

Anatomical Outcome of 25-Gauge Vitrectomy Associated with Scleral Buckling in Stage 5 Retinopathy of Prematurity: A Case Series Study

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Abstract

Purpose: Our purpose is to determine the structural outcome of 25-gauge vitrectomy in addition to scleral buckling in stage 5 retinopathy of prematurity (ROP).

Methods: In a prospective interventional case series, 21 eyes with stage 5 ROP underwent 25-gauge vitrectomy and scleral buckling. Demographic data, disease activity (having plus disease or neovascularization) and the procedure manner were recorded. They were followed 12±2 (range 8-18) months. Anatomical outcomes were assessed during the follow-ups. Success rate was defined as totally reattached retina. In case of vascularly active disease, some eyes received laser therapy or intravitreal bevacizumab before progression to stage 5 ROP.

Results: Twenty one eyes of 16 patients with stage 5 ROP with mean gestational age (GA) of 28±2 weeks and birth weight (BW) of 1190±314 g were included. Lensectomy was done in 81% of eyes. Total reattachment was achieved in 52.3% (success rate) and partial reattachment in 23.8% of the eyes. Reattachments were usually obtained during the first 2-4 weeks. Redetachment occurred in three eyes. Two of them redetached at month 10 and the other one at month 14. Final total reattachment was achieved in 38% of the eyes. Vascularly active disease was seen in 42.8% of the eyes before operation. Success rate was inversely related to disease activity (P=0.044) and directly related to presurgery treatments (P=0.024) [Laser therapy or intravitreal bevacizumab].

Conclusion: The structural outcome of 25-gauge vitrectomy in addition to scleral buckling in stage 5 ROP is promising and vascularly active disease will lower the outcome.

Keywords: Retinopathy of Prematurity, 25-Gauge Vitrectomy, Scleral Buckling

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Introduction

Retinopathy of prematurity (ROP) remains a significant cause of preventable blindness among children, worldwide.^{1,2}

In spite of all screening criteria and recommendations, some patients are referred in advanced stages.

Vitreotomy for these advanced stages may confer some advantages; however it has specific challenges to the surgeon.³

Retinal detachment resulting from ROP is complex and it is difficult to relax all the existing membranes in these advanced stages; because of adherent cortical vitreous to the retina.³ The anatomical outcomes are dramatically different between studies with retinal reattachment rates of 0.8% to 90% for stage 4 or 5 ROP after scleral buckle and/or vitrectomy.⁴

25-Gauge pars plana vitrectomy has evolved significantly since its introduction in 2002^{5,6} and nowadays it is popular in vitreoretinal surgery such as retinal detachment, vitreous hemorrhage, idiopathic macular pucker, idiopathic macular hole, and tractional diabetic macular edema.⁷⁻¹⁰ Because of relatively low rate of complications, this technique has been introduced as a safe and effective treatment approach.¹⁰

Gonzales et al¹¹ described that 25-gauge vitrectomy is also safe and effective treatment approach for tractional retinal detachments in stage 4 and 5 ROP. In this study we report the structural outcome of 25-gauge vitrectomy in addition to sclera buckling in treatment of stage 5 ROP. To our knowledge this is the first report in which 25-gauge vitrectomy is used in combination with scleral buckling for treatment of this potentially blinding condition.

Methods

The premature patients were screened at pediatric retina clinic of Farabi eye hospital.

We encountered 38 patients with stage 5 ROP among 834 premature patients during one year (April 2007 to March 2008). The parents were fully described about the ambiguity of the operation results and, the informed consents were taken. The patients older than one year and those with history of previous surgery were excluded. The operations were performed by one of the first three authors (R R, M RE, and R K).

