

Comparison of three scores to screen for delirium in the recovery room

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Background. Delirium is often seen in the recovery room and is a predictor for postoperative delirium on the ward. However, monitoring to detect delirium in the recovery room as a basic prerequisite for early intervention is rarely used. The aim of this study was to identify a valid and easy-to-use test for early screening of delirium in the recovery room.

Methods. One hundred and fifty-four adult patients admitted to the recovery room during regular working hours were included. A screening assessment for delirium was performed in the recovery room by a trained research team at the time when the patient was judged to be 'ready for discharge'. Delirium monitoring was performed with the Confusion Assessment Method (CAM), the Delirium Detection Score (DDS), and the Nursing Delirium Screening Scale (Nu-DESC). The *Diagnostic and Statistical Manual of Mental Disorders* (DSM)-IV criteria were used as the gold standard.

Results. Delirium in the recovery room was seen in 21 patients (14%) with the DSM-IV criteria, in 11 patients (7%) with the CAM, in four patients (3%) with the DDS, and in 37 patients (24%) with the Nu-DESC. Sensitivity and specificity were 0.43 and 0.98 for the CAM, 0.14 and 0.99 for the DDS, and 0.95 and 0.87 for the Nu-DESC, respectively.

Conclusions. All scores used were very specific, but the CAM and the DDS were less sensitive compared with the gold standard. Overall, the Nu-DESC was the most sensitive test in the recovery room to detect delirium.

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Postoperative delirium is associated with poor outcomes, including increased length of stay, both in hospital and in the intensive care unit (ICU), more frequent medical complications, and increased mortality.^{1–6} Sharma and colleagues could demonstrate a 45% (21 of 47 patients) prevalence of recovery room delirium in hip surgery patients. More than 80% of the patients with recovery room delirium were also diagnosed delirium-positive during their subsequent hospital stay.⁷

Delirium is often the first presenting feature of physical illness or drug toxicity, and a failure to appreciate this may lead to delay in diagnosing and treating the underlying cause.⁸ Early recognition and treatment of delirium is the key component in reducing the duration and severity of delirium and negative outcomes.^{9–11} Naughton and

colleagues¹² could show that the implementation of an early assessment and management protocol could reduce the prevalence of delirium and shorten the length of hospital stay. Despite its importance, delirium is often unrecognized in the hospital setting. Previous studies have shown that clinicians caring for the patient do not recognize delirium in up to two-thirds of cases.^{13 14} A routine delirium assessment in the recovery room may be useful in identifying patients with delirium and could help in directing patients to receive appropriate postoperative care.

Diagnosis of delirium is limited due to the lack of validated delirium-screening instruments for use in the recovery room. The *Diagnostic and Statistical Manual of Mental Disorders* (DSM)-IV classification is considered to be the gold standard for diagnosing delirium. It has been

shown to identify more cases of delirium compared with the ICD-10 criteria in the general population; it has also been shown to be particularly sensitive among acutely ill and hospitalized patients.¹⁵ However, despite these strengths, it is too time-consuming to apply in a busy recovery room and requires extensive training. A scoring system suitable for use in the recovery room should be easy to apply and quick to perform.

In several studies, the Confusion Assessment Method (CAM, Appendix) has shown high sensitivity and specificity^{16 17} and the highest levels of agreement with the DSM-IV classification relative to the DSM-III, DSM-III-R, or ICD-10 criteria.¹⁸ Furthermore, it can be completed within 5 min^{16 17} and was designed for use by non-psychiatric clinicians.¹⁷

The Nursing Delirium Screening Scale (Nu-DESC, Appendix) has shown similar discriminative power based on the area under the curve (AUC tests) and the average completion time is 1 min.¹⁹

The Delirium Detection Score (DDS, Appendix) is modified from the Clinical Withdrawal Assessment for Alcohol (CIWA-Ar) and was developed at our department in order to quantify the severity of delirium.²⁰

The aim of this study was to evaluate the validity of the CAM, the Nu-DESC, and the DDS methods as screening tools in the recovery room. We compared their performance against the DSM-IV, which is the current gold standard.

Methods

This observational study was approved by the institutional review board of the Charité—Universitätsmedizin Berlin (Berlin, Germany). We screened 173 patients over the age of 18 yr, who were admitted to the recovery room after general anaesthesia during regular working hours (9.00 a.m. to 5.00 p.m.) between May and June 2007. Exclusion criteria included a past medical history of psychiatric or neurological illness ($n=17$), a previous cerebral insult ($n=2$), and any history of drug, alcohol, or opioid abuse. Because a verbal response was needed for all tests, patients who did not speak the local language were excluded.

