Original Article

Efficacy of Phacovitrectomy Combined with Internal Limiting Membrane Peeling for Macular Diseases

Zheming Wu[1,*], Jinglin Zhang[2], Yun Chen[1], Rulong Gao[1], Zhende Lin[1]

1. Aier Eye Hospital Group Co., Ltd. Guangzhou Aier Eye Hospital, Guangzhou 510080, China

2. Zhongshan Ophthalmic Center, Sun Yat-sen University, Guangzhou 510060, China

Abstract

Purpose: To observe the efficacy of vitrectomy with internal limiting membrane (ILM) peeling combined with phacoemulsification with intraocular lens (IOL) implantation in the treatment of cataract with co-existing macular diseases.

Methods: A total of 28 cataract patients (28 eyes) with co-existing macular diseases were admitted to Aier Eye Hospital between May 2008 and May 2011. The clinical characteristics were analyzed in this study. Subjects included 6 men and 22 women, aged from 56 to 77 years (mean 64 years), with duration of disease ranging from 2 to 36 months (mean 9.3 months). All patients underwent phacoemulsification with implantation of a hydrophobic acrylic IOL into the capsular bag and pars plana vitrectomy with ILM peeling.

Results: Postoperatively, patients underwent 3- to 18-months of follow-up (mean 7.2 months). Only one eye had macular hole failing to close. Normal macular structure was restored in the other 27 eyes. The presenting visual acuity and best corrected visual acuity (BCVA) did not differ significantly (t=−1.724, P=0.096), with the BCVA in 27 eyes (96.4%) improving by 2 lines or more. The improvement in minimum angle of resolution (MAR) was > 0.3 in 21 eyes, ≥0.1 in 6 eyes and<0.1 in 1 eye. The mean spherical equivalent (SE) was −4.67±5.98D preoperatively and -0.38±0.69D postoperatively (t=4.157, P<0.005).

Conclusion: Combined phacovitrectomy surgery is a reliable and safe procedure in the treatment of cataract complicated by macular disease. (***Eye Science 2012; 27:25−29***)

Keywords: phacovitrectomy; pars plana vitrectomy; internal limiting membrane peeling; macular disease

DOI: 10.3969/j.issn.1000−4432.2012.01.005

Funding: Science&Technology Plan Programs of Yuexiu District Bureau of Science, Technology and Information, Guangzhou (Grant No.2010−WS−021)

* **Corresponding author**: Zheming Wu, Aier Eye Hospital Group Co., Ltd. Guangzhou Aier Eye Hospital, Guangzhou 510080, China. E-mail: wuzming@21cn.com

Introduction

Idiopathic macular hole (IMH), idiopathic macular epiretinal membrane (IMEM), vitreomacular traction syndrome are common macular illnesses. Vitrectomy combined with ILM peeling is frequently adopted for patients presenting with central shadow and metamorphopsia. However, cataract patients complicated with macular diseases display phacoscotasmus, which increases the surgical difficulty. In addition, the severity of cataract was aggravated after Vitrectomy, which also prevented the elevation of visual acuity postoperatively.

In this study, the authors performed ILM peeling combined with phacovitrectomy and IOL implantation upon cataract patients complicated with macular diseases, and gained relatively good clinical outcomes.

Subjects and methods

Study subjects

Twenty eight subjects (28 eyes) clinically diagnosed with macular diseases complicated with cataract at Aier Eye Hospital between May, 2008 and May, 2011 were enrolled in this investigation, including 11 cases of IMH, 13 of IMEM, three of vitreomacular traction syndrome, and one case of macular hole complicated with retinal detachment. The cohort was: 6 male, 22 female; aged between 56 and 77 years, 64 years on average; course of disease ranging from 2 to 36 months, 9.3 months on average. The lens core hardness was graded and the results showed that 22 cases of grade Ⅱ lens core and six grade Ⅲ lens core presented. Preoperatively, naked visual acuity <0.05 was noted in 11 eyes, 0.05~0.3 in 17 individuals; BCVA<0.05 in eight

eyes and 0.05~0.3 in 20 eyes; SE<±3D in 11 eyes, ≥±3D in the remaining 17 eyes. Informed consent in adherence to the Declaration of Helsinki was obtained by the examining clinicians.

