Patterns and factors associated with ocular surface disorders among critically ill patients at Kilimanjaro Christian Medical Centre Referral Hospital

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ABSTRACT

Objective: Ocular surface disorders in critically ill patients pose a significant health challenge**.** This study aimed to investigate the prevalence, patterns, clinical presentation, and risk factors for Ocular Surface Disorder (OSD) among critically ill patients at Kilimanjaro Christian Medical Centre, addressing local dynamics and informing interventions to improve ocular health outcomes in Tanzania and similar settings.
Methods: This was an analytical cross-sectional study of 271 critically ill patients aged 18 years and above admitted to medical High Dependency Units (HDU) / Intensive Care Units (ICU) and surgical ICU at KCMC referral hospital. Demographic and clinical characteristics were collected using the standard data collection tool. Data collected included ocular surface assessment using TBUT, Schirmer's test, fluorescein corneal staining, and assessment for lagophthalmos and exposure keratopathy. Descriptive statistics were used to summarize variables. Associations were assessed using Pearson's Chi-square test, and Poisson regression with robust standard errors was applied to estimate crude and adjusted prevalence ratios. A p-value <0.05 was considered statistically significant.
Results: Prevalence of ocular surface disorders was 49.4%. Conjunctival hyperemia was present in 11.4% of right eyes and 13.3% of left eyes, and abnormal tear film quality in 11.1% and 12.9% of right and left eyes, respectively. Dry eye syndrome was the most common ocular surface disorder among critically ill patients, affecting 43.9% of cases, followed by conjunctivitis (14.0%), exposure keratopathy (4.8%), blepharitis (3.0%), and keratitis (1.5%). Neurological conditions, the use of beta-blockers, mechanical ventilation, oxygen therapy, and low environmental temperature or humidity were independently linked to a higher risk of developing OSD (p<0.05).
Conclusion: Ocular surface disorders are highly prevalent among critically ill patients in ICU, with nearly half of them affected most commonly by dry eye syndrome. Neurological diseases, beta-blocker use, oxygen mask, low GCS, and lower temperature or humidity were significantly associated with ocular surface disorders. Routine daily ocular assessment of critically ill patients is recommended to reduce the burden of preventable ocular surface complications.

Key words: Ocular surface disorders, Critically ill patients, High dependency unit, Intensive care unit

INTRODUCTION

Ocular surface disorders are disorders resulting from changes in the structure and function of any of the ocular surface components that can disrupt its delicate balance. They can present in different patterns such as dry eye syndrome, keratitis / exposure keratopathy, conjunctivitis, blepharitis, ocular surface squamous neoplasia, pterygium, and others[1].

In critically ill patients, Ocular Surface Disorder (OSD) etiology involves a combination of factors such as altered tear film dynamics, reduced blinking frequency, and environmental conditions in critical care settings[2]. Risk factors for OSDs in the ICU include the severity of illness, prolonged sedation, the absence of effective eye care protocols, lagophthalmos, level of consciousness, mechanical ventilation, muscle relaxants, length of ICU stay, fluid maldistribution, and respiratory microorganisms[3-5].

OSDs were frequently encountered in patients under sedation and paralyzed patients in Intensive Care Units (ICUs), with incidence ranges from 3.6% to 60%, and are frequently overlooked in this setting. As in ICUs, treatment is usually focused on the management of organ failures, and eye care becomes a side issue. As a result, ophthalmological complications do occur[6].

Globally, OSDs in critically ill patients have been reported, highlighting the need for targeted research. In the UK, a prospective cohort study was conducted in two phases. The first phase was observational, while the second phase involved implementing an eye care protocol. During the initial phase, the overall rate of Exposure Keratopathy (EK) was 21%, but it increased to 56% among mechanically ventilated patients ($p < 0.001$).

Adjusted Odds Ratios (AOR) for developing EK were 28.6 (8.19–37) for incomplete eye closure, 13.0 (3.16–54.38) for mechanical ventilation, and 1.2 (1.03–1.33) for higher Sequential Organ Failure Assessment (SOFA) score. After introducing the protocol in the second phase, the EK rate decreased to 2.6% (three cases), with a p-value of less than 0.001. Protocol adherence was 97%.[5,7].

