ARTYKUŁ PRZEGLĄDOWY REVIEW ARTICLE

DOI: 10.24292/01.OT.212524

Dry eye disease – the problem of modern days

Marta Misiuk-Hojło, Katarzyna Zimmer

Clinic of Ophthalmology, Medical University of Wroclaw
Head: prof. Marta Misiuk-Hojło, MD, PhD

HIGHLIGHTS

Dry eye syndrome requires a complex therapeutic approach, including innovative lipid microemulsions that stabilize the tear film and alleviate symptoms.

ABSTRACT

Dry eye syndrome is a common ophthalmic condition caused by a deficiency in the tear film, leading to discomfort and damage to the ocular surface. Dry eye syndrome is divided into three main categories: ADDE (aqueous deficient dry eye), EDE (evaporative dry eye), and a mixed form. Diagnosis involves assessing clinical symptoms, laboratory tests, and patient history. Treatment depends on the cause and severity of symptoms, including artificial tears, anti-inflammatory medications, autologous serum eye drops, and innovative lipid microemulsion eye drops. These modern drops stabilize the tear film, protect the ocular surface, and support regenerative processes, providing patients with relief and improved quality of life.

Key words: dry eye syndrome, hydration drops, tear film dysfunction, Meibomian glands dysfunction, dry eye treatment

INTRODUCTION

Dry eye syndrome (DES) is one of the most common ophthalmic conditions and is characterized by a chronic deficiency of the tear film, which can lead to significant discomfort, visual disturbance and even damage to the ocular surface. Symptoms of DES include burning, gritty eyes, redness of the eyes and blurred vision. This condition can be associated with both a deficiency in the aqueous layer of the tear film and excessive tear evaporation [1, 2]. In clinical practice, DES fall into three main categories:

- aqueous-deficient dry eye (ADDE)
- evaporative dry eye (EDE)
- a mixed form that combines features of both [1–4].

The form associated with aqueous layer deficiency, or ADDE, is the result of tear gland dysfunction that leads to inadequate tear production. In this case, the tear film is unable to adequately lubricate the surface of the eye, leading to dryness and damage. Excessive tear evaporation, or EDE, is the most common form of DES and includes causes related to both the eyelids (such as meibomian gland dysfunction) and the ocular surface. Meibomian gland dysfunction causes a deficiency of lipids in the tear film, leading to excessive tear evaporation and tear film destabilization. The mixed form, as the name suggests, combines features of both of the above mechanisms, making its management particularly complicated and requiring a multidisciplinary approach [3–5].

PATHOPHYSIOLOGY AND DIAGNOSIS

The lipid layer of the tear film, produced by the meibomian glands in the eyelids, covers the aqueous layer of the tear film, protecting it from drying out and helping to stabilize it. The lipid layer consists of polar and non-polar lipids, which are separated into two layers. Non-polar lipids are at the interface with the air environment and form a hydrophobic barrier, while polar lipids stabilize the lipid layer on the aqueous surface of the tear film. In cases of DES and corneal epithelial damage, the lipid layer plays a key role in the physiological repair processes of the ocular surface [5].
The diagnosis of DES is a key element in the selection of a targeted therapy. It includes both clinical symptom assessment and laboratory testing. Questionnaires such as the Ocular Surface Disease Index (OSDI) are used to subjectively assess the severity of symptoms. Clinical tests such as Schirmer's test, tear break-up time (TBUT) and ocular surface fluorescein staining provide an objective assessment of tear film function and ocular surface condition. In turn, analysis of tear osmolarity and identification of inflammatory markers can provide valuable information on the pathophysiology of the disease [4–7]. The role of the patient interview should not be overlooked in the diagnosis. Ask about hygiene and work environment, hormonal changes, eating habits and general illnesses [8, 9]. Sometimes an additional element, i.e. environmental or hormonal, can also affect the condition of the ocular surface [9].

AVAILABLE THERAPIES

The choice of therapy depends on the cause and severity of the symptoms of DES, as well as the presence of any general medical conditions affecting, for example, tear production, glands and hormonal changes. Often a combination of therapies is needed for optimal treatment.
Artificial tears are over-the-counter eye drops that relieve dryness and irritation. Anti-inflammatory medications, such as cyclosporine (which modulates the immune response to reduce inflammation and stimulate tear production), address the underlying causes of DES and ultimately reduce ocular inflammation and increase tear production, providing long-term relief from chronic dry eye. Eye drops made from the patient's own serum contain growth factors that also help heal the ocular surface. Other methods include tear film plugging (silicone and dissolvable plugs), laser decongestion of the meibomian glands and surgical lacrimal closure [9, 10]. Innovative methods using stem cells and other advanced therapies to promote healing and regeneration of the ocular surface continue to be investigated [11]. There is also great hope for therapies using interleukin-20 (IL-20); however, only preliminary studies are currently underway [12].
Another new approach to the management of DES is supplementation with vitamin D and omega-3 fatty acids. Their potential role in reducing inflammation and alleviating symptoms in some cases has been investigated [13–16].

