Comparison and Agreement Between the Richmond Agitation-Sedation Scale and the Riker Sedation-Agitation Scale in Evaluating Patients' Eligibility for Delirium Assessment in the ICU

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Background: Delirium evaluation in patients in the ICU requires the use of an arousal/sedation assessment tool prior to assessing consciousness. The Richmond Agitation-Sedation Scale (RASS) and the Riker Sedation-Agitation Scale (SAS) are well-validated arousal/sedation tools. We sought to assess the concordance of RASS and SAS assessments in determining eligibility of patients in the ICU for delirium screening using the confusion assessment method for the ICU (CAM-ICU).

Methods: We performed a prospective cohort study in the adult medical, surgical, and progressive (step-down) ICUs of a tertiary care, university-affiliated, urban hospital in Indianapolis, Indiana. The cohort included 975 admissions to the ICU between January and October 2009.

Results: The outcome measures of interest were the correlation and agreement between RASS and SAS measurements. In 2,469 RASS and SAS paired screens, the rank correlation using the Spearman correlation coefficient was 0.91, and the agreement between the two screening tools for assessing CAM-ICU eligibility as estimated by the κ coefficient was 0.93. Analysis showed that 70.1% of screens were eligible for CAM-ICU assessment using RASS (7.1% sedated [RASS -3 to -1]; 62.6% calm [0]; and 0.4% restless, agitated [$+1$ to $+3$]), compared with 72.1% using SAS (5% sedated [SAS 3]; 66.5% calm [4]; and 0.6% anxious, agitated [5, 6]). In the mechanically ventilated subgroup, RASS identified 19.1% CAM-ICU eligible patients compared with 24.6% by SAS. The correlation coefficient in this subgroup was 0.70 and the agreement was 0.81.

Conclusion: Both SAS and RASS led to similar rates of delirium assessment using the CAM-ICU.

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Abbreviations: CAM-ICU = confusion assessment method for the ICU; MICU = medical and coronary ICU; PICU = progressive ICU; RASS = Richmond Agitation-Sedation Scale; SAS = Sedation-Agitation Scale; SICU = surgical ICU; WMH = Wishard Memorial Hospital

Delirium has been defined as a syndrome of altered consciousness, with a reduced ability to focus, sustain, or shift attention, that occurs over a short time with fluctuations over the course of the day.¹ It is a highly prevalent brain syndrome in critically ill patients in the ICU.^{2–7} Patients with delirium in the ICU have a longer stay in the ICU, greater number of ventilator days, and higher mortality after adjusting for age, sex, race, and severity of illness.^{3,4}

Due to the significant burden of delirium, US national guidelines recommend daily delirium assess-

ments as part of standard ICU care.⁸ The confusion assessment method for the ICU (CAM-ICU) is one of the most commonly used, reliable, and valid tools to diagnose delirium in a time-efficient manner (Fig 1).⁹ A prerequisite and “sister instrument” to delirium evaluation is the assessment of a patient’s level of arousal using standardized, validated arousal scales, also referred to as sedation-agitation scales. Since there is some difficulty defining the gray zone between coma and alertness, sometimes referred to as stupor, a decision was made early in ICU delirium

work to categorize patients as “unable to assess” if they were in a comatose state, which is an inability to respond at all to verbal stimulation. This arousal level has been defined by the Richmond Agitation-Sedation Scale (RASS), developed by Sessler and others,¹⁰⁻¹⁵ as having a RASS score of -4 and -5 (Table 1). If a patient is at this reduced level of consciousness, the ICU teams do not perform a delirium assessment at that time. While the RASS is a common arousal scale used worldwide,¹⁶ a significant proportion of the ICUs use other sedation scales.¹⁷⁻²⁰ The Sedation-Agitation Scale (SAS) developed by Riker et al¹⁸ is a common sedation assessment scale that has been validated in ventilated and nonventilated patients in medical and surgical ICUs (Table 2).²¹⁻²⁵ Though SAS has been used as a sister instrument prior to delirium screening in multiple studies,^{26,27} its reliability in conjunction with the CAM-ICU compared with RASS has not been investigated.

Using the data of a quality improvement project to standardize delirium assessment in the ICU of an urban hospital, we evaluated the correlation between RASS and SAS and their agreement on patients’ eligibility for delirium assessment using the CAM-ICU. We hypothesized that the correlation between these two scales and their agreement in identifying patients eligible for CAM-ICU assessment would be >0.5 among both ventilated and nonventilated patients in the ICU.

MATERIALS AND METHODS

Study Setting and Patient Population

Consecutive patients admitted to the medical and coronary ICU (MICU) or surgical ICU (SICU) services of Wishard Memorial Hospital (WMH) from January 1, 2009, to October 1, 2009, were included in the study. WMH is a 457-bed, university-affiliated, urban public hospital staffed by Indiana University School of

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FIGURE 1. Algorithm outlining the confusion assessment method for the ICU.

