Original Article

The Effects of Passive Blinking on Exposure Keratopathy among Patients in Intensive Care Units

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Abstract

Background: Patients in Intensive Care Units (ICUs) are at risk of eye disorders such as Exposure keratopathy (EK) due to impaired blinking and incomplete eye closure. The aim of this study was to assess the effects of passive blinking exercise (PBE) on EK among patients in ICUs. **Materials and Methods:** This single-blind, randomized, clinical trial was conducted in 2017. The study participants included 51 patients purposively recruited from the three ICUs of Valiasr Teaching Hospital, Arak, Iran. Through coin tossing, one eye of each participant was randomly allocated to the intervention group and the other to the control group. The eye in the control group received routine eye care, whereas the eye in the intervention group received routine eye care and PBE for a week. EK prevalence and severity were assessed daily for 7 consecutive days using fluorescein eye staining papers and an ophthalmoscope with a cobalt blue filter. **Results:** The study groups did not significantly differ from each other in terms of the baseline prevalence and severity of EK. After the intervention, the prevalence of EK (χ^2 = 13.44, df = 1, p < 0.001) and the prevalence of grade II EK (χ^2 = 8.33, df = 1, p = 0.003) in the intervention group were significantly lower than the control group. **Conclusions:** PBE is effective in significantly reducing EK prevalence and severity among patients in ICUs. Therefore, critical care nurses are recommended to use PBE for EK prevention and management.

Keywords: *Blinking, corneal injuries, intensive care units, nurses*

Introduction

Exposure keratopathy (EK) is a common problem among unconscious patients in Intensive Care Units (ICUs).[1] As a clinical syndrome, EK is characterized by the incomplete closure of the eyelids and defective tear film which lead to corneal injury.[2] In clinical examination, EK is characterized by irregular tiny abrasions of the inferior half of the cornea.[3] A review study reported that EK affects 3.6%–60% of patients in ICUs with the highest prevalence in the second to the seventh days of ICU stay.[4] EK is a multifactorial problem. Its main contributing factors are reduced tear production, impaired corneal reflex,[2] impaired blinking,[5] and incomplete eyelid closure.[6] Other risk factors for EK include reduced consciousness, endotracheal intubation, prolonged ICU stay,[7] and electrolyte imbalance.[8] Incomplete eyelid closure, a major risk factor for EK, is a common problem among 75% of patients who receive hypnotics.[6] Absent or incomplete blinking can also lead to EK and corneal injury.[5]

Although EK disappears with improved consciousness, it can cause discomfort, red eyes, and transient or permanent vision loss among patients with prolonged unconsciousness. Moreover, it can cause microbial keratitis, acute corneal perforation, endophthalmitis, and permanent visual impairments.[2] Eye disorders such as EK increase health care costs and reduce Quality of Life (QOL).[9] The most effective strategy for EK prevention among patients in ICUs is to keep the eyes closed using tapes or through tarsorrhaphy.[3] Other measures for EK prevention include using polyethylene covers, lubricant drops, geliperm for eye closure, hydrogel dressing, swimming goggles, methylcellulose drops, and normal saline for keeping the eyes moist.[10]

Passive Blinking Exercise (PBE) by nurses is a modality for EK prevention

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and management. Blinking is essential for distributing and draining tears and increasing oil secretion from the meibomian glands. It also facilitates the distribution of lacrimal gland secretions over the whole eye and the distribution of mucin over the entire cornea.[11] Moreover, maintaining the integrity and moisture of the cornea, and distribution of a thin layer of a tear over the cornea through blinking contributes to the delivery of oxygen and nutrients to the cornea. Moreover, tear includes antibacterial components which prevent the growth and colonization of microorganisms.[12] A study reported that blinking exercises improved the effectiveness of ocular lubricants.[13] Another study reported that blinking exercises after the use of eye drops improved EK recovery by facilitating the distribution of the drops over the whole surface of the eyes.[8] Nonetheless, EK is still a major problem in ICUs[5] because health care providers in ICUs mainly focus on maintaining hemodynamic stability and supporting the function of vital organs, and mostly neglect eye care; therefore, EK is still a common problem among unconscious patients.[14] To the best of our knowledge, there are limited data, if any, about the effects of PBE. Therefore, the present study was designed and carried out to address this gap. The aim of the study was to assess the effects of PBE on EK among patients in ICUs.

