One-year follow-up of deep sclerectomy using ultrasound biomicroscopy

Heba M. El-Saied, Mohamad A. S. Abdelhakim, Mohamed A. Eldaly, Pakinam H. Fouad

Department of Ophthalmology, Kasr El Aini Hospital, Cairo University, Cairo, Egypt

Correspondence to Mohamad Amr Salah Eddin Abdelhakim, MD, 11c, Street 199, Apt. #9, Degla, Maadi, Cairo 11431, Egypt
Tel: +20 100 259 2639
E-mails: m.amr.salah@kasralainy.edu.eg

Received 5 January 2014
Accepted 10 February 2014

Journal of Egyptian Ophthalmological Society
2014, 107:82–85

Introduction
Ultrasound biomicroscopy (UBM) following deep sclerectomy provides a subsurface image that enables the visualization of the postoperative area and measurements of the thickness of the trabeculo-Descemet's membrane and the dimensions of the intrascleral space.

Objective
The aim of this study was to assess the intrascleral bleb surface area following deep sclerectomy, using UBM, to follow it up for 1 year, and to correlate it to the percentage decrease in intraocular pressure (IOP).

Design
This is an interventional case series.

Settings
Patients were recruited from Kasr El Aini Cairo University Hospital's outpatient clinics of ophthalmology from February 2012 until February 2013.

Patients and methods
Seventy-three eyes of 58 patients with open-angle glaucoma were subjected to deep sclerectomy with mitomycin C 0.2 mg/ml.

Primary outcome measures
The intrascleral bleb surface area was measured using a Zeiss Humphrey UBM 840 and IOP was measured using a Goldmann's applanation tonometer.

Results
Sixty eyes of 45 patients were included in the analysis. Intrascleral blebs were found in 85% of the eyes and persisted for an entire year. The mean surface area of intrascleral bleb was 0.84 ± 0.99 mm^2 after a month, 0.97 ± 0.95 mm^2 after 6 months, and 0.89 ± 0.92 mm^2 after a year. Correlation of the percentage decrease in IOP to the surface area of the intrascleral bleb was statistically significant at 1 month, but insignificant thereafter.

Conclusion and relevance
Thus, not only is the height of the intrascleral bleb correlated to the reduction in the IOP but the surface area of the bleb should also be taken into consideration.

Keywords:
deep sclerectomy, intraocular pressure, intrascleral bleb, ultrasound biomicroscopy

J Egypt Ophthalmol Soc 107:82–85

2090-0686

Introduction

Trabeculectomy is the standard filtration surgery for glaucoma, but complications, such as hypotony and choroidal effusion [1], have led several glaucoma surgeons to prefer nonpenetrating procedures, of which deep sclerectomy is the most popular [2].

The dissection of deep sclerectomy has two distinct goals. The first goal is to create a filtering trabeculo-Descemet's membrane (TDM) that will prevent excessive overfiltration and the second goal is to create an intrascleral filtering space. The thin remaining scleral bed of the intrascleral bleb also enables redirection of part of the aqueous humor to the suprachoroidal space and therefore promotes uveoscleral outflow [3].

Ultrasound biomicroscopy (UBM) provides a subsurface image that cannot be obtained with optical slit-lamp examination. It enables the visualization of the postoperative area and measurements of the thickness of the TDM and the dimensions of the intrascleral space [4].

The aim of this work was to assess the intrascleral bleb surface area following deep sclerectomy, to follow-up its evolution over 1 year, and to correlate it to the percentage decrease in intraocular pressure (IOP).

Patients and methods

This was an interventional case series carried out on 73 eyes of 58 patients. Patients were recruited from Kasr

El Aini Cairo University Hospital's outpatient clinics of ophthalmology from February 2012 until February 2013. Approval for the study was obtained from the Ophthalmology Department (according to the WMA Declaration of Helsinki). All patients were provided with a thorough explanation of the study design and aims, and provided written informed consent.

We included eyes with open-angle glaucoma, whether medically uncontrolled or intolerable to medical therapy. Thirty-nine (65%) eyes had primary open-angle glaucoma, 12 (20%) eyes had juvenile glaucoma, six (10%) eyes had aphakic/pseudophakic glaucoma, and three (5%) eyes had steroid-induced glaucoma. The exclusion criteria were eyes with angle closure glaucoma, congenital glaucoma, uveitic glaucoma, or neovascular glaucoma. We also excluded eyes with intraoperative rupture of the TDM (six eyes) and eyes with failed filtration that needed further laser goniopuncture (seven eyes).

