Validation of the Malay 3-Minute Diagnostic Interview for Confusion Assessment Method in a surgical population

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Abstract

Background: Delirium is a common postoperative complication among elderly which can be easily missed and leads to poorer outcomes. The 3-Minute Diagnostic Assessment for Confusion Assessment Method (3D-CAM) is a short and structured tool to assess delirium by healthcare staff with minimal training. This study aimed to validate the translated Malay 3D-CAM (M3D-CAM) in postoperative surgical patients. **Methods:** In this prospective diagnostic study, 3D-CAM was translated into Malay and two assessors (1 and 2) independently interviewed surgical patients above 65 years old with M3D-CAM on postoperative day one. A psychiatrist diagnosed postoperative delirium according to the Diagnostic and Statistical Manual of Mental Disorders 5th Edition (DSM-5) as the reference standard. The sequence of examinations was done randomly with all results blinded to each other and the diagnostic characteristics of M3D-CAM analysed with κ coefficient used to evaluate reliability. **Results:** A total of 427 patients were screened, 111 recruited with a final 100 paired interviews completed. Their mean age was 72 (± 6) years old. Two-thirds of patients were proficient in Malay and English, therefore assessed in both 3D-CAM and M3D-CAM. Delirium was identified in 11% and 12% of patients by assessors 1 and 2 respectively while compared to DSM-5, M3D-CAM had 80% and 90% sensitivity with 96.7% and 97.7% specificity. M3D-CAM had excellent inter-rater reliability (85%), substantial parallel reliability (70%) and features 1 and 3 with substantial parallel agreement ($p < 0.001$).

Conclusion: This study demonstrated that M3D-CAM is reliable and valid for delirium assessment in the postoperative setting.

Keywords: Delirium, Confusion Assessment Method, 3-minute diagnostic, 3D-CAM, Malay 3D CAM, validation

INTRODUCTION

Delirium is a major contributor to postoperative morbidity and mortality in older adult patients after surgery.^{1,2} According to the Diagnostic and Statistical Manual of Mental Disorders 5th Edition (DSM-5), delirium is a neuropsychiatric disorder with acute disturbance in attention and cognition, that is unexplained by another pre-existing neurocognitive condition.³ Clinically, postoperative delirium (POD) manifests as hypoactive, hyperactive or mixed psychomotor

forms that commonly occur within the first three days after surgery.^{4,6} Despite awareness of its importance, the diagnosis is still commonly overlooked and under-diagnosed, with an overall estimated 12-35% detection rate especially in patients with underlying dementia or hypoactive behavioural changes.^{4,7-9}

Although the gold standard in diagnosing delirium had been those set by DSM-5, unfamiliarity and the lack of training frequently contributed to the under-detection of this

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condition.¹⁰ To overcome this difficulty, more than 20 published screening instruments had been developed to improve the practicality for detection of delirium with good diagnostic characteristics.^{4,10,11} In 1990, Inouye *et al.* developed the Confusion Assessment Method (CAM) for a brief, accurate and standardized instrument for detecting delirium by medical staffs who did not undergo extensive training in psychiatry. It is a widely used screening tool with a high sensitivity of 94%, specificity of 89% and excellent inter-rater reliability in many high-quality studies.^{4,11,12} The use of CAM had also been extended by translation into 12 different languages and adapted for use in the intensive care unit (ICU), emergency departments and nursing homes.⁴

However, CAM has its own set of challenges such as relying on substantial interviewer training as a pre-requisite, reliance upon the skill of the rater and a large variability for operationalizing each diagnostic feature. To overcome these issues, an accelerated assessment using the CAM algorithm was developed by Marcantonio *et al.* for brevity and ease of administration with a structured format. The abbreviated version, a new 3-Minute Diagnostic Assessment for CAM-defined delirium, otherwise known as 3D-CAM proved to be highly reproducible and valid for diagnosing delirium as it is specifically constructed for assessments by trained non-psychiatric personnel in general medical patients, above 80 years old with multiple comorbidities and a high burden of baseline cognitive impairment.⁷ The use of 3D-CAM has the potential to improve the recognition of delirium in high risk patients, but to do so widely, it needs to be translated and validated in non-English languages just like CAM previously.

