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Oral Problems and Related Factors in Elderly COVID-19 Patients in an Intensive Care Unit: A Cross-Sectional Study

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ABSTRACT

Objective: Elderly individuals were more affected by the COVID-19 pandemic. Many complications, changes in tongue epithelial cells, and salivary gland dysfunction are associated with COVID-19. This study aimed to explore oral problems and related factors in elderly COVID-19 patients receiving treatment in an intensive care unit.

Material and Methods: This cross-sectional study was conducted with 86 individuals aged ⩾ 65 years who received treatment for COVID-19 in the intensive care unit of a state hospital in western Turkey between May and November 2021. Patient's demographic characteristics, chronic diseases, nutritional status, fluid intake, vital signs, and presence of secretion, intubation status, oxygen therapy, and blood biochemistry tests were evaluated. Eilers' Oral Assessment Guide was used for oral assessment. The data were analysed using t-tests, one-way ANOVAs, Cox regression analysis, and Kaplan−Meier test.

Results: The mean age of the participants was 72.93±7.91 years, and 60.5% of them were male. The mean length of stay in the intensive care unit was 8.55±6.54 days. Of the participants, 41.9% were intubated and 80.2% had at least one chronic disease. The mean Oral Assessment Guide score of the participants was 11.43±2.03, and 31.4% of them showed limited salivary secretion. There were significant differences between the mean Oral Assessment Guide score and length of stay, body mass index, intubation, continuous positive airway pressure treatment, presence of secretion, aspiration status, type of nutrition, and activated partial thromboplastin time value.

Conclusion: Our results indicated that elderly COVID-19 patients, who were intubated, received continuous positive airway pressure treatment, had a body mass index of ⩾ 35 kg/m2, received total parenteral nutrition, and had blood coagulation problems demonstrated an increased risk of deterioration of the oral mucous membrane as their length of stay in the intensive care unit increased.

Keywords: COVID-19, elderly, intensive care units, oral health

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INTRODUCTION

The worldwide COVID-19 pandemic began in 2019 and has greatly affected the elderly population. Studies reported that the mortality rate of COVID-19 patients over 55 years of age was three times higher than that of other age groups. In addition, COVID-19 patients who were 65 years of age and over demonstrated longer stay rates in hospitals and ICUs than other age groups. Further, among COVID-19 patients over 55 years of age, 61−81% of those with severe respiratory distress required intensive care treatment (1,2).

Many local and systemic complications, such as fever, fatigue, dry cough, myalgia, sore throat, and respiratory distress, were reportedly associated with COVID-19 (3). These complications included loss of smell, taste, and dry mouth, which occurred as a result of changes in epithelial cells in the tongue and salivary glands (4,5). In addition, these complications were associated with COVID-19-related salivary gland dysfunction (4).

A study showed that physiological cleaning of the oral cavity was interrupted by the absence of salivary secretion (6). In addition, patients receiving treatment in an intensive care unit, particularly those dependent on mechanical ventilators, were found to be at high risk in terms of oral mucosal health (7).

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Research has shown that medications, fixation plasters, and continuous mouth-opening due to an endotracheal tube, as well as the presence of an endotracheal tube and inability to take fluids and food by mouth caused deterioration in the integrity of the oral and surrounding tissues and led to the development of various oral problems such as periodontal diseases, halitosis, dry mouth, lip cracks, and stomatitis (8). Furthermore, Gil-Montoya et al. (2015) found that oral health problems are more common in elderly patients due to missing teeth, cavities, dental prostheses, and decreased salivation. 9 Research has shown that elderly individuals were more affected by the COVID-19 pandemic and demonstrated a higher rate of intensive care hospitalisation than other age groups. Therefore, this population may be at increased risk of oral health deterioration. To reduce the occurrence of complications related to oral health deterioration, as well as the length of stay in ICUs, it is important to understand the risk factors associated with oral problems in this population. Therefore, this study aimed to examine oral problems and related factors in elderly patients receiving treatment for COVID-19 in an intensive care unit. The results of this study may be utilised to create guidelines on oral care for elderly patients with COVID-19.

