

Dry eye in critically ill patients: integrative review¹

Olho seco em pacientes críticos: revisão integrativa

El ojo seco en pacientes en estado crítico: revisión integradora

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ABSTRACT

Objective: To identify in peer literature publications on the risk of dry eye in patients admitted to adult intensive care units. **Method:** A study in the databases Medical Literature Analysis and Retrieval System Online (MedLine), Cumulative Index of Nursing and Allied Health (CINAHL), Web of Knowledge, Latin American and Caribbean Health Sciences (LILACS in Portuguese), Cochrane, Bibliographical Index Spanish Health Sciences (IBECS in Portuguese) and Nursing Database (BDENF in Portuguese) was conducted. In these, 620 potentially eligible studies were found, and among those, 27 met the inclusion criteria and were selected. The studies were analyzed by two independent researchers who used an instrument adapted to identify the level of evidence of the articles. **Results:** 39 different risk factors for dry eye were identified; the following risk factors were found in 50% or more of the studies: lagophthalmos (85.18%), use of sedatives (70.37%), mechanical ventilation (66.66%) and use of neuromuscular blocking agents (55.55%). **Conclusion:** It was found only one study that specifically addressed the dry eye problem in critically ill patients, further clinical studies are necessary in order to provide strong scientific evidence on the subject.

Descriptors: Dry eye syndromes, Corneal diseases, Intensive care units, Nursing.

RESUMO

Objetivo: Identificar na literatura publicações sobre os fatores de risco para o olho seco em pacientes internados em Unidade de Terapia Intensiva (UTI) de adultos. **Método:** Realizou-se busca nas bases de dados Medical Literature Analysis and Retrieval System Online (MedLine), Cumulative Index of Nursing and Allied Health (CINAHL), Web of Knowledge, Literatura Latino-Americana e do Caribe em Ciências da Saúde (LILACS), Cochrane, Instituto Brasileiro de Engenharia de Custos (IBECS) e Banco de Dados

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em Enfermagem (BDENF). Foram identificadas 620 publicações potencialmente elegíveis, selecionando-se, ao final, 27 publicações que atenderam aos critérios de inclusão. Essas foram analisadas por dois pesquisadores independentes, usando-se instrumento adaptado para verificar o nível de evidência. **Resultado:** Foram identificados 39 diferentes fatores de risco para olho seco, sendo os apontados em 50% ou mais dos estudos, o lagofalmo (85,18%), o uso de sedativos (70,37%), a ventilação mecânica (66,66%) e o uso de bloqueadores musculares (55,55%). **Conclusão:** Foi encontrado somente um estudo que abordasse especificamente o problema do olho seco em pacientes críticos; estudos clínicos são necessários, a fim de se apresentar evidências científicas fortes ao problema.

Descritores: Síndromes do olho seco, Doenças da córnea, Unidades de Terapia Intensiva, Enfermagem.

RESUMEN

Objetivo: Identificar los trabajos publicados sobre los factores de riesgo para el ojo seco en pacientes ingresados en la unidad de cuidados intensivos para adultos. **Método:** Fue realizada una búsqueda en las bases de datos MEDLINE, CINAHL, Web of Knowledge, LILACS, Cochrane, IBECs y BDENF. Se identificaron 620 artículos potencialmente elegibles, mediante la selección final de 27 publicaciones que cumplieron los criterios de inclusión. Estos fueron analizados por dos investigadores independientes, utilizando un instrumento adaptado para comprobar el nivel de evidencia. **Resultados:** Se identificaron 39 factores de riesgo diferentes para el ojo seco, y señaló el 50% o más de los estudios, lagofalmo (85.18%), sedantes (70.37%), ventilación mecánica (66,66%) y el uso de bloqueo neuromuscular (55,55%). **Conclusión:** Sólo un estudio que aborda específicamente el problema de ojo seco se encontró en los pacientes críticamente enfermos; se necesitan estudios clínicos con el fin de proporcionar una fuerte evidencia científica al problema.

Descriptores: Síndrome de ojo seco, Enfermedades de la córnea, Unidades de cuidados intensivos, Enfermería.

