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Original Article

Needle infusion avoids using sutures and prevents hypotony in the 23 gauge sutureless vitrectomy

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Abstract: Objective: To investigate the effects of needle infusion on preventing wound leakage and hypotony in sutureless vitrectomy. Methods: We retrospectively reviewed 230 consecutive eyes of 23-gauge pars plana vitrectomy with or without needle infusion, and further measured the wound leakage and intraocular pressure (IOP) without using a suture. Results: In the eyes with primary needle infusion inserted before infusion cannula removal, IOP was stable during and after infusion cannula removal. No suture was needed in the procedure. Postoperative hypotony did not occurred in all eyes with needle infusion either. Conclusion: Needle infusion inserted before infusion cannula removal can avoid using sutures and prevent hypotony intraoperatively and postoperatively.

Keywords: Hypotony, needle, infusion, sutureless, vitrectomy

Introduction

Currently, microincisional 23-gauge sutureless vitrectomy has gained increased popularity among vitreoretinal surgeons [1]. Unfortunately, poor scleral wound competence was encountered even when the surgeon utilized the recommended angled-incisional approach with good conjunctival placement and/or massaging of the wound at the conclusion of the surgery [2, 3]. Wound leakage has the risks of insufficient tamponade, intraocular hypotony, potentially endophthalmitis and choroidal detachment or choroidal hemorrhage[4]. Various postoperative hypotony rates have been reported with different endotamponades applied [5]. To avoid these complications, some surgeons prefer to perform transconjunctival sutures. However, sutures are very irritating to patient and may cause local inflammatory reaction. Sometimes, wound leakage in an air-filled eye may result in severe hypotony while withdrawing infusion cannula at the completion of surgery, which can be worsen by the procedure of suturing and thus increases the risk of complications.

Here we report a technique of inserting a 30-gauge infusion needle into vitreous cavity prior to the infusion cannula removal to avoid using sutures and prevent hypotony intraoperatively and postoperatively.

Methods

Patients

The study is a retrospective study and has been approved by the ethical committee of the hospital. All consecutive patients who underwent 23 gauge pars plana vitrectomy with fluid-air exchange by a single surgeon (D. Z.) from Nov. 2013 to Aug. 2014 were included. Patients were divided retrospectively into two groups according to whether needle infusion was used before infusion cannula removal at the conclusion of surgery, including early consecutive cases without needle infusion, followed by consecutive cases with needle infusion.

Materials and methods

All patients underwent three-port pars plana vitrectomy (Constellation® Vision System, Alcon Laboratories Inc, Fort Worth, TX, USA) with a single-step trocar/cannula assembly (Alcon Laboratories Inc, Fort Worth, TX). The conjunctiva was displaced anteriorly from the desired sclerotomy site using a cotton swab. All

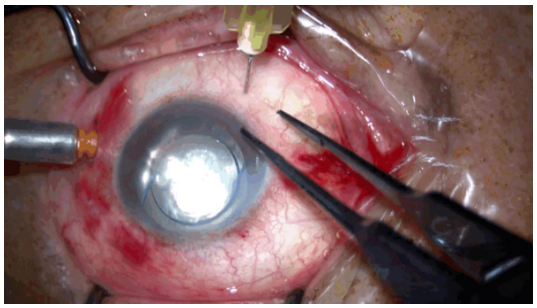

Figure 1. Procedure of Needle Infusion.