Medicine faculty and house staff. It has three types of ICUs: an 8-bed SICU; a 14-bed MICU; and a 29-bed progressive ICU (PICU), a step-down unit from other ICUs. The MICU and SICU are staffed identically with registered nurses at a nurse-to-patient ratio of 1:2, or 1:1 when necessary. In the PICU, the nurse-to-patient ratio is 1:3. The ICU teams rotate every month and consist of a faculty member, a critical-care fellow, four residents, one nurse practitioner, and one critical-care clinical pharmacist.

The following inclusion criteria were used to enroll patients in the study: 1) admitted to the WMH ICUs, 2) age ≥ 18 years, and 3) able to speak English. Patients were excluded if they were (1) not English speaking, (2) hearing impaired, (3) legally blind, (4) admitted with alcohol intoxication, (5) prisoners, or (6) diagnosed as having an Axis I psychiatric disorder. This study (Internal Review Board number 0812-01) was approved as a continuous quality improvement delirium project by the Research Compliance Administration of Indiana University-Purdue University at Indianapolis. We were given permission to use RASS, SAS, and the CAM-ICU scales, and they were not modified in any manner. As RASS, SAS, and the CAM-ICU are routinely used for patient care, the continuous quality improvement

Table 1—Richmond Agitation-Sedation Scale

Score	Term	Description
+4	Combative	Overtly combative, violent, danger to staff
+3	Very agitated	Pulls or removes tubes or catheters; aggressive
+2	Agitated	Frequent nonpurposeful movement, fights ventilator
+1	Restless	Anxious, but movements not aggressive or vigorous
0	Alert and calm	...
-1	Drowsy	Not fully alert, but has sustained awakening (eye opening/eye contact to voice (> 10 s))
-2	Light sedation	Briefly awakens with eye contact to voice (< 10 s))
-3	Moderate sedation	Movement or eye opening to voice (but no eye contact)
-4	Deep sedation	No response to voice, but movement or eye opening to physical stimulation
-5	Unable to rouse	No response to voice or physical stimulus

Table 2—Sedation-Agitation Scale

Score	Term	Description
7	Dangerous agitation	Pulling at endotracheal tube, trying to remove catheters, climbing over bed rail, striking at staff, thrashing side to side
6	Very agitated	Does not calm, despite frequent verbal reminding of limits; requires physical restraints, biting endotracheal tube
5	Agitated	Anxious or mildly agitated, attempting to sit up, calms down to verbal instructions
4	Calm and cooperative	Calm, awakens easily, follows commands
3	Sedated	Difficult to arouse; awakens to verbal stimuli or gentle shaking, but drifts off again; follows simple commands
2	Very sedated	Arouses to physical stimuli, but does not communicate or follow commands, may move spontaneously
1	Unable to rouse	Minimal or no response to noxious stimuli, does not communicate or follow commands

qualified for exemption from informed consent from the patients by the local research compliance administration.

Screening and Data Collection

After familiarizing themselves with the scales through printed manuals and online videos, two critical-care pharmacists, as part of their daily clinical routine, performed the RASS, SAS, and CAM-ICU assessments 48 h after patients' ICU admission and then daily afterward until the patients became delirious, died, or were discharged from the ICU. The SAS was applied first, immediately followed by the RASS. Assessments were made by the same pharmacist, who was not blinded to the initial SAS assessment. A cutoff of RASS > -4 (ie, any response to verbal stimulation) and a SAS > 2 (ie, difficult to arouse, but awakens to verbal stimuli or gentle shaking; follows simple commands, but drifts off again) were used to identify patients eligible for CAM-ICU. Patients were considered delirious if they had a positive CAM-ICU result, achieved by showing signs of acute change in mental status or fluctuating

Table 3—Cohort Demographics

Characteristics	Overall	MICU	SICU	PICU
Admissions	975	308 (31.6)	87 (8.9)	580 (59.5)
Sedation screens	2,469	1,006 (40.8)	238 (9.6)	1,225 (49.6)
Sedation screens per admission, No.	2.53	3.27	2.74	2.11
Female sex	410 (42.0)	121 (39.3)	27 (31.0)	262 (45.2)
Black race	442 (45.3)	131 (42.5)	42 (46.4)	269 (48.3)
Age ≥ 60 y	319 (32.9)	97 (31.5)	24 (27.6)	198 (34.1)
Mechanical ventilation	233 (23.9)	160 (52.0)	50 (57.5)	23 (4.0)

Data given as No. (%) unless otherwise indicated. MICU = medical and coronary ICU; PICU = progressive (step-down) ICU; SICU = surgical ICU.

course, displaying features of inattention, and either disorganized thinking or altered level of consciousness. The average time taken by study personnel to administer RASS or SAS was < 30 s. Baseline demographics, including age, sex, race, and mechanical ventilation status, were also collected prospectively.

