DIFFERENT SURGICAL MODALITIES FOR MANAGEMENT OF PERSISTENT GLAUCOMA AFTER SILICONE OIL REMOVAL IN VITRECTOMIZED EYES

One Year Comparative Study

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Purpose: Aim of this study was to compare outcome of four different surgical modalities for management of persistent glaucoma after silicone oil removal in vitrectomized eyes.

Methods: This is a prospective comparative study, carried out on a cohort of 41 eyes (41 patients). Patients were randomly allocated to Group A (trabeculectomy), Group B (deep sclerectomy), Group C (Ahmed valve), or Group D (Ex-Press Minishunt). Postoperatively, all patients were followed regularly at 1 day, 1 week, 1, 3, and 6 months, and 1 year for intraocular pressure evaluation.

Results: Postoperatively, there was significant drop in intraocular pressure in each group, and significant difference between the four groups regarding drop and percentage drop in intraocular pressure, with Group C showing the highest mean percentage drop in intraocular pressure, whereas Group B with the least. Success rate was 100% with Ex-Press minishunt, 80% with Ahmed valve, and 50% for each of trabeculectomy and deep sclerectomy. Hypotony occurred in 50% with Ahmed valve and 40% with trabeculectomy, whereas glaucoma occurred in 50% with deep sclerectomy and 30% with trabeculectomy.

Conclusion: For controlling persistent glaucoma after silicone oil removal in our work, Ex-Press minishunt had the highest complete success rate with no postoperative complications.

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Since the 1960s, silicone oil has been used as a vitreous substitute for prolonged intraocular tamponade in retinal surgery, usually for a period of 2 to 6 months. The incidence of silicone oil (SO) induced glaucoma as reported in the Silicone Oil Study was 8%. It ranges from 2.2% in 6 months to 56% in 8 months, therefore, the longer the oil stays in the eye the more likely it is to cause secondary glaucoma.[1]

Management may include topical medications alone or in conjunction with surgery and/or laser. Early SO removal may result in IOP control; however, this must be weighed against the risk of recurrent retinal detachment (RD). A persistent IOP rise necessitates glaucoma filtration surgery, but this may present a surgical challenge because glaucoma surgery may be technically difficult, associated with a poor prognosis and increased risk of complications.[2]

Most of the studies focused on the management of glaucoma in silicone filled eyes, and for our best knowledge, no other work studied deep sclerectomy or Ex-Press minishunt for such cases. Therefore, in this study, our target was to compare the outcome of four different surgical modalities for management of persistent glaucoma after silicone oil removal: trabeculectomy, deep sclerectomy, Ahmed valve, and Ex-Press minishunt.

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Methods

This is a prospective comparative study, carried out on a cohort of 41 eyes of 41 Egyptian patients with persistent glaucoma after silicone oil removal in vitrectomized eyes. The study was performed during the time period between August, 2014 and November, 2015. Patients were selected from the Kasr Al-Ainy Cairo University Hospitals Glaucoma outpatient clinic, being referred from the retina outpatient clinic. Kasr Al-Ainy hospital is a central University hospital in Cairo, and it is a tertiary referral center for most of the governorates in Egypt. Approval for the study was obtained from the Ophthalmology department ethical committee (according to the Declaration of Helsinki). All patients received a thorough explanation of the study design and aims, and were provided with written informed consent.

Patients included in this study had persistent high intraocular pressure (IOP) >21 mmHg for 1 month after silicone oil removal, on maximum tolerated topical antiglaucoma medication. All the eyes had undergone previous pars plana vitrectomy for rhegmatogenous retinal detachment, either myopic or traumatic RD and remained silicone filled for 8 months. They all had secondary open angle glaucoma. Patients with history of glaucoma before pars plana vitrectomy were excluded from the study. We also excluded eyes with emulsified silicone oil due to its poorer prognosis, and cases with previous scleral buckle due to technical difficulty caused by conjunctival scarring.

Preoperative Evaluation

All the patients received complete ophthalmological examination, including measurement of the best corrected visual acuity (BCVA), slit-lamp examination (including assessment of conjunctival tissue), intraocular pressure (IOP) measurement with Goldmanns applanation tonometry, dilated fundus examination, and gonioscopy for angle grading using Schaeffers grading system. Gonioscopy was also essential in eyes undergoing Ex-Press minishunt implantation to select an area with no peripheral anterior synechia for its placement. The number of topical antiglaucoma medications was recorded (medication score).

Patients were randomly allocated (using Random computer-generated numbers) to Group A (trabeculotomy with mitomycin C, MMC), Group B (deep sclerectomy with MMC), Group C (Ahmed valve), or Group D (Ex-Press Minishunt; Alcon Inc, Forth Worth, TX, with MMC).

