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BRIEF REPORTS

Serial Administration of a Modified Richmond Agitation and Sedation Scale for Delirium Screening

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OBJECTIVES: Because delirium is a common yet frequently unrecognized condition, this study sought to design a brief screening tool for a core feature of mental status and to validate the instrument as a serial assessment for delirium.

DESIGN: Prospective cohort study.

SETTING: Tertiary VA Hospital in New England.

PARTICIPANTS: A total of 95 veterans admitted to the medical service.

METHODS: A consensus panel developed a modified version of the Richmond Agitation and Sedation Scale (RASS) to capture alterations in consciousness. Upon admission, and daily thereafter, patients were screened with a modified RASS (mRASS) and independently underwent a comprehensive mental status interview by a geriatric expert, who determined whether the criteria for delirium were met. The sensitivity, specificity, and positive likelihood ratio (LR) of the mRASS for delirium are reported.

RESULTS: As a single assessment, the mRASS had a sensitivity of 64% and a specificity of 93% for delirium (LR, 9.4). When used to detect change, serial mRASS assessments had a sensitivity of 74% and a specificity of 92% (LR, 8.9) in both prevalent and incident delirium. When prevalent cases were excluded, any change in the mRASS had a sensitivity of 85% and a specificity of 92% for incident delirium (LR, 10.2)

CONCLUSION: When administered daily, the mRASS has good sensitivity and specificity for incident delirium. Given the brevity of the instrument (<30 seconds), consideration should be given to incorporating the modified RASS as a daily screening measure for consciousness and delirium. *Journal of Hospital Medicine* 2012;7:450–453. © 2011 Society of Hospital Medicine

Vital signs constitute a fundamental component of the physical examination and serve key diagnostic and monitoring purposes. The brain is as vital to life as the cardiovascular, respiratory, and immune/thermoregulatory systems, yet currently no vital sign exists that would allow rapid, reliable, and easily reproducible assessment of cognition.[1] As a result, acute mental status changes frequently go undetected and untreated.[2–4] Delirium is defined as an acute change in attention with fluctuations in cognition, thought, and/or consciousness throughout the course of the day.[5] Because delirium in older patients is common and is associated with increased morbidity, mortality, functional decline, and costs,[6–9] development and validation of a rapid, objective screening assessment could be used by nursing staff to identify patients at high risk for delirium.

Current recommendations for inpatient delirium monitoring usually involve daily cognitive screening with a standardized screening instrument.[6] Because this process is often time-consuming (8-12 minutes), most patients do not undergo routine screening. To facilitate clinical implementation, we focused on developing a brief (<30-second) inpatient screening measure of a feature of mental status that could be administered serially. The purpose of this study was to (1) develop a brief screening tool for a core feature of mental status and (2) validate this screening tool for delirium in an older inpatient population.

METHODS

Consensus Panel

In June 2009, the Veterans Administration sponsored an interdisciplinary conference that solicited input on identifying the most targetable components of delirium and discussing potential clinical instruments. Following this, a consensus panel of 8 representatives from medicine, geriatrics, nursing, psychiatry, and psychology used a modified Delphi method to target characteristic features of delirium and identify instruments that could best capture mental status change. While inattention was agreed upon as the core cognitive feature of delirium, the group came to consensus that capturing the acute onset and fluctuating nature of delirium was better suited as a vital sign. To meet these criteria, the group modified the Richmond Agitation Sedation Scale (RASS).[10]

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Step 1 **State patient's name and ask patient to open eyes and look at speaker.**
Ask 'Describe how you are feeling today'

- If answers with short answer (<10 seconds), cue with second open ended question
- If no response to verbal cue, physically stimulate patient by shaking shoulder