In this study, the primary aim was to translate and develop a version of 3D-CAM in Malay (M3D-CAM) with a secondary aim of validating this tool in our older adult surgical patients.

METHODS

This was a prospective cohort study to validate M3D-CAM in a multiracial surgical patient population of a tertiary referral university-based hospital. The study protocol was approved by Medical Research Ethics Committee and details were reported in ClinicalTrials.gov (NCT03366896). Written informed consent was obtained from all participants or their designated surrogates before surgery.

Translation

The first phase involved cultural adaptation of 3D-CAM into M3D-CAM according to existing guidelines on translation.¹³ Two translators, both anaesthetists proficient in English and Malay (YZ and JW) first performed the forward translation independently. Then, both discussed and merged the copies into a single draft and evaluated again together.

After ethics approval, the first M3D-CAM draft was tested among 20 bilingual healthcare providers from different fields and 5 bilingual patients above 65 years old in the pre-operative anaesthetic clinic. Subsequently, a detailed discussion was made amongst the panel of authors not involved in the first translation (authors CY and CG) to appraise the ease of understanding all instructions, content, and wordings. Based on the feedbacks from the panel and the first batch of 25 participants, adjustments and refinements were made to form the second draft M3D-CAM.

Following this, the second draft M3D-CAM was back translated to English (PS and MM) individually to check for fidelity. The panel reconvened to compare the back translation with the original 3D-CAM and formed a finalized version of M3D-CAM that was approved by the original author. (Figure 1)

Participants and enrolment

Patients above 65 years old who were scheduled for elective and semi-urgent surgery within a period of 3 months in this institution were included in the study. We excluded patients who refused to participate, were unable to communicate in Malay, were planned for postoperative ventilation in ICU, had hearing or speech impairment and preoperative diagnosis of delirium, psychosis, or Glasgow Coma Scale (GCS) of $\leq 11/15$. After obtaining written informed consent, details of baseline characteristics and surgical data were collected.

Validity and reliability testing

The second phase in this study involved Assessor 1 (YZ) and Assessor 2 (a research assistant) for reliability testing. Both were trained in administering 3D-CAM by CG, a psychiatrist before conducting delirium assessment. All assessments were performed in random order by Assessors 1, 2 or psychiatrist (AW) within less than an hour apart. Each would approach patients independently in the surgical wards on postoperative day one and all three were blinded

Figure 1. Methodology flowchart.

to each other's results. Assessor 1 interviewed patients with M3D-CAM and the original 3D-CAM while Assessor 2 interviewed the same patient with M3D-CAM only. To conduct validity testing, AW evaluated the patients according to criteria for delirium in DSM-5. If patients were found to have delirium, the diagnosis was confirmed with a senior psychiatrist (CG) and the primary surgical team was then alerted.

Sample size calculation and data analysis

Sample size was calculated based on the approach of subject to item ratio of 5:1.¹⁴ Therefore, with 20 items in M3D-CAM, the number of patients calculated would be 100. In addition, given the estimated incidence of delirium in our institution among non-cardiac surgical population > 65 years old was 15%.¹⁵ Assuming a width of 95% confidence interval, we needed to enrol 103 and 19 patients for sensitivity and specificity set at 80% respectively. The higher number of 103 was chosen and considering a 5% drop-out rate, the calculated sample size was 108 with the figure rounded up to a total of 110 patients.^{16,17}

Data analysis

All data analyses were performed using IBM software SPSS statistics version 22 package for Windows. Descriptive statistics was performed on baseline characteristics and presented as number

and percentage for categorical data. The diagnostic characteristics of M3D-CAM were matched to a reference standard based on DSM-5 criteria for validation and explored as sensitivity, specificity, positive predictive (PPV) and negative predictive values (NPV). The use of Cohen's κ -coefficient evaluated both inter-rater reliability for M3D-CAM results by Assessors 1 and 2 together with parallel reliability for the original 3D-CAM by Assessor 1 with M3D-CAM results by Assessor 2. Statistical significance was considered at a two-tailed p value of less than 0.05.

