La prevenzione e la cura delle complicanze oculari nel paziente critico
Una revisione bibliografica

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Riassunto

Introduction: ophthalmologic complications are frequent in intensive care patients and this situation is fostered by treatments mainly focused on the management of organ failure. In these patients, the systemic and ocular protective mechanisms are damaged as a result of: metabolic problems, multi-organ dysfunction, mechanical ventilation and reduced level of consciousness. The review aims to define state-of-the-art eye care for patients in the intensive care unit.

Methods: we conducted a literature review published over the past decade on the main biomedical databases using the following keywords: intensive care, eye care, critically ill, eye disorders.

Results: despite the prevailing number of observational studies and clinical trials, there is still a lack of evidence to affirm the greater effectiveness of one preventive treatment compared to another. Studies reporting the implementation of
an eye care program show a reduced incidence of complications. It is also shown how even the ICU staff without previous experience can perform eye screening with reasonable sensitivity and specificity, based on the evaluation of the ocular surface and the level of eyelid closure.

**Discussion and Conclusions:** the main objectives of eye care in the ICU are prevention and early recognition and treatment of the most frequent complications. It is advisable to adopt treatment algorithms since post-hospitalization loss of vision can have devastating effects on the quality of life of patients.

Great emphasis is placed on the etiological responsibility of incomplete eyelid closure and the need to focus each clinical algorithm or guideline. Patients at risk of ocular complications can be identified and treated early only if such policies include: assessment of lagophthalmos levels, timing and methods for preventive treatment, methods to ensure the eyelid closure, clinical reasons to activate ophthalmologic and dedicated sections in clinical documentation to record nursing assessments, treatments and outcomes.

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**INTRODUCTION**

Ocular complications are frequent in ICU patients and this situation is fostered by treatments focused on organ failure, to the detriment of the patient’s ocular surface condition which is given only marginal attention. One of the reasons for the growing frequency of ocular diseases in the ICU is due to the fact that the systemic protection and ocular systems are damaged due to metabolic problems, multi-organ dysfunctions, mechanical ventilation, reduced consciousness levels but also by phenomena such as hypotension and elevated volemic overfill.
canisms protective systemic and ocular are damaged due to metabolic problems, multi-organ failure, mechanical ventilation, reduced level of consciousness and also from phenomena such as hypotension and elevated intravascular volume.1,2,4,5,6

In a healthy individual, the healthy eyelids act as a mechanical barrier that protect the eyes from trauma, dehydration and adhesion of microorganisms. The cornea’s reflex is necessary for an adequate distribution of the film of tears on the ocular surface. Corneal moistness is maintained by a lipid film, also when the eyes are closed during sleep. The production of tears is necessary for the integral maintenance of the ocular surface and also plays a role in the removal of noxious and potentially pathogenic stimuli due to their bacterial properties, since they become the vehicle for the transit of leucocytes.

The corneal and conjunctiva epithelium enhance the maintenance of tears in the eyes; their constant evaporation allows the conjunctiva sac to conserve an adequate temperature to avoid bacterial proliferation. The conjunctiva epithelium also furnishes a physical barrier that protects from physical damages and microorganisms. Corneal reflex is a defense from physical menaces and the REM (Random Eye Movements) are essential during sleep to ensure the distribution of the watery humor behind the closed eyelids, thus preventing corneal anoxia and epithelium breakage.2,3,7

The incidence of eye problems is significantly correlated with admission to the ICU, length of hospital stay, the concomitant pathologies and respiratory or gastrointestinal problems (p<0.01). It is also greatly correlated to the patients’ level of consciousness, use of artificial airways, PEEP (Positive End Expiratory Pressure), accumulated bronchial secretions, and use of sedatives and myorelaxants (p<0.01). The risk of developing eye problems increases by 2.8 times in patients with ICU stays of more than seven days, 7.0 times in patients with state of depressed consciousness, 10.8 times in patients in comas, 2.9 times in patients who were applied a PEEP, 4.2 times in sedated patients and 2.3 times in patients who were administered myorelaxants.8,9

The lack of awareness about the conditions menacing the eyesight may have devastating effects and it is erroneous not to consider the eyes upon assessing a critical patient. This situation is worsened by the impossibility on the part of the sedated patient to complain of eye disturbances and permit a regular screening by the staff, given that the problem is not identified.1,10,11
Post-hospitalization loss of eyesight may have devastating effects on the patients' quality of life and may bring about greater consequences during their illness. The challenge, therefore, lies in the monitoring and early treatment of eye pathologies. A slight lagophthalmos may not be seen and the ointments or eye drops used to protect the eyes may inadvertently spread the infection if the same eye drop applicator is used for both eyes. Also contact lenses, the presence of which are often not recognized, if set in the eyes for a long period may strongly increase the risk of corneal dryness and infection. The damage may cause great pain given that between the epithelial cells of the corneal surface runs a fairly developed network of nerves. The moment a patient is alert and weaned from sedation, the keratopathy from exposition is spontaneously resolved in most of the cases, otherwise it may cause corneal ulcers and loss of eyesight.

