·Clinical Research·

Predictive factors for postoperative visual function of primary chronic rhegmatogenous retinal detachment after scleral buckling

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Abstract

• AIM: To evaluate predictive factors for postoperative visual function of primary chronic rhegmatgenous retinal detachment (RRD) after sclera buckling (SB).

• METHODS: Totally 48 patients (51 eyes) with primary chronic RRD were included in this prospective interventional clinical cases study, which underwent SB alone from June 2008 to December 2014. Age, sex, symptoms duration, detached extension, retinal hole position, size, type, fovea on/off, proliferative vitreoretinopathy (PVR), posterior vitreous detachment (PVD), baseline best corrected visual acuity (BCVA), operative duration, follow up duration, final BCVA were measured. Pearson correlation analysis, Spearman correlation analysis and multivariate linear stepwise regression were used to confirm predictive factors for better final visual acuity. Student´s *t*–test, Wilcoxon two–sample test, Chi –square test and logistic stepwise regression were used to confirm predictive factors for better vision improvement.

• RESULTS: Baseline BCVA was 0.8313±0.6911 logMAR and final BCVA was 0.4761 ±0.4956 logMAR. Primary surgical success rate was 92.16% (47/51). Correlation analyses revealed shorter symptoms duration (r =0.3850, P=0.0053), less detached area (r=0.5489, P<0.0001), fovea (r=0.4605, P=0.0007), no PVR (r=0.3138, P= 0.0250), better baseline BCVA (r=0.7291, P<0.0001), shorter operative duration (r=0.3233, P=0.0207) and longer follow up (r=–0.3358, P=0.0160) were related with better final BCVA, while independent predictive factors were better baseline BCVA [partial R –square (PR^2) = 0.5316, P<0.0001], shorter symptoms duration (PR^2 = 0.0609, P=0.0101), longer follow up duration (PR^2=0.0278, P =0.0477) and shorter operative duration (PR^2=0.0338, P =0.0350). Patients with vision improvement took up 49.02% (25/51). Univariate and multivariate analyses both revealed predictive factors for better vision improvement were better baseline vision [odds ratio (OR) =50.369, P= 0.0041] and longer follow up duration (OR =1.144, P= 0.0067).

• CONCLUSION: Independent predictive factors for better visual outcome of primary chronic RRD after SB are better baseline BCVA, shorter symptoms duration, shorter operative duration and longer follow up duration, while independent predictive factors for better vision improvement after operation are better baseline vision and longer follow up duration.

• KEYWORDS: chronic retinal detachment; scleral buckling; predictive factors

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INTRODUCTION

Primary chronic rhegmatogenous retinal detachment (RRD) usually occurs in young patients, characterized by shallow detached retina, smooth retinal surface, and mostly atrophic retinal hole. Primary chronic RRD rarely has obvious intravitreous proliferation or vitreoretinal interface proliferation, and rarely with complete posterior vitreous detachment (PVD)[1]. According to these clinical features scleral buckling (SB) is more eligible to restore the detached retina. SB has been proved as a safe and effective method in long-standing inferior RRD, RRD secondary to round retinal holes, and chronic RRD with subretinal proliferation[2-5]. However prognostic factors for postoperative visual functions are rarely reported in this type of RRD. So here in this paper we aimed to evaluate some related factors predicting better final visual acuity and predicting better vision improvement (compared with baseline vision of each patient) after SB alone in primary chronic RRD.

SUBJECTS AND METHODS

Patient Group This study was approved by SIR RUN RUN SHAW Hospital Ethic Committee. Totally 48 patients (51 eyes) with primary chronic RRD undergoing SB alone from June 2008 to December 2014 composed this cases group. All patients have signed an informed consent, receiving no stipend. Inclusive criteria: 1) no acute history of chief symptoms like vision loss or visual field defect; 2) chief symptoms lasted more than 3mo and corresponded to the detached retina; 3) fundus examination revealed detached retina with concentric demarcation lines around retinal hole accompanied by retina thinning or fixed. All patients meeting criterion 1+2 or 1+3 entered the study group. Recurrent RRD, proliferative vitreoretinopathy (PVR) C3 or greater and acute RRD were excluded. Demarcation lines should be differentiated from subretinal proliferation. The latter appeared as irregular subretinal strands and elevated the detached retina, like napkin rings formation, while demarcation lines usually appeared as pigmented or depigmented concentric arcs around primary retinal hole, not elevating the retina, which could to some degree restrict expansion of subretinal fluid. All patients underwent encircling silicone band, silicone sponge implant, cryocoagulation and subretinal fluid drainage. Radial or circumferential segment implant was used due to retinal tear type[6].

Main Measures Age, sex, symptoms duration, detached extension (involved quadrants), retinal hole position, size (disk diameters, DD), type (tear or atrophic hole), number (single or multiple), fovea on/off, PVR, PVD, baseline best-corrected visual acuity (BCVA), operative duration, follow up duration, final BCVA. The main hole which most corresponded with the detached retina was taken into account when more than one retinal hole existed.