Step 2 **Score modified RASS below**

Score	Term	Description
+4	Combative	No attention; overtly combative, violent, immediate danger to staff
+3	Very agitated	Very distractible; repeated calling or touch required to get or keep eye contact or attention.; cannot focus; pulls or removes tube(s) or catheter(s); aggressive; fights environment not people
+2	Slightly agitated	Easily distractible; rapidly loses attention; resists care or uncooperative; frequent non-purposeful movement
+1	Restless	Slightly distractible; pays attention most of the time; anxious, but cooperative; movements not aggressive or vigorous
0	Alert and calm	Pays attention; makes eye contact; aware of surroundings; responds immediately and appropriately to calling name and touch
-1	Wakes easily	Slightly drowsy; eye contact>10 sec; not fully alert, but has sustained awakening; eye-opening/eye contact to *voice* **>10 seconds**
-2	Wakes slowly	Very drowsy; pays attention some of the time; briefly awakens with eye contact to *voice* **<10 seconds**
-3	Difficult to wake	Repeated calling or touch required to get or keep eye contact or attention; needs repeated stimuli (touch or voice) for attention, movement, or eye opening to *voice* **(but no eye contact)**
-4	Can't stay awake	Arousable but no attention; no response to voice, but movement or eye opening to *physical* stimulation
-5	Unarousable	No response to *voice or physical* stimulation

FIG. 1. Modified Richmond Agitation and Sedation Scale.

The RASS is an observational instrument that has been validated in the intesive care unit setting for objectively determining level of sedation. It has been shown to be highly reliable and associated with delirium.[11] The RASS is a quick, objective scale of consciousness with a scoring system that captures both hyperactive and hypoactive levels of consciousness. A disadvantage of using the RASS includes its limited attention assessment. The Consensus panel modified the RASS to improve its assessment of attention, using a brief open-ended question that was asked before scoring (Figure 1).

Participants

For this prospective validation study, we recruited 95 medical patients $\geq$65 years of age who had been admitted to a VA hospital. The study was approved by the institutional review board, and participants provided written informed consent. Patients were excluded if they refused (n = 64), anticipated leaving the hospital within 1 day (n = 42), or had vision or cognition impairments that would prevent their ability to complete informed consent forms and cognitive screening tools (n = 19). Five participants were discharged between enrollment and expert assessment.

Mental Status Assessments

After enrollment, 3 study staff members visited each participant independently. First, the trained research assistant obtained informed consent and demographic, cognitive, and functional assessments. The mini-mental state examination was then administered to provide a baseline measure of cognitive function at the time of admission.[12] A nurse-interviewer later administered the modified RASS (mRASS) separately. Finally, a delirium expert performed an independent comprehensive mental status interview including assessments of attention, executive function, memory, and mood. Delirium was diagnosed by the delirium expert according to DSM-IV criteria.[5] Each investigator was blinded to the others' ratings. After the initial assessments, each participant was visited daily throughout the hospitalization by an mRASS assessor and, independently, by the delirium expert.

To determine inter-rater reliability, 60 participants were evaluated with the mRASS by the trained research assistant and the nurse-interviewer simultaneously. The mRASS was scored independently and the assessors were blinded to each others' ratings.

Statistics

The paired mRASS-delirium assessments were analyzed in 3 ways: (1) as single-day independent assessments; (2) longitudinally as a change from baseline including prevalent delirium; and (3) longitudinally as a change from baseline, excluding prevalent delirium cases. We examined 1-point and 2-point changes on the mRASS from baseline, which allowed determination of the most appropriate cut-point for clinical use. Sensitivity, specificity, and likelihood ratios were calculated. The C-statistic was calculated using absolute mRASS score for the single-time assessments, and as a difference between minimum and maximum mRASS for the longitudinal analyses.

RESULTS

Characteristics of the study population are presented in Table 1. Because this was a VA population, the vast majority (94%) of participants were men, with a mean age of 81 years (range, 66-96 years), and 89% were white. This population had a high Charlson Comorbidity Index (mean ± SD, 4.0 ± 2.4), which was reflected in functional assessments, with 37% reporting difficulty with activities of daily living and 58% reporting difficulty with instrumental activities of daily living. Despite the age and comorbidity, delirium prevalence was 11% (n = 10) and incidence was 14% (n = 13). Interrater reliability of the mRASS yielded 98% agreement with a weighted kappa of 0.48 ($P < 0.001$).

