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Case Series

Incidence and Risk Factors of Exposure Keratopathy in Intensive Care Unit: About 91 Cases

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Abstract

Priorities for management of the gravely ill patients in the ICU are based on life-menacing problems; other problems with less immediate outcomes can go undetected. Exposure keratopathy (EK), seen in 37 - 57% of ICU patients, is one of the silent morbidities.

The eyelids, the tear film, the blink, and Bell's phenomenon are the main factors in maintaining the regularity of the ocular surface.

Any lesion or absence of one of these mechanisms variably alters the cornea. The definition of exposure keratopathies varies in the literature, which explains the great variation in the results regarding the incidence and risk factors of their development.

The purpose of our study is to determine the incidence and risk factors of exposure keratopathies in the intensive care unit of the Hospital of Specialties in Rabat, to improve the quality of care of our patients, and to shed the light on the overall management of the patient whose vital prognosis is in danger.

Keywords: *Exposure Keratopathy (EK); Intensive Care Unit*

Introduction and Methodology

Exposure keratopathy (EK) is defined as damage to the cornea primarily due to prolonged exposure of the ocular surface to the external environment. EK can lead to ulceration, microbial keratitis, and irreversible vision loss secondary to healing.

This is a prospective observational non-interventional cohort study over a period of 5 months concerning patients admitted to the neuro-resuscitation department of the Ibn Sina University Hospital in Rabat with a capacity of 8 beds.

We included all patients hospitalized for more than 24 hours in the intensive care unit.

The patients were examined initially after 24 hours of their admission and then daily for chemosis, lagophthalmos, and keratopathy. The clinical examination consisted of inspection and ophthalmoscopic examination of the ocular surface before and after fluorescein instillation with an ophthalmoscope by an ophthalmologist.

The data were collected using a pre-established data sheet, taking into account several variables (age and sex; medical history; reasons for admission and length of stay in the intensive care unit; treatment and drugs received; data from the examination of the eyelids (position), conjunctiva and cornea; the existence of keratopathy and its classification).

The tear film was assessed by examination of the tear meniscus and the T- BUT after fluorescein. The tear film was considered impaired if the tear meniscus was reduced (< 1 mm) and/or if the T-BUT was less than 10 seconds.

The ICU nursing team implemented an eye care protocol that consisted of palpebral occlusion with Seristrips* in intubated and sedated patients and saline lavage upon admission.

Classifications

Lagophthalmos has been classified into 3 grades, successively: Palpebral occlusion, exposed conjunctiva, exposed limbus.

Stage 0: No erosion
Stage 1: Superficial punctate keratitis of the lower third of the cornea
Stage 2: Superficial punctate keratitis exceeding the lower third of the cornea
Stage 3: Macro epithelial ulcer
Stage 4: Stromal infiltration
Stage 5: Stromal ulcer
Stage 6: Microbial keratitis Chemosis has been classified into 3 grades: Absence of Oedema, Oedema without dellen effect, and Oedema with dellen effect.

Table 1: *Corneal damage classified according to the Mercieca into 6 stages.*

Case Series and Results

We examined 91 patients hospitalized in the intensive care unit who met the inclusion criteria.

Descriptive study

Epidemiological characteristics

The average age of the patients was 47± 20 years, 47% of the patients were older than 50 years. We noted a slight male predominance. 18.7% of patients were hypertensive. Half of the patients were transferred directly from the medical and surgical emergency departments (58.2%). The main reason for admission was neurological distress in 38 patients (41.8%), followed by postoperative management of neurosurgery (mainly tumors of the posterior cerebral fossa, 22%) in 28 patients (30.8%), and finally, head trauma in 26.4% of cases.

Clinical data

The average length of hospitalization before admission was 2.8 ± 3.1. Patients were seen on average 1.4 ± 0.7 days after admission. The average length of stay in the ICU for our patients was 10.37 ± 10.06 days [2 - 80]. 84.4% of patients were under invasive ventilation and 85.7% were under vasoactive drugs. 64.8% of patients were under antibiotic therapy. The average PEEP (Positive end-expiratory pressure) used was 5.51 ± 1.17 mmHg.

Ophthalmological examination

The daily examination of the patients revealed an altered tear film in 41.8% of the patients. Chemosis was found in 54.9% of patients. 7.7% had chemosis with the Dellen effect. 50.5% of patients developed exposure keratopathy. Grade 3 lagophthalmos was found in 7.7% of patients with keratopathy.

Statistical analysis: The data were collected in an Excel-TM spreadsheet.

Statistical analyses were achieved using SPSS 20.0 software. A global descriptive study of the entire population was performed. Quantitative variables are described in terms of average +/- standard deviation, and median accompanied by minimum and maximum values. Qualitative variables are expressed using frequency and percentage. To determine the visual prognostic factors, bivariate and then multivariate analyses by linear models were performed. In bivariate analysis, qualitative variables (comparison of frequency) were compared employing the Chi^2 test or Fisher's exact test.

