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Original Article

Incidence and related factors of surface eye disorders in traumatic intensive care unit patients in Iran

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Abstract: Background: Intensive care unit (ICU) patients are exposed to several surface eye disorders ranged from minor complications like corneal dryness to more serious ones such as corneal perforation and blindness. This study is then to assess the incidence of the ocular complications and related factors. Materials and methods: During a prospective cross sectional study in a general adult ICU, ocular complications of the patients were assessed by an ophthalmologist. Data were analyzed using descriptive analysis. A *P*-value of ≤0.05 was considered significant. Results: Out of 155 patients, 130 cases (260 eyes) were covered during the study period, 2016-2017. The most common complications among the patients included dry eye and corneal abrasion (25.8%) followed by conjunctivitis (25%). The mean time of occurrence for dryness and corneal abrasion was 4±2.93 days after admission to the ICU. Lower Glasgow coma scale (GCS) and longer hospital stay were significantly associated with ocular complications in the ICU (P<0.05). Conclusion: Eye surface complications are commonplace in critically ill patients admitted in the ICU. Dry eye, corneal abrasion, and conjunctivitis have been revealed as the most prevalent complications in this study. Lower GCS and longer stay in the ICU predisposed the cases to these complications. Efficient eye care protocol and training the ICU staff are both recommended to reduce complication rates as such.

Keywords: Intensive care unit, lagophthalmos, ocular surface disorders, exposure keratopathy

Introduction

Intensive care unit (ICU) patients are exposed to several eye disorders [1]. Due to the extensive problems in the vital organs that may be life-threatening, it seems that minor ocular complications should be taken more serious [2]. These complications ranged from corneal dryness and keratopathy to the corneal perforation and blindness [3]. In addition to changing the mechanisms protecting the eyes such as eye closure, tear formation, blinking, and corneal reflex, some other iatrogenic causes such as mechanical ventilation, sedation and muscle relaxants should not be neglected as well [4]. Studies have shown that 60% of the patients who have endotracheal tubes and eyelids do not close their eyes completely and are at risk for ocular complications [5, 6]. According to Farrell's and Laight's studies, eye care was neglected in 62% of the patients admitted to the ICU [7, 8]. Suresh et al. have reported that there is no evidence-based guide to eye care in the ICU and meanwhile few studies have explored caregivers' perceptions regarding eye care as to what is important when providing care [9]. A Korean study also found that there were no specific eye care protocols in the ICU [10]. Dowson showed that different methods were used for taking care of eyes in different centers such as rinse eyes with sterile water or normal saline, using antibiotic ointments (e.g. tetracycline or gentamicin) or polyethylene covers, swimming goggles, paraffin gas or closing eyes by adhesive tape [11].

The most prevalent eye complications which have been reported in the ICU patients include exposure keratopathy (3.6% to 60%), chemosis (9% to 80%), and microbial keratitis [2]. These complications can be avoided if evidenced-based protocols are used. This study was per-

formed to determine and identify the incidence and the related factors of ocular disorders in our ICU settings.

Materials and methods

Study design

This prospective descriptive study was approved by the institutional review board (IRB) of Kashan University of Medical Sciences (Approval No: 1962.1393/08/28). Written consent was obtained from each patient or patient's family in this study.

Study population

The study population consisted of the ICU patients who were hospitalized in the surgical and neurosurgical ICU wards of Shahid Beheshti Hospital of Kashan University of Medical Sciences in Iran and met the inclusion criteria (155 cases) during the study period (between 21 March 2016-21 March 2017). The inclusion criteria included hospitalization in the ICU due to trauma, remaining hospitalized for more than 48 hrs in the ICU, and consent to participate in the study. Exclusion criteria included occurence of dry eye and corneal ulcer before admission to the ICU. A totality of 130 patients was included and 25 patients were excluded based on the inclusion and exclusion criteria.

Data collection and measuring tools

Patients' information including age, gender, duration of hospitalization in the ICU, type of trauma leading to hospitalization (penetrating or non-penetrating), facial injury (if existed), Glasgow coma scale, type of eye complication, and type of treatment both for the existing injury or for the eye protection (if performed) were all recorded. Prior to the commencement of data collection, an intensive care unit nurse was trained to evaluate eye problems by an ophthalmologist through which all the probable eye complications reported by the nurse were confirmed by the same ophthalmologist. Also, the same ophthalmologist examined all the eligible patients at the time of admission to the intensive care unit whereas the presence of dry eyes and corneal ulcers was taken into consideration. Schirmer's tape was used to check the dryness of the eye, which is located at the edge of the eyelid. Wetting of the tape up to 15 mm was considered as no corneal dryness. The presence of corneal ulcers was assessed by fluorescein staining and portable slit lamp. If there were dry eye and corneal ulcer at the admission, the patients were excluded from the study. The ophthalmologist was to examine the patients every other day to check for ocular complications.

