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Dry eye and cataract surgery: Narrative review and recommendations for management

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Abstract

Cataract surgery is the most frequently performed surgical procedure in the elderly in Western countries and patients' expectations for postoperative outcomes are very high.

Dry eye disease (DED) is a common multifactorial symptomatic disease of the ocular surface with a complex etiopathogenesis and a prevalence significantly increasing with age.

Cataract surgery and DED have a complex relationship, which needs to be acknowledged, understood, and properly managed, as suggested by daily clinical experience and growing scientific evidence. The surgical procedure can have a relevant impact on the tear film and the ocular surface, and it can, usually transiently, induce or exacerbate DED symptoms. Moreover, preoperative DED can affect surgical refractive outcomes, while postoperative DED symptoms can significantly worsen patients reported outcomes and satisfaction.

At the end of this narrative review summarizing the evidence on this topic, the "Dry Eye and Cataract Surgery" subcommittee of the DROPS workshop formulated some recommendations for ocular surface and DED management pre-, intra-, and post-cataract surgery.

Keywords

Dry eye, ocular surface, symptoms, cataract surgery, phacoemulsification, BUT, OSDI

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Introduction and epidemiological association

Cataract is one of the most common causes of loss of useful vision. Large-scale population-based studies have reported that cataract prevalence increases with age, from 3.9% at age 55–64 years to 92.6% at age 80 years and older.[1,2] With advancements in technology, surgical techniques, instrumentation, design of intraocular lenses, and medications, cataract surgery is a safe and effective intervention, and is the most frequently performed surgical procedure in the elderly in Western countries.[1,2]

Dry eye disease (DED) is a multifactorial symptomatic disease of the ocular surface with a complex etiopathogenesis

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involving tear film instability and hyperosmolarity, ocular surface inflammation and damage, and neurosensory abnormalities.[3] There is strong evidence that the prevalence of DED diagnosis, as well as signs and symptoms, significantly increases with age, especially over the age of 50.[4]

Beyond the obvious epidemiological association with the role of aging, cataract surgery and DED can be closely interrelated, a fact that needs to be acknowledged, understood, and properly managed, as suggested by daily clinical experience and growing scientific evidence. This interrelationship includes the impact of cataract surgery on the tear film, ocular surface and DED, and the potentially relevant, although less obvious, impact of the DED on cataract surgery outcomes.

Literature search

A scientific literature search was conducted on January 31, 2022 using the PubMed database. The search keywords were "(cataract surgery OR phacoemulsification) AND (dry eye OR ocular surface OR tear film OR Meibomian glands)". We screened the papers sequentially with the following order: titles, abstracts, and full-text. Articles were retrieved, and the reference list of each article was reviewed to identify other relevant papers.

Impact of cataract surgery on the tear film and ocular surface

The ocular surface is a morpho-functional unit, covered by a continuous sheet of differentiated epithelia, and is protected by homeostatic mechanisms that regulate tear secretion and distribution.[5] Depending on the health status of the morpho-functional unit, factors with a relevant impact on elements of the ocular surface and/or of the tear film can perturb this dynamic balance, eventually leading to DED.

As highlighted by a recent metanalysis, several studies reported the potential impact of cataract surgery on key aspects of the tear film and ocular surface health.[6]

Tear film stability

A stable open-eye tear film has long been viewed as one of the hallmarks of ocular health, mostly because it provides the primary refracting surface for light entering the visual system as well as creating a protective and lubricated environment for the tissues of the palpebral and bulbar conjunctival surfaces.[7]

Several studies using either fluorescein break-up time (FBUT) or non-invasive break-up time (NIBUT), investigated changes in tear film stability 1 month after cataract surgery.[6,8,9] Despite heterogeneous results (ranging from −3 s[8] to + 1 s[9]), these studies overall demonstrated a significant post-operative decrease in tear film BUT (− 0.69, 95% CI [− 1.07, − 0.30], P < 0.001), as shown by a recent meta-analysis in 1999 eyes.[6] The surgery-related reduction of tear film stability was more evident and of higher clinical relevance in subjects with pre-operative Meibomian gland dysfunction (MGD): − 2.27 s, 95% CI [− 2.66, − 1.88], P < 0.001.[6,10–12] Interestingly, a large prospective interventional comparative case series in 568 eyes showed that diabetic patients without DED had significantly reduced post-operative FBUT compared to non-diabetic patients (−2.8 s, P < 0.05).[13]

