Original Article

FREQUENCY AND OUTCOME OF EXPOSURE KERATITIS IN MECHANICAL VENTILATED PATIENTS ADMITTED TO INTENSIVE CARE UNIT

Ghader Motarjemizadeh[1], Mohammad Amin Valizade Hasanloei[2], Shiva Pakzad[3], Mahsa Asghari[4]*

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Abstract

***Background & Aims*:** Exposure Keratitis (EK) is a common problem in critically ill patients admitted to the Intensive Care Unit (ICU). We conducted exposure keratitis in mechanical ventilatory patients in the intensive care unit of Imam Khomeini Hospital in Urmia for five years.

***Materials & Methods*:** In this retrospective cross-sectional study, the records of the patients were taken from the medical records unit of the hospital and also the demographic characteristics, patients' consciousness level (GCS), APACHE II score, PCO2 from arterial blood gases, exposure keratitis, duration of mechanical ventilation and hospitalization in the intensive care unit, and the mortality of patients were extracted and entered into a checklist. Patients with GCS ≤12 were enrolled in the study and patients with GCS ≥ 13and=3 were excluded. At the end of the study, T-test, Chi-Square test, and Fisher exact test were used to analyze the data. $P<0.05$ was considered statistically significant.

***Results*:** The frequency of exposure keratitis was 33.4%. There was a significant difference between patients in term of their genders, the levels of consciousness (GCS), APACHE II, duration of mechanical ventilation and hospitalization in the intensive care unit, mortality rate, and the frequency of exposure keratitis ($P<0.05$). However, there was no significant difference between patients in term of the mean age, PaCO2 and the frequency of exposure keratitis ($P>0.05$).

Conclusion: The frequency of exposure keratitis was expected in our study. Moreover, the most common factor was the low-level of consciousness and the patients' age group.

***Keywords*:** Exposure keratitis, Mechanical ventilation, Intensive Care Unit

***Address*:** Emam Hospital, Urmia University of Medical Sciences, Urmia, Iran

***Tel*:** +989141438399

***Email*:** aminvalizade@yahoo.com

Introduction

Surface ocular disease (keratitis) occurs due to the exposure of the cornea in about 60% of critically ill patients admitted to ICU (1). In a healthy state, the eyes are protected by the eyelids. The production of tears and frequent blinking make the moisture and protect the eyes. Blinking prevents damage and eye fatigue and spreads tears throughout the ocular surface (2).

[1] *Assistant Professor, Ophthalmology Department, School of Medicine, Urmia University of Medical Sciences, Urmia, Iran*
[2] *Associate Professor, Fellowship of Intensive Care Medicine, Anesthesiology Department, School of Medicine, Urmia University of Medical Sciences, Urmia, Iran (Corresponding Author)*
[3] *Assistant Professor, General Surgery Department, School of Medicine, Urmia University of Medical Sciences, Urmia, Iran*
[4] *General Practitioner, Urmia University of Medical Sciences, Urmia, Iran*

Keratitis may be caused by the viral or microbial infections, ischemia, allergies, vitamin A deficiency, and lack of corneal sensation, nutritional deficiencies, tear problems, exposure of cornea to air and triggers, and the inability of the eyelids to cover the cornea (3). In the intensive care unit, ocular problems in patients can be due to many reasons, including the use of sedative effects on the muscles of the eye, which cause the eyelid not completely close. Patients admitted to ICU often have fluid imbalances, which increase the permeability of the capillary and lead to eye damage. Disorder of the blink reflex and eyelid position makes the eyes not completely close and tears evaporate more quickly. The use of positive pressure ventilation increases the intraocular pressure by increasing intravenous pressure, which leads to conjunctival edema and increases the risk of eye diseases. Hypercapnia increases the intraocular pressure and damages to the eye. Reducing the production of tears by drugs, including antihistamines, atropine, paralytic agents exposes the eye to the dryness and damages (4-6). On the other hand, spontaneous breathing and high-flow oxygen in patients can damage the epithelial cornea. If the eyelid is not completely closed, the suction process can lead to the transfer of pathogens from the airway to the cornea epithelium. In fact, the suction may directly cause corneal infections, if the nursing draws the catheter towards the eye during the suction (7). Some studies have been conducted to investigate exposure keratitis and find the solutions to prevent complications. According to global statistics, the incidence of corneal ulcer in the ICU is estimated to be 22% to 33%. Taking care of eyes is essential in these patients, especially during the first two to seven days of hospitalization (8-11). A few studies have been done in Iran which most were in the field of nursing (12, 13). The percentage of incidence of exposure keratitis in Iran is close to the global statistics. In addition to common nursing care in patients admitted to the ICU, it is necessary to take care of the patients' eyes to prevent the incidence of exposure keratitis and minimize cost.

