Original Article

Eye care in ICU

S. Sivasankar, S. Jasper*, S. Simon*, P. Jacob*, G. John, R. Raju*

Abstract

Context: Patients in intensive care units have impaired ocular protective mechanisms, resulting in a high risk of developing eye complications. Various eye care protocols are being used, but none is proven to be absolutely effective. **Aims:** To compare the efficacy of using a combination of ocular lubricants and securing tape over the eyelids (Open chamber method), with use of swimming goggles and regular moistening of eyelids with gauze soaked in sterile water (Closed chamber method), to prevent corneal epithelial breakdown in the sedated and semiconscious intensive care adult patient. **Settings and Design:** A randomized clinical study was performed. Patients with Glasgow coma scale score of ≤ 10/15, admitted into the Medical ICU of a large teaching hospital, over a four month duration, were studied. **Materials and Methods:** Patients were examined daily by an Ophthalmologist, using a portable slit lamp and the patient's corneas were tested daily using 1% Fluorescein drops. Standard grading scales were used to record eyelid position and corneal and conjunctival changes. **Statistical analysis used:** Quantitative variables were described in terms of their relative frequencies in proportions. Null hypothesis was applied to derive the statistical significance of the observed variations in both the treatment groups. Chi-square test for relationships was used to assess the effect of specific variables on the development of keratopathy. **Results:** Sixty one patients (122 eyes) in the open chamber group and 63 (126 eyes) in the closed chamber group, were analyzed. Incomplete lid closure was seen in 74 eyes (30%). Exposure keratopathy was noticed in 39 eyes (32%) in open chamber group and ten (8%) in closed chamber group and was more severe in the former group. There was no difference in the incidence of conjunctival oedema in both groups. Incomplete lid closure and use of muscle relaxants, were significant risk factors for developing keratopathy. **Conclusions:** Use of swimming goggles and regular moistening of eyelids with gauze soaked in sterile water providing a moisture chamber, is more effective than using a combination of ocular lubricants and securing tape over the eyelids, in preventing corneal epithelial breakdown in sedated and semiconscious intensive care unit patients.

Key words: Exposure keratopathy, Intensive care patients.

Microbial keratitis is a severe complication of corneal exposure in critically ill patients.[1] A variety of eye care protocols are being used, to prevent exposure keratopathy in intensive care patients and there is no clear consensus defining the most effective form of eye protection.[2] A recent report from the United Kingdom revealed that 75% of the Intensive Care Units (ICU) used polyacrylamide gel for eye care, while 25% used ocular lubricants.[3] Other commonly used methods include, placing a securing tape in a horizontal position over the closed eye lids[4] and creating a moisture chamber to prevent corneal dryness.[5]

We carried out a prospective comparative trial to

From:
Departments of Medical ICU and *Ophthalmology, Christian Medical College and Hospital, Vellore, Tamil Nadu - 632004, India

Correspondence:
Dr. George John, Department of Medical ICU, Christian Medical College and Hospital, Vellore, Tamil Nadu - 632004, India. E-mail: yokavi@yahoo.com

compare the efficacy of using a combination of ocular lubricants and placing a securing tape (Open chamber method) and creating a moisture chamber by using swimming goggles and moistening eyelids with gauze soaked in sterile water every 12 hours (Closed chamber method), in preventing corneal epithelial breakdown in intensive care patients [Figures 1 and 2].

Use of closed chamber method offers better protection against exposure keratopathy in the intensive care patients, as compared to the use of a combination of ocular lubricants and securing tape over the eyelids.

Materials and Methods

All patients with a Glasgow coma scale score of ≤ to 10/15 admitted over a four month period to the Medical Intensive Care Unit of a large teaching hospital in South India, were included in the study. Patients were randomized into one of the treatment groups at admission. Those patients ≤ 18 years of age, spent less than 24 hours on the unit, or with primary ocular disease were excluded at the time of analysis.

Figure 1: Open chamber method - using ocular lubricants and a securing tape over the eyelids

Figure 2: Closed chamber method - use of swimming goggles and moistening of eyelids with gauze soaked in sterile water to provide a moisture chamber

A study proforma designed to include various medical and ophthalmologic details was used for each patient. Specific factors such use of muscle relaxants, Riker sedation score and duration of stay in ICU, were recorded. All patients were examined by an ophthalmologist within 24 hours of admission into the ICU and subsequently everyday, until the patient completed the study. A patient was declared to have completed the study if he regained spontaneous eye opening/ died / discharged from ICU, or developed corneal lesions.

