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Pain measurement in mechanically ventilated critically ill patients: Behavioral Pain Scale versus Critical-Care Pain Observation Tool☆

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ABSTRACT

Purpose: The Behavioral Pain Scale (BPS) and Critical-Care Pain Observation Tool (CPOT) are behavioral pain assessment tools for uncommunicative and sedated intensive care unit (ICU) patients. This study compares the discriminant validation and reliability of the CPOT and the BPS, simultaneously, in mechanically ventilated patients on a mixed-adult ICU.

Materials and methods: This is a prospective observational cohort study in 68 mechanically ventilated medical ICU patients who were unable to report pain.

Results: The BPS and CPOT scores showed a significant increase of 2 points between rest and the painful procedure (turning). The median BPS scores between rest and the nonpainful procedure (oral care) showed a significant increase of 1 point, whereas the median CPOT score remained unchanged. The interrater reliability of the BPS and CPOT scores showed a fair to good agreement (0.74 and 0.75, respectively).

Conclusions: This study showed that the BPS and the CPOT are reliable and valid for use in a daily clinical setting. Although both scores increased with a presumed painful stimulus, the discriminant validation of the BPS use was less supported because it increased during a nonpainful stimulus. The CPOT appears preferable in this particular group of patients, especially with regard to its discriminant validation.

1. Introduction

Critically ill patients frequently experience pain and discomfort during intensive care unit (ICU) stay. Approximately 50% of the patients reported moderate to severe pain, both at rest and during routine procedures [1–5]. Untreated acute pain in adult ICU patients has short- and long-term physiological and psychological consequences such as postoperative myocardial infarction, insufficient sleep, and the risk of developing a posttraumatic stress disorder. The consequences of inadequate control of pain are significant, but excessive use of analgesics and sedation can lead to unwanted side effects such as hypoventilation, gastrointestinal hypomotility, gastric bleeding, and renal dysfunction. A systematic assessment of pain is associated with a decreased incidence of pain, use of analgesics, duration of mechanical ventilation, and length of stay (LOS) on the ICU [6–9].

As a result of these findings, the Society of Intensive Care Medicine recommends that pain should be routinely monitored in all adult ICU patients [10]. A patient's self-report of pain is considered as the gold standard in the assessment of pain [11]. However, critically ill patients are often unable to communicate effectively due to severe illness, mechanical ventilation, administration of sedatives and analgesics or a decreased level of consciousness. Vital signs appear to be less valid for pain assessment in ICU patients due to underlying disease and treatment with inotropes and vasopressors [12]. Consequently, pain assessment in patients who are unable to self-report their pain is difficult [13–15]. Therefore, the Society of Intensive Care Medicine advises the use of pain assessment tools that focus mainly on behavioral indicators of pain. The Behavioral Pain Scale (BPS) [15] and Critical-Care Pain Observation Tool (CPOT) [16] are behavioral pain assessment tools for uncommunicative and sedated ICU patients. The content validation, criterion validation, discriminant validation, and interrater reliability of the BPS and CPOT have been tested in previous studies [7,13,15,17,18]. To date, there are no studies available comparing these pain assessment tools simultaneously. The aim of this study was to compare the discriminant validation and reliability of the CPOT and the BPS in mechanically ventilated patients with the purpose to find the most useful clinical pain assessment tool for patients in a mixed-adult ICU.

2. Material and methods

We performed a prospective observational cohort study with a repeated measurement design in a 20-bed mixed closed-format ICU in a teaching hospital in Amsterdam, the Netherlands. The hospital has

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no neurosurgical facility. The local medical ethical committee approved the study and waived the requirement for written informed consent because this study did not require any deviation from the routine standard care on the ICU.

The ICU nurses screened all patients at bedside after admission. Inclusion criteria were as follows: critically ill patients with (1) age ≥18 years, (2) an expected LOS on the ICU of ≥12 hours, (3) mechanical ventilation, and (4) an inability to self-report pain. We excluded patients who were able to self-report pain and who were admitted for elective surgery, who were quadriplegic or paralyzed due to their current condition and/or treatment, who were unable to be repositioned, or who participated in the study during a previous admission.

2.1. Assessments of pain, agitation/sedation, and delirium

The BPS has been previously tested in mechanically ventilated ICU patients, of which the most were unconscious and therefore unable to self-report pain. This scale is based on a sum of 3 behavioral domains: facial expression, movements of the upper limbs, and compliance with ventilation. Each domain is scored from 1 (no response) to 4 (full response). The score ranges from 3 (no pain) to 12 (maximum pain) [15] (see Appendix 1).

The CPOT has been developed for the assessment of pain in critically ill adult patients unable to self-report pain. This scale consists of 4 behavioral domains: facial expression, body movements, muscle tension, and compliance with the ventilation for intubated patients or vocalization for patients without endotracheal tube. Each domain is scored between 0 and 2, and the total score ranges from 0 (no pain) to 8 (maximum pain) [16]. See Appendix 1. An extensive analysis and comparison of the psychometric properties of both tools are given in a recent review of Gelinas et al [19].