INTRODUCTION

Usually, in the Intensive Care Unit (ICU) patients are hospitalized in a state of high clinical severity. Most of the time these patients are sedated, in coma, in use of mechanical ventilation (MV) and various drugs, therefore, ocular protection mechanisms are compromised.¹⁻⁸ In Brazil, the adult ICU provides care to patients older than 14 or 18 years, according to internal hospital routines.⁹

In the ICU there is a constant concern of the medical and nursing staff with the stabilization of the respiratory, cardiovascular and neurological status of the patients.¹⁰ In this context, preventive measures and interventions to care for changes in the ocular surface of ICU patients are not given the due importance, despite its high incidence.^{3-8,11} As most of the time the patients are unable to report ocular symptoms, often this problem is neglected.^{4,10,12}

The tear film covers the frontal area of the eyeball, and the perfect integrity of the ocular surface is determined by the associated stability of the tear film and the epithelial layer of the cornea.¹³⁻⁴ The dysfunction of the lacrimal film, known as “dry eye” is a multifactorial disease of the tears and ocular surface that results in symptoms of discomfort,

visual disturbance, and tear film instability with potential damage to the ocular surface. The problem is accompanied by increased osmolarity of the tear film and inflammation of the ocular surface.¹⁵

The nursing diagnosis definition for dry eye is: a risk of ocular discomfort and damage to the cornea and the conjunctiva due to the reduced quantity or quality of tears to moisten the eye.^{4,12} The preventive approach to the achievement of specific eye care is of paramount importance to patients in the ICU, for not preventing dry eye can negatively impact the lives of patients after discharge.⁴

Numerous questions are raised from the perception that dry eye may negatively impact the lives of patients, both during hospitalization and after discharge from the ICU, and this change in the ocular surface is a clinical problem that can cause the patient to present eye damage. Patients in the ICU are at risk for dry eye due to exposure to internal or external risk factors. Searches for studies that approached the dry eye identification, dismissing or confirming the problem in ICU patients, were carried out to answer these questions.

This study aimed to identify published papers that addressed the problem of dry eye and its risk factors in patients admitted to adult ICUs, in order to answer the question: what are the risk factors involved in dry eye patients admitted to adult ICUs?

METHODS

An integrative literature review was performed (IR – Integrative Review). This was conducted in five stages: thematic issue selection (elaboration of the guiding question), establishing the criteria for inclusion and exclusion of articles, selection of articles (sample selection), analysis and interpretation of results.

The survey of indexed publications was conducted from March to July 2014 in the databases: Medical Literature Analysis and Retrieval System Online(MEDLINE) through the US National Library of Medicine National Institutes of Health(PubMed), Cumulative Index to Nursing & Allied Health Literature(CINAHL) and Web of Knowledge, using the Journals Portal Personnel Improvement Coordination of Higher Education(CAPES), Latin American and Caribbean Health Sciences(LILACS), Cochrane Library, Bibliographical Index Spanish Health Sciences(IBECs) and Nursing Database(BDENF) via the Virtual Health Library(VHL).

The search strategies used in the databases, involved the crossing, in Portuguese, English and Spanish, of the following keywords: “dry eye syndrome”, “keratoconjunctivitis sicca”, “corneal diseases”, “risk factors”, “intensive care unit”, “intensive therapy unit”, “hospital”, “nursing diagnosis” and “nursing.” In addition to search in these databases, a reverse search from found articles was performed, regardless of their year of publication.

Table 1 describes the path of identification and selection of articles components of the study sample.

Table 1 - Database electronic search strategy from March to July 2014.

Database	Strategy	FA	SA	S
MEDLINE	Dry eye syndrome or keratoconjunctivitis and risk factors.	414	24	09
CINAHL	Dry eye syndrome or keratoconjunctivitis and intensive care units.	78	09	04
Web of Knowledge	Corneal diseases and intensive care units.	56	01	01
LILACS	Dry eye syndrome or keratoconjunctivitis and hospital.	41	00	00
Cochrane	Dry eye syndrome or keratoconjunctivitis and nursing diagnosis.	14	03	01
IBECS	Dry eye syndrome or keratoconjunctivitis and nursing.	13	00	00
BDEFN		04	01	00
Total		620	38	15

Note: the articles found and selected via the reverse search were not part of the total sum of articles found in databases.

Obs: FA- Found articles; SA - Selected Articles; S - Sample.

