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Original article

Validation of two Chinese-version pain observation tools in conscious and unconscious critically ill patients

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ABSTRACT

Objectives: To compare the construct validities of the Chinese-versions Critical-Care Pain Observation Tool and Behavioural Pain Scale as measures of critically ill patients' pain by (a) discriminant validation of behavioural scales and vital signs (e.g. heart rate and mean arterial pressure) during a non-nociceptive procedure (noninvasive blood pressure] assessment) and a nociceptive procedure (endotracheal suctioning), (b) criterion validation of behavioural scales and vital signs with patients' self-reported pain and (c) testing the interrater reliability of both scores.
Research methodology/design: In this crossover, observational study, pain responses of 316 critically ill patients (213 conscious; 103 unconscious) were measured by both the Critical Care Pain Observation Tool and the Behavioural Pain Scale scores, vital signs and self-report (if conscious) during noninvasive blood pressure assessment and endotracheal suctioning procedures. Interrater reliability was tested in nociceptive procedures of a pilot study on 20 critically ill patients. Data were analysed by descriptive statistics, multiple logistic regression analysis and receiver-operating characteristic curves.
Setting: A medical intensive care unit in a regional teaching hospital in northern Taiwan.
Results: Patients' self-reported pain was predicted by total Critical Care Pain Observation Toolscores (odds ratio = 1.93, $p < 0.01$) and total Behavioural Pain scores (odds ratio = 1.83, $p < 0.01$) but not by vital signs after controlling for patients' demographic and clinical characteristics. Moreover, Chinese-versions had areas under the receiver-operating characteristic curve of 76.4% and 73.1%, respectively, indicating good ability to detect pain.
Conclusions: The Chinese-versions of the Critical care Pain Observation Toll and Behavioural Pain Score have good construct validity and can sensitively discriminate when critically ill patients experience pain or no pain.

Implications for clinical practice

- The Chinese-version Critical-Care Pain Observation Tool and Behavioural Pain Scale have good construct validity and can sensitively discriminate when critically ill patients experience pain or no pain.
- Both tools can be used to assess pain behaviours in critically ill patients, whether unconscious or conscious.
- Our results show that traditional pain indicators, such as fluctuations in vital signs are not valid pain indicators in conscious and unconscious critically ill patients and behavioural scales remain the best alternative to assess pain in patients unable to self-report.

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Introduction

When patients are intubated or sedated in a critical care setting, self-reported pain is often unavailable and equivocal, requiring clinicians to evaluate pain using alternative measures (Herr et al., 2011). For example, nurses in two Canadian intensive care units (ICUs) used 679 descriptors of pain presence in critically ill patients unable to self-report pain (Haslam et al., 2012), with the most common descriptors of pain presence being restlessness (41%), agitation (24%), and grimacing (13%). Besides these behavioural pain descriptors, physiological descriptors such as changes in heart rate and respiratory rate were used. Pain absence was noted by descriptors such as "appears comfortable" and "patient settled." However, ICU nurses were often uncertain about whether patients' behaviours were due to pain, agitation or delirium or a combination of two or more (Haslam et al., 2012). These results underscore the importance of using validated and reliable pain tools to properly care for critically ill patients unable to self-report their pain (Gelinas, 2016).

Critically ill patients may experience pain in the ICU from common procedures such as inserting a central venous catheter, arterial line, chest tube and endotracheal tube or endotracheal suctioning (Ayasrah, 2016; Puntillo et al., 2014). These procedures result in pain-induced reflex responses that may alter respiratory mechanics, increase cardiac demand, cause contraction of skeletal muscles, muscle spasms and rigidity (Puntillo et al., 2014). Other nursing care procedures (e.g. wound care and turning) may also cause pain in these patients, whereas monitoring blood pressure and body temperature are commonly considered non-nociceptive procedures (Ayasrah, 2016; Gelinas and Johnston, 2007).

A patient's self-reported pain remains the gold standard for pain assessment (Gélinas, 2016). However, for patients who are unable to self-report, behavioural pain scales are alternatives to assessing pain in ICU patients. Eight behavioural scales were reviewed for this population (Gelinas et al., 2013). Of these eight scales, the Bahavioural Pain Score (BPS) and Critical Care Pain Observation Tool (CPOT) were found to have good to very good psychometric properties (BPS: total weighted score = 13.3, and CPOT: total weighted score = 17.5) (Gélinas et al., 2013). Both scales were found in several reviews to have better psychometric properties than others for use in adult ICU patients (Gélinas et al., 2013; Kabes et al., 2009; Li et al., 2008; Pudas-Tahka et al., 2009).

