A Clinical Study on Ocular Surface Disorders in Intensive Care Unit Patients at S.V.R.R.G.G.H., Tirupati - A Hospital Based Descriptive Cross-Sectional Study

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ABSTRACT

BACKGROUND

Due to the impaired ocular defence mechanisms, patients in the intensive care unit are more prone for ocular surface disorders. This creates the need for identifying the causal factors and educating the health care staff working in (intensive care unit) ICU, regarding ocular surface disorders. The prevalence of ocular surface disorders in ICU patients is about 60 %.[1] We wanted to study the proportion and causative factors of ocular surface disorders in intensive care unit patients.

METHODS

A cross sectional study was conducted among 100 patients admitted in intensive care unit of S.V.R.R.G.G. Hospital, Tirupathi, for a duration of one year. A detailed history, clinical examination, fluorescein staining, Schirmer's test and conjunctival cultures was done.

RESULTS

Out of 100 patients, 50 patients were on ventilator support and 50 patients were without ventilator support in ICU. Overall prevalence of superficial punctate keratitis was 78 %, lagophthalmos 20 %, dry eyes 88 %, microbial keratitis 17 % in patients. The prevalence of ocular surface disorders was more in ventilator supported patients.

CONCLUSIONS

Ocular examination should be a part of routine examination in an intensive care unit setting, because the risk of microbial keratitis can be reduced by preventing exposure keratopathy with the help of meticulous eye care.

KEYWORDS

Ocular Surface Disorders, Intensive Care Unit, Ventilator Support, Microbial Keratitis, Eye Care

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BACKGROUND

Ocular surface disorders can result from compromise to the surface or function of the eyelids and their glands, conjunctiva, its accessory glands or cornea. In intensive care units, patients often have high risk of ocular surface disorders due to deranged ocular protective mechanisms as a result of mechanical ventilation, metabolic derangements, decreased level of consciousness and multiple organ dysfunction which can result in serious visual impairment.[2,3]

Improper lid closure can lead to ocular surface dryness, desiccation of the cornea epithelial cells, and ulceration of cornea, with the risk of microbial keratitis. Lesions can widely range from punctuate epithelial keratopathy to macro epithelial erosions, and if not treated, can lead to corneal thinning and perforation.[3-5]

The health care staff in the intensive care unit, are primarily concerned with life threatening conditions; therefore, the ocular signs and symptoms may be missed leading to serious ocular complications like corneal ulceration and infectious keratitis.[1,6]

Hence, meticulous eye care with ocular hygiene, use of lubricants and ointments and ophthalmologist consultation in case of suspicious infection are recommended in the patients admitted in intensive care unit.[7]

Objectives

- To study the proportion and causative factors of ocular surface disorders in intensive care unit patients.
- To estimate the proportion of ocular surface disorders in intensive care unit patients.
- To determine the causal factors
- To educate the intensive care unit staff about proper eye care.

METHODS

This was a hospital based descriptive cross-sectional study. The study was conducted for a period of 1 year from December 2018 to November 2019. A total of 100 patients (50 patients on mechanical ventilator support and 50 without mechanical ventilator support) who were admitted in intensive care unit in this hospital during the study period, satisfying the inclusion criteria were taken as the study subjects.

Inclusion Criteria

1. All patients admitted in intensive care unit of S.V.R.R.G.G. Hospital for more than 7 days.
2. Patients / attendants (in case of patients on ventilator support) who were willing to participate in the study.

Exclusion Criteria

1. Facial and lid injuries.
2. Floppy eyelid syndrome.
3. Lagophthalmos due to autoimmune disorders.

With the institutional ethics committee approval, informed and written consent was taken from patients in her / his vernacular language in case of conscious patients. But in case of semi-conscious and unconscious patients, consent was taken from patient attenders, near relatives or close relatives. Data was collected in standardised proforma as per inclusion and exclusion criteria.

Patient's demographic details were noted. Patients were subjected to complete ocular examination and case sheet proforma were drawn up with details of each patient.

Conjunctival cultures were obtained by using a sterile cotton swab. Fluorescein stain, Schirmer's test were done on all patients. Conjunctival swabs were collected and sent to microbiology department for culture and sensitivity.

