ORIGINAL

Validation of the Dutch version of the Confusion Assessment Method (CAM-ICU) for delirium screening in the Intensive Care Unit

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Abstract - Background Delirium is frequently encountered in hospital settings especially in the Intensive Care Unit (ICU), with an incidence of 42% to 87%. The aetiology of delirium is still unknown but research has shown that prevention and treatment is possible. Early detection is a necessary first step for successful treatment and prevention in the ICU. The Confusion Assessment Method for the ICU (CAM-ICU) is a rapid and easily administered screening instrument to detect delirium in the ICU setting and is based on the Diagnostic and Statistic Manual of Mental Disorders IV criteria (DSM-IV) The aim of this study was to validate the Dutch version of the CAM-ICU. **Methods** The CAM-ICU was translated in accordance with standard translation guidelines. The validation study of the Dutch CAM-ICU version was performed in a large Dutch community hospital with a mixed ICU. The patients were tested by a geriatrician or a psychiatrist for clinical symptoms of delirium according to the DSM IV criteria (= reference standard), and the results were compared with independently scored CAM-ICU outcomes. **Results** Thirty consecutive adult patients with Richmond Agitation and Sedation Scale (RASS) ≥ –3 were assessed for delirium using the CAM-ICU and the DSM-IV criteria, resulting in 60 paired tests. Twenty-nine patients were included in the analysis. Based on the DSM-IV criteria 11 of 29 patients had delirium and 9 of 29 scored positive on the CAM-ICU. Only three patients were diagnosed differently by the geriatrician or psychiatrist and the CAM-ICU, two had a psychiatric disorder and one had been sedated and was therefore excluded. Agreement was calculated using crosstabs analysis, overall agreement was 93.1%. In our validation cohort the incidence of delirium was 37.9%. **Conclusion** The translation of the Dutch CAM-ICU showed good correlation with the original English version and can therefore be used in a Dutch ICU. The results of the validation study showed very good agreement between the clinical diagnoses made by the experts and the detection of delirium using the Dutch CAM-ICU. The Dutch CAM-ICU reliably detects ICU delirium. It therefore provides the means for early detection, treatment and secondary prevention of ICU delirium.

Background

Delirium is a common psychiatric syndrome in Intensive Care Units (ICU). Incidence estimates for delirium vary from 5% for non-ICU patients to 87% for ICU patients [1-3]. ICU delirium is associated with increased morbidity and negatively affects 6-months survival and weaning from mechanical ventilation and contributes to the increased length of stay [4-7]. Delirium is often under-diagnosed by ICU professionals [8,9]. Establishing a diagnosis of delirium can be difficult because of the fluctuating course of delirium symptoms. Delirium receives little attention in the ICUs, because it is, 1. rarely a primary reason for admission, 2. often believed to be iatrogenic due to medications, 3. frequently rationalized as "ICU psychosis", and 4. believed to have no adverse consequences in terms of patient outcome [5]. Despite

international and national guidelines [29,30], no more than 7% of ICUs in the Netherlands have routinely evaluated the presence of delirium with a validated instrument. Fewer than one-third of Dutch ICUs use a protocol to treat ICU delirium [10]. ICU patients and particularly mechanically-ventilated patients, are at risk of delirium. The outcome of delirium is negative: more ventilation days, longer hospitalization and higher morbidity and mortality, therefore detecting and treating this syndrome is very important [4-7].

The CAM-ICU was developed as a screening instrument for the detection of delirium in nonverbal ICU patients. As a screening instrument for delirium the CAM-ICU is the best validated and studied instrument [9, 12-15]. Versions of the CAM-ICU are available in various languages, thus making international comparison of results possible. (www.icudelirium.org, also Dutch version). Implementation of a screening instrument such as the CAM-ICU leads to improved detection of delirium [6, 17-18].

The aim of this study was to assess validity of the Dutch translation of the CAM-ICU by comparing delirium as assessed

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by the Dutch CAM-ICU with a reference standard, i.e. the DSM-IV diagnosis of delirium.

