

Research Article

Pain Behavior Experienced During Nursing Interventions by Patients on Mechanical Ventilation: A Cross-Sectional Study

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Abstract

AIM: The study aimed to examine pain behavior during nursing interventions in patients who were on mechanical ventilation.**METHOD:** The study was carried out in patients who were under treatment at a university hospital during the 2017–2018 period and who were connected to a mechanical ventilator and were unable to communicate verbally. In two intensive cares (n=165), 568 pain assessments were made before and during nursing interventions (aspirating the respiratory tract, wound care, injection applications, bed bath, perineal care, mouth care, etc.). Patients' sedation levels were determined according to the "Ramsay Sedation Scale" and their pain and physiological parameter were determined according to the "Behavioral Pain Scale." The Wilcoxon-signed rank test was used to evaluate the difference between the pain scores and physiological parameters before and during the procedure. A p-value of < .05 was accepted as statistically significant.**RESULTS:** Totally 45.4% of the patients are over age 65, 59.4% were males and 66.1% had chronic diseases. The interventions causing pain score difference was nasogastric intubation, tracheal expiration, nasotracheal expiratory, oropharyngeal expiration, dressing change, perineum care, position change, bed bath, oral care, intravenous catheter application, tracheostomy cannula care, urethral catheter application, and eye care while a significant increase was seen in all physiological parameters during bed bath, perineal care, and nasogastric intubation.**CONCLUSION:** It is concluded that nurses should take some precautions before painful procedures.**Keywords:** Mechanic ventilation, nursing intervention, pain assessment, pain management

Introduction

Patients in the intensive care units (ICU) have been reported to experience pain during nursing interventions, such as catheter insertion, endotracheal aspiration, wound care, breathing and coughing exercises, and position changes (Gélinas, 2016; Georgiou et al., 2015). It is also reported that being in a noisy and alien environment with pumps and mechanical devices also increases the sensation of pain (Çevik, 2016). In addition, the inability of the patients in the ICU to express themselves verbally due to the effect of intubation and sedation increases the intensity of the pain (Klein et al., 2018).

When pain is unrelieved due to inadequate pain assessment and management, patients experience problems, such as agitation, disorientation, fatigue, and sleep disturbances. This situation negatively affects the patients immunologically and physiologically, increases the length of stay in the ICU, and increases morbidity and mortality (Gomarverdi et al., 2019).

Georgiou et al. (2015) conducted a systematic review comprising 10 studies and emphasized that correct assessment and management of pain have a positive effect on the duration of mechanical ventilation, complications, and mortality. Therefore, the assessment and management of pain in the ICU are one of important points of care. The first step in pain management is to evaluate pain accurately (Kaya & Erden, 2019). The following factors can prevent the proper assessment of pain in ICU patients: impairment in verbal communication due to mechanical ventilation, sedation, limitation of vision or movement, injury-related stress or life-threatening illness, impairment in normal sleep-wake cycle, and furthermore, decreased awareness of pain management among nurses, excessive workload, time constraints, lack of record-keeping, and lack of multidisciplinary cooperation (Kizza & Muliira, 2015).

Behavioral pain symptoms are used in the pain assessment of ICU patients who cannot communicate verbally. When feeling

pain, these patients grimace, close their eyes, become restless, get startled, mutter, clench fists, extend/flex arms and legs, bite or try to pull the intubation tube, clench their teeth, or cry; furthermore, muscle tension, decreased movements or hesitation, regression in reflexes, rhythmic movements, dilatation of the pupils, rubbing or protecting the affected area, pulling the damaged organ or area away from the stimulus, kicking, paleness, nausea, vomiting, and facial flushing can also be observed in these patients (Ayasrah, 2016; Olsen et al., 2015; Puntillo et al., 2010; Wøien et al., 2014). Apart from these behaviors, some studies reported that pain creates significant differences in hemodynamic measurements, such as blood pressure and heart rate (Ayasrah, 2016; Chen & Chen, 2015). However, it was stated that vital signs should not be accepted as the only indicator in pain assessment for patients who cannot verbally express their pain (Chookalayi et al., 2017; Jablonski et al., 2017), because changes in these parameters can be observed due to the physiological conditions of ICU patients and the drugs they use (Çevik, 2016; Chang et al., 2012).

