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Pain among non-verbal critically Ill mechanically ventilated patients: Prevalence, correlates and predictors

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ABSTRACT

Purpose: To investigate pain levels and factors that are predictive of pain for mechanically ventilated patients during rest and during routine nursing procedures.
Material and methods: Pain levels were assessed using Behavioral Pain Scale (BPS) and physiological measures among 247 mechanically ventilated patients.
Results: At rest, 33.2% of patients suffered pain, with a BPS > 3; of these, 10% presented significant pain levels (BPS ≥ 5). Variables that correspondingly predicted resting pain were age ($\beta = -0.010$, $p < 0.001$), sedation score ($\beta = -0.153$, $p < 0.01$), and method of ventilation ($\beta = -0.281$, $p = 0.021$). During the procedures, 90% of patients suffered pain, with a median BPS of 6 (IQR: 4–8), and 83% of patients experienced significant pain levels. Age ($\beta = -0.022$, $p = 0.001$), sedation score ($\beta = -0.355$, $p < 0.001$), receiving sedation and/or analgesia in last hour ($\beta = 0.483$, $p = 0.01$), resting pain levels ($\beta = -0.742$, $p < 0.001$) and the type of painful procedure ($\beta = -0.906$, $p < 0.001$) were significant predictors of procedural pain.
Conclusions: Many mechanically ventilated patients suffer resting and procedural pain. Many variables were found to play a role. Clinicians need to consider these variables and intervene to decrease pain among patients at risk.

1. Introduction

Pain is increasingly expressed as one of the most upsetting memories of intensive care units (ICUs) survivors. Procedures performed during care, underlying health condition or disease, catheters or tubes inserted into the patients and being unable to change position are some of the many reasons for this pain [1-3]. Being unable to communicate pain is a major barrier to having adequate pain assessment and management and leads to a great risk of underrated and undertreated pain [4], as clinicians have not yet recognized the degree of pain associated with their caring procedures [5]. Untreated pain has the potential to negatively impact individuals and place them at risk for numerous adverse psychological and physiological consequences, including life-threatening ones. The physiological response to pain may lead to potentially fatal unstable hemodynamic status, alterations in immune system functioning, hyperglycemia, and increased release of catecholamine, cortisol, and antidiuretic hormones. Moreover, uncontrolled pain has been associated with a variety of psychosocial effects, including depression, anxiety, delirium, and posttraumatic stress disorder, and thus, untreated pain has been linked to increased morbidity and mortality [2,3]. Given the potentially serious consequences of untreated pain, pain management in ICU patients is a priority.

In ICUs, a continuous infusion of opioid analgesic at a fixed dose is commonly used to prevent and treat pain [6]. However, recent studies revealed that >50% of critically ill patients experience moderate to severe unrelieved pain [1,5,7]. This has highlighted the fact that despite advances in pain management, pain remains a prevalent problem in ICUs, and pain among critically ill patients is undertreated [2,5].

Recently, the Hierarchy of Pain Assessment Technique (Appendix 1) has been recommended in guiding clinicians in the assessment and management of pain. Self- report of pain, which is the single most reliable indicator of pain, is the first measure of pain existence and intensity in the hierarchy [7,8]. Among patients with limited verbal and cognitive skills, a simple yes/no or vocalization may be used. However, in the absence of self-report of pain, clinicians should explain why self-report cannot be used and need to perform further investigations and observations [8]. For non-verbal patients, one of the most reliable measures is to assess potential causes of pain. Among critically ill patients, these include, but not limited to, being intubated, immobile and undergoing care-related procedures such as turning and endotracheal suctioning [1,5,8]. Furthermore, observation of behaviors associated with pain is a valid approach to pain assessment and has been used over many years as alternative pain measures among

