Original Article

Comparison of Two Pain Scales: Behavioral Pain Scale and Critical-care Pain Observation Tool During Invasive and Noninvasive Procedures in Intensive Care Unit-admitted Patients

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Abstract

Background: Critically ill patients admitted to intensive care units (ICUs) frequently experience pain, but the severity of pain in this group of patients is underestimated by the treatment team due to barriers to verbal communication. The aim of the present study was comparing the severity of pain measured by two scales: behavioral pain scale (BPS) and critical-care pain observation tool (CPOT) in ICU-admitted patients during routine daily procedures. **Materials and Methods:** Ninety patients were enrolled in the study. The severity of pain was measured during resting, invasive (suctioning) and noninvasive (mouthwash and body position change) procedures, and respiratory physiotherapy with two scales: BPS and CPOT. Wilcoxon and Friedman statistical tests were used to compare the score of pain in different situations, and Spearman correlation coefficient was also used to measure the correlation of pain score measured by two scales. **Results:** Patients experienced no pain during resting, mild pain during changing position, and respiratory physiotherapy, mild-to-moderate pain during mouthwash and moderate pain during secretion suctioning. Wilcoxon test used for pairwise comparisons between pain score in different situations showed a significant difference in both scales ($p < 0.05$). There were positive and strong correlations ($r > 0.80$, $p < 0.05$) between the pain score measured by BPS and CPOT from ICU-admitted patients in all procedures. **Conclusions:** Critically ill patients in ICU experience a different range of pain in routine daily care. BPS and CPOT scales could be used successfully for monitoring of pain in this group of patients.

Keywords: *Behavioral pain scale, critical-care pain observation tool, intensive care unit, pain*

Introduction

Pain is an unpleasant subjective and multidimensional experience related to actual or potential tissue damage.[1] Intensive care unit (ICU)-admitted patients experience pain because of the painful interventions and routine daily care procedures.[2] There are barriers to effective verbal communication in these patients such as sedation, decreased level of consciousness, endotracheal intubation, and mechanical ventilation, which are limiting factors for patient's self-report of pain.[1,3,4] The inability to report pain does not exclude the possibility of its existence.[1] Therefore, some behavioral and physical responses can be used to assess and diagnose the pain in this group of patients. These behavioral and observational scales of pain measurement include the nonverbal pain scale (NVP), critical-care pain observation tool (CPOT), behavioral pain scale (BPS), comfort scale, FACES [(face, legs, activity, cry) scale], consolability scale, and pain assessment behavioral scale with numeric rating scale.[1,5] The CPOT and BPS scales are more commonly used than the other pain behavioral monitoring scales,[6,7] and based on various studies, they are valid and sensitive for capturing changes in pain response among patients receiving sedatives or with the lack of ability to communicate.[8-10]

Pain is a frequent complaint in critically ill patients and approximately 50% or more of ICU-admitted patients experience moderate-to-severe pain.[1] The experience of pain in critical care patients has been evaluated in some studies.[11-13] In fact, pain causes acute stress and changes in the nervous system activity,[14] and improved pain management is associated with better treatment outcomes in the ICU setting.[15] In one study by Young *et al.*, BPS was

How to cite this article: Gomarverdi S, Sedighie L, Seifrabiei MA, Nikooseresht M. Comparison of two pain scales: Behavioral pain scale and critical-care pain observation tool during invasive and noninvasive procedures in intensive care unit-admitted patients. Iranian J Nursing Midwifery Res 2019;24:151-5.

Received: March, 2018. **Accepted:** November, 2018.

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Access this article online

Website: www.ijnmrjournal.net

DOI: 10.4103/ijnmr.IJNMR_47_18

Quick Response Code:

used to assess pain before and after the two common procedures in unconscious ICU-admitted patients and it was reported to be a valid and reliable tool in evaluation of the pain of unconscious patients.[8] In another study by Wang *et al.*, BPS scale was compared with observational evaluation of pain in ICU, and it was shown that the pain score measured by BPS scale compared with observational evaluation was significantly higher.[16] To identify the best scale for measuring of pain in noncommunicative patients, the validity and sensitivity of six common pain scales (adult NVP, BPS, comfort scale, FACES, and consolability scale) was assessed by Rahu *et al.*, and it was reported that all tools were valid and sensitive to detect changes in pain response in critically ill communicative and noncommunicative patients.[17]

