Effect of Risk Reduction Nursing Measures on the Occurrence of Corneal Injury for Patients at Intensive Care Unit

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Abstract

Background: Prevention of corneal complications for Intensive Care Unit patients considered an effective way to avoid corneal damage. Polyethylene covering is transparent dressing which creates moist chamber providing a barrier against tear-film evaporation and physical barrier for micro-organisms **Aim:** This study was carried out to evaluate the effect of risk reduction nursing measures on the occurrence of corneal injury for patients in Intensive Care Unit. **Design:** Quasi-experimental design. **Setting:** Anesthetic Intensive Care Unit, at Tanta Emergency Hospital and Anesthetic Intensive Care Unit, at Tanta University Educational Hospital affiliated to Ministry of Higher Education and Scientific Research. **Subjects**: A convenience sampling of 60 mechanically ventilated patients divided into study and control groups (30 patients for each). **Tools**: **Tool I:** Critically Ill Patients Assessment Tool. **Tool II:** Richmond Agitation Sedation Scale. **Tool III:** Clinical Indicators of Corneal Injury Assessment Tool. **Results:** Findings of the present study revealed that there was statistical significant difference were observed among study group regarding physical assessment indicator of corneal injury regarding left eyelids, right and left conjunctiva which (P= 0.001, 0.021, 0.003) respectively. The current results revealed that more than two- third (73.33%) and the majority (93.33%) of study group patients have normal cornea in right and left eyes respectively from 1st to 7th days, and there was a statistical significant difference between control and study groups on the 7^{th} day in relation to corneal ulcer in right and left eyes (P = 0.001 and 0.00) respectively. **Conclusion:** Using eye care protocol reduced the incidence of keratitis, conjunctivitis, dry eye, and corneal ulcers in patients admitted to ICU. **Recommendations:** Eye care should be standardized as a basic part of nursing care provided to all critically ill patients in ICU. Emphasize the importance of assessing critically ill patient's eyelids, conjunctiva, cornea, and pupil for early detection of any eye problem. The study should be applied on large probability sample.

Key Words : Corneal injury , Critically Ill Patient, Intensive care unit & Risk reduction measures.

Introduction

Critically ill patients who admitted to Intensive Care Unit are provided with comprehensive and specialized medical and nursing care. With recent advances in the critical care medicine, it is evident that intensive care plan cannot limit itself with the resuscitative measures only. In contrast, it needs to provide the quality care plan to every organ of the patient.[1] Eye care became the integral part of care plan for critically ill patients.

Those patients who are mechanically ventilated have high propensity to develop corneal injury which may lead to keratitis, corneal perforation and blindness. In addition to alteration in the protective mechanism of eyes, intensive care environment predisposes exposure of ocular surface to microorganisms and complications of overzealous resuscitation that may end up with chemosis and other eye complications. The incidence of eye-related complications in intensive care patients in different studies varies from 23% to 60% which include exposure keratitis and other corneal complications as well. [1]

All over the world, the number of mechanically ventilated patients in Intensive Care Unit rises to 56% at 2020.[2] In Egypt, the incidence of patients requiring mechanical ventilation in Intensive Care Unit is about 40-65% .[3]Annually at Internal Anesthetic Intensive care unit, Emergency Hospitals at Gharbia Governate, Egypt, according to Statistical record center in Tanta University 2021, there are About 220 patients are admitted Intensive Care Unit, and about 120 needs mechanical ventilation.[4]

The ventilated intensive care patients are prone to many eye complications as a result of loss of normal defense mechanism in response to high dose of sedation after mechanical ventilation therapy.[5,6]

Corneal injury indicates damage to the surface layers of the eye, namely the cornea and conjunctiva. There are many factors that cause corneal injury in the Intensive Care Unit. These factors include reduced level of consciousness and loss of natural eye protection mechanisms which including reduced the rate of tear production and the blinking reflex, incomplete lid closure (lagophthalmos), and lid or conjunctival edema ; all occurring with the mechanical ventilation. [7-10]

Prevention of corneal injury is a very important and vital role of the ICU nurse. Eye assessment should be part of a routine patient physical assessment and be performed on admission, followed by an ongoing assessment at the beginning of each new nursing shift. Nurses provides a baseline assessment, monitor response to clinical treatment, identify any changes of the eyes. Each eye should be assessed independently. Eye assessment in ICU should include eye opening, reaction, and eyelid closure, eyelid position, blinking reflex, pupil size and signs of corneal complications. [11]

Eye care is an important aspect refers to measures that maintain ocular health, comfort and protect eye surfaces from potential harm .[12] In recent decades, many evidence-based practices for eye care were developed; these practices include a wide range of interventions such as washing the eyes with normal saline solution, using lubricating ointments or teardrops, moisturizing the eyes by applying a polyethylene eye cover.[10,11,15-22]

Polyethylene film is a single polymer, obtained by polymerization of ethylene. This is low-density plastic that contains no trace of potentially toxic materials. It is a transparent film containing 100% polyethylene in the middle of the cover and double-sided and adhesive drape forms the edges of the cover. This polymer has high resistance to water and other solutions. This feature enables polyethylene film to cover the area from the eyebrow to the cheek that keep eye from any organisms. It is also an eye protector that prevents tears from evaporating away from the eye surface which keeping the eye moistened by tears, and thus forming a moist chamber to preserve the integrity of the cornea.[23,24]

Significance of the study

Critically ill patients who admitted to the Intensive Care Unit have many risk factors for corneal injury, including loss of consciousness, receiving sedative and neuromuscular blocking agents, and mechanical ventilation which lead to lose of eye-protective mechanisms causing exposure to corneal injury, it found to be between 23% and 60% in critically ill patients.

