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Original Article

Assessment of procedural pain in patients with COVID-19 in the intensive care unit

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ABSTRACT

Aim: The purpose of the study was to assess the level of procedural pain in patients treated in the COVID-19 intensive care unit, in a tertiary university hospital.
Method: We performed the procedural pain assessment of COVID-19 patients in this study, and 162 (93.6 %) of 173 hospitalized patients assessed during this period. While pain was assessed before, during, and at the 20th minute after endotracheal aspiration, wound care, and position change, which are procedural patient practices, the pain was assessed before, during, and up to the fourth hour after prone positioning, high-flow oxygen therapy (HFOT), and the non-invasive mechanical ventilation (NIMV) procedure. The Numerical Pain Scale was used for conscious patients in pain assessment, while the Behavioral Pain Scale and the Richmond Agitation-Sedation Scale were used for unconscious patients.
Results: Patients who underwent endotracheal aspiration, wound care, and positioning had higher pain levels during procedure than other time points. Patients in the prone position with HFOT and NIMV applied had the highest pain scores at fourth hour after procedure; this increase was statistically significant ($p = .000$, $p < .05$).
Conclusions: The study found that COVID-19 patients in the ICU had pain due to procedural practices and that the level of pain during the procedures was higher because endotracheal aspiration, wound care, and positioning were all short-term procedures. Moreover, prone positioning was found to be associated with pressure-related tissue damage, and patients' pain levels increased with the increasing duration of HFOT and NIMV procedure.
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Invasive mechanical ventilation is required for coronavirus disease 2019 (COVID-19), which progresses from acute hypoxemic respiratory failure to severe acute respiratory failure in some patients (Kebapçı, 2020; Solverson, 2021). According to the World Health Organization (WHO), there are about 20 million active cases worldwide, of which about 80,000 (4%) have been classified as requiring intensive care (WHO, 2020a).

In the literature, it was determined that approximately 40%-70% of patients hospitalized in the intensive care unit (ICU) due to COVID-19 had pain complaints (Drożdżal et al., 2020; Olsen et al., 2015; Rijkenberg et al., 2017; WHO, 2020b). Treatment of this disease's primary and immediate symptoms, such as infection, moderate-to-severe dyspnea, and heart failure, may cause the pain to be ignored. COVID-19 patients experience localized (e.g., sore throat, pharyngalgia), remote (e.g., headache), and broad body pain (e.g., body aches, muscle and joint pain). In coronavirus, pain can arise due to the body's autoimmune reaction and interventions related to the disease's diagnosis and treatment (Berger, 2020; Bray et al., 2020). Diagnostic and therapeutic procedures such as high-flow oxygen therapy (HFOT), non-invasive mechanical ventilation (NIMV), and prone positioning, in addition to COVID-19, can induce pain (Phua et al., 2020; Wang et al., 2020; Weatherald et al., 2021; Yang et al., 2020). Pain should be assessed and managed effectively in hemodynamically unstable critical ICU patients since it negatively affects recovery (Olsen et al., 2015; Rijkenberg et al., 2017; Drożdżal et al., 2020; World Health Organization (WHO) 2020b).

Effective pain management requires objective pain assessment. Thus, valid and reliable scales should be used for objective pain assessment in ICU patients. Because assessing pain in unconscious

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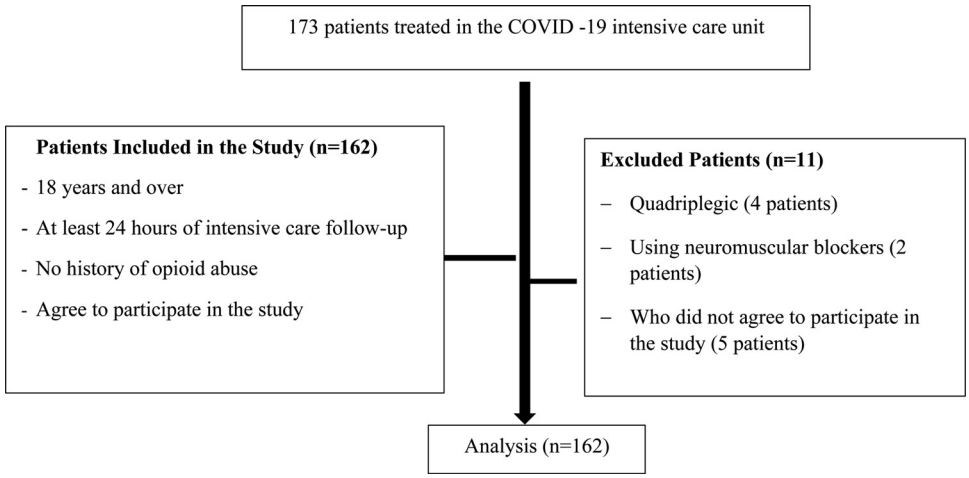