The major interventions for eye treatments are: washing with physiologic solution, eye drops and ointments, taping, paraffin-based medications and polyethylene films. Very little research has been done to determine or compare the efficacy of the different types of treatment, with the result that eye hygiene continues to be done on the basis of beliefs, traditions and experience of the staff.

Literature offers various preventive protocols for ICU patients and there is no evident approval on the more effective forms of eye protection.

**Epidemiology of the problem**

The major eye problems encountered in the ICU include: exposure keratopathy (3.6%-60%), chemosis (9%-80%) and bacterial keratitis. Variability in the incidences of the pathologies in the various studies depends on the various corneal pathology assessment methods. The peak of the incidence for corneal abrasions occurs between the 2nd and 7th day in the ICU.

Mercieca et al. discovered that 75% of patients in the ICU presented lagophthalmos, with consequential predisposition to corneal dryness. In addition, the critical patients were often comatose with tendency towards lagophthalmos, even if not
sedated. In a survey designed to study the effects of the eyelid closure over the cornea, McHugh et al. found that 70% of the patients that had incomplete eyelid closure developed keratopathy, against the 28.9% of those whose eyelids were completely closed.10

Ophthalmologic complications in the ICU

Damage of the corneal epithelium (micro and macro-epithelial defects) may vary from underlying to evident (lesions or ulcers) and may be seen at the patient’s bedside through the use of a luminous pen with a blue filter after the installation of a 2% fluorescent colorant.

An ophthalmologist should be consulted once there is evidence of keratopathy and especially every type of corneal opaqueness.3

Keratopathy due to exposure originates from the absence of physiological mechanisms protecting the cornea, because of the use of sedatives and neuromuscular blockages that inhibit the contraction of the orbicularis oculi muscle, provoking an incomplete eyelid closure (lagophthalmos), corneal exposure and dryness. Its onset is also favored by an altered water balance, both when lacking or excessive. It was also demonstrated in anesthesia patients how much the base production of tears diminishes. Other risk factors could be ventilation with the face mask, which may reduce the support of oxygen to the peripheral cornea and the prone position to reduce venous return flow, conjunctiva kemosis and lagophthalmos.2,15

Exposure keratopathy is characterized by superficial punctate micro-epithelial erosions that mainly involve the third lower part of the exposed cornea. These lesions may evolve in macroscopic defects (corneal abrasions). A bacterial keratitis may arise, become a corneal ulcer, and lead to perforation and formation of scars resulting in a permanent loss of eyesight.2,16

An important factor in the prognosis and early detection of the risk of keratitis is the constant assessment of the patient to recognize the advanced phase when there could al-
tification of the risk of keratitis, is the constant evaluation of the patient for recognizing the advanced phase when potentially severe complications from multi-resistant germs.\textsuperscript{10} Ezra et al. underline the attention that must be given in future studies to superficial punctate keratitis, a less severe form of corneal exposure that may be likewise dangerous for patients.\textsuperscript{17}

The real incidence of \textit{microbial keratitis} in adults in the ICU is unknown.\textsuperscript{2} Here the prevention of infections focuses on bacteremia due to vascular catheters, pneumonia associated to mechanical ventilation, urinary infections and surgical wounds.\textsuperscript{3} Critical patients are mostly prone to microbial keratitis due to the previous exposure keratopathy and their immunosuppression.\textsuperscript{2} Water retention and the consequent conjunctiva chemosis accelerate bacterial contamination, favored also by the elevated presence of multi-resistant germs present in the ICUs. The most common and aggressive germ is the \textit{Pseudomonas aeruginosa}. Patients sedated with closed eyelids and reduced or null blinking reflex, have a reduced capacity to remove the microorganisms from the surface of the eye and this augments the risk of bacterial proliferation and accumulation of toxic metabolytes that give rise later to microbes keratitis.\textsuperscript{2}

Some studies have also found a statistically significant association between a respiratory colonization of \textit{Pseudomonas aeruginosa} and microbial keratitis. The contamination mechanism was an endotracheal aspiration which lead to a migration of germs and the consequential contamination of the corneal surface.\textsuperscript{3,18,19}

The moment an infection develops, the eyelid and conjunctiva swelling with hyperemia, chemosis, secretions or formation of crusts at the eyelid edges may be the first signs. If examined with a portable lamp, the corneal ulcers of bacterial origin reveal a typically clear demarcation at epithelium levels with the underlying dense, suppurative storage, inflammation with distinct margins and edema.\textsuperscript{3}