Surgical Technique

Trabeculectomy. A Fornix-based conjunctival flap was followed by fashioning a rectangular scleral flap (4 mm × 3 mm) and application of MMC 0.4 mg/cc for 2 minutes. Mitomycin C was irrigated by 200 mL of balanced salt solution. Paracentesis was performed for gradual decompression. After that, excision of the inner block by Kelly punch was followed by peripheral iridectomy. The flap was closed using two 10/0 releasable nylon sutures aiming for filtration on minimal pressure then the conjunctiva was closed water tight with 10/0 nylon sutures. Paracentesis wound was secured by hydration. The releasable sutures were removed 2 months after the surgery in all cases.

Deep sclerectomy. Using the same primary steps as above up to application of MMC 0.4 mg/cc for 2 minutes then washing it, but instead of excising an inner block, fashioning and dissecting the deep scleral flap (3 mm × 2 mm) was performed, exposing the preciliary plane. Then the deep flap was excised, followed by deroofing of the canal of schlemm and peeling of juxtacanalicular trabecular meshwork leaving an intact trabeculo-descemet's membrane with gradual aqueous filtration through it. Finally, closure of the flap with two 10/0 nylon sutures and water tight closure of the conjunctiva with 10/0 nylon sutures were followed by securing the paracentesis wound by hydration, as above.

All eyes with postoperative filtration failure were subjected to laser goniopuncture and when not sufficient to control IOP, additional surgery was done to control IOP.

Ahmed valve. A 7/0 vicryl corneal traction suture at 12 o'clock was used to rotate the eye inferiorly. Superior fornix-based periotomy was extended superotemporally to expose the superotemporal area, followed by posterior dissection. After priming the valve with balanced salt solution using a 30-gauge cannula, it was gently tucked into the pocket with the tips of nontoothed forceps holding the eyelet of the end plate taking into consideration not to touch the plate with the forceps. The end plate was secured 10 mm from the limbus by two 10/0 nylon sutures 7 mm from the limbus. The silicone tube of the valve was cut bevel up 1.5 mm anterior to the limbus. A scleral tunnel was made 4 mm posterior to the limbus with 23 G needle and the anterior chamber (AC) was entered parallel to the iris plane, then the tube was inserted through the tunnel to the AC. The tube was secured in place by a single nontight figure of eight scleral suture using 8/0 vicryl then the conjunctiva was closed with 8/0 vicryl sutures.

Ex-Press minishunt. We used the Ex-Press P-model with the decreased bevel angle, external diameter of 400 microns, total device length of 2.64 mm, and a vertical channel back plate. Surgical steps also followed the same primary steps as trabeculectomy, up to application of MMC 0.4 mg/cc for 2 minutes then washing it, but instead of excising an inner block, the AC was filled with viscoelastic and an incision in the blue zone just anterior to the scleral spur and parallel to the iris plane by 25 G needle was performed. The Ex-Press minishunt was inserted, keeping the external plate flush with the sclera (Figure 1). Then, as in trabeculectomy, closure of the flap with two releasable 10/0 nylon sutures, was followed by water tight closure of the conjunctiva with 10/0 nylon sutures and closure of the paracentesis wound by hydration. The releasable sutures are removed 2 months after the surgery.

Postoperative Follow-up

All the patients were examined on the first day postoperatively, after one week, 1, 3, and 6 months, then at 1 year postoperatively. Examination involved measurement of the BCVA, slit-lamp examination (for postoperative complications), and IOP measurement with Goldmanns applanation tonometry. Dilated fundus examination was also done for postoperative complications (choroidal detachment due to hypotony or recurrence of RD).

Postoperative hypotony was diagnosed when IOP was ≤5 mmHg for ≥1 week after glaucoma surgery.

Surgical success rate was assessed. Complete success was defined as IOP ≤21 mmHg and a relative decrease of ≥20% compared with the preoperative IOP, without any additional glaucoma surgery or antiglaucoma medication through all follow-up periods. Qualified success was defined as IOP ≤21 mmHg and an additional reduction of ≥20% in IOP compared with the preoperative IOP, without any additional glaucoma surgery, but with topical medications. Failure was considered when IOP was not controlled with topical medications and the patient needed additional surgical procedure to lower IOP, or when hypotony persisted for ≥2 months.

Statistical Analysis

Data were statistically described in terms of range, mean ± standard deviation (±SD), median frequencies (number of cases), and percentages when appropriate. Comparison of numeric variables between groups was performed using Kruskal Wallis test for nonparametric data, whereas Wilcoxon Signed Rank test was used for within group comparisons. Chi square (χ^2) test was performed for comparing categorical data. Exact test was used instead when the expected frequency is less than five. Complete success was analyzed using Kaplan–Meier survival analysis. Plots for survival and hazard functions were illustrated. Predictors of incident glaucoma were examined using Cox proportional hazards regression to generate hazard ratios (HRs) and also using multiple linear regression analysis to study their effect on postoperative glaucoma and hypotony. All *P* values less than 0.05 were considered statistically significant. All statistical calculations were done using computer program's Microsoft Excel 2007 (Microsoft Corporation, NY) and SPSS (Statistical Package for the Social Science; SPSS Inc, Chicago, IL) version 18 for the Microsoft Windows. Due to lack of reports for the incidence rate of postvitrectomy glaucoma for the Egyptian population, sample size was calculated using MedCalc 10.2.0.0, by referring to success rates of glaucoma surgeries after vitrectomy from literature.

