

## The Impact of Normal Saline on the Incidence of Exposure Keratopathy in Patients Hospitalized in Intensive Care Units

### Abstract

**Background:** Patients in the intensive care unit (ICU) have impaired ocular protective mechanisms that lead to an increased risk of ocular surface diseases including exposure keratopathy (EK). This study was designed to evaluate the effect of normal saline (NS) on the incidence and severity of EK in critically ill patients. **Materials and Methods:** This single-blind randomized controlled trial was conducted on 50 patients admitted to ICUs. The participants were selected through purposive sampling. One eye of each patient, randomly was allocated to intervention group (standard care with NS) and the other eye to control group (standard care). In each patient, one eye (control group) randomly received standard care and the other eye (intervention group) received NS every 6 h in addition to standard care. The presence and severity of keratopathy was assessed daily until day 7 of hospitalization using fluorescein and an ophthalmoscope with cobalt blue filter. Chi-square test was used for statistical analysis in SPSS software. **Results:** Before the study (first day) there were no statistically significant differences in the incidence and severity of EK between groups. Although, the incidence and severity of EK after the study (7<sup>th</sup> day) was higher in the intervention group compared to the control group, their differences were not statistically significant. Although, the incidence and severity of EK, from the 1<sup>st</sup> day until the 7<sup>th</sup>, increased within both groups, this increase was statistically significant only in the intervention (NS) group. **Conclusions:** The use of NS as eye care in patients hospitalized in ICUs can increase the incidence and severity of EK and is not recommended.

**Keywords:** Intensive care unit, exposure keratopathy, normal saline

### Introduction

Patients hospitalized in the intensive care units (ICUs) require constant supervision and complicated and professional care.<sup>[1]</sup> These care services are mainly directed at the vital organs such as the respiratory, cardiovascular, and nervous system, especially during the early days of hospitalization.<sup>[2,3]</sup> Eye care is most often overlooked by medical and nursing personnel. Ocular surface diseases and keratopathy is a relatively common issue in these patients.<sup>[2]</sup> It usually begins with dry eyes and keratopathy and results in bacterial keratitis, corneal problems, and even loss of sight.<sup>[4,5]</sup> The prevalence of eye disorders has been reported as 3.6%–60% in different studies.<sup>[6,7]</sup> The difference in the prevalence of keratopathy reported in previous studies is due to the different assessment methods used.<sup>[2]</sup> Corneal damage may occur at any time;<sup>[4]</sup> however, its highest prevalence is observed during day 2–7 of hospitalization.<sup>[6]</sup>

Although, ICU personnel are aware of the diagnosis and treatment of severe problems in patients, some factors may increase the incidence of ocular surface diseases.<sup>[4]</sup> Natural mechanisms of the eyes, such as blinking and tearing reflexes,<sup>[8]</sup> are impaired in these patients, and thus, the patient is susceptible to keratopathy. Lagophthalmos,<sup>[9]</sup> decreased corneal reflex, fluid imbalance,<sup>[2]</sup> positive-pressure ventilation,<sup>[5]</sup> muscle relaxant drugs use,<sup>[2]</sup> and bacterial contamination of suction<sup>[10]</sup> are factors that can cause keratopathy in these patients.

Despite the numerous reports regarding the high prevalence of ocular surface diseases in patients in ICUs, many care services provided are not evidence-based<sup>[11]</sup> and consensus has not been reached on eye care protocols for these patients.<sup>[9]</sup>

Different methods are used for the prevention of exposure keratopathy (EK) and ocular surface diseases in critically

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ill patients.<sup>[6]</sup> Use of methylcellulose eye drops<sup>[9]</sup> and normal saline (NS) solution,<sup>[2]</sup> and use of adhesive tape,<sup>[12]</sup> polyacrylamide dressing,<sup>[4]</sup> polyethylene covers,<sup>[6]</sup> and tarsorrhaphy<sup>[12]</sup> to close the eyes are commonly used eye care methods. The status of the eyelids must be checked frequently as a necessary measure.<sup>[9]</sup> Available sources are not in agreement regarding the use of NS as eyewash.<sup>[1]</sup> It has been reported that NS increases tear production;<sup>[13]</sup> however, the burning sensation caused by washing the eyes with NS has been reported as one of its unpleasant side effects.<sup>[2]</sup> Some studies have reported a relationship between NS use and increased prevalence of keratopathy in patients in the ICU.<sup>[14,15]</sup> These studies were conducted without a control group; thus, this subject must be studied in a clinical trial with a control group. Therefore, the present study was conducted to assess the impact of NS on EK incidence among patients in ICUs.

