Review

Perioperative pharmacological management in patients with glaucoma

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ABSTRACT

Review’s aim: When a phacoemulsification, a filtration surgery or a combined surgery are necessary, questions about the convenience of continuing certain antiglaucomatous drugs could appear. The aim of this review article is to unify criteria that will guide daily clinical practice and including the developing algorithms of action in the preoperative and postoperative periods of filtration surgery and/or cataract surgery.

Proposed protocols: In the preoperative period of cataract surgery, the use of non-steroidal anti-inflammatory drugs is at the discretion of the surgeon, with the monodose presentation being recommended. The suspension of prostaglandines a few days before the surgery should be considered. Preservative-free drugs ensure a better recovery of the ocular surface (OS) after cataract surgery. Once all modifying factors of the intraocular pressure (IOP) have been removed, baseline IOP should be evaluated again, choosing preservative-free antiglaucomatous drugs when needed.

The use of preservative-free ocular antihypertensive drugs and steroids in the preoperative period of glaucoma surgery reduces the risk of surgical failure. The interruption of...
prostaglandines is recommended. In the postoperative period of glaucoma surgery, steroids are the anti-inflammatory treatment of choice, the preservative-free ones being preferred. When reintroducing antiglaucomatous treatment, preservatives should be avoided to prevent scarring. The appropriate perioperative management of patients with glaucoma is essential to obtain a correct control of IOP, improve the situation of the OS, prevent complications and improve the result of the filtration surgery and cataract surgery.

Conclusions: This protocol aims to unify the different lines of action in order to decrease the incidence of adverse events and maximize the surgical outcome.

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**Manejo farmacológico perioperatorio en pacientes con glaucoma**

**RESUMEN**

**Propósito de la revisión:** Ante la necesidad de realizar una facoemulsificación, una cirugía filtrante o la combinación de ambas, pueden plantearse dudas sobre la conveniencia de mantener determinados fármacos antiglaucomatosos. El objetivo del presente trabajo es unificar criterios que puedan orientar la práctica clínica diaria y que permitan desarrollar algoritmos de actuación en el preoperatorio y el postoperatorio de la cirugía filtrante o de catarata.

**Protocolos propuestos:** En el preoperatorio de la cirugía de catarata, el uso de antiinflamatorios no esteroideos queda a criterio del cirujano, recomendándose el formato de monodosis. Se plantea la suspensión de las prostaglandinas unos días antes de la cirugía. Los fármacos sin conservantes favorecen la mejor recuperación de la superficie ocular (SO) tras la cirugía de catarata. Una vez eliminados todos los aspectos modificadores de la presión intraocular (PIO), se debe reevaluar la PIO basal, prefiriendo los fármacos hipotensores sin conservantes, en caso de necesitarlos.

La utilización de hipotensores oculares y corticoides libres de conservantes en el preoperatorio de la cirugía de glaucoma reduce el riesgo de fracaso quirúrgico. Se recomienda interrumpir las prostaglandinas. En el postoperatorio de la cirugía de glaucoma los corticoides constituyen el tratamiento antiinflamatorio de elección, siendo preferibles aquellos libres de conservantes. Al reintroducir un tratamiento antiglaucomatoso, se deben evitar los conservantes para no potenciar la cicatrización.

**Conclusiones:** el presente protocolo de consenso persigue la unificación de las pautas de actuación con el fin de disminuir la incidencia de acontecimientos adversos y maximizar el resultado quirúrgico.

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**Introduction**

Glaucoma and cataracts are age-related diseases and therefore frequently found in a single patient. Sooner or later phacoemulsification, filtrating surgery or the combination of both will have to be considered.

As patients affected by these diseases are usually on multiple medications and many exhibit deep ocular surface (OS) alterations, several perioperative measures could modify for better or worse glaucomatous patient management. On the other hand, doubts frequently arise about the convenience of maintaining a range of antiglaucoma drugs, particularly prostaglandin analogs, before and after surgery.

There are no validated clinical guides for the perioperative management of glaucomatous patients which could help resolve the above issues. Accordingly, the authors have considered the convenience of such a review on the basis of their clinical experience and a review of existing literature. In any case, the adaptation of these general guidelines to each individual patient is important.