The presence of corneal opaqueness and infiltrates, commonly indicate the upsurge of a keratitis. Subsequently, an ulceration appears, and may progress up to corneal perforation, scleritis, endophthalmitis and also blindness.\textsuperscript{2}

In 1977 Dua identified some practices that increase the risk of infection of the ocular surfaces of critical patients:
Dua ha identificato nel 1997 alcune pratiche che aumentano il rischio di infezione della superficie oculare nel paziente critico:
1) toccare la superficie oculare con la punta di applicatori,
2) utilizzare lo stesso applicatore per entrambi gli occhi,
3) utilizzare cerotti su occhi parzialmente aperti,
4) applicare cerotti ad occhi con presenza di secrezioni,
5) aspirazione tracheale senza appropriata copertura degli occhi,
6) esecuzione routinaria di tamponi congiuntivali in pazienti sedati,
7) mantenere le lenti a contatto in situ.20

In casi di cheratiti microbiche invasive e refrattarie al trattamento medico, potrebbe essere necessaria una cheratoplastica di emergenza.2

La cheratite batterica viene riportata anche per il personale della TI con compromessa immunità corneale e viene suggerito l’utilizzo degli occhiali protrettivi durante la broncoaspirazione.21

Questo tipo di infezione è riportato come potenzialmente devastante; progredisce rapidamente e, se non trattata, può provocare perforazione corneale entro le 48 ore.17

L’incidenza della chemosi in TI varia tra il 9% e l’80% dei pazienti critici.22,23 L’edema congiuntivale o la chemosi, anche chiamati “ventilator eye,” sono complicanze comuni e potenzialmente gravi derivanti dagli effetti avversi della ventilazione meccanica. La ventilazione a pressione positiva e il fissaggio stretto del tubo endotracheale causano un aumento della pressione venosa giugulare e compromettono il ritorno venoso dalle strutture oculari.2,3 La chemosi e il sequestro di liquidi a livello congiuntivale sono conseguenza del carico di liquidi, del bilancio elettrolitico alterato, dell’aumento della permeabilità capillare e di una ridotta pressione oncotica secondaria all’ipoproteinemia causata dallo squilibrio metabolico.2,11,22,23,24 Oh et al. riportano una correlazione statisticamente significativa tra l’incidenza dei disordini della superficie oculare e l’utilizzo della PEEP.8

Le chemosi massive possono impedire la completa chiusura palpebrale, portando a secchezza della superficie oculare, cheratopatia da esposizione, cheratiti microbiche e impediscono un’adeguata perfusione tissutale e ossigenazione.2,3,24 L’alta incidenza di edema congiuntivale nei pazienti in TI (80%) e il fatto che l’alta percentuale di pazienti con

1) Touching of the ocular surfaces with the tips of drop applicators,
2) Using the same eye drop applicator for both eyes,
3) Using band aids on partially open eyes,
4) Applying band aid on eyes that have secretions,
5) Tracheal aspiration without proper covers for the eyes,
6) Routine execution conjunctiva swabs in sedated patients,
7) Keeping contact lenses in place.20

In cases of invasive and refractory microbial keratitis during medical treatment, it may be necessary to perform an emergency keroplastic intervention.2

Bacterial keratitis is also reported in the ICU personnel with damage to the corneal immunity, and the use of protective glasses during bronco-aspiration is recommended.21

This type of infection is reported to be potentially devastating; it progresses rapidly and, if not treated, may provoke corneal perforation within 48 hours.17

The incidence of chemosis varies between 9% to 80% of critical patients.22,23 Conjunctiva edema or chemosis, also called “ventilator eye,” are common and potentially serious complications deriving from the adverse effects of mechanical ventilation. Ventilation, positive pressure and tight fixtures of the endotracheal tube cause an increase of jugular venous pressure and jeopardize venous return flow of the eye structures.2,3 Chemosis and the segregation of liquids at conjunctival levels are the consequence of the load of liquids, altered electrolyte balance, increase of capillary permeability and a reduced secondary oncotic pressure at the hypoproteinemia caused by metabolic unbalance.2,11,22,23,24 Oh et al. report a statistically important correlation between the incidence of ocular surface disorders and the use of PEEP.8

The massive chemosis may impede the complete closure of the eyelid, leading to dryness of the ocular surface, exposure keratopathy, and microbial keratitis, and impedes an adequate tissue perfusion and oxygenation.2,3,24 The high incidence of conjunctiva edema in ICU patients (80%) and the fact that the high percentage of patients with incomplete eyelid closure presents some degree of chemosis (92%), suggest that the same may develop secondarily on exposure or else
Incomplete chiusura palpebrale presentino qualche livello di chemosi (92%), suggeriscono che la stessa si sviluppi secondarmente all’esposizione oppure rappresenti il primo fattore responsabile dell’incompleta chiusura palpebrale.\(^9\)