The high incidence of ocular complications in ICU may remind the fact that eye care is important nursing care for patients undergoing mechanical ventilation. Therefore, the present study was conducted to evaluate the effect of different risk reduction nursing measures on the occurrence of corneal injury.

Aim of the study

The aim of the study is to evaluate the effect of risk reduction nursing measures on the occurrence of corneal injury for patients at Intensive Care Unit.

Research hypothesis

Critically ill patients who will receive risk reduction nursing measures are expected to decrease corneal injury compared to control group who receive routine care.

Subjects and Method

Subjects

Study Design

A quasi- experimental research design was utilized in this study.

Setting

This study was conducted the Anesthetic Intensive Care Unit, in Tanta Emergency Hospital and the Internal Anesthetic Intensive Care Unit, in International Educational Hospital at Tanta University affiliated to ministry of higher education and scientific research.

Subjects

A convenience sampling of 60 mechanically ventilated patients who were admitted to the previously mentioned settings and were selected based on Epi info statistical program.

The sample was divided into two equal groups, 30 patients in each as follow:

Control group: They received routine hospital eye care which included eye irrigation with sterile normal saline and covered the eye with tape.

Study group: They received a combination of polyethylene eye- cover and artificial teardrops with routine hospital eye care.

Tools of data collection

Three tools were used in this study:-

Tool I: Critically Ill Patients Assessment

This tool was developed by the researcher after reviewed the relevant literature[25-28] to assess patients bio-socio demographic characteristics, ventilator parameters and level of consciousness ,It included three parts as follow:

Part (a): Patient's Bio-Socio Demographic Data

This part included bio-socio demographic data regard to patient's age, sex, and clinical data as diagnosis, past medical history and types of medication (sedation – neuromuscular).

Part (b): Mechanical Ventilation Parameters assessment Sheet [29]

It was developed by the researcher**,** it was used to assess; mode of mechanical ventilation which included {controlled mandatory ventilation (CMV), assisted controlled ventilation (ACV), intermittent mandatory ventilation (IMV), synchronized intermittent mandatory ventilation (SIMV), positive end-expiratory pressure(PEEP), continuous positive airway pressure(CPAP)} , positive end expiratory pressure (PEEP), fraction of inspired oxygen (FiO2) and (SPO2) for ventilated patients.

Part (c): Assessment of Glasgow Coma Scale (GCS):[30]

It was developed by **Steven M Green (2021)** and adopted by the researcher to assess the level of consciousness of critically ill patient. It was divided into three main variables: eye opening response (4 items), verbal response (5 items), and motor response (6 items).The researcher checked the response of the subjects pertinent to the three variables of the GCS.

Scoring system

The level of consciousness was determined by the sum of the given score for each variable and classified as follows:

- Score of 13-15 was considered mild level.
- Score of 9-12 was considered moderate level.
- Score of 3-8 was considered severe level.

Tool (II):- Richmond Agitation Sedation Scale (RASS):[31]

This tool was developed by **Sessler (2020)** and adopted by the researcher. It was used to assess patient's anxiety and agitation.

-RASS was a 10-point scale, with four levels of anxiety or agitation (+1 to +4), one level to denote a calm and alert state. (0), and 5 levels of sedation (−1 to −5) culminating in unarousable (−5).

-In addition to, sedation and muscles relaxants data used to assess effect of sedation and muscles relaxant on corneal exposure and eye closure on critically ill patients. It included drug names, dose and frequency.

Tool (III):- Clinical Indicators of Corneal Injury Assessment Tool

This tool was developed by the researcher after reviewed of the related literature [32], Which divided into three parts:-

Part (a): Physical assessment of eye:

This part was used to assess patient's eyelids, conjunctiva, cornea, and pupil from the first day of admission for seven consequent days, and three times per day as following:

- **Assessment of eyelids** for the presence of any Lesions, crusting, redness, swelling / bruising, and lacerations.
- **Assessment of conjunctiva** for the presence of chemosis (edema), discharge, sub-conjunctival hemorrhage, lacerations, and lesions.

Part (b): Corneal Fluorescein Staining (CFS):[33]

It was developed by **Pellegrini M (2021)** and adopted by the researcher.

- It was used to assess the viability of the epithelium and provide extensive details about ocular surface injury. The Corneal Fluorescein Staining was specific in identifying corneal damage in ICU patients

as well as fluorescein testing considered to measure and classify the patients' corneal injury, it was used as the following.

- At the portable slit-lamp microscope with a blue filter, the cornea examined between four and eight minutes following the instillation of fluorescein by using the fluorescein strip. The patient's eyelid gently opened and closed a few times to spread the Fluorescein on the eye surface.
- The concentration and the breadth of the corneal staining provided valuable evidence to measure disease severity and to monitor the response to treatment .Epithelial Erosions counted and scored from zero to five.

Scoring system

-Severity 0: Lack of contact keratopathy.

-Severity 1: Incidence of lesion spots (pits resulting from loss of epithelium cells in one third of the lower epithelium layer of cornea.

-Severity 2: Incidence of pits (small pits) in more than one third of lower epithelium layer of cornea.

-Severity 3: Incidence of macro-epithelial defects.

-Severity 4: Turbidity of stroma layer despite epithelial defects of cornea.