The search was made from studies of risk factors for dry eye in patients admitted to adult ICUs. Only one study that specifically addresses dry eye in critically ill patients was found, however, it did not have the specific objective of identifying risk factors of the problem in question. It is a Randomized Clinical Trial (RCT) of 18 patients that showed the effectiveness of the polyethylene film versus artificial tear gel in the dry eye prevention.⁴

Due to the lack of specific studies on dry eye in critically ill patients, in the IR, articles that addressed the theme “corneal injury” in patients admitted to adult ICUs were also selected. Such strategy was used since, in the case of dry eye due to the instability of the tear film and etiopathogenesis of the problem, the individual develops small defects in the corneal epithelium (superficial or punctiform epithelial erosions), which can be observed by corneal dyeing with fluorescein.¹⁶⁻⁸

After database researches, the following inclusion criteria to select the items were adopted: complete articles; published in Portuguese, English or Spanish; dealing with risk factors for the development of dry eye or corneal lesions in patients admitted to adult ICUs; carried out on humans; without publication time period limit. The selected exclusion criteria were: irrelevance to the subject, publications in languages not covered by the inclusion criteria.

Initially, 414 articles in MEDLINE, 78 on CINAHL, 56 in the Web of Knowledge, 41 in LILACS, 14 in the Cochrane Library, 13 in IBECS and four in BDEFN were located, totaling 620 articles.

The analysis was made using the title and the summary, and 38 articles were pre-selected. Duplicate articles between the databases were counted only once. To read in its entirety, 19 articles were selected, of these, seventeen (17) articles were available in the databases or CAPES journals and the others were available for printing.

After reading, a sample of 15 articles was defined. The other four publications were discarded because they contemplated an evaluation of dry eye in outpatients or patients with a clinical profile different than the one defined for this study, ie, had no relevance to the theme.

Using a reverse search, from the reading of the 15 articles that composed the extracted sample of the surveyed databases, 17 other articles related to the topic were found, all were integrally read, of these, 5 were excluded for not meeting the inclusion criteria for this study.

The characterization of the studies of the sample was performed by grouping together the information and synthesis. The instrument for data collection in scientific journals was applied in the analysis of each study, with the necessary adaptations, namely: inclusion in the questionnaire of the database in which the article was found and removal of the surgery type item, inappropriate for the study.¹⁹

In assessing the type and quality of evidence in the studies, the judgment took into account the methodological approach, the research design employed and the quality of its results.²⁰ Furthermore, it also allows the inclusion of studies with a qualitative approach.

All studies were analyzed by two independent researchers. The results obtained individually were compared. Disagreements were revised so that the doubts were extinguished.

RESULTS AND DISCUSSION

The 27 studies that addressed risk factors for dry eye were available in Medline/Pubmed database, the year of publication ranged from 1993 to 2014. The populations ranged from one (study) to 2500 (records). Almost all of the articles were published in English (96.30%), 33.33% of these in the UK and 18.51% in Australia. The most common designs were randomized controlled trials, systematic reviews/meta-analyses and cohort studies. Evidence levels of grade I (meta-analysis), II (clinical trials) and III (almost experimental) prevailed among the studies (Chart 1). In the chart, the risk factors are presented for dry eye in patients admitted to adult ICUs.

Chart 1 - Summary of articles: risk factors for dry eye in patients admitted to adult ICUs

