Validity and Sensitivity of 6 Pain Scales in Critically Ill, Intubated Adults

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Background Self-report is the best indicator of pain; however, pain is more difficult to assess in noncommunicative patients who may be receiving mechanical ventilation or sedated and unable to report pain.

Objectives To evaluate the validity and sensitivity of 6 pain scales (Adult Nonverbal Pain Scale; Behavior Pain Scale [BPS]; Comfort Scale; FACES; Face, Legs, Activity, Cry, and Consolability scale; Pain Assessment Behavioral Scale with Numeric Rating Scale [NRP]) to identify the best measure of pain in noncommunicative patients.

Methods Fifty communicative and 100 noncommunicative patients receiving mechanical ventilation were observed before and during routine physical examination and endotracheal tube suctioning.

Results All pain scales had moderate to high correlations with the patient’s self-report during suctioning. The FACES score reported by the patient had the highest correlation with the patient’s NRP score ($r=0.76$, $P<.001$) during suctioning; associations between the BPS and NRP scores during physical examination were the weakest ($r=0.21$, $P=.20$). All scales were sensitive in capturing the patient’s pain response in all phases ($P<.001$); sensitivity was higher during suctioning ($P<.001$). Both participants and investigators rated pain higher on the FACES scale.

Conclusions These pain scales commonly used in noncommunicative critically ill adult patients are valid and sensitive for capturing changes in pain response during suctioning in both communicative and noncommunicative patients. However, caution must be used when using the FACES scale because subjectivity may lead to overtreatment or undertreatment of pain. (American Journal of Critical Care. 2015;24:514-524)
Critically ill patients are subjected to a variety of uncomfortable and painful experiences during the course of hospitalization. Critically ill patients often experience inadequate pain relief. Not only do critically ill patients suffer pain that is due to their illness and disease state, but they also have pain caused by common procedures such as suctioning and repositioning. Self-reporting is the best method for evaluation of pain, but pain is more difficult to assess in noncommunicative patients, who may be receiving mechanical ventilation or sedated and unable to report pain. The American College of Critical Care Medicine has developed expert guidelines for preventing and treating pain in noncommunicative patients. In meeting these standards, health care agencies have instituted procedures to assess, diagnose, and treat pain systematically. However, these guidelines are difficult to implement without a single valid and reliable pain scale, especially for noncommunicative patients.

The ability to assess and document a patient’s pain correlates directly with the ability to manage pain. Therefore having a valid and reliable tool to use in managing pain in critically ill, sedated, noncommunicative patients is essential for health care providers. Although several behavioral pain tools have recently gained favor for use in intensive care units, no one tool is used universally in such patients. A systematic review describing instruments developed for pain assessment in noncommunicative patients revealed 5 pain assessment tools. Of those 5 tools, the Behavioral Pain Scale (BPS), the Critical-Care Pain Observation Tool (CPOT), and the Adult Nonverbal Pain Scale (ANVPS) had the highest psychometric score based on quality judgment criteria relating to validity and reliability. Scales such as the BPS, CPOT, and ANVPS show good interrater reliability and discriminant validation, although the degree of correlation with patients’ self-reports of pain vary.

Therefore, the purpose of this study was to evaluate the validity and sensitivity of 6 pain scales in an effort to identify the most appropriate measure of pain in noncommunicative patients (ie, patients receiving mechanical ventilation or sedated).

Methods

Setting and Sample

The study was conducted at Virginia Commonwealth University Medical Center, an academic medical center, and the sample of 150 patients receiving mechanical ventilation was drawn from patients more than 18 years old who were admitted to a medical respiratory intensive care unit. The sample of 150 consisted of 100 patients who were noncommunicative (unable to speak, write, or use eye or hand motions) and 50 communicative patients. This observation study was reviewed by the institutional review board, and a waiver of informed consent was approved. Patients requiring neuromuscular blocking agents and those with overt disease affecting the brain (head trauma, intracranial hemorrhage, and meningitis) were excluded because manifestations of pain may vary in such patients. Male and female patients from all ethnicities and racial backgrounds were recruited.

