Original Article

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Quick Response Code:

Website: www.jehp.net
DOI: 10.4103/jehp.jehp_780_23

Comparison of the accuracy and the response time to behavioral pain scales (BPS and CPOT) during painful procedures in the intensive care unit

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Received: 04-06-2023
Accepted: 02-09-2023
Published: 28-09-2024

Abstract:

BACKGROUND: Pain is one of the most common symptoms in the patients hospitalized in intensive care units, and its correct and timely diagnosis is important. Identifying tools that accurately assess pain in a shorter time will help patients better manage pain. The aim of this study was to compare the accuracy and the duration of response to behavioral pain scales (BPS and CPOT) during painful procedures in the intensive care unit.

MATERIALS AND METHODS: The descriptive-comparative study was conducted in two groups, each including 16 nurses, in the intensive care unit of Besat Hospital in Hamadan in 2022. Each group separately evaluated the patients' pain during position change and secretion suction based on BPS and CPOT scales along with an evaluator. At the same time, the accuracy of the scores given by each nurse and the duration of pain diagnosis were compared using the determined evaluator, and the results were analysed.

RESULTS: Comparing the durations of response to the scales, the average duration of response for BPS and CPOT tools were 13.21 and 13.63, respectively; in general, their difference was significant ($P < 0.001$). Examining the accuracy of the nurses and the evaluators in pain evaluation revealed a significant difference between the two tools, and the results of adaptability were higher for CPOT, in all cases, in comparison with BPS ($P = 0.024$).

CONCLUSIONS: The results showed that CPOT assesses the pain more accurately compared to BPS, but the duration of pain evaluation is a little longer via CPOT. The results of the study can help the nurses working in ICUs by choosing more accurate tools with shorter evaluation duration.

Keywords:

Nursing, pain, pain management, pain measurement, special care

Introduction

Pain is one of the most common and important symptoms in the patients hospitalized in intensive care units (ICUs).[1,2] 50–75% of patients hospitalized in ICUs in the world have mentioned pain as their worst experience.[3] Despite the efforts made in the past decades, pain management in the patients hospitalized in ICUs is still challenging and a major stressor for patients.[4] Patients' dependence on mechanical ventilation in ICUs is considered as one of the important factors causing pain.[5] Due to problems such as reduced levels of consciousness, brain damage, or physiological conditions, measuring and managing pain in the patients under mechanical ventilation is difficult and sometimes not done correctly.[2,6,7]

Improper pain management leads to an increase in the duration of hospitalization,

How to cite this article: Sedighi L, Shirozhan S, Talebi-Ghane E, Taher A, Eliasi E, Gomar R, *et al*. Comparison of the accuracy and the response time to behavioral pain scales (BPS and CPOT) during painful procedures in the intensive care unit. J Edu Health Promot 2024;13:334.

re-hospitalization, dissatisfaction with medical care, and an increase in patients' morbidity and mortality. Therefore, its correct and timely diagnosis by nurses is important.[7-9] The results of studies show that accurate and timely pain evaluation requires the use of easy, consistent, and standard methods. The reason is that patients' pain, like other vital signs, must be evaluated repeatedly, and if the scale is not accurate or requires spending a long time, the patient's pain will not be evaluated correctly.[10,11]

Among the various pain evaluation methods, the most important and reliable one is the patient's self-report.[2,6,7] However, when the patient is unable to express his/her pain, behavioral and physical reactions will be used to examine and diagnose pain in the patients under mechanical ventilation.[12,13] The behavioural and physical reactions of the patients under mechanical ventilation are examined through scales such as BPS, critical CPOT, and nonverbal pain scale (NVPS).[1,2]

Among these tools, BPS and CPOT have been more popular with and used by the nurses working in ICUs due to their higher reliability and similarity to the examined items.[7] In 2019, BPS and CPOT were compared in terms of measured pain intensity in a study in ICUs.[7] However, the accuracy of these two valid tools and the time duration required to use them have never been examined simultaneously. Considering the necessity of frequent pain evaluation in the patients in ICUs, and the effect of the accuracy and the duration of pain measurement on the performance of nurses and patients' pain management, this study was conducted with the aim of comparing the accuracy and the duration of using BPS and CPOT, behavioral pain measurement scales, during painful procedures in the intensive care unit.