Materials and Methods

After approval of the ethics committee of Urmia medical science university, this retrospective cross-sectional study was conducted with the aim of investigating the frequency of exposure keratitis and its outcomes in the patients under mechanical ventilation admitted to the general intensive care unit of the Urmia Imam Khomeini Hospital (GICU) during last 5 years (2012-2016) in IRAN.

In this study, patients with inflammation of the ocular surface layer that are usually associated with pain and vision impairment were considered as keratitis patients. Exposure keratitis was observed in all patients admitted to the ICU. Moreover, the keratitis in the patients which recognized by fellowship intensive care, also was confirmed by ophthalmologist. The sampling method was available. Regarding Glasgow's coma scale (GCS) in patients with invasive ventilation, an equivalent method was used in the APACHEII score table to measure the verbal responses.

Of 1735 patients in this study, 622 of them with GCS less than 12 admitted to the GICU were included in the study. In this study, the patients' demographic characteristics (age, sex), consciousness level (GCS), APACHE II score, PaCO2 from arterial blood gas, exposure keratitis, duration of mechanical ventilation and length of hospitalization in the intensive care unit, and mortality of patients were extracted from patients' medical records and entered into the checklist. Moreover, the exclusion criteria were patients with GCS $\geq$13 and GCS =3, eye trauma and Entropion and Ectropion disorder, hospitalization length less than 48 hours and having surgery recently.

Statistical Methods

Continues variables were presented as mean $\pm$ SD and qualitative variables as numbers (percent). The mean of

age, PaCo2, GCS, duration of mechanical ventilation, and length of hospitalization, and ICU length were compared between patients with and without krititis using independent T-test. The frequency of kretitis among discharged and died patients was compared by Person's chi- squqre test. Statistical analysis was performed by using SPSS version 21 software. P-value < 0.05 was considered statistically.

Results

In this retrospective cross-sectional study, records of patients admitted to the intensive care unit of Imam Khomeini Hospital in Urmia during the years 2012-2016 were investigated. Of 1735 records which were investigated, 65 patients with GCS = 3 and 965 patients with GCS> 13, 73 patients with stay duration less than two days were excluded. Finally, the study was conducted by 622 patients with GCS ≤12, among them 281 patients (45.2%) were male and 341 patients (54.8%) were female. The total mean age of patients was 70.92 ± 15.58 years (median age of 77 years). The mean age of male patients was 70.31 ± 15.93 years and the mean age of female patients was 71.43 ± 15.80 years and APACHEII score was 17.37 ± 3.11. Of 622 patients, 208 (33.4%) patients had keratitis and 414 (66.6%) did not have keratitis. The frequency of age groups less than 40, 40-50, 50-60 and more than 60 years were 7 (3.36%), 26 (12.5%), 19 (9.14%) and 156(75%) in Kerittis Patients (Table 1).

Table 1: Comparison of variables in patients with exposure keratitis under mechanical ventilation

Variable	With keratitis	Without keratitis	P-value
Age	70.31±14.36	71.23±16.35	0.49
PaCO2	34.50±8.59	34.37±9.56	0.86
GCS	6.66±3.06	9.22±2.96	0.001
Duration of mechanical ventilation	15.41±0.84	12.48±0.98	0.03
Length of stay in ICU	21.34±0.98	17.25±1.22	0.008
Duration of hospitalization	32.02±1.02	25.87±1.60	0.01

Table 1 shows the mean age of patients with and without keratitis was 70.31±14.36 years and 71.23±16.35 years, respectively. The mean of age had not significant difference between patients with and without keratitis (P = 0.49).

Of 281 male patients, 106 (37.7%) patients had keratitis and 175 (62.3%) did not have keratitis. Of 341 female patients, 102 (29.9%) had keratitis and 239 (70.1%) did not have keratitis. There was a significant difference between patients with and without keratitis according to their sex (P=0.02). The mean score of APACHEII in patients with and without keratitis was 20.69±2.32 and 16.82±3.45, respectively (P = 0.04).