Statistical analysis

The descriptive analysis was conducted using measuring tools such as frequency distribution, measures of central tendency (mean), and measures of variability (standard deviation). For categorical variables, the Chi-Square test was used to show differences between the patients. The *P*-value of ≤0.05 was considered significant. Also, the SPSS version 22 was used for the statistical analysis.

Results

Population

A total of 155 patients were included. Twenty-five patients were excluded for the reason of early discharge from the ICU (n=8) and death (n=17). Eventually, 130 patients including 260 eyes were covered during this study.

Demographic data and ocular injury characteristics

Of the 130 analyzed cases, 102 (78.4%) were male and the rest were female. The mean and standard deviation age of the participants was 42.48±17.53 years old. The most common causes of ICU hospitalization were head and face trauma (57.7%), multiple trauma (16.2%), chest (12.3%), neck (9.2%), and abdomen (4.6%), respectively. Of the total subjects, 72 patients (46.5%) had experienced penetrated traumas while the rest had shown off non-penetrating traumas. The mean (SD) length of hospital stay in the ICU was 13.7±7.67 days. The most common facial injuries among the patients were eyelid and periorbital hematoma followed by conjunctival hemorrhage. No global rupture was observed (**Table 1**). The incidence of dry eye and corneal abrasion in the ICU patients in this study was 25.8%. This complication was reported more common in men (but no significant) significantly in the age group of 40-59 years (P<0.001) (**Tables 2** and

Table 1. Frequency distribution of the Occular and facial injuries in the patients with ocular trauma admitted to Kashan Shahid Beheshti hospital during the study period

Type of injury	No. (%)
Rupture of the globe of the eye	0 (0)
Periorbital and eyelid hematoma	65 (56.5)
Conjunctival hemorrhage	39 (33.9)
Facial tearing (except eyelid)	29 (25.2)
Eyelid tearing	23 (20)
Orbital bone fracture	4 (3.5)
Total damaged items	115 (44.2)
Sum	260 (100)

3). The second most common complication was conjunctivitis (25%), which was more common in the age group less than 19 years old (**Table 3**). The mean time of dryness and corneal abrasion was 4±2.93 days after admission to the ICU. All the ocular complications due to hospitalization in the ICU were significantly inversely related to the patients' GCS and were positively associated with the duration of hospitalization (**Tables 4** and **5**).

Discussion

The results of this study showed that the most common ocular complications following hospitalization in the ICU are dry eye and corneal abrasion. The median time for the onset of these complications was 4 to 5 days after admission, respectively. The incidence of complications was inversely related to both the level of consciousness of the patients and the duration of hospitalization in the ICU.

The healthiness of the surface of the eye, mainly the cornea, depends on the ability of producing tears, blinking, and closing the eyes during sleep. These can be impaired on the ICU due to some different reasons including diseases such as facial edema, subconsciousness, neurological injury or treatments such as the drying effects of gas flows from non-invasive ventilation (e.g. CPAP) or oxygen masks. In addition, muscle relaxants can reduce the tonic contraction of the orbicularis muscle around the eye, resulting impaired eye closure. Also, sedation may cause blinking impairment and the blink reflex. Whatever the reason, the result is keeping the eyes open and increasing the risk of superficial eye damage [12].

The current study produced results which are in line with the findings of a great deal of previous works done in this field. Kousha O et al., during a two-phase study has reported the overall incidence of exposure keratopathy in their study as 21% [13]. W Narmawala and HC Jani reported the incidence of exposure keratopathy 40% in a total of 146 patients during a prospected study in the ICU at a tertiary care hospital [14]. The result of keratopathy in our study (25.8%) is almost closer to that in our former study. However, Rosenberg JB et al., during a narrative review and meta-analysis concluded that a total of 20% to 42% of the patients in the ICU developed exposure keratopathy [15]. All the mentioned studies including our study lie in this range. In the present study, the incidence of conjunctivitis was 25%. The incidence of this complication was reported by Brito et al. [16] 17.7% among 1442 ICU cases while the incidence was 16.1% among 143 patients admitted to the ICU in the study directed by Imanaka H et al. [17]. As can be seen from the results, the frequency of conjunctivitis is slightly higher in our study. Chemosis (14.6%) and keratitis (6.9%) were other common complications identified in the patients in the current study. Out of the 143 patients in the study performed by W Narmawala and HC Jani, 18 (12.5%) had chemosis [14]. In a study by Abrishami et al., the incidence of chemosis was reported in 22 cases (15.5%) among 142 patients who were admitted to the ICU [18]. These findings are in agreement with our results. The range of chemosis in various studies has been reported from 9 to 80% [2]. Saritas TB et al. [19], and Lenart SB et al. [20], reported the incidence of keratitis in the patients admitted to the ICU in their studies as 10% and 18%, respectively. This discrepancy between the result of the chemosis and keratitis in the current study and those mentioned may be due to methodological differences such as sample size, inclusion/exclusion criteria, and definition of the complications and the outcomes. One of the important findings of this study was the high incidence of ocular complications in the patients with lower GCS and those patients with longer duration of ICU stay. In the present study, GCS less than 8 was significantly associated with the ocular complications. These results are consistent with those of other studies conducted in this field [14, 21, 22]. Such patients are usually under

