Critical Review

A Review of Objective Pain Measures for Use With Critical Care Adult Patients Unable to Self-Report

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Abstract: Critically ill patients experience significant levels of pain and discomfort from multiple intrinsic and extrinsic sources while in the intensive care unit (ICU). The use of objective pain measures in nonverbal patients is an essential alternative approach for pain assessment when self-reports are unavailable. This paper provides a critical review of the psychometric properties of 6 objective pain measures that were developed to assess pain in nonverbal adult patients in the ICU. The strengths and weaknesses of these objective measures are evaluated, as well as their applicability for use with this patient population. Although 2 of the 6 objective pain measures showed good evidence of validity and reliability, none has undergone vigorous validation or has been accepted as a standardized measure. Findings from the available studies of objective pain measures provide useful information to direct future research to develop and validate clinically useful pain measures for use with critically ill patients unable to self-report.

Perspective: *This review provides clinicians with a summary of the psychometric properties of 6 objective pain measures and discusses their applicability for use to assess pain in critically ill adult patients unable to self-report.*

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Key words: *Pain, assessment, measurement, validity, nonverbal, critical care.*

Acute pain has emerged as a leading stressor for patients with various diagnoses and conditions in the intensive care unit (ICU).[37] Unrelieved acute pain gives rise to negative physiologic and psychological events that can be detrimental to critically ill patients' health outcomes.[11,29,35] Common causes of pain in these patients include surgery, trauma, invasive procedures and therapeutic devices, and certain routine nursing interventions.[22,32] Whereas routine pain assessment procedures can be used with ICU patients who are verbal, a substantial number of ICU patients may not be able to provide a self-report of the presence or intensity of their pain. The assessment of pain in these nonverbal critically ill patients poses numerous challenges.

Research on the measurement of pain in critically ill adults who cannot self-report (referred to as nonverbal ICU patients) has emerged only within the past 2 decades. However, no measure of pain in nonverbal ICU patients is accepted as the "gold standard." The purposes of this review are to 1) describe 6 objective pain measures for use with nonverbal ICU patients; 2) provide a critical evaluation of the psychometric properties of these measures; and 3) evaluate the strengths and weaknesses of these measures for use with nonverbal ICU patients.

Overview of Objective Pain Measures

Objective pain measures are observational instruments that can be categorized as either unidimensional or multidimensional. A unidimensional objective measure (eg, behavioral scale) may use a single domain (eg, facial expression) or several domains (eg, facial expression, body movements, sound) to evaluate a person's responses to pain. A multidimensional objective measure evaluates 2

or more pain dimensions (eg, behaviors, physiologic responses) and has several domains within each dimension. In the absence of self-report, unidimensional measures with multiple domains or multidimensional measures are the preferred tools to evaluate acute pain in nonverbal ICU patients.[16,38] In an excellent review of 27 studies, Labus and colleagues[16] demonstrated that self-reports of pain were more likely to be significantly correlated with multi-domain behavioral ratings of pain compared with a single item behavioral rating. Likewise, in a comprehensive review of neonatal/pediatric objective pain measures,[38] the authors concluded that multidimensional measures were more useful clinically and that no single domain was reliable or valid when used alone.

Methods

The PubMed and the Cumulative Index to Nursing and Allied Health Literature (CINAHL) databases were searched using 3 specific strategies. First, the search was limited to papers published in English between 1986 and 2007 and used the key words: Pain, assessment, measurement, and validity. This strategy generated 403 citations. Abstracts were reviewed and articles were selected if they addressed acute pain in adult patients in an acute care setting. Studies or reports that focused on the neonatal/pediatric population, elderly patients with dementia, chronic pain, and outpatient and/or community settings were excluded. The second search strategy explored additional relevant articles by using the "related articles option" on the databases to generate a snowball list of articles. Again, relevant articles were selected if they focused on acute pain in acutely ill adults. The final pool of articles selected for this review was based on their meeting 4 criteria: 1) It described a unidimensional measure with multiple domains or a multidimensional objective pain measure; 2) the measure was used in verbal and/or nonverbal critical care adult patients; 3) the measure had undergone psychometric evaluation; and 4) the article was available in full text. Additional articles were identified using the references from these articles.