## Materials and Methods

This single-blind clinical trial was conducted to evaluate the effect of NS on the incidence of EK in patients hospitalized in the ICUs of Valiasr Hospital, Arak, Iran, in 2015. It has been registered in the Iranian Registry of Clinical Trials (IRCT2015053122510N1). The study was performed in the three ICUs of Valiasr Hospital, containing 23 active beds, during 5 months. The sample volume was determined ( $N = 50$ ) based on previous studies and  $\alpha = 0.05$ ,  $\beta = 0.2$ ,  $p_1 = 19$ ,  $p_2 = 45$ , using sample size formula. Thus, 50 unconscious patients in the ICU who had the inclusion criteria were selected through purposive sampling. Patients who were older than 18 years, had been under mechanical ventilation for a minimum of 7 days, and had a Glasgow Coma Scale (GCS) score of lower than 11, no history of underlying eye disease, no evident injury in the face and eyes, and no blinking reflex were entered into the study. For the random allocation samples to two groups; one eye was assigned to the intervention group and the other to the control group by coin flipping. Therefore, the left eye of half of the patients and the right eye of half of the patients were randomly assigned to the intervention and control groups. In order for the care services to be performed in the same way, all colleagues received training on the study objective and care method before the study and were asked to perform care based on the written protocol provided for them. The study began on the first day of hospitalization of the patients and ended on the 7<sup>th</sup> day. The care protocol in the control group consisted of washing the hands before eye care, and using artificial tears (two drops) every 4 h if the eyes are closed. Moreover, it included using simple eye ointment and artificial tears (two drops) every 4 h, closing the eyes with adhesive tape, covering the eye with a pad during suction, evaluating the eyes using fluorescein and an ophthalmoscope with a cobalt blue filter, and informing the physician if any evident damage (white or yellow dots on the surface of the cornea or redness, swelling,

and inflammation of the conjunctiva) exists in case of lagophthalmos. In the intervention group, in addition to these measures, NS was used every 6 h.

The demographic questionnaire consisted of questions on age, gender, disease history, and cause of hospitalization, the status of eyelids, consciousness level, respiratory status, and prescribed drugs. The eyes were examined daily for 7 days by a nurse who had received training in this regard and was approved by an ophthalmologist. The examination was conducted using fluorescein and an ophthalmoscope with a cobalt blue filter. Corneal Changes Rating Scale was used to evaluate the prevalence and severity of keratopathy [Table 1]. The examiner was blinded to the treatment provided for each eye. The collected data were coded and analyzed using frequency, percentage, mean and standard deviation, and Chi-square test in SPSS software (version 21, IBM Corporation, Armonk, NY, USA).

## Ethical considerations

This study was approved by the research committee and ethics Committee (IR.arakmu.rec. 1394.4) of Arak University of Medical Sciences, Iran. The patients' legal guardians were assured that all data would be used for research purposes only and would remain confidential. The study objectives and methods were explained to patients' legal guardians and informed written consent forms were obtained from them. They could withdraw from the study at any time without any changes in their treatment. The researchers observed the ethical principles issued by the Ministry of Health and Medical Education in all stages of the study.

## Results

This study was carried out in ICUs of Valiasr Hospital in October–February 2015. Of the 61 of patients entered into the study, 11 withdrew from the study; six due to death and five due to increased consciousness and regaining of the blinking reflex. Therefore, 50 patients completed the study. The results showed that the majority of subjects were men (31 individuals; 62%) and had a mean age of 62.47 (18.206). The most common causes of hospitalization

**Table 1: Ocular surface disease category**

Definition	Grade
No exposure keratopathy	0
PEEs involving the inferior third of the cornea	I
PEEs involving more than the inferior third of the corneal surface	II
MED	III
SWED	IV
Stromal scar	V
Microbial keratitis	VI

PEEs: Punctate epithelial erosions; MED: Macro epithelial defect; SWED: Stromal whitening in the presence of epithelial defect

were cerebrovascular accident (CVA) (20 individuals; 40%) and traumatic brain injury (TBI) (17 individuals; 34%), respectively. The remaining patients were hospitalized due to surgery, intracranial neoplasm, Guillain-Barré syndrome (GBS), infection, poisoning, and internal diseases. Among the 50 participants, lagophthalmos was observed in eight (16%) individuals. In each patient, one eye was randomly assigned to the intervention group and the other to the control group; therefore, the two groups were homogeneous in all variables. Chi-square and Fisher's exact tests were used to compare the groups in terms of the prevalence and severity of keratopathy before the intervention (day 1) and after the intervention (day 7). The results presented in [Tables 2 and 3] show that there was no statistically significant difference between the two groups before the intervention ( $p = 0.70$  and  $p = 0.70$ , respectively). Although, the prevalence and severity of keratopathy was higher in the intervention group after the intervention (day 7), this difference was not statistically significant ( $p = 0.50$  and  $p = 0.90$ , respectively). The most important finding of the study was that the increase in prevalence and severity of keratopathy in the control group from day 1 (three individuals) until day 7 (nine individuals) was not significant ( $p = 0.10$ ); however, the increased in prevalence and severity of keratopathy in the intervention group was significant ( $p = 0.03$ ). In other words, administration of NS increased the prevalence and severity of keratopathy.