In Nigeria, a prospective study was done to assess OSDs in ICU patients. Fifty-six patients were involved, and among them, 55.4% developed OSD. The duration of sedation and ventilation as well as the severity of illness, were found to influence the development of OSD significantly, but the position of the eyelids was not associated with the development of OSD[8]. In East Africa and Tanzania, there is limited data about OSDs in intensive care patients.

OSDs in ICU patients can lead to corneal damage, impaired vision, chronic ocular discomfort, increased risk of infection, decreased productivity, and educational impact. Morbidity extends beyond the individual, affecting families and placing an economic burden on the healthcare system[9].

The study aims to establish the prevalence, clinical presentation, patterns, and risk factors for ocular surface disorders among critically ill patients at KCMC from July 2024 to May 2025.

MATERIALS AND METHODS

An analytical cross-sectional study was conducted from July 2024 to May 2025. In the surgical ICU, medical ICU, and medical High Dependency Units (HDU) of KCMC, a zonal referral hospital in Moshi City, Kilimanjaro province. Involving all critically ill patients aged 18 years and above admitted to surgical ICU or medical department ICU / HDU. Excluding patients with a history of ocular surgery within the past 6 months, patients with existing ocular surface disorders unrelated to critical illness, including pterygium, pinguecula, trichiasis, or ocular surface tumors, severe facial or eyelid swelling that impairs adequate ocular examination, patients on topical treatment that were found to cause or worsen OSD, such as Timolol, etc.

Permission to conduct the study was obtained from the university and hospital's responsible authorities, after explaining the aim and nature of the study (certificate number: PG 04/2024). A pilot study was carried out to assess the feasibility and applicability of the tools, and the necessary modifications were made. Written consent was obtained from patients or responsible next of kin for unconscious patients, after explaining the nature and purpose of the study. Then the researcher used the developed tool for data collection.

The researcher made regular visits to the medical and surgical critical care units at KCMC referral hospital to identify potential study participants. The study included adult patients admitted to the medical HDU, medical ICU, or surgical ICU during the study period. For each potential participant, or their next of kin in the case of unconscious patients, the purpose and nature of the study were clearly explained. Informed consent was then obtained from those willing to participate or from their representatives.

Only participants who met the eligibility criteria were included in the study. Data collection was conducted in two main steps: Step one: Patient information, basic patient details were retrieved from the hospital's Electronic Health Management System (EHMS). These included the patient ID, age, ward, length of stay in HDU/ICU (in days), diagnosis, and medications administered. Step two: Risk factor assessment and clinical examination. A detailed clinical assessment was then conducted using a handheld slit lamp (model: PSLAIA-11).

This step included the evaluation of several risk factors such as Glasgow Coma Scale (GCS) score, use of mechanical ventilation, oxygen therapy (via face mask or nasal prongs), and the duration of such interventions. Room temperature and humidity were measured using an HTC-2 Digital Thermometer Hygrometer. Ocular surface examination followed a systematic approach as described by Hearne *et al*[2]. The eyelids were examined for conditions such as entropion, trichiasis, lagophthalmos, abnormal lid margins, and meibomian gland swelling or blockage. Lagophthalmos was graded as follows: Grade 0: Eyelids completely closed; Grade 1: Any conjunctival exposure, Grade 2: Any corneal exposure. Blinking frequency was recorded using a stopwatch, and the quality of the tear film assessed by looking for discharge or debris and the tear meniscus height (to give an idea of quantity). Tear Break-Up Time (TBUT) was measured by applying a fluorescein strip moistened with sterile water into the lower fornix. The patient was asked to blink several times or assisted, the tear film was examined using a portable slit lamp with a broad beam using the cobalt blue filter. After an interval, black spots or lines appear in the fluorescein-stained film, indicating the formation of dry areas. The interval between the last blink and the appearance of the first randomly distributed dry spot of less than 10 seconds was suspicious.

In an interval of about 5 minutes from TBUT, Schirmer's test (Schirmer 1) was performed by placing a testing strip (no. 41 Whatman) filter paper, 5mm wide and 35mm long folded 5mm from one end and inserted at the junction of the middle and outer third of the lower lid, taking care not to touch the cornea or lashes in the inferior conjunctival fornix and asking or assisting the

patient to close their eyes for 5 minutes. After 5 minutes the filter paper was removed, and the amount of wetting from the fold measured less than 10mm of wetting in two measurements was considered abnormal, followed by examination the cornea (fluorescein strip moistened with amethocaine) for the presence of foreign bodies, scars, edema, deposits, staining, and filaments, and examination of the bulbar and tarsal conjunctivae.

