Validity and Reliability of the Thai Version of the Confusion Assessment Method

Suwit Charoensak MD*, Anon Thunmanurukkit MD*,
Gobhathai Sittironnarit MD*, Teerasakdi Sartra MD*

* Department of Psychiatry, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand

Objective: *To investigate the validity and reliability of the Thai version of the confusion assessment method (CAM).*
Material and Method: *One hundred five inpatients who were consulted with the psychiatric consultation-liaison service unit, were enrolled in the present study. The validity assessment of the Thai version of the CAM was done by comparing it with the gold standard diagnosis of delirium by psychiatrists using DSM-IV-TR criteria. The reliability assessment was obtained from a sample of 35 patients assessed by two psychiatric residents.*
Results: *The Thai version of CAM had a sensitivity of 90% and specificity of 94.54. The positive predictive value was 93.75% and the negative predictive value was 91.23%. Likelihood ratio showed 16.5-fold risk of delirium positive through using the Thai CAM. Interrater reliability in diagnosis of delirium was high (k = 0.77).*
Conclusion: *The present study demonstrated that the Thai version of CAM is a valid and reliable tool for assessing and diagnosing delirium in Thailand.*

Keywords: Confusion assessment method, Thai language, Validity, Reliability

Delirium is a common syndrome of acute brain dysfunction that is characterized by alteration of consciousness with reduced ability to focus, sustain, or shift attention, a change in cognition (memory deficit, disorientation, language disturbance), or the development of a perceptual disturbance that develops over a short period of time and tends to fluctuate during the course of the day[1]. Delirium has a high prevalence in hospitalized patients, especially the elderly. It has been estimated that 10% of patients in the emergency department, 10% to 31% of patients in medical units, 50% of patients with hip fractures, and >80% of patients receiving mechanical ventilation in the intensive care unit in the hospital have delirium[2-5]. The prevalence has been increasing with age[6,7]. The studies in Siriraj Hospital (>2,000 beds, university hospital in Thailand) showed that prevalence of delirium in the elderly in psychiatric consultation-liaison was 52.5%[8] and prevalence of delirium in the admitted elderly patients was 40.4%[9].

Delirium is associated with significant mortality, morbidity and increased length of hospital stay and cost. Delirium is also associated with increasing risk of institutionalization and dementia[10]. Despite of its importance, delirium is often undetected and misdiagnosed in the clinical setting. Only 33 to 64% of the patients with delirium are diagnosed[3]. One of important strategies to prevent and manage delirium is early detection and early diagnosis of delirium.

The use of a validated instrument is one of the strategies for improving the recognition and diagnosis of delirium. There are a number of instruments developed for screening and diagnosing delirium. The confusion assessment method (CAM) has been widely accepted and is considered the diagnostic instrument with good validity, reliability and ease of use for both clinicians and non-physicians[11,12]. The CAM consists of 9 diagnostic criteria and four of which are considered core criteria for delirium: (1) acute onset and fluctuation, (2) inattention, (3) disorganized thinking, (4) altered level of consciousness. The first two and at least one of the latter two must be obtained to diagnose delirium. The CAM showed good sensitivity (94-100%), specificity (90-95%), positive predictive value (91-94%) and negative predictive value (90-100%) and its interrater reliability is high (kappa = 0.81-1.00)[11]. It is widely and successfully implemented. The CAM has been translated to many languages but not into Thai. The aim of the present

Correspondence to:
Charoensak S, Department of Psychiatry, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok 10700, Thailand.
Phone: 0-2419-7000, Fax: 0-2411-3430
E-mail: suwitrt@gmail.com

study was to validate and assess interrater reliability of the Thai version of the CAM based on gold standard diagnosis by psychiatrists using DSM-IV-TR criteria for the diagnosis of delirium.

Material and Method

A prospective validation study was conducted in Siriraj Hospital; >2,000 beds university hospital in Bangkok, Thailand. The present study was approved by the Siriraj Institutional Review Board (SIRB), Faculty of Medicine, Mahidol University, Thailand.

Subjects

There were 485 patients aged over 18 years who were consulted with the psychiatric consultation-liaison service unit of Psychiatric Department between November 2010 and April 2011. Of 485 patients, 105 patients were randomly recruited in this study.

Sample size of delirium group was calculated by the following formula.

$$n = \frac{Z_{\alpha/2}^2\ P\ (1-P)}{d^2}$$

$Z_{\alpha/2}$ = 1.96 (confidence level at 95%, two tail)
P = 0.9 (probability of expected sensitivity)
d = 0.1 (probability of error)
$$n = \frac{(1.96)^2(0.9)(0.1)}{(0.1)^2} = 34.57$$

According to data from psychiatric consultation-liaison service unit, about one-third of inpatient cases were delirium. Therefore, the sample size of inpatient cases enrolled in the present study was 3*35 = 105.