Methods

Patients

This study was undertaken in a 14-bed ICU at a large teaching hospital in the Netherlands between October 2007 and January 2008. Consecutively-admitted, mechanically-ventilated patients who had a RASS score of ≥ –3 were included in the study. Patients with a known addiction to alcohol or narcotics were excluded (because of withdrawal delirium); patients with no possible means of communication (e.g. prior neurological disease); and patients for whom medical interventions changed during assessments (for example after sedation with benzodiazepines), were also excluded.

The research nurse checked daily whether newly-admitted patients met the inclusion criteria and during the index ICU period assessed the CAM-ICU independently from the psychiatrist or geriatrician. All assessments were planned between 10.00 and 11.00. None of the raters had access to any of the other's evaluations or ratings. A psychiatrist or geriatrician made the diagnosis of delirium using DSM-IV criteria, the research nurse used the CAM-ICU algorithm. Both physician and nurse raters had access to medical charts and were allowed to interview the nurses involved in daily care of the patient.

Translation process

In general, when directions relating to an instrument are translated, the text should be understandable and meaningful and the translation must be as close to the original text as possible. As a consequence, results of measurements done with the translated instrument should be the same as if the original instrument were used.

After consent was obtained from the author, the CAM-ICU, Attention Screening Examination (ASE) and Richmond Agitation and Sedation Scale (RASS) were translated into Dutch by members of our research group (RV, JJ, KK) a senior geriatrician, a neuropsychologist and a Master of Science in Nursing.

Table 1. Patient Characteristics

VARIABLE	VALUE
Characteristics	
Age (years; mean ± SD)	61.2 ± 15.48
Male/female sex (n)	15/14
Days on ICU (days mean± SD)	16.93± 22.53
Days in Hospital (days mean± SD)	46.86± 44.28
Admitting diagnosis (n[%])	
respiratory problems	6 [20.7]
malignancy	8 [27.6]
heart/vascular system problems	6 [20.7]
other internal problems	6 [20.7]
trauma	2 [6.9]
other	1 [3.4]

The Richmond Agitation-Sedation Scale (RASS) [19]

The RASS measures sedation and agitation and is necessary to establish if the patient can be tested. It is a brief 10-point rating scale (-5 unarousable to +4 combative). The CAM-ICU can only be assessed in patients with RASS > -4. (Appendix 3)

The Confusion Assessment Method for the ICU [2-3, 20]. The CAM-ICU is a screening instrument specifically adapted from the CAM for use in ICU patients. CAM-ICU items are non-verbal tasks such as picture recognition, vigilance A task, simple yes/no logic questions and simple commands. A positive CAM-ICU screen is based on an algorithm including four key criteria for delirium. The validity and reliability of the English version of the CAM-ICU was established in two large studies (N= 750) with Kappa as high as 0.96 and sensitivity 100% and specificity ≥ 93%.

Diagnostic and Statistical Manual of Mental Disorders IV (DSM-IV) [21,22]. The DSM-IV is a categorical classification system. The categories are prototypes, and a patient with a close approximation to the prototype is said to have that disorder. (Appendix 4)

The translation

The translation was done according the principles of good translation. The process of translation involved preparation, forward translation, translation review, harmonization, cognitive debriefing and validation of the translated CAM-ICU [23].

Consensus on the translation was reached on the instrument's contents and structure. Experienced nurses working in a large Dutch hospital commented on the Dutch translation in respect of ambiguous wording, concepts or other elements that they were unable to understand. The Dutch version was judged to be similar to the original English version of the CAM-ICU as checked

Table 2. Performance of clinical diagnosis compared with CAM-ICU

			DSM_IV diagnosis Delirium		
			No delirium	Delirium	Total
Delirium CAM-ICU	No delirium	Count	18	2	20
		% within clinical diagnose delirium	100.0%	18.2%	69.0%
	Delirium	Count	0	9	9
		% within clinical diagnosis delirium	0.0%	81.8%	31.0%
Total		Count	18	11	29
		% within clinical diagnosis delirium	100%	100.0%	100.0%

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by a professional translator. The author of the original CAM-ICU accepted the translation of the Dutch CAM-ICU and published it on the website (www.icudelirium.org). Appendix 1, 2, 3.