Statistical Analysis

The primary analysis was based on all concomitant RASS/SAS screens performed during the stay of all admissions to the ICUs in the study period. Patient characteristics of all admissions were described using mean and SD for continuous variables, frequency and percentages for categorical variables, and median and interquartile range (IQR) for ordinal values. RASS and SAS scores were reported as median and IQR and their rank correlations were estimated using the Spearman correlation coefficient. Their agreement in identifying patients eligible for CAM-ICU was estimated using κ statistics. These analyses were

FIGURE 2. A, Histograms of RASS scores based on level of sedation. B, Histograms of SAS scores based on level of sedation. RASS = Richmond Agitation-Sedation Scale; SAS = Sedation-Agitation Scale.

also performed on the subset of assessments made on patients while they were on mechanical ventilation and based on their MICU, SICU, or PICU status. All data analyses were performed using SAS version 9.3 software (SAS Institute).

RESULTS

During the study period, 2,469 concomitant RASS/SAS assessments were performed on 975 consecutive patient admissions to the ICUs. Table 3 describes the patient characteristics of these admissions. The mean age at admission to our ICUs was 52.3 years (SD $\pm$ 15.8), with one-third being $\geq$ 60 years. The prevalence of delirium was 13.1% in the overall patient population and 50.6% in mechanically ventilated patients. The median RASS score over the course of the ICU stay was 0 (IQR, -4 - 0). Thirty percent of RASS scores were -5 and -4 (coma), 7% were in the range of -3 to -1 (sedated), 62.6% were 0 (calm), and 0.4% ranged from $+1$ to $+3$ (restless, agitated) (Fig 2A). The median SAS score was 4 (IQR, 2-4). For the SAS assessments, 66.5% of screens corresponded to a calm state (SAS 4), 32.8% to being sedated (SAS 1-3), and only 0.6% were characterized as anxious or agitated (SAS 5-6) (Fig 2B).

The RASS and SAS scores in the overall patient population are cross-tabulated in Table 4. The Spearman rank correlation between the scores of these two instruments was estimated to be 0.91. Showing remarkable similarity, 70.1% of screens were eligible for CAM-ICU assessment using RASS of ≥ -3 compared with 72.1% using SAS ≥ 3 . The agreement between the two screening tools for assessing CAM-ICU eligibility as estimated by the κ coefficient was 0.93.

Table 5 shows the cross-tabulation of RASS and SAS scores in the mechanically ventilated subgroup. In this subgroup, the Spearman correlation coefficient between the two scales was 0.7. Using RASS, 19.1%

of screens were eligible for CAM-ICU, compared with 24.6% using SAS. The agreement between the two scales for CAM-ICU eligibility had a κ of 0.81. The correlation between RASS and SAS and their agreement on CAM-ICU eligibility based on patient location are presented in Table 6.

DISCUSSION

Our study found a high level of agreement between the RASS and SAS in identifying patients eligible for delirium assessment in the ICU. The study also confirmed the high correlation between the two scales in evaluating arousal status among diverse patients in the ICU, a high proportion of whom were of black race. Thus, both SAS and RASS can be used interchangeably alongside the delirium instrument CAM-ICU. Prior to our study, Sessler et al¹⁰ had performed a RASS and SAS correlation in their initial report on assessing the validity and reliability of RASS in patients in the MICU and found a correlation of 0.78. Our study confirms their findings and extends them to a larger medical and surgical cohort.

Optimal sedation in the ICU is imperative as inadequate sedation and analgesia can have hazardous consequences, including inadvertent removal of central venous catheters, arterial catheters, endotracheal tubes, aggressive patient behavior resulting in harm to patient and health-care providers, and patient-ventilator dysynchrony.^{28,29} Excessive sedation can lead to increased duration of mechanical ventilation; longer length of hospital stay^{30,31}; and delirium⁶ that, in turn, leads to increased length of ICU and hospital stay⁴ and is also an independent predictor of mortality.³ A protocol-driven approach to sedation may minimize these dilemmas. The Society of Critical Care Medicine guidelines⁸ emphasize the

Table 4—Cross-Tabulation of RASS and SAS Scores in Overall Patient Population

RASS	RIKER-SAS							Total
	1	2	3	4	5	6	7	
-5	73	283	10	1	1	0	0	368
-4	5	319	40	0	5	1	0	370
-3	1	3	14	1	3	0	0	22
-2	1	2	18	5	0	0	0	26
-1	1	0	38	86	4	0	0	129
0	0	0	2	1,544	0	0	0	1,546
1	0	0	0	5	1	0	0	6
2	0	0	1	0	0	0	0	1
3	1	0	0	0	0	0	0	1
4	0	0	0	0	0	0	0	0
Total	82	607	123	1,642	14	1	0	2,469

Bold text indicates patients eligible for the confusion assessment method of the ICU who were identified by both screens. RASS = Richmond Agitation-Sedation Scale; SAS = Sedation-Agitation Scale.