Together, these search strategies identified 5 unidimensional objective pain measures [ie, Behavioral Pain Rating Scale,[18] Behavioral Pain Scale (BPS),[25] Colorado Behavioral Numeric Pain Scale (CBNPS),[34] Pain Behaviors Assessment Tool,[30] and Critical-Care Pain Observation Tool (CPOT)[9] and 3 multidimensional objective pain measures [ie, Pain Assessment Algorithm,[4] Pain Assessment and Intervention Notation Algorithm (PAIN-Algorithm),[28] and Nonverbal Pain Scale (NVPS).[24] Two instruments (the Pain Assessment Algorithm and CBNPS) were excluded because they did not meet the second and third selection criteria for this review. The validity and reliability of the remaining 6 instruments were evaluated using criteria set forth in the psychometric literature.[23,26] Table 1 provides a summary of dimension(s) and domains of each of the objective pain measures included in this review.

Unidimensional Objective Pain Measures

The Behavioral Pain Rating Scale (BPRS)

Description

The BPRS is a unidimensional objective measure that assesses 4 behavioral domains: Restlessness, tense muscles, frowning or grimacing, and patient sounds. Each domain contains 3 descriptors that indicate a progressive increase in pain severity and are scored on a scale that ranges from 0 (normal behaviors) to 3 (extreme pain behaviors). The total BPRS score can range from 0 (no pain) to 12 (most pain).[18]

Psychometric Properties

Two studies evaluated the psychometric properties of the BPRS in post-anesthesia care unit (PACU) adult patients.[18,43] The first study of 30 patients[18] evaluated whether behaviors on the BPRS were associated with patients' self-reports of pain intensity measured by a verbal descriptor scale (VDS). The second study examined the relationship between BPRS scores and patients' self-reports of pain intensity using a 0 (no pain) to 10 (worst pain) numeric rating scale (NRS) in 36 women who had gynecologic surgery and who received morphine patient controlled analgesia (PCA).[43]

Face validity of the BPRS was established because it was based on a previously developed scale[5] and modified by expert clinicians.[18] Both studies showed that the BPRS possessed criterion validity because significant correlations were found between BPRS scores and patients' self-reports of pain intensity. Behaviors in 3 domains (ie, facial expression, muscle tension, patient sound) had moderate correlations with patients' VDS pain scores ($r = .63 - .69$, $P < .05$).[18] Total BPRS scores were found to have moderate to strong correlations with patients' NRS scores ($r = .56 - .80$, $P < .05$).[43] In addition, BPRS scores decreased after the administration of morphine PCA ($F = 12.848$; $P < .001$), which suggests that the measure is responsive to the effects of analgesia. The BPRS demonstrated high internal consistency (ie, Cronbach's $\alpha = 0.92$).[18] The interrater reliability for the BPRS was reported as a Pearson's correlation coefficient. A strong and positive correlation ($r > .80$, $P < .01$) was found between pairs of nurses' BPRS ratings.

Strengths and Weaknesses

Although the BPRS appears to possess satisfactory internal consistency, neither reports[18,43] provided data on the inter-item correlations for each item, which is a criterion for using Cronbach's α as a reliability indicator.[8] The interrater reliability of the BPRS requires additional evaluation since the tests of association between ratings are not estimates of agreement between raters.[26]

Generalizability of the BPRS findings[18,43] to nonverbal ICU patients is limited because it was tested in small homogeneous samples of PACU patients. In fact, patients with major complications and neurological problems were excluded from the studies. Moreover, the BPRS requires a patient to vocalize and to show discernible