Study methods

All patients underwent ocular examinations, including VA, BCVA, optometry, macular optical coherence tomography (OCT), and conventional ocular tests before and after surgery. The patients subsequently received phacovitrectomy, pars plana vitrectomy (PPV), ILM peeling, IOL implantation, and 12% C3F8 tamponade by one single surgeon. The upper transparent cornea was incised during phacovitrectomy; Coomassie brilliant blue staining was used for ILM peeling. After vitreous resection, 0.2 ml brilliant blue staining solution (0.25 mg/ml) was injected into the vitreous cavity (0.5 ml, 0.25%, Brilliant Peel; Fluoron GmbH, Neu-Ulm, Germany). The brilliant blue solution was immediately replaced upon injection. The ILMs were peeled off using tweezers. The peeling area covered optic discs(PD), hemal arch and 3~4 PD outside macula. Prior to surgery, bio-measurements were conducted by IOLMaster (Carl Zeiss Inc., the United States). The spherical diopter power of IOL was calculated according to SRK-T formula. SA60AT foldable single-piece IOL was utilized(Alcon Inc., Switzerland). All patients were told to maintain a face-down position for 3 weeks.

Results

Visual acuity

Preoperative BCVA was significantly better than naked visual acuity(t=–4.618, P<0.005). After surgery, only one eye showed BCVA<0.1; six eyes had 0.1~0.3 BCVA and 21 eyes displayed >0.3 BCVA. No significant difference was noted between naked VA and BCVA (t=–1.724, P>0.05). Naked VA and BCVA were improved compared with those preoperatively. All patients' (28/28) naked VA improved by two lines or more, and 96.4%(27/28) for BCVA. SE was –4.67±5.98D on average preoperatively, and –0.38±0.69D postoperatively. A statistical significance was observed in SE before and after surgery (t=4.157, P<0.005).

Macular OCT outcomes

Preoperative OCT examination showed that 11 eyes had IMH (eight cases of grade Ⅲ and three cases of grade Ⅳ); One case showed macular hole complicated with retinal detachment, 13 were affected by IMEM, and three displayed vitreomacular traction syndrome. Postoperative OCT found that the macular hole was not closed in one eye, while the maximum diameter of the macular hole was shortened from 719 μm before operation to 423 μm postoperatively. The macular holes of the remaining 10 patients were restored. The retinal structure was restored and the macular hole was closed in the patient having macular hole complicated with retinal detachment. Both the 13 patients with IMEM and the three patients with vitreomacular traction syndrome presented macular retina with normal thickness and smooth retinal internal surface.

Postoperative complications

No surgical complication was observed in any of the 28 patients intraoperatively. After-cataract occurred in five patients during follow-up. The patients' visual acuity was restored after undergoing Nd:YAG laser.

Discussion

The basal cell layer consists of vitreous fiber and ILM from retinal interface, both of which are formed from Müller cells at the fifth week of embryonic development. Basal cell layer gradually thickens with age. Since vitreous collage is originally distributed on the retinal ILM, the occurrence of posterior vitreous detachment may stimulate retinal ILM, which has been considered as the cause of epiretinal membrane[1].

Additionally, macular hole and vitreomacular traction syndrome were also deemed as retinal interface diseases. In the 1970s, Blankenship[2] first performed epiretinal membrane peeling on the patients with diabetes mellitus vitreous hemorrhage and subsequently spread this surgical technique. Especially during the recent decade, macular operation has widened surgical indications, treated a larger number of refractory macular illnesses, and relatively enhanced visual function. Beginning from the 1980s, epiretinal membrane peeling has been a common surgical approach. Scholars began to pay more attention to ILM because ILM segments were consistently observed

during pathological examinations of epiretinal membrane[3]. In 1990, Morris et al[4]. reported the procedure of ILM peeling applied in the treatment of Terson syndrome and macular hemorrhage under ILM and yielded relatively desirable surgical outcomes at the annual conference of the American Academy of Ophthalmology. They proposed applying ILM peeling into various types of traction-related macular diseases. In the subsequent decade, ILM peeling was adopted to treat macular illnesses, including epiretinal membrane[5,6], macular hole[7,8], and vitreomacular traction syndrome[9,10] etc. In the current study, OCT examination noted only one eye's macular hole was not closed after peeling treatment, while the diameter of the macular hole was decreased compared with that preoperatively. The present authors speculated that this may be associated with the relatively long course of disease (36 months). The macular structure of the remaining 27 eyes basically recovered. Hence, it is proved that ILM peeling is an efficacious treatment of macular diseases.

Cataract is the most common complication (12~80%) after accounting for vitrectomy[11,12,13]. In 2002, Gottlieb and Martin performed phacovitrectomy in combination with PPV and ILM peeling to clinically treat IMH[14]. Among the 36 eyes reported, visual acuity in 61% eyes increased by at least two lines postoperatively, and approximately 75% affected eyes had after-cataract during follow-up. In 2010, Xiujuan Du and Hongsheng Bi[15] reported three eyes (out of a total of 52 eyes) had after-cataract. In the current study, five out of 28 eyes presented with after-cataract during follow-up, whose incidence of after-cataract was significantly lower than those in foreign literatures. The reasons below may explain the discrepancy.