Complete Ocular Examination Includes

a. Visual acuity: Bedside visual acuity is recorded (in conscious patients).
b. Anterior segment examination was done by handheld biomicroscopic device and the following details were observed.
c. Eyelids: Lagophthalmos
d. Conjunctiva: Dryness, hyperemia, chemosis, discharge
e. Cornea: Clear / hazy, superficial punctuate keratitis, dryness
f. Anterior chamber: Depth, contents
g. Iris: Colour, pattern.
h. Pupil: Size, reaction to light.
i. Lens: Clear, cataract, pseudophakia

Diagnostic Tests

Conjunctival Swabs for Culture and Sensitivity

Patient's lower eyelid was pulled inferiorly, and the conjunctival swab was placed inside the lower eyelid and rolled from lateral canthus to the medial canthus once. The swab was kept in the sterile bottle and immediately taken to the microbiology department for culture and sensitivity. The report was collected after 72 hrs.

The culture and sensitivity were done for both gram positive and gram-negative pathogens. Blood agar and MacConkey agar was used in microbiology for culture and sensitivity. These samples were taken to microbiology department within 20 – 30 minutes, as the micro-organisms survive for half an hour only.

Schirmer's Test

The basic secretion test was performed after instillation of a topical anesthetic to minimise irritation to the cornea during the test. A thin filter paper strip (5 mm wide. 35 mm long) was placed at the junction of middle and lateral thirds of the lower eyelid, with 5mm of the paper folded within the inferior cul– de-sac and 35 mm of paper projecting over the lower eyelid. The test was performed with the patient's eyes open or closed.

Fluorescein Test

The patient lower lid was pulled down, fluorescein strip was made wet with antibiotic drops and placed in the lower fornix for few seconds. Later the eye was examined with handheld slit lamp under cobalt blue filter for corneal pathologies like superficial punctuate keratitis.

Sample Size Calculation

In a study done by Grixti A et al.[1] 60 % of the hospitalised patients in the ICU setup suffered from ocular surface disorders. We calculated the sample size for this study using the formula $4PQ / L^2$ (P = Percentage of ocular surface disorders from previous studies). With an error of 10 %, the sample size was 96. (A total of 100 subjects were taken into account).

Statistical Analysis

Data was analysed using Epi Info software version 7.2.2.6. The data in the results were represented as percentages and frequencies. A P value less than 0.05 was accepted as statistically significant.

RESULTS

The study group consisted of 100 patients, 50 patients were on ventilator support (mechanically ventilated) and 50 patients were without ventilator support in the intensive care unit of S.V.R.R.G.G. Hospital, Tirupati. In this study there were 62 males and 38 females.

The age of the patients ranged between 25 - 75 years. The period of hospitalisation ranged between 10 to 50 days (median 3 weeks). 50 patients had mechanical ventilation, 25 were on sedation, 4 were on muscle relaxants. There was no significant correlation of the degree of keratopathy with the age, sex, or diagnosis. The incidence of exposure keratitis, dry eye and chemosis in the patients enrolled in the study is summarised in the below tables.

Exposure Keratitis	Number of Eyes Involved	Percentage
Lagophthalmos	20	20 %
Dry eyes	88	88 %
Corneal pathology (superficial punctuate keratitis)	78	78 %

Table 1. Exposure Keratitis in Ventilator Patients

In this study of 50 patients on ventilator (100 eyes), 20 (20 %) were found to have lagophthalmos, 88 (88 %) had dry eyes and 78 (78 %) were found to have superficial punctate keratitis.

In this study, out of 50 patients on ventilator (100 eyes) 10 % of eyes and out of 50 patients off ventilator (100 eyes), 5 % of eyes were found to have chemosis respectively.

	On Ventilator		Off Ventilator	
	No. of Eyes	No. of Eyes Involved	No. of Eyes	No. of Eyes Involved
Chemosis	100	10 (10 %)	100	5 (5 %)
Dry Eye	100	88 (88 %)	100	70 (70 %)

Table 2. Chemosis and Dry Eye in ICU Patients

In this study, out of 50 patients on ventilator (100 eyes) 88 % of eyes and out of 50 patients off ventilator (100 eyes), 70 % of eyes were found to have dry eye respectively.

