

Intraoperative Optical Coherence Tomography Guided Bleb Needling

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Abstract

Two patients with history of trabeculectomy presented with uncontrolled intraocular pressure (IOP) postoperatively. The first patient had a flat and vascularized bleb 10 weeks after the surgery, and the second subject developed encapsulated bleb 3 months postoperatively. Both patients were taken to the operating room and intraoperative optical coherence tomography (OCT) guided bleb needling was performed to restore aqueous egress into the subconjunctival space. Postoperatively, IOP of the operated eyes ranged 14-18 mmHg at week 6 and month 3. None of the eyes had any intraoperative or postoperative complications. This novel application of the intraoperative OCT for bleb needling facilitates precision surgery under direct visualization and reduces the risk of complications.

Keywords: Bleb Needling; Optical Coherence Tomography; Encysted Bleb

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INTRODUCTION

Trabeculectomy is the most commonly performed surgery in patients with medically uncontrolled glaucoma. With the use of better intraoperative modifications such as the use of antimetabolites or releasable sutures, the success rate of this surgery is now 70 to 80%.^[1] Failure of the filtering bleb is predominantly attributed to the subconjunctival and episcleral fibrosis which occurs as a part of the wound healing process of the ocular tissues.^[2] Encapsulation of the bleb has been reported in 13 to 29% of patients, and

bleb needling revision is required in approximately 20 percent of trabeculectomies.^[1] It is a well-established method to improve filtration through a failing bleb with the success rate of 80 to 90%.^[3] Transconjunctival needling with the use of antimetabolites aims at breaking the subconjunctival adhesions and to re-establish the fistula from the anterior chamber to a subconjunctival bleb, where aqueous humor may be reabsorbed.

Anterior segment optical coherence tomography (OCT) allows a detailed assessment of bleb and its internal anatomy and provides *in vivo* imaging similar to the histological sections which is very useful for determining the functionality of the bleb.

Real time anterior segment OCT integrated with operating microscope has recently become available and we report the use of this technology for needling of a trabeculectomy bleb.

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METHODS

Two patients underwent bleb needling revision by using OPMI LUMERA 700 microscope (Carl Zeiss Meditec, Germany) integrated with intraoperative real time OCT (iOCT) RESCAN 700 (Carl Zeiss Meditec, Germany). The Zeiss Calisto Eye, a 22" liquid-crystal display (LCD) display screen provided an intraoperative surgical field on the left of the screen and a live OCT view on the right; the surgical and OCT video could be retrieved later. OCT uses a wavelength of 840 nm and has tissue penetration up to 2 mm. Written informed consent was obtained from both patients for recording the surgical procedures prior to surgery and the study adhered to the tenets of the Declaration of Helsinki.

Case 1

A 60-year-old man with the past surgical history of trabeculectomy in the left eye presented to us with intraocular pressure (IOP) of 32 mmHg. The patient had undergone trabeculectomy with 0.02% mitomycin C (MMC) and presented with a relatively flat and extensively vascularized bleb [Figure 1a]. Bleb needling was performed at week 10.

Case 2

A 55-year-old man with the status post of trabeculectomy and subconjunctival Ologen implant for glaucoma secondary to vitreoretinal surgery presented to us for follow-up. At 3-month postoperative visit, the bleb was encapsulated and IOP was 26 mmHg on maximal tolerable glaucoma medications.

Surgical Technique

After anesthetizing the eye with peribulbar block (0.5% bupivacaine +2% lignocaine), a wire speculum was inserted and a 26 G needle loaded on a 2 ml syringe was advanced into the bleb and swept in a side to side motion within the Tenon's fascia, under direct visualization of the iOCT. Multiple perforations were made in the bleb wall and then the needle was introduced with

OCT guidance, under the scleral flap into the anterior chamber to restore the aqueous flow. In the eye with Ologen implant, the needle was guided through the implant to create multiple tracks for aqueous flow. Thereafter, 0.1 ml of 5-FU (5 mg/0.1 ml) was injected 10 mm posterior to the bleb with a 26 G needle, loaded on a tuberculin syringe.

RESULTS

The first case showed a close apposition of conjunctiva and sclera with minimal hyporeflective space intraoperatively on iOCT indicating both episcleral and subscleral fibrosis leading to the bleb failure [Figure 1a]. Postoperatively, the bleb was diffusely elevated with the iOCT showing a diffusely raised bleb with multiple small hypo-reflective spaces, suggestive of a filtering bleb [Figure 1b]. In both cases, IOP ranged 14–18 mmHg at week 6 and month 3.