Table 5—Cross-Tabulation of RASS and SAS Scores in Mechanically Ventilated Subgroup

RASS	RIKER-SAS							Total
	1	2	3	4	5	6	7	
−5	72	275	9	0	1	0	0	357
−4	2	294	36	0	5	1	0	338
−3	1	2	11	1	1	0	0	16
−2	1	0	14	5	0	0	0	20
−1	1	0	20	47	3	0	0	71
0	0	0	0	56	0	0	0	56
1	0	0	0	1	0	0	0	1
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
Total	77	571	90	110	10	1	0	859

Bold text indicates patients eligible for the confusion assessment method of the ICU who were identified by both screens. See Table 4 legend for expansion of abbreviations.

importance of establishing a sedation goal or endpoint that should be regularly redefined for each patient. Use of validated arousal/sedation assessment tools will help achieve the desired level of sedation. The desirable features for any arousal assessment scale include high feasibility for clinical use across various populations and strong psychometric properties, including interrater reliability and sensitivity to change.^{8,32,33} Given the strong agreement between RASS and SAS screenings as a component of the arousal evaluation to accompany delirium assessments in a mixed ICU population, either of these tools could be used as the sister instrument to the CAM-ICU to assess level of consciousness.

Strengths and Limitations

The strengths of our study include its sample size and its diverse patient population. Our cohort has a large proportion of minority patients and includes both medical and surgical inpatients, thus increasing the generalizability of our results. In addition, this is the first study to specifically address whether a specific arousal tool might affect the subsequent decision of conducting a delirium assessment. The major limitation of our study is the inclusion of patients in the PICU, the majority of whom were not

mechanically ventilated. This resulted in a large number of screens with a RASS score of 0 and SAS score of 4, which could have resulted in an artificially inflated correlation coefficient. Still, the correlation between the two scales remained high (although lower) when our analysis was restricted to mechanically ventilated patients, although the majority of assessments were in the comatose range. Finding such a high number of comatose assessments in our study prompted a closer inquiry into the sedation practices that resulted in the institution of a “wake up and breathe protocol”³⁴ at the WMH ICU that couples daily interruption of sedation with spontaneous breathing. Due to a small percentage (7%) of patients in the mildly to moderately sedated range (RASS score: −1–−3), applicability of our findings to other ICUs may be limited. Of patients with a RASS score of −5 (unable to rouse, no response to voice or physical stimulus), 75% had a concomitant SAS score of 2 (arouses to physical stimuli, but does not communicate or follow commands; may move spontaneously). We believe that this discrepancy was due to human errors, including errors in judgment and recording. However, a misapplication of the RASS and/or SAS methodology by the raters cannot be ruled out. Another limitation of this investigation is the concomitant assessment of SAS and RASS by

Table 6—Correlation Between RASS and SAS and Their Agreement in Identifying Patients’ Eligibility for Delirium Assessment Based on ICU Location and Ventilator Status

Ventilator Status	Correlation ^a			Agreement ^b		
	MICU (n = 1,006)	SICU (n = 238)	PICU (n = 1,225)	MICU (n = 1,006)	SICU (n = 238)	PICU (n = 1,225)
Overall	0.865	0.905	0.839	0.892	0.932	0.939
Mechanical ventilation present	0.715	0.589	0.885	0.804	0.748	0.929
Mechanical ventilation absent	0.682	0.542	0.737	0.865	1.00	0.865

See Table 3 and 5 legends for expansion of abbreviations.

^aCorrelation as measured by Spearman rank correlation coefficient.

^bAgreement as measured by κ statistic.

the same person. However, other studies have demonstrated that these instruments have high interrater reliability and reproducibility, and thus, the potential bias of this limitation is minimal.

CONCLUSIONS

There is a strong agreement between RASS and SAS screenings as a component of the arousal examination to accompany delirium assessments in a mixed ICU population. In screening for delirium, either of these tools could be used as the sister instrument to the CAM-ICU to assess level of consciousness.

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Dr Khan: contributed to conception and design of the study; data acquisition, analysis, and/or interpretation; writing or revising the manuscript for important intellectual content; and approval of the final manuscript; and served as principal author.

Dr Guzman: contributed to conception and design of the study, critical revision of the manuscript, and approval of the final manuscript.

Dr Campbell: contributed to conception and design of the study; data acquisition, analysis, and/or interpretation; writing or revising the manuscript for important intellectual content; and approval of the final manuscript.

Dr Walroth: contributed to conception and design of the study, critically revising the article, and approval of the final manuscript.

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