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ORIGINAL ARTICLE

CLINICAL OUTCOMES OF SCLERAL BUCKLING COMBINED WITH PARS PLANA VITRECTOMY FOR RHEGMATOGENOUS RETINAL DETACHMENT

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ABSTRACT

Introduction and Objective: *The various types of primary interventions for rhegmatogenous retinal detachment (RRD) include pars plana vitrectomy (PPV), scleral buckling (SB), and combination of both. Intraocular tamponade with silicone oil (SO) or expanding gas. This research was conducted to evaluate the clinical outcomes of SB combined with PPV as a treatment for RRD.*

Methods: *This research was prospective descriptive study with total sampling for RRD treated by SB combined with PPV from August 2022 to January 2023 in RSUP. Prof. Dr. R.D. Kandou. BCVA, IOP, clinical findings, intraocular tamponade and complications after the surgery were observed.*

Results: *Most of the patients was male with average age of 28 ± 40 years. RRD was observed in 6 eyes and laterality on right eye. BCVA was 2.5 ± 2 logMAR before the surgery and 2.3 ± 1 logMAR 1 month after the surgery. BCVA day 1, 1 week, 2 weeks and 1 month showed no significant difference after the surgery compared to baseline (p = 0.317, p = 0.949, p = 0.611, p= 0.611 respectively). Preoperative IOP was 7 ± 11 mmHg and 13.6 ± 10 mmHg 1 month after the surgery. IOP 1 week and 1 month showed significant difference (p = 0.027, p=0.011). IOP day 1, 2 weeks and 1 month showed there was no significant difference after the surgery on day 1 and 2 weeks.*

Conclusion: *There were several clinical condition seen such as BCVA after the surgery didn't improve as expected, subconjunctival bleeding was found the most as postoperative complications.*

Keyword*: Scleral buckling, Pars plana vitrectomy, silicon oil, retinal detachment*

INTRODUCTION

Rhegmatogenous retinal detachment (RRD) is a potentially blinding disease characterized by the separation of the inner neurosensory retina from the outer retinal pigment epithelium because of a break in the structural integrity of the sensory retina. Primary RRD results from formation of a retinal break, vitreoretinal traction, and entry of the liquefied vitreous through the break.[1] RRDs are caused by fluid passing from the vitreous cavity through a retinal break into the potential space between the sensory retina and the RPE.[2]

The prevalence of RRD ranges from 6.3 to 17.9 per 100,000, with the highest incidence in people who are in their sixties.[1] The Rochester epidemiology project determined that rhegmatogenous retinal detachment has an annual incidence of 12.6 per 100,000 persons in a primarily white population. A given individual's risk is affected by the presence or absence of certain factors, including myopia, family history, fellow-eye retinal tear or detachment, recent vitreous detachment, trauma, peripheral high-risk lesions, and vitreoretinal degenerations.[2]

The principles of surgery for retinal detachment are as follows find all retinal breaks, create a chorioretinal irritation around each break, close the retinal breaks. The most important element in management of retinal detachment is a careful retinal ex- amination, first preoperatively and then intraoperatively. Retinal breaks can be closed by several methods, all of which involve bringing the RPE and choroid into contact with the retina long enough to produce a chorioretinal adhesion that will permanently wall off the subretinal space. This process usually involves 1 of 3 approaches: (1) scleral buckling, (2) vitrectomy, or (3) pneumatic retinopexy.[2]

The various types of primary interventions for RRD include PPV, scleral buckling (SB), and combination of both, and various secondary attempts include repeat PPV alone, buckle revision, combination of PPV and SB, and intraocular tamponade with silicone oil (SO) or expanding gas. The major procedure treating RRD eyes with a detached posterior hyaloid membrane has been reported to increasingly involve pars plana vitrectomy (PPV).[3] Scleral buckling (SB) and pars plana vitrectomy (PPV) have shown similar functional and anatomical results in the treatment of retinal detachment.[4] Therefore, the purpose of this study was to determine the clinical outcomes after SB combined with PPV as a treatment for RRD.