Nº	Title	Author	Year	Study design	N	Journal	Country of the study	Risk Factors	Evidence level
1*	Eye care for ventilated patients	Farrell M, Wray F. ²¹	1993	Literature revision	20 ICUs	<i>Intensive Crit Care Nurs</i>	United Kingdom	Intubation, MV, fixation of ETT/TCT, lagophthalmos*, chemosis**, anasarca***, sedatives.	IV
2*	Moisture chamber versus lubrication for the prevention of corneal epithelial breakdown	Cortese D, Capp L, Mckinley S. ²²	1995	RCT	60 patients	<i>Am J Crit Care</i>	Australia	Lagophthalmos, chemosis, blink of the eyes per minute (< 5 times/min), MV, PEEP, intubation, sedatives.	II
3*	Ocular surface disorders in the critical ill	Imanaka H, Taenaka N, Nakamura J, Aoyama K, Hosotani H. ⁵	1997	Prospective/Retrospective Cohort	143 patients in retrospective Cohort/ 15 patients in prospective Cohort	<i>Anesth Analg</i>	Japan	Hospitalization time, coma, sepsis, MV, PEEP, blink of the eyes per minute (< 5 times/min), lagophthalmos, anasarca, chemosis, sedatives, muscle relaxants, AWB.	III
4	Ocular surface disease in intensive care unit patients	Mercieca F, Suresh P, Morton A, Tullo AB. ¹⁰	1999	Prospective cohort	26 patients	<i>Eye</i>	United Kingdom	Hospitalization time, coma, lagophthalmos, sedatives, muscle relaxants, intubation, PEEP, MV, blink of the eyes per minute (< 5 times/min), fixation of ETT/TCT, chemosis.	III
5	A clear view: the way forward for eye care on ICU	Parkin B, Cook S. ²³	2000	Literature revision	13 studies	<i>Intensive Care Med</i>	United Kingdom	Hospitalization time, intubation, GCS < 7, lagophthalmos, sedatives, muscle relaxants.	IV
6*	Eye care for the critically ill	Suresh P, Mercieca F, Morton A, Tullo AB. ¹¹	2000	RCT	34 patients	<i>Intensive care med</i>	United Kingdom	Hospitalization time, coma, intubation, sedatives, blink of the eyes per minute (< 5 times/min) lagophthalmos, macronebulization, chemosis.	II
7	Eye Care for Intensive Care Patients	Joyce N. ⁶	2002	Systematic review	06 studies	Joanna Briggs Inst Evid Based Nurs Midwifery.	Australia	Coma, sedatives, muscle relaxants, MV, PEEP, fixation of ETT/TCT, blink of the eyes per minute (< 5 times/min), Lagophthalmos, chemosis, anasarca, AWB.	I
8	A randomized controlled study of the efficacy of hypromellose and Lacri-Lube combination versus polyethylene/Cling wrap to prevent corneal epithelial breakdown in the semiconscious intensive care patient	Koroloff N, Boots R, Lipman J, Thomas P, Rickard C, Coyer F. ²⁴	2004	RCT	110 patients	<i>Intensive Care Med</i>	Australia	Type of patient – surgical, hospitalization time, coma, lagophthalmos, MV, PEEP, chemosis, muscle relaxants, sedatives, anesthetics.	II
9	Assessment of corneal epitheliopathy in the critically ill	Ezra DG, Healy M, Coombes A. ²⁵	2005	Descriptive	01 study	<i>Intensive Care Med</i>	United Kingdom	Lagophthalmos.	VI
10*	Development of a new eye care guideline for critically ill patients	Dawson D. ²⁶	2005	Descriptive	22	<i>Intensive Crit Care Nurs</i>	United Kingdom	Lagophthalmos, sedatives, MV.	VI

(To be continued)

(Continuation)

