Viscoelastic-augmented trabeculectomy: A newer concept

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Purpose: Comparison of conventional trabeculectomy (CT) and viscoelastic-augmented trabeculectomy (VAT) in primary open-angle glaucoma. Methods: A total of 65 primary open-angle glaucoma cases were taken for each of the two groups, i.e., CT and VAT. Viscoelastic-augmented trabeculectomy constituted lamellar scleral flap, deep scleral flap, penetrating trabeculectomy, peripheral iridectomy, filling of the anterior chamber with viscoelastic (sodium hyaluronate) and balanced salt solution, movement of visco in bleb, and tight flap closure. Success criteria included intraocular pressure (IOP) <14 mmHg with no devastating complications. Results: Mean IOP was significantly lower after VAT compared to CT at 6 weeks, 12 weeks, and 6 months postoperatively. Target IOP was achieved in 60% cases in VAT group compared to 36.92% in CT group. Conclusion: VAT is effective in reducing IOP to the target level for advanced glaucoma with lower postoperative complications.

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adequate wet-field cautery, and subconjunctival MMC 0.2 mg/ml was applied for 2 min; 4 mm × 4 mm rectangular scleral flap one-third of the thickness dissected to within 1 mm of clear cornea with a bard-parker knife. After creating a paracentesis opening, inner sclerostomy block was dissected out with the blade in the dimensions 2 mm × 3 mm, at the base of the hinge of the superficial scleral flap. Peripheral iridectomy performed through the inner sclerostomy with a Vannas scissor and a single-toothed fine forceps. Scleral flap reapproximated with two 10-0 nylon suture, conjunctival flap closed watertight by running 10-0 nylon suture. Subconjuunctival injection of 0.3 ml gentamycin and 0.3 ml dexamethasone was given, completing the procedure [Fig. 1].

Group B: Viscoelastic-augmented trabeculectomy

Superior rectus bridle suture was placed, fornix-based conjunctival flap was prepared, hemostasis was achieved by adequate wet-field cautery [Fig. 2], and subconjunctival MMC 0.2 mg/ml was applied for 2 min. A 4 mm × 4 mm rectangular scleral flap one-third of the thickness was dissected to within 1 mm of clear cornea with a bard-parker knife [Fig. 3]. After creating a paracentesis opening, inner sclerostomy block was dissected with the blade with the dimensions 2 mm × 3 mm at the base of the hinge of the superficial scleral flap [Figs. 4 and 5]. Peripheral iridectomy was performed through the inner sclerostomy with a Vannas scissor and a single-toothed fine forceps [Fig. 6]. Half the AC space was filled with viscoelastic (sodium hyaluronate) applied through the paracentesis site [Fig. 7]; a small amount of balanced salt solution (BSS) was injected into the AC through the same. While injecting BSS into the AC, when the AC was filled with viscoelastic, movement of viscoelastic into the bleb space and subsequent elevation of the bleb were easily differentiated [Fig. 8]. Thus, the bleb was well elevated by the underlying viscoelastic [Fig. 9]. Half the AC space was again filled with viscoelastic. Scleral flap reapproximated with two 10-0 nylon suture. Conjunctival flap closed watertight by running 10-0 nylon suture. A subconjunctival injection of 0.3 ml gentamycin and 0.3 ml dexamethasone was given, completing the procedure.

Postoperatively, patients were prescribed a combination of antibiotic-steroid (tobramycin 0.3% + dexamethasone 0.1%) eye drops every 2 h for 1 week which tapered over the following 5 weeks. Cycloplegic-mydriatic (homatropine 2%) eye drops
were used when signs of early inflammation appeared and shallow A/C or hypotony was present.

Follow-up was done postoperatively 1 day, 1 week, 6 weeks, 12 weeks, and 6 months afterward, and best-corrected visual acuity (BCVA), IOP, postoperative use of IOP-lowering medication, and proportion of cases with postoperative complications (hyphema, inflammatory reaction, and so on) were recorded and compared in the above two groups.

