Journal of Cardiothoracic and Vascular Anesthesia 31 (2017) 1227–1234

Contents lists available at ScienceDirect

ScienceDirect

journal homepage: www.jcvaonline.com

Critical Care Medicine
Original Article

Pain Measurement in Mechanically Ventilated Patients After Cardiac Surgery: Comparison of the Behavioral Pain Scale (BPS) and the Critical-Care Pain Observation Tool (CPOT)

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Objectives: The Behavioral Pain Scale (BPS) and Critical-Care Pain Observation Tool (CPOT) are behavioral pain assessment tools for sedated and unconscious critically ill patients. The aim of this study was to compare the reliability, internal consistency, and discriminant validation of the BPS and the CPOT simultaneously in mechanically ventilated patients after cardiac surgery.
Design: A prospective, observational cohort study.
Setting: A 20-bed closed-format intensive care unit with mixed medical, surgical, and cardiac surgery patients in a teaching hospital in Amsterdam, The Netherlands.
Participants: The study comprised 72 consecutive intubated and mechanically ventilated patients after cardiac surgery who were not able to self-report pain.
Measurements and Main Results: Two nurses assessed the BPS and CPOT simultaneously and independently at the following 4 moments: rest, a nonpainful procedure (oral care), rest, and a painful procedure (turning). Both scores showed a significant increase of 2 points between rest and turning. The median BPS score of nurse 1 showed a significant increase of 1 point between rest and the nonpainful procedure (oral care), whereas both median CPOT scores did not change. The interrater reliability of the BPS and CPOT showed fair-to-good agreement of 0.74 overall. During the periods of rest 1 and rest 2, values ranged from 0.24 to 0.46. Cronbach's alpha values for the BPS were 0.62 (nurse 1) and 0.59 (nurse 2) compared with 0.65 and 0.58, respectively, for the CPOT.
Conclusions: The BPS and CPOT are reliable and valid pain assessment tools in a daily clinical setting. However, the discriminant validation of both scores seems less satisfactory in sedated or agitated patients and this topic requires further investigation.

Key Words: cardiothoracic surgery; cardiac surgery; intensive care; pain assessment; mechanical ventilation; Behavioral Pain Scale; Critical-Care Pain Observation Tool

PROCEDURAL PAIN and pain at rest are common in critically ill patients and are considerable stressors. Pain has both short- and long-term psychologic and physiologic consequences and has a negative effect on recovery.[1–5] Severe pain and a number of other adverse experiences have been linked to the development of posttraumatic stress disorder–related symptoms after intensive care unit (ICU) stay.[6]

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http://dx.doi.org/10.1053/j.jvca.2017.03.013
1053-0770/

Postcardiac surgery patients in the ICU are prone to experience procedural pain due to chest tubes and wounds. Recent research demonstrated an association between cardiac surgery and the development of chronic postsurgical pain.[5]

Because of these adverse effects of pain, clinical practice guidelines recommend individualized, goal-directed pain management for ICU patients and routine monitoring of pain with a validated scale appropriate for the patient's level of consciousness.[1,2] A patient's self-report of pain is acknowledged as the gold standard in the assessment of pain.[7] However, self-assessment of pain in ICU patients often is hampered due to mechanical ventilation, treatment with sedatives and analgesics, or a decreased level of consciousness caused by severe illness or delirium. In these nonverbal critically ill patients, pain can be monitored with behavioral pain assessment tools such as the Behavioral Pain Scale (BPS) and Critical-Care Pain Observation Tool (CPOT).[1,2,8–12]

Psychometric properties of the BPS and CPOT have been tested and reviewed previously; however, due to inclusion of a small number of nonverbal patients, only limited information was available about critically ill patients after cardiac surgery who were unable to rate their pain.[8,9,11-26] This specific group of patients most likely differs from general ICU patients because they are postanesthesia and underwent specific surgical procedures. Surgical ICU patients indicate the surgical site as the most painful location during rest, whereas medical patients most likely indicate pain in their limbs and back.[27] In addition, there are no studies available to date comparing the BPS and CPOT simultaneously measured exclusively in postcardiac surgery, mechanically-ventilated patients without communication capabilities in a daily clinical setting.

The authors aimed, in this study, to compare the interrater reliability, internal consistency, and discriminant validation of the BPS and the CPOT in mechanically ventilated patients unable to self-report pain after cardiac surgery.

Methods

A prospective, observational cohort study with a repeated-measurements design was conducted. In this design, the patients were their own comparison. The setting was a 20-bed, closed-format ICU with mixed medical, surgical, and cardiac surgery patients in a teaching hospital in Amsterdam, The Netherlands. The local medical ethical committee approved the study and waived the requirement for written, informed consent because of its observational design, according to Dutch and European regulations.

ICU nurses screened all patients after admission for eligibility using a digital screening log. Mechanically ventilated patients after cardiac surgery who were (1) ≥ 18 years old, (2) unable to self-report pain, (3) expected to stay in the ICU ≥ 12 hours, and (4) able to physically respond to stimuli were included in the study. Patients who were unable to be repositioned or were paralyzed or quadriplegic due to their medical condition and/or treatment and patients who participated in the study during an earlier admission to the authors' ICU were excluded.

Assessments of Pain, Sedation/Agitation, and Delirium

The BPS is a validated observational pain scale for unconscious mechanically ventilated patients and is based on the sum score concerning the following 3 behavioral items: facial expression, movements of the upper limbs, and compliance with ventilation. Each item is scored from 1 (no response) to 4 (full response). The total BPS score ranges from 3 (no pain) to 12 (maximal pain) (see the Appendix for a complete description of the items). The selection of items was established from a literature review and a questionnaire among ICU nurses. The psychometric properties of the BPS have been tested in various subsets of critically ill patients (ie, medical, postoperative, and trauma).[9]

The CPOT is a validated observational pain scale for the assessment of pain in both intubated and nonintubated critically ill adult patients incapable of self-reporting their pain. The scale is constructed from literature review, retrospective reviews of common pain characteristics in patients' medical files, and consultation with ICU nurses and physicians. The CPOT is based on the sum of the following 4 behavioral items: facial expression, body movements, muscle tension, and compliance with ventilation for intubated patients (or vocalization for patients without an endotracheal tube). Each item was scored between 0 and 2, and the total CPOT score ranged from 0 (no pain) to 8 (maximal pain)[10–12] (see the Appendix for a complete description of the items).

The Richmond Agitation and Sedation Scale (RASS) was performed 6 times daily to assess the level of agitation and sedation. The RASS ranges from +4 (combative) to −5 (unresponsive); a score of zero indicates an alert and calm state.[28]

The presence of delirium was assessed routinely 3 times daily by the bedside nurses and the attending intensive care physician using the Confusion Assessment Method for the ICU.[29] The RASS and Confusion Assessment Method for the ICU have been part of the routine care since 2006 and nurses have been trained frequently in the use of these tools.

Data Collection

Clinical characteristics and demographic data were extracted from the patient clinical information system (CIS) (Metavison; iMDsoft, Needham, MA) and included the Sequential Organ Failure Assessment score, the Acute Physiology and Chronic Health Evaluation IV predicted mortality, and the administration of analgesics and sedatives in the 4 hours preceding the pain assessments.

Intraoperative and Postoperative Treatment

All patients received general anesthesia, which was tailored to the specific condition of each patient. The anesthesia protocol was based on analgesia, hypnosis, amnesia, skeletal muscle relaxation, and inhibition of sensory and autonomic reflexes. This balanced anesthesia protocol has a focus on the reduction of stress by the administration of a relatively high dose of opioids.