The effect of phacoemulsification on BUT seems to dissipate after 2 or 3 months,[13,14] and there is a lack of strong evidence on post-surgical persistent or long-term decrease in tear film stability. However, a recent multisite, hospital-based, cross-sectional study performed in Japan reported significantly reduced BUT in 89 pseudophakic eyes (mean postoperative period: 4.6 years) compared to 89 contralateral phakic eyes, regardless of the patient's age[15] These results are interesting even if, given the study design, preoperative data were not analyzed.

Tear film volume

Several studies, mainly using the Schirmer I test or meniscometry, investigated changes in tear film secretion or volume 1 month after cataract surgery.[6] Several studies report results ranging from −1.33 mm[16] to + 0.90[12,17] while a recent meta-analysis in 1682 eyes showed no significant post-operative decrease in tear film volume (− 0.69 mm, 95% CI [− 1.07, − 0.30], P < 0.001).[6]

As discussed in detail some years ago by N. Kasetsuwan and colleagues,[18] the percentage of postoperative abnormal Schirmer's tests is largely lower than that of abnormal BUT, suggesting that the surgical impact on tear film stability plays a major role in post-cataract DED compared to the impact on tear fluid secretion.

There is no evidence indicating post-surgical persistent or long-term decrease in tear film volume, and even studies showing transient Schirmer's test or tear meniscus value reduction after surgery reported nearly normalized values by 3–6 months.[19,20]

Tear film osmolarity

Reduced tear production and increased evaporation increase the osmolarity of the tear fluid. Tear film hyperosmolarity is a key element in the DED vicious cycle.[3,5]

Only a few studies reported surgery-related tear film osmolarity changes, showing a peak at 1 week post-operative (ranging from + 4.5 to + 10.6 mOsm/L)[21,22] and normalization (compared to baseline or control group) by 1 or 3 months.[21–23]

Ocular surface staining

Punctate staining of the ocular surface, including cornea, conjunctiva, and lid margin, is a feature of many ocular diseases, and instilled dyes (mainly fluorescein and lissamine green) are used extensively in the diagnosis and management of DED.[24]

Several studies investigated changes in corneal fluorescein staining score 1 month after cataract surgery.[6] These studies reported heterogeneous results (ranging from −1.56 points[25] to + 2.47 points[26]) and, overall, did not show a significant post-operative increase in corneal staining score (+ 0.05 points, 95% CI [− 0.10, + 0.21], P = 0.51), as shown by a recent meta-analysis.[6]

Interestingly, the few studies focusing on patients with pre-operative MGD showed a significant increase in post-surgical corneal staining (+ 0.90 points, 95% CI [+ 0.28, + 0.1.53], P < 0.01).[6]

There is lack of strong evidence on post-surgical conjunctival epitheliopathy. However, clinical and cytological studies suggest transient surgery-related damage of conjunctival epithelium, with recovery in 1–3 months or even later.[17,27,28]

Meibomian glands

The meibomian glands (MG) are modified sebaceous, holocrine glands whose acini discharge their entire contents in the process of secretion, providing the tear film superficial lipid component.[5]

Meibomian gland dysfunction (MGD), defined as a chronic, diffuse abnormality of the meibomian glands, commonly characterized by terminal duct obstruction and/or qualitative/quantitative changes in the glandular secretion,[29] is considered the leading cause of DED worldwide.[30]

Several studies reported short-term cataract surgery-related changes in MG function and/or morphology, but only a few of them specifically focused on MG and MGD. Studies based on clinical parameters reported MG function worsening at 1 month post-surgery. These changes were statistically and clinically more relevant in patients with pre-operative MGD.[10,31]

A prospective observational case series reported significant changes in lid margin abnormalities and meibum expressibility at 1–3 months post-surgery. This study, using a grading score for MG dropout, did not find a significant post-operative change in infrared meibography.[12]

However, a recent controlled study, using tools for a quantitative analysis of infrared meibography images obtained before the surgery and 6 months post-operatively, showed a statistically significant decrease in MG length, width, and area in the operated eyes but not in the contralateral control eyes. Interestingly, at this time point, MG morphological changes were not associated with significant changes in tear film stability and volume.[32]

The findings of these studies warrant further, detailed prospective studies to analyze MG parameters in relation to cataract surgery.

