·Clinical Research·

Non-buckled vitrectomy for retinal detachment with inferior breaks and proliferative vitreoretinophathy

Yan Sheng[1,2], *Wen Sun*[1], *Bin Mo*[2], *Ya-Jie Yu*[2], *Yang-Shun Gu*[1], *Wu Liu*[2]

Foundation item: This study was supported by the Health Bureau of Zhejiang Province, China (No.20100580)

[1]Department of Ophthalmology, the First Affiliated Hospital, College of Medicine, Zhejiang University, Hangzhou 310009, Zhejiang Province, China

[2]Beijing Tongren Eye Center, Beijing Tongren Hospital, Capital Medical University, Beijing Ophthalmology & Visual Science Key Lab, Beijing 100730, China

Correspondence to: Wu Liu. Beijing Tongren Eye Center, Beijing Tongren Hospital, Capital Medical University, Beijing Ophthalmology & Visual Science Key Lab, Beijing 100730, China.wuliubj@yahoo.com

Received:2012-04-01 Accepted:2012-09-11

Abstract

• AIM: To investigate the efficacy of non-buckled vitrectomy with classical endotamponade agents in the treatment of primary retinal detachment (RD) complicated by inferior breaks and proliferative vitreoretinophathy (PVR).

• METHODS: A retrospective, consecutive and case series study of 40 patients with inferior break RD and PVR ≥ C1 was conducted. All patients underwent a standard 3-port 20-gauge pars plana vitrectomy (PPV) with gas or silicone oil tamponade without supplementary scleral buckling. The vitreous and all proliferative membrane were completely removed, and retinectomy was performed when necessary. The mean follow-up was 12.5 months. The primary and final anatomic success rate, visual acuity and complications were recorded and analyzed.

• RESULTS: Primary anatomic success rate was achieved in 35 of 40 eyes (87.5%) and the final anatomic success rate was 100%. The most common cause of redetachment was recurrent PVR. The best-corrected visual acuity (BCVA) at final follow-up was improved in 34 eyes (85%), remained stable in 1 eye (2.5%), and worsened in 5 eyes (12.5%). The mean visual acuity at final follow-up was improved significantly (P=0.000).

• CONCLUSION: This retrospective study provides evidence that vitrectomy without scleral buckling seemed to be an effective treatment for inferior break RD with PVR. With complete removal of vitreous and proliferative membranes and timing of retinectomy, the inferior breaks which complicated with PVR could be closed successfully without additional scleral buckling.

• KEYWORDS: retinal detachment; inferior retinal break; proliferative vitreoretinophathy; vitrectomy

DOI:10.3980/j.issn.2222-3959.2012.05.09

Sheng Y, Sun W, Mo B, Yu YJ, Gu YS, Liu W. Non-buckled vitrectomy for retinal detachment with inferior breaks and proliferative vitreoretinophathy. *Int J Ophthalmol* 2012;5(5):591-595

INTRODUCTION

Retinal detachment (RD) complicated by inferior breaks and proliferative vitreoretinophathy (PVR) remain a challenging situation for vitreoretinal surgery. The main concern is that such classical endotamponade agents as gas or silicone oil are not enough to cover the inferior quadrant completely. Therefore, some surgeons may choose scleral buckling (SB) combined with vitrectomy to increase the endotamponading effect.

In the past few years, some studies have shown vitrectomy and gas without the application of a scleral buckle may be used to treat inferior break RD safely in the absence of PVR and can achieve comparable results of vitrectomy combined with buckle [1-4]. The surgery with vitrectomy and gas alone can possible avoid numerous complications of a scleral buckle, such as choroidal haemorrhage, prolonged operating time, refractive change, diplopia, possible decreased retinal blood flow, and risk of anterior segment ischaemia [5-10]. Moreover, several authors[11,12] demonstrated that vitrectomy without SB achieved favorable and comparable anatomic outcomes than vitrectomy with SB in eyes with PVR, and visual acuity improved significantly in eyes of vitrectomy without SB. Another research group showed that primary retinectomy without SB had good anatomic and functional results for severe PVR[13]. However, to date, there is no data pertaining to non-buckled vitrectomy with classical endotamponade agents repair of inferior break retinal detachments with PVR.