Materials and Methods

Study design and setting

This descriptive-comparative study was conducted in the intensive care unit of Besat Hospital in Hamadan in 2022.

Study participants and sampling

The study population included the nurses and the 10 patients in general ICUs, who were selected through convenience sampling. A total of 32 nurses participated in this study based on the inclusion criteria. The inclusion criteria for nurses included being employed in the general ICUs of the selected hospitals, at least 6 months working experience in the ICU, and holding at least a bachelor's degree. The inclusion criteria for patients included being hospitalized for more than 24 hours in the intensive care unit, being an adult (18–65), having a reduced level of consciousness (a score of 8–11 based on Glasgow scale), not being able to express pain, using/not using a tracheal or tracheostomy tube, being under mechanical ventilation, not receiving sedative and Neuromuscular-blocking drugs, not being addicted to alcohol or any other narcotics, not having an underlying disease causing an increase or a decrease in pain intensity.[7,14]

Data collection tool and technique

In this study, a demographic information form as well as BPS and CPOT were used to collect data. The demographic information included age, gender, educational level, working experience as a nurse, and ICU working experience for nurses. For patients, it included age, gender, reason for admission, date of admission, underlying diseases, and the level of consciousness based on the Glasgow Coma Scale.

The accuracy of pain diagnosis was assessed based on the scores reported by the nurses through BPS and CPOT during positioning and suctioning secretions, as well as the amount of time required to diagnose pain. The amount of time needed to measure pain through these two scales was measured with a chronometer. BPS consists of three main sections (facial expressions, upper limbs, fight with ventilator for intubate patients/vocalization for non-intubate patients) each scored from 1 to 4. The total minimum score is 3 (no pain) and the maximum score is 12 (indicating maximum pain).[7] Dehghani *et al*.[15] in their study reported that Cronbach's alpha was 85 for painful procedures and 76 for nonpainful procedures for this scale.

CPOT consists of four sections. Each section includes a group of different factors: facial expressions, body movements, muscle tension, compliance with the ventilator, or vocalization (including four items for the patients with a tracheal tube or the ability to speak for the patients without a tracheal tube). The highest score that a patient can get is 8, which indicates the high level of pain, and the lowest possible score is zero, which indicates the absence of pain.[7] The validity of this tool was confirmed with high internal cluster correlation nonpainful procedure (0.997) and painful procedure (0.726) in the study of Rafiei *et al*.[16]

The nurses were randomly placed in two groups, and an evaluator was assigned to each group. At first, the patients' pain during suctioning secretions and positioning was assessed by evaluators, using both BPS and CPOT. Then the pain scores were examined in terms of their correlation and the duration of response to ensure that the evaluators had the same performance. Next, the nurses of each group, along with an evaluator, examined the patients' pain during positioning and suctioning secretions based on BPS or CPOT. At the same time, the accuracy of the scores given by each nurse and the duration of pain diagnosis were compared using the

assigned evaluator. Then the evaluators were exchanged, and the pain scores were re-evaluated by the evaluators and the nurses using both tools.

In regard with descriptive statistics, in order to describe and report the quantitative variables with normal distribution, mean, and standard deviation, and for describing non-normal variables, median and interquartile ranges were used. Ratios and percentages were also expressed for qualitative variables. To check the internal reliability of each tool, Cronbach's alpha was used; Cohen's kappa coefficient and ICC were used to check the reliability between the tools. Moreover, through calculating their sensitivity and the specifications, the validity of the tools was also reported. Assuming normality, an independent *t*-test was used to compare quantitative variables in both groups, a paired *t*-test was used to test the differences in the scores of accuracy and duration in BPS and COPT groups, and an analysis of variance was used to compare quantitative variables in several groups. If the variables were not normal, the non-parametric equivalents of the tests were used. SPSS version 20 software was used for data analysis, and the significance level was considered to be 0.05.