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non-verbal patients [1,3,8]. Non-verbal patients often communicate pain through behaviors, body language and non-verbal cues which clinicians have to interpret. However, using behavioral indicators to assess pain among non-verbal patients have several limitations, as they may be a sign of other common conditions rather than pain, like anxiety, and are undetectable in patients who are receiving neuroblocking agents [9]. Difficulties in distinguishing behaviors resulting from pain from other causes like anxiety reflect the decisional uncertainty in the nursing documentation of pain [4]. To deal with such behaviors, nurses frequently select a fast-acting sedative agent as the primary intervention which may lead to a serious treatment interference [10]. Indeed, searching for potential causes of pain and the context of the behavior must be considered when making treatment decisions [8]. Awareness of individual baseline behaviors and changes that occur during painful procedures or other potential sources of pain are useful in differentiating pain from other causes [5,8,11]. In addition, family and/or caregiver input concerning pain indicators should be taken into consideration when assessing pain, and should be encouraged to participate actively in the assessment of patients' pain [8]. Finally, an analgesic is initiated if there are pathologic conditions or if the patient is going to have a painful procedure or if pain behaviors continue despite providing basic needs and comfort measures [8].

Most investigations concerning pain in non-verbal critically ill patients have focused on the development of assessment tools, validity and reliability of these tools as well as the levels of pain experienced by those patients. To date, there is somewhat limited information about factors associated with pain and predictors of pain among non-verbal critically ill intubated patients. Previous studies revealed that different factors were associated with pain among critically ill patients such as the type of caring procedure, patient's heart rate (HR) and blood pressure (BP) [7,12,13]. Because pain is influenced by many biopsychosocial parameters, and due to limited information about predictors of pain among non-verbal ICUs patients, further research to determine other associated factors and predictors of pain among the non-verbal critically ill patients is recommended. Therefore, the aim of this study was to investigate pain levels, associated factors and factors that are predictive of pain during rest and during routine care-related procedures.

2. Materials and method

2.1. Sampling and setting

A cross-sectional prospective correlational design was used. Mechanically ventilated patients were recruited from medical and surgical ICUs at a military hospital in Amman. The sample size was calculated based on a power of 80%, small effect size (0.10) with 12 predictors, and 0.05 criterion of statistical significance, using the statistical software G*Power V.3 (Düsseldorf, Germany; Faul, Erdfelder, Lang, & Buchner, 2007). The sample size needed to avoid type II error was determined to be 184 participants. Data were collected between June and September 2015.

After getting approval from The Ethical and Research Committee in the selected hospital, patients who were undergoing one of the study procedures were evaluated, to determine their eligibility for the study. Inclusion criteria include patients being: 18 years and above, mechanically ventilated for >48 h and hemodynamically stable. Patients were excluded from the study if they were quadriplegic, unconscious after resuscitation, diagnosed with a critical illness such as polyneuropathy, diagnosed with cancer, or receiving neuromuscular blocking agents. A written consent was obtained from patients' next of kin prior to data collection because all patients were unconscious. Identification codes were assigned to each patient to ensure anonymity and confidentiality.

2.2. Measurement and procedures

A structured assessment form containing three sections was used for data collection. The first section was designed to collect the demographic information and personal characteristics such as age and the use of sedatives and/or analgesia prior to and/or during procedures. The second section was the Ramsay Sedation scale (RS). The RS is a 6-point scale that ranks the levels of sedation from "anxious" or "agitated" to "asleep" with no response. The third section was pain assessment sheets. The Behavioral Pain Scale (BPS) (Appendix 2) was used to assess behavioral pain; while responses and physiological changes of blood pressure (BP) and heart rate (HR) were used to assess physiological responses to pain. These hemodynamic measures have been reported as important physiological indicators of pain [7,14,15].