Our research questions included:

1. What oral problems do elderly patients receiving treatment for COVID-19 in an intensive care unit have?
2. What factors are related to the oral problems of elderly patients receiving treatment for COVID-19 in an intensive care unit?

MATERIAL and METHODs

Study Design and Setting: This analytical cross-sectional study was conducted in a state hospital's secondary and tertiary ICUs in western Turkey. The study was conducted with individuals aged ≥ 65 years who received treatment for **COVID-19 in these ICUs between May and November 2021. Inclusion and exclusion criteria:** Patients aged ≥ 65 years who received treatment for COVID-19 in the general intensive care and anaesthesia ICUs which were later converted into the pandemic intensive care unit of the hospital, were included in this study. Patients who tested negative for COVID-19 and those who could not undergo oral examination were not included in the study.

Sampling procedure: A study sample size of 66 was calculated using G*Power 3.1.9.4. With the assumption that a t-test would be performed, an effect size of 0.30, α of 0.05, and power of 0.80 were used. To prepare for the potential loss of data, a total of 86 patients (34 female, 52 male) were included in the study using a non-probability sampling method.

Data Collection: An introductory information form and Eilers' Oral Assessment Guide (OAG) were used for data collection. The introductory information form included questions about demographic characteristics, chronic diseases, nutritional status, fluid intake, vital signs, and presence of secretion, intubation status, oxygen therapy, and blood biochemistry tests. The OAG was used for oral assessment. The OAG is reliable, valid, widely used in clinical practice, practical, sensitive to changes, and has been selected for clinical use as an evidence-based oral mucositis assessment tool. Components of the OAG include voice, swallowing, lips, tongue, saliva, mucous membrane, gingiva, and teeth or dentures.10 According to the OAG, a score between 8 to 13 indicates a risk of deterioration of the oral mucous membrane, whereas a score between 14 to 24 indicates that the oral mucous membrane has deteriorated.

Data Analysis: IBM SPSS for Windows v.25. (SPSS Inc., Chicago, IL, USA) was used for statistical analyses. The mean OAG scores and selected patient variables were analysed using the student's t-test and one-way ANOVA. Analyses regarding the expected and observed survival of the oral mucous membrane according to length of stay in the intensive care unit were performed using multivariate Cox regression. Kaplan–Meier life table analyses were used to compare variables on days 1 and 28. Differences were considered statistically significant at $p<0.05$.

Ethic Approval: The study protocol was approved by Turkey Ministry of Health. Written permission was obtained from the Aydın Adnan Menderes University Faculty of Nursing Noninterventional Clinical Studies Ethics Committee and from the Deanship of the Faculty of Nursing (Ethics Committee No: 50107718-050.99) for the conduct of the study. Everbal consent was obtained from the conscious patients and the authorised relatives of the unconscious patients. The participants and/or authorised relatives were informed of the purpose of the study and that participation was voluntary and the data would remain confidential.

RESULTs

The ages of the participants ranged from 65 to 93 years, with a mean age of 72.93±7.91 years. Of the participants, 60.5% were male, and 41.9% were primary school graduates. Additional demographic information is presented in **Table 1**.

The mean length of stay in the intensive care unit was 8.55±6.54 days, 41.9% of the patients were intubated, and 80.2% had at least one chronic disease. Upon admission to the hospital, patients' symptoms included shortness of breath (88.4%), dry cough (37.2%), fever (27.9%), fatigue (18.6%), and general body pain (5.8%). According to the blood haemogram and biochemical parameters of the participants, 89.4% of the patients had low lymphocyte counts, 61.6% had low haemoglobin levels, 40.7% had low haematocrit values, 31.4% had low activated partial thromboplastin time (aPTT) levels, 22.1% had low erythrocyte counts, and 20.9% had low platelet values. However, the C Reactive Protein (CRP) levels were 90.7%, D-dimer levels were 86%, glucose levels were 84.9%, Laktat dehydrogenase (LDH) levels were 80%, urea levels were 74.1%, leukocyte counts were 65.1%, prothrombin time (PT) levels were 53.5%, Aspartat aminotransferaz (AST) levels were 40.7%, and Alanin aminotransferase (ALT) levels were 24.4%.

