Common Ocular Surface Disorders in Patients in Intensive Care Units

Andre Grixti, MD,[1] Maziar Sadri, MD, MRCS, DOHNS, FRCA primary,[2] Jonathan Edgar, FRCA,[2] and Amit Vikram Datta, MS (Ophthalmol), FRCSEd, FRCOphth[3]

ABSTRACT Ocular surface disorders are frequently encountered in patients in Intensive Care Units (ICUs). Because of significant impairment of major organs, treatment is focused on the management of organ failures. Therefore, ophthalmological complications are frequently overlooked in this setting. To identify the types and frequencies of ocular surface disorders reported in patients in ICUs, a literature review using the keywords: *Intensive Care; Eye care; ICU; ITU; Ophthalmological disorders; Eye disorders* was performed. The databases of CINAHL, PUBMED, EMBASE and COCHRANE library were searched. The higher quality papers are summarized in tables with statements of methodology to clarify the level of evidence. The most prevalent ocular disorders identified in ICU patients were exposure keratopathy (3.6% to 60%), chemosis (9% to 80%), and microbial keratitis. Of the various eye care measures that have been advocated to prevent exposure keratopathy, the most effective is the application of moisture chambers or polyethylene covers. Early diagnosis and effective treatment will help to prevent microbial keratitis and visual loss.

KEY WORDS chemosis, conjunctivitis, exposure keratopathy, intensive care unit (ICU), microbial keratitis, ventilator eye

Accepted for publication October 2011.

From the [1]Department of Ophthalmology, Arrowe Park Hospital, Wirral, and Departments of [2]Anaesthesia and [3]Ophthalmology, Hairmyres Hospital, East Kilbride, Glasgow, United Kingdom.

The authors have no proprietary or commercial interest in any concept or product discussed in this article.

Single-copy reprint requests to Andre Grixti, MD (address below).

Corresponding author: Andre Grixti, MD, Department of Ophthalmology, Arrowe Park Hospital, Arrowe Park Road, Upton, Wirral, UK, CH49 5PE. Tel: 07783974823. E-mail address: grixti.andre@gmail.com

I. INTRODUCTION

Patients in the intensive care unit (**ICU**) often have impaired ocular protective mechanisms as a result of metabolic derangements, multiple organ dysfunction, mechanical ventilation, and decreased level of consciousness. Such patients are at increased risk of ocular surface disorders, which, if not resolved, can result in serious visual impairment.[1,2] Moreover, in the ICU setting, the medical staff is primarily concerned with stabilization of vital bodily functions, including the cardiovascular, respiratory, and neurological status. Sedated ICU patients are incapable of protecting their eyes and may be unable to convey ophthalmological complaints. Because ICU staff members may lack awareness of the risk of injury and fail to perform regular ocular screening, ophthalmological disorders may go unrecognized.[2-4]

II. METHOD OF LITERATURE SEARCH

A literature search was performed, using the keywords *Intensive Care*, *Eye care*, *ICU*, *ITU, Ophthalmological disorders*, *Eye disorders*. The search engines of CINAHL, PUBMED, EMBASE and COCHRANE library were all used in the initial search. A manual search was also performed on the reference lists of all papers relevant to the topic.

A total of 714 hits were provided through the search engines. The abstracts of these papers were reviewed by the first and second authors separately, and 165 papers were considered relevant to the topic. Out of the 165 selected articles, 103 papers focused on common ocular surface disorders in the ICU and were included in this review. The other 62 papers consisted of case reports or studies on ophthalmological conditions that are rarely encountered in the ICU setting and therefore did not meet the criteria for inclusion.

The studies included in this review were conducted at different times, so the parameters and methods employed changed over time. Therefore, there was a significant heterogeneity with lack of raw data in the papers, which made it impossible to perform a meta-analysis. However, we identified the better quality studies, ie, those with a higher level of

OUTLINE

evidence, including meta-analyses, randomized controlled trials, prospective studies, or retrospective studies with acceptable methodology. These studies are summarized in tables with their main conclusions.

