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Risk factors assessment of ocular surface disorders among adult critically ill patients

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Abstract
Ocular complications are common in the critical care setting but are frequently missed due to the focus on life-saving organ support. In critically ill patients, normal eye protection mechanisms, such as tear production, blinking, and keeping the eye closed, are impaired. **This study aims to:** assess risk factors for ocular surface disorders among adult critically ill patients. **Design:** Exploratory research design. **This study was carried in** intensive care units at Assiut university hospital. **Subjects:** A convenience sampling of 60 adults patients. **Tools:** Two tools were utilized to collect data of study, **tool I:** Patient assessment sheet. **Tool II:** Risk factors assessment sheet. **Method:** The researcher assessed risk factors, eye lid closure and occurrence of ocular surface disorders. **Results:** The exposure of adult critically ill patients to ocular surface disorders was high related to right eye were 51% in 7th day, related to left eye were 48% in 5th day. Regarding type of abnormalities in right eye, the result revealed that 80.8% were mixed in 6th day and 3.2% were corneal abrasion in7th day. **Conclusion:** The study confirmed that important risk factors for ocular surface disorders in Intensive Care Unit (ICU) patients were: lagophthalmos, level of consciousness, mechanical ventilation, sedation and muscle relaxant, length of ICU stay, fluid misdistribution and respiratory microorganism. **Recommendation:** It is necessary to disseminate protocols and guidelines for eye care in ICU patients to reduce the risk.

Keywords: Adult critically ill patients, Risk factors & Ocular surface disorders

Introduction
Intensive care units (ICU) treat patients in life-threatening conditions that require the comprehensive care of an interdisciplinary team. During hospitalization, the medical staff mainly focuses on securing basic vital functions, controlling life-threatening disorders, and stabilizing the patient's condition. Less focusing problems, including ocular complications, are sometimes overlooked by medical professionals **(Selvan. et al, 2020**).

Eye complications are common among critically ill patients. Signs of ocular surface disease are found in 20–42%, and even up to 60% of critically ill patients , with exposure to keratopathy in 37–57% of sedated and intubated patients. Frequently identified eye diseases include superficial and direct injuries of the cornea-most often a superficial corneal abrasion (scratch), chemosis, which is conjunctival swelling, and microbial conjunctivitis and keratitis **(Hearne. et al, 2018)**.

The risk of ocular surface disorders increases in persons with general injuries, craniofacial injuries (especially in the eye sockets, in unconscious patients with severe conditions, and in respiratory system infections and ventilator-associated pneumonia (VAP). Another risk factor is the use of mechanical ventilation including Positive End-Expiratory Pressure (PEEP) and Continuous Positive Airway Pressure (CPAP), oxygen masks, and prone position. Patients treated with sedatives, tranquilizers, and neuromuscular blockers are also at greater risk of developing eye complications **(Dharmaratne. et al, 2020).**

Majority of critically ill patients in intensive care setting, having altered state of consciousness (due to sedation or brain conditions) lose protective eye mechanisms. It can lead to eye dryness, infection, ulcerations, even perforation and iatrogenic mechanical corneal injuries, with the end result of visual impairment and decreased quality of life. Everyday care for critically ill patients (sedated and mechanically ventilated) with certain procedures and drugs, can lead to reducing this physiological protective eye mechanisms too **(De França. et al, 2016**).

Comprehensive daily care for intubated, mechanically ventilated patients is a routine nursing care at the ICU. Eye care procedures vary widely between departments in terms of how often and how eyes are cared for. A review of the literature does not indicate clearly which eye care method is most effective.

There is also a lack of standard eye care procedures based on scientific evidence. ICU eye care protocols are not always implemented **(Sanghi. et al, 2021),** so conducted this study that **aim** to assess risk factors for ocular surface disorders among adult critically ill patients.

Significant of study:

Eyelids not closing (lagophthalmos), which is a frequent cause of eye surface damage, occurs in 17–75% of ICU patients. These complications may lead to irreversible pathological changes, blindness, disability, and deterioration in the quality of life of patients after ICU discharge. Eye complications usually occur between the 2nd and 7th days of stay in the ICU **(Panchabhai. et al,2016)**.