Definition of Vision Improvement Visual acuity improved 2 lines on Snellen chart or from handmovement to counting fingers or counting fingers to more than 1/50, compared with baseline vision.

Definition of Success Complete anatomic retinal reattachment.

Statistical Analysis Pearson correlation analysis, Spearman correlation analysis and multivariate linear stepwise regression were used to confirm predictive factors for better final visual acuity. Student's t-test, Wilcoxon two-sample test, Chi-square test and logistic stepwise regression were used to confirm predictive factors for better vision improvement. Significant P value threshold was 0.05. Snellen values were changed into logMAR values, and counting fingers were designated as 2 logMAR, handmovement as 3 logMAR. All of those analyses were done by software SAS 9.1.3.

RESULTS

Totally 30 males and 18 females were enrolled in this group, with an average age of 27.71 years old (27.71±9.60y). Mean follow up duration was 10mo (10.69±13.64mo). The detached retina covered about 1.84 quadrants (1.84±0.67 quadrants), with an average 0.86 DD retinal hole (0.86±1.14 DD), most of which was atrophic hole (98.04%, 50/51) and located at lower half part of the fundus (76.47%, 39/51). Of 7 patients had fovea attached (13.73%, 7/51). No patient had complete PVD. PVR took up 9.80% (5/51), all of which were subretinal proliferation. Average operative duration was 69.02min (69.02±16.52min). Baseline BCVA was 0.8314±0.6912 logMAR and final BCVA was 0.4761 ±0.4956 logMAR. Primary surgical success rate was 92.16% (47/51). The remaining 4 patients had a secondary vitrectomy (2 cases) or intravitreous C3F8 gas injection (2 cases), eventually achieving a satisfactory retinal reattachment.

Pearson correlation and Spearman correlation analyses revealed shorter symptoms duration (r=0.3850, P=0.0053), less detached area (r=0.5489, P<0.0001), fovea (r=0.4605, P=0.0007), no PVR (r=0.3138, P=0.0250), better baseline BCVA (r=0.7291, P<0.0001), shorter operative duration (r=0.3233, P=0.0207) and longer follow-up (r=-0.3358, P=0.0160) were related with better final BCVA (Table 1), while independent predictive factors were better baseline BCVA (PR^2=0.5316, P<0.0001), shorter symptoms duration (PR^2=0.0609, P=0.0101), longer follow-up duration (PR^2=0.0278, P=0.0477) and shorter operative duration (PR^2=0.0338, P=0.0350) (Table 2). Patients with vision improvement took up 49.02% (25/51). Univariate and multivariate analyses both revealed predictive factors for better vision improvement were better baseline vision (OR=50.369, P=0.0041) and longer follow up duration (OR=1.144, P=0.0067) (Tables 1, 3).

DISCUSSION

Many studies had described the predictive factors for functional outcomes of primary RRD after operation. Baseline BCVA, symptoms duration, fovea status, detached extension and PVR had been confirmed as the related variables whether through SB or vitrectomy, and baseline BCVA was even considered the most important valuable[7-12]. Similar to those studies, we also found those factors associated with better postoperative visual acuity in primary chronic RRD group by correlation analysis. But during multivariate analysis process some factors like fovea status, detached extension and PVR were excluded. We explained that they were eliminated because of association significantly with baseline BCVA (fovea status, r=0.5541, P<0.0001; detached extension, r=0.6292, P<0.0001; PVR, r=0.3238, P=0.0204; Spearman correlation analysis), so baseline BCVA might be a better independent surrogate of those factors. However unlike previous studies, we found follow up duration and operative duration were the independent predictive factors for postoperative visual function, which had been rarely reported before. Liu *et al*[13] observed

Table 1 Correlation analyses of predictive factors for postoperative visual acuity and univariated analyses of predictive factors for vision improvement *n* (%)

Variables	$\bar{x} \pm s$	BCVA		Vision improvment	
		r	*P*	$x^2/t/Z$	*P*
Age (a)	27.71±9.60	-0.1438	0.3142[a]	0.86	0.3926[c]
Sex		0.2077	0.1437[b]	1.0711	0.3007[d]
M	30 (62.50)				
F	18 (37.50)				
Symptoms duration (mo)	6.84±14.93	0.3850	0.0053[a]	-0.1607	0.4362[e]
Detached extension (quadrants)		0.5489	<0.0001[b]	5.6492	0.1300[d]
1	15 (29.41)				
2	30 (58.82)				
3	5 (9.8)				
4	1 (1.96)				
Retinal hole position		-0.1789	0.2092[b]	3.6228	0.0570[d]
Upper part	12 (23.53)				
Lower part	39 (76.47)				
Retinal hole size (DD)	0.86±1.14	-0.0745	0.6036[b]	1.1801	0.2380[e]
Retinal hole type		0.1017	0.4778[b]	1.0608	0.3030[d]
Tear	1 (1.96)				
Atrophic hole	50 (98.04)				
Retinal hole number		0.0325	0.8207[b]	0.4727	0.4917[d]
Single	29 (56.86)				
Multiple	22 (43.14)				
Fovea status		0.4605	0.0007[b]	1.3575	0.2440[d]
On	7 (13.73)				
Off	44 (86.27)				
PVR		0.3138	0.0250[b]	0.4008	0.8184[d]
Yes	5 (9.80)				
No	46 (90.20)				
Baseline BCVA (logMAR)	0.8314±0.6912	0.7291	<0.0001[a]	3.1512	0.0008[e]
Operative duration (min)	69.02±16.52	0.3232	0.0207[a]	1.03	0.3099[c]
Follow up duration (mo)	10.69±13.64	-0.3358	0.0160[a]	2.4052	0.0081[e]