Results

Patient Data

Ten eyes of 10 patients were allocated to each group (as one eye in Group C was excluded from statistical analysis, but not excluded from the study, due to

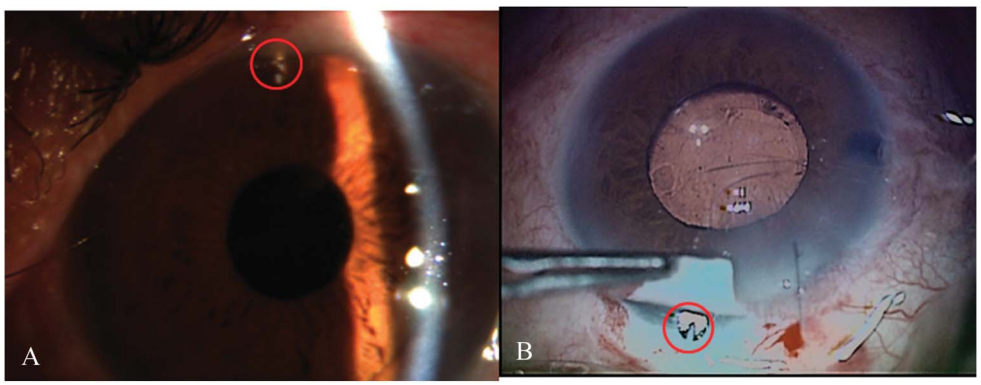

Fig. 1. Ex-Press minishunt. **A.** Tip of minishunt projecting in AC. **B.** Plate of minishunt under scleral flap.

persistent hypotony causing atrophia bulbi). The patients' data including, age, gender, lens status, and type of retinal detachment (RD) needing vitrectomy are shown in Table 1. The four groups were age (P = 0.209) and sex (P = 1.00) matched with no statistical difference between the groups regarding lens status (P = 0.853) and type of RD needing vitrectomy (P = 0.715).

Preoperative Data

All preoperative data including, intraocular pressure (IOP), best corrected visual acuity (BCVA), and preoperative antiglaucoma medication score are also shown in Table 1. There was also no significant difference between the four groups regarding these data (P= 0.699, P= 0.635, respectively), and all the eyes in the four groups had antiglaucoma medication score of three.

Postoperative Data

Postoperative BCVA, IOP changes, and antiglaucoma medication score are shown in Table 2. Postoperative BCVA was statistically insignificantly different between the four groups (P = 0.188), whereas, postoperative antiglaucoma medication score was (P = 0.028). Postoperative IOP, change and percentage change in IOP at each follow-up visit were significantly different between the four groups. Postoperative IOP behavior throughout the follow-up period in the 4 groups is shown in Figure 2.

Comparing preoperative IOP to postoperative IOP at each follow-up period in each group was statistically significant (P = 0.005 for each, except at 3 months in Group B, P = 0.011).

Success Rate

Success rates were compared between the 4 groups (P = 0.079) as shown in Table 2. All the eyes in Group D achieved complete success (100%). In Group A, 2 eyes needed needling for their blebs and 2 were hypotonous for ≥2 months, whereas in Group B, 2 eyes needed trabeculectomy and one needed Ahmed valve, and in Group C, 2 were hypotonous for ≥2 months. Kaplan–Meier survival analysis illustrated complete success rates throughout the 1 year follow-up period (Figure 3).

Complications

Postoperative complications, including postoperative ocular hypertension, hypotony, shallow anterior

