

25-Gauge anterior vitrectomy via the scleral flap in phacoemulsification combined with trabeculectomy for glaucoma and cataract with extremely shallow anterior chamber

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Abstract

Objective: To observe the safety and efficacy of a surgical technique of 25-gauge anterior vitrectomy via scleral flap in phacoemulsification combined with trabeculectomy for glaucoma and cataract with extremely shallow anterior chamber.

Methods: This was a retrospective study composed with 18 eyes of 18 patients (8 males and 10 females), including 11 eyes with acute angle closure glaucoma, 8 eyes with lens subluxation combined with glaucoma. All patients underwent phacoemulsification, intraocular lens (IOL) implantation, trabeculectomy, and anterior vitrectomy via the scleral flap in cases where conservative managements cannot control intraocular pressure (IOP). The main outcomes were best corrected visual acuity (BCVA), anterior chamber depth (ACD), IOP, slit lamp microscopic examinations, medications, fundus examinations and complications.

Results: The average axial length (AL) was 21.5 ± 0.6 mm (range: 20.0 to 23.2 mm). Mean age was 62.3 ± 7.9 years old (range: 46 to 73 years). Mean ACD increased statistically significant from 0.78 ± 0.43 mm to 2.89 ± 0.41 mm 1 week after surgery ($P < 0.001$). Mean IOP decreased significantly from 43.28 ± 9.38 mmHg to 16.72 ± 6.28 mmHg ($P < 0.001$). There were no serious complications occurred, such as endophthalmitis, retinal detachment, suprachoroidal hemorrhage, corneal decompensation and malignant glaucoma.

Conclusions: 25-Gauge anterior vitrectomy via the scleral flap was a safe and effective technology in glaucoma combined with cataract with extremely shallow anterior chamber.

Background

As we all know, glaucoma with crowded anterior chamber and cataract was a challenge for ophthalmologists in surgery, which may lead to a series of complications, such as lens dislocation, corneal endothelial decompensation, iris prolapse, posterior capsular rupture.^[1, 2] The mechanism of narrow anterior chamber could be aqueous misdirection syndromes. Anterior vitreous displacement forward so that it faced against the ciliary body and lens preventing the normal aqueous humor flow.^[3] The posterior pressure increased with the accumulation of aqueous humor in the posterior segment, which leads to the anterior displacement of the iris–lens diaphragm and extremely shallow anterior chamber.^[2, 4, 5] The core of the treatment was to re-establish the anterior chamber to giving more space for surgical operation and create the communication to allow free diffusion of aqueous humor from vitreous to anterior chamber. However, the anterior chamber depth (ACD) cannot be deepened easily though the viscoelastic agents were injected in during surgery.^[6] Chandler et al.^[7] first described the technique of vitreous aspiration by an 18-gauge needle via a pars plana incision to reformation of anterior chamber. The technique was later abandoned because of the high incidence of cataract and the risk of retinal detachment. With the development of technology, vitrectomy with microincision has been widely used in ophthalmology in recent years. Previous study have demonstrated the effectiveness of

partial pars plana vitrectomy (PPV) in malignant glaucoma.^[1] Zhang et al. ^[8] also verified that 23-gauge transconjunctival PPV combined with pars plana lensectomy (PPL) was helpful for glaucoma patients with cataract and shallow anterior chamber.

In our study, we used 25-gauge anterior vitrectomy via the scleral flap in phacoemulsification and trabeculectomy for glaucoma combined with cataract with extremely shallow anterior chamber to solve the problem of anterior chamber reformation during the operation.

Methods

A retrospective case review was consisted of 18 eyes of 18 patients (11 eyes with acute angle closure glaucoma, 8 eyes with lens subluxation combined with glaucoma) attending the hospital between May 2016 to October 2019. Research was performed in accordance with the Declaration of Helsinki and approved by the Ethics Committee. All patients with extremely narrow anterior chamber and uncontrolled intraocular pressure (IOP) responded no to conventional medical therapy or laser iridotomy. Six eyes had undergone YAG laser iridectomy among them. Patients received comprehensive examinations, including slit lamp microscope, gonioscopy, best corrected visual acuity (BCVA), IOP, optical coherence tomography (OCT), corneal topography, A-scan ultrasound biometry, ultrasound biomicroscope (UBM), corneal endothelial cell count and B-scan ultrasonography. ACD and anterior chamber angle were observed by UBM. ACD was defined as the distance between the posterior surface of the cornea and the anterior surface of the lens. Axial length (AL) and central corneal thickness (CCT) were obtained by A-scan ultrasound biometry. BCVA was measured using the LogMAR chart. The lens nucleus was graded 2 to 4 using the Lens Opacity Classification System (LOCS III). The postoperative follow-up time was 3 months for all patients.