Materials and Methods

This single-blind, randomized, clinical trial (code: IRCT20180107038251N1) was conducted in 2017 in the three ICUs of Valiasr Teaching Hospital, Arak, Iran. At the time of the study, there were 23 ICU beds in the study setting. Through purposive sampling, 60 eligible patients were recruited to the study. the study inclusion criteria were the age of more than 18 years, receiving mechanical ventilation, a Glasgow Coma Scale (GCS) score of less than 10, absent blinking reflex, no history of eye disorders or surgery, no facial or ocular trauma, no facial nerve palsy, and no EK. Participants who were weaned from mechanical ventilation during the study were excluded. For randomization, a coin was tossed for each participant to allocate one eye to the intervention group and the other to the control group. Consequently, the participants were same in the intervention and the control groups, and thus their characteristics were the same. With a Confidence Interval (CI) of 0.95, a power of 0.80, a *P1* of 19.8, and a *P2* of 2.45,[15] sample size was calculated to be 51.

Data were collected using a demographic questionnaire and the Corneal Changes Rating Scale. The demographic questionnaire had items on age, gender, chief complaint, medical history, eyelid status, level of consciousness, respiratory status, and medications. This questionnaire was developed based on the existing literature, and its content validity was evaluated and confirmed by 15 health care specialists. Its reliability was assessed and confirmed in a pilot study on 30 patients in ICUs. During the study, a nurse assessed participants' eyes for 7 days under the supervision of a physician. The nurse had been trained for eye examination and was blind to the groups. Eye examination was performed using fluorescein eye staining papers and an ophthalmoscope with a cobalt blue filter. The prevalence and severity of EK were assessed using the Corneal Changes Rating Scale [Table 1]. Patients with keratopathy of above grade III were excluded and referred to an ophthalmologist for eye care.

Initially, all critical care nurses in the study setting were informed of the study aim and methods, trained regarding eye care for patients in ICUs, provided with a written eye care protocol, and asked to provide eye care based on the care protocol. The study intervention started on the first day of participants' ICU admission and ended on the seventh day after admission. The eye care protocol for patients in the control group included the nurses to hand wash and administer artificial tear (2 drops) every 4 h for patients with closed eyes or administration of simple eye ointment together with artificial tear (2 drops) every 4 h and eye closure with tape for patients with lagophthalmos. Moreover, the eyes were covered during endotracheal suctioning. In addition to these care measures, the participants in the intervention group received 30 s PBE every 30 min for a week. In each 30 s round of PBE, the eyelids were passively opened and closed 18–20 times. The eyes were examined daily for 7 days by a nurse who had received training in this regard and was approved by an ophthalmologist. Eye assessment was performed using fluorescein eye staining papers and an ophthalmoscope with a cobalt blue filter. Participants with signs of corneal injury (including white or yellow spots on the cornea or conjunctival redness, edema, or inflammation) were referred to a physician. Routine eye care was provided by nurses in the study setting, and the PBE intervention was provided by the same nurse who performed the eye assessment.

The data were analyzed using SPSS software (version 21, IBM Corp., Armonk, NY, USA). Data description was performed through the measures of descriptive statistics, namely mean, standard deviation, and absolute and relative frequencies. Data analysis was performed using the

Table 1: Ocular surface disease grading

Grade	Definition
0	No EK*
I	Punctate epithelial erosions involving the inferior third of the cornea
II	Punctate epithelial erosions involving more than the inferior third of the corneal surface
III	Macro-epithelial defect
IV	Stromal whitening in the presence of an epithelial defect
V	Stromal scar
VI	Microbial keratitis

*EK: Exposure keratopathy

Chi-square test, paired-sample t-test, and the analysis of variance (ANOVA) or their non-parametric equivalents.

Ethical considerations

This study was approved by the Ethics Committee of Arak University of Medical Sciences, Arak, Iran (code: IR.ARAKMU.REC.1395.305). Participants' legal guardians were informed that the data would solely be used for the purpose of the present study and would be managed confidentially. They were also provided with information about the aims and methods of the study and were ensured that they could withdraw their patients from the study at any time they wished. Written informed consent was obtained from the patients' legal guardians.