incisions were created in a biplanar entry as follows: first tangential to the sclera and then obliquely further into the eye. Authors advocate complete vitrectomy including vitreous base shaving and removal of vitreous around the internal sclerotomies. At the conclusion of surgery, all patients had complete or incomplete fluid-air exchange. Superonasal and superotemporal cannulas were removed respectively. The light probe was introduced through the cannula into the vitreous cavity and the cannula extruded out. The light probe is then slowly withdrawn at the same angle as entry and gentle pressure is done on the conjunctiva over the incision. The sclerotomy was assessed for air leak by wetting with balanced saline solution. Any wound that was noted to leak was depressed again for a while, or suturing was required. In non-needle infusion group, the infusion cannula was directly extruded out at the infusion pressure of 25 mmHg. In the needle infusion group, the proximal infusion line was then clamped and disconnected from the distal part. A 30-gauge needle was connected to the distal part, and introduced into the vitreous cavity to maintain intraocular pressure (IOP). Then the infusion cannula and the clamped proximal infusion line were removed en bloc, followed by the inspection of tightness of the sclerotomy as described above. Finally, the infusion needle was pulled out at the infusion pressure of 25 mmHg (**Figure 1** & Supplementary Video 1, which demonstrates infusion needle insertion and withdrawing). In both groups, pure C_3F_8, when necessary for tamponade, was injected into the eye by a 1 ml syringe with another 30-gauge needle. The different volume of C_3F_8 from 0.3 to 1.0 ml was determined by the various vitreoretinal conditions. IOP was adjusted by repeated infusion and suction. All cases utilizing silicone oil were excluded from the study because there is no need for needle infusion in these eyes. IOP was measured on postoperative day one using a Topcon CT-80 non-contact tonometer (Abdulrehman AlGosaibi GTB, Riyadh, Saudi Arabia).

Statistical analysis

The statistical analysis was carried out using the statistical package for social sciences software version 16.0 (SPSS Inc, Chicago, IL, USA). The student's paired t test and oneway analysis of variance were used to test the statistical significance of the changes in IOP. $P < 0.05$ was accepted as being statistically significant.

Results

We performed a retrospective review of 230 eyes from 204 patients that had undergone successful 23-gauge vitrectomy for various vitreoretinal disorders as follows: idiopathic macular holes, epimacular membrane, macular schisis, proliferative diabetic retinopathy, non-resolving vitreous hemorrhage, rhegmatogenous retinal detachment, ocular trauma, Silicone oil removal and so on. 158 eyes from 136 patients with needle infusion before withdrawing the infusion cannula were in needle infusion group and the other 72 eyes from 68 patients were in non-needle infusion group. Diagnoses and clinical data for the groups are summarized in **Table 1**. There was no significant difference between the two groups regarding patient age, gender, diopter and IOP. All cases in needle infusion group maintained stable IOP after withdrawing the infusion cannula and during the procedure of gas injection. No suture was needed in any sclerotomy. In non-needle infusion group, sutures were required in 11 sclerotomies (9 infusion sclerotomies and 2 superior sclerotomies) of 9 eyes. Needle infusion for elevation of IOP was supplemented in 32 eyes after withdrawing the infusion cannula, when leakage and hypotony occurred. Progressive hypotony leading to collapse of the eyeball due to persistent air leakage, worsen by the procedure of massage, suturing or injection, was present in 6 eyes. On postoperative day 1, mean IOP was 15.49 ± 4.93 mmHg in needle infusion group, compared to preoperative 16.17 ± 3.01 mmHg ($P > 0.05$). In non needle infusion group, mean IOP in the eyes without supplemental needle infusion was 10.81 ± 4.03 mmHg, lower than preoperative 15.94 ±

Table 1. Diagnoses and clinical data

	Needle infusion	No needle infusion	Total
Number of eyes	158	72	230
Eye			
Right	74	38	112
Left	84	34	118
Diagnosis			
RRD	21	11	32
MH	9	5	14
ERM	42	18	60
Schisis	15	6	21
PDR	27	10	37
RVO	11	6	17
Trauma	14	6	20
SiO removal	13	5	18
Other	6	5	11
Diopter			
> -6.0D	25	15	40
Other	133	57	190

RRD: rhegmatogenous retinal detachment; MH: macular hole; ERM: epimacular membrane; PDR: proliferative diabetic retinopathy; RVO: retinal vessel occlusion; SiO: silicone oil.

2.90 mmHg ($P < 0.01$) and that in the needle infusion group ($P < 0.01$). IOP in the eyes with supplemental needle infusion was 13.71 ± 3.49 mmHg, lower than preoperative 15.90 ± 3.37 mmHg ($P < 0.05$), not significantly different from that in the needle infusion group ($P = 0.05$). Hypotony (< 6 mmHg) was present in 5 eyes without supplemental needle infusion, however, none with supplemental needle infusion or in needle infusion group. No patient had choroidal hemorrhage and/or endophthalmitis. No lens and retina damage occurred in the eyes with primary or supplemental needle infusion. Sufficient gas tamponade was observed for the patients with rhegmatogenous retinal detachment or macular hole.