**Objectives**

- To unify the criteria of a group of glaucoma experts which could be used as guidelines in daily clinical practice
- to develop action algorithms for presurgery cataract operations and for filtrating surgery in glaucomatous patients
- to develop action guidelines for the post-surgery period of glaucomatous patients intervened for cataracts or glaucoma
- to clarify as far as possible the approach to prostaglandin derivatives before and after cataract and glaucoma surgery.

**Development**

**Recommendations for presurgery treatment of cataract surgery (Fig. 1)**

Apart from palpebral hygiene measures, presurgery treatment of cataracts could include the use of antibiotics and nonsteroidal anti-inflammatory drugs (NSAIDs).

**Antibiotic medication (Fig. 2)**

Presurgery use of antibiotics is controversial although the guidelines recommend that, if used, it should be the same antibiotic to be used in the post-surgery. In addition, it should be a broad range antibiotic with last generation quinolones being most widely used.

The use of presurgery prophylaxis with topical antibiotics pursues 2 main objectives, i.e., to reduce microbial flora in the pre-corneal lacrimal film prior to surgery and to enable the diffusion of topical antibiotics into the anterior chamber. Despite the widespread use of topical antibiotics prior to surgery, some ophthalmologists decline their use while others consider they play a relevant role.

A recent report by Friling et al. in Sweden examined the value of adding topical antibiotics in a subgroup of patients and concluded that the use of pre- or post-surgery eyedrops do not have a beneficial effect on presurgery 0.05% chlorhexidine and intrachamber cefuroxime at the end thereof. A report issued by the Cataracts Registry of Sweden (2013) indicated the absence of a statistically significant benefit in the use of topical antibiotics either pre-surgery, post-surgery on both when used together with intrachamber antibiotics. This could be due to several reasons. On the one hand, antibiotic levels in the aqueous humor after topical application are extremely low in comparison with the levels reached in tears. Similarly, these drugs exhibit high interpatient variability, and the antimicrobial power is lost because most of its volume is drained when performing the surgical incision. In 2009, He et al. increased the frequency and duration of presurgery antibiotics without finding meaningful conjunctival flora reductions after

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**Fig. 1 – Recommendations for pre- and post-operative cataract surgery management.**

**Fig. 2 – Recommendations for pre- and post-operative cataract surgery use of antibiotics.**
administering a fourth-generation fluoroquinolone 4 times a day during 3 days. These results indicate not only that the presurgery administration of topical antibiotics fails to provide clear benefits but it could also induce bacterial resistance without achieving complete eradication of the bacterial population in SO.

**Anti-inflammatory drugs**

The role of cataract surgery as a causing agent of cystoid macular edema (CME) is well known and the efficacy of NSAIDs in prophylaxis and treatment has been well-documented. Anti-inflammatory drugs are recommended mainly because they maintain midriasis during surgery, which could reduce surgical time and the energy of applied ultrasound. In addition, they improve visual acuity in the immediate post-surgery and reduce the risk of patients presenting CME. However, recently published studies question the efficacy of these drugs. Accordingly, the use thereof would be an option based on the surgeon’s criterion. The recommended dose is 3 times a day between 1 and 3 days before surgery, preferably in single dose format to avoid the toxicity induced by preservatives.

In what concerns the use of topical corticoids prior to cataract surgery, there is no guide or publication recommending its presurgery use, which would only be justified in the presence of intraocular chronic inflammation (chronic uveitis) in order to minimize the effects of said inflammation in the post-surgery period. High susceptibility of uveitis patients for developing post-surgery complications is partly attributed to the combination of chronic uveitis and imbalances in the blood-water barrier induced by surgery. The blood-water barrier could be compromised for several weeks after cataract surgery, even in eyes without uveitis. Perioperative anti-inflammatory treatment is particularly important in these patients as a prolonged rupture of the blood-water barrier facilitates migration and passage of pro-inflammatory proteins and cells. Adequate control of uveitis with appropriate use of topical corticoids and systemic immunosuppressants or biological drugs is a perioperative requirement. Perioperative supplementary anti-inflammatory therapy recommended by Foster consists in the administration of one drop of 1% prednisolone acetate 8 times a day, beginning 2 days before surgery. In a more recent publication, Grajewski proposed to increase topical treatments with 1% prednisolone acetate up to 5 times a day during one week prior to surgery.