First, the recent improvement in IOL design apparently decreased the incidence of after-cataract. Gottlieb and Martin utilized polymethyl methacrylate (PMMA) to make rigid IOL, while the present authors chose foldable IOL made of hydrophobic acrylate. Ursell et al[16]. reported that the incidence of after-cataract hydrophobic acrylate-made IOL implantation was 12%, 44% in PMMA IOL implantation, indicating that hydrophobic acrylate-made IOL can significantly reduce the incidence of after-cataract. This is probably because hydrophobic acrylate–made IOL has a strong adherence to collagen and the rectangle design of IOL enables IOL optics to closely connect with posterior capsula[17]. Second, in this study, the patients with after-cataract had 6~6.5 mm anterior capsulorhexis in diameter, while the subjects without after-cataract had 5~5.5 anterior capsulorhexis in diameter pre- and intra-operatively, and the IOL was completely enclosed in capsula. Therefore, the present authors considered that the size of anterior capsulorhexis might be closely related to the occurrence of after-cataract. Excessive anterior capsulorhexis is likely to cause the upper IOL to lean forward at the early stage of gas-filling. Additionally, the back surface of IOL does not adhere to posterior capsula tightly. For those patients with excessively large anterior capsulorhexis, central posterior capsulotomy was performed simultaneously. This combined surgery effectively prevents the repeated decreases in visual acuity induced by aggravated cataract, and relieves the mental and economic pressure on the patients.

Significant progresses have been achieved in cataract surgery and IOL application. Previously, cataract surgery aimed to extract opacified lens, and IOL implantation was designed to let patients see. Nowadays, the purpose of cataract extraction and IOL implantation has been broadened to achieve the best optic quality postoperatively. The novel concept of cataract surgery can be defined as refractive cataract surgery. The anterior-posterior combined operation for macular diseases differ from those for diabetes mellitus, retinal detachment, vitreous hemorrhage, etc., since bio-measurements of the patients with macular illnesses can be accurately obtained preoperatively and then an accurate IOL diopter can be used to correct preoperative ametropia.

The enrolled patients underwent bio-measurements using IOL-Master. The axial length started from tear film to retinal pigment epithelium, eliminating the influence of retinal edema and epiretinal membrane on axial length measurement. Among all 28 subjects in this study, 11 patients' preoperative SE<±3D and 17 patients' SE ⩾±3D, eight among whom had high myopia. The authors adopted ILM peeling in combination with cataract IOL implantation to treat macu-

lar diseases and rectify preoperative ametropia. Postoperatively, 28 patients had SE <±2.5D, 24 among whom had SE ≤±1.0D. Twenty five among all 28 participants achieved BCVA without wearing glasses after surgery. No significant difference was found between naked VA and BCVA postoperatively (t=-1.724, P=0.096>0.05). Both naked VA and BCVA improved postoperatively. All patients' naked VA (28/28) increased by two lines at least, and 96.4% (27/28) for BCVA. Twenty four patients showed naked VA≥0.3 postoperatively. In September, 2010, Song et al[18]. compared the visual recovery between normal eyes and those undergoing IOL implantation after IMH surgery, and found that the rate of increasing VA in the IOL implantation group was significantly higher compared with that in the lens group (t=4.809, P=0.028), indicating that the im provement in ocular media is of significance for the prognosis of macular diseases. Hence, ILM peeling combined with phacovitrectomy not only recovers macular structure, but also eliminates the influence of ocular media upon visual function, eventually improving visual function.

Anterior-posterior combined surgery requires advanced surgical equipment, such as advanced surgical microscope and vitrectomy instruments, etc. In addition, it requires that the surgeon excel at both anterior and posterior surgical skills. In the current investigation, anterior and posterior surgeries were accomplished by a single surgeon. If such a skillful surgeon was lacking, we recommend that anterior and posterior operations are conducted by two separate doctors in order to decrease surgical complications and maximize surgical efficacy.

Several technique tips deserve attention. First, during phacovitrectomy, the surgeons should make sure that the diameter of central continuous capsulorhexis (CCC) does not exceed 5.5 mm and the posterior capsula is intact, which guarantee the stability of IOL implantation in capsular bags.

Second, most patients in this study were free from retinal detachment, had normal IOP, and were unlikely to present anterior chamber undulation induced by low-pressure from the posterior chamber. Thus, phacovitrectomy was initially performed and the anterior chamber was filled with viscoelastic agents. Transparent corneal cut was temporarily sutured with one stitch, standard sclerotic triple-channel incision was made, and then intra-infusion was performed. If intra-infusion were conducted first, liquified vitreous body would be lost, causing low pressure in the posterior chamber and leading to anterior chamber undulation. If intra-infusion is performed prior to phacovitrectomy, it is likely to produce excessively-high pressure in the posterior chamber, which has a negative influence on phacovitrectomy.