-Severity 5: Incidence of scar in stroma layer.

Part (c): - Eye Grading Guide :[34]

This part was developed by **Mercieca (2020)** and it used to accurately assess the degree of eye exposure and closure for grading lagophthalmos from the first day of admission for seven consequent days, and three times per day. It consisted of three grades:-

- **Grade 1**: Lids completely closed.
- **Grade 2**: Any conjunctival exposure as shown by any white of the eye being visible, but no corneal exposure.
- **Grade 3**: Any corneal exposure, even a very tiny amount. .

Method

1. Official permission. It was obtained from the responsible authorities at Faculty of Nursing, Tanta University to the director of Emergency Hospital, teaching hospital to carry out the study.
2. Ethical Consideration

- Approval of scientific research ethical committee was obtained and code No was 30/1/2022 and the code number of Faculty of Medicine was 35244 /1/22.
- Written informed consent was obtained from the responsible person for critically ill patients.
- Confidentiality and anonymity was maintained by the use of code number instead of name and the right of withdrawal is reserved.
- Privacy of the studied patients was maintained.
- The study didn't cause any harm to the critically ill patients.

3. The tool (I) part (a,b) was developed by the researcher after reviewing related literature, part (c) was developed by **Steven M Green (2021).** Tool (II) was developed by **Sessler (2020)** and adopted by researcher**.** And tool (III) part(a) was developed by the researcher to conduct the study, part (b, c) was developed by **Pellegrini M (2021) and Mercieca (2020)** respectively and adopted by researcher.
4. **Tool validity:** The content validity of the developed tool tested for clarity and applicability by seven experts in Critical

Care nursing and Biostatistics to ensure their validity and modifications was done.

5. The reliability was done on the tools by Cronbach`s Alpha test.
   -Cronbach's Alpha for tool I is 0.850 for 14 items applied on 6 patients.
   - Cronbach's Alpha for tool II is 0.981 for 1 item applied on 6 patients.
   - Cronbach's Alpha for tool III is 0.808 for 8 items applied on 6 patients.
   - Cronbach's Alpha for the studied sheet in total is 0.950 for 6 patients.
6. **Pilot study:** A pilot study was carried out to assess the feasibility and applicability of the tools and the needed modifications was done, a pilot study was done on 10% (6) patients and excluded from the study.
7. The study was conducted at four phases which include assessment, planning, implementation and evaluation phase.
8. Data was collected within six months from 20-4-2022 to 20-10-2022

Results

Table (1): Illustrates distribution of the studied patients according to their demographic characteristics. In this results, it was observed that less than half (46.67%) of control group and more than one quarter (26.67%) of the study group were between 50-60 years old, with a mean age of 43.87±12.401 in control group and 40.67±11.127 in study group. In relation to sex, more than half of the patients in control and study groups (53.33% and 66.67%) were male respectively.

Table (2): Illustrates distribution of the studied patients according to their clinical data. regarding diagnosis the result revealed that more than half (60.00%) of patients in control group and more than one third (40.00%) in the study groups had brain trauma. Concerning previous ICU admission, the majority (86.67%) of patients in control group and more than half (60.00%) in study groups didn't admitted previously to ICU. Regarding past medical history, more than one quarter of patients in control and study groups (26.67% and 33.33%) respectively had diabetes mellitus.

Table (3): Illustrates distribution of the studied patients according to the mechanical ventilation parameters data through out period of the study. More than two third (73.33%) of patients in control group and the majority (86.00%) of study group was on ACV mode of ventilation on admission.

Concerning ventilator parameters, the table revealed that the mean tidal volume was 399.27±100.09 among control group and it was 449.33±44.17 among study group on admission. Also, the mean and SD of PEEP on admission among control & study group was 7.87±1.16 & 7.80 ± 0.76 respectively. Moreover, the mean of SPO2 on admission among control & study group was 91.47±2.89 & 94.80±3.30 respectively. Also, the mean of FIO2 on admission among control & study group was 42.67±5.83 & 42.67±6.95 respectively.

Table (4): Illustrates distribution of the studied patients according to Glasgow Coma Scale (GCS) throughout periods of study. The table shows that there were no statistical significant changes were observed through three times of data collection (on admission, 4th day of admission and 7th day of admission) according to the different items of Glasgow Coma Scale (eye opening response, verbal response and motor response) either for control group or study group (P value > 0.05).

Table (5): Distribution of the studied patients according to their mean score of Glasgow Coma Scale (GCS) throughout periods of study. It was seen in this result that all patients in control group (100%) and the majority (93.33%) of study group reported sever level of GCS on admission and at the end of first week. No significant differences were observed among both group which (P> 0.05).

Table (6): Percent distribution of the studied patients regarding Richmond Agitation Sedation Scale (RASS) throughout periods of study. This table showed that more than two third of the patients in control and study groups were un arousal (73.33% and 80.33%) respectively. No significant changes were observed throughout the three times of data collection (on admission, 4th day of admission and 7th day of admission) regarding RASS either for control group or study group (P value > 0.05

Table (7): Illustrate percent distribution of the studied patients regarding physical assessment indicators of corneal injury throughout periods of the study. Regarding right eyelids, the current results showed that (36.67%) of patients in the control group had normal right eyelids after 7th day of the study compared to (86.67%) of patients in the study group. **In relation to left eyelids,** it was observed that (46.67%) of patients in the control group had normal left eyelids after 7th day of the study compared to (80.00%) of patients in the study group. **Concerning physical assessment of right conjunctiva,** it was observed that (33.33%) of patients in the control group had normal right conjunctiva after 7th day of the study compared to (80.00%) of patients in the study group. **Regarding to left conjunctiva,** it was observed that (20.00%) of patients in control group had normal left conjunctiva after 7th day of the study compared to (83.33%) of patients in the study group.