Where applicable, participants were asked about symptoms such as eye pain, itching, or a gritty sensation. The diagnosis of dry eye syndrome was based on the presence of either gritty sensation or foreign body sensation, decreased tear meniscus, Tear Break-Up Time (TBUT) <10 seconds, or Schirmer's test: <10mm of wetting in 5 minutes. Exposure keratopathy was based on the presence of lagophthalmos (incomplete eyelid closure) with or without inferior corneal staining with fluorescein (punctate epithelial erosions). Corneal abrasion or ulcers / keratitis based on Slit-lamp exam with cobalt blue filter, staining reveals epithelial defect with or without eye pain, conjunctivitis based on red eye, itching, conjunctival injection (hyperemia), papillae or follicles on tarsal conjunctiva, and blepharitis based on abnormal lid margins and meibomian gland openings. For participants diagnosed with Ocular Surface Disease (OSD), appropriate treatment was discussed with the patient or their next of kin, as well as the HDU/ICU care team. For those without OSD, preventive education was provided. All collected data were entered into a secure database, with confidentiality and data protection measures strictly observed. Statistical analysis was performed using STATA software version 17.

Analysis

Categorical variables such as sex, diagnosis, and medication use were presented as frequencies and percentages, while continuous variables such as age and length of ICU stay were summarized using means and standard deviations, and median with IQR. Associations between categorical variables and the outcome (presence of OSD) were initially assessed using Pearson's Chi-square test. To identify independent factors associated with the outcome, crude and adjusted Prevalence Ratios (PRs) were estimated using Poisson regression with robust standard errors. A p-value of less than 0.05 was considered statistically significant.

RESULTS

Demographics, clinical characteristics, and patterns of OSDs

The total number of patients during the study period admitted to HDU, MICU, and SICU was 1182. A total of 271 critically ill patients were enrolled in the study, with a response rate of 86%. The mean age of participants was 55.83 ± 19.84, with an age range spanning from 18 to 93 years (Table 1). The leading diagnoses were circulatory system diseases (56.1%) and neurological diseases (43.2%). Seventy-three percent of patients were on antibiotics, analgesics (42.4%), diuretics (34.3%), and beta-blocker drugs (10.7%). A total GCS of 13-15 in 60.9%, and the majority of the patients (46.1%) stayed in the ward for 1 to 3 days (Table 2). Dry eye syndrome was the most commonly observed OSD, affecting 43.9% of participants, followed by conjunctivitis (14.0%). With the overall prevalence of ocular surface disorder of 49.4% (Table 1). Lagophthalmos of the right eye was observed 4.4% of participants, 95.6% did not have the condition. In the left eye, lagophthalmos was present in 5.5% and absent in 94.5%.

Table 1: Demographic characteristics, type of care unit, and pattern of OSD among critically ill patients at KCMC. (N = 271)

Variable	Frequencies	(%)
Age group (years)		
Youth (18–24)	22	8.0
Young Adult (25–44)	59	21.8
Middle-aged (45–59)	56	20.7
Older Adult (60–74)	81	29.9
Elderly (75+)	53	19.6
Range	(18-93)	
Sex		
Male	154	56.8
Female	117	43.2
Patient ward		
HDU	150	55.3
MICU	65	24.0
SICU	56	20.7
Presence of OSDs (at least in one eye)		
Yes	134	49.4
No	137	50.6
Pattern of OSDs		
Dry eye syndrome	119	43.9
Conjunctivitis	38	14.0
Exposure keratopathy	13	4.8
Blepharitis	8	3.0
Corneal abrasion, keratitis	4	1.5

Table 2: Distribution of diagnoses and medications among critically ill patients (N = 271)