Nº	Title	Author	Year	Study design	N	Journal	Country of the study	Risk Factors	Evidence level
11*	Eye care in ICU	Sivasankar S, Jasper S, Simon S, Jacob P, John G, Raju R. ²⁷	2006	RCT	124 patients	Indian J Crit Care Med	India	Lagophthalmos, muscle relaxants.	II
12	Eye Care for Patients in the ICU	Joyce N. ⁷	2006	Systematic review	06 studies	Joanna Briggs Inst Evid Based Nurs Midwifery.	Australia	Coma, sedatives, muscle relaxants, MV, PEEP, fixation of ETT/TCT, blink of the eyes per minute (< 5 times/min), lagophthalmos, chemosis, anasarca, AWB.	I
13*	Comparing the effectiveness of polyethylene covers (Gladwrap™) with lanolin (Duratears) eye ointment to prevent corneal abrasions in critically ill patients: A randomized controlled study	So HM, Lee CCH, Leung AKH, Lim JMJA, Chan CSC, Yan WW. ²⁸	2008	RCT	116 patients	Int J Nurs Studies	China	Coma, lagophthalmos, blink of the eyes per minute (< 5 times/min).	II
14*	Eye care in the critically ill: Clinical practice guideline	Marshall AP, Elliott R, Rolls K, Schacht S, Boyle M. ²⁹	2008	Literature revision	16 studies	Aust Crit Care	Australia	Coma, lagophthalmos, intubation, MV, sedatives, muscle relaxants.	IV
15	Eye care in the intensive care unit: Narrative review and meta-analysis	Rosenberg JB, Eisen LA. ¹⁶	2008	Meta-analysis	3 ECRs	<u>Crit Care Med</u>	United States	Hospitalization time, GCS < 7, coma, sedatives, anesthetics, lagophthalmos, anasarca, chemosis, MV, PEEP, macronebulization.	I
16	Ocular Surface Disorders In Intensive Care Unit Patients In A Sub-Saharan Teaching Hospital	Desalu I, Akinsola F, Adekola O, Akinbami O, Kushimo O, Adefuleositelu A. ¹	2007	Prospective cohort	56 patients	Internet J Emergen Intensive Care Med	Nigeria	Sedatives, muscle relaxants, systemic organ failure.	III
17*	Randomized trial comparing ocular lubricants and polyacrylamide hydrogel dressings in the prevention of exposure keratopathy in the critically ill	Ezra DG, Chan MP, Solebo L, Malik AP, Crane E, Coombes A, et al. ³⁰	2009	RCT	40 patients	Intensive Care Med	United Kingdom	APACHE II ≥ 16, chemosis, lagophthalmos.	II
18*	Factors related to incidence of eye disorders in Korean patients at intensive care units	Oh EG, Lee WH, Yoo JS, Kim SS, Ko IS, Chu SH, et al. ³¹	2008	Retrospective cohort	2500 medical charts	J Clin Nurs	South Korea	Hospitalization time, GCS < 7, respiratory disease, intubation, PEEP, TCT, sedatives, muscle relaxants, anesthetics.	VI
19*	Corneal / External Disease Panel. Preferred Practice Pattern Guidelines.	American Academy of Ophthalmology (AAO). ³²	2011	Systematic review	119 studies	Dry Eye Syndrome - Limited Revision	United States	Age, sex, hepatitis C, diabetes, diuretics, beta blockers.	I
20	Effectiveness of polyethylene covers versus carbomer drops (Viscotears_) to prevent dry eye syndrome in the critically ill	Güler GE, Eser I, Egrilmez S. ⁴	2011	RCT	18 patients	J Clin Nurs	Turkey	Hospitalization time, sedatives, GCS < 7 and muscle relaxants.	II

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Nº	Title	Author	Year	Study design	N	Journal	Country of the study	Risk Factors	Evidence level
21	<i>Lesões na córnea: incidência e fatores de risco em Unidade de Terapia Intensiva</i>	Werli-Alvarenga A, Ercole FF, Botoni FA, Oliveira JADMM, Chianca TCM. ⁸	2011	Prospective cohort	254 patients	Rev Latino-Am Enferm	Brazil	Hospitalization time, intubation, MV, MV time, TCT, PEEP, fixation of ETT/TCT, blink of the eyes per minute (< 5 times/min), GCS < 7, anasarca, neurologic disease, PNM, sedatives, lagophthalmos, conjunctival hemorrhage, MV, muscle relaxants, vasoactive drugs, diuretics, hypnotics, anxiolytics, antifungals, vitamins, antihypertensives, bronchodilators, APACHE II ≥ 16, TISS 28 ≥ 32, AWB.	III
22*	Ocular care and complications in the critically ill	Kam KY, Hayes M, Joshi N. ³³	2011	Systematic review	10 studies	Trend Anaesth Crit Car	United Kingdom	Sedatives, MV, fixation of ETT/TCT, lagophthalmos.	I
23	Common Ocular Surface Disorders in Patients in Intensive Care Units	Grixti A, Sadri M, Edgar J, Datta AV. ³	2012	Systematic review	102 studies	Clin Prac	United Kingdom	Hospitalization time, MV, PEEP, fixation of ETT/TCT, blink of the eyes per minute (< 5 times/min) sedatives, muscle relaxants, anasarca, lagophthalmos, macronebulization.	I
24	Exposure keratopathy in sedated and ventilated patients	Jammal H, Khader Y, Shihadeh W, Ababneh L, Aljizawi G, Alqasem A. ³⁴	2012	Prospective cohort	74 patients	J Crit Care	Jordan	Lagophthalmos, eye swelling.	III
25	Nursing Interventions for Adult Intensive Care Patients With Risk for Corneal Injury: A Systematic Review	Werli-Alvarenga A, Ercole FF, Herdman TH, Chianca TCM. ³⁵	2013	Systematic review	08 studies	Int J Nurs Knowl	Brazil	Hospitalization time, anasarca, TCT, MV, GCS < 7, blink of the eyes per minute (< 5 times/min), lagophthalmos, muscle relaxants.	I
26	Making a Difference in Eye Care of the Critically Ill Patients	Alansari MA, Hijazi MH, Maghrabi KA. ³⁶	2013	Literature revision	35 studies	J Intensive Care Med	Saudi Arabia	Hospitalization time, sedatives, blockers D, MV, PEEP, GCS < 7, lagophthalmos, chemosis.	IV
27	Effective management of exposure keratopathy developed in intensive care units: The impact of an evidence based eye care education program	Demirel T, Cumurcu S, Firat P, Aydogan MS, Doğanay S. ³⁷	2014	Prospective cohort	300 professionals	Intensive Crit Care Nurs	Turkey	Lagophthalmos, sedatives, MV.	III

Note: Articles selected in reverse search.

