Validation of the Confusion Assessment Method in the Intensive Care Unit in the Post-Anesthesia Care Unit

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Dedication

To my husband, who never felt like he took the back burner.

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Abstract

Introduction: Patients who develop delirium while hospitalized are increasingly recognized as at risk for the development of long term cognitive impairment. We became interested in the contribution of delirium to the development of post-operative cognitive dysfunction (POCD) when we found that patients at Mayo Clinic in Arizona, compared to patients at the Mayo facilities in Rochester, MN, were 17 times more likely to receive the drug physostigmine (Antilirium®) for the treatment of delirium in the Post Anesthesia Care Unit (PACU). However, before we could examine the relationship between delirium and POCD we needed to validate a tool we could use to quickly assess the presence of delirium in patients emerging from anesthesia in the PACU.

Hypothesis: The Confusion Assessment Method in the Intensive Care Unit (CAM-ICU) can be used in the PACU to identify patients with delirium.

Methods: Patients 65 years of age or greater who were going to have a standardized general anesthetic for a surgical procedure were identified on the day of surgery and consent to participate in the study

was obtained. The CAM-ICU was used preoperatively to determine study eligibility (patients who scored less than 7 [scale of 1-10], indicating delirium, on the test were not followed further) and postoperatively, one hour after the patient was admitted to the PACU, to assess for delirium. The CAM-ICU was administered after we asked the patient's nurse whether or not he or she had determined that the patient was delirious.

Results: 168 patients, mean age 75 ± 7 (SD) with the majority of participants having urologic or orthopedic procedures were assessed pre- and post-operatively with the CAM-ICU, and post-operatively by a nursing assessment for delirium. The CAM-ICU took little time to administer and was easy for patients to understand and use. The nurse at the bedside identified 5 of 168 patients as delirious (prevalence of 2.98%). The CAM-ICU was positive for delirium in 11 of 168 (6.55%). The CAM-ICU had a sensitivity of 60% (3/5) and a specificity of 95% (155/163).

Conclusion: In this investigation, the CAM-ICU was easy to use and had a high specificity for identifying post-operative delirium.

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Introduction

Patients who develop delirium during their hospital course are increasingly recognized as at risk for the development of long term cognitive impairment (Deiner & Silverstein, 2009) (Hudetz, 2009). Over approximately the last 10 years there is also increasing awareness that anesthesia per se contributes to the development of cognitive dysfunction – so called post-operative cognitive dysfunction (POCD) (Moller, 1998), defined as a decline in variety of neuropsychological domains such as memory, executive function, and processing speeds (Leung).

We became interested in the contribution of delirium to the development of POCD when we found that patients at Mayo Clinic in Arizona, compared to patients at the Mayo facilities in Rochester, MN, were 17 times more likely to receive the drug physostigmine (Antilirium®) for the treatment of delirium in the PACU, for reasons currently unknown. One theory, and the basis for future studies, is the use of different anesthetic agents and/or their ratios. It is important to note that delirium is a separate entity compared to POCD, characterized as an acute confusional state with alterations and fluctuations in attention and consciousness (Leung). It is imperative to

recognize and treat delirium in postoperative patients, as its development is linked to prolonged hospitalization, functional status and cognitive decline post-discharge, increased cost and increased mortality (Leung).

In order to continue studies of this problem, we needed a tool we could use in the PACU by which we could quickly assess for the presence of delirium. Currently at MCA our quality assurance program does not track the incidence of delirium in the PACU. The diagnosis of delirium is made by the subjective assessment of the nurse caring for the patient in the PACU; when she or he thinks the patient is delirious they contact the patient's anesthesiologist -- he or she then evaluats and treats the patient accordingly. In our interactions with nurses in the PACU it is clear that they are good at assessing those patients who are confused and "thrashing" about in the bed. They are less likely to recognize delirium in those patients who are confused, but who are hypoactive – those who are silent and motionless, likely because they think the patient is merely sleeping.

Delirium is also a problem in ICU patients, and the tool used most frequently in ICUs is the CAM-ICU (Ely, 2001). We have used this

test in several patients in the PACU. The test is readily accepted by patients, easy to use, and if we validate it we will be able to determine the incidence of delirium in our PACU patient population.