Variable	Frequencies	(%)
Diagnosis		
Respiratory system diseases	97	35.8
Renal system diseases	61	22.5
GIT diseases	52	19.2
Neurological diseases	117	43.2
Circulatory system diseases	152	56.1
Musculoskeletal diseases	16	5.9
Immune and endocrine diseases	86	31.7
Other diseases	14	5.2
GCS level		
Mild (13-15)	165	60.9
Moderate (9-12)	37	13.7
Severe (3-8)	13	4.8
Unassessable	56	20.7
ICU/HDU length of stay category		
Short Stay (1–3 days)	125	46.1
Moderate Stay (4–7 days)	83	30.6
Long Stay (8+ days)	63	23.2
Medications		
Sedatives and anesthetics	30	11.1
Diuretics drugs	93	34.3
Systemic chemotherapy agents	5	1.8
Systemic corticosteroids	35	12.9
Antibiotic drugs	199	73.4
Antipsychotics or antidepressants	12	4.4
Antihypertensive drugs	96	35.4
Antiplatelet drugs	18	6.6
Hypoglycemic drugs	49	18.1
Anticoagulant drugs	67	24.7
Analgesic drugs	115	42.4
Beta-blocker drugs	29	10.7
Other drugs	233	86

Clinical presentation of ocular surface disorders among critically ill patients at KCMC referral hospital

Due to the reduced level of consciousness in many critically ill patients, direct symptom reporting was significantly limited. In fact, over one-third (38.7%) of patients were unable to reliably report symptoms such as eye pain, itching, or irritation (Table 3).

Table 3: Distribution of ocular symptoms and signs by eye among critically ill patients (N=271)

Variables	Right eye		Left eye	
	f	(%)	f	(%)
Symptoms				
Presence of eye pain				
Yes	3	1.1	2	0.7
No	163	60.2	164	60.6
Inconclusive due to the patient's condition	105	38.7	105	38.7
Itching				
Yes	18	6.6	18	6.6
No	148	54.7	148	54.7
Inconclusive due to the patient's condition	105	38.7	105	38.7
Irritation/gritty sensation				
Yes	10	3.7	9	3.3
No	156	57.6	157	58.0
Inconclusive due to the patient's condition	105	38.7	105	38.7

Signs				
Redness/conjunctival hyperemia	31	11.4	36	13.3
Chemosis	4	1.5	6	2.2
Abnormal lid margin and meibomian gland openings	8	3.0	8	3.0
Eyelid swelling	2	0.7	2	0.7
Quality of the tear film (presence of discharge, debris, and tear meniscus height)	30	11.1	35	12.9
Tarsal papillae	2	0.7	2	0.7

*f=Frequencies

Table 4 shows the proportion of eyes with OSD based on tear breakup time less than 10 seconds or Schirmer's test less than 10 mm and corneal examination findings.

Table 4: Distribution of ocular surface examination findings by eye among critically ill patients (N=271)

Variables	Right eye		Left eye	
	Frequencies	(%)	Frequencies	(%)
Examination findings				
Tear breakup time, less than 10 seconds	76	28.0	64	23.6
Schirmer's test <10mm	103	38	108	39.9
Corneal staining	2	0.7	4	1.5
Corneal filaments	1	0.4	3	1.1

Bivariate analysis of factors associated with the presence of ocular surface disorders

The analysis indicates that advanced age, reduced consciousness, mechanical ventilation, oxygen therapy, neurological disease, and beta-blocker medication are the principal factors significantly associated with ocular surface disorders among critically ill patients at KCMC (Table 5).

Table 5: Bivariate analysis of factors associated with presence of ocular surface disorders (N=271)

Variables		Presence of ocular surface disorders			
		Present No. (%)	Not present No. (%)	Chi-square	P-value
	Total	134 (49.4)	137(50.6)		
GCS level					
Mild	165	64 (38.8%)	101 (61.2%)	21.151	<0.001
Moderate	37	21 (56.8%)	16 (43.2%)		
Severe	13	9 (69.2%)	4 (30.8%)		
Un-assessable	56	40 (71.4%)	16 (28.6%)		
Mechanical ventilation					
Yes	56	40 (71.4%)	16 (28.6%)	13.645	<0.001
No	215	94 (43.7%)	121 (56.3%)		

ICU/HDU length of stay					
Short stay (1–3 days)	125	58 (46.4%)	67 (53.6%)	5.163	0.076
Moderate stay (4–7 days)	83	37 (44.6%)	46 (55.4%)		
Long stay (8+ days)	63	39 (61.9%)	24 (38.1%)		
Days on oxygen mask					
Not on oxygen facemask	235	108 (45.9%)	127 (54.0%)	8.786	0.032
Short (1–3 Days)	27	19 (70.4%)	8 (29.6%)		
Moderate (4–7 Days)	5	4 (80.0%)	1 (20.0%)		
Prolonged (8+ Days)	4	3 (75.0%)	1 (25.0%)		
Neurological diseases					
Not present	154	96 (62.3%)	58 (37.7%)	19.816	<0.001
Present	117	41 (35.0%)	76 (65.0%)		