Ethical consideration

This research is the result of an approved research project and has been approved by the Research and Ethics Committee of Hamadan University of Medical Sciences (ethics code: IR.UMSHA. REC.1399.450). Before starting the study, written consent was obtained from the participants. It was explained to the participants that at any stage of the research, they could withdraw from participating in the study.

Results

Among the 78 nurses working in the ICUs of Besat Hospital in Hamadan, 32 were included in the study based on the inclusion criteria. The mean age of the nurses was 32 years, and their mean working experience in the intensive care unit was 5.52 years. The evaluators in this study were 37 and 33 years old and, respectively, had 11 and 9 years of working experience in the ICU.

In the first step, in order to ensure the evaluators' similar performances, the patients' pain was evaluated during suctioning secretions and positioning using both BPS and CPOT tools, and the pain scores were examined in terms of correlation and response time. The internal correlation between the evaluators' performances was, respectively, 0.864 and 0.961 in BPS and CPOT; the correlation between them was significant. Moreover, the correlation between each evaluator's response time in responding to BPS and CPOT was 0.669 and 0.638, respectively; the correlation was significant. In addition, the evaluators had a significant correlation of 0.937 and 0.951 in the procedures of suctioning secretions and positioning. It should be noted that other combined correlations between the evaluators were also examined, all of which were significant [Table 1]. Based on the results of this table, it can be concluded that the evaluators have exactly had the same performance and that the hypotheses of the study have been fulfilled.

In the second step, to investigate the nurses' performance, the internal correlation of the scores of each nurse on both occasions of measuring patients was also examined. In this study, the internal correlation of BPS and CPOT was obtained as 0.794 and 0.967, respectively, both of which were significant ($P < 0.001$). The nurses' response duration was also examined, 0.809 and 0.802, respectively. There was a correlation in the durations of responding to BPS and CPOT ($P < 0.001$) [Table 2]. Moreover, the nurses' responses were examined based on secretion suctioning and positioning, 0.945 and 0.915, respectively. There was a correlation between them. Other combined analyses are presented in Table 2.

In the third step, the correlation between the pain scores determined by the nurses and the evaluators was investigated [Table 3]. The results indicate that in all cases, the internal correlation of BPS is lower than that of CPOT.

In the next step, in order to compare the amount of time required to respond to the tools, first, the mean response duration of the nurses was obtained on two occasions. Since the difference between BPS and CPOT values was assumed to be normal, the paired *t*-test was used to compare the difference in time duration between these two tools. The results indicated that the mean response time of BPS and CPOT were 13.21 and 13.63, respectively,

Table 1: *ICC assessment between the evaluators

Tool	Procedure	Response	Total response	Time
BPS	Secretion suctioning	0/853	0/864	0/669
	Positioning	0/873		
CPOT	Secretion suctioning	0/957	0/961	0/638
	Positioning	0/968		
Total	Secretion suctioning	0/937	0/943	0/651
	Positioning	0/951		

*ICC: Intraclass correlation

Table 2: ICC evaluation of each nurse's scores on two occasions of measuring patients' pain

Tool	Procedure	Response	Total response	Time
BPS	Secretion suctioning	0/878	0/794	0/809
	Positioning	0/726		
CPOT	Secretion suctioning	0/969	0/967	0/802
	Positioning	0/965		
Total	Secretion suctioning	0/945	0/92	0/807
	Positioning	0/915		

which had a significant difference ($P < 0.007$). The difference in the mean response time between the tools in the position of secretion suction was 0.24, which was not significant ($P < 0.177$). However, the mean response time of the scales during positioning was 0.61, and a significant difference ($P < 0.020$) was observed [Table 4].