METHODS

This research was prospective descriptive study with total sampling for RRD treated by SB combined with PPV from August 2022 to January 2023 in RSUP. Prof. Dr. R.D. Kandou. Inclusion criteria were eyes with noncomplex macula-on or macula-off primary RRD, single or multiple retinal breaks, unclear hole situation (invisible hole in the preoperative assessment). Exclusion criteria were infected eyes, glaucoma, corneal disorder, retinal vascular disorder and recurrent retinal detachment. Data collected from medical report were age, sex, phakic status, laterality, best-corrected visual acuity (BCVA), intraocular pressure (IOP), number of retinal breaks, macula detachment, macula detachment duration, number of quadrants of detached retina, presence of intraoperative proliferative vitreoretinopathy (PVR), material used for intraocular tamponade, intraoperative use of triamcinolone, perfluorocarbon liquid and the incidence of complications.

For the statistical studies, the decimal BCVA was converted to the logarithm of minimal angle of resolution (logMAR) units after being measured using a Snellen chart. Counting fingers and hand movements both require lower visual acuities—3.00 logMAR units and 2.00 logMAR units, respectively. The BCVA taken at the previous visit served as the final BCVA.

Surgeries were performed by an experienced vitreoretinal surgeon (ES). The surgical procedures consisted of standard pars plana vitrectomy with 25-gauge instruments and scleral buckling. SB procedure include conjunctival peritomy was performed first, and then a 2 mm-wide silicone band was placed over the lower portions of the four rectus muscles. Mattress sutures, using 5.0 non-absorbable sutures, were then used to secure the buckle (14 mm from the limbus), and the band was then fastened. Subretinal fluid was extracted following the removal of all remaining vitreous gel, endolaser coagulation was done around the retinal breaks following fluid-air exchange, and endo-tamponade with silicone oil (SO) was completed. Through the preexisting break with the fluid-air exchange, a significant portion of the subretinal fluid was evacuated. We instructed the patients to stay face-down for 14 days.

The data was analyzed by SPSS according to the data distribution. Quantitative data is summarized using mean range or median as appropriate. The data was tested for normality distribution using Shapiro-Wilk test, based on the normality result the data was tested with the paired t-test or Wilcoxon test. P value less than 0.05 was considered for statistical significance.

RESULTS

There were 6 eyes included in this study. 5 subjects were male and 1 subject was female with the age of 28 ± 40 years and affected unilaterally on oculi dextra. Preoperative BCVA was 2.5 ± 2 logMAR, preoperative IOP was 7 ± 11 mmHg. (Table 1)

Table 1. Patients Characteristics

Characteristics	N(%)
Gender	
Male	5 (83.3)
Female	1 (16.7)
Age, mean	28 ± 40 years
Unilateral	
Oculi Dextra	5(83.3)
Oculi Sinistra	1(16.7)
Phakic Status	
Phakic	5 (83.3)
Pseudophakia	1 (16.7)

Intraoperative findings found macular off , 1 Number of retina break and 1 Quadrant detachment found in 5 patients, location of break on supero-temporal quadrant found in 4 patients. Proliferative vitreoretinopathy (PVR) and choroidal detachment was found in 1 eye. Intraoperative triamcinolone used in 4 eyes and perfluorocarbon in 1 eye. (Table 2).

Table 2. Intraoperative Findings and Procedure

Findings	N(%)
Macular Findings	
Macular On	1 (16.7)
Macular Off	5 (83.3)
Duration of macular detachment (mean, days)	47 ± 83 Days
Number of Quadrant Detachment	
1 Quadrant	5(83.3)
2 Quadrant	1(16.7)
Number of Retinal Break	
1 break	5(83.3)
>2 breaks	1(16.7)
Location of Break	
Supero-temporal	4 (66.7)
Infero-temporal	2 (33.3)
Proliferative Vitreoretinopathy (PVR) grade C	1 (16.7)
Choroidal Detachment	1 (16.7)
Usage of intraoperative	
Internal Limiting Membrane Peeling	1(16.7)
Triamcinolone	4 (66.7)
Perfluorocarbon	1 (16.7)