Ocular surface inflammation

Inflammation is a key element in DED pathogenesis and may be a relevant marker of disease severity.[5,24] Ocular surface inflammation can be investigated using imaging[33] and omics-based biomarkers[34], but the validation of low-cost tools for its quantification in daily clinical practice is still a need that has yet to be met.[24]

A prospective study, using a multiplex immunobead assay to assess tear film cytokine concentration at baseline and 1 month after cataract surgery, showed a significant post-operative increase in IL-6 and Tumor necrosis factor (TNF)-α in 15 patients with pre-operative MGD but not in 35 patients without it.[10]

Another study, using a similar technique in patients treated for 1 month after surgery with 1% prednisolone acetate eyedrops four times daily, showed a peak of tear inflammatory cytokine concentration 1 day after surgery, with recovery to approximately baseline level 1–2 months later. Interestingly, cytokine concentrations (including IL-1β, IL-6, IL-8, MCP-1, TNF-α and IFN-γ) were significantly higher in patients with pre-operative DED at each time point, and 2 months after surgery, cytokine levels significantly correlated with several DED clinical parameters.[14]

In vivo confocal microscopy (IVCM) studies, using sub-basal dendritic (Langerhans)cells located in the central cornea as a biomarker of corneal inflammation,[33] showed increased density of Langerhans cells in the first 3–5 days postoperatively, followed by a decline to the baseline.[35] No significant differences in dendritic cell density, compared to both baseline values and controls, were reported 1 month after surgery.[36]

Corneal nerves

The innervation of ocular surface epithelia (and specifically of the corneal epithelium) is a key element in the homeostasis of the lacrimal functional unit, and neurosensory abnormalities can play a major role in the pathogenesis of DED.[3,5]

The impact of cataract surgery on corneal nerves has been known for many years[37], and several studies have reported short-term corneal sensitivity impairment at the corneal apex [38,39] and in peripheral quadrants,[40] often persisting beyond 3 months after cataract surgery.

More recently, IVCM studies have investigated surgery-related quantitative changes of corneal sub-basal nerve plexus (CSNP) nerves.

One study reported central and temporal CSNP changes, with significant quantitative reduction in subbasal nerves and changes in nerve morphology at 1 month, persisting 3 months after surgery, and subsequent progressive recovery (60% at 6 months, 87% at 8 and 10 months). This analysis reported that the temporal nerve plexus fully recovered in all patients at month 8.[38]

Moreover, a recent study showed a significant reduction of all the CSNP parameters in both eyes 1 month after unilateral surgery. These results require confirmation in further studies, but may have relevant implications in the setting of sequential cataract surgery.[36]

CSNP fiber density has been reported to be lower after cataract surgery in patients both with and without diabetes mellitus (DM); however, lower initial density in patients with DM may predispose them to developing diabetic keratopathy.[41] Given the importance of proper postoperative wound healing in the recovery and maintenance of a healthy ocular surface and the impaired wound healing response that may accompany DM, corneal nerves deserve closer attention particularly in the diabetes population, as the trophic functions of corneal nerves are essential for wound healing of the corneal incision following cataract surgery.