In the final step, the nurses' consistency with the evaluators (accuracy) in completing the tools based on the situation was investigated and compared. Since both tools were used by the same nurse and on the same patients, McNamara's test was used to compare their accuracy. According to the obtained results, to investigate the consistency between the nurses and the evaluators, there was a significant difference between the tools. According to the results, consistency in CPOT was higher than BPS in all cases ($P = 0.024$). However, this difference was not significant in positioning ($P = 0.185$) [Table 5].

Discussion

Intensive care patients' pain management is a complex and important process. American Society for Pain Management Nursing (ASPMN) has recommended using BSP and CPOT to assess pain in mechanically ventilated and anesthetized patients.[17] This study was conducted with the aim of comparing the accuracy and the duration of pain diagnosis by nurses based on BPS and CPOT behavioral scales during painful procedures in the ICU. The findings indicated that given the significant correlation between the pain evaluation scores given by the evaluators' using both BPS and CPOT, both evaluators had the same performance in evaluating patients' pain. However, when the nurses used both tools to assess patients' pain during the two procedures of secretion suction and positioning, the scores of BPS showed a weaker correlation in both procedures, compared to CPOT, both in the comparison of the two groups of nurses and in the comparison of the nurses with the evaluators. Considering that both evaluators had the same performance in evaluating patients' pain, it can be concluded that the difference in the correlation of the pain scores, both among the nurses and between the nurses and the evaluators, in BPS and CPOT is not due to the difference in the performance of the evaluators, but is due to the difference between the tools. In other words, CPOT is a more accurate tool than the BPS in assessing pain in the intensive care unit patients. The weaker correlation obtained through BPS may be the result of evaluators' different interpretations of the practical descriptions of BPS, while the scoring system of CPOT seems to be more logical and the practical descriptions for using this tool are more clear. Therefore, it provides a more accurate evaluation of patients' pain.[14,18,19]

Table 3: ICC assessment of nurses and evaluators

Tool	Procedure	Response	Total response
BPS	Secretion suctioning	0/860	0/834
	Positioning	0/799	
CPOT	Secretion suctioning	0/962	0/953
	Positioning	0/943	
Total	Secretion suctioning	0/941	0/932
	Positioning	0/921	

Table 4: Comparison of the difference in the time required to diagnose pain in both tools through paired *t*-test

Procedure	Tool	Average response time	*P*
Secretion suctioning	BPS	13/57	0/177
	CPOT	13/81	
Positioning	BPS	13/84	0/020
	CPOT	13/45	
Total	BPS	13/21	0/007
	CPOT	13/63	

Table 5: Examining and comparing the consistency between the nurses with the evaluators (accuracy) in completing the tools through McNemar's Test

Procedure	Tool	Consistency				*P*
		Exist		Not exist		
		Count	Row *n* %	Count	Row *n* %	
Secretion suctioning	BPS	42	63/64 %	24	36/36 %	0/024
	CPOT	55	83/33 %	11	16/67 %	
Positioning	BPS	42	63/64 %	24	36/36 %	0/185
	CPOT	50	75/76 %	16	24/24 %	
Sum	BPS	84	63/64 %	48	36/36 %	0/008
	CPOT	105	79/55 %	27	20/45 %	

The comparison of BPS with other tools has also shown that the use of visual tools such as BPS leads to an underestimation of the actual pain score and it is better to use it along with numerical tools.[20] In a study conducted by Kiavar *et al.*,[17] pain evaluation has been done through CPOT and facial expressions (FE), and the obtained data have been compared. The findings indicated that the sensitivity of CPOT is higher than FE regarding recognizing and evaluating pain in the patients under mechanical ventilation. Since FE is a part of BPS, the results seem to be in line with those of the present study.