MOISTURIZING DROPS – LIPID MICROEMULSION

The most common and effective first-line treatment is to replenish the appropriate layer of the tear film with drops. Innovative lipid microemulsion ophthalmic formulations are now available specifically designed for the treatment of DES, particularly the EDE form. These products contain a unique combination of medium-chain triglycerides (MCTs) and phospholipids, which are key components of the tear film lipid layer. In addition, they usually contain sodium hyaluronate, which stabilizes the tear film, and vitamins A and E, which promote regenerative processes and protect ocular cells from oxidative damage [17, 18]. MCTs and phospholipids, which are polar and non-polar forms of lipids, are essential for stabilizing the lipid layer of the tear film. Due to their chemical structure, MCTs are easily absorbed into the lipid layer, strengthening its structure and preventing excessive tear evaporation. Phospholipids, which are part of cell membranes, play an important role

in the formation of a stable lipid barrier, which further protects the tear film from destabilization [17].

Sodium hyaluronate, found in drops (such as Lipitres), is a natural polymer found in the vitreous of the eye and is known for its moisturizing properties and ability to retain water. It stabilizes the tear film, ensuring adequate hydration and protecting the ocular surface from drying out. Vitamin A is a key ingredient in supporting the regeneration of conjunctival bulb cells, which are responsible for the production of mucin, which is essential for maintaining the stability of the tear film. Vitamin E acts as a powerful antioxidant and protects ocular cells from damage caused by reactive oxygen species, which is particularly important in the context of the chronic inflammation associated with DES [17, 19, 20].

WHAT ARE THE CLINICAL BENEFITS?

Thanks to their advanced formulation, lipid microemulsion drops act comprehensively on all three layers of the tear film. Submicroscopic phospholipids and MCTs dispersed in the microemulsion combine with the thin hydrophobic barrier of the lipid layer of the natural tear film, taking over the function of the lipid layer and protecting the ocular surface. As a result, the product not only prevents excessive tear evaporation, but also stabilizes the tear film, which is critical in the treatment of DES.

Regular use of emulsion formulations can significantly improve the comfort of patients with DES, providing immediate and long-lasting relief. Such products fill an important gap in the treatment of DES associated with excessive tear evaporation, providing an effective solution for patients experiencing chronic discomfort associated with this condition. It is worth noting that such products not only have a symptomatic effect, but also promote the physiological repair processes of the corneal and conjunctival epithelium, which is crucial for long-term ocular health [21, 22].

CONCLUSIONS

Lipid microemulsion formulations represent an innovative and effective approach to the treatment of DES, particularly the EDE form. With a unique combination of MCTs, phospholipids, sodium hyaluronate and vitamins A and E, this product effectively protects and stabilizes the tear film, providing patients with relief and improved quality of life. Drops of this type are an important part of the therapeutic armamentarium to provide modern, comprehensive and effective treatment for patients with DES.

CORRESPONDENCE
prof. Marta Misiuk-Hojło, MD, PhD
Clinic of Ophthalmology, Medical University of Wroclaw
50-556 Wrocław, ul. Borowska 213
e-mail: klo@usk.wroc.pl

ORCID
Marta Misiuk-Hojło – ID – http://orcid.org/0000-0002-4020-3203
Katarzyna Zimmer – ID – http://orcid.org/0000-0003-2300-8585

References

1. Zapobieganie i leczenie ciężkiego zapalenia rogówki w przebiegu zespołu suchego oka Wytyczne postępowania klinicznego Polskiego Towarzystwa Okulistycznego 2020 r.
2. Dry Eye Syndrome – Preferred Practice Pattern – American Academy of Ophthalmology, Guidelines.
3. Thompson K, Brown S, Miller J. Dry eye syndrome: Comprehensive etiologies and recent insights. Int J Ophthalmol. 2022; 42(10): 3253--72. http://doi.org/10.1007/s10792-022-02320-7.
4. McCann P, Kruoch Z, Qureshi R et al. Interventions for dry eye: An overview of systematic reviews. J Ophthalmol. 2024; 142(1): 58-74. http://doi.org/10.1001/jamaophthalmol.2023.5751.
5. Verjee MA, Brissette AR, Starr CE. Dry Eye Disease: Early Recognition with Guidance on Management and Treatment for Primary Care Family Physicians. Ophthalmol Ther. 2020; 9(4): 877-88.
6. Messmer E. Pathophysiology of dry eye disease and novel therapeutic targets. Exp Eye Res. 2022; 217: 108944. http://doi.org/10.1016/j.exer.2022.108944.