Care-related pain associated with 6 routine care-related procedures was assessed. These procedures included nociceptive procedures (repositioning, endotracheal suctioning and vascular punctures) and non-nociceptive procedures (mouth care, eye care and chest tube dressing change). These procedures were selected based on previous studies [13,16]. All patients were assessed for only one of the procedures. The first section of the assessment form included demographics and personal characteristics, obtained from the patients' medical records. Before initiating the selected procedure (T1), two research nurses, simultaneously but independently of each other, assessed patients' sedation and pain levels after an observation for 1 min. The mean score of the RS and BPS obtained by the two research nurses were finally recorded on the data collection sheet. At that time, and if the patients' HR and BP were being monitored, the readings were recorded. During the procedure (T2), each patient was observed for 1 min and the mean BPS score was recorded. Immediately after the procedure was completed, patient's HR and BP were recorded. Information about the analgesic and/or sedative agents administered within one-hour period preceding the assessment, as well as the STAT using of other analgesic and/or sedative agents in combination with the procedures, were obtained from the patients' medical records. A pilot study of 15 patients showed that the inter-rater reliability in obtaining pain scores, and sedation scores was excellent.

2.3. Data analysis

Descriptive statistics were conducted for the sample demographics and characteristics, pain intensity at baseline, pain during each of the six selected procedures, sedation level, and analgesics/sedative agents received before and during the procedure. Categorical variables (i.e. gender, reason for admission, type of analgesia and/or sedation, and method of intubation) were presented as percentages and number of cases. However, central tendency measures (means and/or medians) and the dispersion measures (standard deviation [SD] and IQR 1- IQR3) were used to express the quantitative variables (i.e. age, BPS scores, systolic BP, and HR). Mean and SD were used for normally distributed data, while median and IQR were used for skewed ones. Pearson correlation coefficients (r) were used to determine the relationship between pain levels and other study variables, then, pain levels were regressed on these variables. To guarantee meeting all assumptions for analysis used, preliminary data screening was done to assess normality, linear relationships, multicollinearity and homoscedasticity. The assumptions required for all statistical tests used were reasonably well met. However, HR at rest and during procedures were logarithmically transformed for positive skewness. All data were analyzed using SPSS 21.0 software (SPSS Inc., Chicago, III). Statistical significance was established at $p < 0.05$.

3. Results

The baseline characteristics of the study patients are presented in Table 1. A total of 247 critically ill mechanically ventilated

Table 1
Characteristics of the study patients ($n = 247$).

Variables	n (%)
Age in years, median (IQR)	64 (18–88)
Gender	
Male	189 (77)
Female	58 (23)
Reason for Admission	
Emergent cases (RTA, gunshot…..)	178 (59.1)
Cardiopulmonary	74 (24.6)
Abdominal	34 (11.3)
Renal	15 (5.0)
Method of Intubation	
Endotracheal tube	211 (85.4)
Tracheostomy tube	38 (14.6)
Resting BPS score	
=3	165 (66.8)
>3	57 (23.1)
≥5	25 (10.1)
RS score	
Awake (1–2)	123 (49.8)
Asleep (3–6)	124 (50.2)
Analgesia	
Without analgesia	152 (61.5)
Morphine	55 (22.3)
Fentanyl	6 (2.40)
Remifentanil hydrochloride	7 (2.80)
Sedation	
Propofol	4 (1.60)
Midazolam	6 (2.40)
Combination of analgesia and sedation	17 (7.0)

Notes: IQR = interquartile range; RS = Ramsey Scale; BPS = Behavioral Pain Scale; RTA = road traffic accident.

patients were assessed for their pain level at rest and during six routine care-related procedures. The patients' median age was 64 years. The highest percentage (77%) were males. Almost 85% of the patients were intubated via endotracheal tube. Based on a RS score, 50% of the study participants had lower sedation scores (being anxious, agitated and/or restless); however, the rest were asleep.

3.1. Pain levels (resting and procedural)

The overall mean pain level at rest was 3.43 (SD = 0.67). Definitely, 33.2% of patients suffered pain during rest, with a BPS > 3, of these, 10% presented significant pain levels (BPS ≥ 5). During procedures, the overall mean pain level was 6.33 (SD = 2.36). Pain behaviors, BPS > 3, were noted in 90% of the evaluated procedures. Mostly, 83% of patients experienced a significant level of pain (BPS ≥ 5). With a median score of 9.00 (IQR: 8–10), repositioning has the highest procedural pain scores. Median scores and IQR for the rest procedures are presented in Fig. 1.