Figure 1. Flow chart.

patients on mechanical ventilators can be difficult, pain should be assessed using behavioral scales, and sedation should be assessed using sedation scales (Richmond Agitation Scale-Sedation Scale [RASS] and Ramsey Sedation Scale [RSS]) (Rahu et al., 2015; Sılay & Akyol, 2018a; Sılay & Akyol, 2018b). Studies have shown that standardized pain assessment reduces pain levels and analgesic consumption (Erden et al., 2017; Erden et al., 2018). Although there are many studies in the literature on procedural pain (Czarnecki et al., 2011; Sigaks & Bittner, 2015), no studies were found with COVID-19 ICU patients. In this context, the purpose of this study was to determine the pain levels of patients treated in the COVID-19 ICU regarding painful procedural practices.

Methods

Design and Setting

This descriptive cross-sectional study was conducted with the participation of patients treated in the COVID-19 ICU of a tertiary university hospital between September 2020 and March 2021. This unit includes nine beds, and around a third of the patients are on a mechanical ventilator. Some procedures (endotracheal aspiration, wound care, position change, prone position, HFOT, NIMV) are used as treatment and care interventions in the clinic, depending on the patient's medical status. Patients with COVID-19 received 4 hours of HFOT and 4 hours of NIMV, in the prone position adjusted to the patient's needs.

The routine clinical pain management strategy was as-needed analgesia. Nonopioids were given twice daily (BID), and opioids were given in case of severe pain. The analgesic medications were administered by clinical staff based upon the pain levels and not in relationship to procedures.

Sample

Patients hospitalized in the COVID-19 ICU of the specified hospital made up the study's population between September 2020 and March 2021. Patients aged ≥18, admitted to the ICU for at least 24 hours, without a history of opioid usage, conscious patients who chose to participate in the study, and unconscious patients with their relatives' permission were all included in the study. During this period, 162 of the 173 patients in the ICU were reached (93.6 %). Eleven patients were excluded from the study because they did not meet the sampling criteria (Fig. 1).

Data Collection Tools

The researchers collected data for the study using the "Patient Descriptive Information Form (PDIF)" and the "Pain Assessment Form", which they created after reviewing the literature (Kahraman & Özdemir, 2016; Erden et al., 2018; Slay & Akyol, 2018; Efe & Cavdam. 2020).

Patient Descriptive Information Form (PDIF)

The PDIF consists of 9 questions with introductory information about the patients enrolled in the study, such as age, gender, Glasgow Coma Score (GCS), day of ICU stay, medical diagnosis, oxygen intake status, mechanical ventilator status, analgesia, and sedation status.

Pain Assessment Form

This form includes pain and sedation scores (RASS) over time for endotracheal aspiration, wound care, repositioning (other positions), prone position, HFOT, and painful procedural uses of NIVM. Furthermore, the Numerical Pain Scale (NPS) was used to assess pain in patients who could be contacted, the Behavioral Pain Scale (BPS) was used to assess pain in patients who couldn't be reached, and the RASS was used to assess sedation and agitation in all patients.

Numerical Pain Scale (NPS)

In this scale, 0 indicates no pain, and 10 means unbearable pain. It is commonly used to assess pain in conscious patients.

Behavioral Pain Scale (BPS)

Aïssaoui et al. (2005) developed this scale used to assess pain in ICU patients who are unconscious. There are three items (facial expression, upper extremities, and ventilator compliance) and four variables in this scale, with behavioral responses to pain included in each item. The lowest score on the scale is 3, and the highest score is 12. An increase in score means an increase in pain.

Richmond Agitation Sedation Scale (RASS)

Sessler et al. (2002) developed this scale to assess patients' sedation and agitation levels with severe disease, particularly those on mechanical ventilation. Scores on the RASS vary from +4

to -5. Positive RASS scores represent agitated patients; negative RASS scores represent sedated or comatose patients.

