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COMPARISON BETWEEN SCLERAL BUCKLING AND VITRECTOMY IN THE ONSET OF CYSTOID MACULAR EDEMA AND EPIRETINAL MEMBRANE AFTER RHEGMATOGENOUS RETINAL DETACHMENT REPAIR

MAGDA GHARBIYA, MD, GIACOMO VISIOLI, MD, LUDOVICO IANNETTI, MD, PhD, ANDREA IANNACCONE, MD, ANNA CLARA TAMBURRELLI, MD, MARCO MARENCO, MD, PhD, GIUSEPPE MARIA ALBANESE, MD

Purpose: To investigate the incidence and risk factors for the main complications in patients with rhegmatogenous retinal detachment treated with scleral buckling (SB) or pars plana vitrectomy (PPV).

Methods: A retrospective, comparative, observational study was conducted. The medical records of 107 patients with primary rhegmatogenous retinal detachment who were managed with SB (n = 57) or PPV (n = 50) were reviewed. Scleral buckling was performed using scleral encircling solid silicone band and circumferential solid silicone exoplant to support the break. Pars plana vitrectomy was combined with phacoemulsification in phakic eyes and with scleral encircling in inferior detachments. Follow-ups, including spectral-domain optical coherence tomography examination, were scheduled at 1, 3, and 12 months after surgery. Propensity score matching was used to adjust for potential preoperative selection bias.

Results: The overall incidence of postoperative cystoid macular edema (CME) and epiretinal membrane was 14.95% and 30.84%, respectively. Compared with SB, CME was more frequent in the PPV (P = 0.021) and in the PPV pseudophakic eyes (P = 0.027). Postoperative CME was an early, predominantly transient complication and regressed in 67% of SB and in 77% of PPV eyes within 12 months after surgery. No differences were observed regarding epiretinal membrane development. Except for the surgical technique, no preoperative factors associated with CME were identified. A correlation between epiretinal membrane and patients' age was found (P = 0.028).

Conclusion: The incidence of CME after rhegmatogenous retinal detachment repair was higher in patients who underwent PPV, either alone or combined with phacoemulsification, than in those treated with SB. Epiretinal membrane development was correlated to older age, regardless of the surgical procedure.

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Pars plana vitrectomy (PPV) and scleral buckling (SB) are the main treatments for rhegmatogenous retinal detachment (RRD). The choice between the two largely depends on the surgeon's experience, characteristics of the detachment, and other preoperative factors. However, even if both are effective in the anatomical repair of the detachment, differences in the procedures—given the same RRD extent and characteristics—may induce a different range of complications that may lead to incomplete functional recovery.

Postoperative cystoid macular edema (CME) and epiretinal membrane (ERM) represent possible complications that could undermine visual recovery after successful RRD repair.[1–3] The incidence of CME after RRD surgery is reported to be ranging from 3% to 43%, showing great variability among different studies.[4–6]

The development of ERM after RRD repair has been assessed by previous authors with reported rates ranging from 3% to 70%.[7–9] Furthermore, in the literature, only a few studies have compared the incidence of these adverse events between SB and PPV.[1,2,10–12] However, no difference in CME and ERM onset has been highlighted. Of note, a recent meta-analysis that included 10 randomized controlled trials, comparing SB and PPV for primary RRD repair, found no significant differences in the onset of CME and ERM in a total of 265 and 372 patients, respectively.[13]

This high variability in the results among previous studies is probably related to differences in study designs, inclusion and exclusion criteria, surgical techniques, and the sensitivity of the diagnostic tool used to assess the possible postoperative complications. Moreover, statistical analyses in retrospective cohorts do not always consider factors that could have orientated the surgeon in the choice between the two techniques, thus potentially determining a selection bias.

The aim of the present study is to investigate the incidence and risk factors for these two postoperative complications in patients with primary RRD treated with SB or PPV. To minimize any potential bias concerning the choice between the two surgical procedures, we applied a propensity score matching analysis for the significantly associated clinical factors.

Methods

An institutional retrospective, comparative study, approved by the ethical board of the Sapienza University of Rome, was conducted in adherence to the tenets of the Declaration of Helsinki. Medical records of patients who underwent successful repair for primary RRD, by a single experienced retinal surgeon (M.G.), at the Ophthalmology Unit of the Policlinico Umberto I University Hospital of Rome, from January 2018 to December 2020, were retrospectively reviewed. A written informed consent was signed by all the patients included in the study.