The mean OAG score of participants was 11.43±2.03. According to the OAG, 93% of the participants showed a risk of deterioration of the oral mucous membrane, and 7% of the patients demonstrated existing deterioration of the oral mucous membrane. Furthermore, 15.1% of the participants had hoarseness, 7% had pain while swallowing, and 14% had swallowing problems. In addition, 48.8% of the participants had dry and cracked lips, 66.3% had a yellow layer on the

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tongue, and 75.6% had redness of the oral mucous membrane. Salivary secretions were very dark and sticky in 53.5% of the participants, and 31.4% showed existing salivary secretion.

Differences between certain variables and laboratory results of the participants and their mean OAG scores are shown in Table 2. There was a significant difference between the mean OAG score of the participants and length of hospital stay, body mass index (BMI), intubation, oxygen therapy, secretion, aspiration, and type of nutrition ($p<0.05$). The difference between the mean OAG score and troponin and aPTT values was also statistically significant ($p<0.05$) (**Table 2**).

All risk factors were analysed using the Kaplan−Meier method to stay in the ICU until the oral mucous membrane is deteriorated. The observed survival rate of the oral mucous membrane was determined according to the statistically significant risk factors of intubation, oxygen therapy, secretion, and aPTT. The survival rate of the oral mucous membrane in intubated patients was 82.3±17.2% on the 5th day, 74.1±10.1% on the 12th day, 65.9±11.9% on the 14th day, 57.6±12.9% on the 15th day, and 38.4±17.9% on the 24th day; in patients who had secretion, this rate was 89.2±4.6% on the 5th day, 74.6±7.9% on the 12th day, 47.5±15.6% on the 24th day, and 23.7±18.5% on the 26th day.

The survival rate of the oral mucous membrane was 85.6±9.7% in non-intubated patients who received oxygen by nasal cannula on the 6th day, 88.9±10.5% in those who received oxygen by mask on the 12th day, and 50.0±35.4% in those who received continuous positive airway pressure (CPAP) treatment on the 6th day. In patients with a low aPTT value, the survival rate of the oral mucous membrane was 90.9±6.1% on the 5th day and 60.9±13.4% on the 16th day (**Figure 1**).

A multivariate Cox regression model was used to reveal the risk factors that contributed to the deterioration of the oral mucous membrane of the participants (**Table 3**).

This model eliminated the values with a p-value below 0.05, and the final Cox regression analysis was performed. These analyses showed that type of nutrition was the most influential factor in the deterioration of the integrity of the oral mucous membrane during hospitalisation in the intensive care unit. According to Cox regression analysis, after adjusting for BMI and nutritional status of participants, the risk of deterioration of the oral mucous membrane was found to be 92.8% higher in patients receiving total parenteral nutrition (TPN) therapy compared to those receiving oral nutrition. Although there was no significant difference observed between nasogastric nutrition and TPN, the mean survival time of the oral mucous membrane was 22.0±0.00 days for patients receiving oral nutrition, 20.6±2.50 days for patients fed nasogastrically, and 13.3±1.46 days for patients receiving TPN (**Figure 2**).

