Pain Assessment Tool in the Critically Ill Post–Open Heart Surgery Patient Population

Liza Marmo, RN, MSN, CCRN, and Susan Fowler, RN, PhD

ABSTRACT:

Critical-care patients are at higher risk for untreated pain, because they are often unable to communicate owing to altered mental status, mechanical ventilation, and sedation. Pain that is persistent and untreated affects most body systems and results in development of complications chronic pain, and increased length of stay. This descriptive repeated-measures study compared three pain assessment tools in nonverbal critically ill patients in a cardiac postanesthesia care unit (n = 24). Tools included the Critical-Care Pain Observation Tool (CPOT), adult Nonverbal Pain Scale (NVPS), and the Faces, Legs, Activity, Cry, and Consolability scale (FLACC). Two painful events, suctioning and repositioning, were studied. Data were collected immediately before the event, 1 minute after, and 20 minutes after. Both the CPOT and the NVPS demonstrated high reliability (Cronbach alpha coefficients 0.89). The NVPS and the CPOT were highly correlated for both raters (r > 0.80, p = .00) (11 out of 12 times). Correlations between the two raters was generally moderate to high, but higher with the CPOT. There was more disagreement between raters in overall pain scores for the NVPS. When raters disagreed, it was most often in rating the face component on both scales. Disagreement was highest during the event. Both scales adequately capture pain in the nonverbal sedated critically ill patient based on assessment of patients' face, body movements, muscle tension, and respirations, with the NVPS also considering vital signs. Pictures depicting facial expressions for scoring purposes are helpful. Adequate education and understanding of use of the scales is critical for accurate assessment and subsequent interventions.

The International Association for the Study of Pain (IASP) (1994) defines pain as “an unpleasant sensory and emotional experience in association with actual or potential tissue damage, or described in terms of such damage.” The ability to manage a patient’s pain requires adequate assessment to appropriately diagnose and treat.
The critically ill nonverbal patient may experience unnecessary painful treatments and procedures owing to health care providers being unaware of the patient’s pain. Critical care patients are at increased risk for untreated pain when they are unable to communicate because of various factors, including altered mental status, mechanical ventilation, and sedating medications.

Pain that is persistent and untreated affects the body’s endocrine, cardiovascular, immune, neurologic, and musculoskeletal systems. As a result, patients may develop postoperative complications, including a chronic pain syndrome, and stay in the hospital longer (Tennant, 2004).

**BACKGROUND**

The Study to Understand Prognoses and Preferences for Outcomes and Risks of Treatment (SUPPORT), a study of patient and family experience with serious illness conducted in five major teaching hospitals from 1989 to 1994, conducted similar interviews about pain with patients and families during hospitalization. The SUPPORT study found that nearly 50% of patients reported pain, with 15% reporting extremely severe pain or moderately severe pain occurring at least half the time, and nearly 15% of those patients with pain were dissatisfied with its control (Desbiens, Wu, & Broste, 1996).

Blakely and Page (2001) identified the consequences of untreated pain in the critically ill to include an increase in catecholamine and stress hormones which causes tachycardia, hypertension, an increase in oxygen requirements, and decrease tissue perfusion. Agitation has also been shown to be associated with inadequate pain management (Marshal & Sourcey, 2003).

**Review of Literature—Pain Assessment Tools**

Studies have been limited in assessing pain and assessment tools in the unconscious nonverbal patient. The American Society for Pain Management Nursing (ASPMN) (2006) recently released a position statement on pain assessment in the nonverbal patient. The ASPMN has supported the use of two pain assessment tools to observe patient behavior in intubated and/or unconscious persons: the Payen Behavioral Pain Scale (BPS) and the Critical-Care Pain Observation Tool (CPOT) (Table 2).

The BPS is a three-item scale measuring face, upper limb movements, and compliance with ventilation rated on 4-point Likert scales. The CPOT is a four-item scale measuring the face, body movements, muscle tension, and compliance with the ventilator or vocalization rated on 0-2 Likert scales. Scores can range from 0 to 8, with lower scores indicating less pain.