The basic patient characteristics that were recorded included age, gender, BMI, ASA physical status (PS), pain intensity scoring according to the numeric rating scale, nausea, vomiting, shivering, fasting intervals, smoking, type of anaesthesia, duration of surgery, length of stay in the recovery room, and postoperative length of stay in the hospital.

Delirium assessment

Patients were assessed in the recovery room by trained research assistants after being formally declared 'ready for discharge' by the anaesthesiologist in charge of the recovery room. The research team performing the delirium scoring were trained and supervised by a psychiatric expert. The presence of delirium was determined by using

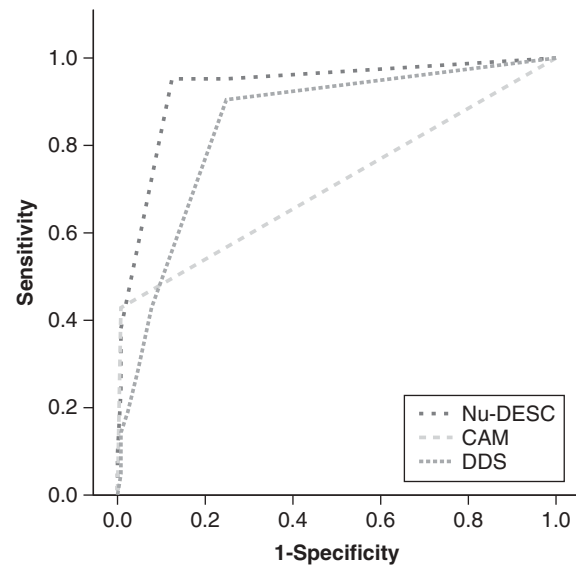


Fig 1 Diagnostic test performance of CAM, DDS, and Nu-DESC was evaluated by ROC analysis using DSM-IV criteria as gold standard and including comparisons of the corresponding ROC curves. The calculated cut-off points were: 1 for the Nu-DESC (corresponding to the published value >1) and 1 for the DDS (recommended cut-off point is >7). The cut-off point for the CAM could not be calculated due to its non-ordinal structure; it has been plotted to graphically display sensitivity and specificity as a binary classifier.

the DSM-IV criteria. In addition, patients were tested with the CAM, the Nu-DESC, and the DDS.^{17 19 20}

The research team did not interfere with the usual recovery room protocol, and the recovery room physicians and nurses were blinded to the results of the study. The presence of delirium was not diagnosed in any patient by the regular recovery room staff.

Statistical analysis

Descriptive statistics were computed for all study variables. Discrete variables are expressed as counts (%) and continuous variables as means with 95% confidence limits. For the discussed clinical parameters, differences between the groups were assessed using Fisher's exact test for frequencies and Mann-Whitney *U*-test for continuous variables. Diagnostic test performance of CAM, DDS, and Nu-DESC was evaluated by receiver operating characteristics (ROC) analysis (Fig. 1). The sensitivity and specificity of the mentioned scores were compared using DSM-IV as the gold standard and McNemar's test. We considered $P<0.05$ to be significant. The obtained *P*-values are to be understood as exploratory ones; therefore, no multiple adjustments were made. Data were analysed using SPSS 13.0 for Windows.

Results

One hundred and fifty-four patients were included in the data analysis. The basic patient characteristics were similar between delirious and non-delirious patients. Patients with delirium according to the gold standard showed

Table 1 Basic patient characteristics until judged 'ready for discharge' from the recovery room and postoperative outcome. Values are mean if not percentage. TIVA, total i.v. anaesthesia. *95% confidence interval (CI)

	Delirium, DSM-IV (n=21)	No delirium, DSM-IV (n=133)	P-value
Age (yr)	55.5 (30.5–80.8)*	53.5 (25.4–77.3)*	0.461
Sex (female)	28% (6/21)	41% (55/133)	0.192
ASA PS			
I and II	57.1% (12/21)	77.4% (103/133)	0.047
III	42.9% (9/21)	22.6% (30/133)	
Smoker	42.9% (9/21)	23.7% (31/131)	0.073
Diabetes	0% (0/21)	7.6% (10/131)	0.213
Duration of surgery (min)	102 (26–321)*	71 (10–192)*	0.042
Volatile	57.1% (12/21)	54.9% (73/133)	0.313
TIVA	42.9% (9/21)	45.1% (60/133)	
Aldrete score (at the time of discharge)	9.95	9.97	0.522
Recovery room length of stay (min)	79 (22–144)*	72 (28–147)*	0.209
Postoperative length of stay in the hospital (days)	5.8 (1.0–15.8)*	4.5 (0–17.3)*	0.011