The patients underwent 25-gauge vitrectomy in addition to scleral buckling (band 240). The buckle (2.5 mm #240 solid silicone band) was positioned just behind the muscle insertion after performing peritomy and isolation of 4 rectus muscles which were fixated supranasally. Vitrectomy was done after scleral buckling. The cannula entry sites varied among the patients according to preoperative examination and finding a suitable site for entry through pars plicata about 1 mm from the limbus. In some cases it was needed to shorten the cannula height to reduce iatrogenic break or lens trauma. If the membranes were located near the lens and there was no space for entering to the eye, lensectomy and vitrectomy would be done through limbus. The sclerotomy sites were created in two plane: first obliquely and then vertically by 25-gauge trocar. We decided to do lensectomy if there was a cataractous lens or obstacle to eye entry through pars plicata.

Vitreotomy was performed through contact lens or binocular indirect ophthalmomicroscope (BIOM) systems by 25-gauge vitrectomy probe and Accurus vitrectomy machine. Cutting and aspiration were varied according to membrane density (cutting rate of 700-1500 per minute and vacuum levels of 200-500). Vitrectomy was performed addressing the organized vitreous in four planes: transvitreous ridge-to-ridge, ridge-to-periphery as possible, ridge to-lens, and membranes from the optic nerve head to the ridge. No tamponade was administered at the end of operation. If a retinal break occurred during vitrectomy operation was terminated without injecting intraocular tamponade. In contrast to adults all the entry sites were sutured with vicril 8-0 sutures. All the patients were examined one day after operation then every 1-2 week for one month and monthly thereafter.

The main outcome measure was the postoperative anatomical status of the retina. Anatomical outcome was categorized as success (totally attached), partial success (attached in some parts), and failure (total retinal detachment). Success rate was defined as total attachment rate. Redetachment was defined as conversion of totally reattachment status to partial or totally detachment status.

Active disease was defined as having plus or neovascularization of iris or retina. In cases of active disease intravitreal bevacizumab (0.625 mg) was injected, 2 days before operation. In cases with avascular area, before progressing to stage 5, indirect Laser was applied (Table 1).

The possible affecting factors such as gestational age (GA), birth weight (BW), operation time, disease activity, cataractous lens, previous treatment modalities (Laser or intravitreal bevacizumab) and limbal versus

pars plicata entry were evaluated.

Statistics

Demographic data were analyzed by using descriptive statistics. To assess the relationship between success rate and possible risk factors, continuous variables were evaluated by T-test and dichotomous variables were evaluated by chi-square tests and when appropriate Fisher exact test was used.

Table1. Demographic characteristics and operation results of stage 5 retinopathy of prematurity patients

Eye	GA* (weeks)	BW** (grams)	Neonatal age at operation time (days)	Vascular activity	Cataract	Lensectomy	Attachment	Redetached	Follow-up (months)	Presurgery medication
1	26	960	75	+	-	+	Total	-	10	+
2	26	960	89	+	+	+	Total	+	10	-
3	34	1200	40	+	-	-	Partial	+	10	+
4	28	1200	120	-	-	+	None	-	9	-
5	25	550	92	+	-	+	Total	-	10	+
6	25	550	92	+	-	+	Total	-	10	-
7	30	1200	180	-	+	+	Total	-	14	-
8	30	1200	180	-	+	+	Total	+	14	+
9	28	1200	83	+	+	+	Total	-	8	+
10	28	1600	60	+	-	-	Total	-	16	+
11	28	1600	73	+	-	-	Total	+	16	+
12	31	1300	46	+	-	-	None	-	17	-
13	27	1000	122	-	+	+	Partial	-	12	-
14	29	750	150	-	+	+	Partial	-	18	-
15	28	750	90	-	-	+	Partial	-	16	-
16	30	1550	96	-	+	+	Total	-	13	-
17	30	1550	106	-	+	+	Partial	-	13	-
18	28	1100	210	-	+	+	None	-	14	-
19	31	1450	150	-	+	+	Total	-	12	-
20	31	1450	150	-	+	+	Total	-	12	-
21	28	1200	270	-	+	+	None	-	11	-

*: Gestational age
 **: Birth weight

Results

Twenty-one eyes of 16 ROP stage 5 patients with mean GA of 28 ± 2 (range, 25-33) weeks and mean BW of 1190 ± 314 (range, 550-1600) grams were included. They were operated from April 2007 to March 2008. The mean neonatal age at operation time was 117 ± 57 (range 53-270) days. All the patients were followed-up for 12 ± 2 months (range, 8-18 months). Lensectomy was done in 81% of the eyes. Attachment was achieved totally in 52.4% (Figure 1) and partially in 23.8% of the eyes.