Results

Of the 60 patients entered into the study, 9 participants were excluded from the study due to death (n = 4) or improved blinking reflex due to improved consciousness (n = 5); 4 of these participants were from the intervention group, and 5 were from the control group. Consequently, 51 individuals completed the study and were included in the final data analysis [Figure 1]. The mean age of the participants was 59.52 (16.80) years, and most of them were men (64.70%). The most common causes of ICU admission were intracerebral hemorrhage (44.60%), trauma (15.80%), and problems such as brain tumor, pneumonia, poisoning, and bleeding due to abortion (39.60%). As one eye of each participant was randomly allocated to the intervention group and the other to the control group, the participants in the two groups were the same.

None of the participants in the study groups had EK at the baseline. However, the prevalence of EK after the study intervention was significantly lower in the intervention group (χ^2 = 13.44, df = 1, p < 0.001) [Table 2]. Moreover, the Chi-square test results showed that the prevalence of grade II EK in the intervention group was significantly lower than the control group in the posttest (χ^2 = 8.33, df = 1, p = 0.003) [Table 3]. Fisher's exact test also showed that EK prevalence in the intervention group was significantly lower than the control group on the third to seventh days of the study intervention (χ^2 = 7.99, df = 1, p = 0.004) [Table 4].

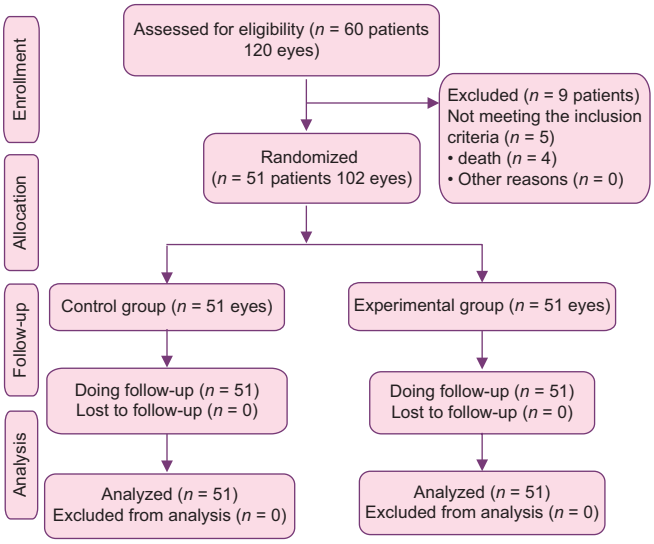

Figure 1: Consort flow diagram

Moreover, 8 participants (15.70%) had lagophthalmos and 7 had EK. In this study, 7 participants had lagophthalmos and EK; 6 of them (85.70%) were in the control group and 1 (14.30%) was in the intervention group. The between-group difference regarding the prevalence of EK among patients with lagophthalmos was statistically significant (χ^2 = 4.567, df = 1, p = 0.032).

Discussion

This study was conducted with the aim to assess the effects of PBE on EK among patients in ICUs. The study findings revealed that none of the participants had EK on the first day of ICU admission. However, some studies reported EK during the first 24 h of ICU admission.[14,16] A study on 70 patients in the eye care ward of a hospital in Pakistan reported EK in 40 of them at the beginning of the study due to problems such as lagophthalmos.[17] Another study reported that during the first 48 h after ICU admission, the prevalence of EK was 53.4% among patients under mechanical ventilation and 5.1% among patients with noninvasive ventilation or without mechanical ventilation.[2] Similarly, a study reported that 7 patients had EK at the baseline probably due to the admission of some of them to ICUs from other hospital wards.[14] The absence of EK in the present study on the first day of the intervention may be due to the fact that we did not include patients with EK in the study.