The aim of this study was to examine the pain behavior during nursing interventions and physiological parameters of patients on mechanical ventilation who cannot communicate verbally.

Research Questions

1. What are the pain behaviors during nursing interventions applied to mechanically ventilated patients?
2. Is there a difference between the pain behaviors of mechanically ventilated patients during different nursing interventions?
3. Are there any significant changes in vital signs during nursing interventions applied to patients with mechanical ventilation?

Method

Study Design

This was a descriptive cross-sectional design.

Sample

The research was conducted on patients who were treated in the Neurology Intensive Care Unit and Anesthesiology and Reanimation Intensive Care Unit in İzmir province between October 2017 and March 2018. Pain assessment was performed before and during a total of 568 nursing interventions (aspiration of the respiratory tract, dressing change (wound care), endotracheal tube/tracheostomy care, nasogastric (NG) tube insertion, urethral catheterization, intravenous (IV) catheterization, injection applications, bed bath, perineum care, repositioning, massaging, oral care, eye care, and fingertip blood sampling for blood glucose measurement) applied to 165 patients within the scope of the study.

Inclusion Criteria

Inclusion criteria were determined as follows: being 18 years of age or older; not being able to communicate verbally; being connected to a ventilator, having a Ramsey Sedation Scale (RSI) score of 4, 5, and 6; not being administered to sedative agents until 24 hours before the evaluation; general condition like being stable; and receiving consent from relatives.

Data Collection

"Case Report Form," "Ramsey Sedation Scale (RSS)," and "Behavioral Pain Scale (BPS)" key terms were used to collect research data. Nursing interventions were implemented by the intensive care nurse who is responsible for the patient's care. Pain assessment before and during nursing interventions was made by a researcher. The researcher observed the nursing interventions applied in accordance with the study permission designed so as to cover the hours when the clinic is suitable (08:00 a.m. to 04:00 p.m.). All the nursing interventions made according to the patients' needs during the day shift were included in the study.

Data Collection Tools

Case Report Form

Patients' descriptive characteristics and treatment information were collected from the patients' file, and the patients' systolic blood pressure (SBP), diastolic blood pressure (DBP), pulse rate (PR), respiratory rate (RR), and oxygen saturation (OS) before and during the interventions were read from the monitor and recorded in this form.

Behavioral Pain Scale

Pain assessment before and during nursing interventions was made via the scale. Behavioral Pain Scale was developed in 2001 by Payen et al (2001). The scale includes 3 items: facial expression, upper limbs, and compliance with ventilation, and 4 variables (0–4 points) for each item, including behavioral responses to pain. The minimum score to be obtained from the scale is 3, while the maximum score is 12. Increased scores indicate increased pain levels. The first items on each sub-scale define no pain, second items define mild pain, third items define moderate pain, and fourth items show increased pain levels. Turkish validity and reliability of the scale were conducted by Vatansever and Aslan in 2003, and the internal consistency Cronbach Alpha value was found to be between 0.71 and 0.93 (Vatansever & Aslan, 2005).

Ramsey Sedation Scale Ramsey Sedation Scale was developed by Ramsay in 1974 to determine the sedation level of patients. The first 3 items refer to the level of wakefulness (1, 2, and 3 points), and the next 3 items (4, 5, and 6 points) refer to the level of sleep (Ramsay, 1974).

Statistical Analysis

The data collected in accordance with the purpose of the research were analyzed by Statistical Package for Social Science (IBM SPSS Corp., Armonk, NY, USA) 21.0 program. This program is a program that allows drawing graphics, storing data, statistical analysis. Introductory information about the patients was presented as numbers and percentages. The Wilcoxon-signed rank test was used to evaluate the difference between the pain scores and physiological parameters before and during the procedure. A p -value of $<.05$ was accepted as statistically significant.

Ethical Considerations

Ege University ethical approval was obtained from the scientific ethics committee (reference no: 17-9/5), and written permission was obtained from the institution and the ICU where the study was conducted. Written and verbal consent was obtained from first-degree relatives of the patients who were included in the

study. Permission to use BPS was obtained from the authors who conducted the Turkish validity and reliability study of the BPS.