Background

The CAM-ICU was first developed in 1990 by Inouye et al. (Inouye, van Dyck, Alessi, & al., 1990) (Ely, 2001), in attempt to improve the assessment of delirium by non-psychiatrists. Based on expert opinion and definitions guided by the American Psychiatric Association (published in the Diagnostic and Statistical Manual of Mental Disorders [DSM], third revised edition), the CAM-ICU was made to assist non-psychiatric clinicians (Inouye, van Dyck, Alessi, & al., 1990) (Ely, 2001). Upon comparison with other delirium assessment tools, the CAM-ICU seems to have the overall best combination of ease and speed of use, data acquirement, reliability, and validity (Ely, 2001) (Smith, Breitbart, & Meredith, 1995). Currently, there is no routine use of a delirium assessment tool in the PACU.

Significance

Better recognition of delirium in the post-operative setting can help in determining the cause(s) and potentially reduce the incidence of post-operative delirium and cognitive dysfunction.

Hypothesis

The CAM-ICU is a valid delirium assessment tool that can be quickly and easily administered with a high specificity and sensitivity.

Research Materials and Methods

The Mayo Clinic Institutional Review Board (IRB) approval was sought and obtained prior to the collection of any data.

From March to July, 2011, patients greater than age 65 years of age (this population has been identified in other studies as having a high incidence of POCD) (Monk, 2008) who had a general anesthetic for a surgical procedure were identified the day of surgery and were asked in the pre-anesthetic care area if they would be willing to participate in the study. Fifteen patients were approached and either refused to participate or did not qualify based on the preoperative CAM-ICU assessment. From this surgical group, we documented the procedure performed knowing that certain procedures have a higher incidence of cognitive impairment (such as total hip arthroplasty probably secondary to venous emboli following implantation of the trochanteric component). We obtained verbal consent from the patient, documenting this consent in the patient's medical record. Written consent is not required by the IRB for a low risk study.

The Confusion Assessment Method in the Intensive Care Unit (CAM-ICU) was used both pre and postoperatively, first to determine study

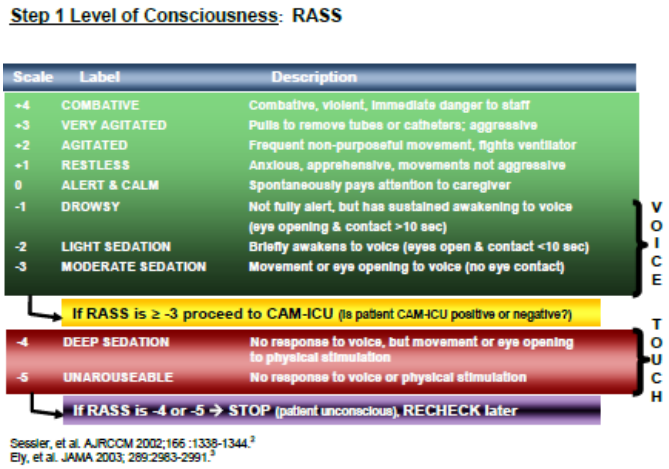
eligibility then as an assessment for delirium. We considered using the Mini-Mental Status Exam (MMSE) to determine study eligibility but for time and validation purposes we had to use the same tool preoperatively and postoperatively.

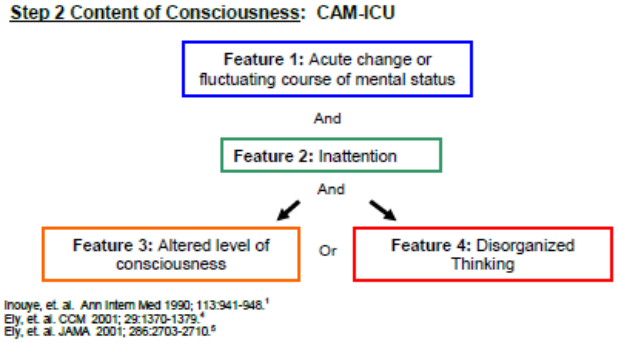
The CAM-ICU took approximately 1-2 minutes to administer, with up to three minutes in the most delirious participant. Those patients who scored less than 7 on a scale of 1-10 preoperatively were not followed further. There were no changes in the patient's anesthetic or surgical plan based on study participation or testing results. One hour after the patient was admitted to the PACU the CAM-ICU was re-administered, after we had asked the patient's nurse whether or not he or she thought that the patient was delirious. Patients with a score of less than 7 on the postoperative CAM-ICU were diagnosed as having delirium. If either the nurse or we thought that an individual patient had changed from the pre-operative baseline we contacted the patient's anesthesiologist with that information, as is the current practice.