Impact of cataract surgery on dry eye symptoms

The wide variety of DED symptoms represents a crucial element for DED definition and diagnosis.[24]

Several studies, mainly using the Ocular Surface Disease Index (OSDI), investigated changes in symptoms 1 month after cataract surgery.[6,16,42] Results are highly heterogeneous, ranging from -3.18[42] to $+1.91$[16] points. A recent meta-analysis demonstrated that considering only MGD patients resulted in a significant overall worsening of the mean OSDI score at this time point $+1.31$ points, 95% CI $[+0.66, +1.95]$, $P<0.001$).[6] This very small difference, although statistically significant, doesn't seem to be clinically relevant but, as interestingly highlighted by Li XM and colleagues, the post-surgical decrease in the score of visual function-related OSDI items can hide the increased score of ocular discomfort- and environmental trigger-related items.[28]

Despite data heterogeneity affecting the meta-analysis, the literature provides strong evidence that cataract surgery can transiently induce DED symptoms.[14]

While some authors reported an improvement in the mean symptoms score (back to pre-operative levels) 3 months after surgery[43], other studies investigated persistent surgery-related DED symptoms, experienced by 27% of patients 3 months after surgery,[25] and by 17% of patients at 6 months of follow-up.[44]

Galor and associates, using the Dry Eye Questionnaire-5 in a telephone survey of 119 subjects, found a 34% overall prevalence of persistent DED-like symptoms, and 18% of severe symptoms, 6 months after cataract surgery.[45] A limitation of the retrospective study design, however, was that DED symptoms, which may have been present preoperatively, could not be assessed.

This is a relevant issue, as there is a high prevalence of pre-existent DED symptoms in patients undergoing cataract surgery. A prospective case series using OSDI or Symptom Assessment iN Dry Eye questionnaires, found that 54.0% of patients presenting for cataract surgery evaluation had symptoms suggestive of ocular surface dysfunction.[46]

Regarding this particular group of patients with pre-existing symptoms, the literature provides evidence of transient surgery-related worsening of DED symptoms,[14] generally decreasing to the preoperative level 3 months after surgery,[43,47] but persisting at 6 months in >10% of patients.[44]

Surgery-related elements with potential impact on dry eye signs and symptoms

As discussed by the Tear Film and Ocular Surface Society (TFOS) Dry Eye WorkShop (DEWS) II Iatrogenic Report, the pathophysiological mechanisms underlying cataract surgery-induced DED are multifactorial and include (but are not limited to) the use of topical anesthetics, antiseptics, antibiotics, and anti-inflammatory drugs, exposure desiccation, possible light toxicity from the operating microscope, nerve transection, elevation of inflammatory factors, goblet cell loss, and MGD.[48]

The potential role of each of these factors is supported by a good rationale but, in many cases, by poor evidence.

The pre-operative instillation of a single dose of povidone-iodine and of a reasonable number of drops of topical anesthetics are of crucial importance for the procedure. However, given their potential toxicity for ocular surface epithelia,[49,50] their misuse and overuse should be avoided.

The lid speculum insertion technique, position and type may have an impact on conjunctiva, MGs, and eyelids. However, these factors have not been specifically assessed in the literature, although a small randomized study showed that the use of an aspirating lid speculum, inducing conjunctival jam, may exacerbate short-term post-surgical DED signs and symptoms, but with differences no longer present 1 month after surgery.[51]

Corneal incision locations and shapes may influence the post-operative tear film and ocular surface because of corneal nerve damage, the subsequent wound healing response and an uneven epithelial surface. A prospective interventional study including 49 patients performed at the Catholic University of Korea, found that incision location did not appear to result in significant differences in post-operative DED, while grooved incisions, both superior and temporal, may aggravate DED signs and symptoms, especially in patients without preexisting DED.[52]

In general, wound size can influence recovery time, and smaller corneal incisions, sparing more nerve fibers, may have a lesser influence on tear secretion and blinking.[40]

However, it is difficult to evaluate the role of this factor in the current small- or micro-incisional phacoemulsification era.[53]

Several reports have highlighted the relevant role of operating room time and length of exposure to the operating microscope light on post-surgical DED symptoms and signs and goblet cell loss, in patients both with and without preexisting DED.[17,52] However, it could also be interpreted that longer times may be required in more difficult or complicated surgery cases, and that such cases could be more prone to develop DED related problems postoperatively, independent of the light exposure.

