Commentary

Utility of the Richmond Agitation-Sedation Scale in evaluation of acute neurologic dysfunction in the intensive care unit

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Multiorgan failure is common in the intensive care unit (ICU) setting with increasing mortality with greater number of dysfunctional organs. An objective assessment of the severity of individual organ dysfunction is essential for clinical care and research. Severity of illness scoring systems in the ICU have been developed over the past 30 years and are currently used widely to risk stratify patients, predict hospital mortality, perform outcome based research, assess resource utilization and measure performance improvement in patient care (1,2). The Sequential Organ Failure Assessment (SOFA) was initially devised in 1994 by an expert panel to describe severity of organ dysfunction in patients with sepsis, and has subsequently been validated as a useful marker for predicting outcomes in medical and surgical ICUs (1). Each of the six organ systems (respiratory, cardiovascular, renal, hepatic, neurologic, coagulation) are assigned values between 0 (normal function) and 4 (significant dysfunction), total scores can range from 0 to 24 (1). In the recent Third International Consensus Definition for Sepsis and Septic shock (Sepsis-3), organ dysfunction due to infection is identified as an acute change in the total SOFA score by ≥2 points. The task force has also developed quick SOFA (qSOFA) model consisting of clinical criteria (systolic blood pressure of 100 mmHg or less, respiratory rate of 22/min or greater, altered mental status) for rapid bedside identification of patients at risk of worse outcomes (3). Serial SOFA score assessments in the first 48 hours after ICU admission correlate well with mortality (4). When compared to other organ dysfunction scores, SOFA has been shown to be consistent and an accurate predictor of mortality (1). Neurologic component of the SOFA score is derived from the Glasgow Coma Scale (GCS). GCS was first developed in 1974 by Teasdale and Jennett as a tool to objectively assess consciousness in patients with head injuries and offer a standardized approach that providers could utilize to monitor neurologic exam (5). Verbal, motor and eye response in the GCS define level of consciousness. Currently, the GCS is used in a broad spectrum of medical and surgical ICU patients and is an integral part of severity of illness and prognostic scoring systems such as the Acute Physiology and Chronic Health Evaluation (APACHE), Simplified Acute Physiology Score (SAPS), SOFA, Multiple Organ Dysfunction Score (MODS) and Logistic Organ Dysfunction Score (LODS) (1). However, several limitations of using the GCS in the critically ill population have been identified; including low interobserver reliability, inability to assess verbal component in tracheally intubated patients, weak prognostic value and erroneous estimation by providers due to lack of standardized assessments (6,7). The Richmond Agitation-Sedation Scale (RASS) is used for routine neurological assessments in the ICU, especially in patients without traumatic brain injury. RASS is a 10 point scale with discrete criteria, with four levels of agitation (+1 to +4), one level for calm and alert state (0), and 5 levels of sedation (−1 to −5) (8). It was initially devised to assist with administration and titration of sedation and analgesia in the ICU and has been shown to have high interobserver reliability, and consistency in estimating the patient's level of consciousness. It is easy to recall and can be administered in less than a minute with a simple three step sequence (observation, response to verbal stimulation and response to physical stimulation) (8-10). Sedation assessments based on the RASS are recommended by critical care consensus guidelines (10).

A prospective cohort study by Vasilevskis *et al*. (11) evaluated the validity of utilizing RASS instead of GCS

to measure the neurologic dysfunction component of the SOFA score. The authors studied 513 patients admitted to either medical or surgical ICU of Vanderbilt University Hospital with a diagnosis of respiratory failure and/or shock. SOFA scores were calculated daily by using variables obtained from the electronic medical record as well as GCS and RASS measures recorded by bedside nurses during routine clinical care. The neurologic component of the SOFA score was calculated using the original GCS approach (SOFA-$Neuro_{GCS}$) and the novel RASS approach (SOFA-$Neuro_{RASS}$). The authors converted the 10-point RASS scale to a 4-point Neurologic Sequential Organ Failure Assessment Score (SOFA-$Neuro_{RASS}$). The final SOFA-$Neuro_{RASS}$ was assigned a score of 0, 1, 2, 3 or 4 for RASS scores of ≥0, −1, −2, −3 or ≤−4 respectively. RASS scores >0 (agitation) were recorded in only 0.6% of assessments and were all given a SOFA-$Neuro_{RASS}$ score of 0. Thus, final SOFA scores were obtained with the traditional GCS based approach ($SOFA_{GCS}$) and the novel RASS based approach ($SOFA_{RASS}$). These scores were calculated at study enrollment and on a daily basis until ICU discharge or death. ICU admission, maximum, mean and 48-hour change in SOFA score were also calculated.

The study showed excellent co-relation between $SOFA_{GCS}$ and $SOFA_{RASS}$ (Spearman rank correlation coefficient >0.9) for all calculated values, thus proving that the RASS score could be used instead of the GCS for calculation of the neurologic component of the SOFA score. In addition, a strong correlation was found between daily $SOFA_{RASS}$ and $SOFA_{GCS}$ was also found (spearman r=0.96, 95% confidence interval: 0.966–0.978). The $SOFA_{RASS}$ also performed well for the purposes of mortality prediction, with a moderate correlation (spearman r=0.58, 95% confidence interval: 0.52–0.64) between $SOFA_{RASS}$ and APACHE II score at study enrollment. Amongst all the calculated SOFA scores, the mean values for both $SOFA_{GCS}$ and $SOFA_{RASS}$ scores were found to be the most accurate for predicting ICU, hospital and 1 year mortality. This is not surprising given that organ dysfunction often worsens over the first few days of the ICU stay and thus the admission or day 1 SOFA score are often not predictive of outcomes.

It is interesting to note that patient sedation did not appear to affect the utility of the RASS score in assessing severity of neurologic dysfunction. The most likely explanation may be the fact that heavily sedated patients (with lower RASS scores) may also be the sickest. Thus the lower RASS scores may be an accurate reflection of their illness severity. How is the clinician to interpret the results of this study? The first point that needs to be highlighted is the fact that organ dysfunction scoring is a dynamic process. Scores obtained on admission or the first 24 hours after ICU admission may not be reflective of illness trajectory and ultimate outcomes. The 2nd point to note is the somewhat limited applicability of these scores for real time clinical decision making. This is reflected by the fact that the $SOFA_{GCS}$ and $SOFA_{RASS}$ scores in this study had an area under the curve (AUC) of 0.77 and 0.78 respectively for the prediction of hospital mortality. These numbers are not accurate enough to be of use for beside prognostication or clinical decision support tools. Another important point to note is that the study was conducted in a single institution that has been at the forefront of 'light' ICU sedation practices and the results may not be applicable to other settings and patient populations.

A more general limitation of using arousal and response based scores such as RASS and GCS alone to evaluate acute neurologic dysfunction is the inability to reliably account for the presence of delirium, which adversely impacts outcomes in the ICU population (12,13). Although the RASS score and modified RASS score have been studied for the detection of delirium in the emergency department and medical floors (14,15); the Confusion Assessment Method for the Intensive Care Unit (CAM-ICU) (16) remains a more validated tool for delirium detection in the ICU. An important diagnostic feature of delirium is the presence of inattention, which can manifest as the inability to make or sustain eye contact. RASS assessment may thus correlate with the CAM-ICU, as they both capture duration of eye contact (9). Future research should be directed towards developing comprehensive neurologic monitoring tools that help better define acute neurologic dysfunction by incorporating the presence of delirium into prognostic and severity of illness scoring systems in the ICU.

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Footnote

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