Measurement of Key Variables

Characteristics of Patients. Age, sex, ethnicity, duration of intubation, and reason for admission to the intensive care unit were collected from the medical record. To describe the sample, a measure of severity of illness was documented on admission to the study by using the Acute Physiology. Age, and Chronic Health Evaluation (APACHE) III. The APACHE III score was recorded from the medical record by using data from the 24 hours of data.
Pain was assessed before and during noxious and non-noxious procedures.

Each patient enrolled in the study received 4 packets of pain assessment tools for the 4 phases of pain assessment. The nurse investigator assessed pain during 4 phases: (1) before physical examination (a procedure that is not noxious) when the patient appeared to be at rest and was comfortable, (2) during routine physical examination, (3) before routine endotracheal suctioning when the patient appeared to be at rest and was comfortable, and (4) during routine endotracheal suctioning (a noxious procedure). The patient’s nurse informed the investigator when the patient required suctioning according to clinical assessments and also when routine physical examination was to occur. The investigator observed the patient for 2 minutes and recorded pain assessments for phase 1 or phase 3. A period of at least 30 minutes separated phase 2 and phase 3 to reduce the effect of one procedure on the other.

Endotracheal suctioning did not occur simply for study purposes. Endotracheal tube suctioning is a noxious event. Heart rate and mean arterial pressure increase significantly during and after suctioning, returning to baseline approximately 5 minutes later. Therefore, it is reasonable to use a routine nursing intervention such as endotracheal suctioning in this study as a noxious procedure.

Communicative Patients. In the 50 patients who could communicate, the investigator used 6 pain assessment tools (ANVPS, BPS, COMFORT, Nurse, FLACC, and PABS) to evaluate pain, and the patients used the NRS and the FACES scale to rate their pain. Before the physical examination and the suctioning procedure, the investigator observed the patient for 2 minutes to assess pain level and then completed each tool. Second, the investigator asked the patient to rate his or her pain as a self-report measure by using the NRS and FACES scale and pointing to the corresponding image. The investigator and the patients used the same FACES scale. FACES-patient indicates results obtained from the patients and FACES-nurse indicates results obtained by the investigator. During the physical examination and suctioning procedure, the investigator observed the duration of the event and then completed each tool. Then the investigator asked the patient to rate his or her pain by using the NRS and FACES-patient.