Study data were collected and managed using REDCap electronic data capture tools hosted at Mayo Clinic Hospital – Phoenix (Harris, Taylor, Thielke, Payne, Gonzales, & Conde, 2009). REDCap (Research

Electronic Data Capture) is a secure, web-based application designed to support data capture for research studies, providing: 1) an intuitive interface for validated data entry; 2) audit trails for tracking data manipulation and export procedures; 3) automated export procedures for seamless data downloads to common statistical packages; and 4) procedures for importing data from external sources.

Figure 1: CAM-ICU





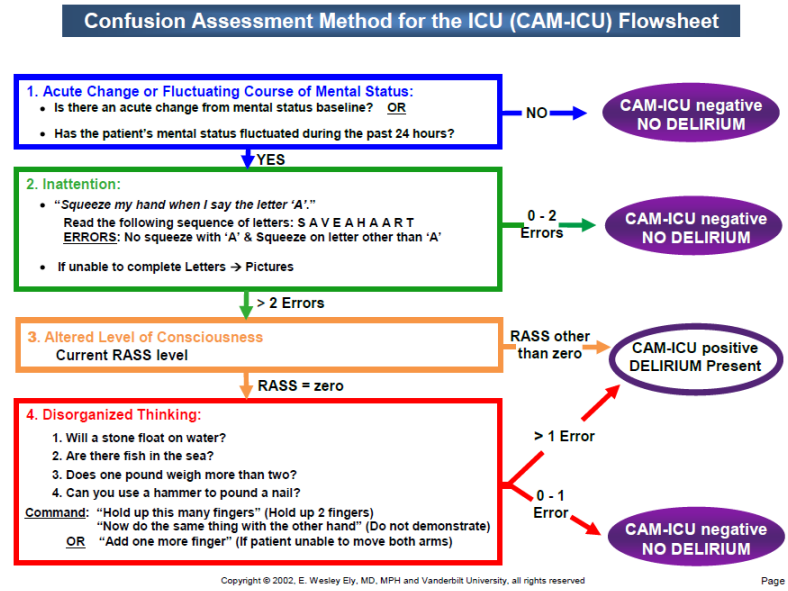


Figure 2: CAM-ICU for PACU Score Sheet

Feature 1: Acute Onset or Fluctuating Course	**Score**	**Points**
Is the pt different than his/her baseline mental status? OR Has the patient had any fluctuation in mental status as evidenced by fluctuation on a sedation scale (i.e., RASS)?	Either question Yes = 0 points No = 10 points	 *If 10, stop here
Feature 2: Inattention		
Letters Attention Test (See training manual for alternate **Pictures**) Directions: Say to the patient, *"I am going to read you a series of 10 letters. Whenever you hear the letter „A," indicate by squeezing my hand."* Read letters from the following letter list in a normal tone 3 seconds apart. **S A V E A H A A R T** **Errors are counted when patient fails to squeeze on the letter "A" and when the patient squeezes on any letter other than "A."**	**Number of Errors >2** Inattention present = 0 points **0-2 Errors** Inattention absent= 10 points	 *If 10, stop here
Feature 3: Altered Level of Consciousness		
Present if the Actual RASS score is anything other than alert and calm (zero)	RASS 0 = 3 points RASS < or > 0 = 0 points	
Feature 4:Disorganized Thinking		
Yes/No Questions (See training manual for alternate set of questions) 1. Will a stone float on water? 2. Are there fish in the sea? 3. Does one pound weigh more than two pounds? 4. Can you use a hammer to pound a nail? *Errors are counted when the patient incorrectly answers a question. **Command** Say to patient: ―Hold up this many fingers‖ (Hold 2 fingers in front of patient) ―Now do the same thing with the other hand‖ (Do not repeat number of fingers) *If pt is unable to move both arms, for 2nd part of command ask patient to ―Add one more finger‖ *An error is counted if patient is unable to complete the entire command.	**Question Errors** 0-1 = 2 points 2-4 = 0 points **Commands** Does both = 2 points Does one = 1 point Does none = 0 points	
	Total Score	