DISCUSSION

Introduction of OCT into the clinical practice brought a landmark change in diagnosis, management, and monitoring of nearly all ocular pathologies. On the same lines, OCT integrated with operating microscope has brought a new paradigm shift in ophthalmic surgery. The feasibility of iOCT was first described by Ehlers et al.^[5] Although its role in vitreo-retinal surgery is well-established, its utility in glaucoma is still in infancy. Use of iOCT has been described before by using hand held OCT which did not allow real time feedback and was cumbersome as the surgery had to be interrupted each time for image acquisition.

During surgical maneuvering, the iOCT with heads up display (HUD) allows rapid visualization of the area of interest and provides the surgeon with information regarding instrument-tissue interactions.

Because of its finer resolution, OCT is able to present detailed view of the bleb wall, and an accurate assessment of the location and extent of fibrosis. Although bleb needling is considered to be a safe procedure, 28% to 30% of cases are known to have minor complications

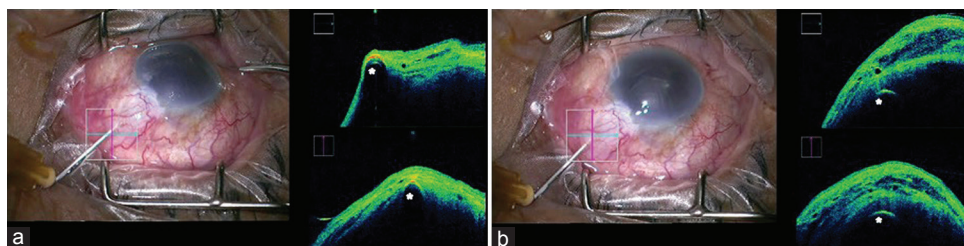


Figure 1. (a) Intraoperative clinical photograph showing a flat vascularised bleb. The corresponding live iOCT imaging- horizontal scan (blue horizontal line) and vertical scan (red vertical line) of the bleb area shows apposition of the conjunctiva and sclera with minimal hyporeflective space, indicating a fibrosed/ non-filtering bleb with 26 G needle *in situ* (white asterisk). (b) Intraoperative OCT (iOCT) imaging showing a relatively diffusely raised bleb with multiple hypo-reflective spaces post bleb needling, with 26 G needle *in situ* (white asterisk).

such as transient conjunctival leakage, small hyphema and temporary shallowing of the anterior chamber. Severe complications such as endophthalmitis, corneal decompensation, choroidal detachment, decompression retinopathy, scleral injury and malignant glaucoma have also been reported.^[6,7]

Compared to slit lamp OCT (SL-OCT; Heidelberg Engineering GmbH, Tiergartenstr, Heidelberg, Germany) guided needling, this novel imaging technique allows an aseptic milieu to carry out this procedure. Thus, it is inferential that the incidence of blebitis or endophthalmitis will decrease once the procedure is done in the operating room with all aseptic precautions. Furthermore, it provides a comfortable positioning to the patient and surgeon. In contrast to slit lamp technique where one hand is essentially used to lift the upper lid; in the operating room, the surgeon can use both his hands in the procedure - one for stabilization of the globe and the other for dissection. The depth of the needle can be precisely located and adjusted while the revision is done. This permits better maneuvering, better breakage of adhesions above and below the scleral flap under visualization and thereby reducing the risk of complications. Therefore, its utility in eyes with encysted bleb with subconjunctival Ologen is useful where multiple needle maneuvering is required. Moreover, in an event of any complications such as shallowing of the anterior chamber, the patient can be offered an immediate remedial management in the operating room compared to an outpatient setting. Moreover, the iOCT being a spectral domain OCT has a better resolution (5–7 μm) than the SL-OCT (time domain OCT). The utility of this technology is unmatched in patients who are uncooperative for slit lamp procedure due to age or physical and mental limitations.

iOCT may reduce the risk of complications as there is direct visualization of the needle inside the bleb and it can be also be used as an excellent teaching tool for trainees.

The high cost and difficulty in repeated refocusing to keep the area of interest in view are the major hurdle in routine use of this device. Studies comparing the ease of surgery, IOP reduction and rate of complications between standard needling procedures and iOCT guided needling will further validate the use of this technology.

In summary, iOCT guided bleb needling is a new technique for glaucoma surgery which can positively affect surgical outcomes and reduce complications with an increased precision of surgery.

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Conflicts of Interest

There are no conflicts of interest.

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