The study findings showed that after the intervention, the prevalence of EK in the control group was significantly greater than that in the intervention group. In line with this finding, a previous study reported that 7 days after the beginning of an eye care intervention, the prevalence of EK in the routine care group was 18%.[14] Another study on 80 patients found that 15% of them developed EK during the first 7 days of the study.[18] Moreover, a study on 74 patients under mechanical ventilation found that 75% of them had lagophthalmos and some levels of EK.[19]

Hartford *et al*.[1] reported EK in 19%, 60%, and 48% of cases in the Pediatric Intensive Care Unit (PICU), Medical Intensive Care Unit (MICU), and Neonatal Intensive Care Unit (NICU), respectively. Another study reported that the prevalence of EK was 27.3%.[5]A two-phase prospective cohort single-center study in a general adult ICU showed that the overall rate of EK was 21% in the first phase, but the rate in mechanically ventilated patients was 56%.[2] Lack of use of EK preventive measures, longer ICU stay,

Table 2: Between-group and within-group comparisons regarding the total pretest and posttest prevalence of exposure keratopathy

Variables	Group	Intervention	Control	Chi-squer	df	*p*
	Time	*n* (%)	*n* (%)			
Total EK*	Before	0 (0)	0 (0)	-	-	-
	After	3 (16.70)	15 (83.30)	13.44	1	<0.001
	Chi-squer	2.66	26.13			
	df	1	1			
	p	0.102	<0.001			

*EK: Exposure keratopathy

Table 3: Between-group and within-group comparisons regarding the pretest and posttest severity of exposure keratopathy

Variables	Group	Intervention	Control	Chi-square	df	*p*
	Grade	*n* (%)	*n* (%)			
EK*	Grade I	3 (27.30)	8 (72.70)	2.90	1	0.093
	Grade II	0 (0)	6 (100)	8.33	1	0.003
	Grade III	0 (0)	1 (100)	0	1	0.999

*EK: Exposure keratopathy

Table 4: Between-group comparisons regarding the prevalence of exposure keratopathy at different measurement time points

Time	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Group	*n* (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)
Intervention	0 (0)	0 (0)	1 (11.10)	1 (6.70)	3 (17.70)	3 (17.70)	3 (16.70)
Control	0 (0)	2 (100)	8 (88.90)	14 (93.30)	14 (82.40)	14 (82.40)	15 (83.40)
Chi-square	-	0.18	7.99	19.20	11.76	11.76	13.44
df	-	1	1	1	1	1	1
p	—	0.317	0.004	<0.001	<0.001	<0.001	<0.001

differences in environment, and comorbidities can be the causes of the higher prevalence of EK in these studies.

Our findings also indicated that the post-test frequency and severity of grade II EK in the intervention group were significantly lower than the control group, implying the effectiveness of PBE in reducing EK frequency and severity. PBE is a nursing measure with potentially positive effects for EK prevention and management.[8] McMonnies found that blinking exercises after using eye drops had significant positive effects on EK.[8] Kuruvilla *et al*.[5] reported a significant relationship between incomplete blinking and EK. Blinking facilitates the distribution of tear film throughout the cornea and prevents tear film evaporation, and subsequent, EK.[20]

The findings of the present study showed a significant direct relationship between lagophthalmos and EK so that the prevalence of EK was greater among participants with lagophthalmos. Some previous studies also reported the same finding. For example, in the study by McHugh *et al*.,[21] 70% of patients with lagophthalmos had EK. Moreover, Kocaçal Güler *et al*.[9] reported that lagophthalmos had a significant relationship with EK.

We also found that EK prevalence in the intervention group was significantly lower than the control group on days 3–7 of the study intervention, and the prevalence of EK among participants with a longer ICU stay was higher. In line with these findings, Kuruvilla *et al*.[5] and Motarjemizadeh *et al*.[22] reported that a longer ICU stay was associated with a higher prevalence of EK. Long ICU stay is usually associated with the greater use of tranquilizers, neuromuscular blocking agents, and positive pressure mechanical ventilation, all of which can increase the risk of lagophthalmos and EK.[23] However, two studies showed that long ICU stay was not associated with increased risk of EK.[21,24] Small sample size and lack of medical assessment for eye problems were the limitations of the present study.

Conclusion

It can be concluded that PBE is effective in significantly reducing the prevalence and severity of EK among patients in ICUs. Therefore, critical care nurses should be trained and encouraged to use PBE for unconscious patients in order to prevent and manage EK and its complications in ICUs.

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Conflicts of interest

Nothing to declare.

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