**Hypotensor drugs**

An additional doubt which arises with respect to glaucoma patients to be operated for cataracts is whether or not to suspend hypotensor treatment, and the length of the presurgery period. The first factor to be assessed is whether said medication could affect the results of the surgery. On the other hand, pressure leaks could occur when the hypotensor treatment is suspended which could damage previously compromised optic nerves. There is a documented relationship between the use of prostaglandin analogs and the appearance of CME after cataract surgery. Some studies as well as case series have related the continued pre- or post-surgery use of prostaglandins with the appearance of CME, while other authors describe it as an unusual occurrence and discuss the existence of a causal relationship. It seems that some eyes exhibit an enhanced susceptibility for developing CME, possibly associated with hematoretinal barrier abnormalities, i.e., posterior capsular rupture, loss of vitreous, aphakia, complicated cataract surgery, previous history of uveitis, diabetes, inflammatory or vascular retinal disease, etc. In contrast, Miyake et al. suggested that the main cause of CME induced by the use of several eyedrops was preservatives (benzalconium chloride, BAK).

On the basis of available studies, it was not possible to establish a clear causal relationship between the use of prostaglandin analogs and development of CME in the early post-surgery period after cataract surgery. The absence of official guidelines by ophthalmological societies is indicative of the lack of said studies and clinical trials and prevents surgeons from practicing evidence-based medicine in a highly frequent operation. However, prudent use of hypotensor drugs is recommended in patients with risk factors for macular edema. At present, the most extended tendency, and that which seems most recommendable according to many authors, is to suspend this topical medication before the intervention. In a surgical context, it is recommended to avoid using prostaglandin analogs as the first line of treatment and, if it became necessary to use them or in the presence of risk factors for CME, treatment with NSAIDs should be associated. The suggested presurgery period during which treatment is suspended is 7 days, and the period for resuming treatment after surgery ranges between 30 (preferably) and 60 days after surgery (Fig. 1).

The rest of hypotensor medication could be maintained up to the surgery day in order to minimize the risk of hypertensive peaks prior to surgery.

**Recommendations for cataract surgery postoperative treatment** (Fig. 1)

Postoperative treatment in cataract surgery could include the use of antibiotics, corticoids and NSAIDs in a range of combinations and frequencies according to ophthalmologist preferences. At this time there are no controlled studies evidencing that one combination is better than others.

At this point in time, the option of postoperative antibiotic prophylaxis is at the surgeon’s criterion as he is better placed to assess the post-surgery environment, the presence of complications and other risk factors related to the patient or the procedure. Some surgeons prescribe post-surgery antibiotics in frequent dose when the intervention has entailed complications or in the presence of known scarring alterations. At present, fluoroquinolones are the favorite topical application agent in our environment due to its relatively broad spectrum, good corneal epithelium penetration and commercial availability. In general, the use of topical antibiotics comprises a period of 2 weeks, usually at a dosage of 3/4 times a day. It is not advisable to use topical antibiotics beyond 2 weeks after surgery unless medical reasons make it advisable (Fig. 2). However, resistance to said agents is on the increase, which reduces the antibacterial efficacy of topical treatments,
particularly in the anterior chamber. In addition, it has been observed that omitting post-surgery eyedrops is not related to increased endophthalmitis rates.

Topical corticoid indications usually comprise a period between 2 and 4 weeks, generally in decreasing dosages, starting with 4–6 times a day and usually utilizing dexamethasone or prednisolone in a formulation with or without preservatives depending on the patient’s characteristics, choice of the ophthalmologist and availability.

The addition of NSAIDs does not seem to provide additional benefits after standard phacoemulsification without complications. On some occasions, NSAIDs are administered together with corticoids or after eliminating the former. NSAIDs are particularly indicated when greater inflammation is expected or evidenced as well as for corticoid-reactive patients. Patients with higher risk of hypertensive response to corticoids are young people, high myopics and patients with glaucoma. In these cases, it is recommendable to suppress corticoids before post-surgery day 10 and substituting them with NSAIDs until the treatment is completed. In cases of confirmed corticoid reaction with severe intraocular pressure (IOP) increase or with slight elevation in patients with previous advanced glaucomatous damage it is recommended to immediately terminate corticoid administration. All patients in corticoid treatment should be under IOP monitoring.