Reattachment was usually obtained during 2-4 weeks after surgery. Demographic data of the patients is shown in table 1. Cataract and disease activity were seen in 57% and 33% of the eyes, respectively. Although, we tried to remove the membranes without making iatrogenic break, it was inevitable, all the time.

Iatrogenic breaks occurred in 3 eyes (eyes number 1, 4, 21). Three of the eyes (17%) were redetached during follow-up because of re proliferation and new break in 2 and one of them respectively; therefore, final total reattachment rate was 38%. Two of them redetached at month 10 and the other one at month 14. None of them has undergone further operations. Only one eye with partial reattachment redetached totally. Thirty-three percent of eyes received pretreatment with intravitreal bevacizumab, in case of active disease (5 eyes) or laser therapy, before being totally detached (2 eyes). We evaluated the factors that may affect success rate. The relationship between success rate and younger GA, BW, operation time, disease activity, site of entry, cataract and presurgery treatments were evaluated (Table 2).

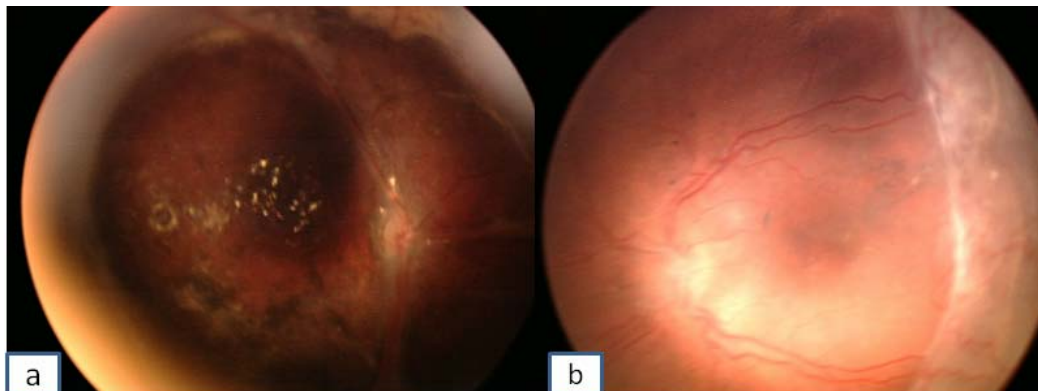


Figure 1. Two of the patients with totally reattached retina after operation: case number 1 (a) and 8 (b)

Table 2. Relationship between final success rate and probable affecting factors

	GA*	BW**	Disease activity	Cataract	Limbal surgery	Presurgery treatment***	Operation time (neonatal age)
Total attachment	P=0.128	P=0.702	P=0.044	P=0.80	P=0.916	P=0.024	P=0.35

*: Gestational age
 **: Birth weight
 ***: Laser or intravitreal bevacizumab

Discussion

Vitreoretinal surgery has been used for total (stage 5) retinal detachment in ROP.¹² Despite relatively acceptable rates of retinal reattachment, functional outcomes have been reported to be poor,¹³⁻¹⁹ albeit; it seems that reattached retina is more favorable than nonattached one.²⁰

There is a trend towards 25-gauge vitrectomy in vitreoretinal surgery and this is primarily due to its minimally invasive nature of this technique.⁶

This manuscript is the first report on 25-gauge vitrectomy in addition to scleral buckling in stage 5 ROP. Although there are many reported advantages using this instrument; including minimal ocular surface disruption, decreased surgical trauma, faster postoperative recovery, increased patient comfort and decreased postoperative cataract rates,⁵⁻¹¹ these advantages are not essential for us since we performed scleral buckling at the same time and the conjunctiva didn't remain intact. The most important practical advantages of this approach in children are the small size of the probe and enhanced surgical access to the retrolental space and to the spaces within retinal folds.^{11,12}