Despite the relevant thermal energy generated by phacoemulsification devices,[54] there is no clear evidence supporting a correlation between phacoemulsification energy and post-operative DED test values.[52]

Another potentially relevant intra-operative factor is the repeated ocular surface drying followed by irrigation to maintain surgical optical clarity.[53] In recent years, this issue has been highlighted by studies showing decreased post-surgical DED signs and symptoms associated with the coating of the intra-operative ocular surface with viscoelastic products.[9,26,55]

Post-operative medications may be further key factors in this context.

Li and colleagues showed that, 3 months after cataract surgery, the decreased goblet cell density and increased squamous metaplasia were clearly more significant in the lower lid-covered region than in the upper lid-covered region and the exposed region of bulbar conjunctiva, interestingly speculating that this suggests a major etiopathogenic role of eye-drop use and misuse.[28]

With regard to the active ingredients of post-surgical medications, usually including antibiotics, steroids, and non-steroidal anti-inflammatory drugs (NSAIDs), the latter have showed the most evident detrimental effects on the ocular surface, with some differences being reported among the various drugs.[56–58]

Major evidence supports the detrimental effects on the ocular surface of repeated instillation of preserved eye-drops.[59] A randomized controlled clinical trial with 2-month follow-up by Jee and colleagues, comparing preservative-free versus preserved post-operative eye drops (sodium hyaluronate 0.1% and fluorometholone 0.1%) in patients with preexisting DED, showed significantly worse OSDI score, BUT, Schirmer I score, fluorescein ocular surface staining score, impression cytology findings, and goblet cell count in the latter group.[60]

Evidence on femtosecond laser-assisted cataract surgery (FLACS)

The introduction of the femtosecond laser into the field of cataract surgery offers a new technology in several steps of the surgical procedure, reducing ultrasound energy and enabling safer and more repeatable cataract surgery. However, the direct contact and sustained vacuum pressure of the suction ring to the ocular surface and the extra laser procedure, which results in prolonged exposure time, may potentially affect tear film and ocular surface function.[61,62]

It is well known that both FLACS and conventional phacoemulsification have (mostly transient) adverse effects on tear film and ocular surface, but few studies have compared DED signs and symptoms between FLACS and conventional cataract surgery.[63,64]

Yu and colleagues, in a prospective consecutive non-randomized comparative cohort study, found higher OSDI score (at 1 week) and higher fluorescein staining of the ocular surface (at 1 week and 1 month) after FLACS, compared to conventional cataract surgery. Moreover, patients with preexisting dry eye who underwent FLACS had more severe ocular surface staining than those having conventional surgery.[42]

Shao and colleagues, in a study on patients without preexisting DED, found similar short-term results, with higher ODSI and staining values in the FLACS group at 1 week but not at 3 months after surgery. They concluded that both FLACS and conventional phacoemulsification affect the ocular surface function of patients, and there are statistically significant differences only in the early post-operative period.[16]

Impact of the ocular surface on cataract surgery outcome

Intra-ocular-lens (IOL) calculation

Modern cataract surgery, based on high-tech pre-operative examination, minimally invasive procedures, and premium or new technology IOLs (aspherical, toric, and/or multifocal/extended depth of focus), is characterized by a paradigm shift from simply treating the disease to optimizing the refractive outcome to a similar degree as in refractive surgery.[65]

Refractive error minimization and quality of vision optimization are, at present, of crucial importance in the context of surgical outcomes.

DED-related loss of tear film and ocular surface homeostasis is an often overlooked but relevant factor, able to significantly affect IOL calculation accuracy and cataract surgery refractive results.