Noncommunicative Patients. Noncommunicative patients were unable to rate their pain by using the NRS, so this tool was omitted for the 100 noncommunicative patients. The sensitivity of each of the 6 pain assessment tools (ANVPS, BPS, COMFORT, Nurse, FLACC, and PABS) was assessed by identifying changes in pain level during the 4 phases. The investigator followed the same steps to observe the patient for 2 minutes to obtain the patient’s pain level before the procedure and then...
<table>
<thead>
<tr>
<th>Pain assessment tools</th>
<th>Psychometric testing</th>
<th>Behavior and physiological parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Communicative</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FACES(^{15})</td>
<td>Adaptation of the picture projection technique in which 6 faces are shown to the child; Concurrent validity tested with 5 different scales; children ages 3-18 years preferred the FACES scale</td>
<td>Drawing of 6 schematic faces depicting changes in severity of expressed pain (score range 0-10, smiling “no hurt” face on the left to a crying “hurts worst” face on the right) Score range 0-10, with lower scores indicating less pain</td>
</tr>
<tr>
<td>Numeric Rating Scale (NRS)(^{12})</td>
<td>Well-tested tool of self-report of pain rating; originally validated in postoperative adult patients Concurrent validity tested with Faces Pain Scale, the Verbal Descriptor Scale, and the Iowa Pain Thermometer (r=0.78 to 0.86 in the cognitively impaired group, except Faces Pain Scale) and (r=0.96 to 0.97 cognitively intact group) n=66, P&lt;.01 selected scales</td>
<td>Combination of horizontal numeric rating scale and word anchors Score range 0-10, with word anchors of “no pain” at one end of the scale, “moderate pain” in the middle, and “worst possible pain” at the opposite end of the scale</td>
</tr>
<tr>
<td><strong>Noncommunicative</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adult Nonverbal Pain Scale (ANVPS)(^{9})</td>
<td>Modified the Face, Legs, Activity, Cry, and Consolability (FLACC) scale to reflect components appropriate to an adult population; content validated by nursing and medical experts in critical care Concurrent validity tested with FLACC during rest, turning, or suctioning (r=0.86, n=59, P&lt;.001). Internal consistency Cronbach α=0.78</td>
<td>Five-item scale: Face Activity/movement Guarding Physiologic I (vital signs) Physiologic II (skin temperature, pupil dilatation) Score range 0-10, with lower scores indicating less pain</td>
</tr>
<tr>
<td>Behavioral Pain Scale (BPS)(^{7})</td>
<td>Developed from staff survey and literature review Test-retest reliability tested during rest and procedure (r=0.71 at rest and r=0.50 during procedure, n=31, both P&lt;.01) Internal consistency: Cronbach α=0.94</td>
<td>Three items: Facial expression Movements of upper and lower extremities Compliance with mechanical ventilation Pain indicator scored 1 (no response) to 4 (full response); score range 3-12, with lower scores indicating less pain</td>
</tr>
<tr>
<td>COMFORT(^{20})</td>
<td>Designed for assessment of pain, no pain, related distress, and sedation in pediatric intensive care unit (PICU); developed from literature review and survey of PICU nurses Concurrent validity tested with visual analog scale (r=0.75, n=50, P&lt;.01) Internal consistency: Cronbach α=0.90</td>
<td>Eight items: Alertness Calmness Respiratory distress Physical movement Muscle tone Facial tension Blood pressure (mean arterial pressure) baseline Heart rate baseline Each category scored from 1 to 5 points; score range 8-40: 8-16=oversedated 17-26=optimally sedated 27-40=inadequately sedated</td>
</tr>
<tr>
<td>FLACC(^{21})</td>
<td>Developed by clinicians on the basis of categories of behavior included in other scales to evaluate pain in children Concurrent validity tested with Objective Pain Scale (r=0.80, n=89, P&lt;.001)</td>
<td>Five items: F: face L: legs A: activity C: cry C: consolability Each equally weighted from 0 to 2; score range 0-10, with lower scores indicating less pain</td>
</tr>
<tr>
<td>Pain Assessment Behavioral Scale (PABS)(^{22})</td>
<td>Modified FLACC to reflect components appropriate to an adult population Concurrent validity tested with verbal report (r=0.69, n=305, P&lt;.001)</td>
<td>Five items: Face Restlessness Muscle tone Vocalization Consolability Score range 0-10, with lower scores indicating less pain</td>
</tr>
</tbody>
</table>
completed each tool. Then the investigator observed during the procedure for the duration of the event and then completed each tool.

Data Analysis
The purpose of this study was to evaluate the validity and sensitivity of pain scales in an effort to identify the most appropriate measure of pain in noncommunicative patients (ie, patients receiving mechanical ventilation or sedated). The questions of validity and sensitivity were answered with 2 separate samples. The first sample, intended to assess validity, was taken from communicative intubated patients. Each patient’s pain was measured with the following pain scales: ANVPS, BPS, COMFORT, FACES-nurse, FLACC, and PABS and patient self-report using the FACES-patient and NRS for the 4 phases of assessment. The NRS served as the reference standard tool for patients’ self-reports of pain. A Spearman correlation coefficient (ρ) was calculated for each scale with the NRS. Before data collection, the power was estimated assuming use of the Pearson correlation coefficient and the Fisher z test. Thus, for the planned sample size of 50 (sample of communicative patients), the 2-sided Fisher z test of the null hypothesis that the Pearson correlation coefficient equals 0 was estimated to have 82% power to detect correlations as small as 0.4.

The second sample, intended to assess sensitivity, was taken from 100 noncommunicative intubated patients. Each patient’s pain was measured with the following pain scales (ANVPS, BPS, COMFORT, FACES-nurse, FLACC, and PABS) for the 4 phases of assessment. A mixed-effects linear model was used to test for changes from before the stimulus (poststimulus minus prestimulus) for both the noxious stimulus and the stimulus that was not noxious for each of the pain scales. The fixed effects included time (before and during stimulus), stimulus (noxious and noxious), time by stimulus interaction, and the RASS score as a covariate. Patient was modeled as a random effect. The homogeneity of the covariates assumption and model assumptions was checked. Because no preliminary data are available, no power calculations were possible. However, a sample of 100 noncommunicative intubated patients is thought to be adequate for assessing sensitivity.