The level of agitation and sedation was assessed with the Richmond Agitation and Sedation Scale (RASS) 6 times daily. This system assigns a score between 4 (combative) and −5 (unresponsive). A score of 0 indicates an alert and calm state [20,21]. The presence of delirium was routinely assessed by the nurses and attending physician using the Confusion Assessment Method for the ICU (CAM-ICU) [22].

2.2. Data collection

We extracted demographic and clinical characteristics from the patient clinical information system (CIS) (iMD-Soft: Metavison, Tel Aviv, Israel), including the Acute Physiology and Chronic Health Evaluation IV predicted mortality (APACHE IV PM) score [23], the Sequential Organ Failure Assessment score [24], and the administration of analgesics and sedatives 1 and 4 hours before the pain assessments.

2.3. Pain medication in the ICU

The intensive care physician prescribed analgesics and/or sedatives, titrated to the patient's requirements. Depending on the degree of agitation and pain, patients received either morphine as a continuous infusion (in combination with midazolam for sedation) or piritramide 2.5 to 5 mg intravenously. Piritramide is a synthetic opioid analgesic with a strength of approximately 0.7 times that of morphine [25].

Epidural levobupicaine/sufentanyl was continued in the ICU if an epidural catheter was inserted perioperatively. Intravenous fentanyl was used for short surgical interventions in the ICU. Intravenous ketamine was used for the treatment of status asthmaticus or pain that was unresponsive to the previously mentioned interventions. Levels of pain were not systematically assessed and recorded until the start of the training for this study.

2.4. Study procedures

The bedside nurse screened and included patients on the day of admission and performed, together with a second nurse, the assessments. The BPS and CPOT were performed simultaneously but independently of each other in 4 conditions: at rest just before a nonpainful procedure, during the nonpainful procedure, at rest just before a painful procedure, and during the painful procedure. The first assessment recorded was always the BPS. We chose turning of the patient (turning) as a painful procedure and oral care as a nonpainful procedure [26]. The procedures were chosen after a literature review and during an expert group meeting with ICU nurses, an intensivist/anesthesiologist, and a clinical epidemiologist. The pairs of assessing nurses were not randomized but assigned by convenience and varied across the 4 procedures; however, the nurse in charge of the patient was always one of them. The assessors were asked to wait for at least 20 minutes after turning, or other painful procedures, before performing the assessments of the second procedure. The timing of the procedures was adjusted to the patient's day schedule. The nurses performed all assessments on the same day between 4:00 AM and 10:00 AM, and recorded the scores in custom-made study forms in the CIS.

2.5. Training of the nursing staff

All ICU nurses were trained to use the BPS and CPOT for 2 hours during the annual ICU training. Training material consisted of a presentation with background information of pain, the study procedures and explanation of the pain scores, the paper versions of the BPS and CPOT, training posters, and an instruction video [18,27]. This was followed by a 30-minute weekly training sessions on the ICU, provided by members of the study group (expert team). We also posted an explanation of the study procedures and the use of BPS and CPOT on the ICU intranet. In addition, an instruction card was available in every patient room. We performed a trial run of 1 month, in which we evaluated 66 test patients to minimize the possible bias of a learning curve and to provide bedside teaching of the study procedures.

2.6. Data analysis

Data were analyzed with SPSS version 18.0 (SPSS, Inc, Chicago, Ill) according to a prospectively defined protocol. Interrater reliability of the BPS and CPOT was tested by the calculation of intraclass correlation coefficients (ICC) for all assessments (two-way random absolute) [28]. Internal consistency was assessed with Cronbach's coefficient α using the scores during turning, when the patient was most likely to be experiencing pain. Values between 0.70 and 0.80 are considered as acceptable, and values >0.8 as good [19,29]. The discriminant validation was examined by calculating within-patient differences in scores between the assessments using the Friedman test. This is the nonparametric alternative to the one-way analysis of variance with repeated measures. To determine which pairs of differences between mean ranks were significant and thus the likely source of a significant Friedman test, we performed a post hoc analysis with a nonparametric related-sample test; the Wilcoxon signed rank test. This test is suitable for ordinal or nonnormally distributed continuous data [30]. The pain scores were not normally distributed, and therefore, we used nonparametric statistical tests. Only patients with complete scores were suitable for analysis. We hypothesized that the score should increase during the painful procedure and remain the same during the nonpainful procedure.

3. Results

During the 4-month study period, 277 medical and surgical ICU patients and patients after major surgery were admitted, 245 patients were screened, and 123 patients met the inclusion criteria. The data of 68 patients (55% of the patients meeting the inclusion criteria) were

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