Epitropoulos and colleagues reported that subjects with hyperosmolar tear film (mean osmolarity 327.8 ± 10.5 versus 301.1 ± 4.9 mOsm/L) showed poorer repeatability of corneal K values and IOL power calculation. The authors found that, repeating IOL calculation 2 times, no one in the control group but 10% of hyperosmolar eyes had a IOL power variability > 0.5 D, the highest difference being 5.5 D.[66]

Two very recent studies investigated the impact of preoperative DED pharmacological treatment on refractive outcomes after cataract surgery. J. Kim and colleagues showed that pretreatment of DED led to a more accurate K value measurement with a higher percentage (94.3% in the pretreatment group versus 65.4% in the non-pretreatment group) of postoperative refractive error ≤ 0.5D. The number of refractive surprises was also significantly reduced in the pretreatment group: from 17.3 to 3.8% using SRK/T formula and from 15.4 to 1.9% using Barrett Universal II formula.[67] Moreover, Hovanesian and colleagues reported that, in patients with preexisting DED, the proportion of eyes that would have achieved the target refraction was significantly higher after 28 days of pharmacological treatment: 47% vs 41% within 0.25 D, and 95% vs 88% within 0.75 D.[68]

The advantages of DED pretreatment led to hypothesizing, in DED patients, a potential benefit in the instillation of artificial tears just before K value acquisition and IOL calculation. This practice is not evidence-based and should be avoided, as evidenced by studies showing a significant increase in measurement variability,[69] changes in IOL cylinder calculation in up to 43.8% of cases, changes in implantation axis > 10° in 17.7% of cases,[70] and significant changes of total, sphere-like, and coma-like aberrations.[71]

Patient satisfaction and quality of life

At present, cataract surgery can be performed with minimal invasiveness and a high profile of safety and efficacy. A recent review surveyed the results and methods of cost-utility analyses of cataract surgery and, despite the observed great heterogeneity of approaches and outcomes, it found consistent favorable cost: quality-adjusted life years (QALY) ratios.[72]

Moreover, studies on patient-reported outcomes have shown major cataract surgery-related improvements in the visual function experienced by patients[73] and, albeit with as yet limited evidence, improvement in their frailty and frailty outcomes.[74]

However, the impact of the procedure on patient-reported outcomes and quality of life (QoL) can be significantly affected by DED symptoms.

Szakáts and colleagues, in a case-control study 2 months after uneventful phacoemulsification, compared patients who were unsatisfied with their postoperative outcome versus satisfied patients. The authors found that severity of DED symptoms (higher OSDI scores) was a significant predictor of patient dissatisfaction after controlling for age and gender (OR: 1.46; 95% CI: 1.02–2.09, $p < 0.05$).[75]

Another recent prospective observational study on consecutive patients who underwent manual small incision cataract surgery reported a significant negative correlation between post-operative patient satisfaction and severe pre-operative ocular surface disease, based on conjunctival impression cytology grading.[76]

Moreover, a recent study assessing the impact on QoL by time trade-off, standard gamble for death, and standard gamble for blindness, showed that at 3 and 6 months after cataract surgery, utility values negatively correlated to DED symptoms.[20]

Evidence on management and treatment

Preoperative

As recently highlighted by the American Society of Cataract and Refractive Surgery Cornea Clinical Committee, proper assessment of the tear film and ocular surface health and treatment of DED prior to cataract surgery can optimize surgical outcomes and patient satisfaction.[77]

Several studies evaluated the effectiveness of pre-operative treatment of MGD, which was shown to be more effective in improving DED symptoms and signs 1–3 months after surgery, even in comparison to "enhanced" anti-inflammatory post-operative treatment.[31]

Moreover, a small controlled clinical trial showed that 12 min vectored thermal pulsation treatment using LipiFlow the day before cataract surgery was able to improve tear film stability and MGs function 1 month after surgery.[78]

Some studies explored the role of pre-operative control of ocular surface inflammation.

A small randomized triple-blind clinical trial showed that 3 days of pre-treatment with betamethasone 0.1% 4 times per day had no significant effect on postoperative DED indices.[79]

Conversely, a randomized contralaterally-controlled double-masked trial showed that the intervention group receiving twice-daily cyclosporine 0.05% from 1 month before to 2 months after second-eye surgery, had statistically significant lower corneal fluorescein and conjunctival lissamine green staining 2 months after cataract surgery. Interestingly, patients enrolled in that study received multifocal IOL implantation and the eyes in the intervention group had significantly higher corrected distance visual acuity (CDVA).[80]

While there is good evidence supporting careful assessment and treatment of preexisting DED, the identification of patients without preexisting DED symptoms and signs but at high risk of developing post-surgical DED is a need that has yet to be met. In fact, in these subjects, there is no evidence supporting the use of single parameters (anamnestic or clinical) for risk assessment.