*Bivariate analysis was also done on age group, type of ward, days on mechanical ventilation, presence of musculoskeletal diseases, and medications used (eg, beta blockers)

Multivariable analysis of factors associated with the presence of ocular surface disorders

In multivariable Poisson regression with robust SE, several factors remained significantly associated with Ocular Surface Disorders (OSDs) after adjustment. Patients with neurological diseases had a 42% higher adjusted prevalence of OSD (aPR = 1.42, 95% CI 1.06–1.90; p = 0.019). Use of beta-blocker drugs also showed a strong independent effect (aPR = 1.45, 95% CI 1.11–1.91; p = 0.007). Likewise, individuals whose Glasgow Coma Scale (GCS) was unassessable, mainly those on mechanical ventilation, had more than twice the prevalence of OSD (aPR = 2.24, 95% CI 1.45–3.44; p < 0.001). Oxygen mask use remained significant after adjustment (aPR = 1.65, 95% CI 1.19–2.27; p = 0.003).

Although crude analysis showed increasing risk with older age and prolonged ICU stay, these associations lost significance in the adjusted model (p > 0.05), suggesting confounding by other clinical variables. Similarly, the type of ward, use of sedatives, anesthetics, diuretics, or presence of diabetes did not independently influence OSD risk.

Environmental factors played a modest but significant role. Patients exposed to lower room temperature (≤ 24.8 °C) and lower humidity (≤ 61%) had reduced protective effect, showing higher OSD prevalence (aPR = 0.74, p = 0.017 and aPR = 0.75, p = 0.023, respectively) (Table 6).

Table 6: Crude and adjusted prevalence ratios for factors associated with ocular surface disorders among critically ill patients (Poisson Regression Analysis with robust SE) (N=271)

Variable	cPR (95% CI)	P-value	aPR (95% CI)	P-value
Neurological diseases				
Not present	1		1	
Present	1.72 (1.35 – 2.20)	<0.001	1.42 (1.06 – 1.90)	0.019
Length of stay category				
Short Stay (1–3 days)	1		1	
Moderate stay (4–7 days)	0.96 (0.71 – 1.30)	0.797	0.98 (0.73 – 1.31)	0.895
Long stay (8+ days)	1.33 (1.02 – 1.75)	0.037	1.09 (0.84 – 1.41)	0.516
Beta-blocker drugs				
Not present	1		1	
Present	1.64 (1.28 – 2.10)	<0.001	1.45 (1.11 – 1.91)	0.007

GCS level				
Mild (13–15)	1		1	
Moderate (9–12)	1.46 (1.04 – 2.06)	0.029	1.15 (0.79 – 1.66)	0.470
Severe (3–8)	1.78 (1.18 – 2.69)	0.006	1.22 (0.80 – 1.87)	0.351
Unassessable (On vent)	1.84 (1.43 – 2.37)	<0.001	2.24 (1.45 – 3.44)	<0.001
Oxygen mask				
No	1		1	
Yes	1.55 (1.20 – 1.99)	0.001	1.65 (1.19 – 2.27)	0.003
Temperature category				
>24.8°C	1		1	
≤24.8°C	0.82 (0.64 – 1.04)	0.104	0.74 (0.58 – 0.95)	0.017
Humidity category				
>61%	1		1	
≤61%	0.79 (0.62 – 1.01)	0.062	0.75 (0.59 – 0.96)	0.023

*Also adjusted for type of ward, age group, diabetic status, sedatives/anaesthetics drugs, and diuretic drugs

Overall, the adjusted analysis indicates that neurological disease, beta-blocker therapy, mechanical ventilation with unassessable GCS, and oxygen mask use were the strongest independent predictors of OSD among critically ill patients. High humidity and environmental temperature aggravate OSD, highlighting the need for preventive eye-care measures targeting these high-risk conditions in intensive and high-dependency units.

DISCUSSION

The prevalence of OSDs was 49.4%, with higher rates among patients with neurological conditions, those using beta-blockers, individuals on mechanical ventilation or oxygen therapy, as well as those exposed to lower temperature and humidity. This prevalence is comparable to an Egyptian study reporting 48.3%[4], reflecting similar clinical environments.