Le **congiuntiviti** sono una complicanza comune nei pazienti in TI e possono essere causate da infezioni batteriche o virali, allergie o fattori ambientali: senza la necessaria cura possono diffondersi rapidamente. Esse rappresentano il maggior disordine oculare nei neonati.\(^{24,25}\)

Negli ultimi anni sono stati proposti numerosi protocolli e algoritmi di trattamento per facilitare la gestione di questi problemi nei pazienti critici, tuttavia sono state condotte poche ricerche sulle patologie oculare meno comuni ma che possono avere effetti altrettanto devastanti sulla capacità visiva dei soggetti. Grixti et al. si propongono di elencare attraverso la loro revisione di 68 articoli anche tali patologie meno comuni, fra le quali si ricordano: endoftalmite endogena, chiusura d’angolo primaria, neuropatia ottica ischemica, anormalità pupillari, occlusioni vascolari, mucormicosi orbito-rino-cerebrale.\(^{1,25}\)

**Materials and methods**

Nel periodo compreso tra maggio e settembre 2013 è stata realizzata una revisione della letteratura con lo scopo di conoscere lo stato dell’arte circa la prevenzione e cura degli occhi dei pazienti ricoverati in terapia intensiva (Tabella 1).

| Tabella 1 – Quesito secondo metodologia P&PICO |
| Population | Uomini, Donne, Adulti, Paziente critico, Incosciente, Sedato |
| & Problem | Patologie oculari |
| Intervention | Cura degli occhi |
| Comparison | Quotisasi |
| Outcomes | È in grado di ridurre le complicanze e migliorare gli outcome clinici? E’ esiste un trattamento preventivo/curativo più efficace? |
| | Is able to reduce complications and improve clinical outcomes? Does exist a more effective preventive-curative treatment? |


Conjunctivitis is a common complication in ICU patients and may be caused by bacterial or viral infections, allergies or environmental factors: with the necessary treatment they may spread rapidly. These are the main eye disorders in newborns.\(^{24,25}\)

Over the last few years numerous protocols and algorithms have been suggested for treatments and to facilitate the management of these problems in critical patients. However, very little research has been done on less common eye pathologies which may have equally devastating effects on the visual capabilities of individuals. Grixti et al. through their review of 68 articles, offered to list down also these less common pathologies, among which they mention: endogenous endophthalmitis, closure of the primary angle, ischemic optical neuropathy, pupil abnormalities, vascular occlusions, and orbital-rhino-cerebral mucormycosis.\(^{1,25}\)

**Materials and methods**

From May to September 2013, a literature review was performed with the aim of acquiring state-of-the-art eye disorder prevention and treatment of patients in the ICU (Table 1).

| Table 1 – Search according to P&PICO methodology |
| Population | Males, Females, Adults, Critically Ill, Comatose, Sedated |
| & Problem | Eye Disorders |
| Intervention | Eye Care |
| Comparison | Any |
| Outcomes | Can complications be reduced and clinical outcomes improved? Does exist a more effective preventive-treatment method? |

The bibliographic research was conducted on the following databases: PubMed, CINAHL, Cochrane Library, using the keywords: intensive care, eye care, critically ill, eye disorders, nursing.

The terms were looked up singly or combined. Moreover, a reference list analysis was done on the more important articles and research was done on Google Scholar.

The review of articles included those that met the following criteria:
I termini sono stati ricercati da soli ed in combinazione. Inoltre è stata effettuata un’analisi delle reference list degli articoli più rilevanti ed una ricerca su Google Scholar.

Sono stati inclusi nella revisione gli studi che rispondevano ai seguenti criteri:
• tipo di partecipanti: pazienti adulti, ricoverati in terapia intensiva,
• data di pubblicazione (ultimi dieci anni, 2003-2013),
• lingua: inglese, italiano,
• esclusione di studi inerenti ambito pediatrico, perioperatorio o personale ospedaliero,
• tipo di studio: tutti ad esclusione di editoriali e opinioni di esperti.
• Altri documenti: linee guida ufficiali governative o di società scientifiche del settore derivanti da ricerca libera. Si è deciso di includere non solamente studi primari ma anche eventuali revisioni che li citassero.

Il processo di selezione ha portato all’inclusione finale nella revisione di 25 articoli.

La valutazione è stata condotta indipendentemente dal primo autore ed è in seguito stata ripetuta da un secondo reviewer per stabilire il consenso.

I 25 articoli risultanti al termine del processo di selezione sono stati analizzati e catalogati in una griglia e ne sono state identificate le seguenti caratteristiche:
1. Identificazione bibliografica;
2. Tipologia dello studio e grado dell’evidenza (riadattamento di una classificazione adottata e definita originariamente da Griffiths et al.26):
   - SR: Systematic Review
   - R: Non-systematic Review
   - RCT: Randomized Controlled Trial
   - O: Observational Study
   - Q: Qualitative Study
   - D: Descriptive Study
3. Obiettivo dello studio;
4. Campione/popolazione;
5. Intervento;
6. Risultati;
7. Conclusioni/commenti.