Preoperative evaluation

All the patients received a complete ophthalmological examination, including measurement of the best-corrected visual acuity, slit-lamp examination, IOP measurement using Goldmann's applanation tonometer, dilated fundus examination, gonioscopy for angle and grading using Schaeffer's method, and Humphery SITA standard perimetry to assess the field of vision.

Deep sclerectomy with mitomycin C

All surgeries were performed under general anesthesia with a fornix-based conjunctival flap. A rectangular superficial scleral flap half of the sclera thickness (4 mm × 3 mm) was fashioned. Subsequently, mitomycin C (0.2 mg/ml) was applied under the scleral flap and the conjunctiva for 3 min and then washed. Then, the deep flap was fashioned in the preciliary plane and was excised. Deroofing of Schlemm's canal was followed by peeling of the juxtacanalicular meshwork. Then, the superficial scleral flap was sutured using 10/0 nylon suture. Ultimately, the conjunctiva was closed using two 8/0 virgin silk sutures at either end.

Figure 1

Ultrasound biomicroscopy showing a flat intrascleral bleb in a pseudophakic eye after deep sclerectomy in case 14.

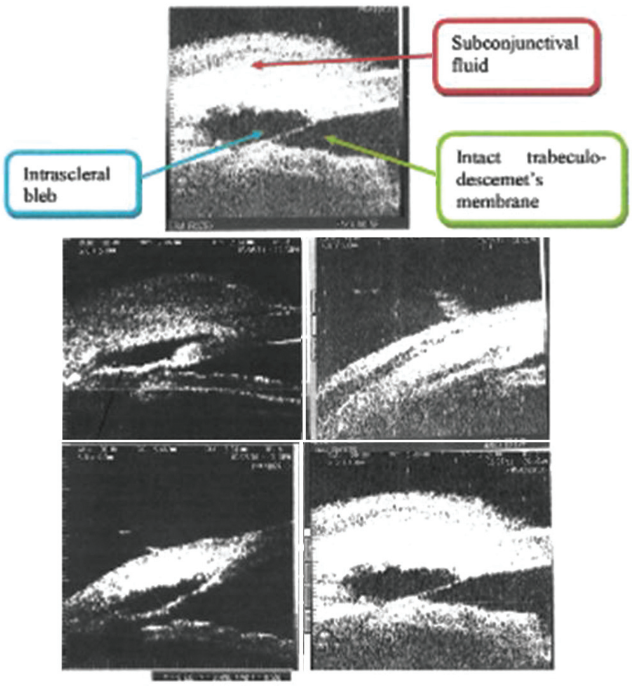
Note that six eyes developed rupture of the TDM and were converted to trabeculectomy and so they were excluded from the study.

Postoperative follow-up

All the patients were examined on the first day postoperatively, after 1 week, and then monthly for 12 months postoperatively. Examination involved measurement of the best-corrected visual acuity, slit-lamp examination, and IOP measurement by Goldmann's applanation tonometer. In addition, Humphery SITA standard perimetry to assess the field of vision was performed at 3 months and 6 months postoperatively.

UBM was performed monthly to assess the presence of intrascleral bleb and its surface area (Figs 1 and 2). A Zeiss Humphrey UBM 840 (Paradigm Medical Industries Inc., Dublin, CA) system was used to provide high-frequency (50 MHz) ultrasonic scan images. Scans

Figure 2



Ultrasound biomicroscopy showing intrascleral blebs, in cases 10, 6, 15, 16, and 28.

were performed by an experienced investigator (P.H.F.) using the technique developed by Pavlin *et al.* [5]. With the patient in the supine position and with the aid of an emersion scleral shell and an examination gel, the surgical area was scanned with the UBM probe. Radial and transverse sections of the sclerectomy area at 12 O'clock were explored using optimal dB gain that allowed the best resolution and quality of images. Biometric measurements of the surgical site were performed using the electronic calipers installed in the instrument. The 'segment caliper' resolution is +5 mm. From longitudinal and transverse scans, the following were assessed:

(1) Presence and maximum length of the intrascleral bleb.
(2) The presence and type of subconjunctival filtering bleb.
(3) The possibility of suprachoroidal drainage as an alternative aqueous pathway.