Table 1. Descriptive characteristics of the patients (n=86)

Characteristics	n	%
Gender		
Female	34	39.5
Male	52	60.5
Age	Mean±SD: 72.93±7.91	
Body Mass Index (BMI)		
18.5-29.9	26	30.3
30-34.9	44	51.1
35-39.9	10	11.6
40>	6	7.0
Education level		
Illiterate	10	11.6
Primary school	36	41.9
Secondary school	26	30.2
High school	14	16.3
*Chronic diseases (n=69)		
Hypertension	45	52.3
Diabetes mellitus	35	40.7
Chronic heart failure	23	26.7
Chronic obstructive pulmonary disease	10	11.6
Chronic renal failure	7	8.1
Cancer	6	7.0
Vital signs.	Mean±SD	
Body temperature (^{0}C)	36.56±0.44	
Pulse (min)	89.55±17.09	
Respiration (min)	23.26±3.62	
Oxygen saturation (SpO2)	90.11±7.94	
Systolic blood pressure (mmHg)	132.39±17.12	
Diastolic blood pressure (mmHg)	75.40±12.21	
Consciousness level		
Conscious	35	40.7
Confused	20	23.25
Unconscious	31	36.05

* Those with more than one chronic disease

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Table 2. Mean OAG scores of the patients according to some variables

Variables	n	OAG score %	Mean ±SD	Test/p
Length of hospital stay (day)				
1-3	13	15.1	10.61±1.70	
4-7	37	43.0	11.13±1.98	F=3.719
8-12	17	19.8	11.29±2.02	**p=0.015**
13 days and over	19	22.1	12.68±1.91	
Body Mass Index (BMI)				
18.5-29.9	26	30.3	10.80±1.70	
30-34.9	44	51.1	11.47±2.07	F=4.081
35-39.9	10	11.6	12.90±2.18	**p=0.047**
40>	6	7.0	13.46±2.44	
Chronic disease				
Yes	69	80.2	11.56±2.03	t=1.245
No	17	19.8	10.88±1.95	p=0.217
Intubation				
Yes	36	41.9	12.02±1.96	t=2.376
No	50	58.1	11.0±1.98	**p= 0.020**
Oxygen (n=50)				
Nasal cannula	21	42.0	11.28±2.14	F=2.83
Oxygen mask	17	34.0	10.61±1.69	**p=0.043**
CPAP	12	24.0	12.33±3.05	
Secretion				
Yes	63	73.3	11.65±1.82	t=1.884
No	23	26.7	10.82±2.46	**p=0.096**
Aspiration				
Yes	45	52.4	13.01±1.92	t=2.381
No	41	47.6	12.01±1.89	**p=0.032**
Type of nutrition				
Oral	40	46.5	10.47±1.55	F=10.22
Nasogastric	29	33.7	12.13±2.04	**p=0.000**
TPN	17	19.8	12.47±2.09	
Fluid intake (ml)				
1100-2000	7	8.1	11.28±2.05	F=1.812
2100-3000	59	68.6	11.69±2.16	p= 0.170
3100-4000	19	22.1	10.68±1.45	
Troponin (ng/mL) (n=77)				
Low	-	-	-	F=5.89
Normal	45	52.3	10.91±1.74	**p=0.018**
High	32	37.2	12.03±2.30	
D-dimer				
Normal	12	14.0	11.00±1.85	t=-0.78
High	74	86.0	11.5±2.06	p=0.43
aPTT (sec)				
Low	27	31.4	11.62±1.84	
Normal	53	61.6	11.58±2.08	F=4.318
High	6	7.0	9.16±0.75	**p=0.016**
Normal	60	69.7	11.16±1.91	
High	10	11.6	14.00±1.63	

