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Combined glaucoma and cataract surgery: Comparison of viscocanalostomy, endocyclophotocoagulation, and ab interno trabeculectomy

Sasan Moghimi, MD, Nikoo Hamzeh, MD, Massood Mohammadi, MD, Nassim Khatibi, BS, Christopher Bowd, PhD, Robert N. Weinreb, MD

Purpose: To compare outcomes of phacoemulsification combined with viscocanalostomy, endocyclophotocoagulation (ECP), or ab interno trabulectomy for intraocular pressure (IOP) control and safety in eyes with open-angle glaucoma and visually significant cataract.

Setting: Farabi Eye Hospital, Tehran, Iran.

Design: Retrospective case series.

Methods: Medical records of patients who had combined surgery and were followed for at least 1 year were reviewed. Complete success, postoperative IOP, number of medications at each visit, and complications were evaluated and compared before and after adjustments for confounders.

Results: Forty-six eyes had combined phacoviscocanalostomy, 35 had phaco–ECP, and 28 eyes phaco–ab interno trabulectomy. The groups were matched for baseline IOP ($P = .24$). At the final follow-up (mean 17.2 months ± 5.5 [SD]), the phacoviscocanalostomy group had the lowest mean IOP (13.5 ± 4.7 mm Hg, 29% decrease) ($P = .01$). There was no significant difference in the final IOP between phaco–ECP and phaco–ab interno trabulectomy (16.4 ± 3.9 mm Hg, 20% decrease versus 15.8 ± 4.2 mm Hg, 15% decrease) ($P = .88$). The reduction in the number of medications was greater with phacoviscocanalostomy (77%) than with phaco–ECP (40%) and phaco–ab interno trabulectomy (44%) ($P = .01$). Phacoemulsification–ab interno trabulectomy had the fewest complications. Intraocular pressure spikes were more frequent in the phaco–ECP group (20%) than in the other groups (4%) ($P = .05$).

Conclusions: All procedures significantly lowered IOP. Phacoemulsification–ab interno trabulectomy resulted in fewest complications and phacoviscocanalostomy led to the largest IOP drop and largest reduction of medications.

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The primary goal of glaucoma treatment is to lower intraocular pressure (IOP) to a level that prevents further damage to the optic nerve.[1] Trabeculectomy is one of the most effective surgeries for the management of glaucoma.[2] However, serious postoperative complications are not uncommon after this procedure; they include choroidal effusion, hypotony, and bleb-related complications as well as shallow anterior chambers.[3] Furthermore, when combined with cataract surgery, the success rate decreases, in large part because of increased inflammation and bleb fibrosis.[4,5] These might be some reasons that U.S. Medicare claims data reported a 43% decrease in the number of trabeculectomies with a concurrent increase in other less invasive surgeries in recent years.[6,7]

These less invasive procedures reduce IOP in a safer manner by augmenting aqueous egress from natural outflow pathways.[8–14] Viscocanalostomy, a nonpenetrating glaucoma surgery introduced by Stegmann et al.,[12] has fewer postoperative complications than trabeculectomy,[5] while it decreases IOP the same amount as phacotrabeculectomy if combined with cataract surgery.[13]

In the past 2 decades, surgical options for glaucoma have expanded with the introduction of several types of minimally invasive glaucoma surgery (MIGS).[8,9,11] These

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From the Hamilton Glaucoma Center (Moghimi, Bowd, Weinreb), Department of Ophthalmology, and Shiley Eye Institute, University of California San Diego, La Jolla, California, USA; Tehran University of Medical Sciences (Moghimi, Hamzeh, Mohammadi, Khatibi), Tehran, Iran.

Corresponding author: Sasan Moghimi, MD, Hamilton Glaucoma Center, Department of Ophthalmology, University of California San Diego, La Jolla, California 92037, USA. Email: sasanimii@yahoo.com.

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procedures have the following 5 shared features: (1) an ab interno microincision that spares conjunctiva and facilitates future glaucoma surgery if needed, (2) minimal tissue trauma, (3) modest efficacy, (4) high safety, and (5) rapid visual recovery.[15,16] They can be easily combined with cataract extraction using the same clear corneal incision (CCI). Endocyclophotocoagulation (ECP) and ab interno trabeculectomy with the Trabectome (Neomedix, Inc.), have gathered much attention because they are minimally invasive and can effectively reduce patient dependence on IOP-lowering medications.[17]

In ab interno trabeculectomy, the Trabectome is used to ablate a strip of trabecular meshwork and inner wall of Schlemm canal, facilitating outflow of aqueous from the anterior chamber to the collector channels. In a study by Francis and Winarko,[18] combined phacoemulsification and ab interno trabeculectomy decreased in IOP from a preoperative mean of 22.1 mm Hg $\pm$ 5.5 (SD) to 15.4 $\pm$ 3.1 mm Hg after 1 year with fewer complications compared to phacoemulsification combined with trabeculectomy.

In endocyclophotocoagulation (ECP), a pulsed diode laser is applied to the ciliary body epithelium under direct visualization, which can lead to a reduction in aqueous production. The reported success of ECP varies as a result of nonuniform patient selection for treatment.[19] Lindfield et al.[8] found that eyes that had phaco–ECP had a decrease in mean IOP from 21.5 $\pm$ 1.6 mm Hg preoperatively to 14.4 $\pm$ 0.8 mm Hg after 2 years; also, the procedure resulted in fewer complications than combined phacoemulsification and trabeculectomy.