Various studies documented that early signs of the eye complications by nurses were poor and the lack of evidence-base practice contributes to high incidence of eye complications among critical ill patients. There is no evidence base practices for eye care nurses to be followed by nurses .Little is known about eye care of critical ill patients patients in Egypt at Assiut university hospital.

Aim of the study:

To assess risk factors for ocular surface disorders (OSDs) among adult critically ill patients

Research question:

What are the risk factors for Ocular surface disorders in critically ill adult?

Patient and method

Study design:

Exploratory research design that was conduct in this study.

Setting:

The research was carried out in Egypt's Assiut University Hospital's intensive care units. These units include: General ICU (16) beds in four different rooms, nurse patient ratio (1:3), trauma ICU (16) beds in three separate rooms, nurse patient ratio (2:3), and anesthetic ICU (12) beds in three separated rooms, nurse patient ratio (1:2). In terms of equipment, amenities, and paternity leave, all ICUs were the same.

Sampling:

Sample was collected according to inclusion criteria for about seven months (from August, 2021 to February, 2022). The sample size was calculated using the Epidemiology Information 2000 statistical software. The calculation was done using the expected frequencies of critical care units from previous studies using 95% confidence interval, 80% power of the study, 95% prevalence of the critically ill patient, and worst acceptable result 5%. The sample size calculated according to the above criteria was 54 critically ill patients **(Taheri, 2017).**

Inclusion criteria:

The study included patients had the following criteria:

- Recent admission to intensive care unit.
- Age 20 to 60 years.
- Unconscious mechanically ventilated patients who did not have spontaneous eye opening.

Exclusion criteria:

The study excluded patients had the following criteria:

- Eye trauma or other ocular surface disorders.

Two tools were utilized to collect data of study:

Tool one:- Patient assessment sheet:

- This tool was developed by the researcher after review of literatures **(Bahtouee. et al, 2019) (Med Pregl, 2017) (Ahmed. et al, 2019)**.
- This tool was used to assess patient profile and condition, and divided into four parts:

Part I: Demographic data and clinical data assessment sheet:

- **Demographic data** includes age and sex etc. **Clinical data** as diagnosis, past history of diseases, length of stay in ICU, medications and overall mortality in addition to lab investigation including complete blood picture (CBC), blood glucose level and arterial blood gas (ABG) in addition to **APACHE II score** (Acute Physiology And Chronic Health Evaluation). APACHE II score = acute physiology score + age points + chronic health points. Minimum score = 0; maximum score = 71. Increasing score is associated with increasing risk of hospital death.
- APACHE II score was calculated based on the worst values recorded during the first 24 h of admission. The online APACHE II Calculator was used to calculate the corresponding score for each patient by using mobile application. The variables were analyzed with the multiple logistical regression model. The scoring result used to predict the patient's mortality rate.

APACHE II score interpretation	
Apache II score	**Mortality rate (%)**
0 – 4	*4*
5 – 9	8
10 – 14	15
15 – 19	25
20 – 24	40
25 – 29	55
30 – 34	75
>34	85

APACHE II Score interpretation adopted from from **(Pujiastuti et al., 2020).**

Part II: Assessment of respiratory and hemodynamic state:

This part was used to assess respiratory rate, pulse, and mean arterial blood pressure taken from bed side

monitor and monitoring intake& output and central venous pressure (CVP).In addition to Parameters of mechanical ventilation include mode of mechanical ventilation, positive end expiratory pressure (PEEP), pressure support (Ps), fraction of inspired oxygen (FIO2), Tidal volume (VT), duration of mechanical ventilation.

Part III: Richmond Agitation Sedation Scale (RASS):-

This tool who recently was used by **(Yeganeh. et al, 2018) (Attia. et al, 2015)**and used to assess patient's anxiety and agitation. One for an alert, calm state and further levels for quality of sedation, which consist of a ten point, with four levels of anxiety or agitation from +1 to +4 [combative]), one level to denote a calm and alert state (0), and 5 levels of sedation from −1 to −5culminating in unarousable (−5). Three sequential steps are used: observation, response to verbal stimulation and response to physical stimulation.