In the present study, we reviewed the results of our patients with inferior break retinal detachments with PVR who were all treated with vitrectomy, gas or silicon oil temponade and without scleral buckling and compared the results with published data from other researches.

SUBJECTS AND METHODS

Subjects Forty eyes of 40 patients with inferior break RD and PVR who underwent pars plana vitrectomy (PPV) without scleral buckling between 2003 and 2009 at Beijing Tongren Hospital Eye Center enrolled in this retrospective, consecutive and case series study. The medical ethics committee of the Beijing Tongren Hospital had approved the study protocol and all participants had given informed consent.

Inclusion criteria were: over 18 years of age, primary RD, one or more inferior breaks (horseshoe tear or round hole between 4 o'clock and 8 o'clock), PVR$\geqslant$C1 (according to the classification of Retina Society [14]) with or without anterior PVR (according to updated classification of Machemer *et al* [15]), and unsuitability for external scleral buckling surgery. Exclusion criteria were: recurrent retinal detachment after scleral buckle with/without vitrectomy, retinal dialysis, giant retinal tears, proliferative diabetic retinopathy, trauma, retinal vascular diseases, intraocular inflammation, choroidal coloboma, optic disc dystrophy, and microphthalmos.

Methods All patients had clinical examinations by slit-lamp biomicroscopy and indirect fundus ophthalmoscopy. Preoperative data collected on each patient included age, gender, ocular history, visual acuity, intraocular pressure (IOP), refractive error, clinical features of the retinal detachment, which included type and distribution of all retinal breaks, area of detachment, grade of PVR, presence or absence choroidal detachment.

In all cases, surgery was performed by a single surgeon under retrobulbar anesthesia. A standard 3-port 20-gauge PPV using the ACCURUS vitrectomy machine (Alcon Laboratories, Inc., USA) and the wide-field viewing system (Mini Quad, Halma Volk Optical Inc, USA) were performed on all patients. Lensectomy or phacoemulsification was combined with vitrectomy if the lens opacity impaired the view during surgery. After central vitreous removal and epiretinal membrane peeling, all patients underwent 360 degree vitreous base shaving under sclera depression to remove all vitreous traction on retinal tears and degeneration areas. Retinotomy and retinectomy was only performed in the area where the residual traction/shortage could not be released even after complete vitreous removal and epiretinal membrane peeling. Subretinal fluid was drained via accessible retinal break with or without injection of a perfluorocarbon liquid. Endolaser photocoagulation or transscleral cryopexy was carried out around the breaks and retinal degeneration areas, and fluid-gas exchanged and gas (C2F6 or C3F8; Tianjing Jingming New Tech Dev Co., Ltd, China) or silicone oil (Oxane 5700; Bausch & Lomb, USA) were tamponaded finally. The choice of gas or silicone oil tamponade was primarily based on surgeon's judgement of retinal relaxation, the possibilities of recurrent proliferation, and patient's compliance in keeping prone position after surgery. A 360 degree prophylactic laser was not used. All patients were postured face-down for at least two or three weeks after surgery.

In the eyes which were temponaded with silicone oil, the oil was removed approximately 3 months after the first successful surgery, or at the time of secondary surgery when needed, using active suction with ACCURUS vitrectomy system (Alcon) at an aspiration vacuum of 600mmHg.

The anatomic success rate, visual acuity and complications were recorded and analyzed. The anatomical success was defined as retinal reattachment without tamponade for more than 3 months.

Statistical Analysis Statistical analysis was performed with SPSS software (SPSS 15.0). Fisher exact test was used to compare each characteristic in reattachment and redetachment eyes with a single operation and in eyes with or without retinectomy. Averaged visual acuity data converted are expressed in logarithm of the minimal angle of resolution unit (LogMAR). The preoperative and postoperative best-corrected visual acuity (BCVA) were both compared with Wilcoxon single-rank test. *P* values of <0.05 were considered statistically significant.