Whenever possible, reintroduction of ocular hypotensors should be delayed until ocular pressure is reassessed after the disappearance of modifying factors such as viscoelastic, inflammation, corneal edema, corticoids, etc. It is convenient to delay the administration of prostaglandins for one month as the literature describes cases of ocular inflammation, CME induction and herpetic reactivation. In addition, during said period a residual hypotensor drugs effect may remain if suspended just prior to the surgery. The remainder of medications, with the exception of miotics, can be utilized since the beginning of the post-surgery period if necessary. The use of miotics is contraindicated because they alter the blood-water barrier, thus increasing inflammation and in addition could produce posterior synechiae.

Topical beta blockers, alpha agonists and carbonic anhydrase inhibitors (CAI) can be applied safely since the initial phases (7 days after surgery), taking into account systemic factors, allergies and corneal edema. In early phases, beta blockers and alfa adrennergics exhibit the drawback of aqueous production inhibition. In later phases they exhibit characteristics which are similar to those seen in phakic eyes. In what concerns prostaglandins, the initial phases characterized by a post-surgery inflammatory period could exhibit reduced efficacy. As for carbonic anhydrase inhibitors, they share with beta blockers and alfa adrennergics the drawback of aqueous production inhibition. The endothelium inhibiting characteristic has no repercussion on normal cornea. However, it could involve an added risk of edema in compromised cornea. The use of preservative-free drugs could enhance the recovery of post-surgery ocular surface. Cataract surgery can be considered as a new baseline situation for patients with previous ocular hypotensive treatment and for this reason the therapeutic scale would not necessarily match presurgery values.

Cataract surgery can generate or worsen dry eye syndrome as the OS can be affected by multiple factors. Apart from the corneal epithelial damage induced by anesthetic eye drops and other active disciplines, as well as by the preservatives used in the post-surgery period (mainly BAK), the surgical trauma will induce by itself OS alterations that will recover normality only after several weeks or even months due to the forced opening of eyelids, corneal incision architecture, long periods of exposure to microscope light, prolonged surgery times, etc., apart from the possible mechanical traumas that the surface could endure during surgery (erosion, desiccation, etc.). These factors alter the normal organization of corneal innervation, give rise to pathological changes in the cornea and associated discomfort, produce an adverse effect in the values of dry eye exploration tests even in patients without dry eye prior to surgery. This does not occur with ultrasound energy utilized during phacoemulsification which seems to exert no influence in the result of said tests.

Inadequate application of eyedrops is also one of the main pathogenic factors for dry eye after cataract surgery. Accordingly, topical treatments should be carefully administered before as well as after surgery to prevent or reduce the appearance of said syndrome. The use of artificial tears and humidified eyedrops is recommended for these individuals administering same by demand according to symptomatology.

Reintroduction of hypotensor drugs

Post-surgery IOP values will determine the reintroduction of hypotensor drugs. However, other variables must also be taken into account, the most relevant of which are:

- The natural history of the disease (see the recommendations of the American Academy of Ophthalmology (AAO) in Preferred practice pattern guidelines, for assessing the hypotensive effect of cataract surgery in the postoperative management thereof), and mainly:
  - To determine whether the patient has ocular hypertension or glaucoma. IOP reduction in patients without glaucoma is attributed to cataract phacoemulsification.
  - The type of glaucoma, either open or closed angle, which gives the possibility of reducing or even eliminating hypotensor drugs, mainly in the latter case, whereas in patients with open angle glaucoma IOP reduction associated to cataract surgery with phacoemulsification could have a limited effect.
  - The evolution phase of glaucoma, adjusting the dose on the basis of the target IOP.
- The systemic characteristics of the patient, which could determine the use of some active principles on the basis of his general condition (for example, the use of beta blockers in patients with bradycardia, cardiopathy or obstructive lung disease).
- Possible topical adverse effects of different active principles.
- Coexisting previous ocular pathologies (dry eye syndrome, OS alterations attributed to some topical anti-glaucoma hypotensor drugs, etc.).
studies which demonstrate the adverse effect of chronic topical medication on the OS as it increases the expression of inflammation markers, pro-inflammatory cytokines and inflammation signs and symptoms. This is particularly important after an operation in which inflammation mediators are active and it is not advisable to enhance them. Adverse inflammatory effects on the OS diminish when using active principles without preservatives. Therefore, the use of preservative-free hypotensor drugs should be a priority in the post-cataract surgery period.