The results of one study in Iran showed that after training of the ICU nurses with CPOT scale, no improvement in relation to documentation of pain in the patients' records was seen in nurses' function, but it could increase nurses' sensitivity to pain in patients with decreased level of consciousness.[18] On the other hand, in another study comparing "CPOT" and "facial expression (FE)" for pain assessment of intubated patients in a cardiac postanesthesia care unit, the sensitivity of CPOT was reported to be higher than "facial expression" for detection and evaluation of pain in intubated postoperative patients.[19]

Pain assessment in patients who are unable to self-report their pain is difficult, and according to the results of many studies, pain score is underestimated in critically ill noncommunicative patients.[4] Untreated prolonged pain could have detrimental effects on many body organ systems and result in chronic pain.[8,19] So, pain assessment tools that focus mainly on behavioral indicators of pain should be used in this group of patients. The BPS and CPOT are two behavioral pain assessment tools recommended for evaluating pain in tracheal intubated and unconscious patients. This study was conducted with two aims: (1) comparison of the BPS and CPOT scale in detecting patient's pain during routine procedures of ICU; and (2) comparison of pain intensity in invasive and noninvasive procedures such as tracheal secretion suctioning, mouthwash, positions change, respiratory physiotherapy, and rest by two study scales.

Materials and Methods

This cross-sectional study was conducted with the aim of comparing pain intensity measured by two scales (CPOT and BPS) among ICU-admitted patients in hospitals affiliated with Hamadan University of Medical Sciences, Iran in 2016–2017. Inclusion criteria: all ICU-admitted patients aged between 18 and 65 years, who were not able to self-report their pain and their expected length of stay in ICU was more than 12 h, were included.[6,9] Patients with progressive neuromuscular disease or paralyzed patients and conscious patients were excluded from study.

After approval by ethical research committee and obtaining written consent from the patient's companion, an expert nurse trained with using two study scales attended the bedside of all eligible patients (n = 90) during the 3-month study period. Calculation of the sample size was performed with considering α = 0.05, power = 80%, and effect size = 0.05, and finally, total sample size was calculated as 90. Patient's pain was measured using a checklist designed according to BPS and CPOT pain-monitoring scales during standard daily care procedures (body position change, secretion suctioning, mouthwash, and respiratory physiotherapy) and in resting state (without any therapeutic procedures).

Patient's demographic information and pain score measured with two study scales were recorded in the checklist. The BPS included three main parts of face status, movement of upper limb, and moaning in the nonintubated patients/patients under mechanical ventilation [Appendix 1]. This scale ranks pain from 3 to 12, and the patient's status based on this scale is painless (3), mild (4–6), moderate (7–9), or severe (10–12) pain. The scores of 6 and higher indicate moderate-to-severe pain, which requires treatment. The CPOT consists of four main parts, which, in addition to the main parts of the BPS scale, include a muscle tone examination. Based on this scale, the patient's pain status is classified as painless (0), mild (0–3), moderate (3–6), or severe (6–8), and the patient's minimum and maximum pain are assessed based on the score obtained [Appendix 2].

In order to decrease interobserver variations, measuring of pain intensity by two scales was done by one trained expert nurse and the results were recorded in the checklist. Pain evaluation in patients started with measuring BPS pain score in different situations and immediately CPOT pain score was measured as the same. Pain measurements were delayed if patients received intravenous sedation or neuromuscular blocking agents. Pain score in each situation was compared with all other situations. p values less than 0.05 were considered as significant. According to the ordinal content of the pain measured by the two scales, we used Friedman statistical tests for comparison of pain score at different situations and to identify the source of the difference; Wilcoxon's signed rank test was used to compare median of pain score and Spearman correlation coefficient was also used to measure the correlation of two scales scores, in which values greater than 0.7–0.8 are considered significant. We used SPSS (version 16, SPSS Inc., Chicago, IL, USA) for analyzing data.

Ethical considerations

This research was approved by the "Committee of Ethics in Research" of Hamadan University of Medical Sciences by this earmark: IR.UMSHA.REC.1395.583.

Because of inability to get the informed consent from the patients (unconscious patients), the form was signed by the parents or a relative accompanying the patient, and after this step, the patient was enrolled in the study.

Results

About 170 patients were admitted to the ICUs of Sina and Besat Hospitals in Hamadan during 3 months. Sixty-one patients lacked the inclusion criteria and parents (relatives) of 19 (from 109 remaining patients) were not willing to participate in the study. Therefore, 90 patients were included. The mean (SD) age of the participants was 44.21 (14.20) years; most of them were men (64%) and 77.87% of the patients in our study were intubated during evaluation. The lowest and highest levels of consciousness of the patients based on the Glasgow Coma Scale were 7 and 11 with median of 8. The background characteristics of the patients are presented in Table 1.