Pathogens	No. of Cases	No. of Eyes	%
Pseudomonas aeruginosa	3	6	6 %
Klebsiella	2	3	4 %
E. coli	1	2	2 %
Staphylococcus aureus	1	2	2 %
Moraxella species	1	2	2 %
Coagulase negative Staphylococci	1	2	2 %
Commensals (Micrococcus)	25	35	70 %

Table 3. Microbial Infections in Patients on Ventilator

Out of 50 patients who were on ventilator support (100 eyes)-

- 3 patients (6 eyes) were positive for *Pseudomonas aeruginosa*,
- 2 patients (3 eyes) positive for klebsiella,
- 1 patient (2 eyes) positive for *E. coli*,
- 1 patient (2 eyes) positive for *Staphylococcus aureus*,
- 1 patient (2 eyes) positive for moraxella species,
- 1 patient (2 eyes) positive for coagulase negative staphylococci,
- 25 patients (35 eyes) show commensals (micrococci).

Microbial keratitis was found only in patients who were on mechanical support. Culture reports of patients who were without mechanical support were found to be negative except for 4 eyes of 3 patients who were positive for *Staphylococcus aureus*.

DISCUSSION

Critically ill patients with ocular surface disorders were estimated to be about 60 %.[1] The eyelids act as an important physical barrier in protecting the ocular surface from external risk factors like trauma and infection. Due to usage of the sedatives and neuromuscular blockers in the sedated patients of intensive care units, it has been reported that 20 % to 75 % had incomplete eyelid closure due to the inhibition of contraction of the orbicularis oculi muscle.[1,6,8,9] Blink reflex, which is one of the important ocular protective mechanisms is also abolished by the neuromuscular blockers.[1,6]

Several factors like adequate tear film distribution, with normal blink reflex, blink rate and complete closure of eyelids during sleep act as protective ocular barriers against infection. Any disruption to these barriers can lead to epithelial defect followed by exposure keratopathy which if not treated can lead to corneal thinning and perforation.

The presence of ocular surface disease was closely correlated with the degree of lagophthalmos, which in turn was closely related to the depth of sedation or paralysis.

In our study out of 100 patients, 50 patients were on ventilator support and 50 patients were without ventilator support in intensive care unit. Exposure keratitis was seen in ventilator support patients, resulting from incomplete eyelid closure (lagophthalmos), corneal exposure and dryness.

The Saritas et al. study 2013, retrospective study of total population of 40 shows, lagophthalmos in 40 %, staining in 15 %, keratitis in 10 %, microbial infection in 42.5 %.[10] In Desalu et al. study 2008, prospective study of 56 patients shows lagophthalmos in 40 %, dry eyes in 16.1 %, corneal pathology in 6.5 %.[11] In Siva Sankar et al. study 2006, randomised control study of 126 total population shows lagophthalmos in 30 %, dry eyes in 100 %, corneal pathology in 19.8 %.[12] In this study, prevalence of lagophthalmos, dry eyes, corneal pathology was found to be 20 %, 88 %, 78 % respectively. A two-phase prospective study conducted by Mc Hugh J et al. conducted in 2008, with a total of 18 patients found the prevalence of exposure keratitis to be 37.5 %.[13]

A prospective cohort study by Jammal H et al. in 2012 with 74 patients have found the prevalence to be 57 %.[14] The cohort studies by Diago Dias de Araujo et al. and Germano et al. have concluded that the prevalence of exposure keratitis was 52 and 25 % respectively.[15,16] The prospective randomised controlled trials conducted by Lenart & Garrity et al. and Bates et al. have found the prevalence of exposure keratitis to be 28 and 17.8 %.[17,18] The comparison between these studies and the present study is summarised in the table below.

Study	Design	Total No. of Patients	Exposure Keratitis
Mc Hugh J et al. 2008[13]	Two phase prospective study	18	37.5 %
Jammal H et al. 2012[14]	Prospective cohort study	74	57 %
Diago Dias de Araujo et al. 2016[16]	Cohort study	230	52 %
Germano et al. 2009[15]	Prospective cohort study	53	25 %
Lenart & Garrity 2000[17]	Prospective randomised controlled trail	50	28 %
Bates et al. 2004[18]	Prospective single blinded randomised controlled trail	28	17.8 %
Present study	Cross sectional	100	80 %

Table 4. Comparison of Prevalence of Exposure Keratitis with other Studies

Exposure keratopathy had been reported to occur in 3.6 - 60 % in ICU patients of other studies, with a peak incidence between 2 to 7 days from admission. The prevalence of corneal abnormalities was higher in patients who stayed for one week or longer in ICU. In the present study exposure keratitis was observed in 80 %.