Criteria Met → Total score < 7	☐ **CAM-ICU Positive (Delirium Present)**
Criteria Not Met → Total score 7 or >	☐ **CAM-ICU Negative (No Delirium)**

Results

A total of 168 patients were assessed pre- and post-operatively with the CAM-ICU, and post-operatively by a nursing assessment for delirium. Assuming the nursing assessment is the gold standard, a PACU delirium prevalence of 2.98% (5/168) was determined. However, the CAM-ICU was positive for delirium in 6.55% (11/168).

Compared to our gold standard, the CAM-ICU portrayed a sensitivity of 60% (3/5) and a specificity of 95% (155/163).

The mean age of the study population was 75 ± 7 (SD) with the majority of participants having urologic or orthopedic procedures. Other surgical categories included abdominal, vascular, thoracic, gynecological, head and neck, back and neurological, and "other."

Table 1: Sensitivity/Specificity of CAM-ICU

	CAM-ICU: Delirium	CAM-ICU: No delirium	
RN assessment: Delirium	3	2	3/5 = 60.0% sensitivity
RN assessment: No delirium	8	155	155/163 = 95.1% specificity

Table 2: Delirium rate by procedure type

Procedure	Total	RN assessment: Delirium	CAM-ICU: Delirium
Urologic	47	1	
Orthopedic	34		2
Other	25	1	
Abdominal	21	2	5
Head/Neck	12		2
Back/Neuro	11		
Vascular	9		
Gynecological	6	1	2
Thoracic	3		
Totals	168	5	11

Discussion

According to previous studies, postoperative delirium can affect 10–70% of patients older than 65 years undergoing surgery depending on the investigated group of patients, the type of surgery and the delirium assessment tool used (Steiner, 2011). With a measured incidence of 2.98% in our PACU (based on the standard RN assessment) or a rate of 6.55% (based on the CAM-ICU), we suspect our results are lower secondary to excluding the more critically ill patients admitted to the ICU and delaying reassessment until the patient was one hour post-operation allowing for further metabolism and excretion of anesthetic medications. Although we report a lower incidence compared to other studies, this value is concerning, representing an alarmingly high rate of delirium in an otherwise healthy population of patients.

Currently, there is no validated method by which to assess delirium in the PACU. In this investigation, the CAM-ICU was shown to be an easy to use delirium assessment tool with a specificity of 95% (155/163) and a sensitivity of 60% (3/5).

Because PACU nurses do not currently try to identify the hypoactive phase of delirium, it is no surprise the CAM-ICU assessment resulted in a higher incidence of delirium. The low sensitivity of the CAM-ICU may have to do with the fact that the test was administered one hour after admission to the PACU whereas the nurse had been with the patient that entire hour. The patient upon admission to the ICU may have been combative or confused, problems that had resolved spontaneously by the time we administered our test, but which may have led the PACU nurse to classify the patient as delirious. To resolve this issue in future studies, we would likely need to have a PACU nurse "blinded" to the patient's behavior during the first hour in the PACU and to the results of the CAM-ICU make a determination as to whether or not the patient was "delirious" one hour after admission to the PACU.

The strengths of this study include the diversity of procedures performed on participants and the comparison of delirium assessment with nursing staff, which is the current standard practice in the PACU. Another important strength was the use of a fast, standardized,

and easy to use delirium assessment tool, which should allow easy implementation of the CAM-ICU in the PACU setting.

Limitations of this study include the lack of a "gold" standard and a time point for making the diagnosis of delirium in the PACU.

Future Directions

The validation of the CAM in the PACU setting allows for a multitude of future studies such as the effect of various anesthetic agents on the incidence of postoperative delirium.

Conclusions

Patients who develop delirium can have long-term cognitive impairment and higher mortality rates (Steiner, 2011), which emphasize the importance of allowing for a quick and accurate diagnosis of delirium. The CAM-ICU can be adapted to the PACU setting allowing for a rapid diagnosis of delirium in PACU patients.

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