The mean of PaCO2 in patients with keratitis was 34.5 ± 8.59 and in patients without keratitis was 34.57 ± 9.56. Then, the mean of PaCo2 was not significant between patients with and without keratitis (P=0.86).

The mean of GCS in patients with keratitis was 6.66±3.36 and in patients without keratitis was 9.22 ± 2.96. The mean of GCS had a significant significant difference between patients with and without keratitis (P = 0.001).

Mean duration of mechanical ventilation in patients with keratitis was 15.41 ± 0.84 days and in patients without keratitis was 12.48 ± 0.98 days. The mechanical ventilation duration differently significant between patients with and without keratitis (P = 0.03).

The mean of hospitalization length in ICU in patients with keratitis was 21.34 ± 0.98 days and in patients without keratitis was 17.25 ± 1.22 days. The mean of Length stay in ICU was significant between patients (P = 0.008).

The mean duration of hospitalization in patients with keratitis was 32.02 ± 1.02 days and in patients without keratitis was 25.87 ± 1.60 days. Also the mean of hospitalization length was statistically significant between patients (P = 0.01).

Table 2 shows the frequency of kerititis (Yes/ No) in discharged and died patients. The frequency of mortality patients with and without kerititis was 112 (53.8%) and 140 (33.8%), although the 96 (46.2%) and 274 (66.2%) of patients with and without kerititis were discharged. These differences were significant among patients (p = 0.001).

Table 2: Distribution of absolute and relative frequency of the outcomes of mortality in patients with and without kerititis

Keratitis	Outcome		Sum total
	Discharged patients	Died patients	
Yes	96 (46.2%)	112 (53.8%)	208 (100%)
No	274 (66.2%)	140 (33.8%)	414(100%)
Sum total	370 (59.5%)	252 (40.5%)	622 (100%)

Figure 1.

Discussion

Exposure keratitis is a clinical syndrome, which determined by closed eyes and inadequate tear film, causing extensive damage to the cornea with wide stretch and intensity. Its iatrogenic causes are mechanical ventilation, sedation and receiving muscle relaxation and loss of patient's consciousness (11).

This study was conducted with the aim of investigating the frequency of exposure keratitis in mechanical ventilatory patients and the outcomes of hospitalization in ICU of the Urmia Imam Hospital at a 5-year interval. There was a significant difference between patients with and without keratitis in term of sex and the level of consciousness, APACHEII mean score and the duration of mechanical ventilation and length stay in the

intensive care unit. However, there was no significant difference between patients with and without keratitis in term of age and PaCO2.

The frequency of the obtained keratitis was relatively considerable. The use of artificial tear, antibiotic droplets, topical eye antibiotic ointment, and closure of eyes with adhesive and etc. in a special way was performed in about 75% of keratitis patients. In the current study, of 208 patients with keratitis, 53 patients were exposed to tarsorrhaphy surgery for exposure keratitis for 5 years, and 11 patients were exposed to bilateral tarsorrhaphy.

Few studies have been conducted in this field. This current study showed that exposure keratitis is more common in patients with decreased level of consciousness and between the age group of 40-60 years, who were under mechanical ventilation and admitted to the intensive care unit. Accordingly, this study is aligned with Obaid K et al. (11). Unlike their study which showed a frequency of 21%, in this study the frequency was 50% higher than their study. They also have asserted that exposure keratitis frequency is greater in patients receiving mechanical ventilation (56%).

In a study carried out by Jamie B et al. (9) 20% - 42% of patients was exposed to keratitis. The frequency of keratitis in our study was 33.4% of patients, which was in the middle of the reported range by Jamie B et al. (9). In our study, like Jamie's study (9), after observing the clinical signs and the suspicion of keratitis, the ophthalmologic consultation was done.

Mela EK et al. (7), in 2009 in a study on 134 patients undergoing mechanical ventilation and relaxation for 7 days examined the patients for corneal and ulcer. Moreover, 77% of the patients had been colonized with at least one species of bacteria during 7 to 42 days of admission, which was more than twice the frequency of the patients in our study. In their study, Pseudomonas Aeruginosa species, Acinetobacter, Staphylococcus Epidermidis were the most commonly isolated bacteria. They reported that timely diagnosis of surface colonization and the early administration of topical antibiotics could prevent corneal infection. We did not sample the eye discharge of patients; therefore, we did not have access to the species involved in cases of infectious keratitis. However, since we know the native bacteria in our intensive care unit, our study mentioned that increasing the hospitalization in intensive care units, ventilatory support and low level of consciousness increases the exposure keratitis, and the physicians of the intensive care units should be aware of this issue.