TABLE 1. Baseline Characteristics of the Study Population (n = 95)

Characteristics	Values
Age, years, mean (SD)	81.0 (7.3)
Gender, male, no. (%)	89 (94)
Race, white, no. (%)	85 (89)
Charlson Comorbidity Index, mean (SD)	4.0 (2.4)
BMI, kg/m^2, mean (SD)	27.2 (6.3)
Mini-mental state examination, mean (SD)	24.4 (4.1)
AUDIT, mean (SD)	2.4 (2.9)
Tobacco use, pack-years, no. (%)	54 (56)
Current	8 (8)
Never	16 (17)
Prior	68 (72)
Functional impairment, no. (%)	
Difficulty with ≥1 ADL	35 (37)
Difficulty with ≥1 IADL	55 (58)
Length of hospital stay	
Mean (SD), days	6.3 (5.4)
Median, days	5
mRASS per patient, mean (SD)	3.8 (3.3)

Abbreviations: ADL, activity of daily living; AUDIT, Alcohol Use Disorders Identification Test; BMI, body mass index; IADL, independent activity of daily living; mRASS, modified Richmond Agitation Sedation Scale; SD, standard deviation.

When the mRASS was analyzed as a single-day independent assessment, any abnormal score (ie, a score ≠ 0) had a sensitivity of 64% and a specificity of 93% for delirium relative to the expert evaluation (Table 2). With an abnormal mRASS as ≥2 or ≤−2, the sensitivity fell to 34%, while the specificity increased to 99.6%.

When the mRASS was used longitudinally to detect change in delirium during the hospital stay among all participants, it had a sensitivity of 74% and specificity of 92% for any change. Increasing the stringency of the criteria by looking at a change of ≥2 mRASS points decreased the sensitivity (22%) and increased the specificity (100%).

To capture the potential of the mRASS administered on a longitudinal basis as a diagnostic aid, the prevalent cases of delirium were excluded. In this analysis, any change in the mRASS had a sensitivity of 85% and a specificity of 92% for incident delirium. With more stringent criteria of a change of 2 points, the sensitivity was 23% and the specificity was 100%.

DISCUSSION

In this study, we developed a modified RASS (mRASS) for serial mental status assessment. Whereas a single measurement of the mRASS had modest sensitivity and good specificity for delirium, longitudinal measurement increased the sensitivity with no loss in specificity. Importantly, the <30 seconds required for the mRASS could be incorporated into daily workflow and provides an objective measure of consciousness. As such, we believe the mRASS can potentially serve as a longitudinal measure of consciousness—much like a vital sign for mental status.

TABLE 2. Performance of the mRASS for Delirium Screening

Criteria	mRASS	Sensitivity* (95% CI)	Specificity* (95% CI)	LR+	LR−
Single-day independent assessments†					
	Any abnormal	63.9% (51.9–76.0)	93.2% (90.3–96.4)	9.4	0.4
	RASS ≥2 or ≤−2	34.4% (22.5–46.3)	99.6% (98.8–100)	86	0.7
Longitudinal assessments‡					
Any delirium	Any change	73.9% (56.0–91.9)	91.7% (85.3–98.1)	8.9	0.3
	Change in 2 points	21.7%	100%		0.8
Incident delirium	Any change	84.6% (65.0–100.0)	91.7% (85.3–98.1)	10.2	0.2
	Change in 2 points	23.1%	100%		0.8

Abbreviations: CI, confidence interval; LR+, positive likelihood ratio; LR−, negative likelihood ratio; RASS, Richmond Agitation and Sedation Scale; mRASS, modified Richmond Agitation and Sedation Scale. *95% CIs could not be calculated for the analyses with a zero cell. †C-statistic (absolute change) for the single-day assessments was 0.80 (95% CI, 0.73–0.86). ‡C-statistic (difference) for the longitudinal assessments was 0.85 (95% CI, 0.75–0.94) for any delirium and 0.90 (95% CI, 0.79–1.00) for the incident delirium.

Altered consciousness is a clinical and diagnostic feature of delirium,[5,13] and fluctuation in mental status is a diagnostic feature of delirium. As such, a screening instrument able to quantify the level of consciousness longitudinally and allow comparison to prior and subsequent determinations has face validity as a delirium screening instrument.