Inclusion criteria were established as follows: 1) primary RRD successfully repaired using a single uncomplicated surgical procedure; 2) preoperative clear ocular media; 3) a follow-up, including spectral-domain optical coherence tomography (SD-OCT) examination, at 1, 3 and 12 months after surgery; 4) age $\geq$ 18 years; and 5) presence of an accurate preoperative description of retinal detachment (RD).

Exclusion criteria were: 1) macular pathologies in the treated or fellow eye, such as age-related macular degeneration or any disease affecting the vitreomacular interface (e.g., ERM and macular hole); 2) presence of glaucoma or history of retinal vascular occlusion, in the treated or fellow eye; 3) previous intraocular surgery other than uncomplicated cataract surgery; 4) any further surgery during the follow-up period including cataract surgery or laser capsulotomy; 5) history of uveitis or any ocular pathology, other than noncomplicated RRD; 6) vitreous hemorrhage or proliferative vitreoretinopathy of Grade B or greater; 7) presence of an RRD with retro-equatorial or giant retinal tears; 8) history of diabetes or any inflammatory systemic disease; 9) low-quality ($<$25 units) or unreliable OCT images; and 10) silicone oil tamponade.

Surgical Techniques

In patients who underwent SB, a 240 encircling solid silicone band was positioned (Mira Inc., Uxbridge, MA), external subretinal fluid drainage was performed at the surgeon's discretion, and cryotherapy was applied to the retinal break(s). Finally, a circumferential solid silicone scleral exoplant was positioned to support the break(s). For patients who underwent PPV, a 25-gauge vitrectomy using a noncontact wide-viewing system, including core vitrectomy and creation or confirmation of posterior vitreous detachment, was performed. Peripheral vitrectomy and vitreous base shaving were carried out with scleral indentation. Endophotocoagulation was applied to all the retinal breaks after perfluorocarbon liquid/air exchange. At completion, the air was exchanged with 20% SF6 (MICROMED s.r.l., Rome, Italy). All phakic eyes underwent combined standard phacoemulsification and intraocular lens implantation. In inferior detachments, PPV was combined with scleral encircling. As part of a standardized protocol, postoperative therapy for both surgical techniques consisted of topical antibiotics (4 times a day for 10 days) and dexamethasone eye drops (4 times a day for 10 days and then tapered on a

From the Department of Sense Organs, Sapienza University of Rome, Policlinico Umberto I University Hospital, Head and Neck Department, Rome, Italy.

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M. Gharbiya: Conceptualization, Methodology, Writing—Original draft preparation, Supervision; G. Visioli: Data curation, Formal analysis, Writing—Original draft preparation; L. Iannetti: Data curation, Investigation, Reviewing and Editing; A. Iannaccone: Investigation, Writing—Original draft preparation; A. C. Tamburrelli: Investigation; M. Marenco: Data curation, Reviewing and Editing; G. M. Albanese: Investigation, Data curation, Writing—Original draft preparation.

Reprint requests: Giacomo Visioli, MD, Department of Sense Organs, Sapienza University of Rome, 155, Viale Del Policlinico, Rome 00161, Italy (e-mail: giacomo.visioli@uniroma1.it).

weekly basis). Starting from day 10 after surgery, patients also received topical nonsteroidal anti-inflammatory drugs eye drops for the next 3 months. Patients who developed CME received NSAIDs combined with steroid eye drops.

Data Collection

Data collection and SD-OCT analysis were performed according to a previously described protocol.[14] Experienced investigators (M.G. and L.I.) evaluated the automated segmentation and manually corrected for any misalignment. All scans were further evaluated for the presence of CME and/or ERM after surgery. CME was defined as circular or ovoid hyporeflective cystoid spaces within the retina; ERM was defined as any single, irregular, and hyperreflective line above the internal limiting membrane, and it was staged according to a 4-grade OCT classification.[15]