RESULTS

Forty eyes of 40 patients were included in this study, 26 males and 14 females, with a mean age of 48.0 years (ranging from 19 to 75 years). Average follow-up was 12.5 months (ranging from 3 to 56 mouths). The ocular history ranged from 0.5 to 60 months (average, 5.6 months). The mean preoperative IOP was 11.5±3.7mmHg (ranging from 4 to 19mmHg). Based on preoperative biomicroscopic examination and confirmation at surgery, all the patients included in this study had one or more inferior breaks (horseshoe tear or round hole) located between 4 o'clock and 8 o'clock. The PVR of these eyes were classified as grade C1 in 18 eyes, C2 in 9 eyes, C3 in 8 eyes, D1 in 2 eyes, D2 in 2 eyes, and D3 in one eye. Two of the 40 eyes had anterior PVR. Except for one eye, the other 39 eyes in this study were macula-off detachment. At baseline, one eye was aphakic, 5 eyes were pseudophakic, 9 eyes were high myopic (>6 diopter), and 27 eyes had total RD.

In the first operation, nine patients were performed vitrectomy combined with phacoemulsification and 6 patients with lensectomy. The intraocular gas of C2F6 or C3F8 was used in 18 patients and silicone oil was used in the other 22 patients. Preretinal membranes were peeled in 38 eyes and subretinal membranes were removed in 14 eyes. Retinectomy was applied in 16 eyes (40%). The extent of retinectomy was less than 6 clock hours in 5 eyes and more than 6 clock hours in the other 11 eyes.

In this study, primary retinal reattachment was achieved in

35 of 40 eyes (87.5%). Of the 35 successful eyes, 17 eyes were tamponaded with gas, the other 18 eyes were tamponaded with silicon oil . Of the 5 eyes which developed recurrence of RD, four eyes experienced a new retinal tear associated with postoperative PVR and 1 eye failed to reattach due to reopening of the breaks; as re-treatment of the 5 eyes, four eyes required 1 repeat surgical procedures, one eye required 2 repeat surgical procedures. At the end of follow-up, retina were successfully reattached in all eyes. The final anatomical success rate was 100%.

Characteristics in reattachment and redetachment eyes with a single operation were illustrated. There was no statistical difference in these characteristics between reattachment and redetachment eyes (P>0.05, Fisher exact test, Table 1).

The characteristics in eyes which underwent or did not undergo retinectomy were listed (Table 2). In eyes with PVR D, the rate of retinectomy was higher than that of eyes with PVR C (P=0.006, Fisher exact test). No statistically significant difference was found in the incidence of postoperative PVR and redetachment between retinectomy group and non- retinectomy group. (P=0.47, 0.32, Fisher exact test). Preoperative BCVA ranged from LP to 20/200 (mean 20/500). Final postoperative BCVA ranged from HM to 20/50 (mean 20/200). The BCVA at final follow-up, compared with baseline BCVA, was improved (increased ≥1 line) in 34 eyes (85%), remained stable in 1 eye (2.5%), and worsened (decreased ≥1 line) in 5 eyes (12.5%). Overall, mean BCVA improved significantly from 2.11±0.88 Log MAR preoperative to 1.31±0.47 Log MAR postoperative (P=0.000, Wilcoxon single-rank test).

The intra-operative complications included iatrogenic retinal break, which occurred in 17 cases (42.5%). No case suffered from choroidal haemorrhage or other sight threatening complications during the operation. There were 11 cases (27.5%) complicated by an early rise in IOP after first surgery. Within 2-3 weeks, IOP of these 11 cases were controlled through topical medical therapy. At the last follow up, the IOP ranged from 10.0mmHg to 23.0mmHg (mean 15.3mmHg).

