Miniviscocanalostomy in primary open angle glaucoma

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Abstract: Purpose: To evaluate the efficacy of a new modified technique inviscocanalostomy as a non penetrating surgery in primary open angle glaucoma. **Methods**: this modified technique applied for 50 eyes of 30 patients (35-46 years with a mean age of 40 years years)with uncontrolled primary open angle glaucoma by medical therapy. **Results**: follow up period up to one year revealed significant reduction in intraocular pressure (IOP) as *p* value <.0.001 with complete success in 86 % of cases while qualified success in 14% of cases. Visual field stability occurred in majority of cases. Regarding intraoperative complications: Descement membrane detachment (6 %), Ocular hypotony (2%) and hyphema (2%). **Conclusion**: miniviscocanalostomy is an effective non penetrating glaucoma surgery in controlling IOP with significant visual field stability and potentially reduced risk of sight-threating complications.
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1. Introduction:

Non-penetrating surgical procedures are intended to facilitate the passage of aqueous humor through the trabeculum and Schlemm's canal by by-passing the inner wall of SC which is the site of maximum resistance to aqueous outflow[1]. Viscocanalostomy May occur by several means, the most propable one was that the Aqueous humor outflow from the AC through the window in Descemet's membrane into the scleral lake may exit through the new openings in the SC and into the normal physiologic channels. Finally, a combination of both increased egress of aqueous through the SC and increased uveoscleral outflow may be the reason for the intraocular pressure reduction obtained after viscocanalostomy[2]

2. Subjects and Methods

This prospective study included 50 eyes of 30 patients with uncontrolled primary open angle glaucoma by medical therapy with a mean age of 40 years (range35-46 years).they were assigned to receive this new modification of viscocanalostomy.

Inclusion criteria :

* Primary open angle glaucoma with:
-no previous surgery.
- Uncontrolled IOP level $\leq$ 30 mmHg despite maximally tolerated medical therapy.
- Intolerance or poor compliance to medical treatment and progressive visual field loss despite a numerically controlled IOP (low target pressure patients).

Exclusion criteria:

* Previous ocular surgery.
* Any corneal abnormality that could interfere with accurate applanation tonometry.
* The eye in question was the patient's only Seeing Eye.
* Other types of glaucoma.

Preoperative Preparation

A complete ophthalmologic examination was done which included Gonioscopy using the Goldmann three mirror lens, Anterior segment examination by slit-lamp, IOP monitoring using a slit-lamp mounted applanation tonometer, optic nerve head examination using fundus biomicroscopy, best corrected visual acuity and refractive state and a recent visual field examination in the day before the surgery. All patients were given topical prophylactic ciprofloxacin antibiotic eye drops 4 times daily in the day before the surgery and any systemic anti-glaucoma medication was stopped on the day of surgery.

All patients were informed about the surgical procedure and a written consent was taken before the surgery.

Surgical Technique of miniviscocanalostomy (Figures 1-4)

Anesthesia:

All operations were carried out either under general or local peribulbar anesthesia.

Miniviscocanalostomy:

The surgery was done either under general or local peribulbaranaesthesia.

After a superior rectus bridle suture was taken, a fornix based conjunctival flap was created extending

from 1 to 11 o'clock (Stegmannviscocanalostomy was from 2 to 10 o'clock).

No cauterization was done for as postoperative filtration will depend on the intrascleral and episcleral plexus of veins. Hemostasis was achieved with a microsponge.

A triangle-shaped scleral flap 2.0 x 2.0 x 2.0 mm of 1/3 of the scleral thickness was dissected to create a lamellar flap and extended about 0.5 mm into clear cornea. (scleral flap in Stegmannviscocanalostomy was square shaped 5.0 x 5.0 mm).

A second smaller square or triangular flap was dissected 0.5 mm inside the border of the initial flap and extended into clear cornea for about 0.5 mm.In some cases the second deep flap dissection was done by blade 15 and in other cases that was done by diamond knife. This second flap constituted approximately 2/3 of the scleral thickness to leave a thin translucent layer of sclera overlying the uvea.

As this flap was dissected forwards in the right plane. Two important surgical land marks appeared if dissection was done in the correct surgical plane: the color change from the scleral white to the blue zone of the shlemms canal, and the change of direction of the deeper scleral bundles.

One surgical slit was then made at 12 o clock to create the surgical ostium in the SC(two slits on either side needed in Stegmannviscocanalostomy). Aqueous was noticed from the opened slit of the SC. A finely polished cannula (outer diameter 150 um) was then introduced into the ostia of SC. both right and left, to inject high viscosity sodium hyaluronate (4 %) for 4.0 to 6.0 mm on each side.