Results

It was determined that 45.4% of the patients were over 65 years old (age range, 18–82), 59.4% were male, 66.1% had a chronic disease, and 53.9% of the patients were connected to a mechanical ventilation device with an intubation tube, and 46.1% with a tracheostomy tube (Table 1). The reasons for hospitalization in the ICU were intracerebral hemorrhage (27%), respiratory failure (23%), trauma (16%), cardiac arrest (15%), and liver failure (12%). The mean score of the patients on the RSS was (4.92 ± 1.03) .

During the NG tube insertion, an increase in the patients' pain score was observed (3.00 ± 2.13). Other nursing interventions that increased pain score were tracheal aspiration (2.88 ± 1.83), nasotracheal aspiration (2.42 ± 1.90), oropharyngeal aspiration (2.16 ± 1.80), dressing change (1.76 ± 1.55), perineum care (1.70 ± 1.42), repositioning (1.55 ± 1.37), bed bath (1.39 ± 1.36), oral care (1.06 ± 1.55), IV catheterization (1.00 ± 1.27), tracheostomy

Table 1.
Distribution of Patients to Their Demographic Characteristics (N=165)

Demographic Data	Frequency, n	Valid, %
Age range		
18–40	38	23.1
41–65	52	31.5
66–75	35	21.2
76+	40	24.2
Gender		
Female	67	40.6
Male	98	59.4
The reason for hospitalization in intensive care		
Intracerebral hemorrhage	27	16.4
Shortness of breath	23	14
Trauma	16	10
Cardiac arrest	15	9.1
Liver failure	12	7.3
Cerebrovascular disease	9	5.9
Ascites	5	3.3
Acute MI	5	3.3
Sepsis	5	3.3
Fracture	5	3.3
Other (COPD, suicide, GIS bleeding)	43	24.1
Chronic disease		
Yes	109	66.1
No	56	33.9
Total	165	100

cannula care (0.87 ± 1.35), urethral catheterization (0.66 ± 1.15), and eye care (0.27 ± 0.59). Except during urethral catheterization, fingertip blood sampling, and tracheostomy cannula care, patients experienced a significant increase in the level of pain during all other nursing interventions ($p < .05$) (Table 2).

Nursing interventions that caused a significant increase in the mean SBP score of patients were bed bath, eye care, oral care, perineum care, oropharyngeal aspiration, tracheal aspiration, repositioning, NG tube insertion, dressing change, IV catheterization, and fingertip blood sampling ($p < .05$).

Nursing interventions that caused a significant increase in the mean DBP score were bed bath, eye care, perineum care, tracheal aspiration, repositioning, NG tube insertion, dressing change, and IV catheterization ($p < .05$). No significant increase was observed in SBP and DBP scores during nasotracheal aspiration, urethral catheterization, and tracheostomy cannula care interventions ($p > .05$) (Table 3).

Nursing interventions that caused a significant increase in the mean PR score of patients were bed bath, perineum care, repositioning, tracheal aspiration, eye care, oral care, oropharyngeal aspiration, NG tube insertion, and IV catheterization ($p < .05$). Interventions that caused a significant increase in RR were bed bath, perineum care, repositioning, dressing change, oropharyngeal aspiration, IV catheter application, tracheal aspiration, NG tube insertion, and fingertip blood sampling ($p < .05$).

On analyzing the differences between OS values measured before and during the interventions, it was observed that the only interventions that caused a statistically significant decrease were perineum care (95.58 ± 2.85 vs. 94.12 ± 3.74) and NG tube insertion (97.12 ± 1.95 vs. 95.37 ± 2.13) ($p < .05$).

Discussion

The 5 most frequently performed nursing interventions during this study were repositioning (19.7%), bed bath (11.6%), eye and mouth care (10.2%), dressing change (9.2%), and perineum care (8.5%). Patients in the ICU are immobile, and basic care requirements are determined individually for each patient, regardless of the need for medical treatment. In a study conducted by Gélinas et al. (2017) with 4812 patients in 28 different countries, the most common nursing interventions were repositioning, endotracheal aspiration, mobilization, breathing exercises, and repositioning.