In additional to, Sedation and muscles relaxants data was used to assess effect of sedation and muscles relaxant on OSDs on mechanically ventilated patients. It included drug names and action **(de França.etal,2016).**

Part IV: - Full Outline of Un Responsiveness (FOUR) score scale: -

- This tool was adopted from **(Zeiler. et al, 2017).**"FOUR" is acronym for "Full Outline of Un Responsiveness. This tool used to assess neurological state**.** This score comprises four main items (Eye response (0-4), Motor response (0-4), Brain stem reflexes (0-4) and Respiration (0-4)) Where total score of this tool are 17 items. This part used to evaluate effect of altered level of conscious in protective mechanism of eyes.

Tool Two: Risk factors for ocular surface disorders (OSDs) assessment sheet:-

- This tool was developed by the researcher after reviewing of literatures **(Zhou. et al, 2020) (Hearne. et al, 2018) (Wolffsohn. et al, 2017) (Panchabhai. et al, 2016) (Kuruvilla. et al, 2015)** and is divided in to two parts:

Part I: - Risk factors assessment sheet:-

- This part was used to identify risk factors and assess all of these mechanisms that can be impaired eyes for critical ill patients in ICUs. Note the following:

- **Disease process as** fluid maldistribution, altered level of consciousness, Peripheral or central neurological injury, Immunosuppression and Pre-existing eye condition.
- **Treatment process as** Use of muscle relaxant or sedation, Mechanical positive pressure ventilation and prone position.
- **ICU environment as** Length of stay, Respiratory micro-organism and type of suction.

Part II: - Eyelid closure assessment sheet:-

This part was used to accurately assess the degree of eye exposure. It consists of three grades:-

- **Grade 0 -** Lids completely closed.
- **Grade 1 -** Any conjunctival exposure as shown by any white of the eye being visible, but no corneal exposure.
- **Grade 2 -** Any corneal exposure, even a very tiny amount**.**

Method

Data was collected in two phases:-

Preparatory phase:

- Permission to conduct the study was obtained from the hospital responsible authorities in anesthesiology department, critical care and emergency ICU after explaining the aim and nature of the study.
- The tool was developed by the researcher based on the relevant literature reviewing.
- The developed tool was tested for clarity and reliability by 7 experts in the field of the study and the necessary modifications was done.

A pilot study: was carried out in order to assess the feasibility and applicability of the tools and the necessary modifications was done. The pilot study was done on 6 patients whom were included in the study if no major modification was necessary.

Ethical consideration:

1. Research proposal was approved from Ethical Committee in the Faculty of Nursing.
2. There is no risk for study subject during application of the research.
3. The study was followed common ethical principles in clinical research.
4. Written consent was obtained from parents that are willing to participate in the study, after explaining the nature and purpose of the study.
5. Patients were assured that the data of this research were used only for the Confidentiality and anonymity were assured.
6. Patients had the right to refuse to participate and or withdraw from the study without any rational any time.

Assessment phase:

- During this phase the researcher assessed patient from the first day of admission and record patient demographic and clinical data Also, was assessing APACHE II score before any data collection by taking this information from his/her sheet using tool I (part I) .
- The researcher assessed respiratory and homodynamic state of patient in addition to mechanical ventilation data by using tool I (part II) Also, laboratory investigation included complete

blood picture was monitored on first, third and seven day, blood glucose level or arterial blood gas was monitored daily by using tool I(part I).

- Then assessed patient from the first day of intervention and record level of sedation (RASS) daily tool I (part III) by using three sequential steps: observation, response to verbal stimulation and response to physical stimulation.
- Then assessed FOUR score scale one time daily by using tool I (part IV).
- Furthermore assessed patient's risk factors for ocular surface diseases related to process diseases, treatment diseases and ICU environment by using tool II (part I).

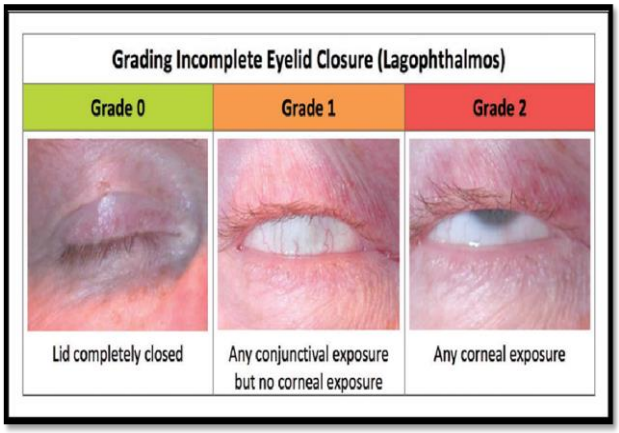
Category Risk factors in ICU patients for developing OSD