3.2. Risk factors

Table 2 shows the Pearson's correlation coefficients and their p values between resting and procedural pain levels scored with BPS and the selected variables. Results show that pain levels at rest (T1) were significantly correlated with age, sedation score, systolic and diastolic BP, past surgical history and the method of intubation. These results suggest that patient was more likely to have higher BPS scores at rest if the patient is younger, had lower sedation score and higher levels of haemodynamic measures (systolic and diastolic BP), had a past surgical history and was ventilated via a tracheostomy tube. However, no significant correlations were found between resting pain levels and other variables.

During routine care-related procedures (T2), procedural pain levels were significantly correlated with age, sedation score, past surgical history, the three haemodynamic measures (systolic BP, diastolic BP and HR), resting pain levels and if the patient was administered analgesia and/or sedation in the hour prior to the procedure. The results suggest that younger patients who had lower sedation scores, had higher levels of systolic BP, diastolic BP and HR, had higher levels of resting pain levels, were not administered analgesia and/or sedation in the hour prior to the procedure were more likely to experience higher levels of procedural pain. Furthermore, the type of routine care-related procedures was significantly correlated with procedural pain levels ($r = -0.795$, $p < 0.001$). These results showed that patients undergo repositioning or endotracheal suctioning were more likely to experience higher procedural pain levels.

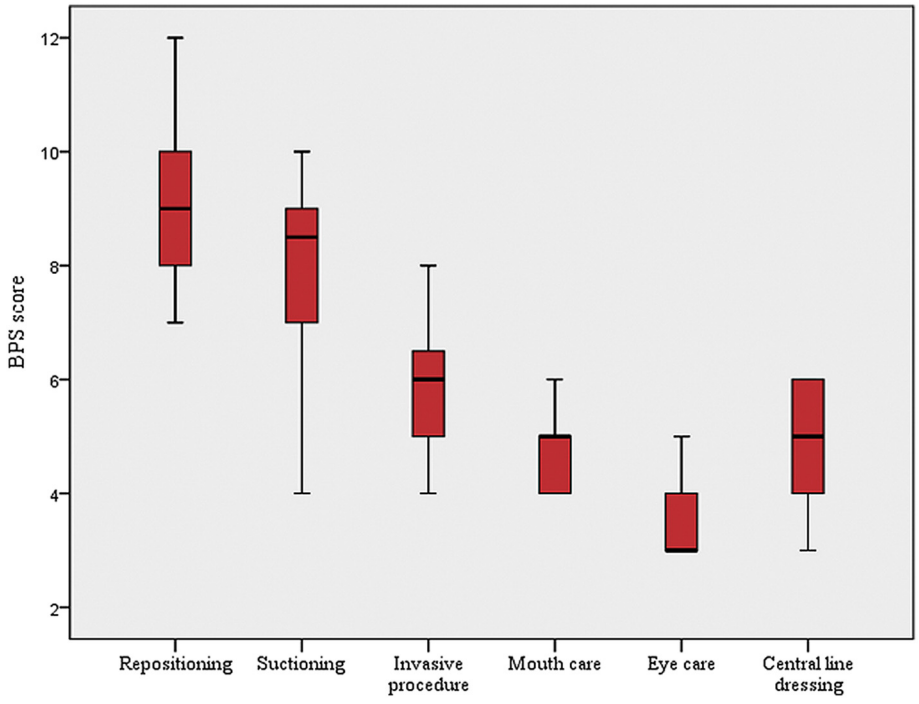

Fig. 1. Scores of the behavioral pain scale (BPS) according to each care-related procedure. Values expressed as the median and interquartile range.

Table 2
Factors correlate with resting and procedural pain levels ($N = 247$).