Nasogastric tube insertion procedure caused a significant increase in pain scores in the present study. Similarly, Kahraman and Özdemir (2016) also found that NG tube insertion increased the pain score of the patients from 3.7 ± 0.8 to 8.1 ± 1.6 . On the other hand, in the study of Al Sutari et al. (2014), it was stated that NG tube insertion was the procedure that caused the least pain in unconscious patients connected to mechanical ventilation. Although the study results differ, it is thought that factors such as irritation of the nasal mucosa, stimulation of the gagging and coughing reflex, and severe decrease in the saturation rate during the NG tube insertion procedure may cause increased pain.

Table 2.
Mean Pain Scores Before and During Nursing Interventions and Distribution of Differences

Nursing Intervention	n	Mean Pain Score Before Intervention	Mean Pain Score During Intervention	Difference	p	Z'
Bed bath	33	3.33 ± 0.69	4.72 ± 1.46	1.39 ± 1.36	.00	-4.05
Eye care	29	3.34 ± 0.55	3.62 ± 0.67	0.27 ± 0.59	.02	-2.27
Oral care	29	3.34 ± 0.55	4.41 ± 1.70	1.06 ± 1.55	.00	-4.05
Perineum care	24	3.66 ± 1.67	5.37 ± 1.83	1.70 ± 1.42	.00	-3.64
Oropharyngeal aspiration	12	3.58 ± 0.66	5.75 ± 2.22	2.16 ± 1.80	.00	-2.69
Nasotracheal aspiration	7	3.71 ± 0.75	6.14 ± 2.34	2.42 ± 1.90	.042	-2.03
Tracheal aspiration	17	3.76 ± 1.03	6.64 ± 1.72	2.88 ± 1.83	.000	-3.54
Repositioning	56	3.64 ± 0.88	5.19 ± 1.60	1.55 ± 1.37	.000	-5.42
NG tube insertion	8	3.25 ± 0.70	6.25 ± 2.12	3.00 ± 2.13	.017	-2.38
Urethral catheterization	3	4 ± 1.00	4.66 ± 1.52	.66 ± 1.15	.317	-1.00
Dressing change (wound care)	26	3.84 ± 1.084	5.61 ± 1.76	1.76 ± 1.55	.000	-3.67
IV catheterization	12	3.41 ± 0.90	4.41 ± 1.78	1.00 ± 1.27	.038	-2.07
Fingertip blood sampling	20	3.30 ± 0.57	3.75 ± 1.11	.45 ± 1.05	.066	-1.84
Tracheostomy cannula care	80	3.25 ± 0.70	4.12 ± 1.35	.87 ± 1.35	.102	-1.63

*Wilcoxon-signed rank test, *p* < .05.
Note: NG = nasogastric; IV = intravenous.

Ribeiro et al. (2017) performed 300 pain evaluations during tracheal aspiration and found that the pain score increased significantly. The average pain score during tracheal aspiration was 6.64 ± 1.72 in the present study. In the study of Gomarverdi et al. (2019), average pain score during tracheal aspiration was reported as 7 points. In the study of Kaya and

Erden (2019) with 74 ICU patients connected to mechanical ventilation, a significant increase was observed in pain score during endotracheal aspiration compared to before aspiration. Studies reporting similar results can be found in the literature (Aissaoui et al., 2005; Arroyo-Novoa et al., 2008; Chang et al., 2012; Esen et al., 2010).