Despite these recommendations, the Faces, Legs, Activity, Cry, and Consolability scale (FLACC) (Table 3) is often used to assess pain in the critically ill population. The FLACC is intended to be used to measure postoperative pain in children under the age of 7 years (Merkel, Voepel-Lewis, Shayevitz, & Malviya, 1997).

**Table 1. Adult Nonverbal Pain Scale (NVPS)**

<table>
<thead>
<tr>
<th>Category</th>
<th>0</th>
<th>1</th>
<th>2</th>
</tr>
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<tbody>
<tr>
<td>Face</td>
<td>No particular expression or smile.</td>
<td>Occasional grimace, tearing, frowning, wrapped forehead.</td>
<td>Frequent grimace, tearing, frowning, wrapped forehead.</td>
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<tr>
<td>Activity (movement)</td>
<td>Lying quietly, normal position.</td>
<td>Seeking attention through movement or slow, cautious movement.</td>
<td>Restless, excessive activity and/or withdrawal reflexes.</td>
</tr>
<tr>
<td>Guarding</td>
<td>Lying quietly, no positioning of hands over areas of the body</td>
<td>Splinting areas of the body, tense</td>
<td>Rigid, stiff.</td>
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| Physiology (vital signs) | Baseline vital signs unchanged | Change in any of the following:  
  - SBP > 20 mm Hg  
  - HR > 20/min | Change in any of the following:  
  - SBP > 30 mm Hg  
  - HR > 25/min  
  - RR > 20 above baseline, or 5% decrease SpO2, or mild asynchrony with ventilator  
  - RR > 20 above baseline, or 10% decrease SpO2, or severe asynchrony with ventilator |
| Respiratory            | Baseline RR/SpO2 synchronous with ventilator | RR >10 above baseline, or 5% decrease SpO2, or mild asynchrony with ventilator | RR >20 above baseline, or 10% decrease SpO2, or severe asynchrony with ventilator |

The FLACC is a five-item pain assessment tool measuring faces, legs, activity, crying, and consolability rated on scales of 1 to 3. Scores can range from 5 to 15, with lower scores indicating less pain. The FLACC scale has not been found to be a valid and reliable tool in the cognitively impaired elderly and has not been tested in the critically ill population (Baiardi et al., 2002).

The Nonverbal Pain Scale (NVPS) (Table 1), developed at Strong Memorial Hospital/University of Rochester, was not named in the position statement, but it shows validity in the critically ill in a published research study by (Odhner, Wegman, Freeland, Steinmetz, & Ingersoll, 2003). This scale is similar to the BPS and CPOT pain scales. The NVPS is a five-item pain scale measuring the face, activity/movement, guarding, vital signs, and respirations rated on 0-2 Likert scales. Scores can range from 0 to 10, with lower scores indicating less pain.

<table>
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<tr>
<th>Indicator</th>
<th>FLACC Scale</th>
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<tr>
<td><strong>Facial description</strong></td>
<td>0: No particular expression or smile</td>
</tr>
<tr>
<td><strong>Legs</strong></td>
<td>0: Normal position or relaxed</td>
</tr>
<tr>
<td><strong>Activity</strong></td>
<td>0: Lying quietly, normal position, moves easily</td>
</tr>
<tr>
<td><strong>Cry</strong></td>
<td>0: No cry (awake or asleep)</td>
</tr>
<tr>
<td><strong>Consolability</strong></td>
<td>0: Content, relaxed</td>
</tr>
</tbody>
</table>

Turning and suctioning have been identified as painful or nociceptive procedures (Puntillo et al., 2001; Stanik-Hutt et al., 2001). Endotracheal suctioning is the mechanical aspiration of pulmonary secretions from a patient with an artificial airway in place (AARC, 1993). Repositioning is turning from one side to another with body support to remain off the back.

The three scales selected for the present study were the NVPS, the CPOT, and the FLACC. The NVPS was recommended after the ASPMN document was released. The CPOT was one of the recommended pain assessment tools of the ASPMN. Finally, FLACC was the tool most commonly used in practice.