RESULTS

Patient characteristics

From 26th June 2016 until 26th September 2016, a total of 437 patients were screened for eligibility from elective surgical lists. Electronic medical records were preliminarily evaluated for suitability to be included with a final number of 110 patients approached and recruited with informed consent. Ten patients dropped out after enrolment because they were discharged before completing reviews by all 3 researchers, refused to be interviewed postoperatively or had their surgery cancelled. A final number of 100 patients were studied within this period as shown in Figure 2.

Their mean age was 72 ($\pm$ 6) years old, with mostly females (58%) and a multi-ethnic population of 46% Chinese, 34% Malay and 18%

Figure 2. Consort diagram of study.

Table 1: Demographic characteristics of the study population

Characteristics (N = 100)	
Age, mean (SD)	71.78 (5.51)
Female n (%)	58 (58%)
Race, n (%)	
Malay	34 (34%)
Chinese	46 (46%)
Indian	18 (18%)
Others	2 (2%)
Language - understood both Malay and English, n (%)	64 (64%)
Severe sensory Impairment – Vision, n (%)	1 (1%)
Surgical discipline, n (%)	
Orthopaedics	45 (45%)
General surgery	20 (20%)
Urology	8 (8%)
Gynaecology	7 (7%)
Others	
Urgency of operation, n (%)	
Elective	65 (65%)
Semi-Emergency	35 (35%)

Indian (Table 1). Almost two-thirds were proficient in both Malay and English. Ten patients (10%) were diagnosed to have delirium postoperatively by the psychiatrist with DSM-5; 8 of them (80%) displayed hypoactive features while the remaining 2 showed hyperactive behaviours. Using the M3D-CAM, Assessors 1 and 2 identified 11% and 12% respectively with delirium. Assessor 1 diagnosed 7.8% delirium amongst the 64 patients who could be tested with 3D-CAM in English. The overall duration of the interviews with M3D-CAM by both assessors were less than 5 minutes.

Diagnostic test characteristics

The validity of M3D-CAM was examined by comparing the detection of postoperative delirium of each assessor using M3D-CAM to the reference standard of diagnosis by a psychiatric expert. Assessor 1 achieved a sensitivity of 80% whilst Assessor 2 achieved 90% (Table 2). Specificity of 96.7% and 97.7% were respectively found by the assessors administering M3D-CAM. In comparison, the sensitivity was 60% and specificity 96.6% in a subset of 64 participants who understood both languages, English and Malay when 3D-CAM was also used (Table 2).

Table 2: Diagnostic characteristics of M3D-CAM

Diagnostic test characteristics of M3D-CAM compared to the reference standard (N=100)		
	Assessor 1	Assessor 2
Sensitivity, % (95% CI)	80 (60 – 100)	90 (71 – 109)
Specificity, % (95% CI)	96.7 (93 – 100)	97.7 (94.6 – 100)
Positive predictive value, % (95% CI)	72.7 (46 – 99)	81.8 (59 – 104)
Negative predictive value, % (95% CI)	97.7 (94 – 100)	98.9 (96.7 – 101)
Diagnostic test characteristics of M3D-CAM compared to the reference standard (N=64)		
Sensitivity, % (95% CI)	60 (20 – 102)	
Specificity, % (95% CI)	96.7 (92 – 102)	
Positive predictive value, % (95% CI)	60 (20 – 102)	
Negative predictive value, % (95% CI)	96.6 (92 – 101)	

Reliability characteristics

Overall, M3D-CAM had a near perfect inter-rater reliability of 85% in diagnosing delirium according to Landis and Koch's measurement of observer agreement.¹⁸ On evaluating reliability of individual M3D-CAM features to detect delirium, feature 2 scored moderate agreement (κ -coefficient 0.53) whereas remaining features of 1, 3 and 4 scored substantial agreement (Table 3).