BCVA was 2.5 ± 2 logMAR before the surgery, BCVA D+1 data was not normally distributed (p= 0.00), therefore Wilcoxon Signed Rank Test showed that there was no difference (p = 0.317) after the surgery day 1 compared to baseline. The BCVA 1 week, 2 weeks and 1 month showed normally distributed, T-paired test and showed there no significant difference after the surgery compared to baseline (p = 0.949, p = 0.611, p= 0.611 respectively). Preoperative IOP was 7 ± 11 mmHg and 13.6 ± 10 mmHg 1 month after the surgery. IOP 1 week was not normally distributed (p= 0.022), therefore Wilcoxon Signed Rank Test showed that there was significant difference (p = 0.027) 1 week after the surgery compared to baseline. IOP day 1, 2 weeks and 1 month was normally distributes, T-paired test showed there was no significant difference after the surgery on day 1 (p = 0.37) and 2 weeks (p = 0.062) compared to baseline. T-paired test on IOP 1 month showed significant difference (p=0.011) compared to baseline. (Table 3)

Ophthalmol Ina 2023;Supplement Ed.: 103-112

Table 3. Preoperative and postoperative BCVA, IOP

	Pre-Operative	Postoperative D+1	D+7	D+14	D+30
BCVA (mean ± range LogMar)	2.5 ± 2	2.3 ± 2⁺	2.5 ± 1.8	2.3 ± 1	2.3 ± 1
IOP (mean ± range mmHg)	7 ± 11	13.5 ± 38	23.5 ± 46⁺*	16.3 ± 32	13.6 ± 10º

⁺Data was not distributed normally
*Wilcoxon test showed statistically significant $p<0.05$
ºT-paired test showed statistically significant $p<0.05$

Subconjunctival bleeding found in 6 eyes, followed by corneal edema 5 eyes and subretinal hemorrhage in 2 eyes as postoperative complications respectively. (Table 4)

Table 4. Complications after surgery

Complications	N(%)
Ocular Hypertention	1 (16.7)
Subconjunctiva Bleeding	6 (100)
Corneal Edema	5 (83.3)
Retina Redetachment	1 (16.7)
Subretinal Hemorrhage	2 (33.3)

DISCUSSION

Machemer et al. more than 50 years ago, countless advances have been made in vitreoretinal surgery, including microincisional vitrectomy, safer and improved vitrectomy platforms with state-of-the art fluidics systems, high-speed vitreous cutters, and a wide range of surgical instruments. SB procedures have been shown to be as effective as PPV in the management of noncomplex RRD and, in some cases, they may be even superior. The non-inferiority of SB approach was confirmed in a recent systematic review including 10 randomized and controlled trials analysing more than 1300 eyes.[5]

The vitreous base is a three-dimensional structure which encompasses a circumferential area that straddles the ora serrata, characterized by high density of collagen fibrils oriented at right angles to the peripheral retina. At the posterior edge of this anatomical landmark, vitreous adherence to the retina is remarkable. A broad circumferential buckle such that used in the present study guarantees adequate and uniform peripheral support, which provide strong indentation only in correspondence to the break. Further traction exerted in different areas not covered by the segment may create new breaks and potentially cause a re-detachment.[5]

The posterior border of the buckle was always sutured at 15 ± 2 mm posterior to the limbus, with minimum adjustments between cases. This technique was effective even in cases of multiple retinal breaks. In those eyes in which the break was located posteriorly to the buckle, the released vitreous traction and the combined effect of cryopexy, subretinal fluid drainage, and air tamponade manuvres were enough to seal the lesions and maintain the retina flat.[5] We sutured the buckle 14 mm posterior to the limbus and showed a favorable result without reducing the eye motility.

In PPV, the vitreous body and the vitreous base are removed; intraoperatively, perfluorocarbon liquids (perfluoro n-octano, PFCL) are used to unfold the retina. Fibrous membranes are removed to relieve the vitreoretinal traction, while the retina flattens. Once the retina is flattened, the tear is sealed by chorioretinal adhesion induced by endophotocoagulation. At completion of the procedure, the vitreous cavity is filed with silicone oil or a gas bubble to promote adhesion between the retina and the RPE. The scleral buckle creates an indentation in the wall of the eye, which brings the detached retina closer to the eye wall and relieves the vitreoretinal traction by supporting the vitreous base. Thus, the combined procedure may hasten healing and result in better postsurgery anatomical and visual outcomes.[6] Therefore in this study we observed the clinical outcome in patients who underwent PPV and SB surgery, although there was no statistically significant in BCVA but there was improvement anatomically.