**METHOD**

**Study Design**
A repeated-measures design was used.

**Human Subjects Protection**
Permission was obtained from the institution’s Nursing Research Council and Internal Review Board.

**Participants**
Based on Cohen (1977), 280 observations were needed for a medium (0.30) effect size at a .05 level of significance and 80% power. Twenty-five subjects were observed six times each by two different raters or observers for a total of 300 observations.

Inclusion criteria for critically ill subjects included: 1) ≥18 years of age; 2) admitted to the cardiac post-anesthesia care unit (CPACU) for coronary artery bypass graft, aortic valve replacement, or mitral valve replacement surgery; and 3) intubated and consequently unable to speak or give a verbal self-report of pain.

Exclusion criteria included spinal cord injury, receiving neuromuscular blockade, and change in sedative or analgesia during the study period. Exclusion criteria were based on the recommendation by Herr et al. (2006) to select a behavioral pain tool in which the patient is able to respond to in all categories of behavior (i.e., movement of upper arms).

**Data Collection**
Four nurses were trained in data collection to make certain they collected data in the same fashion to avoid bias. But only two nurses, simultaneously and independently, assessed one patient at the same time using study instruments. A target of 85% agreement was sought between investigators to ensure consistency and accuracy before study implementation. An in-service was provided to the CPACU staff before the study.

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There were three study periods each involving the use of the NVPS, CPOT, and FLACC scales, which took approximately 15 seconds each study period. The first period occurred just before the subject being positioned or suctioned. This was done with the subject at rest and at least 3 hours after surgery. The second period was done 1 minute after the subject was positioned or suctioned. The third period was done 20 minutes after positioning or suctioning. These time periods were identical to those used by Gelinas et al. (2006) in their validation study of the CPOT.

Data Analysis

Data were analyzed using SPSS version 15.0 software. Cronbach alphas for internal consistency were determined. Interrater agreement was calculated using the Pearson correlation coefficient (Feher, Waltz, Strickland, & Lenz, 2004), frequencies, and percentages.

FINDINGS

Both the CPOT and the NVPS were very reliable, with identical Cronbach alpha coefficients of 0.89.

Agreement between raters when assessing pain before, during, and after a painful event ranged from 56% to 100% (Table 4). Each subject (n = 25) was observed three times (before, during, and after) with an event of suctioning and three times (before, during, and after) with an event of turning, for a total of 75 observations for each rater/event, with total agreement between raters on the NVPS of 78% (58 out of 75) for suctioning and 79% (59 out of 75) for turning. Total agreement on the CPOT was 80% (60 out of 75) for suctioning and 85% (64 out of 75) for turning. Agreement on the FLACC was 78% (58 out of 75) and 84% (63 out of 75) for suctioning and turning, respectively.

Regarding individual scale items, nurse raters agreed most often on assessment of respirations (92%) followed by activity/body movement (83%), guarding (77%), and the face (75%) (Table 5). The highest disagreement was in the face component of the NVPS and CPOT, with 37 out of 150 observations (25%).

There was more disagreement with the NVPS (21 times, or 14%) compared with the CPOT (16 times, or...
10%) (Table 6). There was 21% disagreement between raters on guarding or muscular tension, with slightly higher disagreement when using the CPOT compared with the NVPS (11% vs. 10%, respectively). Nurse raters disagreed 26 times, or 17%, on activity or body movement of patients, with, once again, slightly higher disagreement when using the CPOT compared with the NVPS (9% vs. 8%, respectively). Finally, there were only 12 disagreements, or 8% of the time, on respirations, with no difference noted between the CPOT and the NVPS.

When comparing the two events of suctioning and turning, there was more disagreement during suctioning (56 times) than turning (49 times) (Table 7). Highest disagreement during suctioning focused on assessment of the facial movements (24 times) with slightly higher disagreement when using the NVPS compared with the CPOT. Regarding turning, nurse raters disagreed most on guarding (13 times), with higher disagreement with the NVPS compared with the CPOT. There was no difference between suctioning and turning regarding assessment of respirations.