Variable	Resting pain levels	Procedural pain levels
	(r)	(r)
Age	−0.359***	−0.450***
Gender	0.027*	0.113
Past medical history	0.011	0.057
Past surgical history	0.147	0.132
Method of ventilation	0.196**	0.008
Systolic BP	0.128	0.564***
Diastolic BP	0.149	0.378***
Heart rate	0.055	0.647**
Sedation score	−0.322***	−0.538***
Sedation and/or analgesia in last hour	0.122	0.266***
Type of painful procedure	−0.081	−0.795***
Resting pain levels	_	0.382***

Note: BP = Blood pressure; T1 = Time 1; T 2 = Time 2; (r) = Pearson correlation.
* $p < 0.05$.
** $p < 0.01$.
*** $p \leq 0.001$.

3.3. Factors predict resting and procedural pain levels

Scores on resting and procedural pain levels were predicted from the following variables: age, gender (coded 1 = male and 2 = female), past medical history (coded 1 = with no past medical history and 2 = with a past medical history of other diseases like hypertension, diabetes, …) and past surgical history (coded 1 = have no surgical history and 2 = have a surgical history), that were entered in block I as control variables. In the next step, haemodynamic measures (systolic BP, diastolic BP and HR), sedation score, method of intubation (coded 1 = endotracheal tube, 2 = tracheostomy tube), sedation score and whether receiving sedation and/or analgesia in last hour (coded 1 = was receiving sedation and/or analgesia and 2 = was not receiving) were entered in block II. The rationale for this order of entry was that factors that have been entered in block I cannot be modified by the healthcare team and based on previous literature [7]. Part correlation (sr^2) was requested to assess the predictive usefulness of each variable in both models. Results for this hierarchical regression are summarized in Tables 3 and 4.

The results showed that sociodemographic and background characteristic variables alone explained only 13.4% ($R^2 = 0.134$, F (4, 242) = 9.37, $p < 0.001$) of the variance in resting pain levels (see Table 3). The only significant predictor was age ($\beta = -0.015$, $p < 0.001$). The negative sign for the slope of age indicated that lower score on age (being younger) predicted higher score on resting pain levels. As other variables were entered next to the model, after controlling for sociodemographic and background characteristics, the amount of the explained variance increased from 13.4% in Model I to 22% in Model II ($R^2 = 0.220$, F (11, 235) = 6.04, $p < 0.001$). The R^2 change was statistically significant, R^2 change = 0.086, $p = 0.001$. Age remained significant in Model II and was the most significant predictor. Other significant predictors were sedation score and method of intubation. The predictive relation of sedation score to resting pain levels was as predicted; lower scores on sedation (being anxious, agitated and/or restless) predicted higher scores on resting pain levels. In contrast, higher scores on method of intubation (ventilated via a tracheostomy tube) predicted higher scores on resting pain levels. The other predictor variables were not significantly related to resting pain levels when other predictors were significantly controlled; their partial slopes were not significant. The squared part correlation (sr^2) for each predictive variable is presented (see Table 3).

Using the same method of regression, procedural pain levels were predicted (Table 4). Demographic and background characteristics were entered first as control variables (Model I). In the second step other variables as well as the type of painful procedure (coded, 1 = repositioning, 2 = endotracheal suctioning, 3 = vascular punctures, 4 = mouth care, 5 = eye care and 6 = dressing change) and resting pain levels were added (see Table 4). The analysis showed that Model I explained approximately 25.5% of the variance in procedural pain levels, ($R^2 = 0.255$, F (4, 242) = 20.76, $p < 0.001$). Significant predictors were age ($\beta = -0.075$, $p < 0.001$) and past medical history ($\beta = 0.985$, $p < 0.01$). Once again, the negative sign for the slope of age indicated that being younger predicted higher level of pain during care-related procedures. However, the positive sign for the slope of past medical history indicated that higher scores on past medical history (having a past medical history of other diseases like hypertension and diabetes) predicted higher scores on procedural pain levels.