Results

Patients
The sample consisted of 50 communicative and 100 noncommunicative patients and was evenly divided between males and females (Table 2). Most patients were African American, with no difference in race and ethnicity between the communicative and noncommunicative groups. The mean age was 56 (SD, 12.7) years in the communicative patients and 52 (SD, 16.6) years in noncommunicative patients, with no significant difference in age between the 2 groups ($F_{1,149} = 2.29; P = .13$). Severity of illness was higher in the noncommunicative patients than in the communicative patients ($F_{1,49} = 22.71; P < .001$). The RASS scores at baseline differed significantly between the 2 groups; noncommunicative patients were more sedated ($z = 8.35, P < .001$). Ninety-six percent of the communicative patients were alert or mildly sedated, whereas 61% of noncommunicative patients were moderately to deeply sedated.

Pain Level

Validity, Communicative Intubated Patients. The mean scores of the investigators’ ratings of the pain scales (ANVPS, BPS, COMFORT, FACES-nurse, FLACC, and PABS) and patients’ ratings using FACES-patient and NRS are presented in Table 3. The pain intensity score before and during physical examination increased slightly, whereas a significant increase was seen during suctioning. However, patients pointed to higher pain intensity on the FACES scale than they communicated as a numeric value during the suctioning procedure (mean score during suctioning NRS = 3.88, FACES-patient = 5.22). Interestingly, investigators’ ratings of pain were even higher than patients’ self-reports (NRS = 3.88, FACES-Nurse = 6.73) during the suctioning procedure.

In addition, the pain scales varied in their association with the NRS before and during the 2 procedures (Table 4). All pain scales had significant moderate to high correlations with the patient’s self-rating by using the NRS during the suctioning procedure. However, before physical examination, only the FACES-patient and FACES-nurse had significant correlations with the NRS. As expected, patients’ self-rating by using the FACES-patient, where the patients chose the face that best represented their pain level, had the highest correlation with the NRS ($ρ = 0.76, P < .001$) during the suctioning procedure. Interestingly, only BPS had a non-significant correlation of 0.21 ($P = .20$) with patient self-report during physical examination, whereas all other tools showed significant moderate correlation. Interestingly, 68% of the communicative patients rate pain during physical assessment as “0” when using the NRS (mean score, 1.95; SD, 3.21; median, 0; range, 0–10), whereas nurses rated patients’ pain level as 4 or greater when using the BPS 71% of the time (mean score, 4.2; SD, 1.09; median, 4.0; range,
### Table 2
Sample characteristics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Yes (n = 50)</th>
<th>No (n = 100)</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
</tr>
<tr>
<td>Sexa</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>27</td>
<td>54</td>
<td>45</td>
</tr>
<tr>
<td>Male</td>
<td>23</td>
<td>46</td>
<td>55</td>
</tr>
<tr>
<td>Ethnicitya</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hispanic</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Non-Hispanic</td>
<td>50</td>
<td>100</td>
<td>96</td>
</tr>
<tr>
<td>Racea</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black or African American</td>
<td>33</td>
<td>66</td>
<td>58</td>
</tr>
<tr>
<td>White</td>
<td>17</td>
<td>34</td>
<td>35</td>
</tr>
<tr>
<td>American Indian or Alaskan Native</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Asian</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Other</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Diagnosis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Respiratory disorders</td>
<td>20</td>
<td>40</td>
<td>22</td>
</tr>
<tr>
<td>Neurological disorders/alt mental status</td>
<td>10</td>
<td>20</td>
<td>25</td>
</tr>
<tr>
<td>Gastrointestinal, genitourinary, or hematological disorders</td>
<td>5</td>
<td>10</td>
<td>14</td>
</tr>
<tr>
<td>Cardiovascular disorders</td>
<td>5</td>
<td>10</td>
<td>6</td>
</tr>
<tr>
<td>Sepsis</td>
<td>3</td>
<td>6</td>
<td>14</td>
</tr>
<tr>
<td>Trauma, motor vehicle accidents</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Unclear cause, other</td>
<td>7</td>
<td>14</td>
<td>16</td>
</tr>
<tr>
<td>RASS categoriesb</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moderate/deeply sedated</td>
<td>1</td>
<td>2</td>
<td>61</td>
</tr>
<tr>
<td>Alert/mildly sedated</td>
<td>48</td>
<td>96</td>
<td>37</td>
</tr>
<tr>
<td>Restless/agitated</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td><strong>Mean (SD)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age, years</td>
<td>56</td>
<td>12.7</td>
<td>52</td>
</tr>
<tr>
<td>Duration of intubation,abc days</td>
<td>5.2</td>
<td>4.4</td>
<td>4.3</td>
</tr>
<tr>
<td>Score on Acute Physiology and Chronic Health Evaluation III**</td>
<td>65.8</td>
<td>19.2</td>
<td>85.7</td>
</tr>
<tr>
<td>RASS baseline score**</td>
<td>-0.3</td>
<td>0.7</td>
<td>-2.8</td>
</tr>
</tbody>
</table>