Disease processes	- Fluid maldistribution
	- Risk of facial oedema
	- Chemosis and lid swelling
	- Altered level of consciousness (low GCS)
	- Reduces blink reflex and is associated with lagophthalmos
	- Peripheral or central neurological injury
	- Immunosuppression
	- Pre-existing eye conditions
Treatment processes	- Continual positive airway pressure (CPAP) and oxygen masks
	- Gas flow causes drying effects of the eye.
	- Use of muscle relaxants or sedation
	- Reduces blink rate, impairs blink reflex and is precursor to lagopthalmos
	- Mechanical positive pressure ventilation
	- Increases jugular pressure, causes conjunctival oedema increasing risk of lagophthalmus
	- Associated with increased length of stay and use of sedation and muscle relaxants
	- Prone position - Direct injury during positioning. - Causes conjunctival oedema increasing risk of lagophthalmos.
ICU environment	- Length of stay Increased length of stay associated with increased risk of OSD.
	- Respiratory micro-organisms - Increased exposure to micro-organisms (can be multi-resistant organism).
	- Increased risk of exposure from tracheal suctioning.

GCS: Glasgow Coma Scale; **ICU**: intensive care unit; **OSD**: ocular surface disease

(Panchabhai T.etal, 2016)

- Moreover assessed patient's ability to maintain eyelid closure to determine degree of eye exposure from the first day of admission for seven consequent days by using tool II (part II).



Schematic showing the different grades of lagophthalmos adopted from(Panchabhai T.etal, 2016)

- Finally assessed each patient's eye independently (examine lids, conjunctiva, and pupil) from the first day of admission for seven day.

Statistical analysis:

- Data were computerized and analyzed by computer programme SPSS (ver.25). Data were presented by using descriptive statistics in the form of frequencies and percentages or means ± standard deviations for qualitative data.

Results

Table (1):- Distribution of Demographic data and Clinical data For Study Patients (n=60)

Demographic data and Clinical data	No	%
Age group		
Less than 30 years	15	25.0
From 30-40 years	13	21.7
More than 40 years	32	53.3
Mean ± SD (range)	**42.38±12.42(22-60)**	
Sex		
Male	45	75.0
Female	15	25.0
Diagnosis		
Respiratory system diseases	23	38.3
CNS diseases	26	43.3
Renal system diseases	5	8.3
GIT diseases	18	30.0
Neurological diseases	3	5.0
Others diseases	15	25.0
Length of the stay in ICU		
Less than 15 day	23	38.3
From 15-20 days	20	33.3
More than 20 days	17	28.3
Mean ± SD (range)	**17.28±5.99(7-32)**	
Past history of diseases		
Respiratory system diseases	2	3.3
Cardiovascular system diseases	6	10.0
CNS system diseases	0	0.0
Endocrine system diseases	12	20.0
others diseases	0	0.0
Medications		
Antibiotic drugs	60	100.0
Anti-hypertension drugs	9	15.0
Antiplatelet	4	6.7
Hypoglycemic drugs	8	13.3
Antihistaminic drugs	5	8.3
Anticoagulant	22	36.7
Analgesic drugs	58	96.7
Others drugs	53	88.3

Table (2): Distribution of Richmond Agitation Sedation Scale (RASS) For Study Patients (n=60)

Richmond Agitation Sedation Scale (RASS)	No	%
RASS of first day		
Unarousable	46	76.7
Deep sedation	7	11.7
Moderate sedation	2	3.3
Agitated	2	3.3
Very agitated	3	5.0
RASS of second day		
Unarousable	46	76.7
Deep sedation	7	11.7
Moderate sedation	2	3.3
Agitated	2	3.3
Very agitated	3	5.0

Richmond Agitation Sedation Scale (RASS)	No	%
RASS of third day		
Unarousable	38	63.3
Deep sedation	15	25.0
Moderate sedation	2	3.3
Drowsy	2	3.3
Agitated	2	3.3
Very agitated	1	1.7
RASS of fourth day		
Unarousable	34	56.7
Deep sedation	21	35.0
Moderate sedation	2	3.3
Agitated	3	5.0
RASS of fifth day		
Unarousable	24	40.0
Deep sedation	31	51.7
Moderate sedation	5	8.3
RASS of six day	0	0.0
Unarousable	17	28.3
Deep sedation	28	46.7
Moderate sedation	15	25.0
RASS of seven day		
Unarousable	11	18.3
Deep sedation	35	58.3
Moderate sedation	14	23.3