As the rest of the predictors were entered in the Mode II, the overall regression, including all twelve predictors, was statistically significant, $R^2 = 0.787$, F (12, 234) = 71.92, $p < 0.001$. The R^2 change from Model I to Model II was statistically significant, R^2 change = 0.531, $p < 0.001$. Procedural pain levels could be predicted quite well from this set of twelve variables, with approximately 79% of the variance in procedural pain scores accounted for by the regression. However, five of the twelve predictors were significantly predictive of procedural pain scores; these included age ($\beta = -0.022$, $p = 0.001$), sedation score ($\beta = -0.355$, $p < 0.001$), whether receiving sedation and/or analgesia in last hour ($\beta = 0.483$, $p < 0.01$), the type of painful procedure ($\beta = -0.906$, $p < 0.001$) and resting pain level ($\beta = -0.742$, $p < 0.001$). The nature of the predictive relation of sedation score was as expected. The negative sign for the slope for sedation score indicated that lower sedation scores

Table 3
Summary of hierarchal regression analyses predicting resting pain levels.

	Model I			Model II			
	β	sr^{2*}	R^2	β	sr^2	R^2	R^2 change
Control variables			0.134***			0.220***	0.086***
Age	−0.015***	−0.335		−0.010***	−0.228		
Gender	0.031	0.030		0.058	0.030		
Past medical history	−0.018	−0.006		0.064	0.039		
Past surgical history	0.085	0.073		0.101	0.081		
Method of ventilation				0.281*	0.133		
Systolic BP				0.003	0.074		
Diastolic BP				0.002	0.027		
Heart rate				0.003	0.039		
Sedation score				−0.153**	−0.184		
Sedation and/or analgesia in last hour				0.096	0.064		

Note: BP = Blood pressure; sr^2 = the squared semipartial correlation coefficient, that is, the unique proportion of the dependent variable (resting pain levels accounted for by the selected independent variable).
* $p < 0.05$.
** $p < 0.01$.
*** $p \leq 0.001$.

Table 4
Multiple hierarchal regression of procedural pain levels on demographic, background characteristics and haemodynamic measures.

	Model I			Model II			
	β	sr^2	R^2	β	sr^2	R^2	R^2 change
Control variables			0.255***			0.787*	0.531***
Age	−0.075***	−0.478		−0.022***	−0.120		
Gender	0.471	0.020		0.015	0.002		
Past medical history	0.985**	0.146		−0.106	−0.018		
Past surgical history	0.252***	0.028		0.160	0.036		
Method of ventilation				−0.133	−0.018		
Systolic BP				0.002	0.014		
Diastolic BP				0.002	0.007		
Heart rate				−0.005	−0.021		
Sedation score				−0.355***	−0.118		
Sedation and/or analgesia in last hour				0.483**	0.090		
Resting pain level				0.742***	0.186		
Type of the procedure				−0.906***	−0.569		

Definition of abbreviations: BP = Blood pressure; sr^2 = the squared semipartial correlation coefficient.
* $p < 0.05$.
** $p < 0.01$.
*** $p \leq 0.001$.

(being anxious, agitated and/or restless) predicted higher procedural pain levels. The predictive relation for receiving analgesia and/or sedation prior to or during the procedure was also as predicted; the higher scores on receiving analgesia and/or sedation in the last hour (not receiving analgesia and/or sedation) predicted higher pain scores during the procedures. Resting pain levels was a strong predictor of procedural pain level ($sr^2 = 0.186$). A positive sign for the slope of resting pain scores indicated that higher score on resting pain levels predicted higher procedural pain scores. The strongest unique predictive contribution was from the type of painful procedure ($sr^2 = -0.569$). Hence, 57% of the variance in procedural pain levels was uniquely predictable from the type of painful procedures (when the rest variables were statistically controlled). The negative slope for the type of painful procedure indicated that lower scores on the type of painful procedures (i.e., repositioning and endotracheal suctioning) predicted higher scores on procedural pain levels.