Based on the results presented in Table 2, the median BPS score during resting, body position change, secretion suctioning, mouthwash, and respiratory physiotherapy procedures was 3, 5, 6, 7, and 4, respectively. The lowest BPS score during resting, body position change, mouthwash, and respiratory physiotherapy procedures was 3. In addition, the lowest score in the secretion suctioning procedure was 4. The highest BPS score during resting, body position change, mouthwash, and secretion suctioning was 12, and this value was 10 in the respiratory physiotherapy procedure [Table 2].

The median CPOT score during resting, body position change, secretion suctioning, mouthwash, and respiratory physiotherapy was, respectively, 0, 3, 3, 4, and 1. The lowest amount of CPOT score was 0 during resting, body position change, mouthwash, and respiratory physiotherapy procedures and 1 in the secretion suctioning procedure. The highest CPOT score was 8 during resting, body position change, mouthwash, and secretion suctioning procedures and 7 during the respiratory physiotherapy procedure. The pain score measured by two scales had a strong correlation (Spearman correlation range: 0.85–0.97) [Table 2].

The results of this investigation indicated that the median of pain severity in the different procedures with each of the BPS and CPOT scales were significantly different ($p < 0.001$ in both cases). Based on both scales, the patients experienced no pain during resting, mild pain during changing position and respiratory physiotherapy, mild-to-moderate pain during mouthwash, and moderate pain during secretion suctioning [Tables 3 and 4]. The obtained results indicated that suctioning the secretions via endotracheal tube was more painful than mouthwash and changing body position. Body position change was also more painful compared to physiotherapy and resting state, respectively [Tables 3 and 4].

Table 1: Background characteristics of the patients (n=90)

Variables	Values	Statistics
Age (years)	Mean (SD)	44.21 (14.20)
Consciousness level (GCS)	Median (range)	8 (7-11)
Sex: male	(No, %)	57 (64%)
Intubation condition	Intubated (no, %)	70 (77.80%)

SD=Standard deviation, GCS=Glasgow Coma Scale

Table 2: Median pain score in different procedures measured by BPS and CPOT scale and Spearman's correlation

Procedure	Median (first quartile, third quartile)		Spearman's correlation	
	BPS	CPOT	Statistic	p
Resting	3 (3, 4)	0 (0, 1)	0.97	<0.001
Changing position	5 (4, 7)	3 (2, 4)	0.90	<0.001
Mouthwash	6 (4, 7)	3 (2, 5)	0.90	<0.001
Secretion suctioning	7 (5, 8)	4 (2, 5)	0.88	<0.001
Respiratory physiotherapy	4 (3, 4)	1 (0, 1)	0.85	<0.001

BPS=Behavioral pain scale, CPOT=Critical-care pain observation tool

Table 3: Pairwise comparison of pain score measured by BPS during different procedures

Position 1	Position 2	Wilcoxon test statistics (Z)	p
Resting	Body position change	−7.54	<0.001
	Mouthwash	7.64	<0.001
	Secretion suctioning	−8.05	<0.001
	Respiratory physiotherapy	1.34	<0.001
Changing position	Mouthwash	−1.33	<0.001
	Secretion suctioning	−4.90	<0.001
	Respiratory physiotherapy	−7.31	<0.001
Mouthwash	Secretion suctioning	−5.02	<0.001
	Respiratory physiotherapy	−7.67	<0.001
Secretion suctioning	Respiratory physiotherapy	−8.10	<0.001

BPS=Behavioral pain scale

Discussion

Effective pain management is an important goal for all patients and improves patient outcome, especially in critically ill patients. Although pain assessment is difficult in noncommunicative ICU-admitted patients, in order to optimal pain control, pain score must be measured in a valid and reliable manner.[1] Some observational and BPSs are used to assess pain severity in critically ill patients and this study was aimed to evaluate the use of BPS and CPOT pain scales and their agreement in detecting pain among patients hospitalized in ICUs.