Table (3): Distribution of Risk factors Assessment for Ocular Surface Disorders For Study Patients (n=60)

Risk factors Assessment for OSDs	No	%
Disease process as risk factor		
- Fluid mal-distribution	60	100.0
- Altered level of consciousness.	60	100.0
- Peripheral or central neurological injury.	30	50.0
- Immunosuppression.	12	20.0
Treatment process as risk factor		
- Mechanical positive pressure ventilation.	18	30.0
- Use of muscle relaxant or sedation&-Mechanical positive pressure ventilation.	42	70.0
ICU environment as risk factor		
- Length of stay.	47	78.3
- Length of stay&-Respiratory micro-organism.	13	21.7

Table (4): Distribution of Eye closure assessment sheet for Study Patients (n=60)

Eye closure grading	Right eye closure (n=60)		lift eye closure (n=60)	
	No	%	No	%
1st day				
Grade 0	0	0.0	6	10.0
Grade I	44	73.3	42	70.0
Grade II	16	26.7	12	20.0
4th day				
Grade 0	0	0.0	4	6.7
Grade I	38	63.3	34	56.7
Grade II	22	36.7	22	36.7
5th day				
Grade 0	0	0.0	0	0.0
Grade I	32	53.3	34	56.7
Grade II	28	46.7	26	43.3

Eye closure grading	Right eye closure (n=60)		lift eye closure (n=60)	
	No	%	No	%
6th day				
Grade 0	0	0.0	0	0.0
Grade I	8	13.3	10	16.7
Grade II	52	86.7	50	83.3
7th day				
Grade 0	0	0.0	0	0.0
Grade I	8	13.3	10	16.7
Grade II	52	86.7	50	83.3

Table (5): Distribution of Eye examination For Study Patients (n=60)

Eye examination	Cornea RT		Cornea LT	
	No	%	No	%
1st day				
Abnormal	0	0.0	0	0.0
Normal	60	100.0	60	100.0
2nd day				
Abnormal	10	16.7	12	20.0
Normal	50	83.3	48	80.0
3rd day				
Abnormal	21	35.0	21	35.0
Normal	39	65.0	39	65.0
4th day				
Abnormal	24	40.0	21	35.0
Normal	36	60.0	39	65.0
5th day				
Abnormal	27	45.0	29	48.3
Normal	33	55.0	31	51.7
6th day				
Abnormal	26	43.3	28	46.7
Normal	34	56.7	32	53.3
7th day				
Abnormal	31	51.7	28	46.7
Normal	29	48.3	32	53.3

Table (6):- Distribution of Eye examination (abnormality) For Study Patients (n=60)

Abnormalities of cornea	Cornea RT		Cornea LT	
	No	%	No	%
2nd day				
Cloudy: iris may be difficult to see	10	100.0	11	91.7
Mixed	0	0.0	1	8.3
3rd day				
Cloudy: iris may be difficult to see	9	42.9	5	23.8
Mixed	12	57.1	16	76.2
4th day				
Cloudy: iris may be difficult to see	6	25.0	3	14.3
Mixed	18	75.0	18	85.7
5th day				
Cloudy: iris may be difficult to see	5	18.5	5	17.2
corneal abrasion	1	3.7	1	3.4
Mixed	21	77.8	23	79.3
6th day				
Cloudy: iris may be difficult to see	4	15.4	9	31.0
corneal abrasion	1	3.8	1	3.4
Mixed	21	80.8	19	65.5
7th day				
Cloudy: iris may be difficult to see	9	29.0	8	28.6
corneal abrasion	1	3.2	1	3.6
Mixed	21	67.7	19	67.9

Table (1): Illustrates demographic and clinical data for study patients. Regarding to age, it was noticed that nearly half of patients more than 40 years old (53.3%) respectively. Regarding to sex, the majority of patients were male (75 %) respectively. As regard to diagnosis, just below the half of patients were complained from CNS diseases (43.3%) respectively. As regard to length of stay, most of patients stayed less than 15 days in ICU on range (17.28±5.99) respectively.