Table 1. Patient Demographic and Preoperative Data in the Four Groups

	Group A (Trabeculectomy)	Group B (Deep Sclerectomy)	Group C (Ahmed Valve)	Group D (Ex-Press Minishunt)	*P*
Age, range (mean ± SD), years	15–50 (29.5 ± 3.9)	25–60 (39.6 ± 4.1)	20–60 (36.5 ± 3.6)	26–54 (38.1 ± 2.8)	0.209
Gender (males), n (%)	9 (90)	9 (90)	9 (90)	8 (80)	1.00
Preoperative IOP, range (mean ± SD), mmHg	28–42 (34 ± 5.2)	24–42 (33.6 ± 6.8)	24–42 (35 ± 4.7)	30–42 (36.9 ± 4.1)	0.699
Preoperative BCVA					0.635
LogMAR, range (mean ± SD)	0.1–0.5 (0.3 ± 0.2)	0.1–0.5 (0.3 ± 0.2)	0.01–0.5 (0.2 ± 0.2)	0.1–0.5 (0.2 ± 0.1)	
Snellen/decimal (range)	6/9–6/18 (0.63–0.33)	6/9–6/18 (0.63–0.33)	6/6–6/18 (1.00–0.33)	6/9–6/18 (0.63–0.33)	
Preoperative antiglaucoma medication score, n (%)					
0	0	0	0	0	
1	0	0	0	0	
2	0	0	0	0	
3	10 (100)	10 (100)	10 (100)	10 (100)	
Type of RD needing vitrectomy, n (%)					0.715
Traumatic RD	5 (50)	6 (60)	4 (40)	3 (30)	
Myopic RD	5 (50)	4 (40)	6 (60)	7 (70)	
Lens status, n (%)					0.853
Pseudophakic	8 (80)	7 (70)	8 (80)	6 (60)	
Aphakic	1 (10)	1 (10)	2 (20)	2 (20)	
Phakic	1 (10)	2 (20)	0	2 (20)	

BCVA, best corrected visual acuity; IOP, intraocular pressure; RD, retinal detachment.
P values < 0.05 are considered statistically significant.

Table 2. Postoperative Best Corrected Visual Acuity (BCVA), Intraocular Pressure (IOP) Changes (Absolute postoperative Value, Difference and % Difference From preoperative Values), Medication Score (Number of Medications), and Success Rate in the Four Groups

Postoperative Data	Group A	Group B	Group C	Group D	*P*
IOP, range (mean ± SD), mmHg					
1 Day					
Value	2–12 (6.0 ± 3.0)	10–18 (14.0 ± 2.1)	4–8 (5.6 ± 0.13)	6–8 (7.1 ± 1.1)	*<0.001*
Difference	22–36 (28.0 ± 5.1)	12–28 (19.6 ± 5.8)	22–36 (29.4 ±4.9)	24–34 (29.2 ± 4.4)	*0.005*
% Difference	70–92.9 (82.4 ± 7.9)	46.2–66.7 (57.4 ± 7.2)	75–89.5 (83.7 ± 4.4)	75–85 (80.5 ± 3.7)	*<0.001*
1 Week					
Value	4–12 (6.0 ± 2.5)	14–18 (15.6 ± 1.8)	4–6 (5.0 ± 1.1)	6–8 (7.1 ± 1.1)	*<0.001*
Difference	22–36 (28.0 ± 5.1)	8–28 (18.0 ± 6.5)	24–36 (30.0 ± 4.3)	24–34 (29.8 ± 4.3)	*0.001*
% Difference	70–90 (82.3 ± 6.3)	30.8–66.7 (52.0 ± 10.2)	82.4–89.5 (85.7 ± 2.6)	75–85 (80.5 ± 3.7)	*<0.001*
1 Month					
Value	4–18 (9.6 ± 4.5)	16–24 (20.2 ± 2.3)	4–6 (5.6 ± 0.8)	8–10 (8.2 ± 0.6)	*<0.001*
Difference	14–34 (24.4 ± 6.3)	2–26 (13.4 ± 8.5)	22–36 (29.4 ± 4.3)	22–34 (28.9 ± 4.1)	*<0.001*
% Difference	50–88.9 (71.4 ± 13.4)	7.7–62 (36.6 ± 19.5)	78.6–87.5 (83.9 ± 2.5)	73.3–81 (78.1 ± 2.6)	*<0.001*
3 Months					
Value	6–26 (13.0 ± 7.3)	16–26 (21.0 ± 3.6)	6–8 (6.8 ± 1.0)	8–12 (9.6 ± 1.3)	*<0.001*
Difference	4–34 (21.0 ± 8.7)	0–26 (12.6 ± 8.9)	22–34 (28.2 ± 4.4)	20–34 (27.3 ± 5.1)	*<0.001*
% Difference	14.3–85 (61.1 ± 22.7)	0–61.9 (33.9 ± 22.6)	76.5–85 (80.4 ± 2.8)	64.7–81 (73.6 ± 6.0)	*<0.001*
6 Months					
Value	10–22 (14.9 ± 4.3)	12–18 (16.0 ± 2.1)	8–12 (9.4 ± 1.3)	8–12 (10.2 ± 1.6)	*<0.001*
Difference	9–28 (19.1 ± 5.7)	6–28 (17.6 ± 6.7)	20–32 (25.6 ± 4.2)	18–32 (26.7 ± 5.1)	*0.004*
% Difference	30–72.2 (55.7 ± 12.8)	25–70 (50.7 ± 11.6)	68.4–80 (73.0 ± 3.4)	60–80 (71.7 ± 6.7)	*<0.001*
1 Year					
Value	12–18 (15.2 ± 2.3)	13–19 (16.2 ± 1.9)	8–14 (11.2 ± 2.1)	10–14 (11.8 ± 1.2)	*<0.001*
Difference	12–26 (18.8 ± 4.8)	7–27 (17.4 ± 6.9)	18–32 (23.8 ± 4.0)	18–30 (25.1 ± 4.7)	*0.029*
% Difference	40–65 (54.7 ± 8.0)	29.2–67.5 (50.0 ± 11.4)	61.1–76.2 (67.9 ± 5.1)	56.3–75 (67.6 ± 6.1)	*<0.001*
BCVA					
LogMAR, range (mean ± SD)	0.1–0.5 (0.2 ± 0.1)	0.1–0.4 (0.3 ± 0.1)	0.01–0.4 (0.2 ± 0.1)	0.1–0.4 (0.2 ± 0.1)	0.188
Snellen/ decimal (range)	6/9–6/18 (0.63–0.33)	6/9–6/12 (0.63–0.50)	6/6–6/9 (1.00–0.63)	6/9–6/12 (0.63–0.50)	
Antiglaucoma medication score, n (%)					*0.028*
0	7 (70)	5 (50)	10 (100)	10 (100)	
1	1 (10)	2 (20)	0	0	
2	2 (20)	3 (30)	0	0	
3	0	0	0	0	
Success rate, n (%)					0.079
Complete	5 (50)	5 (50)	8 (80)	10 (100)	
Qualified	1 (10)	2 (20)	0	0	
Failure	4 (40)	3 (30)	2 (20)	0	