Surgical Procedure

All surgeries were operated by a skilled ophthalmologist. After successful local anesthesia, we made a conjunctival flap with the base of the fornix, then created a scleral flap in a size of 3 mm x 5 mm, with a depth of half of the scleral thickness. The anterior chamber was difficult to deepen despite the injection of viscoelastic agent through a self-sealing clear corneal incision. A pars plana incision 4.0 mm posterior to the limbus was made with corneal cutter (about 20-gauge) under the scleral flap. Anterior vitrectomy with 25-gauge was performed through this incision followed. During the operation, we observed outflow of aqueous fluid from the posterior chamber to the incision. After the creation of this pathway, the eyeball softened as the posterior pressure reduced. And the depth of anterior chamber was deepened easily. Then capsulorhexis, phacoemulsification and intraocular len (IOL) implantation were performed successfully. Trabeculectomy and iridectomy was operated subsequently. Patient with subluxation was implanted with a capsular tension ring. The conjunctival and scleral lap were sutured with 10 - 0 nylon sutures finally. During 25-gauge anterior vitrectomy, no infusion or illumination was required. On the other hand, the scleral incision required no stitches.

Postoperatively, patients received a standard treatment, including tobramycin dexamethasone eyedrops and nonsteroidal anti-inflammatory eye drops four times a day for 4 weeks. All glaucoma medications were discontinued. Additional therapeutic measures were taken if necessary. Postoperative examinations were arranged 1 week, 1 month and 3 month after the surgery. Additional reviews were scheduled depending on the condition.

Statistical analysis

Data were analyzed using SPSS software version 18.0. Normal distribution was assessed with the Kolmogorov–Smirnov test. A one-way analysis of variance (ANOVA) and LSD t-test was used to analyze the differences among groups. A P-value of < 0.05 was considered statistically significant.

Results

The basic information was presented in Table 1. The mean age was 62.3 ± 7.9 years (range: 46 to 73 years). The mean AL was 21.5 ± 0.6 mm (range: 20.0 to 23.2 mm). We observed a significant increase in ACD, the preoperative mean ACD was 0.78 ± 0.43 mm, postoperative mean ACD was 2.89 ± 0.41 mm, 2.97 ± 0.26 mm, 3.0 ± 0.29 mm respectively during the follow-up time (Table 3). The IOP varied from 29.0 mmHg to 58.0 mmHg before operation, with a mean pressure of 43.28 ± 9.38 mmHg. And the IOP was 16.72 ± 6.28 mmHg on the first week, which decreased significantly. IOP was 14.94 ± 5.17 mmHg, 14.28 ± 4.13 mmHg on the first month, third month respectively. The BCVA was significantly improved in all cases which was listed in Table 4. No serious complications happened.

Table 1
Participant demographics

	Mean (SD)	Range
Gender (male:female)	8:10	
Age (years)	62.3 ± 7.9	46–73
AL (mm)	21.5 ± 0.6	20.0-23.2
CCT(mm)	500 ± 25	450–590
AL: axial length; CCT: central corneal thickness;		

Table 2
data of intraocular pressure before and after surgery

	Intraocular pressure (mmHg)		
	Mean (SD)	Range	P-value
Pre-op	43.28 ± 9.38	29.0–58.0	
1st week	16.72 ± 6.28	5.0–28.0	< 0.001
1st month	14.94 ± 5.17	7.0–25.0	< 0.001
3rd month	14.28 ± 4.13	8.0–21.0	< 0.001

Table 3
data of anterior chamber depth before and after surgery

	Anterior chamber depth (mm)		
	Mean (SD)	Range	P-value
Pre-op	0.78 ± 0.43	0.1–1.5	
1st week	2.89 ± 0.41	2.2–3.5	< 0.001
1st month	2.97 ± 0.26	2.2–3.5	< 0.001
3rd month	3.0 ± 0.29	2.6–3.5	< 0.001

Table 4
data of best-corrected visual acuity before and after surgery

	Visual acuity (LogMAR)		
	Mean (SD)	Range	P-value
Pre-op	1.06 ± 0.39	0.7–1.7	
1st week	0.66 ± 0.24	0.3-1.0	< 0.001
1st month	0.68 ± 0.25	0.3-1.0	< 0.001
3rd month	0.62 ± 0.21	0.3–0.9	< 0.001

Discussion

Glaucoma with extremely shallow anterior chamber and cataract was a complex clinical problem. High IOP and narrow anterior chamber for long time may lead to severe visual impairment, decompensation of the corneal endothelium and increasing the difficulties during the surgery, including iris prolapse, capsular rupture, suprachoroidal hemorrhage, crystal dislocation, endothelial damage, malignant glaucoma.^[1, 9, 10] It was showed that ciliary or pupillary blockage resulting in the forward displacement of the lens-iris diaphragm was the main mechanism.^[6, 11] When medical or laser treatment failed to induce IOP, surgical intervention is necessary. The main focus of the operation was how to overcome the difficulties of surgery in the presence of high IOP and extremely shallow anterior chamber.