Table (2): Shows Richmond Agitation Sedation Scale (RASS).It was noticed that all patients were unconscious

Table (3): Show Risk factors Assessment for OSDs. It was observed that all patients nearby had the majority of risk factors (100%-80%) respectively.

Table(4): Shows Eye closure assessment sheet. It was observed that all patients had incomplete eyelid closure and observed that there is a significant increase in grading day every day in both eyes.

Table (5): Shows cornea assessment for study patients. Results revealed that there is significant increase in presence of corneal abnormalities day every day .Regarding right eye, It is noticed that nearly half of patients had ocular surface disorders in 7^{th} day (51.7%) .Related to lift eye, It is noticed that nearly half of patients had ocular surface disorders in 5^{th} day (48.3%) respectively**.**

Table (6): Shows cornea abnormalities for study patients. Regarding right eye, It was noticed that majority of complained patients had mixed types of abnormalities in cornea such as cloudy, corneal abrasion ,corneal ulcer and keratopathy in both eyes in 3^{rd},4^{th},5^{th} and 6^{th} days (75.0%, 77.8%, 80.8%, 67.7%) respectively. Related to lift eye, It was noticed that majority of complained patients had mixed types of abnormalities in cornea such as cloudy, corneal abrasion, corneal ulcer and keratopathy in both eyes in 3rd,4^{th} and 5th days(76.2, 85.7, 79.3) respectively.

Discussion:

Rationale and key points Eye care is an important aspect of the nursing management of patients who are critically ill. All patients in acute care settings with absent or compromised eye defense mechanisms are at risk of eye complications and ocular surface disease. **(Parekh. et al, 2019).**

Eye complications are common among ICU patients. Signs of ocular surface disease are found in 20–42% and even up to 60% of ICU patients, with exposure to keratopathy in 37–57% of sedated and intubated patients. Frequently identified eye diseases include superficial and direct injuries of the cornea—most often a superficial corneal abrasion (scratch), chemosis, which is conjunctival swelling, and microbial conjunctivitis and keratitis **(Hearne. et al, 2018)** .

The study confirmed that important risk factors for ocular complications in ICU patients were: lagophthalmos, mechanical ventilation, length of stay in the ICU setting, and inadequate eye care. Some of the factors can be modified by proper eye care according to protocols. It is necessary to disseminate and precisely follow guidelines and train doctors and nurses in how to make an early diagnosis and treat eye complications in ICU patients **(Panchabhai. et al, 2016)**.

Regarding demographic data:

In this study, most of patients were male and nearly half of study and control groups were more than forty years old respectively with no statistically difference between both groups. **The opinion of the researcher that this was related to** the limited nature of the study sample. **This in agree with (Babamohamadi etal, 2018**) who found that there was no significant difference between two groups in demographic data ($p > 0.05$).

Regarding risk factors for ocular surface disorders (OSDs) development:

Incomplete eye lid closure(lagophtalmus)

Incomplete eyelid closure and lack of lubrication are the main mechanisms that underlie the development of corneal damage in patients who are critically ill. Unconscious, sedated and/or paralyzed patients and those with a reduced Glasgow Coma Scale score depend on healthcare professionals to maintain their ocular surface to prevent complications such as corneal abrasion, infection and ulceration, perforations and blindness whilst incomplete eyelid closure can also predispose to chemosis **(Sanghi.et al, 2o21).**

The finding of current study revealed that high percentage of patients had lagophtalmus and significant increase gradually in grading and development of abnormalities in cornea day every day. **Point of view this may be due to** incompetent eye closure is a major factor to the occurrence of iatrogenic complications while in study group interventions which achieve closure or cover the eye and maintain corneal moisture, appear to reduce the incidence of complications. **These finding is supported with (McCall. et al, 2016)** who studied (A bundle improves eye care in PICU) showed that incomplete eye lid closure and prolonged intensive care stay were risk factors of corneal surface disorders development. **Furthermore (Kuruvilla. et l, 2015)** found that eyelid closure act as a protective mechanical barrier to corneal exposure and drying.