BCVA: Best-corrected visual acuity; PVR: Proliferative vitreoretinopathy. [a]Pearson correlation analysis; [b]Spearman correlation analysis; [c]Student's *t*-test; [d]Chi-square test; [e]Wilcoxon two-sample test. *P* value less than 0.05 was considered as significant level.

Table 2 Multivariate linear stepwise regression of related factors predicting better visual acuity

Variables	PR^2	MR^2	*P*
Baseline BCVA	0.5316	0.5316	<0.0001
Symptoms duration	0.0609	0.5925	0.0101
Follow up duration	0.0278	0.6203	0.0477
Operative duration	0.0338	0.6541	0.0350

PR^2: Partial R-square; MR^2: Model R-square.

long-term postoperative vision improvement in macula-off primary RRD after SB. They revealed that even 5-10y after surgery, visual acuity was still improving, which suggested that the reconstruction process of retinal synapse and functional recovery could last a very long period, corresponding with our study. Some studies found that postoperative subretinal fluid usually occured in long-standing retinal detachment, and some of which might spontaneously resolve at a long period follow up with vision improved [14-16]. Though we have not evaluated the subretinal fluid condition in this study, it might also to some degree contribute to persistent vision improvement here accordingly. Besides, we found longer operative duration of SB could lead to lower postoperative vision, though exactly reason were not found so far, we suggested shortening operative time during treatment might be more beneficial for patients.

For each patient his/her self, the most cared was how much he/she could benefit from the treatment. So in this study, we compared the final BCVA with baseline BCVA and found that about a half of patients were satisfied with their vision improvement. While only two factors confirmed were associated with vision improvement: baseline BCVA and follow up duration, and the former was much more important (OR=50.369, 95%CI 3.471-730.996). It meant that baseline BCVA might not only mainly affect the final visual

Table 3 Logistic stepwise regression of related factors predicting better vision improvement

Variables	B	SE	OR	95%CI	*P*
Baseline BCVA	3.9194	1.3648	50.369	3.471-730.996	0.0041
Follow up duration	0.1344	0.0496	1.144	1.038-1.261	0.0067

B: B value; SE: Standard error; OR: Odds ratio; CI: Confidential interval.

function of reattached retina on total group level, but also determine the recovery potential of the impaired retina of each patient, and so was the factor follow up duration, which might be a little helpful in our clinical activities.

In primary chronic RRD, most patients could not remember exactly the onset of symptoms, and usually the impaired eye was found occasionally, so retinal detachment duration might be much longer than symptoms duration. As we all know, during the first day of retinal detachment many types of cells like polymorphonuclear neutrophils, monocytes, and macrophages migrate from the choroidal and retinal capillaries into subretinal space, and free retinal pigment epithelium cells are also seen in the subretinal space within 72h, containing outer-segment fragments frequently, which indicates that they may play a role in phagocytosis of cellular debris. Several days after retinal detachment, the inner segments begin to show signs of degeneration: swelling, disruption, loss of mitochondria, and overall disruption of the organized rough endoplasmic reticulum and Golgi apparatus, but it is interesting to note that the connecting cilium (essential for production of the outer segment) is retained even in severely affected inner segments in long-term detachments. As in monkey retinas detached for 1wk, rod and cone outer segments regain approximately 30% of their normal mean length within 7d of reattachment, 60% of their length after 30d, and 100% by 150d. Though all those data are collected from animal experiments, they are comparable with cellular changes in some human retinal detachment specimen analysis after vitreoretinal surgery, which may explain the relatively good regeneration of outer segments and render a long time vision improvement following reattachment [17]. Besides, in this study of primary chronic RRD, despite of long retinal detachment duration and detached retina thinning or fixed, there was an excellent success rate (92.16%), similar to others' studies, so SB is a good choice for this type of RRD[4-5,18-21].

In conclusion, independent predictive factors for better visual outcome of primary chronic RRD after SB are better baseline BCVA, shorter symptoms duration, shorter operative duration and longer follow up duration, while independent predictive factors for better vision improvement after operation are better baseline vision and longer follow up duration.

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