* Eyeball exposition;

** Conjunctival Edema;

*** Generalized Edema; PNM - Pneumonia; MV - mechanical ventilation; PEEP - Positive End- Expiratory Pressure; GCS - Glasgow Coma Scale; AWB - Accumulated water balance; ETT - endotracheal tube; APACHE II - Acute Physiology and Chronic Health disease Classification System II; TISS 28 - Therapeutic Intervention Scoring System; TCT - Tracheostomy.

In the study, 39 different risk factors were identified. Those indicated in 50% or more of studies were: lagophthalmos (85.18%), sedatives (70.37%), MV (66.66%) and muscle relaxants (55.55%). Risk factors raised by the studies in this review are summarized in Chart 2.

Chart 2 - Risk factors for dry eye in critically ill patients

Risk Factors	Articles	n=27	%
Lagophthalmos	1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14, 15, 17, 18, 21, 22, 23, 24, 25, 26, 27	23	85,18
Sedatives	1, 2, 3, 4, 5, 7, 8, 10, 12, 14, 15, 16, 18, 20, 21, 22, 23, 26, 27	19	70,37
Muscle relaxants	3, 4, 5, 7, 8, 11, 12, 14, 16, 18, 20, 21, 23, 25, 26	15	55,55
Anesthetics	8, 15, 18	3	11,11
Diuretics	19, 21	2	7,40
Beta blockers	19	1	3,70
Vasoactive drugs	21	1	3,70
Hypnotics	21	1	3,70
Anxiolytics	21	1	3,70
Antifungals	21	1	3,70
Vitamins	21	1	3,70
Bronchodilator	21	1	3,70
MV	1, 2, 3, 4, 7, 8, 10, 12, 14, 15, 16, 20, 21, 22, 23, 25, 26, 27	18	66,66
Hospitalization time	3, 4, 5, 6, 8, 15, 18, 20, 21, 23, 25, 26	12	44,44
PEEP	3, 2, 4, 7, 8, 12, 15, 18, 21, 23, 26	11	40,74
Intubation	1, 2, 4, 5, 6, 14, 18, 21, 25, 26	10	37,07
Chemosis	1, 2, 3, 4, 6, 7, 8, 12, 15, 17, 26	10	37,07
Coma	3, 4, 6, 7, 8, 12, 13, 14, 15	9	33,33
Septic shock	3	1	3,70
Systemic organ failure	16	1	3,70
Respiratory disease	18	1	3,70
Hepatitis C	19	1	3,70
Diabetes	19	1	3,70
Neurological disease	21	1	3,70
PNM	21	1	3,70

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Risk Factors	Articles	n=27	%
Anasarca	1, 3, 7, 12, 15, 21, 23, 24, 25	9	33,33
Blink of the eyes per minute (<5 times/min)	3, 2, 4, 7, 12, 13, 21, 25	8	29,62
Fixation of TCT	1, 4, 7, 12, 21, 22, 23	7	25,92
GCS < 7	5, 15, 18, 20, 21, 25, 26	7	25,92
AWB	3, 7, 12, 21	4	14,81
Age	19	1	3,70
Macronebulization	6, 15, 23	3	11,11
APACHE II ≥ 16	17, 21	2	7,40
TISS 28 ≥ 32	21	1	3,70
TCT	18, 25	2	7,40
Sex	19	1	3,70
Surgical patient	8	1	3,70
MV time	21	1	3,70
Conjunctival haemorrhage	21	1	3,70

Among the 27 articles, it was identified that the most common corneal alteration in ICU patients is superficial corneal abrasion or punctiform corneal injury, with an incidence between 3.6% and 60%.^{1-8,10-1,38-9} The punctiform corneal injury is characterized by punctate epithelial erosions, mainly located in the lower third of the cornea and, if left unassisted, these lesions can develop into macro epithelial defects such as corneal ulcer.^{6-8,10-1,39}

