Case Report

Cyclodialysis Cleft and Hypotony Following Combined Phacoemulsification and Excisional Goniotomy with the Kahook Dual Blade

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Abstract

A 69-year-old woman with bilateral primary open-angle glaucoma who underwent cataract extraction with intraocular lens implantation and excisional goniotomy with the Kahook Dual Blade (KDB; New World Medical, Rancho Cucamonga, CA, USA) in both eyes one year prior was referred for evaluation of significant visual acuity loss and pain in the left eye. On initial examination, intraocular pressure in the left eye was 3 mmHg and slit lamp examination revealed normal anterior chamber depth. Gonioscopy revealed a cyclodialysis cleft that was confirmed by anterior segment optical coherence tomography. Prominent chorioretinal folds suggestive of long-standing hypotony maculopathy were observed during fundoscopic examination. The cyclodialysis cleft, thought to be created inadvertently during the KDB goniotomy, resolved after three sessions of argon laser photocoagulation and the patient's symptoms and visual acuity partially improved.

Keywords: Kahook Dual Blade, cyclodialysis cleft, hypotony, glaucoma surgery

Introduction

Glaucoma surgical care is constantly evolving through new technologies and techniques designed to lower intraocular pressure (IOP) by enhancing the physiological aqueous drainage pathway in patients with earlier stages of primary open angle glaucoma (POAG).[1] The trabecular meshwork (TM) - particularly the juxtacanalicular portion - is one of the main sites for aqueous humor drainage resistance and contributes most to the rising IOP along the outflow pathway through Schlemm's canal (SC).

Novel glaucoma surgical techniques involve the most recently developed microinvasive glaucoma surgeries (MIGS), which are preferred over traditional trabeculectomy and tube-shunt surgical procedures due to their favorable safety profile. MIGS procedures which target the trabecular outflow pathway to lower IOP include several mechanisms such as use of trabecular micro-bypass implants, ab-interno canaloplasty, ab-interno trabeculotomy (AIT), or the excision of diseased TM using the Kahook Dual Blade (KDB; New World Medical, Rancho Cucamonga, CA, USA) to perform goniotomy.[2] The single-use KDB is designed to strip the anterior wall of SC by entering the TM via an ab-interno approach with a clear corneal excision. The blade is advanced clockwise or counterclockwise along the nasal TM, creating two parallel incisions and completely removing the TM tissue in the angle, typically without damaging the adjacent anterior chamber angle structures.[3] Though comparative studies regarding the safety profile of KDB with or without phacoemulsification surgery can be found in the literature, surgeons should be aware of unexpected postoperative complications caused by potential damage to the outer wall of SC creating a cyclodialysis cleft (CDC). The most common CDC

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etiologies are trauma or anterior segment surgeries, with rare cases of iatrogenic CDC formation following MIGS.[4,5,6]

A CDC can be defined as the separation of the longitudinal ciliary muscle fibers from the scleral spur, causing a pathological secondary outflow pathway for the drainage of aqueous humor into the suprachoroidal space.[7] Increased uveoscleral outflow caused by the CDC can predispose the eye to complications such as hypotony maculopathy and optic disc edema, leading to decreased visual acuity.

We report a case of a postoperative CDC complication following elective cataract extraction with intraocular lens (IOL) implantation combined with KDB goniotomy. Argon laser photocoagulation (ALP) was the treatment of choice, resulting in a successful closure of the cleft.

Case Report

A 69-year-old woman with POAG was seen in clinic for postoperative hypotony of the left eye (OS) following cataract extraction and intraocular lens (IOL) implantation combined with KDB goniotomy of both eyes (OU) one year prior. She denied any history of blunt ocular trauma. Comprehensive initial examination revealed a best corrected visual acuity of 20/40 in the right eye (OD) and 20/50 OS. IOP was 17 mmHg OD and 3 mmHg OS. The anterior chambers were deep and quiet with posterior chamber IOLs visualized OU and pupil irregularities observed OS. No relative afferent pupillary defects were noted in either eye. Gonioscopy revealed open angles OU with a 2 mm CDC at 10:00 clock hours nasally OS, spanning two clock hours (Figure 1A), which was later confirmed by ultrasound biomicroscopy and anterior segment optical coherence tomography (OCT) (Figure 1B-C). Posterior segment evaluation revealed a cup-to-disc ratio of 0.45 OD and 0.30 OS, with choroidal folds observed. Fundoscopic examination revealed hypotony maculopathy with prominent chorioretinal folds OS. The patient's OCT scans also demonstrated increased macular thickness confirming hypotony maculopathy (372 µm) OS (Figure 2A). Slit lamp examination and ultrasound biomicroscopy findings were unremarkable OD.