**Results**

Surgical success was defined in terms of IOP measurement according to the following criteria:
1. Complete success – final IOP <14 mmHg without medication
2. Qualified success – final IOP <14 mmHg with medication
3. Failure – IOP >14 mmHg with medications.

**Outcome analysis**

BCVA, IOP, and postoperative use of antiglaucoma medication of both the groups were assessed in mean ± standard deviation (SD).

Postoperative complications of both the groups were expressed in percentage and proportions. Significance of difference in means was inferred by unpaired $t$-test. Significance of difference in proportions was inferred by Chi-square test.

For significance, $P \leq 0.05$ was considered statistically significant.

The mean age of patients in Group T was $56.72 \pm 12.378$ years and in Group V was $53.15 \pm 10.708$ years ($P = 0.08$ NS).

The preoperative mean BCVA (in log mar) in Group T and Group V was found to be $0.771 \pm 0.5367$ and $0.703 \pm 0.5673$, respectively. The postoperative mean BCVA (in log mar) in Group T was $0.646 \pm 0.3340$ and $0.555 \pm 0.3619$ in Group V.
The preoperative number of antiglaucoma medications was similar in both the groups: 2.42 ± 0.527 in Group T and 2.42 ± 0.497 in Group V. The mean number of postoperative antiglaucoma drugs used was 0.35 ± 0.623 (0.00) SD and 0.17 ± 0.517 (0.00) in Group T and V, respectively [Fig. 10].

In the present study, mean preoperative IOP was 26.14 ± 2.822 (26.00) (22–38) mmHg in Group T and 25.23 ± 3.181 (25.00) (21–36) mmHg in Group V (P = 0.08NS) according to Table 1 and Fig.11. Table 2 and Fig. 12 show mean postoperative IOP in Group T (trabeculectomy with MMC) was 18.52 ± 4.493 mmHg and in Group V (VAT), it was 16.71 ± 4.775 mmHg at the 6-month follow-up.

In Group T (trabeculectomy with MMC), 28 patients (40%) had complications during 1 week of postoperative follow-up. Six patients had shallow AC with hypotony, conjunctival hyperemia, hyphema, and subconjunctival hemorrhage each, and four patients had shallow AC with hyphema.
In Group V (VAT) of ten patients (21.54%) who had complications, shallow AC with hypotony and subconjunctival hemorrhage was seen in four. Two patients had hyphema in the 1st week of postoperative follow-up as shown in Fig. 13.

**Discussion**

Reducing IOP in a glaucoma patient limits disease progression and slows visual field loss. Therefore, the primary goal in the management of glaucoma is to lower the IOP to a predetermined level (target IOP) which is based on the patient’s baseline IOP level, at which further glaucomatous nerve damage is minimal.

Viscoelastic within a bleb might function as a valve that can prevent overfiltration because it would be absorbed more slowly than aqueous humor. VAT is based on the speculation that an ongoing presence of viscoelastic within the bleb...
may prevent AC collapse caused by overfiltration, which causes corneal endothelial decompensation or permanent peripheral anterior synechiae formation with subsequent IOP elevation. It also prevents adhesion of the subconjunctival since viscoelastics act as an antifibrotic agent, thus preventing subconjunctival fibrosis and allowing for better control of IOP.

This barrier is reabsorbed from the site of application within 7 days and therefore does not require a second operation for removal.

In the present study, 130 patients of primary open-angle glaucoma were included. They were divided into two groups.
- Group T: 65 patients underwent trabeculectomy with MMC
- Group V: 65 patients underwent VAT.

All the surgeries were performed by single surgeon to minimize the variability in the results. Postoperative follow-up in both groups was done at 6 months.

No significant statistical difference was observed among the groups according to sex. The males were 58.46% in Group T as compared to 50.77% in Group V and females were slightly less in Group T (41.54%) and as opposed to Group V (49.25%).

The change in the mean BCVA in both groups postoperatively was found to be −0.125 and −0.148 in Group T and Group V, respectively, which was not significant.

In both groups, there was significant reduction in the mean number of drugs required to control IOP postoperatively [Table 6]. In both groups, the difference was significant ($P = 0.75$ NS).