P value < 0.05 is considered statistically significant. Italic values denote statistical significance.

chamber (AC), choroidal detachment, failure of filtration, and recurrent RD were observed in the 4 groups (Table 3). One eye in Group C developed atrophia bulbi. None of the eyes in the four groups had recurrent RD, and there was no significant difference regarding shallow AC ($P = 0.140$). Otherwise there

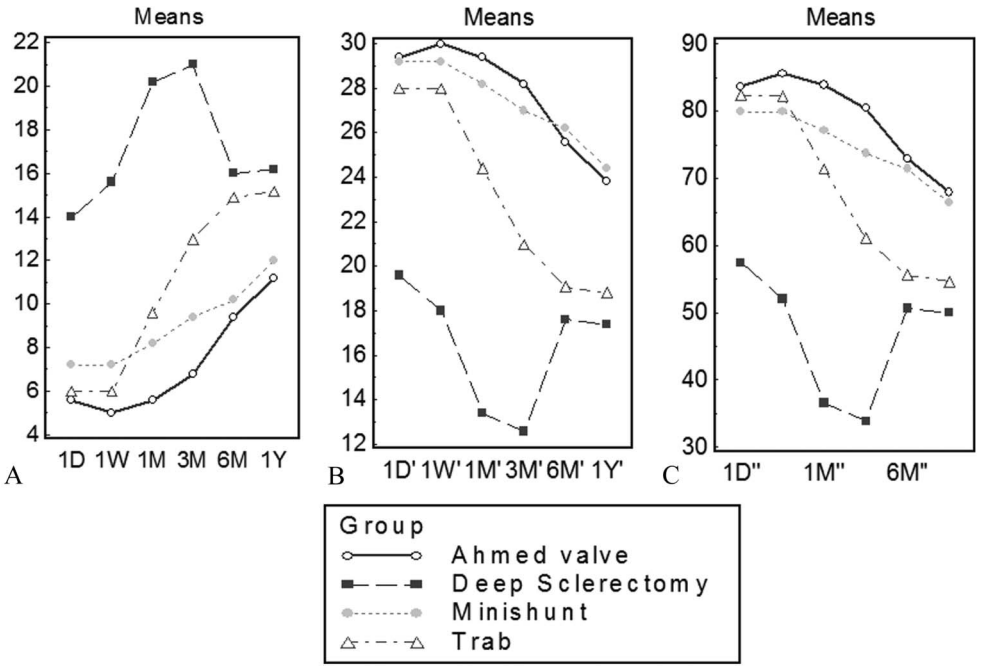

Fig. 2. Postoperative intraocular pressure (IOP) behavior during the follow-up period in the four groups. **A.** Postoperative IOP values, (**B**) Postoperative IOP difference from preoperative values, and (**C**) Postoperative IOP percentage difference from preoperative values.

was significant difference between the four groups regarding the rest of postoperative complications.

Postoperative ocular hypertension. Ocular hypertension defined as a constant elevation of IOP above 21 mmHg was diagnosed in 3 eyes (30%) in Group A and in 5 eyes (50%) in Group B, whereas none of the eyes in Groups C and D developed ocular hypertension (P = 0.01) (Table 3). The interval between the glaucoma surgery and the diagnosis of ocular hypertension varied from 1 to 6 months (Table 4).