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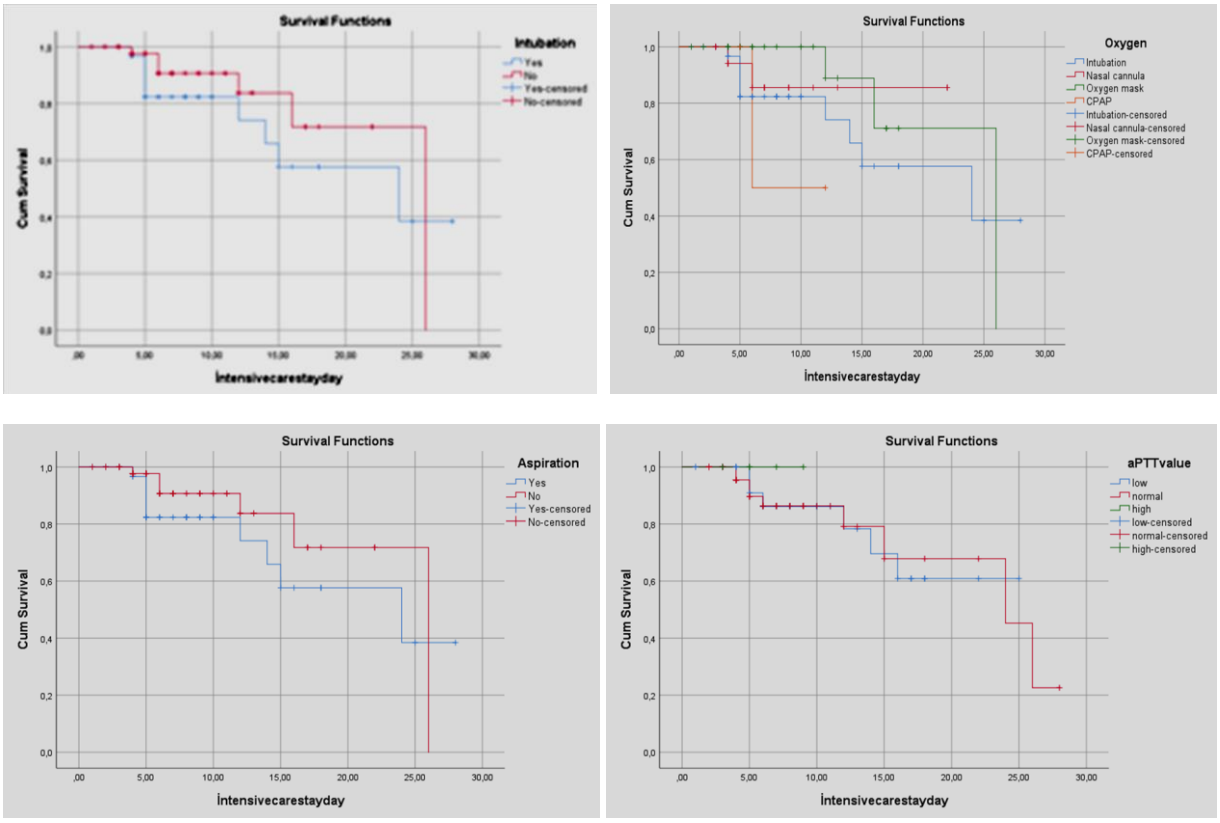

Fig. 1. Kaplan Meier analysis results for patients' length of stay in the intensive care unit and risk factors for deterioration in the oral mucous membrane

Table 3. Multivariate cox regression model

Risk factors	Beta	SE	Wald	p	Exp(Beta)	%95 G.A.
Nutrition	2.47	1.08	5.18	**0.023**	0.08	0.43/3.96
Body Mass Index (BMI)	1.37	0.87	2.54	**0.018**	0.24	0.04/1.37
Intubation	0.27	0.56	0.24	0.621	1.31	0.43/3.96
Aspiration	0.27	0.56	0.24	0.623	1.31	0.43/3.96
Troponin	0.94	0.68	1.93	0.163	0.03	0.10/1.47
aPTT	8.75	16.92	0.00	0.956	3.52	3.32/1.36

aPTT, A partial thromboplastin time.