There are several mechanisms that can alter IOP in post-cataract surgery: inflammation mediators, corticoid responders and the intra-surgery use of viscoelastics are among the most important ones. Accordingly, it is recommendable to eliminate all IOP modifiers, be attentive to the existence of possible interferences and reassessing baseline IOP. In general, this can be done between the first and third month. Only in this way it would be possible, having the post-surgery baseline IOP, to establish the target IOP. The way in which the type of glaucoma can diminish IOP associated to cataract surgery has been described in previous paragraphs.

**Recommendations for presurgery treatment in glaucoma surgery (Figs. 3 and 4)**

**Management of hypotensor medication prior to anti-glaucomatous surgery**

There is broad consensus about suspending hypotensor medication after any type of anti-glaucomatous surgery. However, there is no agreement or guideline recommending the interruption of said treatment in the presurgery phase.

Theoretical benefits of presurgery suspension

The aim of topical hypotensor therapy interruption is to obtain a number of benefits with a view to the surgical prognostic. On the one hand, it aims at reducing the impact on the failure rate and on the other to reduce the risk of pre-and post-surgery complications. Conjunctival scarring is the most common cause of surgical failure infiltrating procedures. The presence of factors enhancing this scarring can only increase said risk. In this regard, the pro-inflammatory effects of some hypotensor drugs as well as OS alterations related to the chronic use of topical anti-glaucomatous drugs with the usual preservatives would also have a negative influence.

In order to improve OS condition at the time of filtering surgery, some authors have proposed the use of topical fluorometholone or topical NSAIDs 4 weeks before surgery. On the other hand, maintaining certain drugs up

**Fig. 3 – Recommendations for pre- and post-operative glaucoma surgery management.**

**Fig. 4 – Recommendations for pre- and post-operative glaucoma surgery use of topical antibiotics.**
to surgery could theoretically enhance the appearance or increase the severity of some complications. Active principles with pro-inflammatory profiles (parasympathomimetics and prostaglandins) could facilitate larger ruptures of the blood-water barrier. In this regard, in the concomitant presence of prostaglandins or BAK, a theoretical increase of CME risk in predisposed eyes must be taken into account.

Similarly, the persistence of the aqueous production inhibitor effect (beta blockers, carbonic anhydrase inhibitors and alfa adrenergics) in the first postoperative phases would reduce the cleansing effect of adequate aqueous circulation. On the other hand, flow reduction by means of a filtrating procedure could diminish the efficacy thereof. However, and to summarize, the suspension of all drugs does not appear to be absolutely necessary. This suggestion is apparently limited to the interruption of prostaglandins and to avoid the use of drugs with preservatives in the presurgery period, in accordance with the consensus reached by this group of experts.

Drawbacks of presurgery suspension
Presurgery interruption of hypotensor treatment during a period of time should obviously cause increased IOP and give rise to a phase of lack of tension control. As is known, glaucomatous damage occurs due to the persistence in the mid/long term of damaging tension levels, and it is not frequent that moderate tension increases for limited periods of time produce a progression of glaucomatous damage.

However, extreme care must be taken in cases exhibiting advanced glaucomatous optic neuropathy with higher risk of progression, considering the substitution of topical drugs by systemic hypotensors.

Naturally, in any case close follow-up of IOP is essential to monitor individual response to treatment suspension, particularly when the presurgery preparation has included the administration of corticoids. As is known, glaucoma eyes are the most frequent corticoid reactives although fluorometholone exhibits lower risk of causing secondary hypertension due to its low penetration. Finally, the approach of interrupting medication requires adequate management of the surgery waiting times and sufficient capacity to predict surgery dates in order to avoid the prolongation of “sub-therapeutic” treatment situations.

Issues to be clarified about presurgery treatment suspension
Even though at the theoretical level there are reasons to advise treatment interruption, the minimum time after which a reduction/elimination of the possible negative effects of the medication on filtrating surgery can be expected is not well established. It is possible that a period of one or 2 weeks would be enough to eliminate the pro-inflammatory effects or the disappearance of the aqueous production inhibitor effect. However, the best time to suspend drugs and preservatives as well as to introduce corticoids has yet to be exactly established in order to revert the OS alteration and conjunctival fibrosis with the objective of achieving a better prognosis in what concerns the hypotensor efficacy of filtrating surgery. It seems to be demonstrated that prolonged topical medical treatment of glaucoma increases for groceries and sub conjunctival scarring in filtrating surgery postoperative period. It has been demonstrated that the administration of topical NSAIDs as well as topical fluorometholone 4 times a day starting up to one month prior to trabeculectomy is able to reduce the need of checkups applying needles in the post-surgery period as well as increasing reduction in final IOP, particularly with topical fluorometholone. Some authors have proposed that 0.1% topical diclofenac is at least equally effective as topical corticoid treatment with 0.1% dexamethasone and even better in some series in what concerns number of medications for glaucoma after surgery, IOP value or bleb morphology.