-Statistical significant difference were observed among study group regarding left eyelids, right and left conjunctiva which P= 0.001, 0.021, 0.003 respectively.

Table (8): Percent distribution of the studied patients regarding Corneal Fluorescein Staining (CFS) as an indicator of corneal injury throughout periods of study.

The current results revealed that more than two- third (73.33%) and the majority (93.33%) of study group patients have normal cornea in right and left eyes respectively from 1st to 7th days, and there was a statistical significant difference between control and study groups in right and left eyes (P = 0.001 and 0.00) respectively. As regard to corneal abrasion in right eye, it was observed that (60.00%) of patients in control group had corneal abrasion after 7th day of the study compared to (13.34%) of patients in the study group. Also, regarding corneal abrasion in left eye, it was observed that (60.00%) of patients in the control group had corneal abrasion after 7th day of the study compared to (6.67%) of patients in the study group. Regarding corneal ulcer in right eye, it was observed that small percentage (13.33%) of both control & study group had incidence of macro-epithelial defect after 7th day of the study. Also, regarding corneal ulcer in left eye, it was observed that (20.00%) of patients in control group had incidence of macro-epithelial defect after 7th day of the study compared to no one of any patients in the study group.

Table (9): Percent distribution of the studied patients regarding eye grading guide as an indicator of corneal injury throughout periods of study. The result revealed that more than one third of the patients in control and study groups in relation to eye grading guide in right eye had grade I (46.67%, 46.67%) respectively. No significant changes were observed between the three times of data collection (on admission, 4th day of admission and 7th day of admission) in right eye among both control & study group (P value > 0.05). On the other hand, about half of study group (53.33%) had grade II throughout period of the study.

-Significant changes were observed between control and study groups in left eye (P value = 0.040).

Table (10): Represents comparison between Glasgow Coma Scale (GCS) of the studied patients and their eye grading guide as an indicator of corneal injury at 7th day of intervention. In this table, it was observed that near to half (46.67%) of the control group and more than one third (40.00%) of study group had sever level of GCS reported grade I of eye grading guide in the right eye. Also, less than half (46.67%) of control group and one third (33.33%) of study group had sever GCS reported grade I of eye grading guide in left eye. No significant difference was observed among study group in both right & left eye.

Table (11): Comparison between Richmond Agitation Sedation Scale (RASS) of the studied patients and their eye grading guide as an indicator of corneal injury at 7th day of intervention. Regarding right eye, it was observed that about one third (33.33%) of control group who are un arousal reported grade II of eye grading guide compared to more than one quarter (26.67%) in study group. Also, regarding left eye, it was observed that about more than one quarter (26.67%) of control group who are un arousal reported grade II of eye grading guide compared to near to half (46.67%) in study group.

Table (12): Comparison between Corneal Fluorescein Staining (CFS) of the studied patients among groups and their eye grading guide as indicator of corneal injury at 7th day of intervention. Regarding right eye, it was observed that near to one quarter (20.00%) of control group who have grade I of eye grading guide reported lack of contact keratopathy (normal cornea) compared to near to half (46.67%) in study group. Also, regarding left eye, it was observed that near to one quarter (20.00%) of control group who have grade I of eye grading guide reported lack of contact keratopathy (normal cornea) compared to more than one third (40.00%) in study group.

-Statistical significant difference were observed among control and study groups regarding right eye which (P = 0.001, 0.000) respectively and left eye which (P = 0.000)

Table (1): Distribution of the studied patients according to their demographic characteristics.

Characteristics	The studied patients (n=60)				χ^2 P
	Control group (n=30)		Study group (n=30)		
	N	%	N	%	
Age (in years)					
(21-<30)	4	13.33	8	26.67	
(30-<40)	2	6.67	8	26.67	2.570
(40-<50)	10	33.33	6	20.00	0.056
(50-60)	14	46.67	8	26.67	
Range	(21-60)		(23-59)		t=1.107
Mean ± SD	43.87±12.401		40.67±11.127		P=0.297
Gender					
Male	16	53.33	20	66.67	FE
- Female	14	46.67	10	33.33	0.430

Table (2): Distribution of the studied patients according to their clinical data.

Clinical data	The studied patients (n=60)				χ^2 P
	Control group (n=30)		Study group (n=30)		
	N	%	N	%	
Diagnosis					
- Respiratory failure	6	20.00	8	26.67	
- Ischemic stroke	4	13.33	6	20.00	
- Sepsis	2	6.67	4	13.33	**0.305** **0.721**
- Traumatic brain injury	18	60.00	12	40.00	
Previous ICU admission					
- Yes	4	13.33	12	40.00	
- No	26	86.67	18	60.00	**FE** **0.039***

Past medical history					
- Heart diseases	2	6.67	2	6.67	
- Hypertension	6	20.00	10	33.33	
- Liver diseases	4	13.33	2	6.67	
- Chronic renal failure	2	6.67	0	0.00	**5.602 0.031***
- Respiratory diseases	4	13.33	8	26.67	
- Neurological disease	12	40.00	2	6.67	
- Diabetes mellitus	8	26.67	10	33.33	

Table (3): Distribution of the studied patients according to the mechanical ventilation parameters data through the period of the study.