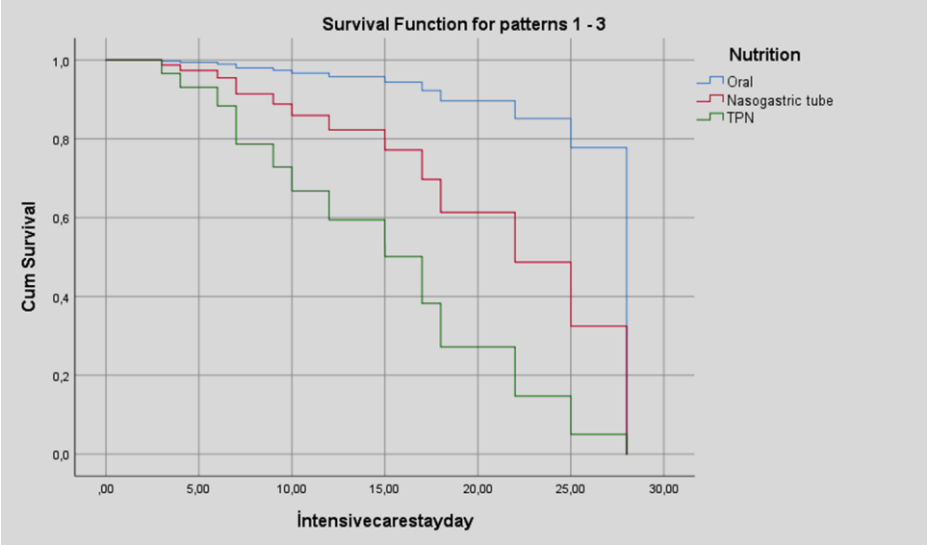

Fig. 2. Expected survival curve of the oral mucous membrane for patients' nutritional status

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DISCUSSION

In this study, oral problems and related factors in elderly patients receiving treatment for COVID-19 in an intensive care unit were examined. The results indicated that there was a difference between the mean OAG score and length of stay in the intensive care unit, BMI, intubation, CPAP treatment, secretion, aspiration, and type of nutrition.

The risk of deterioration of the oral mucous membrane increased after an average of two weeks in the intensive care unit in participants who were intubated, had salivary secretion, and underwent aspiration procedures. When salivary secretions of the participants were evaluated, 31.4% showed existing salivary secretion. Studies have shown that intubated patients' salivary secretion decreased and their risk of developing oral problems increased for reasons such as having the mouth continuously open and receiving oral aspiration. Moreover, the endotracheal tube facilitated the entry of bacteria into the respiratory tracts of these patients and resulted in impairment of the cough reflex as well as mucociliary activity, which caused an increase in secretion. In these patients, the increased number of gram (-) bacteria caused changes in the oral flora and plaque on teeth (11). Rello et al. (2003) found that within 48 hours of admission, intubated patients in an intensive care unit showed changes in oral flora due to gram-negative microorganisms in the oropharynx (12). It was reported that the oral health of patients with COVID-19 who received treatment in an intensive care unit deteriorated due to intubation, tracheostomy, external ventilation, and breathing through the mouth (13). In COVID-19 patients, the virus has been reported to cause dysfunction of epithelial cells, trigger local inflammatory reactions which typically appear with sudden onset of single or multiple blisters or ulcerations, and lead to dry mouth (4). Wu et al. (2020) found that if dry mouth continued for an extended period of time it had further serious effects on oral health, including cavities, inflammation and cracks on the lips, ulcerations of the oral mucosa and/or inflammation of the buccal mucosa and tongue, oral candidiasis, and parotid gland enlargement (13). Furthermore, studies have shown that since dry mouth is common in the elderly and COVID-19 patients, their risk of developing mouth lesions is relatively high. Dry mouth in these populations may occur as a result of aging-related physiological changes, the treatments administered to the elderly in ICUs, and dysfunction of the salivary glands due to COVID-19.

In our study, participants with a BMI of $\geqslant$ 35 kg/m^2 had a higher mean Oral Assessment Guide (OAG) score compared to those with a BMI of $\leqslant$ 35 kg/m^2. One study reported that among hospitalised COVID-19 patients with a mean age of 63 years, the three conditions associated with the most adverse outcomes were hypertension, obesity, and diabetes (3). Studies that investigated the relationship between obesity and oral health reported that a BMI over 30 kg/m2 increased the risk of periodontitis by more than fourfold (14) and that there were significant correlations between the parameters defining oral hygiene, periodontal diseases, and obesity (15). These findings suggest that BMI plays a significant role in the development of oral problems. Therefore, patients with high BMIs receiving treatment in ICUs should be identified as a high-risk group for oral health impairment. Future research should focus on determining the frequency of oral assessments for these patients, and appropriate oral care protocols should be implemented accordingly.