Implementation of the Study

While pain assessment was performed up to the 20th minute before, during, and after endotracheal aspiration, wound care, and position change, which are procedural patient practices, pain assessment was performed up to the fourth hour before, during, and after prone positioning, HFOT, and NIMV procedures. The patients did not receive any pain relief measures during the procedure.

Ethical Aspect of Research

Because the study was done in a university hospital, written permission was received from the university's Faculty of Medicine Non-Interventional Clinical Research Ethics Committee (No: 21/Date:04.09.2020) and the hospital's chief physician (No: 21827/Date:11.09.2020). Moreover, written informed consent was obtained from conscious patients and relatives of unconscious patients in accordance with the Declaration of Helsinki, along with an informed consent form for each patient.

Statistical Analysis

SPSS (IBM, IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp. [Released 2016]) was used to analyze the obtained data. The descriptive data from COVID-19 patients were analyzed using frequencies and percentages. As descriptive data, the mean, standard deviation, minimum, and maximum values were given. In addition, in repeated measurements for pain assesment done at different time intervals in patients, the analysis of variance (F) test was used, and Fisher's least significant difference test (LSD) test, one of the post-hoc tests, was used to determine from which times the statistically significant statistics came. For all tests, $p < .05$ was considered significant.

Results

Descriptive Characteristics of the Patients

The mean age of patients included in the study was 63.92 ± 8.97 (45-88) years. The mean day of ICU stay was 3.48 ± 1.14 (2-6) days. Also, 53.7% of the patients were men, 57.4% had acute respiratory distress syndrome (ARDS), 61.7% had GCS 14-15, and 36.4% were treated with a combination of HFOT and NIMV oxygen therapy. Additionally, 88.9% of patients were treated with analgesics, and 55.5% of analgesics used in these patients were non-opioids (Table 1).

Introduction of Procedural Practices

Five hundred fifty (550) procedures were performed on COVID-19 ICU patients during the study. Of these, 162 were position changes other than prone, 144 were prone, 93 were HFOT, 76 were NIMV practice, 52 were endotracheal aspiration, and 23 were wound care procedures. Among these procedures, a change of position was performed in 110 of the conscious patients, of whom 100 were in the prone position, 93 in HFOT, and 76 in NIMV. Repositioning was performed in 52 unconscious patients, prone positioning in 44, endotracheal aspiration in 52, and wound care in 23.

Table 1
Descriptive Characteristics of the Patients (N = 162)

Descriptive Characteristics	Mean ± SD	Min-Max	
Age (year)	63.92 ± 8.97	45-88	
ICU admission (day)	3.48 ± 1.14	2-6	
		N=162	**% (100)**
Gender	Man	87	53,7
	Women	75	46,3
Diagnosis	ARDS	93	57,4
	COVID pneumonia	62	38,3
	ARDS+LungCa	7	4,3
Glasgow Coma Score (GCS)	14-15 oriented	100	61,7
	8-13 confused	10	6,2
	8< stupor-coma	52	32,1
Received oxygen therapy	HFOT+ NIMV	59	36,4
	Invasive MV	52	32,1
	HFOT	34	21,0
	NIMV	17	10,5
Analgesic administration	Yes	144	88,9
	No	18	11,1
Type of analgesia	Opioid	64	44,5
	Nonopioid	80	55,5
Administering sedation	Yes[a]	62	38,3
	No	100	61,7

[a] fentanyl + midazolam; remifentanil.Mean ± SD = Mean Standard deviation; ICU = intensive care unit; ARDS = acute respiratory distress syndrome; LungCa = lung cancer; HFOT = high flow oxygen therapy; MV = mechanical ventilation; NIMV = non-invasive mechanical ventilation,;

Pain Levels

Table 2 displays the patients' pain levels concerning procedural practices and times. There was a significant difference in all procedural pain levels ($p < .05$). It was found that mean pain scores (T2) were higher during endotracheal aspiration, wound care, and position change than at other times (T1 and T3) and that there was a significant relationship with pain during the procedure ($p < .05$). Furthermore, when compared with other times, the mean pain scores of all patients in the prone position showed a significant increase at T5 ($p < .05$). HFOT and NIMV were found to increase pain scores in both T2 and T5, and these increases were significant ($p = .000$).

