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Survey of Bedside Clinical Neurologic Assessments in U.S. PICUs*

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Abstract

Objective—To understand how routine bedside clinical neurologic assessments are performed in U.S. PICUs.

Design—Electronic survey.

Setting—Academic PICUs throughout the United States.

Subjects—Faculty representatives from PICUs throughout the United States.

Interventions—None.

Measurements and Main Results—We surveyed how routine bedside neurologic assessments are reported to be performed in U.S. PICUs and the attitudes of respondents on the utility of these assessments. The survey contained questions regarding 1) components of neurologic assessments; 2) frequency of neurologic assessments; 3) documentation and communication of changes in neurologic assessment; and 4) optimization of neurologic assessments. Surveys were received from 64 of 67 institutions (96%). Glasgow Coma Scale and pupillary refl were the most commonly reported assessments (80% and 92% of institutions, respectively). For patients with acute brain injury, 95% of institutions performed neurologic assessments hourly although assessment frequency was more variable for patients at low risk of developing brain injury and those at high risk for brain injury, but without overt injury. In 73% of institutions, any change detected on routine neuroassessment was communicated to providers, whereas in 27%, communication depended on the severity or degree of neurologic decline. Seventy percent of respondents thought that their current practice for assessing and monitoring neurologic status was suboptimal. Only 57% felt that the Glasgow Coma Scale was a valuable tool for the serial

assessment of neurologic function in the ICU. Ninety-two percent felt that a standardized approach to assessing and documenting preillness neurologic function would be valuable.

Conclusions—Routine neurologic assessments are reported to be conducted in nearly all academic PICUs in the United States with fellowship training programs although the content, frequency, and triggers for communication vary between institutions. Most physicians felt that the current paradigms for neurologic assessments are suboptimal. These data suggest that optimizing and standardizing routine bedside nursing neurologic assessments may be warranted. (*Pediatr Crit Care Med* 2018; 19:339–344)

Keywords

neurologic assessments; neuro check; Glasgow Coma Scale

Brain injury is the most common cause of death in critically ill children admitted to the ICU (1). Additionally, up to 10% of children admitted to ICUs are either discharged with a new functional deficit or develop one within the first few years after hospitalization (2, 3). These neurologic insults occur both in patients with acute brain injury and in patients with primary cardiac, respiratory, and other organ system dysfunction (2–4). Some of these new deficits may be preventable if detected and treated prior to irreversible damage.

The current practice for evaluating and trending a patient's neurologic status in the ICU is serial "neuro checks" or neurologic assessments. Neurologic assessments are modifications of the neurologic examination that are typically performed by bedside nurses and include evaluations of consciousness, cranial nerves, communication, and the sensorimotor system. A consciousness or coma scale, like the Glasgow Coma Scale (GCS), is traditionally the core component of an ICU neurologic assessment (5). Although serial bedside neurologic assessments are typically performed in PICUs, delayed recognition of neurologic decline occurs and can lead to increased patient morbidity and mortality.

In order to improve early recognition and treatment of neurologic decline in critically ill patients, it is important to understand the current practice. We sought to characterize how physicians' self-report bedside nursing neurologic assessments are performed in PICUs throughout the United States to determine if there is a standardized and consistent approach within and across institutions.

MATERIALS AND METHODS

Survey

An electronic survey was created (SurveyMonkey Inc., San Mateo, CA) to address four topics related to bedside nursing neurologic assessments in PICUs: 1) components; 2) frequency of administration; 3) documentation and communication of neurologic changes; and 4) optimization. The survey contained 28 questions (supplement 1, Supplemental Digital Content 1, <http://links.lww.com/PCC/A613>) and was developed by a multidisciplinary team of experts in pediatric critical care, neurology, and nursing. It was piloted by local critical care medicine physicians, and modifications were made based on suggestions. The survey was distributed to the 67 U.S. PICUs with pediatric critical care medicine fellowship

programs (as listed on www.abp.org as of November 1, 2016) by e-mailing fellowship program directors and other faculty member contacts in PICU leadership positions. The e-mail asked the individual to either complete the survey as a representative of their institution or forward the survey to another faculty member. Only faculty completed surveys were evaluable. If responses were not received after the first attempt, repeated attempts were made by the authors over a 3-month period of time.