Risk factors for postoperative ocular hypertension. The risk factors for ocular hypertension, concerning the age, gender, preoperative IOP, lens status, and type of RD needing vitrectomy were studied using multiple linear regression analysis but were found to be statistically insignificant (P = 0.772, 0.802, 0.488, 0.797, 0.336, respectively).

Also the effect of these factors on the time from glaucoma surgery till the occurrence of postoperative ocular hypertension was studied using Cox regression survival analysis, and was also found to be statistically insignificant (P= 0.804, 0.829, 0.835, 0.788, and 0.823, respectively).

Postoperative hypotony. Persistent hypotony (IOP ≤5 mmHg) after 1 week was diagnosed in 4 eyes (40%) in Group A and in 5 eyes (50%) in Group C, whereas none of the eyes in Groups B and D developed hypotony (P = 0.004) (Table 3). Hypotony was successfully treated in all eyes except for 1 eye in Ahmed valve group which resulted in atrophia bulbi.

Risk factors for postoperative hypotony. The risk factors for hypotony, concerning the age, gender, preoperative IOP, lens status, and type of RD needing vitrectomy, were studied using multiple linear regression analysis but were found to be statistically insignificant (P= 0.223, 0.376, 0.433, 0.946, and 0.762, respectively).

Discussion

The occurrence of IOP rise after vitrectomy and silicone oil tamponade may be early postoperative due to pupillary block, inflammation, pre-existing glaucoma and/or migration of silicone oil in the anterior chamber,[3] or late onset and it may persist after silicone oil removal due to chronic inflammation, infiltration of the trabecular meshwork by silicone bubble (emulsified, nonemulsified, or macrophage endocytosed) or synechial angle closure.[4]

For our best knowledge, this was the first prospective study to compare trabeculectomy, deep sclerectomy, Ahmed valve, and Ex-Press minishunt in cases of persistent glaucoma after silicone oil removal. Most of other studies focused on the management of glaucoma in silicone filled eyes, and for our best knowledge, no other work studied deep sclerectomy or Ex-Press minishunt for such cases.

In this work, 10 age- and sex-matched patients were allocated to each group. Preoperative data were not statistically significantly different between the four groups. The mean preoperative IOP was 34 ± 5.2 mmHg

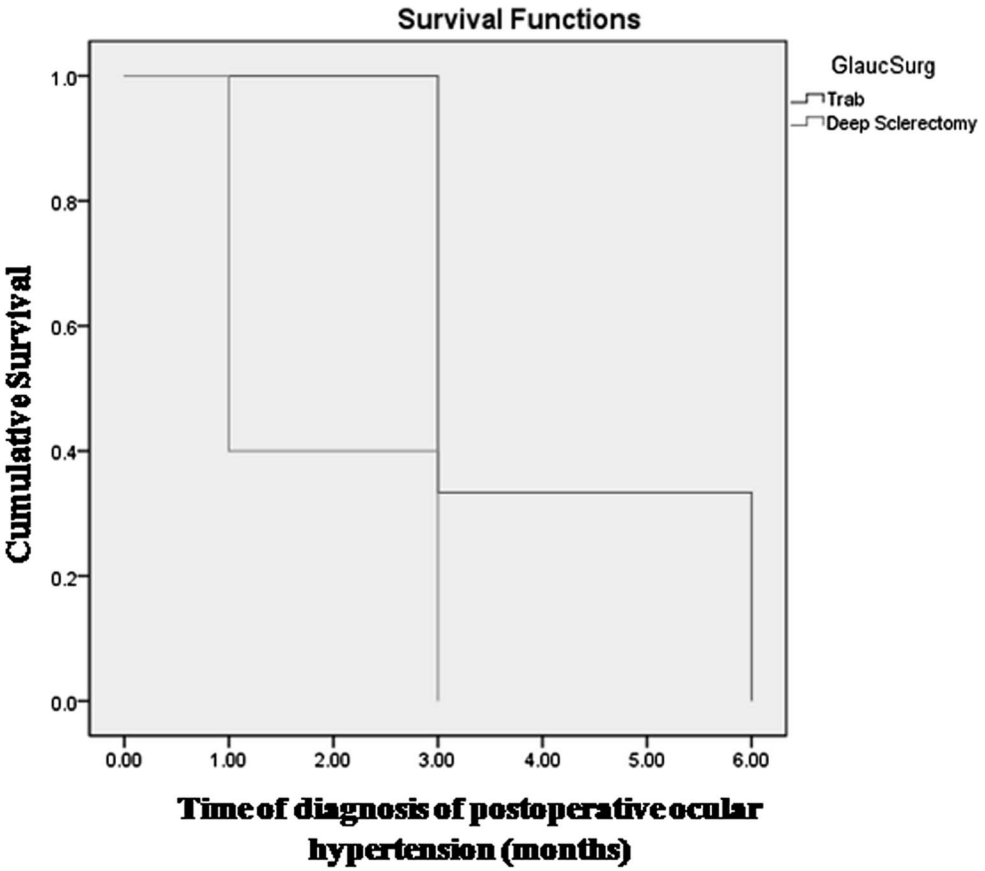

Fig. 3. Kaplan–Meier survival indices for complete success during the postoperative follow-up of 1 year.