Discussion

Microincisional sutureless vitrectomy was primarily used for "simple" cases, such as epimacular membranes, macular holes and vitreomacular traction. These eyes could have large amount of remnant vitreous base, which would obstruct scleral incisions and reduce leakage. During the past few years, with further improvement of instruments and newer vitrectomy systems, the indications for sutureless vitrectomy have expanded to nearly all surgical cases, including retinal detachment, proliferative diabetic retinopathy and ocular trauma. Incisional vitreous incarceration may be related to postoperative complications, such as endophthalmitis due to an incisional vitreous wick, peripheral retinal tears resulting from postoperative vitreous contraction, and fibrovascular proliferation which is thought to be a major risk factor for recurring vitreous hemorrhage in diabetic patients, so, the authors always prefer to perform a complete vitrectomy including peripheral vitreous removal, which at the same time increases the risk of wound leakage. Other factors that contribute to wound leakage include increased surgical duration, prior vitrectomy and young age [6, 7]. In addition to a proper wound construction, partial or complete fluid-air exchange at the end of surgery is another approach to aid in sclerotomy closure [8]. It is possible that the increased surface tension of air, compared to fluid, helps to seal the sclerotomy internally. However, it is dangerous when air fails to seal the sclerotomy and goes out of the eye while withdrawing the infusion cannula at the end of surgery. Persistent air leakage, which is often worsened by an inappropriate pressure or unsuccessful suturing, would result in collapse of the eye. Moreover, the air leakage makes the supplemental infusion more difficult and further increases subsequently the risk of choroidal hemorrhage. On the other hand, if an infusion needle is inserted before withdrawing the infusion cannula and maintained after its removal, we don't see any problem of the leak of the sclerotomy, because the IOP can be controlled by the vented gas forced infusion of the vitrectomy system. We suggest that there are enough time and increase of IOP which are helpful for the wound closure. Some surgeons suggested that momentary elevation of IOP up to 60 mmHg accelerates the closure of sclerotomy [9]. It is possible that the internal pressure from the infusion combined with the external pressure from the cotton tip help close the internal lip against the external lip of the oblique wound. This has been shown very nicely in clear cornea cataract wound, where the higher the IOP, the tighter the seal of the oblique or biplanar incision [10]. Adequate IOP and timely incision collapse in the immediate postoperative period may reduce leakage and avoid postoperative hypotony. This can explain the absence

of postoperative hypotony in the needle infusion group and the eyes with supplemental needle infusion. Furthermore, early wound closure also reduced adverse effect of suturing. In the non needle infusion group, there were two superior sclerostomies, which may not be able to close early due to low IOP, in this case, suturing is required due to the gas injection and leakage.

We suggest that the supplemental needle infusion provide sufficient IOP on postoperative day one, so the primary needle infusion is not necessary in each case. In the present study, there were 32 eyes (44%) needed supplemental infusion due to wound leakage and hypotony in the non needle infusion group. Injection on a soft eye was difficult and fraught with risk of lens and retina damage, which would contribute to further air leakage and lead to collapse of the eyeball. In contrast, with primary needle infusion, IOP was very stable during surgery for each case. The infusion needle was not removed until leak of any wounds has been resolved. This not only makes sutureless vitrectomy safer for patients, but also let surgeons feel easier during and after the surgery.

To reduce the rate of wound leakage, there are increasing number of surgeons move to 25 and 27-gauge vitrectomy systems. However, wound leakage is still inevitable, so needle infusion may also be used in these conditions.

In conclusion, by using needle infusion before withdrawing infusion cannula, we can avoid using sutures and prevent hypotony intraoperatively and postoperatively, especially for the eyes undergoing complete vitrectomy in the 23-gauge sutureless vitrectomy.

Disclosure of conflict of interest

None.

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