The survey request explicitly stated that 1) the aim of the survey was to assess what physicians think actually happens in PICUs with respect to routine neurologic assessments and 2) consulting with physician or nursing colleagues, or the institution's patient care handbook was permitted and encouraged. Limited demographic information was obtained about each institution's ICU, and no identifying information was collected from the survey respondent. The survey took approximately 5 minutes to complete. This study was determined to be exempt by the institutional review board at the Children's Hospital of Philadelphia.

Statistical Analysis

A survey was considered evaluable if the respondent progressed beyond the demographics page. Data were analyzed using descriptive statistics. For institutions with more than one response, responses to each question were combined where appropriate (i.e., components of neurologic assessments and documentation and communication of neurologic status changes). For responses addressing the frequency of neurologic assessments, analyses were conducted using the most frequent assessment of the multiple respondents (e.g., using every 2 hr if there were two respondents, one answering every 2 and one every 4 hr). All faculty respondents were included in the analyses for questions asking personal opinions about neurologic assessments.

RESULTS

The survey was distributed between November 2016 and March 2017. Surveys were sent to 67 institutional representatives. Evaluable surveys were received from 64 of 67 institutions (96% response rate). The institutions represented 41 PICUs and 23 combined PICU/cardiac ICUs (CICUs) with a median of 27.6 beds (interquartile range, 21–35). Multiple responses were received from eight institutions (two surveys from each of seven institutions and three surveys from one institution) due to the faculty member initially contacted distributing the survey to multiple other faculty members at the institution.

Three institutions did not complete the survey section on neurologic assessment components, and five institutions did not complete the sections on GCS or documentation and communication of neurologic change. Therefore, the denominators for those analyses have been adjusted to 61 and 59 institutions, respectively.

Routine bedside neurologic assessments were conducted in 98% of the reporting institutions (63/64). In 75% (48/64), performing neurologic assessments required a physician order.

Components of Bedside Nursing Neurologic Assessments

The components of routine bedside neurologic assessments varied between institutions (Fig. 1). Ninety-three percent of PICUs (57/61) used a coma scale including the GCS (84%), Alert Voice Pain Unresponsive (AVPU) scale (36%), and the Full Outline of UnResponsiveness (FOUR) score (3%) (6–9). Twenty-six percent of PICUs (16/61) used more than one coma scale. Pupillary reflex was performed at 92% of institutions. Two institutions reported incorporating sedation (e.g., State Behavioral Scale [SBS] or Richmond Agitation Sedation Scale [RASS]) or pain scales (e.g., Face, Legs, Activity, Cry, Consolability scale [FLACC]) in neurologic assessments (10–12). Three institutions performed more customized neurologic assessments that include cognition, speech, behavior, communication, muscle tone, extremity sensation, and fontanel fullness. Two institutions reported deferring some of the brainstem reflexes (e.g., corneal and gag) on routine assessment if a patient's mental status or consciousness is normal for age. Reported approaches to scoring the verbal component of the GCS in intubated patients were variable (Fig. 2). Fifty-eight percent of institutions used a pediatric modification of the GCS. The reported age cutoffs for using the pediatric GCS were less than or equal to 1 (42%), 2 (9%), 4 (12%), 5 (33%), and 8 (3%) years old. Only 57% of physicians reported GCS as a valuable tool for the serial assessment of neurologic function in the ICU.

Frequency of Bedside Nursing Neurologic Assessments

Fifty-three percent (34/64) of institutions had more than one way for determining frequency of assessments. The frequency of bedside neurologic assessments was determined by physician discretion in 94% (60/64), nursing discretion in 23% (15/64), and by institutional protocol in 53% (34/64) of institutions. Respondent comments included that 1) institutional protocols determined the minimum assessment frequency although physicians can order more frequent assessments when clinically indicated and 2) nurses had the autonomy to assess and document assessment more frequently than ordered if they are concerned that the patient's neurologic status may have changed.