There was a trend towards a poorer final visual acuity in eyes that used PFCL than in eyes without the use of PFCL. The number of quadrants detached was greater in eyes with PFCL than in eyes without PFCL use (2.8 ± 1.3 vs 2.4 ± 1.0) which might have affected the final visual acuity.[3] We did not use PFCL to detect small peripheral breaks but to protect the macula which will be taken out right before injecting silicone oil.

The presence of a macular detachment and choroidal detachment before the primary surgery was significantly correlated with a poorer final BCVA.[3] Preoperative VA and the presence of PVR grade C or worse have been proposed as statistically significant predictors for visual outcome.[7] The present study investigated whether a systematic and straightforward SB approach, which remains roughly unchanged in all cases, could be effective in the management of noncomplex RRD regardless of the number and location of retinal breaks. Radice et al states that anatomical success at 12 months after scleral buckling in management of RRD.[5] Burton *et al* reported that patients with a macular detachment less than 5 days had better visual outcomes, and approximately 1 line of vision was lost for 1 additional week until 27 days. Ross and Kozy reported no statistically significant differences in anatomic or visual outcomes if the repair was performed within the first 7 days of macular detachment and suggested that non emergent treatments may be more cost-effective. Studies from Hassan *et al* and Diederen *et al* demonstrated that good postoperative outcomes could be obtained in patients treated within 10 days of macular detachment. Williamson *et al* demonstrated that patients with a shorter duration of vision loss (less than 3 days) had significantly better visual outcomes than those with 4–6 days of vision loss.[7] Our study attempted to specify the number of days of vision loss based on the patients' history. Better preoperative VA and the lack of PVR grade C or worse were determined to be potential good prognostic variables based on this study, which is in line with other research.

Proliferative vitreoretinopathy (PVR) may be due to retinal pigment epithelium (RPE) cells from the large area of exposed RPE and blood-borne cells from any concurrent clinical or subclinical associated vitreous hemorrhage. RPE cells migrate toward the vitreous cavity and proliferate into the epiretinal and subretinal space with an increase in cytokine production followed by formation of cellular membranes, which may grow and contract.[6] The use of silicone oil tamponade after vitrectomy has been reported to be effective in the overall success rate of complicated RRD cases with PVR.[3] We use silicone oil tamponade for all patients with/without PVR.

Traumatic incidences of SCH have risen secondary to the increased use of contact lenses as well as the number of people undergoing ocular surgeries. Contact lens wearers have a higher tendency to have conjunctivochalasis, pinguecula, and superficial punctate keratitis. These conjunctival diseases can cause increased inflammation through dryness and friction between the lenses and conjunctiva itself as well as a possible disruption of tear flow. Material defects and surface deposits in hard lenses, as well as defects at the rims with prolonged use of disposable contact lenses, can promote SCH. Ocular surgeries, especially in patients on anticoagulation, increase the risk for SCH (subconjunctival hemorrhage/subconjunctiva bleeding). Cataract surgery, refractive surgery, local anesthesia such as sub-Tenon's injections can potentiate SCH. Subconjunctival hemorrhage results from bleeding of the conjunctival or episcleral blood vessels and subsequently leaks into the subconjunctival space. Blood vessels can wear and tear over time. The elastic and connective tissues become fragile with age and underlying comorbidities which can result in the ease of spread of the hemorrhage in the elderly.[9] In this study, we found subconjunctival hemorrhage/bleeding the most after the surgery because friction between SB material and conjunctiva causes bleeding.