7. Huang R, Su C, Fang L et al. Dry eye syndrome: comprehensive etiologies and recent clinical trials. Int Ophthalmol. 2022; 42(12): 3253-72. http://doi.org/10.1007/s10792-022-02320-7.
8. Versura P, Campos E. Menopause and dry eye. A possible relationship. Gynecol Endocrinol. 2005; 20(5): 289-98. http://doi.org/10.1080/09513590400027257.
9. Patel S, Mittal R, Kumar N et al. The environment and dry eye – manifestations, mechanisms, and more. Front Toxicol. 2023; 5: 1173683. http://doi.org/10.3389/ftox.2023.1173683.
10. O'Neil EC, Henderson M, Massaro-Giordano M et al. Advances in dry eye disease treatment. Curr Opin Ophthalmol. 2019; 30(3): 166-78. http://doi.org/10.1097/ICU.0000000000000569.
11. Giannaccare G, Taroni L, Senni C et al. Intense pulsed light therapy in the treatment of meibomian gland dysfunction: Current perspectives. Clin Optom (Auckl). 2019; 11: 113-26. http://doi.org/10.2147/OPTO.S217639.
12. Wang HH, Chen WY, Huang YH et al. Interleukin-20 is involved in dry eye disease and is a potential therapeutic target. J Biomed Sci. 2022; 29(1): 36. http://doi.org/10.1186/s12929-022-00821-2.
13. Chan HN, Zhang XJ, Ling XT et al. Vitamin D and ocular diseases: A systematic review. Int J Mol Sci. 2022; 23(8): 4226. http://doi.org/10.3390/ijms23084226.
14. Faulkner WJ. The role of omega-3 essential fatty acids in dry eye disease. Int J Clin Exp Ophthalmol. 2017; 1: 55-9. http://doi.org/10.29328/journal.ijceo.1001008.
15. Rao SK, Mohan R, Gokhale N et al. Inflammation and dry eye disease – where are we? Int J Ophthalmol. 2022; 15(5): 820-7. http://doi.org/10.18240/ijo.2022.05.20.
16. McCann P, Kruoch Z, Lopez S et al. Interventions for dry eye: An overview of systematic reviews. JAMA Ophthalmol. 2024; 142(1): 58-74. http://doi.org/10.1001/jamaophthalmol.2023.5751.
17. Chhadva P, Goldhardt R, Galor A. Meibomian Gland Disease: The Role of Gland Dysfunction in Dry Eye Disease. Review Ophthalmol. 2017; 124(11S): S20-6. http://doi.org/10.1016/j.ophtha.2017.05.031.
18. Roucaute E, Huertas-Bello M, Sabater AL. Novel treatments for dry eye syndrome. Curr Opin Pharmacol. 2024; 75: 102431. http://doi.org/10.1016/j.coph.2024.102431.
19. Mondal H, Kim HJ, Mohanto N et al. A Review on Dry Eye Disease Treatment: Recent Progress, Diagnostics, and Future Perspectives. Pharmaceutics. 2023; 15(3): 990. http://doi.org/10.3390/pharmaceutics15030990.
20. Bhujel B, Oh SH, Kim CM et al. Current Advances in Regenerative Strategies for Dry Eye Diseases: A Comprehensive Review. Bioengineering (Basel). 2023; 11(1): 39. http://doi.org/10.3390/bioengineering11010039.
21. Vickers LA, Gupta PK. The Future of Dry Eye Treatment: A Glance into the Therapeutic Pipeline. Ophthalmol Ther. 2015; 4(2): 69-78. http://doi.org/10.1007/s40123-015-0038-y.
22. Zhang X, Vimalin JM, Qu Y et al. Dry Eye Management: Targeting the Ocular Surface Microenvironment. Int J Mol Sci. 2017; 18(7): 1398. http://doi.org/10.3390/ijms18071398.

Authors' contributions:
All authors have equal contribution to the paper.

Conflict of interest:
None.

Financial support:
None.

Ethics:
The content presented in the article complies with the principles of the Helsinki Declaration, EU directives and harmonized requirements for biomedical journals.