Ventilator Profile	The studied patients (n=60)													
	Control group (n=30)							Study group (n=30)						
	On Admission		4th day of admission		7th day of admission		χ^2 P	On Admission		4th day of admission		7th day of admission		χ^2 P
	N	%	N	%	N	%		N	%	N	%	N	%	
1.Ventilation mode														
- **ACV**	22	73.33	24	80.00	24	80.00	0.514	26	86.67	26	86.67	26	86.67	0.00
- **SIMV**	8	26.67	6	20.00	6	20.00	0.773	4	13.33	4	13.33	4	13.33	1.00
	Range Mean ± SD													
1. Tidal volume	(208-550) 399.27±100.09		(300-500) 430.00±76.12		(300-500) 433.53±77.70		F=1.463 P=0.237	(370-570) 449.33±44.17		(370-570) 452.67±46.08		(370-570) 456.00±47.53		F=0.158 P=0.854
2. PEEP	(6-10) 7.87±1.16		(6-10) 8.13±1.38		(6-10) 8.53±1.57		F=1.766 P=0.177	(6-9) 7.80±0.76		(6-10) 7.93±0.94		(6-10) 7.93±0.94		F=0.226 P=0.798
3. SPO2	(85-96) 91.47±2.89		(85-96) 91.33±2.72		(89-95) 91.80±1.82		F=0.272 P=0.763	(90-100) 94.80±3.30		(90-100) 95.00±2.65		(91-100) 95.07±2.54		F=0.072 P=0.931
4. FIO2	(40-60) 42.67±5.83		(40-100) 46.00±15.69		(40-100) 61.33±28.25		F=8.277 P=0.001*	(40-60) 42.67±6.95		(40-60) 42.67±6.95		(40-60) 42.67±6.95		F=0.00 P=1.00

Table (4): Distribution of the studied patients according to Glasgow Coma Scale (GCS) throughout periods of study.

Glasgow Coma Scale (GCS)	The studied patients (n=60)												
	Control group (n=30)							Study group (n=30)					
	On admission		4th day of admission		7th day of Admission		χ^2 P	On admission		4th day of Admission		7th day of admission		χ^2 P
	N	%	N	%	N	%		N	%	N	%	N	%	
1. Eye opening response (E)														
- No response	30	100.00	30	100.00	30	100.00	-	28	93.33	28	93.33	28	93.33	0.00
- Open to verbal command	0	0.00	0	0.00	0	0.00		2	6.67	2	6.67	2	6.67	1.00
2. Verbal response (V)														
- No response	22	73.33	22	73.33	22	73.33	0.00	24	80.00	24	80.00	24	80.00	0.00
- Incomprehensible speech	8	26.67	8	26.67	8	26.67	1.00	6	20.00	6	20.00	6	20.00	1.00
3. Motor response (M)														
- No response	22	73.33	22	73.33	22	73.33	0.00	24	80.00	24	80.00	24	80.00	0.00
- Responds with extension	4	13.33	4	13.33	4	13.33	1.00	4	13.33	4	13.33	4	13.33	1.00
- Responds with flexion	2	6.67	2	6.67	2	6.67		0	0.00	0	0.00	0	0.00	
- Withdraws from pain stimuli	0	0.00	0	0.00	0	0.00		2	6.67	2	6.67	2	6.67	
- Responds with movement	2	6.67	2	6.67	2	6.67		0	0.00	0	0.00	0	0.00	

Table (5): Distribution of the studied patients according to their mean score of Glasgow Coma Scale (GCS) throughout periods of study.

Total GCS Level	The studied patients (n=60)													
	Control group (n=30)						χ^2 P	Study group (n=30)						χ^2 P
	On Admission		4th day of Admission		7th day of admission			On admission		4th day of Admission		7th day of Admission		
	N	%	N	%	N	%		N	%	N	%	N	%	
- Severe	30	100.00	30	100.00	30	100.00	-	28	93.33	28	93.33	28	93.33	0.00 1.00
- Moderate	0	0.00	0	0.00	0	0.00		2	6.67	2	6.67	2	6.67	
Range Mean ± SD	(3-8) 3.80±1.49		(3-8) 3.80±1.49		(3-8) 3.80±1.49		F=0.00 P=1.00	(3-9) 3.67±1.65		(3-9) 3.67±1.65		(3-9) 3.67±1.65		F=0.00 P=1.00
Gp1 Vs Gp2 t P	0.111 0.740		0.111 0.740		0.111 0.740									

- Group 1: Control group.
- Group 2: Study group.

Table (6): Percent distribution of the studied patients regarding Richmond Agitation Sedation Scale (RASS) throughout periods of study.

Richmond Agitation Sedation Scale (RASS)	The studied patients (n=60)													
	Control group (n=30)						χ^2 P	Study group (n=30)						χ^2 P
	On Admission		4th day of admission		7th day of admission			On admission		4th day of admission		7th day of admission		
	N	%	N	%	N	%		N	%	N	%	N	%	
- Un arousal	22	73.33	22	73.33	22	73.33	0.00 1.00	24	80.00	24	80.00	24	80.00	0.00 1.00
- Deep sedation	4	13.33	4	13.33	4	13.33		4	13.33	4	13.33	4	13.33	
- Moderate sedation	4	13.33	4	13.33	4	13.33		0	0.00	0	0.00	0	0.00	
- Light sedation	0	0.00	0	0.00	0	0.00		2	6.67	2	6.67	2	6.67	
Gp1 Vs Gp2 χ^2 P	6.078 0.107		6.078 0.107		6.078 0.107									

- Group 1: Control group.
- Group 2: Study group.