a No significant difference among communicative and noncommunicative categories.
b RASS = Richmond Agitation-Sedation Scale; we have further summarized the RASS’s 10 levels of sedation as moderate/deeply sedated (RASS score of -5, -4, or -3), alert/mildly sedated (RASS score of -2, -1, or 0), or restless/agitated (RASS score of +1, +2, +3, or +4).11, 28
c Duration of intubation=days of intubation before enrollment in the study.
d P < .001.

### Table 3
Mean (SD) scores for the 50 communicative patients

<table>
<thead>
<tr>
<th>Evaluation</th>
<th>NRS</th>
<th>FACES-patient</th>
<th>ANVPS</th>
<th>BPS</th>
<th>COMFORT</th>
<th>FACES-nurse</th>
<th>FLACC</th>
<th>PABS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Physical examination</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before</td>
<td>1.51 (2.88)</td>
<td>3.35 (3.40)</td>
<td>0.75 (1.06)</td>
<td>3.86 (1.30)</td>
<td>17.48 (3.08)</td>
<td>1.86 (2.52)</td>
<td>0.45 (1.00)</td>
<td>0.43 (0.85)</td>
</tr>
<tr>
<td>During</td>
<td>1.95 (3.21)</td>
<td>2.54 (2.48)</td>
<td>0.88 (0.95)</td>
<td>4.17 (1.09)</td>
<td>17.88 (2.06)</td>
<td>1.38 (1.79)</td>
<td>0.71 (0.90)</td>
<td>0.68 (0.93)</td>
</tr>
<tr>
<td><strong>Suctioning</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before</td>
<td>1.29 (2.35)</td>
<td>3.80 (3.32)</td>
<td>0.64 (0.78)</td>
<td>3.89 (1.02)</td>
<td>17.68 (2.23)</td>
<td>1.26 (1.45)</td>
<td>0.43 (0.79)</td>
<td>0.41 (0.69)</td>
</tr>
<tr>
<td>During</td>
<td>3.88 (3.55)</td>
<td>5.22 (3.05)</td>
<td>3.08 (1.63)</td>
<td>7.08 (1.71)</td>
<td>23.40 (4.04)</td>
<td>6.73 (2.51)</td>
<td>2.76 (1.67)</td>
<td>2.96 (1.81)</td>
</tr>
</tbody>
</table>

Abbreviations: ANVPS, Adult Nonverbal Pain Scale; BPS, Behavior Pain Scale; FACES-patient, use of FACES scale by the patient as a self-report measure by pointing to the corresponding image; FACES-nurse, use of FACES scale by the investigator to score patients’ pain level by selecting the corresponding image; FLACC, Face, Legs, Activity, Cry, and Consolability scale; NRS, Numeric Rating Scale; PABS, Pain Assessment Behavioral Scale.
No one tool was superior to the other in capturing pain response during the noxious procedure.