4. Discussion

Critically ill patients experience moderate-to-severe pain at rest and during care-related procedures and those who are non-verbal are at a great risk of underrated and undertreated pain [4,17]. This study donates to the currently limited research that focuses on pain assessment. The findings offer insight into prevalence, associated factors and predictors of resting and procedural pain among a large adult inpatient population who were critically ill and mechanically ventilated. The current study findings confirm previous findings that critically ill mechanically ventilated patients do experience pain at rest and during routine care-related procedures [1,7,18-20]. Around 33% of the current study patients experienced pain at resting conditions, and around 10% of them experienced moderate-to-sever pain. In a sample of 70 ICUs patients, Robleda et al. (2014) reported that 61% of patients experienced pain under resting conditions, and 33% experienced significant pain levels (BPS ≥ 5) [1]. This highlighted that appropriate assessment and management of pain at resting conditions are needed. Frequent assessment of pain among patients who cannot provide self-report of pain at a resting condition could promote patients' outcomes and improve the quality of care.

Undergoing care- related procedures was associated with increased pain intensity, and pain intensity was higher according to the following descending order: repositioning, endotracheal suctioning, invasive procedures, mouth care as well as dressing change, and eye care. Such procedures were performed frequently to improve comfort, oxygenation and hemodynamics [19], but it can be a real source of pain. Previous literature revealed that clinicians often consider the pain associated with their care-related procedures as too transient to be considered or not painful at all [20]. Therefore, patients undergoing painful procedures were not pre-medicated to prevent or treat procedural pain and there was a lack of analgesic practices [4,20].

The analysis revealed that resting and procedural pain levels were predictable from patients' age. Younger patients were predicted to experience higher pain levels. However, there were no significant predictions based on gender. These findings are consistent with previous studies [7,12]. In contrast, Puntillo et al. (2014) [21] reported that age differences and other patient characteristics like gender were not related to procedural pain associated with 12 routine care-related procedures [21]. However, patients in the study by Puntillo and colleagues were conscious and could communicate their pain, while in the current study patients were not. Self- report of pain is the standard method to assess the existence as well as the intensity of pain; however, the inability to communicate pain does not negate a patient's pain experience or the need for appropriate pain management and validated behavioral pain scales provide alternative measures for pain assessment [17]. This implies the individuality of pain experience. Therefore, clinicians should give high attention to each individual experience of pain, regardless of age and gender, and frequently assess pain at rest and during care-related procedures.

Patients who had a lower sedation score were predicted to have higher levels of resting and procedural pain than patients who were asleep. This raises the question about the effectiveness of sedation therapy in relieving pain and whether critically ill patients really receive appropriate control for sedation therapy. Due to a critical illness and the need for special care-related procedures, like mechanical ventilator, an ICU patient may experience anxiety, agitation, fear or pain [17]. To effectively manage these deleterious effects, intravenously continuous sedation therapy at fixed doses is usually administered in ICUs [6,11]. However, the accurate control of the depth of sedation is often not well managed. Patients are frequently over or under-sedated [6]. Definitely, a continuous infusion of sedative agents in subanesthetic doses does not relieve somatic pain and should not be given in place of analgesic drugs [22,23]. Being sedated does not equate to having no or little pain. Sedation should be accompanied by analgesia because analgesics act synergistically with the effect of sedatives, resulting in lower sedative dose requirements, and thus, minimizing the side effects of sedative agents, particularly, among critically ill mechanically ventilated patients who often required deep prolonged sedation [24]. Furthermore, the frequent use of pain and sedation scales enhanced more effective sedation management as well as pain. The dynamic nature of pain and sedation, which continually changes in critically ill patients, justifies the need for frequent assessments [23].

It is important to note that procedural pain scores were more likely to increase if the patient was not administered pre-emptive analgesia prior to the procedure. However, only 38.5% of the study patients received analgesic agents one hour before the procedures, and this is not specific to the procedure. These findings confirm previous literature [6,17,21,25] that pre-emptive analgesia in ICU patients, as well as in hospitalized patients, is a neglected issue, and clinicians often consider pain associated with routine procedures as too temporary to be addressed [20]. The use of preemptive analgesia before routine care-related procedures has been studied in different types of procedures and with different pharmacological interventions. Robleda and colleagues [18] found that intravenous fentanyl prior to repositioning mechanically ventilated ICU patients decreased the incidence of pain during this procedure. In contrast, Puntillo and Ley [26] reported that no differences in pain scores associated with withdrawal of chest drainage tubes between groups of pre-emptive administration of morphine, a nonsteroidal anti-inflammatory (ketorolac) and verbal information. According to Puntillo and Ley, the short duration and the low pain intensity associated with this procedure prohibited significant differences among treatment groups. To achieve a better overall management of pain in the ICUs, the development of effective regimens and protocols establishing the preemitive optimal drugs, dose and timing are necessary to aid clinicians.