The reported minimum neurologic assessment frequency ranged from every 1 hour to every 12 hours (Fig. 3), with every 4 hours being the most common (48%). Twelve institutions (19%) had no minimum frequency. For ICU patients deemed to be at low risk for acute brain injury, the most common frequencies for performing neurologic assessments were every 4 (47%) and every 2 (27%) hours. For patients with acute brain injury, 95% of institutions reported performing neurologic assessments hourly. For patients deemed to be at high risk for acute brain injury, but without overt brain injury, neurologic assessments were performed hourly at 63% of institutions, and every 2 or 4 hours at 30% of institutions.

Documentation and Communication of Neurologic Status Changes

Seventy-three percent of institutions (43/59) reported that any change detected on routine neurologic assessment was communicated to the medical team, whereas 27% (16/59) reported that communication depended on the severity or degree of neurologic decline. Communication was determined by ICU protocol in 44% (26/59), physician order in 58% (34/59), and by nurse discretion in 92% (54/59). Although 83% of institutions had more than one trigger for communication, nurse discretion was the only determinant for

communication of neurologic decline in 8% (5/59). Communication was individualized to the patient in 68% of institutions (40/59). Changes in neurologic status were documented in 98% of institutions (58/59) via a neurologic assessment section, free-text nursing comments, or physician progress note in the electronic medical record. One institution did not routinely document neurologic status changes.

Optimization of Neurologic Assessments

Seventy-five percent of institutions reported that there was no standardized system in their ICU to characterize the preillness neurologic function of children with developmental disabilities or chronic brain injury. Comments reported that some information was documented in physician notes, recent clinic letters, and nursing assessments in the electronic medical record. The Pediatric Overall Performance Category (POPC), Pediatric Cerebral Performance Category (PCPC), or Functional Status Scale (FSS) was used at three institutions (13, 14). Ninety-two percent of respondents felt that a system to more clearly define preillness neurologic functioning of patients would be beneficial to their practice.

Sixty-nine percent of respondents did not think that their current neurologic assessments were optimal to monitor neurologic status in ICU patients. Comments centered around the following: 1) standardization, consistency, and education regarding neurologic assessments with guidance for when to communicate neurologic changes; 2) decision support for appropriate diagnostic tests or interventions when neurologic status declines; 3) standardizing preillness neurologic assessments; 4) designing scales to monitor neurologic status in patients with developmental disabilities; and 5) individualized neurologic assessments based on specific disease processes (e.g., stroke, traumatic brain injury, or hydrocephalus).

DISCUSSION

Seventy percent of respondents to this survey of routine neurologic assessments from 64 academic PICUs with fellowship programs responded that their current practice for assessing and monitoring neurologic status was suboptimal. Reported institutional performance of routine neurologic assessments was highly variable in component content, frequency of assessment, and in the documentation and communication of changes in a patient's neurologic status. Nearly all respondents felt that a standardized approach to assess and document preillness neurologic function would be valuable.

Over 90% of surveyed institutions that responded used a published and validated coma scale (i.e., GCS, AVPU, or FOUR) as the main component of the neurologic assessment (5, 6, 9, 15). However, only half of the survey respondents felt that the GCS was a valuable tool for the serial assessment of neurologic function in an ICU setting. This may be due in part to limitations in performing the GCS in the ICU environment, challenges interpreting the GCS in critically ill children, or its inability to detect subacute neurologic decline (16–19). For example, patients can have subtle impairments in their neurologic functioning (e.g., slowed processing, reduced attentiveness or alertness, or decreased wakefulness) that are indicative of an evolving acute neurologic process, but continue to receive the maximum GCS score. The verbal component of the GCS is not testable in intubated patients. Most surveyed

institutions classify intubated patients as a 1T (T standing for “tube”). It is unclear how summative scores are calculated using this substitution because recording a verbal response of 1 would inappropriately underestimate the patient’s actual level of consciousness. In response to reservations about the utility of the GCS based on its reliability, consistency of assessment scores, and its handling of confounders, a new structured approach to the assignment of responses was introduced in 2014, recommending using a rating of “non-testable” for patients with factors interfering with communication (i.e., intubation) and not reporting a summative score (20, 21).