<table>
<thead>
<tr>
<th>Evaluation</th>
<th>Scale</th>
<th>FACES-patient</th>
<th>ANVPS</th>
<th>BPS</th>
<th>COMFORT</th>
<th>FACES-nurse</th>
<th>FLACC</th>
<th>PABS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical examination</td>
<td>Before</td>
<td>0.4684</td>
<td>0.0946</td>
<td>0.1115</td>
<td>0.1760</td>
<td>0.5290</td>
<td>0.1500</td>
<td>0.1039</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(P=.003)</td>
<td>(P=.56)</td>
<td>(P=.49)</td>
<td>(P=.27)</td>
<td>(P&lt;.001)</td>
<td>(P=.35)</td>
<td>(P=.52)</td>
</tr>
<tr>
<td></td>
<td>During</td>
<td>0.5724</td>
<td>0.4058</td>
<td>0.2067</td>
<td>0.3877</td>
<td>0.6134</td>
<td>0.4917</td>
<td>0.5877</td>
</tr>
<tr>
<td></td>
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<td>(P=.001)</td>
<td>(P=.009)</td>
<td>(P=.20)</td>
<td>(P=.01)</td>
<td>(P&lt;.001)</td>
<td>(P=.001)</td>
<td>(P&lt;.001)</td>
</tr>
<tr>
<td>Suctioning</td>
<td>Before</td>
<td>0.2197</td>
<td>-0.1485</td>
<td>0.2050</td>
<td>0.3385</td>
<td>0.4607</td>
<td>0.1072</td>
<td>0.0186</td>
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<tr>
<td></td>
<td></td>
<td>(P=.18)</td>
<td>(P=.35)</td>
<td>(P=.19)</td>
<td>(P=.03)</td>
<td>(P=.002)</td>
<td>(P=.50)</td>
<td>(P=.91)</td>
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<tr>
<td></td>
<td>During</td>
<td>0.7613</td>
<td>0.5594</td>
<td>0.5557</td>
<td>0.6527</td>
<td>0.5288</td>
<td>0.6320</td>
<td>0.5649</td>
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<tr>
<td></td>
<td></td>
<td>(P&lt;.001)</td>
<td>(P&lt;.001)</td>
<td>(P&lt;.001)</td>
<td>(P&lt;.001)</td>
<td>(P&lt;.001)</td>
<td>(P&lt;.001)</td>
<td>(P&lt;.001)</td>
</tr>
</tbody>
</table>

Abbreviations: ANVPS, Adult Nonverbal Pain Scale; BPS, Behavior Pain Scale; FACES-patient, use of FACES scale by the patient as a self-report measure by pointing to the corresponding image; FACES-nurse, use of FACES scale by the investigator to score patients’ pain level by selecting the corresponding image; FLACC, Face, Legs, Activity, Cry, and Consolability scale; PABS, Pain Assessment Behavioral Scale.

3-8), with no difference in rating ($F_{39} = 0.56, P = .46$) between NRS and BPS.

**Sensitivity, Noncommunicative Intubated Patients.** The 6 pain scales (Figure 1) were all sensitive in capturing the patient’s pain response before and during the stimulus that was not noxious (routine physical examination) and before and during the noxious stimulus (endotracheal tube suctioning; $P < .001$). However, overall sensitivity was higher during suctioning. Interestingly, during suctioning, investigators tended to rate pain higher on FACES-nurse (mean score, 6.48) than on similar tools with descriptors in other tools. Further studies are warranted, as this subjectivity has implications for overtreatment or undertreatment of pain.

**Behavioral pain tools (ANVPS, COMFORT, FACES, FLACC, and PABS)** to compare the relationship with the patient’s self-report of pain via the NRS. However, no one tool was superior to the other in capturing pain response during the noxious procedure and showed moderate to high associations to the NRS. Even though patients tended to score higher on FACES-patient than a numeric value during suctioning, the investigators also rated pain higher in both the communicative and the noncommunicative group by using the FACES-nurse scale. Visual images such as FACES scales (Figure 2) may add subjectivity and bias versus selecting behavior descriptors in other tools. Further studies are warranted, as this subjectivity has implications for overtreatment or undertreatment of pain.