Table 1 Characteristics in reattachment and redetachment eyes with a single operation *n*(%)

	Reattachment	Redetachment	*P*(Fisher's)
n	35	5	
Totally RD	23 (65.7)	4 (80.0)	1.000
Anterior PVR	2 (5.7)	1 (20.0)	0.338
Choroidal detachment	2 (5.7)	1 (20.0)	0.338
High myopic	8 (22.8)	1 (20.0)	1.000
Aphakic	1 (2.8)	0 (0.0)	1.000
Pseudophakic	4 (11.4)	1 (20.0)	0.507
Retinectomy	14 (40.0)	2 (40.0)	1.000
Silicone oil tamponade	18 (51.4)	4 (80.0)	0.355

Table 2 Characteristics in eyes which underwent or did not undergo retinectomy *n* (%)

	Without retinectomy	Retinectomy	*P* (Fisher's)
n	24	16	
Preoperative PVR/Grade C	24 (100)	11 (68.7)	0.007
Preoperative PVR/Grade D	0 (0.0)	5 (31.3)	0.007
postoperative Hypotony	0 (0.0)	0 (0.0)	
postoperative PVR	3 (12.5)	1 (6.2)	0.638
Redetachment	4 (16.7)	1 (6.2)	0.631

DISCUSSION

With the advances in surgical techniques and equipment of vitrectomy, the indication of PPV in treatment of RRD has been gradually expanding. Generally, PPV combined with SB is the standard treatment for RD with severe PVR and RD with inferior breaks. [3,16,17] During the past decade, several authors addressed the view of PPV and gas alone without SB as a safe and effective treatment for uncomplicated retinal detachment with inferior break [1-3]. Moreover, PPV has been successfully used without SB for complicated RD such as pseudophakic RD and RD with PVR[4,11,12]. But so far, there is no literature on the efficacy of non-buckled vitrectomy for inferior break RD with PVR. In present study, the primary anatomical success rate of PPV and gas/silicon oil alone without scleral buckling in RD which complicated by inferior breaks and PVR was 87.5%, and the final anatomical success rate was 100%. Previous studies found the primary anatomically successful rate after vitrectomy in eyes of RD with PVR ranged from 60% to 80%, depending on severity of PVR[18]. In a pilot study[19] of 10 eyes with primary inferior break RD with PVR ≥ CP2 which underwent PPV and silicone oil and segmental scleral buckle, the primary anatomical success rate was 80% . Comparing with the previous reports, the present study showed a higher anatomical success rate of PPV without SB for eyes of RD with PVR, one reason for this may due to that the majority of eyes in our study had PVR grade C1, which usually had a favorite outcome postoperatively.

In Machemer's lecture [20], he showed that there were three factors required to achieve retinal reattachment-that is, relief of traction, alteration of intraocular currents, and chorioretinal adhesion. In treating RD with severe PVR, relaxation of vitreoretinal traction completely is the key to surgical success. In the present study, all proliferative membranes and vitreous were completely removed, and 16 eyes (40%) had been performed retinectomy. By these procedures, all tractions may be released completely and a complicated RD can be simultaneously converted into an uncomplicated RD. Alteration of intraocular currents can be achieved with intraocular tamponade and with SB. It is generally assumed that SB combination with vitrectomy may increase the endotamponading effect and help close inferior breaks. Some authors stated that the time required for the tamponade agents to close the retinal breaks is within the early hours after surgery[4]. After that time, fluid will not enter the subretinal space through the break. And chorioretinal adhesion can be achieved with photocoagulation or cryopexy.

Regarding to the favorable anatomic outcome in present study, we attribute the success to the followings: (1) a mild severity of PVR in majority of the eyes; (2) complete release of the traction, especially by opportune retinectomy. With this regime, we achieved a higher primary anatomical success rate (87.5%), and only one eye (2.5%) failed to reattach due to reopening of the break. So we can hypothesize that, for eyes with inferior breaks and PVR, if there is still residual traction after complete vitrectomy, the well-timed retinectomy as a primary procedure may have similar or better effect than using a scleral buckle in relaxing retina and closing breaks, while avoiding the risks of SB at the same time. Based on the above analysis, we suggest that retinal detachment in eyes with inferior breaks and PVR can be successfully treated with non-buckled vitrectomy.

The major failure cause of present study is the development of postoperative PVR (80%). It was consistent with the consequences in several studies that PVR is still the most common cause of failure of surgery for RRD [18,21]. Postoperative PVR is most strongly associated with PVR grade at presentation, preoperative vitreous haemorrhage, the presence of choroidal detachment preoperatively, excessive cryotheraphy and repeated surgical procedures, *etc* [21].Previous studies showed that the incidence of postoperative PVR varied between 2.5% and 28% in different series with different inclusion criteria [4,22-26]. In present study, the relatively higher incidence of PVR (10%) may be explained by the inclusion of RD with PVR grade ≥C1.