In addition, the parallel reliability between M3D-CAM compared to its original version was a substantial agreement of 70%. Again, on evaluating reliability of individual 3D-CAM features to detect delirium, feature 2 showed moderate parallel agreement while features 1 and 3 have substantial parallel agreement of 65% and 71% respectively (Table 3). κ -values of feature 4 could not be determined because the number of positive responses was the same in 3D-CAM and Malay 3D-CAM.

DISCUSSION

The results of this study showed that M3D-CAM is a reliable screening instrument for POD in elderly patients. With M3D-CAM, the assessors identified an incidence of 11-12% POD, a figure which corresponded well to the incidence of POD in a local study conducted with different assessment instruments (4-Abbreviation Test and CAM) in a similar cohort of non-cardiac, elderly surgical population.¹⁵ A similar incidence rate has also been reported in a study of a neighbouring country.¹⁹ However, the incidence of POD in this group of ageing population is slightly lower than the reported 13-50% in a recent systematic review on the incidence and outcome of delirium in non-cardiac surgery.⁴ Plausible explanations of a relatively lower POD incidence in our study were due to the exclusion of perioperative Intensive Care Unit (ICU) patients and those who underwent emergency operations. Both groups of patients have consistently shown to result in

higher POD rates.^{4,20} In this study, the majority of affected patients presented clinically with hypoactive delirium with features dominated by symptoms of drowsiness and inactivity compared to hyperactive delirium, which would have been mainly symptoms of restlessness and agitation.²¹ Hypoactive presentation has been the main reason for the under detection of POD in the literature.^{22,23}

Older patients with delirium have an increased risk of admission to long term care or institutionalization upon discharge, lengthy and costly hospital stays with higher mortality rates while persistent delirium symptoms may lead to cognitive decline and dementia.^{4,5,20,21,24-26} Many studies have reported that early detection of postoperative delirium is vital as prompt measures can be taken to reduce its complications, including recognizing and treating underlying medical factors, optimizing the environment or analgesics and lastly, pharmacological treatment for recalcitrant postoperative delirium.^{5,8,27,28} Hence, finding useful assessment instruments with validated translations in non-English languages will facilitate the diagnosis of delirium and widen the use in different populations.¹²

Just like the original 3D-CAM, the aim to be a short, structured diagnostic assessment with strong performance characteristics was achieved with M3D-CAM. Both sensitivity and specificity when validated against the reference standard were high (80-90% and >96% respectively) and these were similar to the findings of Marcantonio *et al.* and the Chinese version of 3D-CAM (3D-CAM-CN).^{7,29} The slightly lower sensitivity compared to specificity was not unlike the findings for 3D-CAM-CN in surgical ICU patients. This was attributed to lower true positives in the postoperative setting because of the inherent challenge faced when recovering patients were interviewed after surgery. Distinguishing inattention or fluctuating changes of consciousness was difficult under the influence of uncontrolled pain or sedative effects of analgesic drugs. The

Table 3: Reliability agreement of both M3D-CAM and 3D-CAM in our study population

Features	M3D-CAM (N=100)		3D-CAM (N=64)	
	κ -value	<i>p</i> -value	κ -value	<i>p</i> -value
1 – Acute onset and fluctuating course	0.687	<0.001	0.646	<0.001
2 – Inattention	0.529	<0.001	0.446	<0.001
3 – Disorganized thinking	0.725	<0.001	0.714	<0.001
4 – Altered level of consciousness	0.662	<0.001	–	–
Diagnosis of Delirium	0.853	<0.001	0.702	<0.001

same was true in other studies involving different assessment instruments such as Nursing Delirium Symptom Checklist (NuDESC) and Confusion Assessment Method for the Intensive Care Unit (CAM-ICU) done in postoperative patient populations which had an even lower sensitivity.³⁰ The contrast was the opposite in the original study of 3D-CAM in which the investigators described a lower specificity instead of sensitivity due to the superimposed effect of delirium on demented elderly patients in medical wards.^{7,31} DSM-5, being the reference standard, has demonstrated a stronger ability to detect subtle changes in mental status compared to less rigorous methods and hence, still the standard of reference.³²

In this study, the sensitivity for detecting delirium with 3D-CAM was substantially lower at 60% compared to using M3D-CAM in two-thirds of the study population who were able to communicate in both English and Malay. Other than postoperative factors mentioned above, the difference in test performance could reflect lower proficiency in English compared to Malay because in this region, English is commonly the second or third language after Malay and their mother-tongue.³³ The importance of delirium assessment tools that are familiar to the language and culture of patients is therefore, highlighted by this finding.

