrent validity compared with the NPI.

Prevalence and Profile of Everyday Functioning and Neuropsychiatric Symptoms in AD and FTD
The demographic details of the patient groups are shown in Table 2. There was no significant difference between the groups in terms of age and mean MMSE. Education level was significantly higher in the FTD than AD ($F_{1,88} = 7.2, P = .008$). There were significantly more female patients with AD than FTD ($\chi^2 = 4.1, P = .043$).

Repeated-measures ANOVA revealed a significant interaction between the patient groups and the CBI subscale performance ($F = 2.00, P = .015$). One-way ANOVA for each CBI subscale demonstrated that FTD patients showed significantly higher scores in comparison with the AD patients in self-care, elation, disinhibition, and eating habit subscales (Table 3). There was no significant difference between the groups in memory, orientation and attention, and everyday skills. In contrast, the following functional subscales showed significant correlation with MMSE performance: memory ($r = -0.36, P = .0007$); orientation and attention ($r = -0.42, P < .0001$); and self-care ($r = -0.36, P = .0006$). No other CBI features showed significant correlation with MMSE.
The subscale scores correlated with the MMSE, except for hallucination ($r = -0.24$, $P = .026$). However, a plot of the hallucination scores by the MMSE revealed that the relationship between these scores was not linear. Hallucination score was high in patients with a middle range of MMSE performance, and patients with high and low MMSE scores had low scores in hallucination. Age was not significantly correlated with the CBI scores.

The frequency of each functional domain of the CBI in each patient group is shown in Figure 1. The symptoms related to anxiety (FTLD:AD = 68.8%:32.0%, $\chi^2 = 7.53$, $P = .006$), elation (FTLD:AD = 50.0%:25.3%, $\chi^2 = 3.85$, $P = .049$), and stereotypic and motor behaviors (FTLD:AD = 87.5%:61.3%, $\chi^2 = 4.02$, $P = .045$) were more common in the FTLD group than in the AD group. Abnormal eating habits (FTLD:AD = 62.5%:42.7%), disinhibition (FTLD:AD = 37.5%:22.6%), challenging behavior (FTLD:AD = 43.8%:22.7%), and impaired self-care (FTLD:AD = 62.5%:46.7%) were also more frequent in the FTLD group than in the AD, but the statistical test failed to reach a significant level.

**DISCUSSION**

The primary aim of this study was to examine the validity and reliability of the CBI. The CBI showed adequate test-retest reliability and convergent validity with...
respect to individual symptom domain scores of the NPI. The NPI is a well-validated, informant-based interview respect to individual symptom domain scores of the NPI. Good correlation between the NPI and the CBI subscale scores established the psychometric property of the CBI.

The CBI has several advantages when compared with the NPI. The CBI is given as a self-administered questionnaire as opposed to an interview, so it is suitable for use in the busy clinical practice setting. Furthermore, the present study showed that disturbances in memory, orientation and attention, everyday skills, and self-care correlated significantly with the MMSE, suggesting these domains may be used as a global scale of dementia severity. In contrast, the other neuropsychiatric symptoms did not show a significant correlation with the dementia severity. Thus, the CBI covers a wider range of symptom dimensions than the NPI, so a detailed clinical profile of the dementia patient can be obtained. A disadvantage of the CBI is that the item numbers in the subscales are variable (2-11) and it is difficult to directly compare the frequency of the psychiatric symptoms between different domains. Another disadvantage of the CBI is that it only assesses a frequency of the symptoms and it is unable to capture the severity of the neuropsychiatric symptoms. A previous study using the NPI showed that frequency and severity might reflect some different aspects of behavioral disturbances, while these were significantly correlated for all symptoms ($P = .0001$). Practically, inclusion of severity rating may make the CBI too redundant for use in a clinical setting.

The CBI profiles confirmed previous studies that reported that disinhibition, stereotypic behavior, elation, anxiety, poor self-care, and changes in eating habits occur more frequently in patients with FTLD compared with AD. Miller et al showed that stereotyped behavior, hyperorality, loss of personal awareness, and reduction of speech are the symptoms that most clearly differentiate FTD from AD. Bozeat et al reported, using the previous version of the CBI, that stereotypic behavior, changes in eating preference, disinhibition, and decrease in self-care were found more frequently in FTD than in AD patients. In their patient population, frequency of elation was not significantly different between the FTD and the AD patients, and the frequency of anxiety was not reported. Levy et al showed, using the NPI, that patients with FTD exhibited more apathy, disinhibition, euphoria, and aberrant motor behavior than patients with AD. Although the between-group difference did not reach significance, they also reported that anxiety occurred more commonly in FTD than AD patients.

Our study should be considered preliminary because the patients with FTD and SD were not evaluated separately. The small sample size of the FTLD patients, especially SD, limited the statistical power of the analysis. Although Bozeat et al showed that the FTD and SD patients were behaviorally very similar and that there were no significant differences between patients with FTD and SD using the factor analysis, they also mentioned that patients with SD scored higher on mental rigidity and depression and were less disinhibited than patients with FTD. Further study must be performed using a larger population of FTD and SD patients. Overall, we conclude that the CBI reliably reflects the everyday functional ability and neuropsychiatric features of dementia patients, and may be a useful tool for helping in the evaluation of patients’ symptoms in everyday clinical practice settings.

References