Third, IOL was implanted after ILM peeling. The sclerotic incision was temporarily sealed using a sclerotic nail before implantation, infusion was given, the IOP was adjusted to low level using sclerotic nail and then IOL was implanted. Otherwise, the overly-high pressure from posterior chamber overflows viscoelastic agents and increases the difficulty of IOL implantation.

Fourth, vitreous cavity gas-liquid exchange and 12% C3F8 gas exchange were performed after IOL implantation.

Vitrectomy with ILM peeling can effectively recover macular structure. In addition, phacovitrectomy with IOL implantation can efficiently treat ametropia and cataract. The combined operation not only recovers macular morphology and function, but also improves refraction status. To sum up, it enhances the patients' visual acuity, reduces surgery times, and relieves mental and economic burdens, thus deserving widespread application in clinical settings.

References

1 Ge J. Ophthalmology. Beijing: People's Medical Publishing House, 2005: 234-236.

2 Blankenship GW, Machemer R.Pars Plana Vitrectomy for the Management of Severe Diabetic Retinopathy: an Analysis of Results Five Years Following Surgery.Ophthalmology, 1978; 85(6): 553-559.

3 Sivalingam A, Eagle RC Jr, Duker JS, et al. Visual prognosis correlated with the presence of internal-limiting membrane in histopathologic specimens obtained from epiretinal membrane surgery. Ophthalmology, 1990 Nov; 97(11): 1549-1552.

4 Morris R, Kuhn F, Witherspoon CD. Hemorrhagic macular cysts. Ophthalmology, 1994 Jan; 101(1): 1.

5 Park DW, Dugel PU, Garda J, et al.Macular pucker removal with and without internal limiting membrane peel-

ing: pilot study. Ophthalmology. 2003 Jan;110(1):62–64.

6 Sakamoto H,Yamanaka I,Kubota T,et al.Indocyanine green-assisted peeling of the epiretinal membrane in proliferative vitreoretinopathy. Graefes Arch Clin Exp Ophthalmol, 2003 Mar;241(3):204–207.

7 Mester V,Kuhn F.Internal limiting membrane removal in the management of full-thickness macular holes. Am J Ophthalmol, 2000 Jun;129(6):769–777.

8 Tognetto D,Grandin R,Sanguinetti G,et al.Internal limiting membrane removal during macular hole surgery: results of a multicenter retrospective study. Ophthalmology, 2006 Aug; 113(8): 1401–1410.

9 Gandorfer A,Rohleder M, Kampik A. Epiretinal pathology of vitreomacular traction syndrome. Br J Ophthalmol, 2002 Aug;86(8): 902–909.

10 Petropoulos IK,Stangos AA,Brozou CG,et al.Vitrectomy for vitreo-macular traction syndrome. Klin Monatsbl Augenheilkd, 2003 Mar;220(3):122–126.

11 Fleckner MR,Hochman MA,Buzney SM,et al. Complications of surgery for subfoveal choroidal neovascularization. Int Ophthalmol Clin, 2000 Winter;40(1):201–214.

12 Graham K, D′Amico DJ. Postoperative complications of epiretinal membrane surgery.Int Ophthalmol Clin. 2000 Winter;40(1):215–223.

13 Javid CG,Lou PL.Complications of macular hole surgery.Int Ophthalmol Clin, 2000 Winter;40(1):225–232.

14 Gottlieb CC,Martin JA.Phacovitrectomy with internal limiting membrane peeling for idiopathic macular hole. Can J Ophthalmol, 2002 Aug; 37(5): 277–282.

15 Du XJ,Bi HS,Wang XR,et al. Internal limiting membrane peeling combined with phacoemulsification for idiopathic macular holes. Journal of Otolaryngology and Ophthalmology of Shandong University,2010;24 (6): 67–69.

16 Ursell PG,Spalton DJ,Pande MV.Relationship between intraocular lens biomaterials and posterior capsule opacification.J Cataract Refract Surg,1998;24(3):352–360.

17 Peng Q,Apple DJ,Visessook N,et al.Surgical prevention of posterior capsule opacification:intraocular lens optic barrier effect as a second line of defense.J Cataract Refract Surg,2000;26(3):198–213.

18 Song ZJ,Lv L,Chen L.Comparison of postoperative vision recovery between phakic eyes and pseudophakic eyes of idiopathic macular hole.Recent Advances in Ophthalmology,2010;30(9):878–880.