Corneal complications after intraocular surgeries are well known. Theoretically, they can occur more often after procedures involving anterior segment of the eye. Such of these complications are corneal edema, Descemet's membrane abnormalities, endothelial dysfunction, corneal epithelial abnormalities, and infectious keratitis. The occurrence of corneal epithelial defects (CED) after pars plana vitrectomy (PPV) is not well described in the literature. The incidence of CED after PPV may reach up to 23.8%. The mechanism of this disorder is not well understood. Diabetes mellitus (DM) had been known to be a risk factor in the development of postoperative corneal complications. The mechanism behind that is the abnormal corneal histopathological structure in diabetic patients. Other risk factors that can lead to the development of postoperative CED might be classified into intrinsic and extrinsic. Intrinsic factors include patient-related disorders such as diabetic keratopathy, corneal dystrophies, corneal degenerations, and limbal stem cell deficiency. Extrinsic factors are mechanical (e.g., trauma by instruments) or chemical (e.g., disinfectants and agents used intraoperatively). Other extrinsic factors are the duration of the surgery and type of procedures, for example, vitrectomy and phacoemulsification.[10] Frequent fluid–gas exchange in vitrectomy is considered to cause the post-operative epithelia defect.[10] In this study, we found 5 eyes with corneal edema, without any systemic disease therefore we suggest that corneal edema occurred due to frequent fluid-gas exchange and long surgery period.

Subretinal hemorrhage is a sight-threatening complication that can occur as a result of a deep suture, following scleral depression, or during subretinal fluid drainage. The visual outcome depends on whether the bleeding reaches the macula or not. Self-limiting and small hemorrhages not reaching the macula commonly do not affect visual and anatomical outcomes. When the blood collects in the submacular area, it can cause severe visual impairment. Subretinal blood can cause damage to photoreceptors in several ways: a barrier effect mechanism between photoreceptor and retinal pigment epithelium; a toxic effect caused by iron; and/or mechanical injury caused by coated blood. Subretinal blood can impede retinal reattachment and promote PVR. Management of subretinal bleeding depends on its severity. Small and self-limiting hemorrhages might not require treatment and can be successfully managed by positioning the patient in order to prevent the blood from reaching the macula. In some cases, the intravitreal injection of air can be useful for this purpose. In more severe cases, subretinal drainage with an extrusion needle might be required. If vitrectomy is needed, perfluorocarbon liquids could be used to displace subretinal blood and drain it through a retinotomy or a break. The use of tissue plasminogen activator (TPA) has proved useful, especially if there is a significant clot.[8] In this study, we found subretinal hemorrhage 2 patients that resolved by itself without any intervention.

Vitrectomy is tended to responsible for the significantly post-operative high IOP. Frequent fluid–gas exchange in vitrectomy is considered to cause the post-operative high IOP or epithelia defect. The fluid-air or fluid-gas exchanges at the end of operation are adopted to establish an air- or a gas-filled vitreous cavity which facilitates superior wound integrity and therefore decreases the risks of these two complications.[11] This explanation may be associated with this study where we found 1 patient with high IOP post surgery.

Pseudophakic RRD were associated with higher risk of recurrence. Buckle mispositioning, insufficient indentation, new peripheral break formation were the main causes of RRD recurrence. RRD recurrence in pseudophakic eyes was mainly caused by small anterior breaks, presumably located at the posterior edge of the vitreous base. Bradford et al. who suggested that such anterior tears may be due to persistent chronic traction upon the vitreous base.[5] The redetachments were caused due to the development of new breaks, undetected breaks at the initial surgery, a reopening of treated breaks, or PVR. The reopening of breaks suggests that a traction by residual vitreous cortex may have induced the rRRD. Surgeons can reduce the traction by SB. Therefore, the reduction of traction by residual vitreous strands by SB was essential. Another option to counteract the peripheral vitreous traction is a 360-degree laser retinopexy, but recent data suggest that there is no benefit of this in increasing the reattachment rate.[3] This explanation maybe associated with this study where we found recurrent detachment in 1 eye.

This study has several limitations, including a small sample and short follow-up. The strength of this study was a single-surgeon case series. This fact may have guaranteed high homogeneity of the data and reliable statistical results.

In conclusion, primary RRD may be efficiently managed with a SB and PPV approach. Ab-externo techniques as on SB still hold an important role in RRD management. SB combined with PPV as management in RRD will optimize anatomical and functional results although the recovery time may vary from case to case. There were several clinical condition seen such as BCVA after the surgery didn't improve as expected, subconjunctival bleeding, corneal edema and subretinal hemorrhage were complications found the most in these eyes. To verify the findings of this investigation, larger, prospective, and comparative studies are needed.

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