The mRASS has other features that make it appropriate for serial measurement in a manner similar to a vital sign. First, it objectively described consciousness on a scale, which is an improvement relative to many of the subjective descriptions clinically used. Consistent with other studies of the RASS,[10,11] the mRASS has good interrater reliability, allowing a common language to be used to describe level of consciousness across health care settings that can become the basis for a systematic and standardized monitor of cognitive change, improving continuity of care and communication between providers. It can be further used to objectively establish a patient's baseline and monitor change longitudinally.

The current study is limited by the lack of diversity and small size of the study population, which limits external validity (generalizability). Additional studies evaluating the utility of the mRASS by a variety of health care team members in a larger, more ethnically/racially diverse and heterogeneous population should be completed before we can determine if it can perform as a mental status vital sign, and if it is associated with better patient outcomes. Additionally, this study selected patients who were physically and cognitively capable of enrolling and excluded patients with severe cognitive and sensory impairment who were unable to provide consent to participate. Thus, some of the sickest, frailest, and most cognitively impaired patients were excluded. Unfortunately, this study therefore excluded a population significantly more vulnerable to the development of delirium.

Because a change in mental status (such as delirium) is common, morbid, and costly, a brief tool that can reliably and effectively assess mental status is needed. The mRASS used in this study provided an objective measurement of consciousness, a key component of mental status, and was demonstrated to reliably screen for presence or absence of delirium when administered longitudinally. Further study in diverse populations with administration by a variety of health care team members is needed to determine whether the mRASS can accurately serve as a mental status vital sign. If adopted widely, the mRASS could be used alongside the traditional vital signs to establish patient baselines, monitor change, improve provider communication, and potentially improve patient outcomes.

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References

1. Chester JG, Rudolph JL. Vital signs in older patients: age-related changes. *J Am Med Dir Assoc*. 2011;12:337–343.
2. Levkoff SE, Besdine RW, Wetle T. Acute confusional states (delirium) in the hospitalized elderly. *Annu Rev Gerontol Geriatr*. 1986;6:1–26.
3. Gustafson Y, Brannstrom B, Norberg A, Bucht G, Winblad B. Underdiagnosis and poor documentation of acute confusional states in elderly hip fracture patients. *J Am Geriatr Soc*. 1991;39:760–765.
4. Inouye SK, Foreman MD, Mion LC, Katz KH, Cooney LM Jr. Nurses' recognition of delirium and its symptoms: comparison of nurse and researcher ratings. *Arch Intern Med*. 2001;161:2467–2473.
5. Diagnostic and Statistical Manual of Mental Disorders. 4th ed. Washington, DC: American Psychiatric Association; 1994.
6. Inouye SK. Delirium in older persons. *N Engl J Med*. 2006;354:1157–1165.
7. Leslie DL, Marcantonio ER, Zhang Y, Leo-Summers L, Inouye SK. One-year health care costs associated with delirium in the elderly population. *Arch Intern Med*. 2008;168:27–32.
8. McCusker J, Cole M, Abrahamowicz M, Primeau F, Belzile E. Delirium predicts 12-month mortality. *Arch Intern Med*. 2002;162:457–463.
9. Rudolph JL, Inouye SK, Jones RN, et al. Delirium: an independent predictor of functional decline after cardiac surgery. *J Am Geriatr Soc*. 2010;58:643–649.
10. Sessler CN, Gosnell MS, Grap MJ, et al. The Richmond Agitation-Sedation Scale: validity and reliability in adult intensive care unit patients. *Am J Respir Crit Care Med*. 2002;166:1338–1344.
11. Ely EW, Truman B, Shintani A, et al. Monitoring sedation status over time in ICU patients: reliability and validity of the Richmond Agitation-Sedation Scale (RASS). *JAMA*. 2003;289:2983–2991.
12. Folstein MF, Folstein SE, McHugh PR. "Mini-mental state". A practical method for grading the cognitive state of patients for the clinician. *J Psychiatr Res*. 1975;12:189–198.
13. Inouye SK, van Dyck CH, Alessi CA, Balkin S, Siegal AP, Horwitz RI. Clarifying confusion: the confusion assessment method. A new method for detection of delirium. *Ann Intern Med*. 1990;113:941–948.