III. PHYSIOLOGICAL MECHANISMS OF EYE PROTECTION

In a healthy individual, the eyelids offer a mechanical barrier to the eye against trauma, desiccation, and adherence of microorganisms.[5-8] The blink reflex is necessary for adequate distribution of the tear film over the ocular surface.[1,2,9] Muscle tonus of the eyelids during sleep is the exact converse of that found during waking. There is a tonic muscular activity in the orbicularis oculi muscle with a concomitant inhibition of tonus of levator palpebrae superioris.[10] The lipid layer of the tear film coupled with eyelid closure during sleep prevents evaporation of tears, maintaining moistness of the cornea.[7] Bell's phenomenon, in which there is upward rotation of the eyeball during sleep, hence protecting the cornea, was observed by Hall in 42% of healthy individuals.[11]

The tear film is a dynamic structure. Its production and turnover are essential for maintainance of a healthy ocular surface.[12,13] Physiologically, the precorneal tear film maintains the functional integrity of the avascular cornea by providing a moist, oxygenated environment and nutrients for the epithelial cells.[14] It also lubricates the cornea, forming a smooth refractive surface,[15,16] and serves as a medium to dilute and remove noxious stimuli, flushing out any debris or microorganisms.[6,9,17] Tears are bactericidal, as they contain a number of substances with antimicrobial properties, such as lysozyme, beta-lysin, lactoferrin, interferon, tear lipocalin, complement components, and immunoglobulins that inhibit bacterial colonization and growth.[5,18-21] The tear film also allows the passage of leukocytes in the event of injury or infection.[20,22] Hence, a dry eye is more susceptible to infection.[21] Constant evaporation of tears maintains the conjunctival sac at a temperature unfavorable for bacterial proliferation.[23] The epithelial cells also produce a mucinous material known as glycocalyx, which is responsible for the adhesion of the tear film to the ocular surface epithelia and provides corneal protection.[5,13]

The conjunctival epithelium forms a mucous membrane covering the ocular surface, providing a physical barrier against injury and invasion from microorganisms.[22] The normal bacterial flora of the conjunctiva may have an inhibitory effect on the survival of more pathogenic species.[20] In addition, the conjunctiva and the lacrimal gland form part of the common mucosal immune system that helps the ocular surface to mount a cell-mediated immune response.[17,18,24]

An intact corneal epithelium provides a powerful barrier to microbial invasion.[5] The presence of a corneal reflex enables the patient to react to physical threats to the eye and is essential to protect the cornea.[25] Hence, it is uncommon for microbial keratitis to occur in the absence of predisposing risk factors. Random eye movements (**REMs**) during sleep may serve as a protective mechanism by promoting circulation of the aqueous humor behind the closed lids, thus preventing corneal anoxia and epithelial breakdown.[26]

IV. OCULAR SURFACE DISORDERS OCCURRING IN THE ICU SETTING

A. Exposure Keratopathy

1. Prevalence

Breakdown of the innate physiological eye protective mechanisms will predispose to ocular surface damage.[27] Exposure keratopathy has been reported to occur in 3.6% to 60% of ICU patients, with a peak incidence between 2 and 7 days from admission.[14,28] The major studies on the prevalence and predisposing factors for ocular surface disorders in ICUs are summarized in Table 1.[2,6,15,28-30] A prospective audit designed by Dawson identified a similar rate of ocular surface disease in 37.5% of ventilated ICU subjects.[31]

The variation in reported incidence resulted from different assessment methods for exposure keratopathy. In some of the studies, only macroepithelial injury was assessed, and less severe forms of corneal pathology, such as superficial punctate keratopathy, were overlooked.

2. Pathogenesis

Sedatives and neuromuscular blockers are commonly used in the ICU to facilitate the management of patients on mechanical ventilation. These agents inhibit active contraction of the orbicularis oculi muscle, resulting in incomplete eyelid closure (lagophthalmos), corneal exposure, and dryness.[1,5,6,17,32-35]