Statistical method
Means or proportions were used to describe demographic and clinical characteristics of the study sample. Absolute agreement between the two tests (DSM-IV and CAM-ICU) was examined using a two-by-two table. SPSS software version 14 (SPSS Inc., Chicago, Il) was used for analyses. For the validation of the Dutch version we followed the method Ely et al used. In a pilot study they found a test sensitivity of 95% averaging across raters, and a test specificity of 88%. They stated that instrument sensitivity was the critical feature and that the lower limit of 95% confidence interval had to be 85% or higher, while an acceptable specificity would be 75% or higher [3]. After consulting a statistician we discussed the lower limit of the sensitivity and specificity and reached a consensus that the lower limit for sensitivity should be 80%, and for specificity 70%. The sample size was calculated to ensure the appropriate number of patients necessary to

achieve the expected lower limit of the 95% confidence interval for the CAM-ICU sensitivity and specificity in alert or lethargic patients. Because there are no data on prevalence of delirium in Dutch ICUs, we assumed an incidence of delirium of 50% which would require 30 patients. Because the CAM-ICU has been well validated in several studies we did not have to do a extended study with a large population. In a two-by-two table we only needed five patients per cell and for comparison we needed a minimum of 20 patients. The performance test characteristics for the CAM-ICU were estimated from simple two-by-two tables, a cross tab analysis to compare the outcome (delirium yes/no) of the CAM-ICU and DSM-IV.

Results

A total of 30 patients were included. One patient was excluded because sedatives had been given between clinical and CAM-ICU assessments. The average age of the patients was 61.2 years, (27-87), male/female ratio was 15/14, the average stay on the ICU was 16.93 days and average stay in hospital was 46.86 days. Reasons for being admitted to ICU were pulmonary disease 20.7%, malignancy 27.6.%, cardiovascular 20.7%, internal medical conditions 20.7%, trauma 6.9% and other 3.4%. (Table 1)

Eleven of 29 patients had delirium (DSM-IV, 37.9%), and 9 of 29 patients screened positive on the CAM-ICU (31%). Absolute agreement between clinical diagnosis and CAM-ICU was 93.1%. CAM-ICU sensitivity was 81.8% and specificity 100%. (Table 2) Evaluation of discordant cases showed that two CAM-ICU positive patients were diagnosed with a primary psychiatric disorder (schizophrenia).

Discussion

Screening instruments can be useful for detecting delirium. Besides the CAM-ICU, instruments available for the ICU include the Cognitive Test for Delirium (CTD) by Hart (1996) with a sensitivity of 100% and a specificity of 95.1%, and the Intensive Care Delirium Screening Checklist (ICDSC) by Bergeron (2001) with a sensitivity of 99% and a specificity of 64%. The CTD and ICDSC scales are not well validated instruments and more research needs to be done [11]. With the rise in clinician and nursing workload and the ever-increasing numbers of protocols being implemented into ICU practice, ICU staff may feel that there is little time available to routinely evaluate their patients [28]. The CAM-ICU is easy to administer and takes two minutes to complete, the CTD takes > 15 minutes to complete and the time it takes to complete the ICDSC is not known.

This study evaluated CAM-ICU (Dutch version) validity compared with a diagnosis of delirium (based on the DSM-IV) in ICU patients. Absolute agreement between research nurse-based CAM-ICU assessments and clinical diagnosis of delirium based on the DSM-IV was 93.1%. A sensitivity of 81.8% and a specificity of 100% demonstrate that the CAM-ICU Dutch version is a valid measure of delirium in ICU patients. Our sensitivity of 81.8% was under the lower limit of 85% stated by Ely et al [3]. We discussed this in our group and found the sensitivity acceptable. If patients

Appendix 1. CAM-IC

(Dutch version as applied; English version can be found at www.icudelirium.org.)