In an attempt to remedy this issue, Villani and colleagues recently hypothesized that the ocular surface might not have DED but a high level of frailty, conceptually defined as increased vulnerability and decreased ability to cope with stressors. In 2020, the team created and validated (in an internal population) the Ocular Surface Frailty Index.[81] This new tool, whose score can be calculated easily and quickly using non-invasive and low-tech procedures, was shown to be a good predictor of the post-operative development of DED symptoms (OR 9.45; 95% CI, 4.74–18.82), making it possible to identify a small group of asymptomatic patients (19%) with a high risk of post-surgical DED symptom onset (50%).[81]

Intraoperative

Prospective interventional controlled studies on the intra-operative management of the ocular surface are limited to the three aforementioned clinical trials investigating the effect of coating the ocular surface with viscoelastic products.[9,26,55]

Specifically, two of these studies, coating with hydroxypropyl methylcellulose 2%, showed short-term improved DED signs and symptoms in the study group, at least in some sub-groups of patients.[26,55]

The third study, using intra-operative ocular surface coating with an ophthalmic viscosurgical device, reported significantly better values in DED symptoms and tear film stability 1 month after surgery.[9]

Postoperative

Several studies highlighted the efficacy of post-surgical treatment with artificial tears (various polymers including combinations of hyaluronic acid, carboxymethylcellulose, trehalose, and hydroxypropyl -guar) on DED symptoms and signs.[60,82,83]

Interestingly, a randomized clinical trial treating the experimental group with preservative-free HP-Guar in addition to the usual treatment regimen, at 1 month after surgery showed significant improvement in DED signs and symptoms and in flow cytometric assessment of Human Leukocyte Antigens (HLA)-DR, relative to the control group receiving only the usual treatment.[82]

A randomized clinical trial performed in patients with newly developed cataract surgery-related DED, showed that, compared to placebo, post-surgical treatment with cyclosporine 0.05% two times per day for 3 months resulted in statistically significant higher Schirmer's test score and BUT at the end of follow-up.[83]

Another randomized controlled study compared treatment with preservative-free versus preserved sodium hyaluronate 0.1% and fluorometholone 0.1% eyedrops after cataract surgery in patients with preexisting DED. The authors reported that, 2 months after surgery, OSDI score, BUT, Schirmer I score, fluorescein staining score, impression cytology findings, goblet cell count, and inflammatory mediator concentrations were significantly improved in eyes treated with the preservative-free formulations relative to those with preserved formulations.[60]

Recommendations for management

On the basis of both evidence and clinical experience, the "Dry Eye and Cataract Surgery" subcommittee of the DROPS workshop formulated several recommendations for ocular surface and DED management pre-, intra-, and post-cataract surgery.

The most relevant pre-operative recommendations are:

–to <u>C</u>heck the ocular surface and look for potential DED signs;
–to <u>H</u>ear the patient's symptoms, medical history, lifestyle, expectations and concerns;
–to <u>E</u>xplain to the patient that surgery might (transiently) induce or exacerbate DED symptoms;
–to <u>C</u>ontrol the tear film and ocular surface, preparing them for surgery.

The intra-operative suggested action is to <u>K</u>eep in mind the ocular surface, trying to minimize eyedrop overuse and misuse, desiccating stress and light toxicity, and speculum and other surgical insults.

The most relevant post-operative recommendations are:

–to <u>AC</u>knowledge the patient's symptoms (even in absence of clear objective signs) and reported outcomes;
–to <u>T</u>reat the patient's DED signs and symptoms in a tailored and dynamic manner.

These considerations led us to formulate the slogan "CHECK & ACT!"

Conflict of interest

The author(s) declared the following potential conflicts of interest with respect to the research, authorship, and/or publication of this article: Edoardo Villani: Consultant or speaker for Abbvie-Allergan, Alcon, FB Vision, Fidia, Santen, Thea, Visufarma.

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