CAM translation and back-translation

After receiving permission for the use of the CAM from Professor Sharon Inouye, the CAM was translated from English to Thai version and then back translated to English by a professional translator to ensure accuracy of context and concordance with the original version. This Thai version was then reviewed by psychiatrist to ensure that it was congruent with Thai culture.

Validation of the CAM Thai version and interrater reliability

All subjects were independently interviewed by a third-year resident in psychiatry using the Thai CAM and Thai Mental Status Examination (TMSE), and by attending psychiatrists using DSM-IV-TR criteria for diagnosis of delirium. The Thai CAM interviewer did not know the results of the psychiatric

diagnosis that was performed by the attending psychiatrists who were rotating to the consultation-liaison service unit. The diagnosis of delirium by psychiatrists using DSM-IV-TR criteria was regarded as the gold standard. Concurrent validation was determined by sensitivity, specificity, positive predictive value, negative predictive value and likelihood ratio.

For interrater reliability testing, a subset of 35 patients was enrolled to test the interrater reliability. Two third-year residents in psychiatry independently scored the Thai CAM in the same interview.

Statistical analysis

The statistical package for the social sciences (SPSS17.0) was used. The validity analysis, sensitivity and specificity of the Thai version CAM were calculated and compared to diagnosis by a research psychiatrist using the Thai CAM and attending psychiatrist using DSM-IV-TR criteria. In addition, the positive predictive value and negative predictive value were determined. The likelihood ratio for positive test was defined as sensitivity/(1-specificity). For inter-rater reliability, the kappa coefficient was used for calculation. Differences in baseline characteristics between delirium and non-delirium groups were tested by Chi-square test or Mann-Whitney U-test. A p-value less than 0.05 indicates statistically significant differences.

Results
Subjects

Between November 2010 and April 2011, 105 participants were enrolled in the present study. More than half of the patients were female (53.3%) and the mean age was 57.79±19.96 years. The baseline demographic characteristics are summarized in Table 1. Underlying disease was present around 68.6%. The most common causes of admission were infection (14.3%) and neurological problems (14.3%). Details of causes of admission are shown in Table 2.

Of 105 patients, 50 patients were diagnosed as delirium by psychiatrists using DSM-IV-TR. There were statistically significant differences between delirium and non-delirium groups in age, gender, presence of underlying disease and TMSE score (Table 3). Sixty percent of patients in delirium group were male and of advanced age with presence of underlying disease. The mean TMSE score in delirium group differed from mean TMSE score in non-delirium group with statistically significant difference.

Table 1. Demographic characteristics of inpatient participants

Items	n (105)	%
Mean age (years) ± SD	57.79±19.96	
Gender, male:female	49:56	
Education		
Elementary school	47	44.8
High school	26	24.8
Bachelor	17	16.2
Marital status		
Single	20	19.0
Married	20	19.0
Widowed	65	62.0
Income per month		
No income	61	58.1
>6,000 baht	44	41.9
Underlying disease	72	68.6

Table 2. Causes of admission of inpatient participants

Cause of admission	n (105)	%
Infection	15	14.3
Neurological conditions	15	14.3
Cancer	13	12.4
Gastrointestinal conditions	12	11.4
Cardiac conditions	11	10.5
Gynecological conditions	11	10.5
Orthopedic conditions	7	6.7
Respiratory conditions	6	5.7
Obstetrics conditions	4	3.8
Vascular conditions	4	3.8
Toxicological conditions	3	2.9
ENT* conditions	2	1.9
Traumatic conditions	1	1.0
Urinary tract conditions	1	1.0

* ENT = the ear, nose, and throat

Validity of the Thai CAM

The Thai CAM showed good sensitivity (45/50 patients, 90.00%), specificity (52/55 patients, 94.54%), positive predictive value (93.75%) and negative predictive value (91.23%) for the diagnosis of delirium based on DSM-IV-TR as gold standard. Thai CAM has a likelihood ratio (probability ratio) of 16.5.

Interrater reliability

Interrater agreement of the Thai CAM between two raters (Two third-year residents in psychiatry) was good in diagnosis of delirium (k = 0.77). Interrater reliability of each features of the CAM (k = 0.86-1.00) is demonstrated in Table 4.

Discussion

Delirium is a common syndrome that is associated with significant poor outcome especially in elderly patients[10]. Early detection and early diagnosis of delirium are crucial for patient's care. The use of a valid instrument to detect and early diagnosis of delirium can enhance the management quality. This Thai version of the CAM showed good sensitivity and specificity (90.00% and 94.54%, respectively) and high positive predictive value and negative predictive value (93.75% and 91.23%, respectively). Interrater reliability was also high, with kappa = 0.77. Thus, the Thai version of the CAM is a valid instrument for practical use in Thailand.