Table (7): Percent distribution of the studied patients regarding physical assessment indicators of corneal injury throughout periods of study.

Physical assessment of eye	The studied patients (n=60)												
	Control group (n=30)						χ^2 P	Study group (n=30)						χ^2 P
	On Admission		4th day of Admission		7th day of Admission			On admission		4th day of Admission		7th day of admission		
	N	%	N	%	N	%		N	%	N	%	N	%	
Eyelids right														
- Normal	30	100.0	22	73.33	17	36.67	**16.445**	30	100.00	26	86.67	26	86.67	4.390
- Redness	0	0.00	2	6.67	2	6.67	**0.002***	0	0.00	4	13.33	4	13.33	0.111
- Swelling	0	0.00	6	20.00	11	56.67		0	0.00	0	0.00	0	0.00	
Eyelids left														
- Normal	30	100.0	26	86.67	16	46.67	**40.333**	30	100.00	26	86.67	24	80.00	**17.884**
- Redness	0	0.00	4	13.33	0	0.00	**0.000***	0	0.00	4	13.33	4	13.33	**0.001***
- Swelling	0	0.00	0	0.00	14	53.33		0	0.00	0	0.00	2	6.67	
Conjunctiva right														
- Normal	30	100.0	26	86.67	18	33.33	**19.027**	30	100.00	28	93.33	24	80.00	**7.683**
- Discharge	0	0.00	2	6.67	10	60.00	**0.001***	0	0.00	2	6.67	6	20.00	**0.021***
- Subconjunctival hemorrhage	0	0.00	2	6.67	2	6.67		0	0.00	0	0.00	0	0.00	
Conjunctiva left														
- Normal	30	100.0	26	86.67	20	20.00		30	100.00	24	80.00	25	83.33	
- Chemosis	0	0.00	0	0.00	2	6.67	**15.00**	0	0.00	0	0.00	0	0.00	**11.554**
- Discharge	0	0.00	2	6.67	6	66.67	**0.021***	0	0.00	6	20.00	5	16.67	**0.003***
- Subconjunctival hemorrhage	0	0.00	2	6.67	2	6.67		0	0.00	0	0.00	0	0.00	

Table (8): Percent distribution of the studied patients regarding Corneal Fluorescein Staining (CFS) as an indicator of corneal injury throughout periods of study.

Corneal Fluorescein Staining (CFS)	The studied patients (n=60)													
	Control group (n=30)						χ^2 P	Study group (n=30)						χ^2 P
	On admission		4th day of admission		7th day of admission			On admission		4th day of admission		7th day of admission		
	N	%	N	%	N	%		N	%	N	%	N	%	
CFS right														
- Lack of contact keratopathy	30	100.0	20	66.67	8	26.67		30	100.0	22	73.33	22	73.33	
- Incidence of lesion spots	0	0.00	8	26.67	8	26.67		0	0.00	6	20.00	2	6.67	
- Incidence of pits	0	0.00	2	6.67	10	33.33	**42.552 0.000***	0	0.00	2	6.67	2	6.67	**18.730 0.005***
- Incidence of macro-epithelial defects	0	0.00	0	0.00	4	13.33		0	0.00	0	0.00	4	13.33	
Gp1 Vs Gp2 χ^2 P	-		0.381 0.827		**15.467 0.001***									
CFS left														
- Lack of contact keratopathy	30	100.0	20	66.67	6	20.00		30	100.0	30	100.0	28	93.33	
- Incidence of lesion spots	0	0.00	6	20.00	12	40.00		0	0.00	0	0.00	2	6.67	
- Incidence of pits	0	0.00	4	13.33	6	20.00	**45.171 0.000***	0	0.00	0	0.00	0	0.00	4.091 0.129
- Incidence of macro-epithelial defects	0	0.00	0	0.00	6	20.00		0	0.00	0	0.00	0	0.00	
Gp1 Vs Gp2 χ^2 P	-		**12.00 0.002***		**33.378 0.00***									

- Group 1: Control group.
- Group 2: Study group.

Table (9): Percent distribution of the studied groups regarding eye grading guide as an indicator of corneal injury throughout periods of study.

Eye grading guide	The studied patients (n=60)													
	Control group (n=30)							Study group (n=30)						
	On admission		4th day of admission		7th day of admission		χ^2 P	On admission		4th day of admission		7th day of admission		χ^2 P
	N	%	N	%	N	%		N	%	N	%	N	%	
Right Eye														
- Grade I	14	46.67	14	46.67	14	46.67		14	46.67	14	46.67	14	46.67	
- Grade II	10	33.33	10	33.33	10	33.33	0.00 1.00	10	33.33	10	33.33	10	33.33	0.00 1.00
- Grade III	6	20.00	6	20.00	6	20.00		6	20.00	6	20.00	6	20.00	
Gp1 Vs Gp2 χ^2 P	0.00 1.00		0.00 1.00		0.00 1.00									
Left Eye														
- Grade I	14	46.67	14	46.67	14	46.67		12	40.00	12	40.00	12	40.00	
- Grade II	8	26.67	8	26.67	8	26.67	0.00 1.00	16	53.33	16	53.33	16	53.33	0.00 1.00
- Grade III	8	26.67	8	26.67	8	26.67		2	6.67	2	6.67	2	6.67	
Gp1 Vs Gp2 χ^2 P	**6.421 0.040***		**6.421 0.040***		**6.421 0.040***									

- Group 1: Control group.
- Group 2: Study group.