PPV alone without SB in treatment of RD may possibly avoid the risks of SB, such as choroidal haemorrhage, prolonged operating time, refractive change, diplopia, possible decreased retinal blood flow, and risk of anterior segment ischaemia[5-10].In present study, except for iatrogenic retinal break and early rise in postoperative IOP, there were no other significant complications. The low incidence of complication may be due to such a non-buckled surgery.

In present study, the main intra-operative complication was iatrogenic retinal break, of which the incidence rate was 42.5%. The relatively higher incidence may be related to a more intensive vitreous shaving and epiretinal membrane removal during surgery. All these iatrogenic retinal breaks had been successfully undergone endolaser or cryoretinopexy and none of them developed recurrent retinal detachment.

Furthermore, hypotony is a potentially devastating complication of retinectomy surgery [13].Previous studies found the risk of hypotony after retinectomy ranging from 11% to 39%[13]. In present study, 16 eyes (40%) had been performed retinectomy, none of them experienced hypotony which is defined as a pressure lower than 5mmHg. Although the current study consists of a relatively small number of cases with retinectomy, it still showed that the complication rate of hypotony after successful retinal reattachment after retinectomy was very low.

With functional success defined as a final visual acuity of 5/200 or better, the final functional success rates were between 26% and 67.3% in RD with severe PVR [13].This study has a higher functional success rate (77.5%). These results might be due to the reduction of the complications associated with SB and the high primary anatomic success rate.

In conclusion, our preliminary data indicates that non-buckled vitrectomy with classical endotamponade agents is an effective treatment for inferior break retinal detachments with PVR while avoiding the risks of applying a buckle during PPV. With complete vitreous removal by vitreous shaving, removal of all proliferative membranes and timing of retinectomy, the inferior breaks which complicated with PVR could be closed successfully without scleral buckling. The main limitation of this study is its retrospective non-comparative nature and relatively small number of subjects recruited in this study. Therefore, a prospective, randomized, controlled clinical trail comparing PPV alone with PPV and SB for inferior break retinal detachments with PVR will be necessary to clarify this point. Furthermore, some new ophthalmologic examinations, such as optical coherence tomography (OCT) can be used in future study.

Acknowledgments: We thank Kurtis Feng for the critical reading of this manuscript.

REFERENCES

1 Tanner V, Minihan M, Williamson TH. Management of inferior retinal breaks during pars plana vitrectomy for retinal detachment. *Br J Ophthalmol* 2001;85(4):480-482

2 Sharma A, Grigoropoulos V, Williamson TH. Management of primary rhegmatogenous retinal detachment with inferior breaks. *Br J Ophthalmol* 2004;88(11):1372-1375

3 Wickham L, Connor M, Aylward GW.Vitrectomy and gas for inferior break retinal detachments: are the results comparable to vitrectomy, gas, and scleral buckle? *Br J Ophthalmol* 2004;88(11):1376-1379

4 Martìnez-Castillo V, Verdugo A, Boixadera A, Garcìa-Arumì J, Corcóstegui B. Management of inferior breaks in pseudophakic rhegmatogenous retinal detachment with pars plana vitrectomy and air. *Arch Ophthalmol* 2005;123(8):1078-1081

5 Flindall RJ, Norton EW, Curtin VT, Gass JD. Reduction of extrusion and infection following episcleral silicone implants and cryopexy in retinal detachment surgery. *Am J Ophthalmol* 1971;71(4):835-837

6 Hayashi H, Hayashi K, Nakao F, Hayashi F. Corneal shape changes after

scleral buckling surgery. *Ophthalmology* 1997;104(5):831-837

7 Domniz Y, Cahana M, Avni I. Corneal surface changes after pars plana vitrectomy and scleral buckling surgery. *J Cataract Refract Surg* 2001;27(6):868-872