in the trabeculectomy Group (A), 33.6 ± 6.8 mmHg in the deep sclerectomy Group (B), 35 ± 4.7 mmHg in Ahmed valve Group (C), and 36.9 ± 4.1 mmHg in the Ex-Press minishunt Group (D). All the eyes in the four groups had a preoperative medication score of three.

Honavar et al[5] found that glaucoma antedated vitrectomy in 13.3% of the eyes in their study, therefore, in our study we excluded patients with history of glaucoma before pars plana vitrectomy.

Postoperatively, we had a significant drop in IOP in each group at each follow-up period. There was also a significant difference between the four groups regarding the postoperative IOP, drop in IOP (from preoperative value), and in the percentage change in IOP at each follow-up visit. Ahmed valve group showed the highest mean percentage drop in IOP, whereas deep sclerectomy group had the least, at 1 day (83.7 ± 4.4 and 57.4 ± 7.2%, respectively),

Table 3. Postoperative Complications: Ocular Hypertension, Hypotony, Shallow Anterior Chamber (AC), Choroidal Detachment, Failure of Filtration and Recurrent Retinal Detachment (RD), and Postoperative Complication Score (Number of Compliations) in the Four Groups (Number and Percentage of Eyes)

	Group A, n (%)	Group B, n (%)	Group C, n (%)	Group D, n (%)	*P*
Postoperative ocular hypertension	3 (30)	5 (50)	0	0	*0.01*
Postoperative hypotony	4 (40)	0	5 (50)	0	*0.004*
Shallow AC	3 (30)	0	4 (40)	1 (10)	0.140
Choroidal detachment	2 (20)	0	5 (50)	0	*0.009*
Failure of filtration	3 (30)	5 (50)	0	0	*0.010*
Recurrent RD	0	0	0	0	
Postoperative complication score:					0.076
0	4 (40)	5 (50)	3 (30)	9 (90)	
1	4 (40)	5 (50)	5 (50)	1 (10)	
2	2 (20)	0	2 (20)	0	

P value < 0.05 is considered statistically significant. Italic values denote statistical significance.

Table 4. Timing of Postoperative Ocular Hypertension Diagnosis Postglaucoma Surgery (Number of Eyes [%])

Timing of Ocular Hypertension Diagnosis Post-glaucoma Surgery, Months	Group A, n (%)	Group B, n (%)	Group C, n (%)	Group D, n (%)
1	0	3 (60)	0	0
3	2 (66.7)	2 (40)	0	0
6	1 (33.3)	0	0	0

1 week (85.7 ± 2.6 and 52.0 ± 10.2%, respectively), 1 month (83.9 ± 2.5 and 36.6 ± 19.5%, respectively), 3 months (80.4 ± 2.8 and 33.9 ± 22.6%, respectively), 6 months (73.0 ± 3.4 and 50.7 ± 11.6%, respectively), and 1 year (67.9 ± 5.1 and 50.0 ± 11.4%, respectively) postoperatively.

Trabeculectomy has a limited role in the management of silicone oil induced glaucoma after PPV with SO injection, therefore adjuvant like mitomycin C (MMC) is used to prevent fibrosis and failure of trabeculectomy.[2] For this reason, we used MMC in our study as an adjuvant to trabeculectomy (Group A), deep sclerectomy (Group B), and Ex-Press minishunt (Group D).

As to success rate, in our work there was no statistically significant difference between the four groups, whereas there was a significant difference regarding postoperative topical antiglaucoma medication score. In the Minishunt group, success rate was 100%. In the trabeculectomy group, complete success was achieved in 50% of cases, 10% qualified success (with medscore 1), and 40% failure (20% needing surgery and 20% with persistent hypotony for ≥2 months). In the deep sclerectomy group, complete success was also 50%, qualified success 20% (with medscore 1), and failure 30% (needing further glaucoma surgery). Finally, in the Ahmed valve group, complete success was 80% and 20% failure due to persistent hypotony for ≥2 months.

Budenz et al[6] studied the management of silicone oil induced glaucoma by either SO removal alone or glaucoma surgery with SO removal (trabeculectomy with or without antifibrotic agents, glaucoma drainage implant surgery and/or modified Schocket procedure). They found that SO removal alone was associated with persistent IOP elevation and required reoperation for glaucoma, whereas concurrent SO removal and glaucoma surgery lead more to hypotony. They reported success rates of 56% and 48% at 24 and 36 months, respectively.