## Discussion

The results of the present study showed that some patients had keratopathy since the first day of hospitalization in the ICU, and its prevalence and severity increased despite nursing care provision and increased hospitalization

**Table 2: Comparison of the prevalence of keratopathy in the two groups before and after the intervention**

Group time	Control	Intervention	<i>p</i>
	Frequency (Percentage)	Frequency (Percentage)	
Before the intervention (day 1)	3 (6)	4 (8)	0.70
After the intervention (day 7)	9 (18)	13 (26)	0.90
<i>p</i>	$\chi^2=2.3$ $p=0.1$	$\chi^2=4.5$ $p=0.03$	

**Table 3: Comparison of the severity of keratopathy in the two groups before and after the intervention**

Group time	Control		Intervention		<i>p</i>
	Grade II	Grade I	Grade II	Grade I	
Before the intervention	2	1	3	1	$\chi^2=0.21$ $p=0.700$
After the intervention	3	6	6	7	$\chi^2=1.872$ $p=0.500$
<i>p</i>	$\chi^2=4.181$ $p=0.124$		$\chi^2=6.47$ $p=0.030$		

duration (7 days). However, this increase was only significant in the intervention group, in which NS was administered in addition to standard care services. The presence of keratopathy on the first day of hospitalization is in agreement with some previous studies. A study conducted on 70 patients who were hospitalized in the ophthalmology ward due to lagophthalmos showed that 40 patients had lagophthalmos at the beginning of the study.<sup>[16]</sup> So *et al.* stated that corneal epithelial abrasion was observed in some patients during the first 24 h of hospitalization in the ICU.<sup>[5]</sup> Comorbidities present in the patients may be effective in the incidence of keratopathy on the first day of hospitalization.<sup>[16]</sup> In the present study, some patients had been in other wards (e.g., emergency ward) before hospitalization in the ICU and incidence of keratopathy in them may be due to lack of suitable and adequate care services.

Nevertheless, in the present study, the prevalence and severity of keratopathy had increased in both groups, but this increase was only statistically significant in the intervention group. Some studies have suggested that increase in duration of hospitalization in the ICU can increase the prevalence of keratopathy.<sup>[17]</sup> However, McHugh *et al.*<sup>[10]</sup> and Ezra *et al.*<sup>[11]</sup> found that increased duration of hospitalization in the ICU did not increase keratopathy incidence. The difference in the findings of these studies may be due to the difference in the eye care provided. Although, there is no consensus on the use of NS as eyewash or eye drop, the results of the present study showed that the use of NS can increase keratopathy in patients hospitalized in the ICU. This finding is in agreement with that of the studies by Desalu *et al.*<sup>[14]</sup> and Kalhori *et al.*<sup>[15]</sup> It has been reported that the stimulatory property of NS can increase tear secretion. Nevertheless, Trees and Tomlinson found no difference in tear evaporation rate immediately after artificial tears and NS use; the natural evaporation duration (returning to baseline) is 9.5 and 37.5 min for artificial tears and NS, respectively. In other words, high tear evaporation rate after NS use may be the cause of dry eyes and keratopathy incidence in critically ill patients.<sup>[13]</sup> Thus, NS use may increase corneal damage and is not recommended.<sup>[15]</sup> The findings of this study may assist in the creation of a standard care method in ICUs, increase the knowledge of nurses, and result in the provision of suitable eye care, and thus, reduced eye complications in patients in the ICUs.

The small sample volume and the simultaneous use of artificial tear drop and NS, in order to control the possible side effects of NS, in the intervention group were the limitations of the present study.

## Conclusion

The results of the present study showed that NS use as eye care in patients in ICUs can increase the prevalence and severity of keratopathy in these critically ill patients.

Through the presentation of an eye care method, this study can assist the accurate and timely evaluation of high-risk patients and the prevention and timely treatment of ocular surface diseases, and prevent their progression. Thus, it can be effective in the reduction of the complications and expenses of hospitalization. This study was part of a master's thesis in critical care nursing.

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### Conflicts of interest

There are no conflicts of interest.

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