Saritas BT et al. (6) stated that patients admitted to intensive care units are prone to dryness of the eyes, keratopathy and eye infections. Therefore, counseling with ophthalmologists for early diagnosis should be done. They reported conjunctival hyperemia, dirty secretions, corneal change, and corneal filaments in 40 patients, of them 10% had exposure keratitis. The frequency of exposure keratitis in our study is more than three times in the study of Saritas BT et al. (6). This is due to the difference of the patient population in two studies. The mean age of the patients in the study of Saritas BT et al. (6) was 40.1±18.5 which was much lower than the mean age of the patients in our study (3 decades less). The mean age was in the range of 40-60 years old in patients of our study, which the most exposure keratitis is observed in this age group. Greicasti et al. (5) in the United Kingdom stated that ocular surface disorders often affect the patients in the intensive care unit, and early diagnosis of these disorders prevents the microbial keratitis and loss of vision. We did not find any case in our study that led to a visual loss, which should be due to the lack of follow-up of patients (even after discharge). Perhaps if a follow-up study is designed to address this, cases that lead to loss of vision can be achieved.

Nurses and medical staff in the intensive care unit primarily paid their attention to the serious life threats problems, and this may cause a lack of attention to other issues of exposure keratitis, which can progress to the loss of patient's vision (10). Necessary medical treatment is taken to consult with an ophthalmologist.

Some clinical trials have been conducted in this regard (10, 12). One of them carried out by Davoodabady Z et al. (12), in which the effect of normal saline used to wash the eyes has been studied and finally, they noted that the use of Normal saline is not recommended because it increases the amount of exposure keratitis.

The difference between the current study and Davoodabady Z et al. (12) in addition to the study design, was in the population of patients, the sample size and the period of study. The Sample size of their study was approximately 1/12 more than this study and the patients had been studied in the first week of admittance. Like this study, they presented that exposure keratitis is a common problem in patients admitted to the intensive care unit. In their study, the effect of education on reducing the amount of exposure keratitis in intensive care unit patients has been studied (14, 15).

Wasea et al. (14) studied the effect of training on reducing the amount of exposure keratitis in the three units of intensive care, surgical, internal, and pediatric that showed education reduced 10% in the frequency of exposure keratitis. The highest frequency was 60% in PICU, and the average frequency of exposure keratitis was 40%, which is more than the current study, and also the highest frequency of exposure keratitis in this study was between the age group of 40-60 years and admitted patients were adults. The limitation of their study, like this study, was patients' lack of following. This study also included the limitations of the retrospective studies, such as the lack of separation of infectious and non-infectious cases of exposure keratitis and incomplete medical records. The study by Demirel et al. (15) in Turkey, also discusses the effects of training which was designed to reduce the frequency of exposure keratitis.

Chionni N et al. (16) in 2018, in a single-center prospective cohort study, on 779 patients admitted to intensive care unit, indicated that at least one risk factor leading to exposure keratitis in 55% of patients is often Iatrogenic. Finally, they asserted that the prevention of exposure keratitis to DVT and GI prophylaxis should be put on the agenda of the intensive care unit.

Lorie R., (17) in 2017, examined the amount of keratopathy exposed in children under sedation in the radiology unit and said that these children were at risk of exposure keratitis, which could have permanent effects. This study was conducted in accordance with the study of Lorie R., (17) on adult patients admitted to the intensive care unit with GCS of less or equal to 12. These often do not require intravenous sedation and were assessed to receive intravenous sedation according to measurable criteria needed for sedation such as VAS or BPS. However in general, the policies that we use in our unit is to get less intravenous sedation drugs to reduce the amount of pneumonia and duration of mechanical ventilation. On the other side, no patient in the intensive care unit receives the muscle relaxation drugs.

Finally, according to the above issues mentioned, the results of previous studies and the current stuty can be said that the frequency of exposure keratitis in our study is within the expected range (its upper range), and more than that of some studies and less than that of some studies. This confirms other studies which stated, the longer the hospitalization period in the intensive care unit, the lower the level of consciousness and the longer the duration of mechanical ventilation causes more observed exposure keratitis. Moreover, the physicians in the intensive care unit should be considered the vision of the patient and take the necessary measures in this regard along with other treatments.

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