The M3D-CAM demonstrated excellent inter-rater reliability of 85%. The clear explanations on how to code each feature from 3D-CAM had been well translated into M3D-CAM to reduce the amount of judgment required by assessors.⁷ The reproducibility across assessors was consistent with high inter-rater agreement among other translated versions of 3D-CAM.^{7,29} Like its original version, the first 10 items in the M3D-CAM were based on patient's direct response while the subsequent 10 were rated based on observation on patient's behaviour. All features 1-4 would be coded as present or absent. To cumulatively diagnose delirium, features 1 and 2 with either one of features 3 or 4 should be present. The agreement for reliability was statistically significant with three features 1, 3 & 4 demonstrating substantial agreement in their κ -values. Feature 2 was notably the only one with moderate agreement at 0.529 in M3D-CAM and 0.446 in 3D-CAM respectively.³

Feature 2 represented inattention, a core characteristic of delirium which was considered positive when patients' answers were incorrect, "don't know" or they had none or nonsensical response towards the items as its indicators.³⁴ In 3D-CAM the first 4 items to test for

inattention were cognitive tasks with interviewer's instructions to recall numbers or words for weekdays and months backwards followed by 2 items based on interviewer's observation.⁷ The κ -values in 3D-CAM and M3D-CAM were both moderate indicating no difference between the versions of the items in these two languages. In Malay, the words for days and months are name-specific akin to English, hence no cultural adaptation was required unlike the Chinese language in 3D-CAM-CN.²⁹ Another probable explanation was because items 4-7 would have required a higher level of cognitive function to indicate Feature 2 or inattention.³⁴ A better understanding of instructions, recall of numbers or names and subsequent execution of speech would be needed for these cognitive tasks and because it depended on cognitive function, other factors such as education level would have been linked to a poorer performance and lower agreement.^{35,36} Therefore, to examine the feature of inattention, some studies have suggested to utilize not only a single assessment method but to take it a step further with additional assessment instruments.^{29,37}

The strength of this study included having a majority of the study population with bilingual ability.³⁸ This allowed parallel testing of M3D-CAM alongside with the original English version by the assessors. A substantial κ -value of 0.71 was demonstrated, which would otherwise be impossible in previous study populations who could only communicate in a single language.²⁹ Conducted in a rigorous design in which the screening instruments and psychiatric examination were administered with results blinded to each assessor, this translated version underwent a high-quality evaluation culminating in an assessment with good diagnostics characteristics and agreement for use in a Malay speaking community.

This study has limitations. Assessments were done during daytime and only once per day by each assessor. As with the criteria for a fluctuating course in delirium, some patients' diagnosis could have been missed. Secondly, the present study was performed in a single centre by an experienced trained research team and only enrolled patients after surgery. This may limit the generalizability of our results. We did not examine confounding variables such as pain scores or the effects of prescribed analgesics with sedative effects on the first postoperative day. Furthermore, no stratification of participants' baseline cognitive function was investigated for the analysis of M3D-CAM's psychometric properties that could be affected by pre-existing cognitive impairment.

In conclusion, despite being a common neuropsychiatric disorder with potentially serious sequelae, the diagnosis of POD is still regrettably not often actively sought in the geriatric population. We report that M3D-CAM is a reliable, sensitive, and specific screening tool for clinicians of non-psychiatric background. Coupled with the ease and brevity of its use, M3D-CAM can be easily incorporated into the daily clinical practice for prompt detection of POD in patients who can speak only Malay.

DISCLOSURE

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