Fisher's exact test: The multivariate analysis consisted of a binary logistic regression using a stepwise ascending method. Only variables with a $p < 0.05$ in bivariate analysis were held for the multivariate model. The odds ratios, their 95% confidence intervals, and the p are presented for each significant variable studied. For all statistical tests, a p-value of less than 0.05 is considered statistically significant.

Patients were examined initially after 24 hours of admission and then daily for chemosis, lagophthalmos, and keratopathy. The clinical examination consisted of inspection and ophthalmoscopic examination of the ocular surface before and after fluorescein instillation using an ophthalmoscope by an ophthalmologist. The data were collected using a pre-established data sheet, taking into account several variables (age and gender; medical history; reasons for admission and length of stay in the intensive care unit; treatment and drugs received; data from the examination of the eyelids (position), conjunctiva and cornea; the existence of keratopathy and its classification) The tear film was assessed by examination of the tear meniscus and TBUT (short for tear film break up time) after fluorescein. The tear film was considered damaged if the tear meniscus was reduced.

Evolution

Patients with grade 1, 2, and 3 exposure keratopathy received eyewash, antibiotic therapy, preservative-free hyaluronic acid-based tear substitutes, and vitamin A-based ointment. Palpebral occlusion was performed with adhesive strips (steristrips) by the paramedical staff

Characteristics of eye impairment	n (%)
Tear film	
Altered	38 (41,8)
Lagophtalmos	
Grade 1	59 (64,8)
Grade 2	25 (27,7)
Grade 3	7 (7,7)
Chemosis	50 (54,9)
Chemosis with Dellen effect	7 (7,7)
Keratopathy	
Grade 0	45 (49,5)
Grade 1	21 (23,1)
Grade 2	16 (17,6)
Grade 3	6 (6,6)
Grade 5	1 (1,1)
Grade 6	2 (2,2)
Bilateral disorder	85 (93,4)
Frequency (percentage)	

Table 2: *Characteristics of the population studied.*

Characteristics of the population	n = 91
Age	47 ± 20 (4-83)
< 50 years	44 (48,4)
> 50 years	47 (51,7)
Sex	
Female	44 (48,4)
Male	47 (51,6)
Mortality	41 (45,1)
History	
Hypertension	17 (18,7)
No comorbidities	53 (58,8)
Admission source	
Emergency department	53 (58,2)
Neurology	10 (11)
Neurosurgery	28 (30,8)
Admission reason	
Neurological distress	38 (41,8)
Post-operative management (neurosurgery)	28 (30,8)
Cranial trauma	24 (26,4)
Causal pathology	
Posterior fossa tumor	20 (22)
Hemorrhagic stroke	20 (22)
Length of stay in the emergency department (days)*	2,78 ± 3,08 (0-15)
Duration before review (days)*	1,44 ± 0,68 (1-3)
Length of stay in ICU (days)*	10,37 ± 10,06 (2-80)
Mechanical ventilation	77 (84,6)
Sedated patients	75 (82,4)
Use of vasopressors	87 (85,7)
Patients receiving antibiotic therapy	59 (64,8)
PEEP used (mmHg)*	5,51 ± 1,17
Mean ± standard deviation*	
Frequency (Percentage)	

Table 3: *Characteristics of eye impairment of patients in our series.*

at each treatment. The evolution was marked by epithelial healing with an average delay of 4 days. Antibiotic eye drops (Moxifloxacin) were continued for an average of 10 days in patients with grade 3 keratopathy.

Epithelial healing without corneal opacity was obtained in all patients with grade 1 to 3 keratopathy. For patients with stromal ulceration (Stage 5) and corneal abscess (Stage 6).

a treatment based on prepared fortified eye drops was used. The evolution was favorable with the healing of the stromal ulceration and the corneal abscess with the appearance of corneal neo vessels and stromal fibrosis. The long-term evaluation was not performed as some patients were lost to follow-up and others unfortunately died.

Analytical study

There was no statistical support for an association between PEEP and the risk of developing chemosis: OR: 1.770 (p: 0.2; [95% CI: 0.738 - 4.243]); There was no statistically significant relationship with either variable r = 0.135 with p at 0.2.

There was no statistically significant relationship between the two variables r = 0.135 with p at 0.2. Concerning the correlation between chemosis and lagophthalmos: There was a positive correlation r = 0.426 of medium intensity.

Discussion

Chemosis occurring in the ICU environment, also known as the "Eye of the ventilated", is an often overlooked but potentially serious complication in intensive care patients, resulting from the undesirable physiological effects of mechanical ventilation [1]. Positive pressure ventilation and tight taping of the endotracheal tube increased jugular venous pressure, which compromises venous return to the structures and leads to fluid sequestration in the periocular tissues and chemosis. Fluid overload, electrolyte imbalance, capillary hyperpermeability, and low plasma oncotic pressure secondary to hypoproteinemia associated with extended periods of immobilization, particularly in the prone position can lead to the development of severe facial edema and chemosis [1-3].