Despite conventional medical management with topical 1% atropine (atropine sulfate 1%; Anneal Pharmaceuticals, Bridgewater, NJ, USA) 3 times daily, the cleft remained open. We proceeded with three subsequent sessions of ALP applied to the CDC (100 applications; 200 µm spot size, 0.5 s duration, 400-500 mW power) with 2-week and 1-month intervals between sessions. The patient used cyclosporine (Restasis®; Allergan Inc, Irvine, CA, USA) and over-the-counter artificial tears OU for her chronic dry eye prior to presentation. Following the first laser session, prednisolone acetate (Alcon Laboratories, Fort Worth, TX, USA) 4 times daily and 1% atropine once daily were prescribed OS and continued for a duration of 2 weeks postoperatively. Cleft closure was achieved, with successful attachment of the ciliary body to the scleral spur and mild suprachoroidal fluid (Figure 3A-B), and there was moderate improvement of the maculopathy compared to preoperative presentation (Figure 1). Postoperative IOP remained low at 3 mmHg and visual acuity at postoperative 11 months remained stable at 20/50 despite the patient's persistent hypotony.

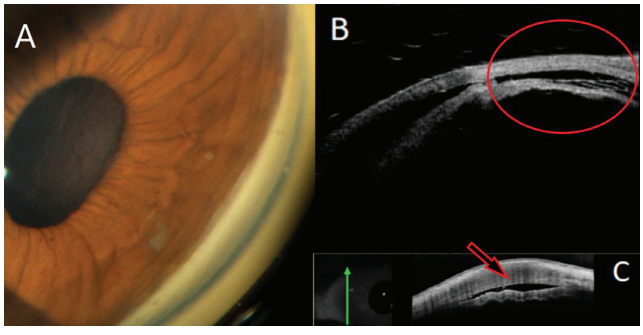

Figure 1. Formation of cyclodialysis cleft in the left eye at 10:00 clock hours: A) Gonioscopic view, B) Ultrasound biomicroscopy, C) Anterior segment optical coherence tomography

Discussion

The patient presented with a CDC spanning two clock hours following combined phacoemulsification and excisional

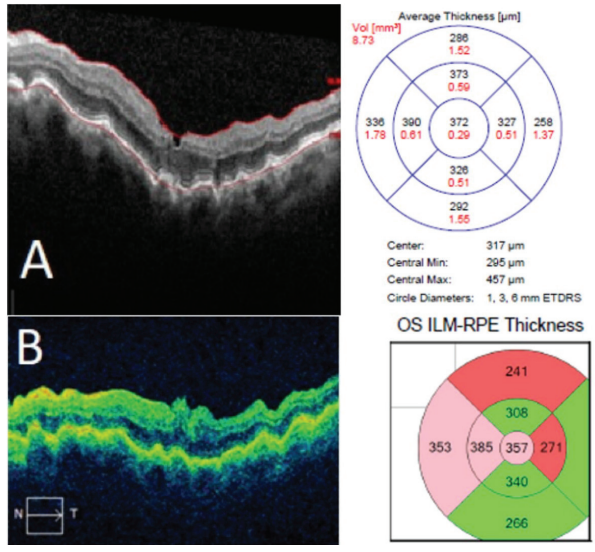

Figure 2. Macular thickness of the left eye: A) Preoperative data, B) Data at postoperative 11 weeks showing mild-moderate resolution in thickness

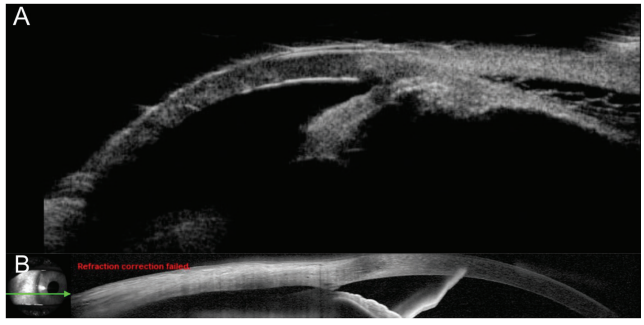

Figure 3. Closure of the cyclodialysis cleft in the left eye: A) Ultrasound biomicroscopy, B) Anterior segment optical coherence tomography

goniotomy with KDB. Although there are different treatment modalities for traumatic or iatrogenic CDC, initial management of clefts smaller than four clock hours includes conservative treatment with topical 1% atropine sulfate and ALP before surgical management.[8] Argon laser treatment is used to generate an inflammatory response to induce adhesion in the cleft, and postoperative steroid use should be tapered to maintain the inflammation and fibrosis.