Gentle pressure on Schwalbe's line using a cellulose sponge was then applied to separate the Descement's membrane from the corneoscleral junction and create an intact window in Descement's membrane through which aqueous started to Percolate from the AC into the subscleral lake.

The deeper scleral flap was then excised at its base using a Vannas scissors.Five 10/0 nylon sutures were used to suture the superficial flap in a watertight manner.

High viscosity sodium hyaluronate was injected into the subscleral lake to help as a space maintainer and acts as a physical barrier to fibrinogen migration postoperatively. Superficial scleral flap closed with only 3 sutures " one at apex of trangle of the flap and other two sutured on either edge of the traiangle and that was fewer number of stitches of traditional viscocanalostomy " 5 sutures".

The conjunctival flap was sutured using 8-0 silk sutures.

Postoperative follow up:

Postoperatively all patients received a fixed combination of tobramycin and dexamthasone eye drops and ointments for about one week.

- Postoperative follow up visits were done at one day, one week, one month, six months and one year after surgery to assess stability of anterior chamber and exclude any shallowing, any intraocular inflammation, examination of the upper bulbar conjunctiva at the site of surgery and if there was any postoperative filtering bleb. IOP monitoring and assessment of degree of IOP reduction, complete success was defined as an IOP of 21 mmHg or less without the use of topical antiglaucomatous medications while qualified success was defined as an IOP of 21 mmHg or less with the use of a single topical betablocker while failure was defined as an IOP of more than 21 mmHg with or without antiglaucomatous medications. Other assessment criteria included BCVA, Optic nerve head examination using fundus biomicroscopy, Visual field examination and recording of anyintraoperative or postoperativ complications.

The data was analysed using the mean and the standard deviation(**SD**) for qualitative data, the percent for quantitative data and **P-value** for demonstratation of the data significance.

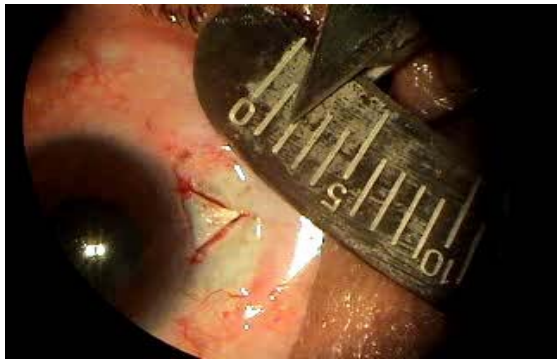

Fig. 1: Superficial scleral dissection at 12 oclock 2x2x2mm.

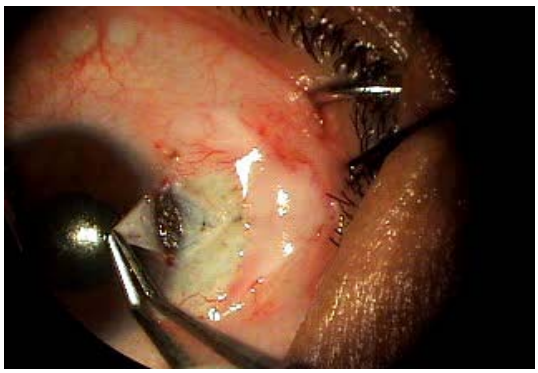

Fig. 2: After removal of deep scleral flap.

Fig. 3: Injection of haelon into Schlemms canal lumen.

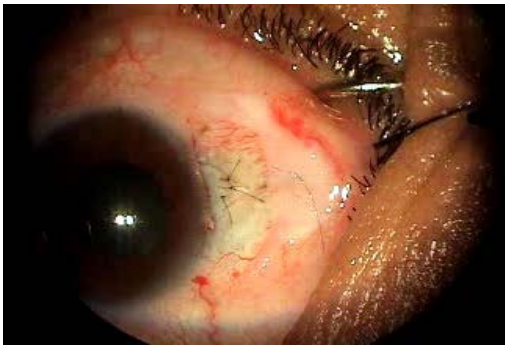

Fig. 4: Closure of the scleral flap only with 3 sutures.

3. Results

This study revealed a significant reduction in IOP in postoperative period as the mean IOP of the studied eyes was 24.4 ±1.9, that was reduced to 17.2± 2.2 in the first day postoperative with more reduction at first month to 16.1±1.1 and till after one year (mean IOP= 16.1± 1.2) with significant reduction in IOP (*p* value < 0.001) (Table 1 and Figure 5).

Complete success was in 43 cases (86%) with no need for any antiglaucomatous treatment.

While only 7 cases in the study(14 %) shown a qualified success after minicanalostomy with elevation of IOP from the first day after surgery needed for one antiglaucomatous treatment in the form of betablockereyedrop that was sufficient to control the IOP.