Table 2 Sensitivity and specificity of the CAM, the DDS, and the Nu-DESC compared with the DSM-IV criteria, n=21/154 (14%)

	Delirium, n (%)	Sensitivity	Specificity
CAM	11 (7%)	0.43	0.98
DDS	4 (3%)	0.14	0.99
Nu-DESC	37 (24%)	0.95	0.87

Table 3 The AUC for the used scores compared with DSM-IV criteria calculated with the published cut-off points. AUC values; *95% confidence interval (CI)

	AUC	CI (95%)	P-value
CAM	0.71	0.57–0.85*	0.002
DDS	0.85	0.76–0.94*	<0.001
Nu-DESC	0.93	0.87–1.0*	<0.001

a significantly longer duration of surgery ($P=0.042$), a higher ASA PS ($P=0.047$), and an increased postoperative length of stay in the hospital ($P=0.011$). No significant differences were found in length of stay in the recovery room and the modified Aldrete score upon departure (Table 1).

Twenty-one out of 154 patients (14%) showed delirium according to the DSM-IV criteria. Eleven patients (7%) showed delirium according to the CAM, four patients (3%) according to the DDS, and 37 patients (24%) according to the Nu-DESC. Sensitivity and specificity were, respectively, 0.43 and 0.985 for the CAM, 0.14 and 0.99 for the DDS, and 0.95 and 0.87 for the Nu-DESC (Tables 2 and 3). Sensitivity differed between scores. The Nu-DESC was the most sensitive test compared with the DDS ($P<0.001$) and the CAM ($P=0.003$), whereas the sensitivity between CAM and the DDS did not differ significantly ($P=0.07$). Specificity did not differ significantly between scores. False positives were 1.5% for the CAM, 12.8% for the Nu-DESC, and 0.8% for the DDS. False negative rates were 57% for the CAM, 85% for the DDS, and 5% for the Nu-DESC.

Positive predictive values for the different tests were: 0.54 for the Nu-DESC, 0.82 for the CAM, and 0.75 for

the DDS. Negative predictive values were: 0.99 for the Nu-DESC, 0.92 for the CAM, and 0.88 for the DDS.

Discussion

In this study, 14% of the patients had delirium according to the gold standard in the recovery room. The evaluated delirium scores in the recovery room showed different sensitivities, whereas the specificities were high in all tests.

The Nu-DESC with a sensitivity of 95% was the most sensitive test to detect delirium in the recovery room. The Nu-DESC score is based on the Confusion Rating Scale (CRS).²¹ Although the CRS was not based on the DSM-IV criteria from the outset, the addition of the fifth item of 'psychomotor retardation' (thereby forming the Nu-DESC) was modelled after the DSM-IV wording. In addition, the criterion 'orientation' can also be found in the DSM-IV criteria. The criteria 'inappropriate behaviour', 'inappropriate communication', and 'illusions/hallucinations' are not directly transferable to the DSM-IV criteria. A score of 2 or more points identified delirium. In our study, 33 patients showed 'psychomotor retardation', 38 patients displayed 'disorientation', 14 displayed 'inappropriate behaviour', 26 'inappropriate communication', and four patients had 'illusions, hallucinations, or both'.

In our study, the criterion of 'psychomotor retardation' was the single most important factor accounting for the high sensitivity of the Nu-DESC. The hypoactive state of delirium is more frequently observed than the hyperactive state,²² and the Nu-DESC has already proven to be a sensitive tool for detecting this more prevalent form of delirium in other clinical settings.¹⁹ A possible explanation for the high rate of Nu-DESC positive patients could be that this assessment tool also detects patients in the prodromal phase of delirium. It is common for patients to display one or more symptoms without having the full syndrome of delirium. Such symptoms may precede or follow an episode of full-blown delirium or may never progress to full-blown delirium. The latter condition is known as sub-syndromal delirium.²³ However, we did not perform

delirium screening after discharge from the recovery room in these patients.