Pediatric modifications to the GCS are essential to evaluate infants and young children who cannot reliably follow commands, answer questions, or localize to a painful stimulus due to their degree of brain maturation. Pediatric modifications of the GCS have demonstrated reasonable reliability in recent emergency department and ICU-based studies (7, 8, 22, 23). However, only 60% of institutions in this study report using a pediatric GCS, and these institutions have variable age cutoffs. Numerous pediatric modifications to the GCS exist, but there is no universally accepted standard (21, 22). Most scale modifications focus on verbal response to account for age-appropriate developmental milestones, and some add a grimace, facial expression, or crying component, as a marker of nonverbal communication (24, 25). Motor response is modified for children less than 2 years old because they cannot consistently follow commands or reliably localize to a painful stimulus.

Seventy-five percent of respondents reported that there is no standardized system in their ICU to characterize the pre- illness neurologic function of children with developmental disabilities. Children with developmental disabilities or chronic brain injury comprise a quarter of the PICU population and are often at high risk for neurologic decline (26). These patients may not have a normal GCS at baseline, making recognition of neurologic decline in this population challenging. Despite the numerous pediatric modifications to the GCS, none are designed to assess neurologic function in patients with neurodevelopmental disabilities (21, 22). For example, differentiating between normal and abnormal flexion, GCS motor responses in children with spastic cerebral palsy can be challenging, even for experienced providers. Ninety-two percent of physicians felt that a system to more clearly define pre- illness neurologic functioning of patients would be beneficial to their practice.

Although these data demonstrate variability in routine bedside clinical neurologic assessments in U.S. PICUs, it is unclear whether standardizing these assessments would impact the identification of new neurologic deficits, more timely access to rescue therapies, or improved functional outcomes. New clinical assessment tools, designed to overcome limitations of the GCS, may improve detection of neurologic decline particularly for critically ill children who are intubated and/or sedated, and those with developmental disabilities. Tools should be sensitive to the mechanisms of acute brain injury that commonly occur in PICU patients and be flexible to accommodate situations where neurologic decline is expected (e.g., after administering sedatives) to minimize unnecessary physician notifications.

This study had limitations. First, these survey answers were self-reported and represent what clinicians say they do, but may not accurately reflect actual institutional practice. This was

highlighted by institutions with multiple responders with answers differing between respondents. Despite this, the large variability in reported practice presumably reflects lack of consistency in practice. Second, this survey only assessed practice at academic centers with PICU fellowship programs and may not represent practice at nonacademic centers. Third, variability in patient populations between institutions may influence neurologic assessment practices. Fourth, the survey was distributed to physicians in leadership positions who may be less familiar with day-to-day clinical practice in their unit. Fifth, the survey only addressed variability in the GCS verbal component. Because GCS motor response contains most of the predictive power in severe brain injuries, in the future, we will explore motor response practice patterns (27, 28). Sixth, we may have biased respondents by assessing attitudes toward the utility of neurologic assessments using a yes/no response rather than a Likert scale. Seventh, use of assessment scales like SBS, RASS, and FLACC and neurologic outcome scales like POPC, PCPC, and FSS may be underreported due to the reliance on free-text responses to identify the use of these measures. Finally, this survey included institutions with PICUs and combined PICUs/ CICUs but did not assess practice in dedicated CICUs.

CONCLUSIONS

Neurologic assessments are reported to be routinely conducted by bedside nurses in nearly all PICUs, although the content, frequency, and triggers for documentation and communication of decline vary greatly between institutions. Most physicians feel that current approaches for neuroassessments are suboptimal. Further investigation is needed to determine whether standardization of neurologic assessments will lead to improved identification of neurologic deficits and functional outcomes.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figure 1. Specific components of routine bedside nursing neurologic assessments used at responding institutions ($n = 61$). AVPU = Alert Voice Pain Unresponsive, ext = extremity, FOUR = Full Outline of UnResponsiveness, GCS = Glasgow Coma Scale.

Figure 2.
How verbal Glasgow Coma Scale responses are reported at responding institutions ($n = 59$).
T = tube.

Figure 3.

Frequency of routine bedside nursing neurologic assessments for patients at varying risk levels for brain injury at responding institutions ($n = 64$). ABI = acute brain injury.