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with a history of psychosis were excluded (as in the study of Ely [3]), sensitivity would be even higher - up to 100% - which is far above the lower limit, and also the absolute agreement would be 100%. Our results confirm those of others using the CAM-ICU. Studies using the English, Swedish and Chinese versions of CAM-ICU showed sensitivity values ranging from 73% to 100% and specificity values ranging from 89% to 100% [2-3, 24-25]. Because the results were the same we do not think it is necessary to perform another validation study for the CAM-ICU.

A high level of agreement between CAM-ICU ratings and diagnosis of delirium is clinically important. Eleven of 29 patients had delirium (DSM-IV); all but two screened positive on the CAM-ICU, and none of the patients without delirium did. So, nurse-based assessments of delirium can be an efficient way of detecting delirium in the ICU. These are positive findings and need to be further implemented in daily practice in ICUs in the Netherlands.
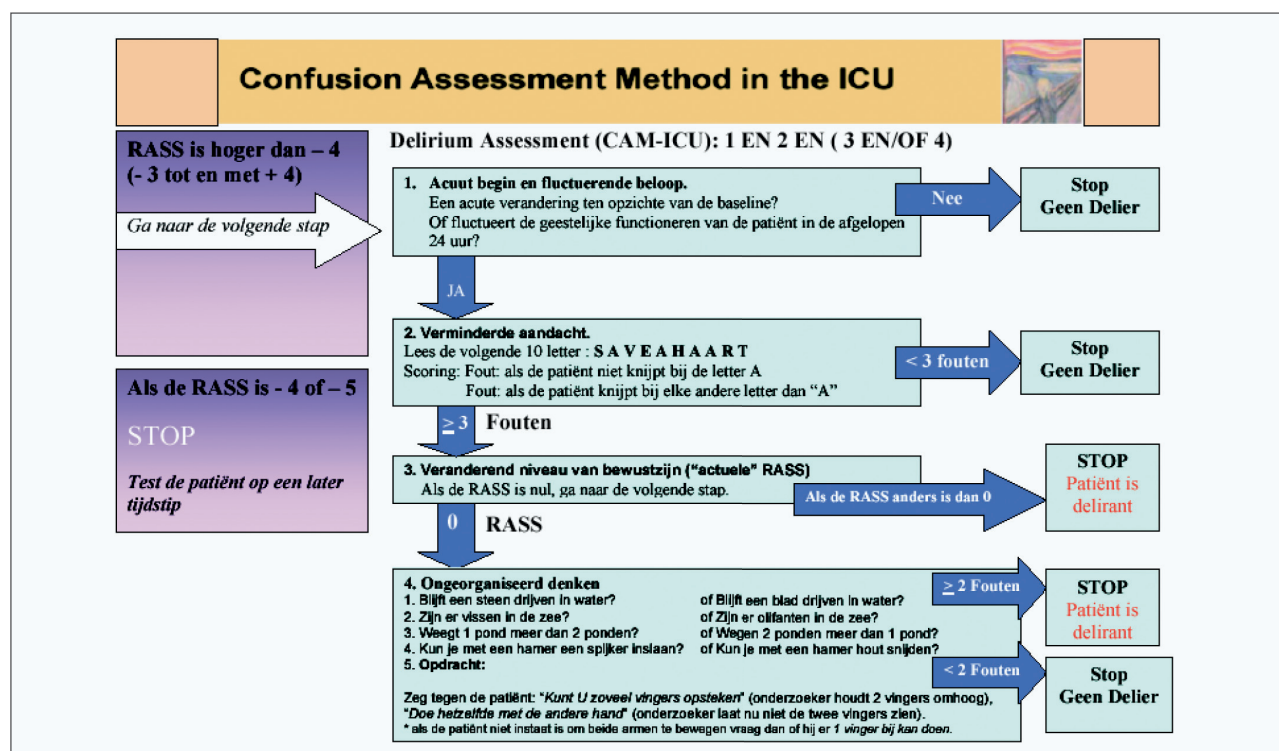
In most studies different assessments are planned on the same day. Because of the fluctuating nature of delirium symptoms, with night-time restlessness, often no symptoms during the day and worsening of symptoms starting at sundown, different raters may see different behaviours and classify patients accordingly. In other studies, the time interval between CAM-ICU assessments and clinical judgments varied from 10 minutes to 4 hours or was based on a chart review [2-3, 6, 13, 20]. It could in part explain some of the lower CAM-ICU sensitivity values found,