A detailed eye examination was carried out to assess eyelid position, pupillary reaction, intraocular pressure and conjunctival and corneal changes. A portable slit lamp and Perkins's tonometer were used for bedside evaluation. The cornea was examined for erosions, by instillation of 1% Fluorescein drops. The grading of eyelid position, corneal changes[9] (grades 1-6) and conjunctival oedema (grades 1-3) are given in Table 1.

Results

A total of 146 patients were recruited. Twenty two patients were excluded at the time of analysis. Analysis was carried out for 122 eyes (61 patients) randomized into the open chamber group and 126 eyes (63 patients) into the closed chamber group. The mean age of the

Table 1: Grading for eye lid position, conjunctival oedema and corneal changes

Eye lid position

1. Only conjunctival exposure
2. Lower 1/4th of the cornea exposed
3. Lower ½ of the cornea exposed
4. ¾th of the cornea exposed
5. Cornea fully exposed

Conjunctival oedema

Grade 0 - Absent
Grade 1 - Conjunctival oedema without dellen formation
Grade 2 - Conjunctival oedema with dellen formation

Corneal changes

1. Punctate epithelial erosions involving the inferior third of the cornea
2. Punctate epithelial erosions involving more than the inferior third of the cornea
3. Macroepithelial defects
4. Stromal whitening in the presence of epithelial defect
5. Stromal scar
6. Microbial keratitis

patients was 39.2 years and 42.3 years in the open chamber and closed chamber group, respectively.

Incomplete lid closure was noticed in 74 (30%) of the 248 eyes analyzed. The extent of ocular surface exposure of the eyes analyzed in both the groups is given in Table 2.

A total of 27 patients (21%) had exposure keratopathy. Twenty two patients (81.5%) had bilateral lesions, while five (18.5%) had unilateral lesions. Hence, exposure keratopathy was noted in 49 (19.8%) of the 248 eyes in the study. Thirty nine (32%) eyes in open chamber group and ten (8%) eyes in closed chamber group had evidence of corneal disease, showing a significant difference between the two groups (*P*-value of 0.001 and chi-square of 22.5). The extent of exposure keratopathy in both these groups is given in Table 3. Most corneal lesions developed within 48 hours of admission in both groups; 37 of 39 (95%) in open chamber and eight of ten (80%) in closed chamber group. Exposure keratopathy was more severe in the open chamber group, than in the closed chamber group. Tarsorrhaphy was performed in one patient in the open chamber group who had unilateral grade 4 corneal lesions.

Grade 1 conjunctival oedema was noted in 32 eyes (22%) in the open chamber group and 36 (28%) in the closed chamber group. No significant difference was observed in the incidence of conjunctival oedema (chi-square = 0.085).

Table 2: Extent of ocular surface exposure

	Open chamber (Total number of eyes-122)	Closed chamber (Total number of eyes-126)
No corneal or conjunctival exposure	88 (72)	86 (68.2)
Only conjunctival exposure	10 (8.2)	14 (11)
Lower ¼th of the cornea exposed	18 (14.7)	20 (15.8)
Lower ½ of the cornea exposed	6 (4.9)	6 (4.8)

Figures in parenthesis are in percentage

Table 3: Extent of exposure keratopathy

	Open chamber (Total number of eyes-122)	Closed chamber (Total number of eyes-126)
No exposure keratopathy	83 (68)	116 (92)
Grade I	18 (15)	8 (6.5)
Grade II	12 (10)	2 (1.5)
Grade III	8 (6.0)	-
Grade IV	1 (1.0)	-

Figures in parenthesis are in percentage

The other significant problems observed were lid abrasions and conjunctival abrasions in 15 (12%) eyes in open chamber group and oedema of the eyelids due to the pressure of the goggles over the globe in eight (6.5%) eyes, in the closed chamber group.

Analysis of the influence of specific factors on the development of keratopathy was carried out for all the 124 patients, irrespective of the eye care protocol implemented. It was found that incomplete lid closure and use of muscle relaxants were significantly associated with corneal disease (*P*-values of 0.001 and 0.025 respectively). However, sedation score and mean duration of stay in ICU had no significant effect on the incidence of keratopathy.

All 34 eyes with incomplete lid closure at admission in the open chamber group developed exposure keratopathy, while only 11 (27.5%) of the 40 eyes in the closed chamber group showed evidence of the same. The protection against keratopathy in the presence of incomplete lid closure in the closed chamber group appears significant (*P*-value = 0.001).