Level of consciousness

Many critically ill patients have altered levels of consciousness which may impact on the protective mechanisms of the eye. When unprotected, the eye is at risk of injury, such as corneal dehydration, abrasion, perforation and infection. The reported incidence rates for corneal abrasion varies widely in the international health care literature; 3-60% intensive care patients are affected.2-4 The provision of fundamental eyecare to this patient population is essential and particularly important in the first 2-7 days, when the peak incidence of iatrogenic eye injury occurs. An important consideration to guiding assessment and management is the alteration in normal physiological mechanisms that provide protection against eye injury and infection. Eyelid closure and blinking provide a mechanical barrier to injury and minimize dehydration and the desiccating of the outer eye epithelium **(Panchabhai. et al, 2016)**. **The finding of current study revealed** that all patients were unconscious that did not have spontaneous eye opening and the frequency of blinking was limited so that increase risk for corneal complications as corneal abrasion and corneal ulcer. **Point of view for this result could be due to** majority of critically ill patients in intensive care units, having altered state of consciousness (due to sedation or brain conditions) lose protective eye mechanisms. It can lead to eye dryness, infection, ulcerations, even perforation and iatrogenic mechanical corneal injuries, with the end result of visual impairment and decreased quality of life. **This result was in line with (de França.etal,2016)**who documented that altered levels of consciousness impact on the protective mechanisms of the eye that increase risk of OSDs, such as corneal dehydration, abrasion, and ulceration.

Mechanical ventilation

Mechanically ventilated patients receiving neuromuscular blocking agents or sedatives are at risk for corneal complication because of impaired defensive mechanisms. The findings confirmed the relationship between the duration of mechanical ventilation and the development of eye complications, The relationship between using sedation and an increased risk of ocular surface disorders **(Amescua. et al, 2019)**, **as shown in our study** that all patients on mechanical ventilation for more than seven days with positive end-expiratory pressure (PEEP) more than 5 mmH2O and increase incidence of ocular surface diseases. **This result due to** the longer exposure to risk factors for eye complications. **This is in line with (Ebadi. et al, 2017)**who found that mechanically ventilated patients with positive end-expiratory pressure (PEEP) more than 5 mmH2O can develop a condition called "ventilatory eye" and iatrogenic corneal injury, due to decreased venous drainage, conjuctival edema and chemosis. Infection risk is higher in patients who require frequent endotracheal suctions, especially if there is an inappropriate technique.

Sedation and muscle relaxant

The use of sedatives and neuromuscular blockers also alters the blinking reflex, incomplete eyelid closure and subsequently lead to stagnation of the tear film and thus interfere with tear film coverage of the eye and increase the tear film evaporation result in dryness of the ocular surface **(Kousha. et al, 2018)**.

The finding of current study revealed that majority of patients on sedation and muscle relaxant associated with increase development of ocular surface diseases. **This result may be due to** paralyzed and sedated patients leading to incomplete eyelid closure, a loss of the blink reflex and a lack of random eye movements so these patients are susceptible to corneal complications. **These finding were supported** with (**Cho OH. et al, 2017)** who documented that Sedatives and neuromuscular blocking drugs inhibit eye muscles and lead to lagophtalmus-incomplete eyelid closure, which can lead to iatrogenic eye conditions. **Furthermore, this result was in line with (Med Pregl, 2017)**.who documented that critically ill patient unable to maintain normal eye protective mechanisms such as eyelid closure and an intact blink reflex because of the use of sedation and muscle relaxants were more susceptible to corneal complications.

Length of stay

The result of our study revealed that there was significant increase of eye abnormality with increase length of stay. **The researcher view this result could be due to** the longer exposure to risk factors for eye complications such as unconscious patients with severe conditions, respiratory system infections,ventilator-associated pneumonia (VAP). Another risk factor is the use of mechanical ventilation including Positive End-Expiratory Pressure (PEEP) and Continuous Positive Airway Pressure (CPAP), oxygen masks, and prone position. Patients treated with sedatives, tranquilizers, and neuromuscular blockers are also at greater risk of developing corneal complications. **These finding were matching with (McCall. et al, 2016)**who found that the proportion of patients with epithelial deficits increased as duration of Pediatric Intensive Care unit (PICU) admission increased.