Although both scales allow us to obtain behavioural scores, they do not include the same number of behavioural indicators. The CPOT has four indicators: facial expression, body movement, muscle tension and compliance with the ventilator. Each indicator is scored from 0 to 2 points, with total scores ranging from 0 (no pain) to 8 points (most severe) (Gelinas et al., 2006). The BPS includes three indicators: facial expression, movement of upper limbs and compliance with the ventilator. Each indicator is scored from 1 to 4 points; total scores range from 3 (no pain) to 12 points (most severe) (Payen et al., 2001). Both the BPS and CPOT were shown to discriminate between nociceptive and non-nociceptive procedures (i.e. discriminant validity), to be related to patients' self-reported pain (i.e. criterion validity) and to lead to consistent scores when used independently by different raters (i.e. interrater reliability). However, these scales are of limited use in patients with a Glasgow coma scale (GCS) score of 3 or a Richmond Agitation Sedation Scale score of -5, indicating that the patient is unresponsive or unarousable (Gelinas, 2016).

The BPS and CPOT each has its advantages and disadvantages. For example, BPS items are simpler and easier to use than CPOT items because the former are more succinctly worded, despite each BPS item having four response options and each CPOT item having three response options. However, the succinct wording of some BPS items leaves room for different interpretations of their operational definitions. For example, movement of "upper limbs" could be confused with muscle tension and the description of "compliance with ventilator" lacks clarity (Gélinas et al., 2013). Furthermore, the item on upper extremity movements was shown to be an unreliable pain indicator under certain conditions, e.g. if the patient had physical restraint devices (Li et al., 2008). Thus, the interrater reliability of the BPS was inconsistent across studies (Chen et al., 2011a). On the other hand, these two scales have three similar items related to facial expression, body movements and ventilator compliance (Gelinas et al., 2006; Payen et al., 2001). The CPOT has a fourth item assessing muscle rigidity, and ventilator compliance can be replaced with vocalisation in non-mechanically ventilated patients (Gelinas et al., 2006). Although the CPOT had comparable feasibility with the Nonverbal Pain Scale-Revised, the CPOT was considered more user-friendly (Topolovec-Vranic et al., 2013).

Despite their disadvantages, the BPS and CPOT were recommended by the American College of Critical Care Medicine as the most valid, reliable behavioural pain scales for assessing pain in adult ICU patients unable to self-report, but with intact motor function and observable behaviours (Barr et al., 2013). However, more validation studies of the BPS and CPOT are needed in non-medical, postoperative and brain-injured ICU patient populations, and these scales need to be translated into foreign languages (besides French or English) (Barr et al., 2013). On the other hand, many ICU nurses consider changes in vital signs valuable for pain assessment despite evidence that such changes are not correlated with patients' self-reported pain (Chen and Chen, 2015; Gelinas, 2016). This belief of ICU nurses is likely related to the ubiquitous presence of vital-sign monitoring devices in ICUs, making vital signs seem like a quick and easy way to assess pain in unconscious patients (Chen and Chen, 2015; Rose et al., 2012), lack of awareness about guidelines for pain assessment and management, and unfamiliarity with behavioural pain tools (Gelinas, 2016; Rose et al., 2012). Thus, ICU nurses need to be informed that changes in vital signs should be used only as prompts to assess pain using validated tools such as the BPS and CPOT or patients' self-reported pain (Gelinas, 2016).

Therefore, the aims of this study were to validate the construct validity of the Chinese-versions CPOT and BPS as measures of critically ill patients' pain by (1) discriminant validation of behavioural scales and vital signs (i.e. respiratory rate [RR], heart rate [HR], mean arterial pressure [MAP], pulse oximeter oxygen saturation [SpO_2]) during a non-nociceptive procedure (noninvasive blood pressure [NBP] assessment) and a nociceptive procedure (endotracheal suctioning), (2) criterion validation of behavioural scales and vital signs with patients' self-reported pain (yes/no), and (3) testing the interrater reliability of proportion of responses in which the 2 raters agreed in nociceptive procedures.

Materials and methods

Study design and sample

For this crossover, observational study, critically ill patients were purposively sampled from the ICUs of a regional teaching hospital in northern Taiwan. Patients were enrolled if they met these criteria: conscious (GCS score >8) or unconscious (GCS score <8), on mechanical ventilation >8 hours, and age 18 years and older. Patients were excluded if they were quadriplegic and receiving neuromuscular blocking medications (e.g. succinylcholine, cisatracurium, pipecuronium, rocuronium and vecuronium) or being investigated for brain death. Of 331 patients in the ICUs from May 2010 to January 2012, 316 were enrolled and completed the study.

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