Similarly, there is no general agreement on the range of suspension possibilities: avoiding drugs with conservatives, suspending all active principles or only some, substituting by other less damaging topical drugs, substituting by oral hypotensor medication or directly call off any hypotensor treatment.

Profiles of drugs for presurgery suspension
(a) Active principle: of all drugs generally used as hypotensors, the group of prostaglandins is closely related with possible negative effects on impending filtrating surgery. For this reason it would be advisable to suspend its application prior to surgery. Suspending the rest of hypotensor drugs does not appear to be necessary even though their use could be suspended a few days prior to surgery in order to avoid blocking the production of aqueous.

(b) Presence of preservatives: the negative effects of preservatives on OS is well-known (particularly BAK). Considering present-day availability of drugs, it would be advisable to use preservative-free ocular hypotensors hypotensors and corticoids in the presurgery period.

Recommendations for postoperative treatment of glaucoma surgery (Fig. 3)

It is necessary to differentiate standard and routine postoperative treatment after filtrating surgery and the actions to be taken when signs of failure appear.

(a) Antibiotic treatment: the prophylactic use of topical antibiotic in the post-surgery period does not seem to alter the conjunctival flora and does not prevent the appearance of recurring episodes of bleb infections or endophthalmitis. In any case, current consensus recommends the establishment of topical antibiotic treatment 3–4 times a day during the first postoperative week. Longer usage periods are unnecessary and could give rise to adverse effects on the OS due to the active principle as well as the preservative (Fig. 4). In addition, intermittent and chronic use of topical antibiotics after trabeculectomy has been associated with increased risk of endophthalmitis related to the bleb.

(b) Anti-inflammatory treatment: in routine postoperative treatment it is important to maintain anti-inflammatory treatment during a sufficient period of time and intensity to avoid exaggerated cicatrization and therefore filtrating surgery failure.

(c) Topical corticoids: post-surgery use of topical corticoids, specifically 1% prednisolone acetate, is more extended and constitutes the anti-inflammatory treatment of choice. According to a survey carried out in Australia and New
Zealand, 54% of surgeons utilize topical corticoids after trabeculectomy during 1–2 months.63 Intensive postoperative treatment of conjunctival cicatrization determines the final IOP, and the use of corticoids must be assessed against the appearance of blebs. Their use could be necessary for up to 4 months.63 Current recommendations establish that, despite the low risk of cataracts, topical steroids must be used for extended periods of time, particularly in cases with high risk of surgery failure, in order to improve trabeculectomy success rates.64 It has been proposed to apply topical steroids 8 times a day during one week, followed by 4 times a day during 3 additional weeks, twice a day during 4 weeks and once a day during the last week. Specifically, the administration regime will depend on the technique that was applied, with drainage devices requiring longer and more intense use of topical steroids (about 3 months) than in trabeculectomy (1.5–2 months), with the latter requiring in turn more intense and extended usage periods than in nonperforating procedures (about one month). With equivalent effects, if preservative-free anti-inflammatory are available, their use would be preferable.

NSAIDs: only a few studies have researched the usefulness of NSAIDs in glaucoma surgery, one of their possible applications being preventing IOP increases (improving trabeculectomy results) in the postoperative period, associated to the use of corticoids.65 One reference indicates that topical diclofenac could be equivalent to the use of topical corticoids in the post-surgery of trabeculectomy with mitomycin,66 which means that there is no evidence supporting the isolated use thereof in standard trabeculectomy. There is no scientific evidence assessing the usefulness of NSAIDs in nonperforating glaucoma surgery. In both types of procedures, topical NSAIDs could play a role as a treatment added to topical corticoids in selected cases with higher inflammatory response or risk of failure. In this regard, it is recommended to apply topical NSAIDs 3 times a day during 2 weeks after gonipuncture in nonperforating deep sclerectomy. For drainage implants, a recent retrospective study suggests that adding keratolac to topical corticoids could reduce the need of using them while improving hypotensor efficacy.67 On the other hand, another prospective study pointed out that the use of topical keratolac could be more efficient than dexamethasone and would reduce the hypertensive postoperative phase. In contrast, it produces more incision leak and conjunctival retraction problems.68 Taking all this into account, it could be concluded that the use of topical NSAIDs (specifically keratolac) could be useful in association with topical corticoids in the postoperative period of drainage implants.