Similar outcomes were seen in a study done by Jeong and Sung[6] in which postoperative reuse of IOP-lowering medications at 1 year (%) was 70.2 ± 4.6 in CT group and 42.4 ± 4.9 in VAT group. Number of medications at 1 year ($n$) was 1.30 ± 1.08 in CT group and 0.73 ± 0.98 in VAT group.

The mean postoperative IOP in Group T (trabeculectomy with MMC) was 18.52 ± 4.493 mmHg, and in Group V (VAT), it was 16.71 ± 4.775 mmHg at 6-month follow-up.

Jeong and Sung[6] conducted a study in which the mean postoperative IOP was significantly lower in the VAT group than in the CT group at 1 day, 1 week, and 1 month postoperation. At 3 months, 6 months, and 1 year, the mean IOP was not significantly different between the two groups.

The mean postoperative IOP at 3 months and 6 months was $13.1 ± 3.9$ and $13.9 ± 4.3$ in CT group and $11.9 ± 4.1$ and $13.4 ± 5.4$ in VAT group, respectively.

The comparison of mean changes in the baseline IOP and postoperative IOP at 6 months in Group T ($7.62 ± 4.765$ mmHg) and Group V ($8.37 ± 5.234$ mmHg) was not significant statistically ($P = 0.39$) as shown in Table 3 and Fig. 14, which was comparable to a study done by Jeong and Sung who found that mean postoperative IOP for both groups was significantly lower than preoperative levels ($P < 0.05$).

Lopes et al.[5] studied 28 eyes in which subconjunctival 2.3% sodium hyaluronate was injected in trabeculectomy versus 27 eyes in control group in which BSS was injected. Mean IOP decreased from $26.0 ± 10.0$ mmHg to $11.6 ± 4.1$ mmHg in the study eyes ($P < 0.001$) and from $24.9 ± 9.7$ mmHg to $13.0 ± 4.1$ mmHg in the control eyes ($P < 0.001$).

In our study, overall success rate (complete success and qualified success) at 6 months was 36.92% in Group T and 60% in Group V. (Table 4 and Fig. 15) The difference between the two groups in success rate was significant statistically ($P = 0.0145$).

Jeong and Sung[6] in their study found the probability of success using Kaplan–Meier graphs and concluded that the complete success rate was significantly higher in the VAT group ($P = 0.042$).

Lopes et al.[5] studied 28 eyes in which subconjunctival 2.3% sodium hyaluronate was injected in trabeculectomy versus 27 eyes in control group in which BSS was injected. Complete success rates were 77.8% for the study group and 84.0% for the control group, 12 months after surgery ($P > 0.5$).

According to Table 5, the comparison of postoperative complications in both the groups was found to be significant statistically ($P = 0.037$ S), which was comparable to a study done by Hoffman et al.[8] who studied injection of 2.3% sodium hyaluronate in a patient of flat AC after trabeculectomy. Sodium hyaluronate restabilized the AC, facilitated filtration, and prevented complications from hypotony.

**Limitations**

1. Small population size: The study would have been more informative if the sample size was larger
2. Smaller follow-up duration: If a longer follow-up duration was given, the results could have been more informative, especially with regard to the late bleb complications associated with MMC
3. This study had undertaken patients with primary open-angle glaucoma alone. Further research on other types of glaucoma such as angle closure glaucoma, secondary glaucomas, juvenile glaucoma is required.

**Conclusion**

We found that although both CT and VAT surgeries significantly lower IOP in primary open-angle glaucoma patients, VAT provided comparable IOP reduction with fewer complications.

Although the results of this study have been encouraging, we believe a longer duration of follow-up will be more

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**Figure 15: Success rate**

| Group  | Success Rate (%) |
|--------|------------------|
| Group T | 36.92            |
| Group V | 60              |

Comparison of success rate between Group T and Group V.
informative in deciding whether VAT is superior to CT for the long-term management of glaucoma.

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Conflicts of interest
There are no conflicts of interest.

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