Table 2. Frequency distribution of the occular complications by age in the patients with ocular trauma admitted to Kashan Shahid Beheshti hospital during the study period

Type of complication	Age				Sum	*P* value*
	<19	20-39	40-59	>60		
Without eye complication	32 (32)	21 (21)	18 (18)	29 (29)	100	-
Dry eyes and corneal abrasions	5 (7.5)	27 (40.3)	30 (44.8)	5 (7.5)	67	<0.001
Conjunctivitis	30 (46.2)	15 (23.1)	14 (21.5)	6 (9.2)	65	0.021
Chemosis	16 (42.1)	8 (21.1)	11 (28.9)	3 (7.9)	38	0.036
Keratitis	3 (16.7)	4 (22.2)	6 (33.3)	5 (27.8)	18	0.39
Total eyes	79 (30.4)	68 (26.2)	72 (27.7)	41 (15.8)	260	-

*Chi Square test (Compared to uncomplicated cases as base line).

Table 3. Frequency distribution of the occular complications by gender in the patients with ocular trauma admitted to Kashan Shahid Beheshti hospital during the study period

Gender	Male	Female	Sum	*P* Value*
Type of complication				
Without eye complication	66 (66)	34 (34)	100	-
Dry eyes and corneal abrasions	44 (65.7)	23 (34.3)	67	0.079
Conjunctivitis	34 (52.3)	31 (47.7)	65	0.965
Chemosis	22 (57.9)	16 (42.1)	38	0.376
Keratitis	11 (61.1)	7 (38.9)	18	0.688
Sum	160 (61.5)	100 (38.5)	260	-

*Chi Square test.

mechanical ventilation in as much as several studies have shown the association between mechanical ventilation and ocular complications [22-25]. These patients usually receive muscle relaxants and sedatives to tolerate the mechanical ventilation and have a low level of consciousness. Hence, their eyelids usually remain open and have no blinking too. This provides the conditions for superficial eye complications 12]. The current study also proved that the longer the hospital stay in the ICU, the higher the risk of ocular complications as indicated in other studies [19, 23, 26, 27]. The ocular complications in the ICU generally depend on the nursing care provided in the ward. However, many superficial corneal injuries are preventable by having a clear protocol for initial evaluation and timely treatment criteria [11, 15, 28]. On the other hand, training the ICU staff plays an important role in reducing superficial ocular complications in the hospitalized patients [14, 29].

There are a few limitations in our study need to be considered. Firstly, this study is a part of internship thesis and has a time limit. Therefore, it is recommended to consider a follow-up period to monitor the effects of eye care methods in the long term. Secondly, this study was designed as a descriptive study, which should be conducted as a clinical trial to increase the strength and quality of the study. Lastly, this study was conducted in a single center, which was better to be performed in multiple centers to increase the sample size. In this case, both the sample size would increase and comparison between centers would be possible.

Conclusion

On the whole, it can be concluded from this study that the ocular surface complications are common among the critically ill patients in the ICU. Dry eye, corneal abrasion and conjunctivitis have been among the most prevalent complications. Lower GCS and longer stay in the ICU predispose to these complications.

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Disclosure of conflict of interest

None.

Table 4. Frequency distribution of the occular complications based on Glasgow coma scale (GCS) in the patients with ocular trauma admitted to Kashan Shahid Beheshti hospital during the study period

Type of complication	GCS			Total	*P* Value*
	≤8	9-12	13-15		
Without eye complication	30 (30)	32 (32)	38 (38)	100	-
Dry eyes and corneal abrasions	36 (53.7)	23 (34.3)	8 (11.9)	67	<0.018
Conjunctivitis	29 (44.6)	22 (33.8)	14 (21.5)	65	<0.001
Chemosis	25 (65.8)	11 (28.9)	2 (5.3)	38	<0.001
Keratitis	12 (66.7)	3 (16.7)	3 (16.7)	18	0.011
Sum	161 (61.9)	47 (18.1)	52 (20)	260	-

*Chi Square test.

Table 5. Frequency distribution of the occular complications based on duration of hospitalization in the patients with ocular trauma admitted to Kashan Shahid Beheshti hospital during the study period

Type of complication	Duration of hospitalization (day)			Total	*P* value*
	1-5	6-10	11-15		
Without eye complication	14 (14)	44 (44)	42 (42)	100	-
Dry eyes and corneal abrasions	3 (4.5)	13 (19.4)	51 (76.1)	67	<0.001
Conjunctivitis	10 (15.4)	16 (24.6)	39 (60)	65	0.035
Chemosis	2 (5.3)	7 (18.4)	29 (76.3)	38	<0.001
Keratitis	1 (5.6)	3 (16.7)	14 (77.8)	18	0.013
Sum	40 (15.4)	65 (25)	155 (59.6)	260	-

*Chi Square test.

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