Our results indicated that the integrity of the oral mucous membrane deteriorated more rapidly in the participants receiving TPN therapy. Lee et al. (2012) reported that 81% of patients developed dry mouth after the initiation of TPN therapy (16). Dryness of the oral mucosa in patients receiving TPN therapy may be due to the inability of patients to be fed orally. As a result, a decrease in salivary secretion may increase the risk of deterioration of the oral mucous membrane. In our study, the mean survival time of the oral mucous membrane was 13 days in the participants who received TPN. Thus, prolonged TPN therapy may contribute to the development of oral problems. Therefore, the transition of patients receiving TPN to oral nutrition should be considered a priority.

The findings of our study showed that 31.4% of the participants had low aPTT values and that there was a difference between the mean OAG scores. Moreover, these patients' oral mucous membrane began to deteriorate during the first week. It was determined that 86% of the patients had high D-dimer levels, but there was no difference between the mean OAG scores. Christensen (2020) reported that among hospitalised COVID-19 patients, prothrombin time (PT) and aPTT were generally normal, with slight or less frequent moderate prolongation, whereas D-dimer levels increased (17). In addition, Han et al. (2020) also found that D-dimer values were higher in COVID-19 patients than healthy individuals (18). In our study, abnormal laboratory values accelerated the deterioration of the mucous membrane. This may cause bleeding and ulcerative formation in the oral mucosa. Similarly, Turaeva (2021) found that abnormal laboratory findings related to bleeding coagulation were associated with facial xeroderma and white, light yellow, and brown plaques on the tongue mucous membrane in COVID-19 patients (19).

Kakkar and Berry (2007) demonstrated that dry mouth is one of the side effects of CPAP treatment (11). In a study conducted with patients receiving CPAP treatment, 40% of the patients had oral symptoms. The results revealed that 44.6% of the patients reported experiencing dry mouth since the initiation of treatment, along with symptoms of halitosis and periodontal bleeding (20). CPAP treatment is commonly used for COVID-19 patients. The inability of patients to consume anything orally during CPAP treatment and differences in the use of moisturisers may have triggered dry mouth.

Limitations: This study had some limitations. In this study, the OAG limited the oral assessment of participants to parameters included in the guide. Since the participants were COVID-19 positive and nearly half of them were intubated, their saliva was assessed by observation. In addition, we could not measure the amount and pH of saliva.

CONCLUSION

The reults of our study indicated that a BMI $\geqslant$ 35 kg/m2, intubation, secretion, aspiration, CPAP treatment, and high aPTT values increased the risk of deterioration of the oral

mucous membrane in elderly COVID-19 patients in the intensive care unit. We observed an increased risk of oral mucous membrane deterioration in participants who were intubated, had secretions, underwent aspiration, and had high aPTT values after an average of two weeks in the intensive care unit. The survival rate of the oral mucous membrane decreased to 50% on the 6th day in participants receiving CPAP treatment. The integrity of the oral mucous membrane deteriorated more rapidly in patients who received TPN therapy than in those who were fed by other methods. Thus, oral care should be a priority of nursing care for elderly COVID-19 patients in ICUs. In addition, these patients should be assessed with consideration of the results of this study. Our findings suggest that oral assessment is important, especially in patients receiving CPAP treatment and those whose bleeding coagulation parameters are outside of the normal range. It may be beneficial to shorten the duration of intubation and TPN therapy as much as possible, and to conduct oral care protocols carefully in these patients.

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Ethical approval: All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and/or with the Helsinki Declaration of 1964 and later versions.

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