The CAM was translated and validated in more than 10 languages[13]. The methodologies were different among these studies, including methods of translation (e.g. translation and back translation, expert panel consensus and unspecified) and reference standard ratings (DSM-III, DSM-IIIR, DSM-IV, or International Classification of Diseases, Tenth Revision, criteria or a consensus diagnosis). In the present study, method of translation was translation

Table 3. Differences in demographic, underlying diseases and TMSE score of patients between delirium group and non-delirium group

	Delirium (n = 50)	Non-delirium (n = 55)	p-value
Gender, male:female	30:20	19:36	0.009
Age range (mean ± SD)	27-96 years (69.18±15.27)	18-80 years (47.44±18.06)	<0.001
Presence of underlying disease	43 (86.0%)	29 (52.7%)	<0.001
Underlying psychiatric disease	9 (18.0%)	10 (18.2%)	0.981
TMSE* score (mean ± SD)	9.18±7.42	23.25±4.98	<0.001

* TMSE = Thai mental status examination

Table 4. Interrater reliability (two psychiatric residents) of the Thai CAM

Component of CAM	Kappa
Diagnose delirium	0.77
Acute onset	1.00
Inattention	0.86
Disorganized thinking	0.94
Altered level of consciousness	0.90
Disorientation	0.93
Impairment of memory	1.00
Perceptual impairment	1.00
Psychomotor agitation	1.00
Psychomotor retardation	1.00
Altered sleep wake cycle	1.00

CAM = confusion assessment method

and back translation, and reference standard was DSM-IV by psychiatrists.

In the present study, the interrater agreement for each CAM component was very good (0.81-1.00). In the present study by Hestermann et al[14], interrater reliability for each CAM feature varied from k = 0.50 to 1.00 and inattention had the lowest interrater reliability (k = 0.50). Although interrater reliability for inattention in the present result had the lowest k-value (k = 0.86), it was still very good agreement. The authors agree with Hestermann et al[14] that the use of digit span for attention evaluation should be added for evaluation.

In the present study, the authors had eight out of 105 patients that indicated discordance with the gold standard. Five patients were of false negative diagnosis. The authors had three false positive diagnose, which the psychiatrist diagnoses were dementia, manic episode bipolar disorder and depression. The false positive diagnosis may be from the clinical manifestation of dementia, bipolar manic episode, and depression that could mimic the symptoms of delirium such as inattention, disorganization of thinking, acute onset of symptoms, and psychomotor agitation.

The strength of the present study was that it was designed to conduct a blind assessment between the CAM rater and the gold standard psychiatrists. In addition, the present study recruited the subjects randomized from consultation-liaison service without the clinicians knowing the diagnosis beforehand.

The CAM was designed for non-psychiatrist clinicians to use for quickly and accurately diagnosing delirium. The present study was performed by a third-year resident in psychiatry who was familiar with the clinical of delirium. The authors suggest that further study should study the Thai CAM when used by non-psychiatrist clinicians and/or nurses.

In summary, the Thai version of CAM is a valid and reliable instrument for the assessment of delirium in Thailand.

Conclusion

The Thai version of CAM showed good validity and reliability. The authors hope that the use of Thai version of CAM could improve the early screening and diagnoses of delirium and improve both the delirium care and the outcomes of the care.

Acknowledgement

Potential conflicts of interest

None.

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ความแม่นยำและความน่าเชื่อถือของ *the confusion assessment method* ฉบับภาษาไทย

สุวิทย์ เจริญศักดิ์, อานนท์ ธรรมานุรักษ์กิจ, กอบหทัย สิทธิรณฤทธิ์, ธีรศักดิ์ สาตรา

วัตถุประสงค์: เพื่อศึกษาความแม่นยำ และความน่าเชื่อถือของ *the confusion assessment method (CAM)* ฉบับภาษาไทย

วัสดุและวิธีการ: การศึกษานี้ทำในผู้ป่วยในที่ถูกส่งปรึกษามาที่หน่วยให้คำปรึกษา ภาควิชาจิตเวชศาสตร์ จำนวน 105 ราย หาค่าความแม่นยำของ *the CAM* ฉบับภาษาไทยในการประเมินภาวะ *delirium* โดยเทียบกับการวินิจฉัย โดยจิตแพทย์ตาม *DSM-IV-TR* ซึ่งเป็น *gold standard* ส่วนค่าความน่าเชื่อถือของ *the CAM* ฉบับภาษาไทยได้จากการทำแบบทดสอบในผู้ป่วยกลุ่มตัวอย่าง จำนวน 35 ราย โดยแพทย์ประจำบ้านจิตเวชศาสตร์ 2 คน

ผลการศึกษา: *The CAM* ฉบับภาษาไทยมีค่าความไว ร้อยละ 90 และความจำเพาะ ร้อยละ 94.54 *positive predictive value* มีค่าร้อยละ 93.75 *negative predictive value* มีค่าร้อยละ 91.23 และ *positive likelihood ratio* 16.5 เท่า *the CAM* ฉบับภาษาไทยมีค่าความน่าเชื่อถือสูงในการวินิจฉัยภาวะ *delirium (k = 0.77)*

สรุป: *The CAM* ฉบับภาษาไทยเป็นเครื่องมือที่มีความแม่นยำและมีความน่าเชื่อถือ สำหรับการประเมินและการวินิจฉัยภาวะ *delirium*