***Filtrating surgery failure***

With the appearance of the first signs of failure a number of scaled measures are recommended, the first being intensifying anti-inflammatory treatment with corticoids.69 Even though all publications refer to corticoid with preservatives, it seems natural that at equal power preservative-free corticoids are recommended in order to reduce cicatrical response to a greater extent. Should it be necessary to reintroduce anti-glaucomatous treatment, whenever possible it should be free of preservatives to avoid enhancing the ongoing cicatrization. It is recommended to avoid the use of prostaglandins during the first month. The type of anti-glaucomatous treatment should be selected on the basis of local and systemic patient conditions.

***Treatment of post-surgery hypertensive peaks***

Even though the levels of IOP after phacoemulsification tend to normalize during the first 24 hours after surgery, increased IOP is one of the most frequent complications after cataract surgery with phacoemulsification and intracocular lens implant, requiring a specific management. Surgeons must be attentive to the situation and determine the IOP variability (high and low) which can occur in normal, glaucomatous and suspected glaucomatous eyes during the first day after surgery.70 The exact mechanism which causes postoperative IOP increase is not known although it is attributed to multiple reasons, including trabecular mesh occlusion caused by retention of viscoelastic and lens material, inflammatory cells, etc. These tension increases are statistically more frequent and generally higher in patients with glaucoma.71 The first postoperative IOP check varies considerably between ophthalmologists, ranging from operation date, the day after, during the first week, at week 2 or over 14 days.72

A possible strategy for managing hypertensive peaks is prevention. At present there are no specific guides for prophylaxis of hypertensive peaks in complication-free cataract surgery. There are contradictory articles about the effect of hypotensor drugs for preventing postoperative hypertensive peaks. Borazan compared to the effectiveness of 1% brinzolamide, 0.2% brimonidine, 250mg oral acetazolamide, intrachamber 0.5% acetylcholine and timolol with similar results in the reduction of hypertensive peaks in the early phacoemulsification post-surgery.73 Immediate postoperative instillation of topical dorzolamide has also demonstrated its efficacy in diminishing IOP during the first postoperative 24h.74 Even more controversial were the results of studies with prostaglandin analogs which do not appear to exhibit any beneficial effect. Unal found that the prophylactic use of one drop of bimatoprost before phacoemulsification did not yield significant IOP differences vis-à-vis placebo at 3 h after surgery, but did produce significant IOP reductions after 24h.75 In contrast, Lai did not evidence a significant IOP reduction in the first 24h post-surgery with the utilization of a single dose of latanoprost after surgery, while a single dose of timolol gel achieved said reduction after only 2 h and up to the first 24h after surgery.76 It must be taken into account that at the present time recommendation proposals advise caution in the use of this pharmacological group in a surgical context (avoid its use or apply it associated to NSAIDs).

In what concerns the application of fixed combinations (2h before surgery and 4, 8 and 24h thereafter), satisfactory results have been obtained to prevent IOP increases with latanoprost/timolol (IOP reduction in the first 8h and 24h post-surgery77 and dorzolamide/timolol (IOP reduction at 6 and 24h after phacoemulsification), even though these combinations did not entirely prevent hypertensive peaks.77,78 Regardless of all these findings, 87% of surgeons in the United
Kingdom who apply hypertensive peaks prophylaxis prefer oral acetazolamide over topical hypotensor agents.\textsuperscript{72} At present, pre-operative use of hypotensor drugs has not clearly demonstrated their efficiency to avoid said complication.

The contributions of this review include the importance of improving the condition of the OS prior to surgery, with the use of anti-inflammatory drugs in some cases and avoiding or substituting anti-glaucomatous drugs with preservatives by other preservative-free drugs in order to avoid damaging the OS. There is an increasing amount of evidence that these measures could improve the result of glaucoma filtering surgery.

Conflict of interests

No conflict of interests has been declared by the authors.

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