Table (10): Comparison between Glasgow Coma Scale (GCS) of the studied patients and their eye grading guide as an indicator of corneal injury at 7th day of intervention.

Eye grading guide	The studied patients (n=60) Total GCS level							
	Control group (n=30)		χ^2 P	Study group (n=30)				χ^2 P
	Severe			Severe		Moderate		
	N	%		N	%	N	%	
Right Eye			-					
- Grade I	14	46.67		12	40.00	2	6.67	
- Grade II	10	33.33		10	33.33	0	0.00	2.449 0.294
- Grade III	6	20.00		6	20.00	0	0.00	
Left Eye								
- Grade I	14	46.67		10	33.33	2	6.67	
- Grade II	8	26.67	-	16	53.33	0	0.00	3.214 0.200
- Grade III	8	26.67		2	6.67	0	0.00	

Table (11): Percent comparison between Richmond Agitation Sedation Scale (RASS) of the studied patients among groups and their eye grading guide as indicator of corneal injury at 7th day of intervention.

Eye grading guide	The studied patients (n=60) Richmond Agitation Sedation Scale (RASS)													
	Control group (n=30)						χ^2 P	Study group (n=30)						χ^2 P
	Un arousal		Deep Sedation		Moderate Sedation			Un arousal		Deep sedation		Light sedation		
	N	%	N	%	N	%		N	%	N	%	N	%	
Right Eye														
- Grade I	8	26.67	4	13.33	2	6.67		10	33.33	2	6.67	2	6.67	
- Grade II	10	33.33	0	0.00	0	0.00	9.221 0.056	8	26.67	2	6.67	0	0.00	3.857 0.426
- Grade III	4	13.33	0	0.00	2	6.67		6	20.00	0	0.00	0	0.00	
Left Eye														
- Grade I	8	26.67	4	13.33	2	6.67		8	26.67	2	6.67	2	6.67	
- Grade II	8	26.67	0	0.00	0	0.00	7.744 0.101	14	46.67	2	6.67	0	0.00	3.854 0.426
- GradeIII	6	20.00	0	0.00	2	6.67		2	6.67	0	0.00	0	0.00	

Table (12): Percent comparison between Corneal Fluorescein Staining (CFS) of the studied patients among groups and their eye grading guide as indicator of corneal injury at 7th day of intervention.

Corneal Fluorescein Staining (CFS)	The studied patients (n=60) Eye grading guide													
	Control group (n=30)						χ^2 P	Study group (n=30)						χ^2 P
	Grade I		Grade II		Grade III			Grade I		Grade II		Grade III		
	N	%	N	%	N	%		N	%	N	%	N	%	
CFS right														
- Lack of contact keratopathy	6	20.00	2	6.67	0	0.00		14	46.67	8	26.67	0	0.00	
- Incidence of lesion spots	4	13.33	4	13.33	0	0.00		0	0.00	2	6.67	0	0.00	
- Incidence of pits	4	13.33	4	13.33	2	6.67	**21.65 0.001***	0	0.00	0	0.00	2	6.67	**33.82 0.000***
- Incidence of macro-epithelial defects	0	0.00	0	0.00	4	13.33		0	0.00	0	0.00	4	13.33	
CFS left														
- Lack of contact keratopathy	6	20.00	0	0.00	0	0.00		12	40.00	16	53.33	0	0.00	
- Incidence of lesion spots	4	13.33	6	20.00	2	6.67		0	0.00	0	0.00	2	6.67	
- Incidence of pits	4	13.33	2	6.67	0	0.00	**28.93 0.000***	0	0.00	0	0.00	0	0.00	**30.00 0.000***
- Incidence of macro-epithelial defects	0	0.00	0	0.00	6	20.00		0	0.00	0	0.00	0	0.00	

Discussion

Intensive care patients have a great possibility of developing adverse eye changes due to mechanical ventilation, and the use of medications, such as muscle blocking drugs, sedatives and diuretics that interfere with the cornea's protective mechanisms, interfering with effective eyelid closure and the production of tears.[35]

According to the findings of the current study, less than half of the participant patients in both groups were between (50-60) years old. This could be explained by the fact that the majority of eye diseases are considered to be age-related disease because the prevalence of the eye diseases rises with age. This is consistent with the findings reported by **Alvarenga et al (2021)** who revealed that the average age was approximately 55.9 years.[36] **In relation to sex**, more than half of the participant patients were male. This might be explained by the fact that men are more prone to road and motor accident. Similarly to **Silva et al (2021)** who reported that more than half of the patients were men.[37]**Concerning diagnosis,** more

than half of patients in the control group and more than one third of patients in the study group diagnosed with traumatic brain injury and connected to mechanical ventilation which increase the risk of development of corneal complications due to altered level of consciousness, loss ability to close eye lid completely and a reduced ability to use the protective blink reflex. Similarly to **(Demirel et al., 2020)** who reported that the patients with exposure keratopathy were diagnosed with some clinical conditions such as, head or facial trauma, intracranial hemorrhage, cerebral-vascular events.(38)