**Discussion**

Although pain assessment is difficult in sedated, critically ill patients, pain must be assessed in a valid and reliable manner to ensure adequate pain management by using a pain tool that is useful for such patients. The use of unidimensional pain scales such as the NRS is recommended for patients who are able to self-report pain intensity. However, when patients are unable to self-report their pain, valid and reliable behavioral pain scales such as the BPS and the CPOT are recommended in the clinical practice guidelines for the management of pain, agitation, and delirium in adult patients in the intensive care unit.

At the time of our study, BPS was more commonly used than CPOT because of its better psychometric properties and more frequent use in research studies. We used the BPS along with other behavioral pain tools (ANVPS, COMFORT, FACES, FLACC, and PABS) to compare the relationship with the patient’s self-report of pain via the NRS.
Figure 1  Sensitivity of 6 pain scales in noncommunicative intubated patients during a procedure that was not noxious and a noxious procedure. Scores on the Face, Legs, Activity, Cry, and Consolability Scale are from 0 to 10; the score for cry was not included because it was inappropriate in this sample, resulting in a range of scores from 0 to 8. Scores on the Pain Assessment Behavioral Scale are from 0 to 10; the score for vocalization was not included because it was inappropriate in this sample of nonverbal patients, resulting in a range of scores from 0 to 8.
range of scores for the CPOT is 0 to 8, further analysis is needed to explore variation in score ranges in these tools during noxious procedures and procedures that are not noxious.

The clinical practice guidelines for management of pain recommend that observational pain scales that include vital signs alone not be used for pain assessment. Interestingly, 2 observational pain scales in our study (ANVPS and COMFORT) both use physiological data such as heart rate and blood pressure and showed moderate to high associations with the NRS as well as significant sensitivity in capturing the patient’s pain response during a noxious stimulus. It may be that the combination of physiological along with behavioral measures affected this relationship.

Limitations

This study was conducted in an intensive care unit in a single institution. Although the unit was fairly representative of general medical populations in a critical care setting, the findings may not be generalized to every type of medical population. An important limitation of this study was that we used 1 noxious condition, no stimulus control, and assumed absence of pain at baseline, although we did measure pain at this time and evaluated the change in pain over time. The use of suctioning may bias the investigators to rate higher assuming that suctioning causes pain. Even though we used endotracheal suctioning to elicit pain response, endotracheal suctioning is comparable to other common procedures that cause pain in critically ill patients. Use of 4 evaluators may have contributed some measurement error, but extensive training and education was done before implementation until reliability for each tool achieved a Cronbach α of 0.80 or better. In addition, completing all tools at one time may have created bias among the raters; however, we attempted to reduce that effect by random ordering of the tools, completing one tool before starting another, and enrolling no more than 2 patients at a time. In addition, interrater reliability was evaluated before study implementation and again during the midcycle of enrollment of patients. Since the goal of the study was to compare multiple pain tools, the use of 1 procedure was required so that all tools could be evaluated simultaneously.

Conclusion

Pain assessment remains a challenge in noncommunicative critically ill patients whose pain experience is inferred from observation of behaviors and physiological measures. In this study, we evaluated commonly used pain scales in noncommunicative critically ill adult patients. Our study aim was to evaluate and identify an effective scale for assessing pain in these patients. We found that all tools were valid and sensitive to capturing changes in pain response during a noxious procedure in critically ill communicative and noncommunicative patients. However, caution is necessary when using the FACES scale because its subjectivity may lead to overtreatment or undertreatment of pain. Further analysis is needed to define discrete behavior descriptors that are reliable and useful in measuring pain response.

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FINANCIAL DISCLOSURES

None reported.

Figure 2: Wong-Baker FACES Pain Rating Scale.


for more about assessing pain in noncommunicative patients, visit the Critical Care Nurse Web site, www.ccnonline.org, and read the article by Stites, “Observational Pain Scales in Critically Ill Adults” (June 2013).
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25. Chanques G, Viejo, CA 92656. Phone, (800) 899-1712 or (949) 362-2050. To purchase electronic or print reprints, contact American Association of Critical-Care Nurses, 101 Columbia, Aliso Viejo, CA 92656. Phone, (900) 362-2045; fax, (949) 362-2046; e-mail, reprints@aacnjournals.org.
Learning objectives: 1. Identify 6 pain assessment tools and their roles in pain assessment for noncommunicative intensive care unit (ICU) patients. 2. Compare and contrast the use of pain assessment tools in communicative and noncommunicative ICU patients. 3. Identify additional research needed to ensure pain assessment is further investigated in noncommunicative patients.