The LSD test, one of the post-hoc tests, was performed to determine the times of significance, according to the data in the Table 2. T1 and T2 in endotracheal aspiration and wound care and T1, T2, and T3 in position change were found to be the causes of the differences. These differences were found to be caused by T1-T4-T5 times in the prone position, HFOT, and NIMV procedures.

Discussion

In ICU patients with COVID-19, both the disease itself and the procedural diagnostic and treatment interventions cause pain. In this particular patient group, treatment of the illness precedes pain treatment (Drożdżal et al., 2020; Meyer-Frießem et al., 2021). Diagnosis of pain is critical to pain control. The pain levels caused by procedural practices specific to COVID-19 patients were examined in this study.

Endotracheal aspiration is one of the most painful procedures in intensive care. According to our findings, patients with COVID-19 who underwent endotracheal aspiration had a higher (T2) pain level (3.29 ± 0.45) during the procedure than at other times. Other studies conducted in the intensive care unit found that the level of pain in patients increased during endotracheal aspiration, similar to our findings (Aissaoui et al., 2005; Arroyo-Novoa et al., 2008; Yaman Aktaş & Karabulut, 2016; Czarnecki et al., 2011; Erden et al., 2018; Esen et al., 2010; Lee et al., 2013; Puntillo et al., 2014). In this context, it may be recommended not to routinely perform en-

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Table 2
Pain Levels of the Patients by Procedural Practices and Times

Procedural practices		Times[a] Mean ± SD					
		T1	T2	T3	T4	T5	F/P
Endotracheal aspiration (N = 52)	Conscious (n = 0)	3.00 ± 0.00[T2]	3.29 ± 0.45[T1]	3.15 ± 0.60	-	-	6.97
	Unconscious (n=52)						**.002**[c]
Wound care (N = 23)	Conscious (n = 0)	3.26 ± 0.86[T2]	3.38 ± 0.89[T1]	3.30 ± 087	-	-	3.94
	Unconscious (n = 23)						**.048**[b]
Position change (N = 162)	Conscious (n = 110)	0.26 ± 0.55 T2,T3	1.74 ± 0.97 T1,T3	0.92 ± 1.30 T1,T2	-	-	102.89
							.000[c]
	Unconscious (n = 52)	3.00 ± 0.00 T2,T3	3.37 ± 0.68 T1,T3	3.12 ± 0.32 T1, T2	-	-	10.86
							.001[c]
Prone position (N = 144)	Conscious (n = 100)	0.00 ± 0.00 T2,T3,T4,T5	0.75 ± 1.26 T1,T4,T5	0.79 ± 1.28 T1, T4,T5	1.61 ± 1.62 T1,T2,T3,T5	2.75 ± 1.21 T1,T2,T3,T4	173.91
							.000[c]
	Unconscious (n = 44)	3.00 ± 0.00 T2,T3,T4,T5	3.05 ± 0.21 T1,T4,T5	3.00 ± 0.00 T1, T4,T5	3.25 ± 0.71 T1,T2,T3,T5	3.27 ± 0.58 T1,T2,T3,T4	6.42
							.008[c]
HFOT (N = 105)	Conscious (n = 105)	0.02 ± 0.19 T2,T3,T4,T5	0.65 ± 1.09 T1,T4,T5	0.05 ± 0.27 T1, T4,T5	1.25 ± 1.32 T1,T2,T3,T5	2.62 ± 1.16 T1,T2,T3,T4	164.732
	Unconscious (n = 0)						**.000**[c]
NIMV (N = 80)	Conscious (n = 80)	0.05 ± 0.27 T2,T3,T4,T5	1.18 ± 1.79 T1,T4,T5	1.25 ± 1.83 T1, T4,T5	2.56 ± 1.22 T1,T2,T3,T5	3.41 ± 1.27 T1,T2,T3,T4	142.65
	Unconscious (n = 0)						**.000**[c]

[a] T1: pre-procedure; T2 = sequence of procedures; T3 = 20 min after the procedure; T4 = 2 hours after the procedure; T5 = 4 hours after the procedure.
[b] $p < .05$.
[c] $p < .01$.HFOT = high flow oxygen therapy; NIMV = non-invasive mechanical ventilation; N = number of patients; Mean ± SD = mean standard deviation; F = analysis of variance in repeated measures; T1, T2, T3, T4, T5 = groups with significant difference with LSD tests.

dotracheal aspiration in patients with COVID-19 unless there is an indication for it and to use analgesics before the procedure if it is to be performed after all.