The findings of current study revealed that all patients in control and study groups on sedation. This may be explained by the majority of patients on ACV mode of mechanical ventilation that require sedation and lead to incomplete eyelid closure, loss of blink reflex and lack of normal eye movement. These findings were supported with **Cho OH. et al (2019),** who documented that Sedatives and neuromuscular blocking drugs inhibit eye muscles and lead to lagophthalmos-incomplete eyelid closure, which can lead to iatrogenic eye conditions.(39)

In the current study, more than two thirds of patients in the control group and the majority of the study group were on ACV mode for seven days with positive end-expiratory pressure (PEEP) more than 6 mmH_2O. This may be interpreted that the majority of participant patients had sever traumatic brain injury and all patients were on sedation. This is in line with **Ebadi. et al, (2019),** who found that mechanically ventilated patients with (PEEP) more than 5 mmH_2O can develop a condition called ventilatory eye, conjunctival edema and chemosis.(40)

The findings of current study revealed that all patients were unconscious. This result could be due to majority of patients admitted to ICU as a result of traffic accident, that may affect their level of consciousness and their spontaneous eye opening and the frequency of blinking was limited so that increase risk for corneal complications as corneal abrasion and corneal ulcer. This result was in line with **de França.etal (2023)** who documented that altered level of consciousness has an impact on the protective mechanisms of the eye and increase risk of OSDs, such as corneal dehydration, abrasion, and ulceration.(41)

In the current study, the majority of patients in the study group had normal eye assessment (eye lid and conjunctiva) after 7^{th} day of the study compared to less than half of patients in the control group had normal eye assessment. It might be due to the use of eye care protocol (polyethylene eye- cover and artificial teardrops with routine eye care such as eye irrigation with sterile normal saline in the study group, which created a moist chamber and provided a barrier against tear-film evaporation. This result is in line with **Dawson, (2020)** who documented that the use of polyethylene covers is an effective method in preventing eye complications.(42)

Regarding Corneal Fluorescein Staining (CFS) in the current study, it was revealed that more than two- third and the majority of study group patients have normal cornea in right and left eyes from 1st to 7th days. It might be due to the use of eye care protocol (polyethylene eye- cover and

artificial teardrops with routine eye care in the study group. Similarly to **Ehsani et al. (2020)**, who reported that the use of three methods of eye care including the use of polyethylene cover, liposic ointment, and artificial tear drops were more effective than washing the eye with normal saline alone.(43)

Regarding eye grading guide in the current study, the result revealed that more than half of the participant patients in the control and study groups had grade II and III. This indicated to the presence of incomplete eyelid closure. It might be explained by the majority of patients were unconscious, sedated and reported severe level of GCS that lead to corneal abrasion and ulceration. These findings were supported with **Mc Call. et al. (2019)** who showed that incomplete eyelid closure and prolonged intensive care stay are risk factor for corneal surface disorders development.(44)

The findings of current study revealed that the studied patients were on sedation and the majority of them reported sever level of GCS and more than two- third were unarousable that leading to lagophthalmos which lead to corneal complication. This result is in line with **Med Pregl,(2022)** who documented that critically ill patient unable to maintain normal eye protective mechanisms such as eyelid closure and an intact blink reflex because the use of sedation and muscle relaxants were more susceptible to corneal complications.(45)

Concerning Corneal Fluorescein Staining (CFS) in relation to eye grading guide, it was observed that eye grading guide had statistically significant positive relation with the incidence of corneal abrasion and ulcer among control and study groups either in right or left eye. In the current study, the participant patients were unconscious so that those patients did not have spontaneous eye opening, incomplete eye lid closure and the frequency of blinking was limited leading to increase risk for corneal complications as corneal abrasion and corneal ulcer. This result is in line with **Andrea et al., (2020)** who found that altered levels of consciousness has an impact on the protective mechanisms of the eye that increase risk of eye injury, such as corneal dehydration, abrasion, and ulceration.(46) Also **Fiona et al., (2022),** found that mechanically ventilated patients who are unconscious considered high risk group who are dependent on eye care to maintain eye integrity. These patients are susceptible to corneal dehydration, abrasions and ulcer as a result of impairment of basic eye protective measures.(47)

In the current study, it was found that patients on sedation and muscle relaxants medications were more susceptible to incomplete eye lid closure that contributing to development of corneal complications. This results are agreed with **Andrea et al., (2020)**, who found that critically ill patients were unable to maintain normal eye protective mechanisms such as eyelid closure and an intact blink reflex because the use of sedation and muscle relaxants are more susceptible to corneal complications.(46)

Conclusion

The current study showed that using eye care protocol reduced the occurrence of keratitis, conjunctivitis, dry eye, and corneal ulcers in mechanically ventilated patients. Additionally, this study showed that polyethylene cover and artificial

teardrops were effective in preventing corneal injury in critically ill patients.

Recommendations

The following suggestions are made in light of the study's findings:

- It is necessary to disseminate protocols and guidelines for eye care in ICU patients to reduce the risk of corneal injury.
- Eye care should be standardized as a basic part of nursing care provided to all critically ill patients in ICU with impaired conscious level.
- Emphasize the importance of eye physical assessment for critically ill patients in relation to eyelids, conjunctiva, cornea, and pupil for early detection of any eye problem.
- Assess the ability of critically ill patients' ability to maintain eyelid closure by Eye Grading Guide should be performed daily in intensive care units.
- Applying polyethylene eye cover should be standardized in ICU as a moist chamber method of eye care instead of routine eye cover with tap.
- Apply the present study to large probability sampling with impaired of conscious level.

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