Table 3.
Distribution of Differences Between Mean SBP, DBP, PR, RR, and OS Before and During Nursing Interventions

Nursing Intervention	n	SBP Difference		DBP Difference		PR Difference		RR Difference		OS Difference	
		p	Z'	p	Z'	p	Z'	p	Z'	p	Z'
Bed bath	33	.00	-3.63	.00	-3.79	.00	-3.67	.00	-3.83	.08	-1.72
Eye cleaning	29	.00	-3.37	.01	-2.48	.00	-2.76	.14	-1.46	.70	-.37
Oral care	29	.01	-2.44	.06	-1.81	.00	-2.76	.14	-1.78	.35	-.93
Perineum care	24	.01	-2.50	.00	-2.83	.00	-3.64	.00	-3.65	.01	-2.50
Oropharyngeal aspiration	12	.04	-2.00	.08	-1.70	.00	-2.67	.01	-2.55	.94	-.07
Nasotracheal aspiration	7	.50	-.67	.59	-.52	.34	-.94	.68	-.41	1.00	.00
Tracheal aspiration	17	.00	-3.18	.00	-3.14	.00	-3.13	.02	-2.31	.87	-.15
Repositioning	56	.00	-3.93	.00	-3.92	.00	-5.02	.00	-5.09	.58	-.54
NG tube insertion	8	.01	-2.52	.01	-2.53	.01	-2.52	.02	-2.20	.02	-2.26
Urethral catheterization	3	.18	-1.34	.15	-1.41	.10	-1.60	.31	-1.00	.18	-1.34
Dressing change	26	.00	-2.79	.00	-3.24	.00	-3.36	.00	-3.23	.31	-.99
IV catheter application	12	.00	-2.67	.01	-2.50	.03	-2.14	.20	-1.27	.18	-1.34
Fingertip blood sampling	20	.04	-2.05	.06	-1.83	.10	-1.60	.03	-2.12	.65	-.44
Tracheostomy cannula care	80	.06	-1.82	.05	-1.89	.06	-1.84	.41	-.81	.10	-1.63

*Wilcoxon-signed rank test, *p* < .05.
Note: SBP = systolic blood pressure; DBP = diastolic blood pressure; PR = pulse rate; RR = respiratory rate; OS = oxygen saturation.

The average pain score of the patients was 3.84 ± 1.08 before dressing change, and the pain score increased to 5.61 ± 1.76 during the procedure ($p < .001$). Puntillo et al. (2014) also reported that wound care significantly increased patients' pain scores. Wibbenmeyer et al. (2011) found a significant increase in pain score during dressing change in 38 patients who were treated for burns and could not communicate. The fact is that wound care and dressing change are generally applied to the tissues with damaged integrity and are an invasive procedure that explains the increase in the pain felt by the patients.

In the present study, the pain score increased by 1.55 ± 1.37 during repositioning and by 1.39 ± 1.36 during bed bath ($p < .001$). In different studies conducted in the ICU, it has been determined that repositioning and bed bath are among the painful procedures (Ayasrah, 2016; Chanques et al., 2014; Echegaray-Benites et al., 2014). In the EEG evaluation performed simultaneously with the Intensive Care Pain Observation Scale, it was determined that the pain values increased significantly during the repositioning process (Faritous et al., 2016). It can be said that similar movements, which are painful for traumatic patients who have long-term movement limitation and muscle weakness, are applied in interventions, such as turning the patient in the bed, wiping body parts by moving the extremities, changing the bedsheet, and repositioning. Hence, a similar increase in pain during both interventions is an expected result.

It is known that factors such as drugs used in patients on mechanical ventilators, patient's mouth staying open for a long time due to endotracheal tube, presence of endotracheal tube, and patches used for fixation, disruption of tissue integrity in the mouth and surrounding tissue as a result of not taking fluid and food orally cause pain during oral care (Özveren, 2010). The significant increase in the average pain score determined during oral care in the present study is also seen in the literature (Ayasrah, 2016; Gomarverdi et al., 2019; Kara, 2019).

The pain score of the patients increased from 3.41 ± 0.90 to 4.41 ± 1.78 during IV catheterization ($p < .05$). In similar studies (Aissaoui et al., 2005; Puntillo et al., 2014), IV catheterization was reported to cause a significant increase in pain. In the literature, it is reported that pain complications are quite common due to reasons such as inability to enter the peripheral vein, insertion of the catheter in a movable joint area, dislodgement of the catheter, choosing an incorrect catheter, and penetration of the intravenous needle or catheter tip into the subcutaneous tissue by piercing the vein wall (Jacinto et al., 2011).