Table 4: Pairwise comparison of pain score measured by CPOT scale during different procedures

Position 1	Position 1	Wilcoxon test statistics (*Z*)	*p*
Resting	Body position change	−7.83	<0.001
	Mouthwash	−7.72	<0.001
	Secretion suctioning	−8.01	<0.001
	Respiratory physiotherapy	−0.05	0.959
Body position change	Mouthwash	−2.35	0.019
	Secretion suctioning	−5.55	<0.001
	Respiratory physiotherapy	7.61	<0.001
Mouthwash	Secretion suctioning	−4.88	<0.001
	Respiratory physiotherapy	−7.57	<0.001
Secretion suctioning	Respiratory physiotherapy	−8.00	<0.001

CPOT=Critical-care pain observation tool

The results of our study showed that critically ill noncommunicative patients experience pain during seemingly nonpainful care procedures (mouthwash) and even during resting. Both study scales, BPS and CPOT, demonstrated an increase in pain score from resting to turning or suctioning of endotracheal secretions. The results of the present study, in addition to the positive and strong correlation of the BPS and CPOT, indicated that despite the similarities and differences between these tools, both are suitable scales for assessing pain among critically ill patients in ICUs and could discriminate between painful and nonpainful procedures in both groups of conscious and unconscious patients. In both scales, FEs and noncooperation of the patient with the mechanical ventilation device are signs of pain among the patients. The difference between these two tools is that tone movements in the muscles of the arm and calf (whole body) are assessed in the CPOT scale, but only upper limb movements were considered in BPS scale.[1,6] Compared to CPOT scale, measuring of pain score during presumed nonpainful procedures such as mouthwash and oral care showed a greater variations when BPS scale was used. This finding is consistent with the results of other studies. Both BPS and CPOT scales showed good reliability and internal consistency in Rijkenberg *et al.* study, but CPOT scale remained unchanged during nonpainful procedures, whereas BPS score was significantly increased at the same time. They mentioned that the increase in BPS score during presumed nonpainful procedure such as oral care may be related more on a touch reflex rather than pain.[6] It was mentioned in previous studies that more than 50% of critically ill patients in ICU experience moderate-to-severe pain,[1] and this is nearly consistent with our study results that median pain score of painful procedures such as suctioning of tracheal secretions was 7 and 4 for BPS and CPOT scales, respectively, which is classified in the category of moderate pain. The BPS and CPOT showed low pain scores in some studies.[6,8,9] This difference may be related to measuring pain in sedated patients, which results to lower pain score measurement, but we did not measure pain after sedation or narcotic injection in our investigation.

In another study by Severgini *et al.*, comparing two scales of CPOT and BPS to assess pain in critically ill conscious and unconscious patients, it was found that CPOT and BPS scores increased during nursing care in ICU and the results were significantly correlated. This finding is consistent to our findings that a strong correlation was found between the scores of BPS and CPOT scales. Although both scales can be used for assessment of pain intensity, BPS was found to be more specific (91.7%) than CPOT (70.8%), but less sensitive (BPS 62.7%, CPOT 76.5%). The combination of BPS and CPOT resulted in better sensitivity 80.4% and better results in the assessment of pain in patients during nursing care procedures in Severingini study.[20] It was confirmed by several studies that these two commonly used pain assessment tools: CPOT[4,9,21] and BPS,[7,8] are both reliable and valid in the assessment of pain in the unconscious critically ill patient.

In addition to comparing two commonly used scales of pain assessment (CPOT and BPS), we compared pain score with two scales; during different routine procedures in ICU, such as changing position, mouthwash, or suctioning and respiratory physiotherapy, and based on our own data, a significant difference ($p < 0.001$) was detected between different procedures' pain score and resting position. This finding supports the idea that most of the critically ill patients feel pain during routine care procedures and also demonstrated that BPS and CPOT are good tools for capturing these changes in pain response and provide information about pain in unconscious ICU-admitted patients.

We evaluated pain after routine day care procedures in both intubated and nonintubated critically ill patients admitted to ICU in our study. One limitation of such comparison is that mouthwash in nonintubated patients was categorized in one procedural group with tracheal suctioning, which may result in different levels of pain. But considering that both scales were compared with each other in every single patient, we can ignore this limitation.

Conclusion

According to the high correlation between the pain score measured by BPS and CPOT, both scales could be used successfully for monitoring of pain in critically ill patients. Both scales are sensitive for capturing changes in pain response and discriminate between painful and nonpainful procedures.

Acknowledgments

We would like to thank the staff of Intensive Care Units of Sina and Besat hospitals, the patients who participated in our study, and all those who helped us in this study. We also acknowledge Hamadan University of Medical Sciences for their financial support in this project (No. 9512177888).

Financial support and sponsorship

Hamadan University of Medical Sciences.

Conflicts of interest

Nothing to declare.

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