Discussion

The ocular surface in healthy individuals is protected by natural defence mechanisms such as bactericidal effect of the tear film, blinking of eyelids and adequate lid closure.[6] The tear film provides mechanical lubrication to wash away organisms and also contains antimicrobial substances such as immunoglobulins, lysozyme, lactoferrin, ceruloplasmin and complement components.[1] Use of muscle relaxants and sedation in patients on ventilator contributes to inadequate lid closure by decreasing the tonic contraction of ocular muscles.[7] Thus, inadequate protective mechanisms and constant exposure of the ocular surface to the environmental pathogens, put the ICU patients at high risk of developing exposure keratopathy. Eye care is therefore of paramount importance in ICU patients, to avoid easily preventable complications of the eye, as poor vision can have a devastating effect on the quality of life in those who recover.

Previous studies have reported that about 40% of patients develop exposure keratopathy during their stay in the ICU.[8,9] Despite the use of a variety of eye care protocols, none has been proven to be absolutely

effective and eye complications continue to be a significant problem in ICU patients.

Our study revealed that 39 (32%) out of 122 eyes developed exposure keratopathy with use of ocular lubricants and securing tape, while 10 (8%) out of 126 patients had evidence of the same, when a moisture chamber was created with use of swimming goggles and regular moistening of the eyelids with gauze soaked in sterile water. This reflects that use of swimming goggles is more effective in preventing exposure keratopathy. In a similar study, Cortese *et al* reported that a moisture chamber is more effective than lubricating drops, in preventing corneal epithelial breakdown.[5] Moreover, patients in the open chamber had more severe corneal disease and one patient required tarsorrhaphy to facilitate corneal healing.

Conjunctival oedema termed as ventilator eye, occurred in 32 (22%) eyes in the open chamber group and 36 (28%) eyes in the closed chamber group. Moisture chamber did not seem to prevent the development of chemosis. However, it was technically more difficult to apply a securing tape over the eyelids when chemosis was present. Fifteen eyes (12%) in the open chamber had conjunctival abrasions, while the tape was being removed.

The pressure of the goggles over the eyelids caused significant lid oedema in eight eyes (6.5%). However, oedema subsided when the tension of the goggles was reduced.

In this study, we have observed that incomplete lid closure and use of muscle relaxants are the most important predictive factors for developing exposure keratopathy. However, it was observed that while all 34 eyes with incomplete lid closure developed corneal disease in the open chamber group, only 11 (27.5%) of 40 eyes in the closed chamber group showed evidence of the same. This suggests that a moisture chamber is better in preventing keratopathy, even in those patients with incomplete lid closure.

The main strength of our study lies in its prospective design, systematically comparing the two different practices. The results of our study clearly indicate that use of closed chamber method reduces the incidence of exposure keratopathy to 8%, compared to 32% with use of ocular lubricants and taping the eyelids. We, therefore, suggest the use of closed chamber method as regular eye care practice in the intensive care units for all sedated and semiconscious patients, to prevent exposure keratopathy. However, regular assessment of eye hygiene and a prompt ophthalmologic opinion obtained early in the event of any evidence of keratopathy, helps to minimize further complications. Further studies to assess the benefit of combined use of ocular lubricants and closed chamber method, are recommended.

References

1. Kirwan JF, Potamitis T, El-Kasaby H, Hope-Ross MW, Sutton GA. Microbial keratitis in intensive care. BMJ 1997;314:433-4.
2. Laight SE. The efficacy of eye care for ventilated patients: outline of an experimental comparative research pilot study. Intens Crit Care Nurs 1996;12:16-26.
3. King DJ, Healy M. Prevention of eye disease in intensive care - a telephone survey. Int Care Med 2003;29:15.
4. Wincek J, Ruttum MS. Exposure keratitis in comatose children. J Neurosci Nurs 1989;21:241-4.
5. Cortese D, Capp L, McKinley S. Moisture chamber versus lubrication for the prevention of corneal epithelial breakdown. Am J Crit Care 1995;4:425-8.
6. Parkin B, Cook S. A clear view: The way forward for eye care on ICU. Intensive Care Med 2000;26:155-6.
7. Lenart SB, Garrity JA. Eye care for patients receiving neuromuscular blocking agents or propofol during mechanical ventilation. Am J Crit Care 2000;9:188-91.
8. Hernandez EV, Mannis MJ. Superficial keratopathy in intensive care unit patients. Am J Ophthalmol 1997;124:212-6
9. Mercieca F, Suresh P, Marton A, Tullo AB. Ocular surface disease in intensive care unit patients. Eye 1999;13:231-6.