Higher levels of resting pain were found to be a strong predictor of greater intensity of procedural pain, and this raises the issue of clinician responsibility to assess routinely the levels of pain before performing care-related procedures. Although the use of pain assessment tools for ICU patients is recommended in evidence-based guidelines to control pain, little adherence is given by the clinician to assessing pain among patients unable to self-report. Therefore, recent studies recommended the use of the evidence-based algorithm for pain management for ICU patients. Pain management algorithms are a more comprehensive approach than an assessment tool because it can guide clinicians to manage the patient's pain based on the findings from the assessment, and this could increase the ICU clinicians' adherence to pain assessment [27]. Within these algorithms, routine monitoring of pain and the use of preemptive analgesia and/or nonpharmacologic interventions (e.g., relaxation) are recommended to alleviate pain in adult ICU patients prior to painful procedures [27,28].

The type of painful procedure was the strongest predictor of procedural pain, indicating that some procedures were more painful than others. Particularly, a higher level of procedural pain was associated with undergoing repositioning and endotracheal suctioning. These results support the documented findings reported by previous literature [1,7,25]. These procedures cannot be avoided, therefore, clinicians could be asked to perform them in the correct way, avoid repeating them too often, and to carefully evaluate their worth. Ambrogi et al. [25] reported that training in the proper way of patient repositioning decreased the percentage of patients who reported pain during the procedure.

During routine care-related procedures, the abovementioned set of predictors explained around 79% of the variance in procedural pain. If the patient requires a painful procedure and/or has any of these potential causes of pain, the clinician should assume that the patient could experience pain and provide suitable treatment such as a bolus dose of intravenous opioids [6]. However, and due to frequent changes in some of these variables, and the dynamic nature of pain, frequent pain assessment is needed.

5. Limitations

Result of this study is limited to it is prospective descriptive design that assess predictors of pain prior to and during routine nursing procedures among critically ill patients. Thus, we cannot infer causation from the results; we can only infer that resting and procedural pain levels are associated with these factors. Therefore, the relationships between these factors and pain should be examined in future studies. Another limitation is that many of the study patients were undersedation. Therefore, generalizability of the study findings is limited for those patients have similar characteristics of the study sample. This study assess pain prior to and during procedures; however, previous literature found that some of these procedures, like repositioning, is associated with pain at 30 min after the procedure, thus, studies examined pain after procedures is recommended to enhance our understanding of pain experience. This study used BPS and RS to assess pain and sedation levels, although these measures may prove to be highly reliable and useful in clinical practice, future studies using a combination of self- report trial, behavioral and family/caregiver input approaches is probably required among none-verbal mechanical ventilation patients.

6. Conclusion

Pain management in the intensive care unit requires evaluation and monitoring of significant parameters to detect and quantify pain. Determining the potential causes of pain is one of the most reliable measures of pain assessment among patients unable to self-reporting their pain. The results of this study call attention to the fact that patients do experience pain at rest and during routine care-related procedures. Pain at rest might be predicted by patient's age and being ventilated via a tracheostomy. Patients are more likely to experience higher levels of pain during procedures if they are younger, undergo repositioning or tracheal suctioning, received no analgesia 1 h before the procedure, have higher resting pain levels and lower sedation scores. In planning for pain management in critically ill patients treated in ICUs, clinicians should pay great attention to the fact that pain experience is highly individual and consider these variables while follow clinical practice guidelines.

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Conflict of interest

The author declares that there are no conflicts of interest associated with this publication.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jcrc.2018.10.002.

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