In a cohort study, concurrently conducted in Brazil with 254 patients in the ICU, it was found that 151 patients had corneal injury. The incidence of punctiform lesion was 55.1% and corneal ulcer type was 11.8%. It is noteworthy that, during the development of the study, 19 (13.6%) punctiform injuries evolved to corneal ulcer.⁸

This aforementioned Brazilian study aimed to estimate the incidence of corneal damage, to identify risk factors and to propose a risk prediction model for the development of corneal injury in adult patients in the ICU. Among the risk factors identified in the risk prediction model for corneal injury of the corneal ulcer type, the exposure of the eyeball (lagophthalmos) was considered statistically significant.

Patients with incomplete eyelid closure have a much higher frequency of alterations in the ocular surface compared to those who have completely preserved eyelid closure (100% versus 37%).³⁴ In a study with 124 patients, it was found that changes in the ocular surface are directly associated with incomplete eyelid closure (p = 0.001).²⁷ Any degree of incomplete eyelid closure invariably leads to a drying of the ocular epithelium.¹¹

The studies on the risk factors for corneal injury in ICU patients began in the 90s. The first one was

conducted in 20 UK ICUs to identify possible risk factors for eye injuries in hospitalized patients, interventions to prevent ocular lesions and clinical relevance of each of them. The following risk factors were raised: intubation, MV, fixation of ETT/TCT, lagophthalmos, anasarca, chemosis and sedatives.²¹

The only study on dry eye in ICU patients was performed in 2011. It is an RCT with 18 patients in which it was demonstrated the effectiveness of polyethylene film versus artificial gel tear to prevent dry eye. Despite not having statistically significant results, the authors emphasize that lagophthalmos is one of the most important predictors of dry eye in critically ill patients. It is noteworthy that the study included a relatively small sample, it was not conducted to specifically identify the incidence and risk factors of dry eye and it was carried out with a non-Brazilian population.⁴

The risk factors for dry eye, indicated by 50% or more of the analyzed studies were lagophthalmos (85.18%),^{3,5-8,10-1,16,21-3,25-31,33-7} sedatives (70.37%),^{1,3-6,8,10,16,21-4,26,29,31,33,36-7} MV (66.66%),^{1,3-8,10,16,21-2,24,26,29,33,35-7} and muscle relaxants (55.55%).^{1,3-8,10,23-4,27,29,31,35-6}

Lagophthalmos is described as the incomplete or inadequate eyelid closure and is diagnosed when part of the conjunctiva or cornea is visible.⁵ Usually, the complete eye closure occurs due to the orbicular muscle contraction.^{6,7} This was identified as the most prevalent risk factor (23 studies - 85.18%). If patients are unable to blink or close their eyes, ocular surface dryness can easily occur due to exposure of ocular structures, such as the conjunctiva and the cornea, and the increase in the evaporation of the tear film.⁵⁻⁷

The presence of lagophthalmos pointed in early studies,²¹ was identified as a risk factor for dry eye in an RCT with 60 inpatients in ICU.²² It has been shown that patients with lagophthalmos are more likely to develop changes in the ocular surface.

Equally complex and threatening to dry eye are the sedatives and muscle relaxants. These were identified respectively in 70.37% and 55.55% of the studies. When sedatives and muscle relaxants are administered, the closing of the eyelids is determined only by passive forces. The inability to keep them completely closed leads to exposure of the conjunctiva and/or cornea, resulting in ocular drying. The degree of eye exposure is closely related to the intensity of the sedation or muscular relaxation.¹⁰ Additionally, sedatives and muscle relaxants can suppress the blink act, preventing an adequate tear distribution on the ocular surface.²⁴

Sedative and muscle relaxant drugs were also identified as important risk factors in the study of dry eye in critically ill patients, although the results have not shown statistical significance.⁴

Varying degrees of change in the ocular epithelia can be found in patients who are under moderate to severe sedation or unconscious for more than 48h. The problem was evidenced in 11 of the 26 patients of a study conducted in the UK, which mainly developed inferior punctiform

epithelial erosions.¹⁰ Another prospective study conducted in Japan also found changes in the ocular surface in 60% of the studied patients.⁵