Note that laser goniopuncture was performed in seven eyes that presented with failure of filtration, confirmed clinically and with UBM, and with an IOP above 21 mmHg. It was performed 1–6 months after deep sclerectomy and followed by UBM 2 weeks after goniopuncture. The surface area of these blebs was recorded, but as these eyes were excluded from our study, these parameters were omitted.

Statistical analysis

Data were statistically described in terms of range, mean ± SD, or frequencies (number of cases) and percentages when appropriate. The correlation between various variables was assessed using the Spearman rank correlation equation for non-normal variables. All P values less than 0.05 were considered statistically significant. All statistical calculations were carried out using the computer program statistical package for the social science (SPSS, version 18; SPSS Inc., Chicago, Illinois, USA) for Microsoft Windows.

Results

Sixty eyes of 45 patients fulfilled the inclusion and exclusion criteria for analysis. Their age ranged from 25 to 65 years, with a mean of 52.30 ± 13.55 years; the female to male ratio was 11 : 9.

The preoperative IOP ranged from 22 to 50 mmHg, with a mean of 29.15 ± 7.36 mmHg. Postoperative IOP was followed up in the 60 eyes for 1 year (Table 1).

Postoperative intrascleral bleb

An intrascleral bleb was found in 51 eyes after 1 month of surgery (85%), whereas after 6 months of surgery and up to 1 year, it was found in 54 (90%) eyes. UBM was used to measure the surface area of the bleb (Table 1).

Correlation of the percentage decrease in IOP to the surface area of the intrascleral bleb at 1 month ($r = 0.502$; $P < 0.001$), using Spearman's ρ, was statistically significant, whereas at 6 months ($r = 0.067$; $P = 0.610$) and 1 year ($r = 0.126$; $P = 0.336$) postoperatively, it was statistically insignificant.

Subconjunctival bleb was also detected in some of the eyes using UBM. It was diffuse in 18 (30%) eyes, shallow in 33 (55%) eyes, flat then shallow in three (5%) eyes, and flat in six (10%) eyes. No (0%) eyes developed cystic bleb or tenon cyst. The UBM also did not detect any suprachoroidal space in any of the 60 eyes.

Discussion

Deep sclerectomy may lead to a reduction in IOP by a number of possible mechanisms, which might include the creation of a subconjunctival filtering bleb, removal of juxtacanalicular tissue, where the majority of the flow resistance is considered to be located, filtration to the supraciliary/suprachoroidal space, vaulting of the residual trabecular meshwork toward the intrascleral cavity leading to widening of the cribriform interspace (similar to laser trabeculoplasty), and development of new aqueous drainage veins in the scleral space months after deep sclerectomy [6].

Most UBM studies have evaluated the surgical area in the early postoperative period. The presence of an intrascleral space and a thin remaining TDM was a common finding. The volume of the intrascleral space did not appear to be associated with control of

Table 1 Postoperative percentage reduction in intraocular pressure and bleb surface area (mm^2) at 1 month, 6 months, and 1 year

Time of assessment postoperatively	IOP reduction (%)		Bleb surface area (mm^2)		P value
	Range	Mean	Range	Mean	
1st month	36.4–76	45.12 ± 26.73	0–3.91	0.84 ± 0.99	**<0.001**
6th month	33.3–76	52.49 ± 11.41	0–3.82	0.97 ± 0.95	0.610
1 year	33.3–72	51.58 ± 12.15	0–3.60	0.89 ± 0.92	0.336

IOP, intraocular pressure; $P < 0.05$ is considered statistically significant.

IOP in previous reports [7]. The significance of the suprachoroidal hyporeflective area is unclear [8].

In our study, intrascleral blebs were found in 85% of eyes and persisted for the entire year of the follow-up period. The mean surface area of the intrascleral bleb was 0.84 ± 0.99 mm^2 after a month, 0.97 ± 0.95 mm^2 after 6 months, and 0.89 ± 0.92 mm^2 after a year.