The CAM had a lower rate of delirium detection with a sensitivity of 43%. The CAM is based on the DSM-III-R. For diagnosis, an algorithm consisting of four features is used. These four features are all comparable with the DSM-IV criteria. The first feature 'acute onset and fluctuating course' is related to criterion 3 of the DSM-IV criteria ('developing over a short period of time and tends to fluctuate during the day'). The second and the fourth features 'inattention' and 'altered level of consciousness' can be found in criterion 1 ('disturbance of consciousness') of the DSM-IV criteria. Feature 3 'disorganized thinking' is reflected in criterion 2 of the DSM-IV criteria ('a change in cognition').

The CAM was validated for use in a patient population different from ours, for example, the geriatric ward¹⁵ and emergency room.¹⁶ In these studies, the CAM showed high sensitivities of 0.81–0.86 and high specificities of 0.84–1.0. The main difference to our study was that the patients in the other settings were seen for a longer period of time—hence, detection of a 'fluctuating course' might have been facilitated. Of 154 patients, 24 had an 'acute onset and fluctuating course' (16%). In the study of Monette and colleagues,¹⁶ this criterion was found in 27 of 110 patients (25%). This might be a reason for the low sensitivity of 43% compared with a sensitivity of 94% and 100% as described by Inouye and colleagues,¹⁷ since this feature is essential for the diagnosis of delirium with the CAM. The frequencies of the other items in our population were: 15 patients (10%) with 'inattention', 16 patients (10%) with 'disorganized thinking', and 32 patients (21%) with 'altered level of consciousness'.

The DDS with a sensitivity of 14% had the lowest rate of delirium detection. It is modified from the CIWA-Ar. In our study, 43 patients (28%) were positive on the DDS item 'orientation'; two patients (1%) were positive for 'hallucinations', 11 for 'agitation' (7%), five for 'anxiety' (3%), and 12 for 'paroxysmal sweating' (8%). There is only a low correspondence between the items of the DDS and the items of the DSM-IV criteria. Only one of the items evaluated in the DSM-IV criteria is also evaluated in the DDS ('orientation'). The other DDS criteria do not correspond directly to the DSM-IV criteria and are not always seen in cases of delirium (e.g. tremor and sweating).²⁴ This partially explains the low sensitivity of the DDS in our study. Another reason might be that the DDS looks for agitation but not psychomotor retardation, while the hypoactive form of delirium is much more frequent than the hyperactive state.²²

Patients who were classified positive for delirium showed a significantly longer duration of surgery and a higher ASA PS. This is in agreement with other studies that suggest that the preoperative comorbid state is a primary determinant of the development of delirium.^{25 26} The duration of surgery or anaesthesia and its impact on postoperative cognitive function is also well documented.²⁶ The concept of patient vulnerability (risk factors) in relation to stressor events (precipitants that trigger an episode of delirium) has proved to be a practical approach to understanding delirium.²⁷ In patients with numerous comorbidities, an increased vulnerability to precipitants may exist. The precipitants do not alone cause delirium; they interact with the underlying risk factors. Thus, a sizable insult, such as major surgery or a serious infection, is required to trigger delirium in a previously fit person, but even a minor perturbation can result in delirium in a person with many risk factors. People with multiple chronic diseases are therefore especially prone to delirium.²⁸

Patients classified positive for delirium in the recovery room had a significant longer postoperative length of stay in the hospital compared with patients without delirium. However, length of stay in the recovery room was not significantly increased. Patients with delirium according to DSM-IV tended to stay for an increased length of time in the recovery room. However, due to the small (highly unequal) number of patients and the high variability, it could not reach statistical significance.

Limitations of the study were the relatively small sample size and the low rate of delirium (14%) in our study population. Another limitation was that three delirium scores were measured only once per patient during the stay in the recovery room.

The main objective of this study was to verify a valid assessment tool for delirium screening in the recovery room.

In conclusion, patients with delirium according to the DSM-IV criteria in the recovery room had an increased postoperative length of stay in the hospital. The Nu-DESC detected 95% of these patients. Therefore, it could prove to be a valuable tool in nurse-based routine screening for early signs of delirium. Given the 12.8% false positive delirium rate, we suggest confirmation with DSM-IV criteria before treatment. The routine use of a delirium-screening instrument before departure from the recovery room might prove beneficial in sensitizing medical staff in the recovery room and on the ward to patients without full cognitive function, thereby leading to a more prompt diagnosis and treatment.