The exact causes leading to CDCs remain unclear, but common etiologies consist of blunt trauma and anterior segment surgeries (e.g., phacoemulsification). CDC formation following MIGS is rare but has been observed in cases of combined phacoemulsification with KDB goniotomy, AIT, microhook AIT (μLOT), and supraciliary microstenting (CyPass Micro-Stent).[5,6,7,9] Berk et al.[5] treated a post-AIT CDC with direct suture cyclopexy combined with topical homatropine and dexamethasone drops, while Ishida et al.[6] treated a post-uLOT CDC with sulfur hexafluoride gas injection and also observed spontaneous resolution in two other cases. In the case of our patient, CDC formation likely occurred due to damage to the posterior TM from possible misalignment during KDB goniotomy. There was no reported intraoperative surgical wound leak or evidence of phacoemulsification trauma to the iridocorneal angle.

Ishida et al.[6] noted that CDCs leading to persistent hypotony after 3 to 4 months should be treated immediately to prevent hypotony maculopathy. Our patient had a longer history of hypotony which led to significant visual impairment and macular pathology requiring three sessions of ALP to close the cleft and improve the macular edema. This was demonstrated quantitatively by reduced central thickness of the internal limiting membrane and retinal pigment epithelium (ILM-RPE) from 372 nm to 357 nm (Figure 2) OS at 11 months postoperatively. However, our clinical evaluation of ILM-RPE reduction is limited by the use of machines from two different manufacturers (Cirrus OCT and Spectralis OCT).

The patient's improvement can be explained by several hypotheses. It is possible that a residual cleft remained with an overall decrease in size after three sessions of laser treatment, which appeared sufficient to improve macular thickness. It is also likely that OCT thickness may have been an insignificant finding due to measurement variability between the Cirrus and Spectralis technologies. The low postoperative IOP observed OS may suggest the treatment is a temporary solution; however, this finding is not unexpected given the patient's longstanding history of hypotony. Though the IOP remained low, the patient's visual acuity remained stable at 20/50 OS and subjectively improved based upon the patient's comments, therefore further treatment with other surgical options was not indicated. Hypotheses for this subjective improvement include the use of topical steroids, slight improvement in occult corneal folds, or relative improvement noticed as the atropine wore off.[10]

Different treatment modalities to manage CDCs vary according to the severity and the length of the cleft. Laser therapy options following conventional cycloplegic treatment include ALP, transscleral diode photocoagulation, neodymium-doped yttrium aluminum garnet (Nd:YAG) laser, and argon laser endophotocoagulation.[5,11,12] To manage wider cyclodialysis clefts refractory to laser cyclophotocoagulation, direct cyclopexy has been used to treat postoperative AIT-related CDCs and other etiologies leading to CDC apart from MIGS.[6] In the current literature, Han et al.[13] demonstrated that long term outcomes of ALP compared favorably to surgical cyclopexy in the management of smaller clefts. ALP has been historically used as the primary method to treat CDC non-invasively since Joondeph[14] reported the first successful CDC case treated with ALP in 1980. Our report confirms that ALP remains a viable treatment option for a relatively small (≤4 clock hours) CDC induced by KDB goniotomy.

Further research is needed to address the safety of combined phacoemulsification with MIGS procedures, as it may increase the risk of CDC creation related to iridocorneal angle trauma from mispositioning of the device posterior to the TM structures. As novel MIGS devices are introduced, possible inadvertent CDC formation must be considered in eyes with postoperative hypotony. ALP appears to be an effective treatment method to promote cleft closure, leading to resolution of symptoms.

Ethics

Informed Consent: Obtained.

Peer-review: Externally and internally peer reviewed.

Authorship Contributions

Surgical and Medical Practices: S.D., Concept: I.W., S.D., Design: D.Ş., I.W., S.D., Data Collection or Processing: S.D., Analysis or Interpretation: C.D., I.W., S.K., D.Ş., T.Ş., Literature Search: D.Ş. T.Ş., Writing: D.Ş., I.W., S.D., C.D., T.Ş.

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