8 Fison PN, Chignell AH. Diplopia after retinal detachment surgery. *Br J Ophthalmol* 1987;71(7):521-525

9 Kwartz J, Charles S, McCormack P, Jackson A, Lavin M. Anterior segment ischaemia following segmental scleral buckling. *Br J Ophthalmol* 1994;78(5):409-410

10 Yoshida A, Feke GT, Green GJ, Goger DG, Matsuhashi M, Jalkh AE, McMeel JW. Retinal circulatory changes after scleral buckling procedures. *Am J Ophthalmol* 1983;95(2):182-188

11 Oyagi T, Emi K. Vitrectomy without scleral buckling for proliferative vitreoretinopathy. *Retina* 2004 ;24(2):215-218

12 Siqueira RC, Gomes CV, Dalloul C, Jorge R. Vitrectomy with and without scleral buckling for retinal detachment. *Arq Bras Oftalmol* 2007;70(2):298-302

13 Tan HS, Mura M, Oberstein SY, de Smet MD. Primary Retinectomy in Proliferative Vitreoretinopathy. *Am J Ophthalmol* 2010;149(3):447-452

14 The Retina Society Terminology Committee (1983) The classification of retinal detachment with proliferative vitreoretinopathy. *Ophthalmology* 1983;90(2):121-125

15 Machemer R, Aaberg TM, Freeman HM, Irvine AR, Lean JS, Michels RM. An updated classification of retinal detachment with proliferative vitreoretinopathy. *Am J Ophthalmol* 1991;112(2):159-165

16 Hanneken AM, Michels RG. Vitrectomy and scleral buckling methods for proliferative vitreoretinopathy. *Ophthalmology* 1988;95(7): 865-869

17 Lewis H, Aaberg TM, Abrams GW. Causes of failure after initial vitreoretinal surgery for severe proliferative vitreoretinopathy. *Am J Ophthalmol* 1991;111(1):8-14

18 Pastor JC. Proliferative vitreoretinopathy:an overview. *Surv Ophthalmol* 1998:43(1):3-18

19 Boscia F, Furino C, Recchimurzo N, Besozzi G, Sborgia G, Sborgia C. Oxane HD vs silicone oil and scleral buckle in retinal detachment with proliferative vitreoretinopathy and inferior retinal breaks. *Graefes Arch Clin Exp Ophthalmol* 2008;246(7):943-948

20 Machemer R. The importance of fluid absorption, traction, intraocular currents and chorioretinal scars in the therapy of rhegmatogenous retinal detachments. *Am J Ophthalmol* 1984;98(6):681-693

21 Kon CH, Asaria RH, Occleston NL, Khaw PT, Aylward GW. Risk factors for proliferative vitreoretinopathy after primary vitrectomy: a prospective study. *Br J Ophthalmol* 2000;84(5):506-511

22 Heimann H, Zou X, Jandeck C, Kellner U, Bechrakis NE, Kreusel KM, Helbig H, Krause L, Schüler A, Bornfeld N, Foerster MH. Primary vitrectomy for rhegmatogenous retinal detachment: an analysis of 512 cases. *Graefes Arch Clin Exp Ophthalmol* 2006;244(1):69-78

23 Johansson K, Malmsjö M, Ghosh F. Tailored vitrectomy and laser photocoagulation without scleral buckling for all primary rhegmatogenous retinal detachments. *Br J Ophthalmol* 2006;90(10):1286-1291

24 Rodrìguez de la Rúa E, Martìnez V, Aragón J, Sanabria RM, Giraldo A, Mayo A, Pastor JC, Miranda I, Garcìa Arumì J.Clinical risk factors for postoperative proliferative vitreoretinopathy (PVR). A prospective study. *Arch Soc Esp Oftalmol* 2003;78(2):91-97

25 Bui Quoc E, Bernard A, Azan F, Renard G, Chauvaud D. Results of treating rhegmatogenous retinal detachment with vitrectomy and silicone oil tamponade. *J Fr Ophtalmol* 2005;28(9):944-952

26 Asaria RH, Kon CH, Bunce C, Charteris DG, Wong D, Luthert PJ, Khaw PT, Aylward GW. How to predict proliferative vitreoretinopathy: a prospective study. *Ophthalmology* 2001;108(7):1184 -1186