Our study found that the pain level during procedure (T2) was higher in patients undergoing wound care than at other times. Studies conducted with intensive care patients have found that patient pain levels increase during wound care (Erden et al., 2018; Puntillo et al., 2014). Although tissue perfusion and care of a damaged wound may cause pain due to nerve damage, widespread muscle pain, especially in COVID-19 patients, may increase tissue tenderness. The study found that the patients' pain level significantly increased during the change of position (T2) and decreased at the 20th minute (T3) after positioning. Examining the literature, we find that patients' pain levels are higher during position change (Erden et al., 2018; Olsen et al., 2020; Robleda et al., 2016), parallel to our study, and patients' pain decreases significantly in the hours after position change (Ibdah et al., 2020). Pharmacologic/non-pharmacologic analgesia should be administered before treatment and care procedures such as wound care and change of position.

Prone positioning is widely used in COVID-19 patients with moderate to severe ARDS because it improves oxygenation and minimizes the need for mechanical ventilators (Navas-Blanco & Dudaryk, 2020; Solverson, Weatherald, & Parhar, 2021). Peripheral nerve damage and musculoskeletal (back and shoulder) pain result from prolonged prone positions (Ghelichkhan et al., 2020; Meyer-Frießem et al., 2021; Ogawa et al., 2021; Tavernier et al., 2020). This study found that pain levels increased over time in patients in the prone position, reaching the highest pain level in the fourth hour (T5) after positioning. The literature also indicates that the duration of remaining in the prone position and the level of pain in patients with severe acute respiratory failure increase in direct proportion with COVID-19 (Bamford et al., 2020; Elharrar et al., 2020; Slessarev et al., 2020; Solverson, Weatherald, & Parhar, 2021; Telias, Katira, & Brochard, 2020; Weatherald et al., 2021). This finding may be related to patients with COVID-19 who remain in the prone position for long periods for oxygen therapy and experience back and shoulder pain due to pressure-induced tissue damage in the skin and subcutaneous tissues.

In COVID-19 patients, HFOT and NIMV are combined for various reasons, including the treatment of acute respiratory failure, acute pulmonary edema, and the maintenance of oxygenation (Agarwal et al., 2020; Ogawa et al., 2021). Although the location of the pain was not specified in the tables, conscious patients were asked about the location of the pain in addition to the level of the pain. Patients reported the location of the pain as the face and nose for HFOT and NIMV procedures and the shoulder and back for the prone position. The patients' shoulder and back pain was found to be highest at the fourth hour (T5) of the prone position in our study ($p = .000$). While no study in the literature has examined nasal and facial pain in patients with COVID-19 who have undergone HFOT, some studies indicate that pain was more severe during the procedure in patients who underwent NIMV (Aissaoui et al., 2005; Olsen et al., 2020; Robleda et al., 2016). Because the change of position, endotracheal aspiration, and wound care are short-term procedural practices, patients experience more pain during the procedure, whereas other procedural practices (Prone position, HFOT, and NIMV) increase pain levels with increasing duration due to the pressure associated with the medical device.

Limitations of the Study

This study is single-center and is limited to COVID- 19 patients treated only in the intensive care unit.

Conclusions

In conclusion, it was found that procedural practices performed on conscious and unconscious patients with COVID-19 in the ICU caused pain, and because endotracheal aspiration, wound care, and position change were short-term procedures, patients had more severe pain during those procedures. Moreover, patients' pain levels were found to increase with increasing duration of prone positioning, HFOT, and NIMV procedures related to pressure-induced tissue damage. In light of this, it is recommended that no painful procedural practices be performed unless: (1) pharmacologic or non-pharmacologic analgesia methods are used before the procedures; (2) supportive surface procedures are used; (3) pain assessment and management in COVID-19 be done effectively.

Implications for Nursing

Symptom management to prevent the severity of the disease in patients with COVID 19 causes pain to be ignored. Pain should be controlled in order to reduce the complications related to pain in patients with COVID 19 who have hemodynamic instability. Therefore, pharmacologic and non-pharmacologic analgesic methods should be used before procedural procedures.

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