Quality and limits of the evidences

The review aimed at examining possibly all existing literature. Despite this, the research strategy may not have taken into consideration some sources due to the impossibility of obtaining documents in different languages other than English or Italian. The choice to include meta-analyses and literature
QUALITY OF THE EVIDENCE AND LIMITS

The review led to the possible simultaneous identification also of primary studies.

The quality of the evidence results to be discrete inasmuch as most of the studies were of the observational type (9/25; 36%), followed by controlled randomized trials of various levels (6/25; 24%) of reviews, of which 5/25 (20%) were of the systematic type and descriptive studies (3/25; 12%).

DISCUSSION

How to prevent and treat the complications

Over the last few years, numerous treatment protocols and algorithms have been drawn up to facilitate the management of these problems in sedated and mechanically ventilated critical patients. The review of Joyce offered the following recommendations based only on three small randomized clinical trials:

1. Eye treatments should be part of the care addressing all ICU patients;
2. Ointments and eye-drops are more effective in reducing the incidence of corneal abrasions as against not administering eye drops;
3. Polyethylene films are more effective in reducing the incidence of corneal abrasions compared to eye drops and ointments;
4. Eyelid closure can also be applied.24

Eye drops or lubricating ointments, band aids for the closure of the eyelids, medications based on hydrogel dressings and moisturizing chambers (closing the eye within a circumscribed space using films or eyeglasses) are the most frequently used trial methods.15

Polyethylene is transparent, very subtle (about 0.01 mm), adheres to the surfaces easily and is highly resistant to water and other solutions. This characteristic allows it to cover the upper orbit’s area up to the cheek, keep the eyelid closed, maintain the moisture deriving from the liquid tears, and form a moisturized chamber that preserves the cornea’s integrity.2,3,12,27

Il film di polietilene è trasparente e molto sottile (circa 0.01 mm), aderisce alle superfici con facilità e possiede elevata resistenza all’acqua e ad altre soluzioni. Questa caratteristica gli permette di coprire l’area dell’orbita superiore fino alla guancia, tenendo chiusa le palpebre, mantenendo l’umidità derivante dal liquido lacrimale e formando una camera umidificata che preserva l’integrità della cornea.2,3,12,27
Another strategy is represented by medications based on polyacrylamide hydrogel dressings, composites with 96% water. The gel’s porosity is such as to make it permeable to watery vapors, gases and small protein molecules, but impermeable to bacteria. These medications are mainly used for skin wounds and lesions (and do not require a license for topical eye usage) and their efficacy in preventing exposure keratopathy is under debate. Their effectiveness resembles that of lubricating drops, but is safer to use. One has to avoid every type of lagophthalmos underneath the medication and monitor the water component (it must not dry up otherwise it may provoke abrasions).2,28

A review indicated that the use of eye lubricants is by far more effective than a passive eye LI closure.29,30 Ezra et al. sustained that the use of lanoline ointments is more effective in preventing keratopathy compared to the basic eye hygiene or medications with a polyacrylamide hydrogel base.31 A series of previous works suggest that eyelid bandaging may be equally effective or superior to eye lubricants, However, studies like that of Bates et al., which compare the efficacy of the application of eyelid bandages and the use of eye lubricants in eye patients subjected to general anesthesia or those in the ICU, do not demonstrate statistically important differences in the incidence of corneal abrasions.32 Furthermore, in the study of Sivasankar et al., the polyethylene films demonstrated greater protection against corneal ulcers compared to the lubricants.3,13,33 This data was confirmed by the study of Shan and Elem.34,35

These studies were validated by a meta-analysis conducted by Rosenberg et al. The moisturized chamber methods furnishes much more ocular surface protection compared to lubricant ointments (p<0.001).3 However, the study of So et al. found no statistically important differences between the polyethylene films and ointments.36 Ezra et al. sustain in a subsequent study that eye lubricants and hydrogel dressings medications are equally effective, but only if the personnel applying these products have been adequately trained to do so.17

However, also the economic factors have to be taken into consideration; the lanoline ointments are by far cheaper than the hydrogel-dressings medications and of more practical use, requiring less observation and less time.17
During general anesthesia, applying a band aid on the eye remains as the single, best protective measure; the water-based ointments (such as methylcellulose 4%) are more tolerated compared to paraffin-based lubricants, which are inflammable and are better to be avoided when using electro-scalpels and oxygen in proximity with the patient’s face. The preservative-free ointments are preferable, since the preservative may cause a corneal de-epithelialization and conjunctival hyperemia.16