In contrast to the results of the present study, the results of the comparison between BPS and CPOT regarding evaluating pain during secretion suctioning and positioning procedures in the study of Gomarverdi *et al*.[7] show that both tools had strong correlations in terms of pain scoring (positioning, 0.90 and suction secretions, 0.88) and did not differ much in this regard. The results of another study conducted on critically ill patients under mechanical ventilation indicated the correlation between the pain scores evaluated by BPS and CPOT.[21] In addition, the findings of the study by Rijkenberg *et al*.[14] show that the inter-rater reliability during painful procedures has been almost equal in

BPS and CPOT, 0.60 and 0.61, respectively. A review of the published studies on pain tools also shows that the inter-rater reliability is similar in both BPS and CPOT and is reported as moderate to high.[22,23]

In a study designed and conducted with the aim of comparing BPS and CPOT, Severgnini *et al*. stated that both tools are suitable for evaluating patients' pain. BPS is more specific and has a lower sensitivity than CPOT for evaluating pain in the patients under mechanical ventilation, and CPOT is less specific and has a higher sensitivity than BPS. Therefore, it is recommended to use a combination of both tools to assess pain in the critically ill patients under mechanical ventilation in order to increase accuracy.[24]

In the second part of the study, investigating the correlation of the response time with BPS and CPOT indicated that assessing pain with CPOT is less time consuming than BPS. This difference was significant in suctioning but was not significant in positioning. The review of the studies conducted on pain evaluation tools in the intensive care unit has often compared tools in terms of validity, reliability, and the correlation of pain scores in different tools, and the mean response time has been ignored.[14,17-19,21,24,25] Therefore, in future studies, the response time can be considered by researchers.

Limitations and Recommendation

One of the limitations of this study was the lack of complete homogeneity of the patients evaluated by the nurses, and in order to control this limitation, the patients were similar in terms of level of consciousness, connection to the mechanical ventilation device, and age range. Also, the number of patients evaluated by the nurses was increased up to four times. In future studies, it can be considered to evaluate the accuracy and the response time to BPSs in patients hospitalized in Trauma ICUs, Neurosurgical ICUs, or Cardiac Surgery ICUs.

Conclusion

The results indicated that CPOT evaluates pain in the patients admitted to the intensive care unit more accurately compared to BPS. The pain evaluation time through CPOT was longer than BPS in secretion suction, but there was no significant difference in positioning. Therefore, it is recommended to compare the duration of pain evaluation through these tools in different patient conditions in future studies. The results of the present study can help the nurses working in ICUs by choosing a more accurate tool with a shorter evaluation time.

Acknowledgement

This research is the result of a research project approved by the Research and Ethics Committee of Hamadan University of Medical Sciences under the ethics code IR.UMSHA. REC.1399.450. The authors express their appreciation and gratitude to the managers of Besat Hospital in Hamadan, the nurses working in ICUs, as well as all the patients who helped us carry out this research.

Financial support and sponsorship

This research is the result of a research project approved by the Research and Ethics Committee of Hamadan University of Medical Sciences under the ethics code IR.UMSHA. REC.1399.450.

Conflicts of interest

There are no conflicts of interest.

References

1. Sole ML, Klein DG, Moseley MJ. Introduction to Critical Care Nursing E-Book. Elsevier Health Sciences; 2020.
2. McGuire DB, Kaiser KS, Haisfield-Wolfe ME, Iyamu F. Pain evaluation in noncommunicative adult palliative care patients. Nurs Clin 2016;51:397-431.
3. Marino PL. The ICU book. Lippincott Williams & Wilkins; 2007.
4. Urden LD, Stacy KM, Lough ME. Critical Care Nursing, Diagnosis and Management, 7: Critical Care Nursing. Elsevier Health Sciences; 2013.
5. Barr J, Fraser GL, Puntillo K, Ely EW, Gélinas C, Dasta JF, *et al*. Clinical practice guidelines for the management of pain, agitation, and delirium in adult patients in the intensive care unit. Crit Care Med 2013;41:263-306.
6. Kirksey KM, McGlory G, Sefcik EF. Pain evaluation and management in critically ill older adults. Crit Care Nurs Q 2015;38:237-44.
7. 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. Iran J Nurs Midwifery Res 2019;24:151-5.
8. Arbour C, Gélinas C, Michaud C. Impact of the implementation of the Critical-Care Pain Observation Tool (CPOT) on pain management and clinical outcomes in mechanically ventilated trauma intensive care unit patients: A pilot study. J Trauma Nurs 2011;18:52-60.
9. Brady Boyce BA, Yee BH. Incidence and severity of phlebitis in patients receiving peripherally infused amiodarone. Crit Care Nurse 2012;32:27-34.
10. Pasero CL, Coyne PJ. Assessing and treating the pain of pancreatitis. Am J Nurs 1998;98:14-6.
11. Gordon DB, Dahl JL, Miaskowski C, McCarberg B, Todd KH, Paice JA, *et al*. American pain society recommendations for improving the quality of acute and cancer pain management: American Pain Society Quality of Care Task Force. Arch Intern Med 2005;165:1574-80.
12. Herr K, Bursch H, Ersek M, Miller LL, Swafford K. Use of pain-behavioral evaluation tools in the nursing home: Expert consensus recommendations for practice. J Gerontol Nurs 2010;36:18-29.
13. Chanques G, Jaber S, Barbotte E, Violet S, Sebbane M, Perrigault P-F, *et al*. Impact of systematic evaluation of pain and agitation in an intensive care unit. Crit Care Med 2006;34:1691-9.
14. Rijkenberg S, Stilma W, Endeman H, Bosman R, Oudemans-van Straaten H. Pain measurement in mechanically