Microbial Keratitis in ICU

Critically ill patients are particularly at risk of developing microbial keratitis secondary to exposure keratopathy and immune suppression. The most common infectious organism was *Pseudomonas aeruginosa*. Exposure keratopathy combined with proximity of the pathogenic organisms to the damaged cornea were identified as predisposing factors for corneal infection.

Hilton et al. and Parkin et al. found a statistically significant association between microbial keratitis and respiratory colonisation by *Pseudomonas aeruginosa*. In a sample size of 10 eyes *Pseudomonas aeruginosa* were isolated from C / S in total 10 eyes. In Parkin et al. study, among 9 eyes (patients in ICU) 8 eyes were isolated from *Pseudomonas aeruginosa*.[19, 20]

Mela et al. study 2010, among 70 patients, 54 patients had microbial keratitis. Three species were isolated by C / S - *Pseudomonas aeruginosa*, acinetobacter spp, *staphylococcus epidermidis*. In this study 48 % patients were colonised by single species, 51 % colonised by two or > than two spp. Three major species are accounted for 92 % of single isolates and 100 % of mixed isolates.

Saritas et al. study, out of 40 cultures from conjunctiva, 17 were positive for bacteria. 10 *Staphylococcus epidermidis*, 2 *Pseudomonas aeruginosa*, 2 *Acinetobacter baumannii*, 1 *Staphylococcus haemolyticus*, 1 klebsiella, 1 *Proteus mirabilis*.[10] In present study, out of 100 eyes (of patients on ventilator), 6 *Pseudomonas aeruginosa*, 3 klebsiella, 2 *E. coli*, 2 moraxella spp, 2 coagulase negative staphylococci, 2 *staphylococci aureus*, 25 commensals (micrococcus) were isolated. In our current study, the prevalence of exposure keratitis was seen (dry eye and corneal pathologies) high in patients who were on mechanical ventilation when compared to patients without ventilator support. The prevalence ranges from 70 % - 88 %.

The presence of dry eye in patients with ventilator (mechanical) support was 88 % and without mechanical support was 70 % [with significant P value]. Total of 158 eyes gave a wetting of less than 10 mm on performing Schirmer's test. The presence of corneal pathologies in patients with mechanical support was 78 % and without mechanical ventilator support was 70 % [with significant P value]. The prevalence of chemosis was seen in 10 % and 5 % of the patients who were on mechanical ventilation and without mechanical ventilator support respectively. The microbial keratitis was seen in patients with mechanical support with a prevalence of 17 % and in patients without mechanical support was 4 %.

CONCLUSIONS

Patients in ICU who were on ventilator support were more prone to develop dry eyes, keratopathy and microbial ocular infections. These ocular surface disorders were seen from day 2 to day 7 after their admission into ICU. But patients were taken for study after seven days of admission into ICU. Microbial infections were more prevalent in patients who were on ventilator support than patients who were without ventilator support. But exposure keratitis was seen in both patients with and without ventilator support. In patients who have recovered from chronic intensive care therapy may suffer from visual loss which can produce an affirmative effect on their quality of life.

Ocular examination should be a part of routine examination in an ICU setting, because the risk of microbial keratitis can be reduced by preventing exposure keratopathy with help of meticulous eye care. Early diagnosis of ocular surface disorders is mandatory in all patients admitted in the intensive care therapy for prompt treatment. The ophthalmologist can examine the patient and advise taping the eyelid. It is an effective method of preventing exposure keratitis in incomplete eye closure. Installation of antibiotic eye drops, and artificial tear drops are advised to prevent

microbial keratitis and dry eye. An ophthalmologist should give instructions to nursing staff about preventive measures. Proper nursing care should be given by ICU nursing staff by periodical cleaning of eyes and face, cleaning the eyes with cotton soaked in warm saline. The nursing staff should be trained well about nursing care in ICU patients.

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