Another intervention that caused an increase in pain scores in the present study was eye care ($p < .05$). Similar results were observed by Deghani et al. (2014); however, there are studies in the literature reporting no increase in pain during eye care (Siffleet et al., 2007; Vatanserver, 2004; Young et al., 2006)

No increase in pain scores was observed during urethral catheterization, fingertip blood sampling, and tracheostomy cannula care ($p > .05$). It has been reported that the use of lubricant during urethral catheterization reduces surface friction on the urethral wall and prevents trauma (Bradsley, 2005; Robinson, 2009). In line with this data, it is thought that the selection of

appropriately sized catheter, lubrication with anesthetic gel, and attention toward appropriate positioning of the patient was effective in preventing pain in the present study.

Blood collection from the fingertip is performed using thinner needles or lancets, the fingertip is rubbed to increase blood supply, compared to venous blood collection, because less blood volume is required and the procedure is quick. These factors may have been effective in the lack of a significant increase in pain scores. Similarly, several factors may have been effective in the lack of a significant increase in pain scores during tracheostomy cannula care: the non-invasive nature of the procedure, absence of infection or open wound around the cannula, keeping the area clean and dry, using an appropriate sized cannula, not moving the cannula while wiping the surrounding skin, and fixing the cannula using gauze.

During bed bath, eye care, tracheal aspiration, repositioning, dressing change, IV catheterization, perineum care, and NG tube insertion, a significant increase was found in mean SBP, DBP, and PR levels ($p < .05$) (Table 3). It is known that pain increases BP, PR, and RR by stimulating the sympathetic nervous system (de Jong et al., 2013). Endotracheal aspiration may cause an increase in BP and PR, especially by stimulating the sympathetic nervous system (Kalender & Tosun, 2015). In Güçlü's (2019) study, it was reported that there were significant changes in BP, PR, and RR levels during aspiration and repositioning, and different studies also reported significant increases in BP, PR, and RR levels during repositioning (Gélinas & Johnston, 2007; Vázquez et al., 2011).

There are several studies in the literature that found a significant increase in BP, PR, and RR levels during tracheal aspiration (Arbour & Gélinas, 2010; Arroyo-Novoave et al., 2008; Chen & Chen, 2015; Ribeiro et al., 2017). Similar to the results of this study, Aissaoui et al. (2005) reported an increase in the mean BP and PR levels of patients during tracheal aspiration and IV catheterization ($p < .05$).

A similar study in the literature also reported a significant decrease in the mean OS level of patients during NG tube insertion (Kahraman & Özdemir, 2016). During tracheostomy cannula care and urethral catheterization, there was no significant change in any of the physiological parameters ($p > .05$). The interventions that caused no change in physiological parameters were procedures that caused no significant change in pain level.

Conclusion and Recommendations

Based on the results of the present study, it was found that aspiration, bed bath, dressing change, oral care, IV catheter application, eye care, and repositioning caused a significant increase in pain scores. Prior to these interventions, nurses should take necessary precautions before any pain occurs in the patient. Based on the results of the study, it is recommended to monitor physiological parameters during bed bath, eye care, tracheal aspiration, repositioning, dressing change, IV catheterization, perineum care, and NG tube insertion interventions, which are found to cause significant changes in physiological parameters. In addition, NG tube insertion and perineum care significantly decreased the OS levels. For this reason, patients should be

supported during these interventions with proper positioning, oxygen and medication administration, and allowing the patient to rest. Further studies evaluating a larger number of interventions with an equal sample size for each intervention would be required. In addition, further studies should be conducted to evaluate the pain level of patients during nursing interventions using more than one pain scale and compare these measurement tools.

The study aimed to evaluate the pain level of the patients during the massage, exercise, IV blood sampling, IV/intramuscular drug administration, and mobilization; however, these interventions were excluded from the study due to lack of observation. In addition, because the number of interventions evaluated was unequal, a statistical ranking could not be made among the interventions with respect to inducing pain.

Ethics Committee Approval: Necessary ethics approval was obtained from the academic institution's Human Research Ethics Committee prior to commencement of this study (17-9/5-22.09.2017).

Informed Consent: Since the patients are unconscious, verbal communication cannot be established with the patients. Verbal consent was obtained from the relatives of the patients for the study.

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