Table 1: (X±SDof preoperative IOP versus postoperative IOP)

	Mean	±Std. Deviation	Repeated measures ANOVA	*p*-value
Pre_operative	24.4000	±1.94049	238.5	< 0.0011
One_day	17.2333	±2.26949		
One_month	16.1667	±1.17688		
Six_month	16.1000	±1.18467		
One_year	16.1000	1.21343		

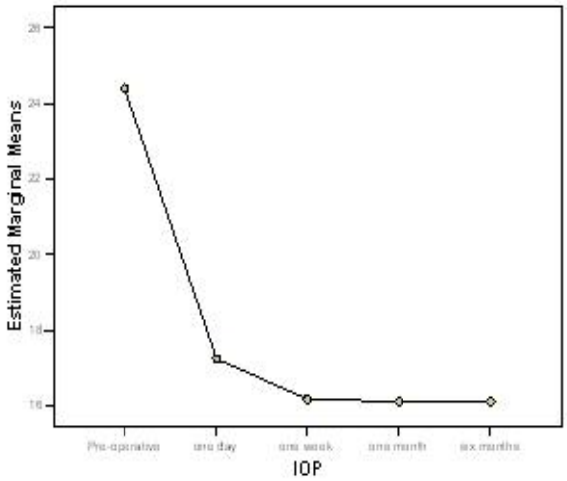

Fig 5: of preoperative IOP versus postoperative IOP

Regardingof the effect of the study on the visual field one year after the surgery, only 8 cases (16%) presented with field deterioration four cases of which related to the group of qualified success patients, 2 cases(4%) show significant improvement in field as regarding the field retinal sensitivity and other parameters and 80 % of cases presented with follow up stability in field.

The study represented significant stability of the visual acuity (*p* value<0.001).that was ranged preoperatively between 6/12 and 6/36.

Only 2 cases(4%) showing drop in one line of Landolt's broken ring chart in V.A (the two cases of descement membrane detachment). One was dropped from V.A equals 6/18 to V.A equals 6/24 and the other case was dropped from V.A equals 6/24 to V.A equals 6/36.

While 48 cases(96%) showing no change in the visual acuity.

As regarding the postoperative complications of miniviscocanalostomy were hyphema 4 cases (8 %), Descement membrane detachment 3 cases (6%) and long standing upper bulbar conjunctival injection 7 cases (14%) (from one to three months,after that completely disappeared after steroid eye drop application).

4. Discussion

Viscocanalostomy is one of non penetrating glaucoma surgeries its idea depending on injecting a high viscocity sodium hyaluronate to dilate the schlemm's canal and create microperforations in its wall to facilitate aqueous passage from anterior chamber to the canal lumen.That was associated with formation of a subscleral lake allowing the passage of aqueous from the anterior chamber through an intact descement's window then passed into the dilated ostia

of the schlemm'scanal.And finally aqueous then flows to the deep and intrascleral venous plexus then into the ciliary veins [3].

In this study a new modification of viscocanalostomy was done depending on decreasing the dissection area from 5x5 mm as in traditional viscocanalostomy (parabolic-shaped) to be only 2x2x2 mm(triangular –shaped) and in stead of doing 2 radial slits on either side of schlemms canal to be only one vertical slit at 12 o clock (the site of maximal resistance to aqueous outflow), This modified technique was evaluated as non penetrating surgical technique in 50 eyes of 30 patients with primary open angle glaucoma that were uncontrolled with maximally tolerated medical therapy.The efficacy of this technique compared with the efficacy of traditional viscocanalostomy.

In this study complete success was in 43 cases (86%) with no need for any antiglaucomatous treatment.

While only 7 cases in the study (14 %) shown a qualified success after minicanalostomy with elevation of IOP from the first day after surgery needed for one antiglaucomatous treatment in the form of betablockereyedrop that was sufficient to control the IOP.

These results similar to those achieved in traditional viscocanalostomy who reported that complete success occurred in his study in 86.2% of the cases [4].

Also this complete success is similar to other studies with complete success occurred in his study in 89% of the cases, and others who reported that the complete success was 88% [5].

Studies done by Yarangumelistudied 44 eyes in 22 patients with glaucoma. One eye was randomly selected for trabeculectomy or viscocanalostomy, and the other eye was treated with the other surgical procedure 2 weeks later. At a mean follow-up of 18 months, complete success rates (IOP less than or equal to 18 mm Hg without medication) were 64% for trabeculectomy and 59% for the viscocanalostomy. Complication rates were similar between the 2 groups [6].

Other studies done by Yalvac *et al.*, evaluated 50 eyes of 50 patients with primary open-angle glaucoma who were randomized to undergo traneculectomy (25 eyes) or viscocanalostomy (25 eyes). Complete success (IOP 6-21 mm Hg without medication) was achieved in 55% of eyes in the trabeculectomy group and in 35% of eyes in the viscocanalostomy group at 3 years. Early transient complications occurred more frequently in the trabeculectomy group [7].