Vitrectomy in these advanced stages of disease presents challenges to the surgeon³ but it can help in removing the anteroposterior traction or those with centripetal direction. There are some difficulties in removing all peripheral tractions because of flexibility of the 25-gauge instrument which is one of its limitations to have appropriate maneuver. In our study, we performed scleral buckling simultaneously to reduce peripheral traction and alleviate 25-gauge limitation, of course it doesn't mean that 20-gauge vitrectomy eliminates the need for scleral buckling and it is not obvious what would be the results if we performed only vitrectomy in these eyes.

Sears and Sonnie³ suggest that scleral buckling adds little to the success or failure of vitrectomy in stage 4 ROP. Of course there is no report on evaluating the benefit of scleral buckling in addition to vitrectomy in stage 5 ROP. Our logic was this point that separation of all peripheral membranes is not possible all the time; so sclera buckling can help reduce the peripheral tractions.

Our results showed final total reattachment of 38%, which is consistent with some

previously reported studies.¹² Lakhanpal et al²¹ reported success rate of 45% for stage 5 ROP in contrast with Shah et al²² who reported success rate of 14.3% for these patients. Because there are substantial heterogeneity in the patient population and severity of the disease it is difficult to compare the study findings with each other. Most studies included different stages of disease and utilized different surgical techniques, which may explain this variance in success rates between reports.²¹

During follow-ups, the success rate was going to be decreased (3 eyes were redetached). It is obvious that the longer the duration of follow-up, the lower the percentage of retina that remained attached¹⁸ which are probably due to new break or re proliferation.

The advanced stage of ROP is not likely to respond to scleral buckling alone and vitrectomy approach is necessary to address the tractions directly.¹¹ In 81% of our cases lens and retrolental tissue were involved and lensectomy was required, though only 57% of the eyes were cataractous.

Among the baseline characteristics which were assessed, we found that disease activity i.e. existing plus neovascularization and presurgery treatment were the only statistically significant risk factors for success or failure rate. Plus disease remains a significant variable associated with failed retinal reattachment and vascularly active stage 5 ROP detachments present a poor prognosis.²³ Dilated iris and retinal vessels indicate activity of the disease and have been proposed as relative contraindications to surgery by Hubbard.²⁴ Surgery on active cases appears to cause a higher re proliferation rate²⁵ and management of such eyes are challenging; so we tried to use intravitreal bevacizumab in active eye disease if possible (6 out of 9 eyes). Now we perform anti-VEGF injection 1-2 days before vitrectomy routinely in active disease to hasten the activity of disease and it seems to be more effective (not published data). We didn't use intraocular tamponades at the end of surgery, because the main obstacle for the retina to be attached is tractions exerted by membranes. If we are successful in removing these tractions, the retina will attach gradually. Besides, in the case of remaining tractions at

the conclusion of the operation or if an iatrogenic break occurs during surgery, no tamponade would help the patient.

There are some studies which showed relationship between failure rate and young patient's age at the operation time,¹² but we didn't find such a relationship between these two variables; maybe because of low number of our patients.

In our recent experience, the operation is facilitated by autologous plasmin (unpublished data). It causes easier separation between internal limiting membrane (ILM) and the posterior hyaloid membrane and has shown promising results in other studies.²⁵⁻²⁸

Although we didn't evaluate functional

outcome; the poor visual outcome after a lensectomy vitrectomy procedure for retinal detachment due to ROP demands that emphasis be placed on prevention of retinal detachment in premature infants.¹²⁻¹⁸

Conclusion

In summary, the surgical outcome of 25-gauge vitrectomy in addition to scleral buckling seems to be promising but functional outcome should be determined. Vascular active disease was a risk factor for failure of stage 5 ROP treatment, so Anti-VEGF pharmacotherapy may help as adjuvant before surgery. Poor outcomes emphasize the need for prevention.

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