Correlation of the percentage reduction in the IOP to the surface area of the intrascleral bleb showed a moderately strong positive correlation after 1 month postoperatively, but no significant correlation thereafter at 6 months and 1 year.

In a study by Fernández-Buenaga *et al.* [9], intrascleral blebs' characteristics were compared after deep sclerectomy with three intrascleral implants using Visante anterior segment optical coherence tomography. Overall, the correlation between the scleral bleb height and the IOP was statistically significant at 45, 90, and 135°. However, Sk-Gel did not show any statistically significant correlation between the scleral height and IOP, whereas the other two groups (Esnoper and Aquaflow) showed a significant correlation. There were no differences in the bleb height among implants [9].

In another study by Khairy *et al.* [10], there was a poor correlation between the level of IOP at the time of UBM and the length of the intrascleral space (r^2 = 0.0016) and the height of the intrascleral space (r^2 = 0.136).

In our study, there was a subconjunctival bleb in 90% of the eyes, but no suprachoroidal space in any of the 60 eyes. In a study by Chiou *et al.* [11], the incidence of subconjunctival bleb was 100%, whereas the incidence of a suprachoroidal hypoechoic space was 44.4%.

Conclusion

Thus, not only is the height of the intrascleral bleb correlated to the reduction in the IOP but the surface area of the bleb should also be taken into consideration. Other studies have focused only on the height of the intrascleral bleb and did not take its surface area into consideration. In our study, the intrascleral bleb surface area was directly correlated to the percentage decrease in IOP. This could be explained as in trabeculectomy; a diffuse bleb is associated with greater decrease in IOP than a high bleb, which could be localized and encysted.

However, a limitation of our study was the small number of eyes studied; further studies with larger samples are needed. A randomized-controlled trial on a larger number of patients for a longer period of time is recommended to study this trend.

Acknowledgements

Special thanks are due to Professor Dr Amr Abdel Hakim, Professor of Ophthalmology and former head of the Ophthalmology Department Faculty of Medicine Cairo University, for initiating the concept of this study.

Conflicts of interest

There are no conflicts of interest.

References

1 Shaarawy T, Nguyen C, Schnyder C, Mermoud A. Comparative study between deep sclerectomy with and without collagen implant: long term follow up. Br J Ophthalmol 2004; **88**:95–98.

2 Bluestein E, Stewart W. Non-penetrating glaucoma surgeries. Arch Ophthalmol 2003; **307**:223–226.

3 Vaudaux J, Mermoud A. Aqueous dynamics after deep sclerectomy: ex-vivo study. Ophthalm Pract 1998; **16**:204–209.

4 Kazakova D, Roters S, Schnyder CC, *et al.* Ultrasound biomicroscopy images: long-term results after deep sclerectomy with collagen implant. Graefes Arch Clin Exp Ophthalmol 2002; **240**:918–923.

5 Pavlin C, Harasiewicz K, Sherar M, Foster FS. Clinical use of ultrasound biomicroscopy. Ophthalmology 1991; **98**:287–295.

6 Johnson DH, Johnson M. How does non-penetrating glaucoma surgery work? Aqueous outflow resistance and glaucoma surgery. J Glaucoma 2001; **10**:55–67.

7 Negri-Arangure I, Croxatto O, Grigera DE. Midterm ultrasound biomicroscopy findings in eyes with successful viscocanalostomy. J Cataract Refract Surg 2002; **28**:752–757.

8 Netland PA Ophthalmic Technology Assessment Committee Glaucoma Panel, American Academy of Ophthalmology. Non-penetrating glaucoma surgery. Ophthalmology 2001; **108**:416–421.

9 Fernández-Buenaga R, Rebolleda G, Casas-Llera P, Muñoz-Negrete FJ, Pérez-López M. A comparison of intrascleral bleb height by anterior segment OCT using three different implants in deep sclerectomy. Eye 2012; **26**:552–556.

10 Khairy HR, Atta HR, Green FD, van der Hoek J, Azuara-Blanco A. Ultrasound biomicroscopy in deep sclerectomy. Eye 2005; **19**:1–6.

11 Chiou AG-Y, Mermoud A, Hediguer S-MA, Schnyder CC, Faggioni R Ultrasound biomicroscopy of eyes undergoing deep sclerectomy with collagen implant. Br J Ophthalmol 1996; **80**:541–544.