Singh et al[7] reported that the 12-month success rate for trabeculectomy with MMC in silicone filled eyes was lower than that reported for most refractory glaucomas.

Jonas et al[8] found that 93.4% of patients with silicone oil induced glaucoma had normalization of IOP after SO removal that was in contrary to Flaxel et al[9] and Moisseiev et al[10] who reported persistent IOP elevation in all eyes after SO removal.

Wong et al[11] reported that SO removal alone did not achieve normal IOP. However, combining SO removal and medical therapy, only 25% achieved normal IOP, whereas control of IOP was achieved in 71.4% eyes that underwent surgical intervention.

Trans-scleral cyclophotocoagulation was used as an adjunctive therapy to glaucoma surgery for treatment of patients with medically uncontrolled glaucoma persisting after SO removal.[12]

Malhotra et al[13] reported an overall IOP control of 82% with all lines of antiglaucoma therapy: SO removal, trabeculectomy with MMC, AC shunts, and cyclodestructive procedures.

Glaucoma drainage implants offer a good surgical option in cases of refractory glaucoma associated with SO. But there is a possibility of SO escape through the glaucoma drainage tube. Al-Jazzaf et al[14] found a cumulative probability of success of 76% at 1 year with the inferotemporal positioning of Ahmed's valve to reduce the chance of SO flow into the tube. In another study by Ishida et al,[15] comparing Ahmed valve in eyes with and without silicone oil tamponade, they found that Ahmed valve can control IOP in majority of cases but the presence of silicone oil is associated with increased risk of failure of the valve.

Ahmed valve had many drawbacks and disadvantages as limitation of ocular movement, tube obstruction by SO bubbles, corneal touch, tube exposure, increased incidence of hypotony, postoperative endophthalmitis, especially with inferotemporal positioning of the device and increased need for penetrating keratoplasty.[16]

Ex-Press minishunt has not been evaluated before in vitrectomized eyes, but some retrospective nonrandomized case–control studies have compared its IOP lowering effects with conventional trabeculectomy in nonvitrectomized eyes, showing no difference in mean IOP or success rates between groups, but the Ex-Press group demonstrated statistically significant lower rates of early postoperative hypotony and choroidal effusion.[17,18] However, de Jong,[19] reported higher success rates with the minishunt.

In our work, there was a significant difference between the four groups regarding postoperative

complications. The Ex-Press minishunt showed no postoperative complications apart from transient shallow AC in one eye which resolved spontaneously. However, Ahmed valve showed hypotony with choroidal detachment in 50% of the eyes, of which 2 eyes had a failure due to persistent hypotony for ≥2 months. This was apart from one eye that was excluded from the statistical analysis (but not excluded from the study) as it developed atrophia bulbi. This high incidence of hypotony might be attributed to absence of ligation suture round the tube of Ahmed valve in this study.

Trabeculectomy also showed hypotony in 40% of the eyes, of which 2 were considered as failure due to persistent hypotony for ≥2 months, which might be due to the size of the osteum caused by Kelly punch (1 mm) in comparison with the size of the internal lumen of the Minishunt (50 microns). However, neither deep sclerectomy nor Minishunt showed hypotony, therefore, there was a significant difference between the four surgical techniques in inducing postoperative hypotony (P = 0.004). Studying age, sex, preoperative IOP, type of RD needing vitrectomy, and lens status as risk factors for hypotomy showed no statistical significance.

In our study, postoperative ocular hypertension occurred in 50% of the eyes undergoing deep sclerectomy and 30% with trabeculectomy, due to failure of filtration. Ocular hypertension was diagnosed at one to six months postoperatively. Age, sex, preoperative IOP, type of RD needing vitrectomy, and lens status had no statistically significant effect on the time of ocular hypertension diagnosis. None of the eyes undergoing Minishunt or Ahmed valve developed postoperative ocular hypertension, therefore, there was a significant difference between the four surgical techniques in inducing postoperative ocular hypertension (P = 0.01). Also studying age, sex, preoperative IOP, type of RD needing vitrectomy, and lens status as risk factors for hypotomy showed no statistical significance.

As a conclusion, for controlling persistent glaucoma after silicone oil removal in our work, Ex-Press minishunt had the highest complete success rate (100%) with no postoperative complications. Ahmed valve had a high complete success rate (80%) but also high incidence of hypotony (50%), trabeculectomy had a 60% total success rate (complete + qualified) with 30% incidence of postoperative hypertension, whereas deep sclerectomy had a 70% total success rate (complete + qualified) with 50% incidence of glaucoma. Further studies with longer follow-up periods and higher sample size, are needed in this field.

Key words: Ahmed valve, deep sclerectomy, Ex-Press minishunt, persistent glaucoma, silicone oil, trabeculectomy.

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