As for the mean IOP that was assessed at one day, one week, one month,, six months and one year. our study revealed a significant reduction in the mean IOP as the mean IOP of the studied eyes was 24.4 $\pm$ 1.9, that was reduced to 17.2$\pm$ 2.2 in the first day postoperative with more reduction at first month to 16.1$\pm$1.1 and till after one year (mean IOP= 16.1$\pm$ 1.2) with significant reduction in IOP (p value < 0.001).

These results were similar to those obtained by carassa 4 et al in 1998 who obtained that the mean preoperative IOP was 27. 7 $\pm$ 9. 5 mmHg and reached 12. 0 $\pm$ 3. 0 mmHg at the end of the follow up period [4].

Also these results were similar to the good pattern of reduction obtained by stegmann studies[2].

Also other studies described that the reduction occurred under the effect of antiglaucomatous medications was better to control IOP with time and the follow up revealed less pattern of IOP reduction.[3]

As discussed there was a variations either in degree of success of viscocanalostomy or in degree of reduction of mean IOP during the follow up period and there is a possibility to explain this variation according to the learning curve and surgical experience in good dissection of the flaps and good exposure of Schlemm's canal and injection of the haelon into the canal lumen.

As for the effect of this technique on the final visual field of the patients, there was a significant stablility in the visual field during the follow up period till one year after the surgery as there was no change in 80 % of the cases.

A small percentage of cases (4%) showing some improvement in the visual field as regarding the retinal sensitivity that was improved in the 2 cases in which no complications was occurred and showing complete success in IOP reduction.

While only (16%) of cases showing deterioration in the retinal sensitivity, this deterioration that occurred in only 8 cases four cases of which shown elevation in IOP in the first postoperative day and subjected to treatment in form of a betablocker eye drop in order to reduce IOP all over the follow up period of one year,and the other 4 cases showing this deterioration despite complete success in controlling IOP " this mostly due to unsuitable target IOP for those patients".

This excellent percentage in stability of the visual field one after viscocanalostomy was most properly due to stable anterior chamber during and after the surgery that was in 80% of the cases so no sudden decompression of the globe occurs.

The above results was similar to those shown only 5 % of the cases in his study (4 eyes from the total number of 67 eyes in the study) presented with deteriorated visual field [5].

As for the effect of viscocanalostomy on the final visual outcome of the patients, there was a stable visual acuity after one year in (96%) showing no change in the visual acuity. (*p* value<0.001).

This high significant stability in the visual acuity was in agreement with other results that shown 64 cases in his study out of 67 cases (95.5%).[5]

Also other studies done by and showed no effect of viscocanalostomy on the visual acuity in most of the cases that remained stable during the follow up period.[3]

Therefore, a significant stability in both visual acuity and visual field of these patients that give miniviscocanalostomy a great benefit as one of non penetrating glaucoma surgeries.

As regarding postoperative complications of miniviscocanalostomy were hyphema 4 cases (8 %),Descement membrane detachment 3 cases (6%) and long standing upper bulbar conjunctival injection 7 cases (14%) (from one to three months,after that completely disappeared after steroid eye drop application).

There was a similar studies that presented with a low rate of Intra-operative and postoperative complications as discussed by Jonescu-cuypersstudies [8].

Also in agreement with another study done in ***Cologne, Germany***, compared viscocanalostomy to the standard trabeculectomy in treating white patients with open angle glaucoma,Intraoperative complications included bleeding into the conjunctiva in one case of VSC and IOP spikes in 3 cases of VSC necessitating re- operation.[8]

Furthermore studies followed up 57 eyes of viscocanalostomy for five years. No serious complications were met with a low rate of these complications.[3]

Moreover a bigger study by entailing 56 eyes with medically uncontrolled POAG obtained incidence of Postoperative complications that included hyphema (2%); hypotony less than 10 mmHg (2%); positive Seidel test (17%); further surgery to lower IOP (12%). Despite watertight closure of the scleral flap, 26 patients had evidence of subconjunctiva drainage (microcysts or bleb) at 1 year.[9]

As regarding the number of sutures, different studies revealed that may affect postoperative IOP reduction levels as 10. and this explains good postoperative results of this modified technique as sutures only three in number due to smaller dissection.

Lastly, this study was associated with a low percentage of complications which were not serious thus reflecting the safety of this surgery which so has the advantage as a non penetrating glaucoma surgery giving good reduction of IOP with less complications as compared with the commoner operation in glaucoma surgeries which is the subscleraltrabeculectomy.

Conclusion:

Minicanalostomy is an effective and safe surgical approach in primary open angle glaucoma.

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