Combined phacoemulsification and nonpenetrating glaucoma surgery, or MIGS, is becoming increasingly popular as a surgical alternative to phacotrabeculecomy.[7] To our knowledge, no published study has compared the safety and efficacy of nonpenetrating glaucoma surgery, ECP, and ab interno trabulectomy procedures. The purpose of the current study was to evaluate the success and complications of phacoviscocanalostomy, phaco–ECP, and phaco–ab interno trabulectomy in eyes with coexisting cataract and open-angle glaucoma (OAG).

PATIENTS AND METHODS

This nonrandomized retrospective interventional trial conducted was performed from 2010 to 2015 at the glaucoma clinic at Farabi Eye Hospital, Tehran, Iran. It was approved by the local ethics committee of Tehran University of Medical Sciences and followed the tenets of Declaration of Helsinki. All patients provided informed consent, and their information remained confidential during the course of the trial.

All patients with coexisting glaucoma and cataract attending the glaucoma clinic between 2010 and 2015 who had phaco–ECP, phacoviscocanalostomy, or phaco–ab interno trabulectomy with a follow-up of at least 12 months were enrolled in the study. Inclusion criteria were as follows: OAG, defined by glaucomatous optic disc damage with or without visual field damage; age greater than 40 years; a visually significant cataract; and an IOP of less than 30 mm Hg with or without the use of glaucoma medication. Patients with secondary angle-closure glaucoma or neovascular glaucoma, history of surgery to the enrolled eye, or a history of trauma to the eye were excluded from the study.

Preoperatively, all patient had a thorough ophthalmologic examination including slitlamp biomicroscopy, visual acuity, IOP measurement using a Goldmann applanation tonometer, and a visual field (static automated white-on-white threshold perimetry program 24-2, SITA-standard, model 750, Humphrey Instruments, Inc.). Patient demographics, diagnosis, preoperative cup-to-disc ratio, IOP, and medications were recorded. Postoperative data, including IOP and complications at day 1, 1 week, and 1, 3, 6, 12, and 24 months, were collected and semiannual visual field tests performed.

Surgical Technique

The same surgeon (S.M.) performed all surgeries using topical anesthesia. In the phacoviscocanalostomy group, phacoemulsification and intraocular lens (IOL) implantation through a temporal CCI was performed before the viscocanalostomy. For the viscocanalostomy, a fornix-based conjunctival flap was dissected superiorly and the sclera was exposed. A square 5.0 mm $\times$ 5.0 mm scleral superficial flap was dissected anteriorly into clear cornea. After the deep scleral flap was dissected, trabeculo-Descemet membrane was exposed and sodium hyaluronate injected through Schlemm canal. The deeper scleral flap and the roof of Schlemm canal were then excised. The superficial scleral flap was closed with four 10-0 nylon sutures, and the conjunctival wound was sutured with 10-0 nylon sutures. At the end of the procedure, subconjunctival ceftazidime and betamethasone were injected.

After clear corneal phacoemulsification and IOL implantation in the phaco–ECP group, a 300-degree ECP was performed through the temporal incision and enlarged side port. A straight endoscopic probe (Endo Optiks, Inc.) was used to deliver an 810 nm diode laser energy (Oculight SL, Iridex Corp.) at 250 mW and 3500 millisecond settings (total 0.875 watts). Each patient received subconjunctival ceftazidime and betamethasone at the end of the surgery.

In the phaco–ab interno trabulectomy group, ab interno trabeculectomy was performed before phacoemulsification. The patient's head and the microscope were tilted to give the best gonioscopic view of the angle. A modified Swann-Jacobs goniolens was placed on the cornea for visualization of the anterior chamber angle structure. The instrument tip was inserted through a 1.7 mm temporal CCI and advanced along the meshwork nasally, ablating approximately 60 to 90 degrees of the trabecular meshwork and the inner wall of Schlemm canal. After irrigation/aspiration to remove blood, the temporal incision was enlarged for standard temporal clear corneal phacoemulsification and posterior chamber IOL implantation. Subconjunctival ceftazidime and betamethasone were injected at the end of procedure.

Postoperatively, all eyes received topical ciprofloxacin every 6 hours for 1 week and betamethasone every 2 hours during the first week, with gradual tapering over the next 4 weeks. Glaucoma medications were administered if necessary.

Outcome Measures

The main outcome was the postoperative success rate. Complete success (criterion 1) was defined as IOP of 21 mm Hg or less or a 20% or more reduction from the baseline IOP level without the use of glaucoma medication and without secondary glaucoma surgery. Qualified success rate (criterion 2) was defined as an IOP of 21 mm Hg or less or a 20% or more reduction from the baseline IOP level with or without the use of glaucoma medication and without secondary glaucoma surgery. Criterion 3 was defined as IOP no higher than baseline with a decrease of at least 1 ocular hypotensive medication.

Statistical Analysis

Univariate comparisons between treatment groups were performed using the Kruskal-Wallis test for continuous variables and the