Appendix

The CAM Diagnostic Algorithm (Inouye and colleagues)¹⁷

Symptoms	Symptoms rating	
1 <i>Acute Onset or Fluctuating Course</i> This feature is usually obtained from a family member or nurse and is shown by positive responses to the following questions: Is there evidence of an acute change in mental status from the patient's baseline? Did the (abnormal) behaviour fluctuate during the day, that is, tend to come and go, or increase and decrease in severity?	<input type="checkbox"/> Neg	<input type="checkbox"/> Pos
2 <i>Inattention</i> This feature is shown by a positive response to the following question: Did the patient have difficulty focusing attention, for example, being easily distractible, or having difficulty keeping track of what was being said?	<input type="checkbox"/> Neg	<input type="checkbox"/> Pos
3 <i>Disorganized thinking</i> This feature is shown by a positive response to the following question: Was the patient thinking incoherent, such as rambling or irrelevant conversation, unclear or illogical flow of ideas, or unpredictable switching from subject to subject?	<input type="checkbox"/> Neg	<input type="checkbox"/> Pos
4 <i>Altered level of consciousness</i> This feature is shown by an answer other than 'alert' to the following question: overall, how would you rate this patient's level of consciousness? [alert (normal), vigilant (hyperalert), lethargic (drowsy, easily aroused), stupor (difficult to arouse), or coma (unarousable)]	<input type="checkbox"/> Neg	<input type="checkbox"/> Pos
The diagnosis of delirium by CAM requires the presence of features 1 and 2 and either 3 or 4		
<i>Delirium</i>	<input type="checkbox"/> Yes	<input type="checkbox"/> No

The Nursing Delirium Screening Scale (Gaudreau and colleagues)¹⁹

Symptoms	Symptoms rating		
1 <i>Disorientation</i> Verbal or behavioural manifestation of not being oriented to time or place or misperceiving persons in the environment	<input type="checkbox"/> 0	<input type="checkbox"/> 1	<input type="checkbox"/> 2
2 <i>Inappropriate behaviour</i> Behaviour inappropriate to place, for the person, or both; e.g. pulling at tubes or dressings, attempting to get out of bed when that is contraindicated, and the like	<input type="checkbox"/> 0	<input type="checkbox"/> 1	<input type="checkbox"/> 2
3 <i>Inappropriate communication</i> Communication inappropriate to place, for the person, or both; e.g. incoherence, non-communicativeness, nonsensical or unintelligible speech	<input type="checkbox"/> 0	<input type="checkbox"/> 1	<input type="checkbox"/> 2
4 <i>Illusions/hallucinations</i> Seeing or hearing things that are not there; distortions of visual objects	<input type="checkbox"/> 0	<input type="checkbox"/> 1	<input type="checkbox"/> 2
5 <i>Psychomotor retardation</i> Delayed responsiveness, few or no spontaneous actions/words; e.g. when the patient is prodded, reaction is deferred, the patient is unarousable, or both	<input type="checkbox"/> 0	<input type="checkbox"/> 1	<input type="checkbox"/> 2
Total score			
<i>Delirium</i>	<input type="checkbox"/> ≥ 2 yes	<input type="checkbox"/> < 2 no	

The Delirium Detection Score. The DDS (mod. for the recovery room), Otter and colleagues²⁰

Symptoms	Symptoms rating
1 <i>Orientation</i> + orientated to time, place, and personal identity, able to concentrate + not sure about time, place, or both, not able to concentrate + not oriented to time, place, or both + not oriented to time, place, and personal identity	<input type="checkbox"/> 0 <input type="checkbox"/> 1 <input type="checkbox"/> 4 <input type="checkbox"/> 7
2 <i>Hallucinations</i> + none + mild hallucinations at times + permanent mild-to-moderate hallucinations + permanent severe hallucinations	<input type="checkbox"/> 0 <input type="checkbox"/> 1 <input type="checkbox"/> 4 <input type="checkbox"/> 7
3 <i>Agitation</i> + normal activity + slightly higher activity + moderate restlessness + severe restlessness	<input type="checkbox"/> 0 <input type="checkbox"/> 1 <input type="checkbox"/> 4 <input type="checkbox"/> 7
4 <i>Anxiety</i> + no anxiety when resting + slight anxiety + moderate anxiety at times + acute panic attacks	<input type="checkbox"/> 0 <input type="checkbox"/> 1 <input type="checkbox"/> 4 <input type="checkbox"/> 7
5 <i>Paroxysmal sweating</i> + no sweating + almost not detectable, only palms + beads of perspiration on the forehead + heavy sweating	<input type="checkbox"/> 0 <input type="checkbox"/> 1 <input type="checkbox"/> 4 <input type="checkbox"/> 7
<i>Delirium</i>	(≥ 8 pts) <input type="checkbox"/> yes (< 8 pts) <input type="checkbox"/> no

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