1. Which 2 procedures were identified as causing pain in critically ill patients?
   a. Suctioning and central-line placement
   b. Mobility and venous access device placement
   c. Blood draws and mobility
   d. Repositioning and suctioning

2. According to the authors, which of the following best aligns with the nurse’s ability to manage a patient’s pain?
   a. The family’s ability to interpret and express pain
   b. The physician’s ability to prescribe and manage pain
   c. The nurse’s ability to assess and document pain
   d. The patient’s ability to express level and location of pain

3. In some disease processes the expression of pain may not be typical. For that reason, which of the following diagnoses excluded a patient from the study?
   a. Head trauma and meningitis
   b. Neuromuscular blocking agents and Parkinson’s disease
   c. Intracranial hemorrhage and seizure disorders
   d. Multiple sclerosis and taking Avonex

4. Which of the following pain scales was developed for the pediatric population and then modified to meet the assessment needs of the adult population?
   a. Adult Nonverbal Pain Scale (ANVPS)
   b. Behavioral Pain Scale (BPS)
   c. Critical-Care Pain Observation Tool (CPOT)
   d. FACES Pain Scale

5. How was interrater reliability determined for this study?
   a. Internal rate of return was calculated for each measurement result.
   b. Study investigators reached consensus for interpretation of measurement results.
   c. Study investigators assessed the same patient at the same time.
   d. Each investigator was trained on every pain scale used for the study.

6. How long was the patient observed before the investigator implemented noxious stimulus and pain assessment?
   a. Two minutes
   b. Ten minutes
   c. Prior 2 shifts
   d. There was no observation period prior to pain assessment.

7. Which of the following is true for the assessment of pain on noncommunicative patients?
   a. Noncommunicative patients were excluded from the study.
   b. Noncommunicative patients were unable to use the Numeric Rating Scale (NRS).
   c. The sensitivity of the NRS was assessed during all 4 phases of the study.
   d. Because of their inability to communicate, there was not a 2-minute observation time prior to pain assessment.

8. Which scale was developed by pediatric ICU nurses and uses an 8-parameter assessment?
   a. ANVPS
   b. Pain Assessment Behavioral Scale
   c. Face, Legs, Activity, Cry, and Consolability
   d. COMFORT Scale

9. Which of the following best describes study participants’ characteristics?
   a. There were more females in the study than males.
   b. Most study participants were identified as black or African American.
   c. Most study participants were identified with neurological disorders.
   d. The mean number of intubation days for study participants was 2.8 days.

10. Which of the following pain assessment tools demonstrated the best results during noxious stimulus?
    a. There was no significant difference between behavior tools used.
    b. The ANVPS outperformed the other behavior tools with noncommunicative patients.
    c. The FACES tool performed better with the pediatric patient population.
    d. There was no correlation between the behavioral tools and the numeric rating scale.

11. Which of the following is considered a limitation of the study?
    a. There was inconsistency in the assumption of pain prior to noxious stimulus.
    b. The study population was not representative of a general medical population.
    c. Interrater reliability was addressed at the beginning of the study.
    d. The study was conducted in a single ICU within 1 institution.

12. Which statement best describes the findings of the study?
    a. Pain assessment for pediatric and adult patients requires the use of different pain assessment tools.
    b. All tools evaluated offered some degree of creditable pain assessment during noxious stimulation.
    c. Communicative and noncommunicative patients require different pain assessment tools.
    d. The subjectivity of NRS scale excludes it from being used with communicative patients experiencing pain.

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4.  ❑ a ❑ b ❑ c ❑ d
5.  ❑ a ❑ b ❑ c ❑ d
6.  ❑ a ❑ b ❑ c ❑ d
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Validity and Sensitivity of 6 Pain Scales in Critically Ill, Intubated Adults
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