DISCUSSION

The CPOT and the NVPS demonstrated internal consistency with scale items measuring the experience or trait of pain. Nurses agreed 56%-100% of the time, with low agreement due to the complex nature of responding to pain, especially when the person has an endotracheal tube in place orally. Nurses were able to use the pain scales with ease and understanding, as demonstrated in correlations between the raters. It is uncertain why raters agreed more on pain items of the CPOT compared with the NVPS. The CPOT has four categories of assessment, whereas the NVPS has five, creating more opportunity for disagreement. Interestingly, the NVPS includes vital signs of heart rate, blood pressure (systolic), and respiratory rate, which are very objective measures based on numbers visually displayed. Furthermore, the NVPS uses categories of activity and guarding, which are more general than the CPOT categories of muscle tension and body movement. In addition, the CPOT appears to have more descriptors to define each category.

Greater disagreement between raters was evident in the face component of both scales but less with the CPOT. This may be due to the picture used by previous investigators as well as in this investigation to capture visual understanding of facial changes described in the CPOT. During suctioning, the facial expression of a patient with an endotracheal tube is altered. There was greater disagreement between raters in the facial component of both scales during suctioning versus turning.

The guarding assessment component of both scales includes words such as tense and rigid. In the NVPS, when a patient is tense the nurse would rate this 1, whereas if the patient is rigid a score of 2 would be recorded. The CPOT uses both words, tense and rigid, in ratings of 1 or 2, but a patient has to be observed to be “very” tense and rigid to receive a score of 2. It is uncertain how nurses define tense and rigid, differentiate the two terms, or quantify tense and rigid from very tense and rigid.

Only the NVPS addresses changes in vital signs (systolic blood pressure and heart rate) indicative of increased discomfort or pain. Although this is a very objective measure evidenced by numbers recorded on monitors, nurses still disagreed. Nurses need to be keenly aware of patient vital signs before, during, and after painful events to accurately assess and intervene appropriately.

Limitations

Study findings are limited owing to use of a convenience sample of patients recovering from open heart surgery at only one institution. Data were collected only during daytime hours owing to schedules of the raters.

Implications for Practice

The CPOT appears to be a better tool to detect pain in intubated post–open heart surgery adults compared with the NVPS, as evidenced by better agreement between nurse raters. Nurses require a pain assessment tool that is easy to use with clear descriptors for each item of the tool and takes limited time to complete. Assessments need to be timely and comprehensive to adequately diagnose pain and treat it appropriately and effectively.

Institutions are challenged to use pain assessment scales across patient care settings and populations. It would be ideal to have one pain assessment scale used throughout the institution, but many factors prohibit this, such as the patients’ age, cognitive status, and ability to verbally articulate pain. Perhaps the goal is to use one tool across specialties such as critical care, medical surgical, and pediatrics. Most importantly, pain scales need to be appropriate and consistently used for individual patients. For example, one nurse should not use tool A for assessing pain in patient Mr. Smith and yet another nurse use pain tool B in assessing the same patient on the same nursing unit. Nurses need to collaboratively evaluate the evidence behind a particular assessment tool, try the tool in practice, and decide on standard use of one tool within their practice arena.
Implications for Future Research
Further research is necessary to assess the reliability of pain assessment tools in other patient populations, including pediatrics. Future research could also answer the following question: Is pain assessment consistent and similar throughout the continuum of care, such as the emergency department, critical care, medical surgical, and rehabilitation, despite use of different assessment tools in each patient care area?

SUMMARY
Both the NVPS and the CPOT adequately capture pain in the nonverbal sedated critically ill patient based on assessment of the patient’s face, body movements, muscle tension, and respirations, with the NVPS also considering vital signs. Nurses’ pain observations were more in agreement with use of the CPOT. Nurses disagreed most often on the face component of both scales, followed by muscle tension. Disagreement was highest during the event (suctioning or turning), with higher differences during suctioning. Nurses need to be educated on the use of pain scales with attention to the interpretation of each behavior or item on the tool for accurate assessment and subsequent interventions.

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REFERENCES