Other authors corroborate the aforementioned, proving the importance of this risk factor to the problem when considering a statistically significant association between changes in the ocular surface and the administration of muscle relaxants ($p = 0.025$).²⁷

Depending on the clinical severity of the patient, he/she may remain sedated for long periods of time. The average duration of sedation (4.06 ± 2.90 vs 1.80 ± 0.94 days) is also significant for the development of ocular alterations.¹

Caring for a patient in critical condition often requires MV support to ensure comfort and to facilitate the treatment, which is a challenge for nursing. Detailed nursing care is required to maintain the physical integrity and the functioning of the organs, which includes the care of mechanically ventilated patients. The MV risk factor was pointed in 18 studies (66.66%). Changes to the ocular surface may be associated with the MV. The process of intubation and drugs used to facilitate this procedure can generate a sharp increase in intraocular pressure, which predisposes patients to lesions.^{21,39} In addition, the exacerbation of conjunctival edema occurs if the endotracheal tube tape is secured too tightly. The "fixation tape" can compromise the venous return to the head, leading to venous congestion, potentially increasing intraocular pressure.^{6-7,21,33}

It is further believed that high intrathoracic pressure occurs due to the use of positive end-expiratory pressure (PEEP) above 5 cm H₂O.⁶⁻⁷ The positive MV pressure promotes venous stasis and fluid retention, resulting in chemosis (conjunctival edema) and subconjunctival bleeding.²⁸ Chemosis can lead to secondary ocular exposure due to incomplete or inadequate eyelid closure, increasing the dry eye and predisposing it to defects in the mechanism of epithelial repair.^{3,6-7}

The frequency of eye disorders in patients on MV ranged from 20-57% in analyzed studies.^{5,10,34} In a Nigerian study with 56 patients, the MV (4.55 ± 2.97 vs $1.62 \pm 1, 02$ days) was statistically significant for the development of ocular surface changes, with a $p < 0,05$.¹

Despite not having found a frequency equal to or greater than 50% for the risk factor hospitalization time, in 12 studies (44.44%)^{3-5,8,10-1,16,23-4,31, 35-6} this was identified as an important predictor for the development of ocular abnormalities in critically ill patients.

Studies have shown that the ocular surface changes are highly prevalent, particularly in the early days of hospitalization.^{10,26} In another study, 67.5% of the patients developed ocular surface changes during the first or second day of admission in the ICU.¹ In the Chinese study, which examined 2500 records, the average time found for the identification of alterations of the ocular surface was 6.8 days.³¹

CONCLUSION

Regarding the review, studies that address the risk factors for corneal injury in critically ill patients are highlighted, particularly RCTs, systematic reviews/meta-analyses and cohort studies. However, no study brought strong evidence, specifically, in relation to risk factors for dry eye in this population.

Risk factors identified and that are not included in the North American Nursing Diagnosis Association I - NANDA-I (2013) - were: hospitalization time, PEEP, intubation, chemosis, coma, septic shock, systemic organ failure, respiratory disease, hepatitis C, PNM, anasarca, blink of the eyes per minute (<5 times / min), fixation of ETT, GCS <7, AWB, macronebulization, APACHE II score ≥ 16 , ≥ 32 TISS 28, TCT, MV time and conjunctival hemorrhage. The following risk factors identified are contemplated in NANDA-I: age (aging), autoimmune diseases, gender (female), MV, neurological lesions with sensory loss or motor reflex (lagophthalmos, lack of spontaneous reflex blinking due to reduced consciousness or other medical conditions), treatment-related side effects.

It is noteworthy that almost all publications identified for the survey of risk factors in this study were of non-Brazilian populations. In accordance to this, it is necessary to conduct studies to determine the risk factors in Brazilian patients.

Preventive approaches to eye care are vital for ICU patients because the majority of them are susceptible to alterations of the ocular surface, related to multiple factors. Thus, the professionals involved in the care of these patients should be aware of the problem and the precautions to be implemented to prevent dry eye and possible complications during hospitalization and after their discharge from the ICU. There are limitations to these approaches: the lack of knowledge and training of nurses on the issue at hand, in addition to the lack of studies addressing dry eye in critically ill patients.

Although the nursing diagnosis for the risk of dry eye is recorded in NANDA-I, clinical studies that seek to determine the incidence and risk factors of this problem in critically ill patients and those aimed at testing care ways to prevent dry eye in critically ill patients are necessary.

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