Among critically ill patients, assessing OSD symptoms was challenging due to impaired consciousness, with 38.7% unable to report discomfort. Among those who could communicate, symptoms were uncommon, including pain (≤1.1%), itching (6.6%), and irritation (≤3.7%). Clinical signs were more reliable; conjunctival hyperemia occurred in 11.4% of right eyes and 13.3% of left eyes, while abnormal tear film quality was seen in 11.1% and 12.9%, respectively. Tear breakup time <10 seconds was recorded in 28% of right eyes and 23% of left, and Schirmer's test <10mm in 39.9%. Corneal staining and filaments were rare. These findings differ from a Turkish study reporting higher rates of hyperemia, secretions, and staining, likely due to its smaller sample size (40 patients) and inclusion of individuals who stayed in ICU >7 days or had suspected ocular problems[8].

In this study, dry eye syndrome was the most common OSD among critically ill patients (43.9%), followed by conjunctivitis (14.0%). These findings are comparable to an Indian study reporting dry eye at 46% and conjunctivitis at 23%[11], likely due to similar single-center designs and diagnostic methods. However, an Iranian study reported different patterns, partly because it used a higher Schirmer's test cutoff (<15mm) and combined dry eye with corneal abrasions[12]. These differences emphasize the need for standardized diagnostic protocols in ICU/HDU ocular assessments.

Patients with unassessable GCS (those on mechanical ventilation) had significantly higher OSD prevalence (cPR = 1.84; 95% CI: 1.43–2.37; p < 0.001) compared to those with mild GCS[13-15]. This indicates that ventilated patients are more than twice as likely to develop OSD. These findings align with previous studies[12,13] likely due to sedation, reduced blinking, and lagophthalmos. Differences from a Turkish study may reflect a smaller sample size and narrower inclusion criteria[8].

Use of beta-blocker medications was significantly associated with OSDs. This association remained significant in the adjusted model (aPR = 1.45; 95% CI: 1.11–1.91; p = 0.007). These findings were similar to findings from the study that was conducted in Poland[13]. This could be because beta-blockers, particularly non-selective types like propranolol, can reduce aqueous tear production by inhibiting β-adrenergic stimulation of the lacrimal gland.

Use of an oxygen face mask was significantly associated with ocular OSDs. This association remained significant in the adjusted model (aPR = 1.65; 95% CI: 1.19–2.27; p = 0.003). These findings were similar to a study done in London[2]. Oxygen face masks lead to

increased evaporation of the tear film, destabilizing it and promoting ocular surface dryness.

From a public health perspective, the high prevalence of ocular surface disorders among critically ill patients underscores the need to integrate routine eye care into standard ICU and HDU practice. Simple preventive measures such as regular ocular assessment, eyelid closure support, prophylactic lubricants, and staff training could substantially reduce avoidable ocular morbidity and long-term visual impairment in this vulnerable population.

Strengths

This study provides locally generated evidence on ocular surface disorders among critically ill patients in Tanzania, a setting where published data are limited. The study used standardized ocular surface assessment tools (TBUT, Schirmer's test, fluorescein staining) and applied multivariable Poisson regression to identify independent predictors, strengthening the validity of the findings.

Limitations

The cross-sectional design limits causal inference between risk factors and ocular surface disorders. Some patients were unable to report symptoms due to reduced consciousness, which may have led to underestimation of subjective symptoms. Additionally, the study was conducted at a single referral hospital, which may limit generalizability to other settings.

CONCLUSIONS

The study found that nearly half of the patients (49.4%) had some form of OSD. Common signs were conjunctival hyperemia and decreased quality of the tear film, with a common examination finding being Schirmer's test <10mm of wetting in 5 minutes. Dry eye syndrome was the most frequently observed condition (43.9%), followed by conjunctivitis and exposure keratopathy. OSDs were significantly associated with neurological diseases, beta-blocker use, oxygen mask, low GCS, and lower temperature or humidity. Elderly age and longer ICU stays showed trends in univariate analysis, but were not significant in multivariate analysis.

Recommendations

Routine ocular assessments should be integrated into ICU and HDU care. Healthcare providers working in critical care units should receive training on early identification and management of ocular surface disorders. Further research should explore longitudinal outcomes of ocular surface disorders in critically ill patients and evaluate the effectiveness of structured eye-care protocols.

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