The prophylactic administration of topical antibiotics may prevent microbial keratitis in ICU patients presenting a superficial bacterial contamination of the eye.2 Early monitoring of corneal alterations may anticipate the use of topical antibiotics and prevent the onset of infective keratitis.19 In situations where the eyelids cannot close because of the loss of tissue (facial burns) or prolapsed conjunctiva, hydrogel dressings or polyethylene films may be applied.2

Sivasankar and Ezra do not cite statistically important differences in the development of chemosis between groups of patients treated with eye lubricants and eyelid band-aids and those treated with moisturized chambers (eyeglasses) or groups treated with hydrogel dressings medications against lanoline ointments.13,17

In serious cases of chemosis and lagophthalmos, when the prolapsed conjunctiva passes through the closed eyes, it is advisable to apply temporary closure with hypoallergenic band-aids and those treated with moisturized chambers (eyeglasses) or groups treated with hydrogel dressings medications against lanoline ointments.13,17

Evidence at hand does not clarify, however, whether these methods contribute to protecting ocular surface or only to keeping the eyelids closed.14

Eye hygiene in the ICU has always been considered important, but the practice revealed to be very different in terms of methods and frequency. The more common methods and instruments seem to be that of clearing the eye with physiological solution or sterile water every 2-4 hours and the instilling of lubricating solutions such as methylcellulose. The use of ointments is advisable wherever is the risk is classified as highly probable (presence of conjunctiva edema).14
Behavioral protocols and algorithms: from monitoring to prevention

Factors such as the Glasgow Coma Score, intubation and length of hospital stays in the ICU have proven to be good predictors for the development of ocular surface disorders, but the major prediction factor remains that of the incomplete closure of the eyelid. Therefore, the main intervention to prevent exposure keratopathy is to ensure an adequate eyelid closure.3,11,14

Werli-Alvarenga tried to estimate the incidence of corneal lesions, identifying the risk factors and suggesting a risk prediction model for these lesions. The independent variables acknowledged as predisposing factors against the risk of punctate corneal lesions were: length of hospital stays, ventilation support aids, presence of edema and blinking reflex lower than five times per minute. Glasgow Coma Score and exposure of the eye globe were the variables correlated to corneal ulcerations.27

Also Suresh et al. identified the position of the eyelids as the main risk factor. The same authors categorized the patients with lagophthalmos into four groups:
1) Closed eyelids;
2) Exposure of the conjunctiva;
3) Exposure of the cornea;
4) Bedridden patients under mechanical ventilation.

There are various preventive measures that may be implemented in each of the categories (from only lubricants up to lubricants and band-aids). The application of the algorithm on 23 patients demonstrated a reduction of the rate of chemosis and generally, of damages to the ocular surface by 42% to 8.7%.3,22

Also Dawson proposes a protocol wherein the interventions depend on the assessment of the eyelid closure. He suggested the following measures: drops based on hypromellose if the eyelids are closed and, if the closure is compromised (less than five blinks per minute) the hypromellose-based drops should be used in association with the polyethylene.27,37

Various studies analyzed the adherence to the eye care guidelines for mechanically ventilated ICU patients. Dawson reported that only 25.5% of the patients receive an eye as-

Protocoli e algoritmi di comportamento: dal monitoraggio alla prevenzione/trattamento

Fattori quali il punteggio Glasgow Coma Score l’intubazione e il tempo di degenza in TI hanno dimostrato di essere buoni predittori per lo sviluppo di disordini della superficie oculare, ma il maggiore fattore predittivo rimane l’incompleta chiusura palpebrale. Quindi il principale intervento per prevenire la cheratopatia da esposizione è garantire un’adeguata chiusura palpebrale.3,11,14

Werli-Alvarenga ha cercato di stimare l’incidenza delle lesioni corneali, identificare i fattori di rischio e proporre un modello di predizione del rischio per tali lesioni. Le variabili indipendenti riconosciute come predisponenti il rischio di lesioni corneali puntiformi sono state: tempo di degenza, presidi per supporto ventilatorio, presenza di edema e riflesso di ammiccamento minore di cinque volte al minuto. Il punteggio Glasgow Coma Score e l’esposizione del globo oculare sono state le variabili correlate a ulcerazioni corneali.27

Anche Suresh et al. identificano la posizione delle palpebre come il principale fattore di rischio. Gli stessi autori categorizzano i pazienti con lagofthalmo in quattro gruppi:
1) palpebre chiuse,
2) esposizione della congiuntiva,
3) esposizione della cornea,
4) pazienti pronati in ventilazione meccanica.