Chandler first described the technique of vitreous aspiration by an 18-ga needle via a pars plana incision.^[7] As the technology develops, microincisional vitrectomy surgery (MIVS) has been widely used in clinical practice, with the advantages of shorter operation time, faster wound healing, less trauma and reduced postoperative inflammation. Previous studies had confirmed that the efficacy of PPV was effective for softening the eye and deepening the anterior chamber through removing the anterior vitreous.^[12-14] Sharma et al.^[1] described vitrectomy–phacoemulsification–vitrectomy in management of malignant glaucoma. He et al.^[15] also confirmed that clinical efficacy of modified partial PPV and phacoemulsification for malignant glaucoma. Zhang et al. verified that 23-gauge transconjunctival PPV and PPL was benefit to glaucoma and cataract patients with narrow anterior chamber.^[8]

In our research, all patients with high IOP and shallow anterior chamber responded no to medical therapy or laser iridotomy required surgical intervention. However, the anterior chamber was difficult to deepen during surgery. At the beginning of surgery, 25-gauge anterior vitrectomy was performed under the scleral flap in order to reduce positive posterior pressure. In this way, the eyeball softened and the anterior chamber deepened significantly. According to previous experience, we suggest that the removal of vitreous is about 0.5 ml according to Morgan.^[16] Matlach et al.^[17] suggested continuing to vitrectomy until the anterior chamber deepens intraoperatively. Then phacoemulsification, IOL implantation and trabeculectomy were operated with more space, decreasing the risk of surgery. Anterior chamber was formed and postoperative IOP was well controlled. The mean IOP was 16.72 ± 6.28 mmHg at first week after surgery and maintained stability. At the last visit, the anterior chamber was remained well with a mean depth of 3.0 ± 0.29 mm. The BCVA was improved in all patients. There were no serious complications occurred, such as endophthalmitis, retinal detachment, suprachoroidal hemorrhage, anterior chamber disappearance, corneal decompensation and malignant glaucoma.

The advantages of this technology were as follows: firstly, it reduced the disturbance of conjunctiva and sclera with faster wound healing and less inflammation. Secondly, the scleral incision required no stitches with less time. Thirdly, it also reduced the incidence of malignant glaucoma. Aqueous fluid from posterior chamber could flow into anterior chamber to reduce IOP. Fourthly, only one 25-gauge vitreous cutter was used during vitrectomy. It required no precorneal contact lenses, fiberoptic illumination probe or infusion, which can be easily operated with anterior segment surgeon. It is hoped that our experience will help to simplify the operation and achieve satisfactory result.

The main limitations of our study were as follows: firstly, not all of preoperative corneal endothelium data were obtained due to corneal edema. Secondly, our study was a retrospective research, which was lack of controlled studies.

Conclusions

In conclusion, 25-gauge anterior vitrectomy via the scleral flap in phacoemulsification combined with trabeculectomy was safe and effective for glaucoma combined with cataract with extremely shallow anterior chamber. Further research with a larger sample size and longer follow-up is required to determine this technology.

List Of Abbreviations

IOL: Intraocular lens

IOP: Intraocular pressure

BCVA: Corrected visual acuity

ACD: Anterior chamber depth

AL: Axial length

PPV: Pars plana vitrectomy

PPL: Pars plana lensectomy

OCT: Optical coherence tomography

UBM: Ultrasound biomicroscope

CCT: Central corneal thickness

Declarations

Ethics approval and consent to participate: Research was carried out in accordance with the Declaration of Helsinki and approved by the Ethics Committee of the Lishui People's Hospital. Informed consent was obtained from each subject before the examination.

Consent for publication: Not applicable.

Availability of data and materials: All data generated and analyzed during this study are included in relevant published articles.

Competing interests: The authors state that they have no conflict of interest.

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Authors' contributions: XY and BW design of the work; XY performed the operation; HS and YM acquisition, analysis and interpretation of data; HS and YM drafted the work; HS, BW, XY and YM revised it. All authors have read and approved the manuscript.

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