ventilated critically ill patients: Behavioral pain scale versus critical-care pain observation tool. J Crit Care 2015;30:167-72.
15. Dehghani H, Tavangar H, Ghandehari A. Validity and reliability of behavioral pain scale in patients with low level of consciousness due to head trauma hospitalized in intensive care unit. Arch Trauma Res 2014;3:e18608. doi: 10.5812/atr.18608.
16. Rafiei M, Ghadami A, Irajpour A, Feizi A. Validation of critical care pain observation tool in patients hospitalized in surgical wards. Iran J Nurs Midwifery Res 2016;21:464-9.
17. Kiavar M, Azarfarin R, Totonchi Z, Tavakoli F, Alizadehasl A, Teymouri M. Comparison of two pain evaluation tools, "facial expression" and "critical care pain observation tool" in intubated patients after cardiac surgery. Anesth Pain Med 2016;6:e33434. doi: 10.5812/aapm. 33434.
18. Juarez P, Bach A, Baker M, Duey D, Durkin S, Gulczynski B, *et al*. Comparison of two pain scales for the evaluation of pain in the ventilated adult patient. Dimens Crit Care Nurs 2010;29:307-15.
19. Puntillo K, Pasero C, Li D, Mularski RA, Grap MJ, Erstad BL, *et al*. Evaluation of pain in ICU patients. Chest 2009;135:1069-74.
20. Ahlers SJ, van Gulik L, van der Veen AM, van Dongen HP, Bruins P, Belitser SV, *et al*. Comparison of different pain scoring systems in critically ill patients in a general ICU. Crit Care 2008;12:1-8.
21. Liu Y, Li L, Herr K. Evaluation of two observational pain evaluation tools in Chinese critically ill patients. Pain Med 2015;16:1622-8.
22. Gélinas C, Puntillo KA, Joffe AM, Barr J. A validated approach to evaluating psychometric properties of pain evaluation tools for use in nonverbal critically ill adults. Semin Respir Crit Care Med 2013;34:153-68.
23. Chanques G, Pohlman A, Kress JP, Molinari N, De Jong A, Jaber S, *et al*. Psychometric comparison of three behavioural scales for the evaluation of pain in critically ill patients unable to self-report. Crit Care 2014;18:1-12.
24. Severgnini P, Pelosi P, Contino E, Serafinelli E, Novario R, Chiaranda M. Accuracy of critical care pain observation tool and behavioral pain scale to assess pain in critically ill conscious and unconscious patients: Prospective, observational study. J Intensive Care 2016;4:1-8.
25. Pudas-Tähkä SM, Axelin A, Aantaa R, Lund V, Salanterä S. Pain evaluation tools for unconscious or sedated intensive care patients: A systematic review. J Adv Nurs 2009;65:946-56.