Esistono diverse misure preventive che possono essere attuate in ognuna delle categorie (dai soli lubrificanti fino a lubrificanti e cerotti). Applicando l’algoritmo su 23 pazienti è stata dimostrata una riduzione del tasso di chemosi ed in generale di danni alla superficie oculare dal 42% al 8.7%.3,22

Anche Dawson propone un protocollo nel quale gli interventi dipendono dalla valutazione della chiusura palpebrale. Propone le seguenti misure: gocce a base di hypromellose se le palpebre sono chiuse e, se la chiusura è compromessa (meno di cinque ammiccamenti al minuto), le gocce a base di hypromellose dovrebbero essere utilizzate associate al film di polietilene.27,37

Diversi studi analizzano l’aderenza alle linee guida sulla cura degli occhi nei pazienti ventilati meccanicamente in TI. Dawson riporta che solamente il 25.5% dei pazienti riceve una valutazione oculare e solo il 55.3% presenta una documentata cura dell’occhio.14,37
Negli studi che riportano l’implementazione di un programma di cura degli occhi, l’incidenza dell’abrasione corneale si è significativamente ridotta, in un range dal 3.3-15%.12,22,36

L’algoritmo di Dawson è più completo se comparato con quello di Suresh, però è anche più complicato. Esso enfatizza il trattamento e la diagnosi dei disordini oculi.37

Dawson, a seguito di un audit e di una revisione, conferma l’utilità della lubrificazione dell’occhio, anche se non è chiara la frequenza di applicazione e di valutazione. La chiusura palpebrale con cerotto non è popolare per rischio di lesione e aumento del distress nei familiari. Si sono dimostrati di maggior utilità il gel di polyacrylamide, i film di polietilene e la lubrificazione, anche se Dawson non ha potuto definire se uno prevalesse sull’altro.22,37

Diversi autori propongono delle scale per misurare l’entità dei vari disturbi oculari adottabili in TI e che potrebbero entrare negli algoritmi e protocolli di prevenzione e trattamento. Ezra, Sivansakar ed altri ripropongono strumenti esposti da Mercieca et al. e successivamente modificati, che considerano posizione palpebrale e severità della chemosi .9,13,17,30,31

(Tabella 2)

Table 2 – Proposed grading scales to measure eyelid position, conjunctival edema and corneal changes

<table>
<thead>
<tr>
<th>Position palpebrare</th>
<th>Edema congiuntivale/Severità della chemosi</th>
<th>Conformations corneali</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Palpebre chiuse</td>
<td>Grade 0 – Absent</td>
<td>1. Punctuated epithelial erosions involving the third lower cornea</td>
</tr>
<tr>
<td>2. Esposizione della sola congiuntiva</td>
<td>Grade 1 – Conjunctival edema without eyelid prolapse</td>
<td>2. Punctuated epithelial erosions involving more than the third lower cornea</td>
</tr>
<tr>
<td>3. Cornea parzialmente esposta</td>
<td>Grade 2 – Conjunctival edema with prolapsed conhexa</td>
<td>3. Macropithelial defects</td>
</tr>
<tr>
<td>4. Cornea completamente esposta</td>
<td>Grade 4 – Completely exposed cornea</td>
<td>4. Whitening of the corneal tissue in the presence of epithelial defects</td>
</tr>
</tbody>
</table>

| Erosioni epiteliali puntiformi coinvolgenti il terzo inferiore della cornea | | 5. Scars, ulcerations of the corneal tissue |
| Erosioni epiteliali puntiformi coinvolgenti più del terzo inferiore della cornea | | 6. Infective keratitis |
| Diffetti macroepiteliali | | Changes and adaptations by Mercieca F et al. (1999), Suresh P et al. (2000), Sivasankar S et al. (2006), Ezra DG et al. (2005) |
| Schiarimento del tessuto corneale in presenza di difetti epiteliali | | Another guideline focuses mainly on the reduced risks of Pseudomonas aeruginosa (particularity virulent and responsible for devastating keratitis). In this protocol, comatose patients are administered eye care every two hours. At treatment |
| Cicatrici, ulcerazioni del tessuto corneale | | assessment and only 55.3% present documented eye care.14,37 |
| Chiratrice infettiva | | |

Un’altra linea guida si focalizza principalmente sulla riduzione del rischio di infezione da Pseudomonas aeruginosa (particolarmente virulento e responsabile di devastanti keratitis). In questo protocollo, ai pazienti incoscienti viene praticata la cu-
The eyes are monitored for swollen eyelids, conjunctival hyperemia, corneal opaqueness, and epithelial damage. If the corneas are exposed the lubricant is administered every two hours. These patients who are at risk of corneal exposure, have to keep their eyes closed. Eye swabs are performed if the respiratory cultures are positive for *P. aeruginosa*. When behavior modes were adopted, the isolation of germs greatly decreased (p < 0.001).38

The closed-circuit tracheal respiratory systems, asepsis in maneuvers and the polyethylene films, are strategies that protect the eyes from contamination with respiratory secretions.12,36