Reason for admission

In the current study, we documented that nearly below the half of patients diagnosed with CNS diseases which increased risk of development of ocular surface disorders. **The researcher explain this result may be due to** altered level of conscious, loss

of ability to close eye lid completely and a reduced ability to use the protective blink reflex. **These finding agree with (Amescua. et al, 2019)** who found that the variables that presented significant association with corneal complications were: presence of neurological disease, intubation, and mechanical ventilation. **This result on other hand with (McCall. et al, 2016)** who found that deficit development was not significantly associated with the reason for admission and although patients admitted with non-respiratory sepsis appeared most likely to develop corneal epithelial deficit.

Fluid mal-distribution

Different states as circulatory volume overload, high blood vessel permeability and inadequate endotracheal tube fixation can lead to a reduction of venous drainage from the eye, edema of the eye and lagophtalmus as a consequence. Lagophtalmus can lead to infection due to exposure of the eye to a lot of pathogens in the intensive care setting **(Selvan. et al, 2020).**

The finding of this study revealed that, majority of patients have fluid overload. **The opinion of the researcher that this result may potentially** lead to the conjunctival edema. Also, mechanically ventilated patients for extended periods of time in supine position provoke the accumulation of liquid on their face that may lead to conjunctival chemosis so; eye lid does not close completely that contributing in occurrence of corneal complications. **This agree with (Sansome. et al, 2020)** who documented that patients in the ICU often experience fluid overload, electrolyte problems, and increased permeability. All of these are situations may potentially lead to the conjunctival chemosis. **Furthermore, This in line with** (**Bhala. et al, 2020)** found that critical illness is frequently associated with capillary leak and fluid retention that causes peripheral edema and conjunctival edema and then may lead to inadequate eyelid closure.

Respiratory micro-organism

Respiratory secretions are thought to be the major source of ocular surface infection, with aerosols from tracheal suctioning and direct contact from suction catheters both being implicated. Pseudomonas infection rates can thus be reduced if endotracheal suctioning is done from the side (rather than head) of the patient & cover the eyes **(Gronthoud. et al, 2020).**

The present finding revealed that occurrence of respiratory micro-organism and patients need for tracheal suctioning .**This result was matching with** (**Cho OH. et al, 2017)** who showed that the use of a closed suctioning system (CSS) is more beneficial in preventing ocular complications than the use of an open suctioning system (OSS).

The health of the front surface of the eye, particularly the cornea depends on the ability to produce tears, to blink, and to close the eyes with rest or sleep. These can be impaired on the intensive care unit (ICU) whether by disease (e.g. facial oedema, impaired conscious level, peripheral or central neurological injury) or treatments (e.g. the drying effects of gas flows from CPAP or oxygen masks). In addition to particular muscle relaxants and sedation reduces and impairs the blink reflex. Whatever the cause, those unable to close the eye for themselves, or in whom blinking rates are substantially reduced, are at increased risk of damage to the front of the eye, and this risk is higher in those mechanically ventilated, due to greater length of stay, use of sedative/paralysing drugs and the effects of positive pressure ventilation **(Dharmaratne. et al, 2020).**

An essential aspect of nursing care for critically ill patients is to provide proper eye care (EC) in ICU. ICU nurses play an essential role in preventing and monitoring eye problems and management. Nurses need to take special care of the patient's eye at the beginning of admission in ICU. Meticulous nursing care is required to prevent eye complications that can result from corneal exposure **(Selvan. et al, 2020),**so conduct this study to identify risk factors for development of ocular surface disorders among adult critically ill patients.

Eye health assessment should be a part of routine patient physical assessment practice in patients in intensive care setting. During an eye health assessment one should perform: assessment of other eye structure, assessment of the white of the eye, and assessment of eye protective mechanisms, required constant care and increased awareness of OSDs complications and their risk factors in ICU settings is therefore crucial to help prevent these complications and maintain the quality of life of patients after discharge **(Carnevali.etal,2021).**

Conclusion:

The study confirmed that important risk factors for ocular complications in ICU patients were: lagophthalmos, level of consciousness, mechanical ventilation, sedation and muscle relaxant, length of ICU stay, fluid mal-distribution and respiratory microorganism. Some of the factors can be modified by proper eye care according to protocols.

Recommendation:

- It is necessary to disseminate protocols and guidelines for eye care in ICU patients to reduce the risk.
- Eye care should standardize as a basic part of care provided to all critically ill patients in intensive care units.

- Equip intensive care units with simple illustrated booklet about nursing eye care guidelines.

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