although Ely et al. found no differences in the diagnosis, where they were up to four hours apart [2]. To our knowledge this is the first study carefully doing CAM-ICU ratings and making the clinical diagnosis of delirium at the same time, so as to avoid measuring unwanted inter-assessment score variances due to symptom fluctuations. In our study we planned assessments not more than one hour apart from each other, but never together and with blinding of the results. Strict adherence to the assessment protocol was achieved throughout the study. In fact, this may be the reason why nurse-based CAM-ICU ratings predicted delirium diagnosis so well.

The first problem was making the clinical diagnosis. In a previous study delirium recognition was very poor [8]. The clinical diagnosis made by an ICU physician could therefore not be automatically used as a reference standard against the CAM-ICU. In this study the CAM-ICU ratings were compared with a clinical diagnosis made by a psychiatrist or geriatrician who were well trained in all aspects of delirium. In other studies the validation procedure was done differently. In one study agreement between the two measures was based on a chart-based method and research nurse CAM-ICU ratings comparison [20]. And in some studies it is not clear if CAM-ICU ratings had been related to clinical judgement by experts [6, 24-25].

A potential limitation is that our research nurse selected the patients to be included and also made the CAM-ICU assessments. This may have biased the results thus challenging

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Appendix 2. Flowchart CAM-ICU

(Dutch version as applied; English version can be found at www.icudelirium.org.)

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validity. However, subjects both with and without delirium were selected. Patient selection was in part based on RASS sedation evaluation and not based on the presence or absence of delirium as measured with the CAM-ICU. Therefore, we believe that the validity of our results is not challenged. Another limitation is that assessment, although done at the time of clinical diagnosis, took place in the morning for practical reasons and often the first signs of delirium start to appear at sun downing [26]. The small number of patients was also a limitation of this study, although this does not influence its validity it can affect the precision of its estimates.

During this study all the CAM-ICU measurements were performed by one trained research nurse. This was not a limitation because all CAM-ICU assessments were done in the same way, so a possible bias due to different raters was anticipated. Further study on if CAM-ICU administered by nurses in daily practice has the same results on sensitivity and specificity is indicated. However, before implementation of the CAM-ICU into daily practice, nurses should be educated on delirium. Pun et al. established that it only takes minimal training to record excellent compliance by bedside nurses in using delirium instruments. Education should be considered the core component of the

implementation, as it has been shown to improve delirium assessment reliability [27].

The validation of a delirium instrument for the ICU opens new frontiers for investigation [3]. Aspects such as the impact of delirium on relation to outcome, determination of risk factors for delirium in the ICU, prevention, but also incidence of delirium in Dutch ICUs need to be further studied.

Acknowledgement

Appendix 3. RASS

(Dutch version as applied; English version can be found at www.icudelirium.org.)

Appendix 4. DSM-IV criteria

THE DIAGNOSTIC AND STATISTICAL MANUAL OF MENTAL DISORDERS (DSM-IV) CRITERIA FOR DELIRIUM

a. Disturbance of consciousness: That is, reduced clarity of awareness of the environment, with reduced ability to focus, sustain, or shift attention.

b. A change in cognition: such as memory deficit, disorientation, language disturbance or the development of a perceptual disturbance that is not better accounted for by a pre-existing established or evolving dementia.

c. The disturbance develops over a short period of time (usually hours to days) and tends to fluctuate during the course of the day.

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