McHugh et al. determined that the ICU staff without previous ophthalmologic experience, may perform patient screenings for exposure keratopathy with reasonable sensitivity (77.8%) and specificity (96.7%), and comparing the assessment with that done by the oculists, the screening would help in early recognition and treatment.2,10

A very recent survey conducted in the UK ICUs, aimed at acquiring knowledge of the protective methods used, and prevalence of the use of the assessments of eyelid position and eye treatment protocols. This survey updates and completes the data of the previous survey of King and Healy in 2003.39 It highlighted that 34% of the 217 ICU respondents, did not assess eyelid closure, regardless of the presence of eye care protocols in the facilities themselves. The major part of the ICUs used more than one preventive method, mainly, treatments with hydrogel dressings and lanoline ointments.40

This study evidenced three main problems:
1) The data suggest that the protocols do not encourage eyelid closure assessment, a fundamental step in identifying lagophthalmos and the main factor that favors the development of exposure keratopathy and the consequent infective keratitis;
2) The great variety of protective therapies adopted reflects the lack of really effective therapy for the prevention of exposure keratopathy, and which is not too expensive or technically complex. The moisturized chambers have probably demonstrated to be the best performing ones in the research but were used only in two out of the 217 ICU par-
ri performance nella ricerca, ma sono utilizzate solamentene in 2 su 217 terapie intensive partecipanti, evidenziando la difficoltà di applicazione con le frequenti valutazioni pupillari. Un largo numero di combinazioni utilizzate includono metodi non evidence-based come garze inumidite e eye pads, che possono anche essere dannose se il lagofthalmos continua a persistere al di sotto di esse;

3) con un numero così basso di TI che tengano registro delle complicazioni oculari, non può essere ottenuta una stima accurata della loro incidenza.28

L’evidenza attualmente disponibile non aiuta nell’indicare quanto spesso i lubrificanti oculari debbano essere applicati per essere efficaci.12,28,41,42,43 Negli studi esistenti, le gocce lubrificanti sono state somministrate con intervalli che vanno da ogni 2 ad ogni 12 ore, senza considerare la viscosità delle stesse. Alcuni riportano una somministrazione di gocce hypromellose ogni 6 ore (meno viscose e permanenti nell’occhio per meno tempo) altri combinazioni di hypromellose e unguenti alla lanolina ogni 2 ore.

Il protocollo elaborato da Kam et al. è molto esplicativo ed immediato rispetto a quelli proposti precedentemente. Non è stato testato per efficacia in trial clinici, ma i suoi componenti sono tutti evidence-based e sono tenuti insieme a partire dalla comprensione delle cause alla base delle complicanze oculari e dei metodi per la loro prevenzione.28

Conclusions

La nostra revisione conferma le attuali conoscenze relative alla prevenzione e al trattamento delle complicanze oculari nei pazienti adulti e sedati in terapia intensiva. Viene ribadita fortemente la responsabilità eziologica dell’incompleta chiusura palpebrale e la sua centralità in ogni algoritmo di comportamento o linea guida.

Nonostante il numero prevalente di studi osservazionali e trial clinici, mancano ancora evidenze per poter affermare la maggior efficacia di un trattamento preventivo rispetto ad un altro, per definire con precisione i fattori predisponenti di maggiore importanza e per misurare in contesti diversi, l’incidenza delle complicanze oculari nei pazienti critici sedati o inconsci in terapia intensiva.

Our review confirms the actual know-how related to the prevention and treatment of ophthalmologic complications in adult patients and sedated in intensive care. What is strongly underlined is etiologic responsibility of the incomplete eyelid closure and its centrality in every behavioral algorithm or guideline.

Despite the prevalence of observational studies and clinical trials, we are still lacking in evidence to be able to affirm greater effectiveness of one preventive measure compared to another to define with precision the more important predisposing factors and to measure, in different contexts, the incidence of ophthalmologic complications in sedated critical patients or the comatose patients in the ICU.

The study also aimed at analyzing the systematic reviews and the meta-analyses given that there are no recent ex-
Lo studio ha voluto anche analizzare le revisioni sistematiche e le metanalisi poiché non esistono studi sperimentali recenti che portino nuove evidenze sull’argomento. Inoltre, questa tipologia di studi è spesso rivolta alla proposta di possibili protocolli e linee guida ed i ricercatori erano interessati a conoscere le diverse componenti degli stessi.

I pazienti a rischio di complicanze oculare possono essere identificati e trattati precocemente solamente se le linee di condotta includono: la valutazione del grado di lagofalmo, i tempi e i metodi per il trattamento preventivo, i metodi per garantire la chiusura palpebrale, le motivazioni per attivare la consulenza specialistica e lo spazio nella documentazione clinica per registrare le valutazioni, i trattamenti e gli esiti.

**Bibliography**