Ocular damage associated with mechanical ventilation is related to a positive expiratory pressure (PEEP) higher than 5 cm H_2O. This pressure promotes sodium and water retention and exacerbates chemosis. The incidence of exposure keratopathy ranges from 3.6% to 60% in patients who have stayed in intensive care units, according to the study [1,2].

The known risk factors for exposure keratopathy in intensive care units are first of all factors inherent to the patients represented by the loss of consciousness and facial paralysis. All these factors alter palpebral occlusion and blinking and result in lagophthalmos [4-7]. The risk is also significantly increased in patients with head and/or eye trauma. The early onset of chemosis in the postoperative period can be explained by several factors including the duration of surgery, head position, and excess fluid intake. Factors inherent to invasive ventilation and the treatments administered are represented by sedative treatments, neuromuscular blocking agents, and mechanical ventilation.

Lagophthalmos is mainly related to chemosis, and the incidence found in our study is similar to that of other series. Lagophthalmos is the main cause of ocular surface disorders in intensive care patients. Mercieca., *et al.* reported a percentage of 75% of lagophthalmos in sedated patients. In addition, it has been reported that positive-pressure mechanical ventilation increases the risk of exposure to keratopathy by causing chemosis and reducing tear production.

This risk increases with the length of hospitalization, the existence of underlying pathology, or additional trauma. Studies have shown that 60% of intubated-ventilated patients have lagophthalmos and are therefore at risk of keratopathy.

The risk factors found in the series were sedation, neuromuscular paralysis, lagophthalmos, organ failure, length of stay in intensive care, and mortality for the series of Imanaka., *et al*. In the Hernandez., *et al*. study, the main risk factor was altered consciousness (Glasgow score).

Various eye care protocols have been described to protect the corneal surface in patients admitted to the ICU, including the use of lubricants (methylcellulose gel and ointment) and steristrips, bandaged lenses, the use of wet chamber glasses or wet chamber with

swimming goggles, moistening of the eyelids with gauze soaked in sterile water, the use of polyethylene blankets and tarsorrhaphy and the use of punctum eye plugs. The elevation of the head is also recommended. However, we have not found a totally effective and/or standard protocol in the literature, and unfortunately, exposure keratopathy still develops in intensive care patients.

Various studies have compared the effectiveness of these methods of care in preventing superficial ocular lesions and have shown sometimes contradictory results.

In the study by Lenart., *et al*. eye care with a lubricating ointment on a regular and defined schedule effectively reduced the prevalence of EK in sedated patients.

In the study by Babamohamadi., *et al*. the effects of vitamin A ointment and wet chamber in preventing ocular surface disorders were compared, and the results showed that both methods were ineffective. Bendavid's study concluded the superiority of the combined use of bandaged lenses and punctum eye plugs over the use of lubricants alone to stop the keratopathy process.

Limits of the Study

This is a non-interventional observational study that does not describe a new protocol and does not compare different therapeutic means. Nevertheless, this study may form the basis of further research as it aims to determine the risk factors and incidence of exposure keratopathy using a simple protocol of care in an intensive care unit.

Conclusion

Exposure keratopathy is an undeniably serious and frequent complication in the intensive care unit as corroborated by our study. Lagophthalmos and chemosis are the two main risk factors.

Prevention is first of all a matter of awareness of the nursing staff and methods that are accessible and known to be effective. These methods can be adapted on a case-by-case basis.

Patients at risk, intubated patients, sedated patients, patients with incomplete palpebral occlusion (lagophthalmos) and long duration of stay in the intensive care unit) require surveillance by qualified personnel and a trained ophthalmologist to propose the appropriate means of prevention and to treat if necessary, any keratopathy.

Bibliography

1. Mercieca F., *et al*. "Ocular surface disease in intensive care unit patients". *Eye (London)* 13.2 (1999): 231-236.
2. Soner Demirela., *et al*. "Effective management of exposure keratopathy developed in intensive care units: The impact of an evidence-based eye care education program". *Intensive and Critical Care Nursing* 30.1 (2014): 38-44.
3. Andre Grixti. "Common Ocular Surface Disorders in Patients in Intensive Care Units". *The Ocular Surface* 10.1 (2012): 26-42.
4. Hernandez EV and Mannis MJ. "Superficial keratopathy in intensive care unit patients". *American Journal of Ophthalmology* 124.2 (1997): 212-216.
5. Imanaka H., *et al*. "Ocular surface disorders in the critically ill". *Anesthesia and Analgesia* 85.2 (1997): 343-346.
6. Sivasankar S., *et al*. "Eye care in ICU". *Indian Journal of Critical Care Medicine* 10.1 (2012): 11-14.
7. Suresh., *et al*. "Eye care for the critically ill". *Intensive Care Medicine* 26.2 (2000): 162-166.

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