Statistical Analysis

Statistical analysis was performed with STATA, v. 14.0 (StataCorp, TX). Continuous variables were reported as mean ± SD; categorical variables were reported as counts and percentages. Normal distribution of continuous variables was analyzed by the Shapiro–Wilk test. Parametric values were compared using the unpaired *t*-test, whereas Mann–Whitney test was used for nonparametric values. Fisher's exact test was used to compare categorical variables. A linear panel regression analysis reporting marginal effects was used to test for the differences of best-corrected visual acuity (BCVA) values between baseline and postoperative follow-up times within SB and PPV groups. To identify variables associated with the onset of CME or ERM, we used a backward stepwise logistic regression analysis, including the following clinically relevant factors: surgical technique, sex, age, duration of symptoms before surgery, macula-on versus macula-off RD, preoperative axial length, eye lens status, multiple retinal breaks, retinal breaks localization, and RRD extent. In the analysis, backward elimination threshold was set at 0.20 level and factors with $P < 0.05$ were retained as final predictors. Finally, to compare PPV versus SB group by accounting for any potential preoperative selection bias, a propensity score matching was applied for the onset of CME. In the first step, we used a Probit regression with the incidence of CME (SB vs. PPV) as dependent variable and the preoperative factors as independent variables that could have influenced surgeon's choice between the two procedures. For the second step, different matching techniques were assessed to reduce the differences between groups. Similar model was applied to test for the differences between SB and PPV alone in pseudophakic eyes. When applicable, we reported *P* values and 95% confidence intervals (CIs).

Results

A total of 107 eyes of 107 patients (69 men and 38 women), with a mean age of 59.70 ± 12.33 years (range, 19–86 years), were included in the study. Of these, 57 patients underwent SB and 50 PPV (Figure 1).

Overall, compared with patients treated with SB, those in the PPV were significantly older and were more likely pseudophakic, with a longer duration of symptoms and a lower preoperative visual acuity. Baseline descriptive statistics and differences between groups are shown in Table 1.

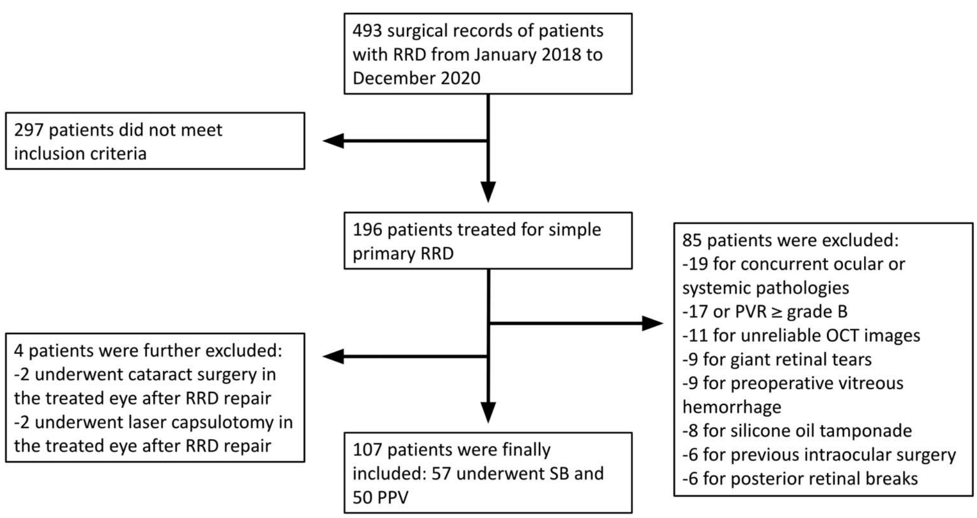

Fig. 1. Flow chart of patients' selection in the present retrospective study comparing SB and PPV in primary RRD repair. All patients were operated at the Ophthalmology Unit of the Policlinico Umberto I University Hospital of Rome, by the same experienced vitreoretinal surgeon. PVR, proliferative vitreoretinopathy.

Table 1. Demographics and Clinical Characteristics of Patients Who Underwent Retinal Detachment Repair With Scleral Buckling or Vitrectomy

Characteristic	All Eyes (n = 107)	SB Eyes (n = 57)	PPV Eyes (n = 50)	Difference (95% CI)	*P*
Sex					
Female, n (%)	38 (35.51)	22 (38.60)	16 (32.00)		*0.546*
Male, n (%)	69 (64.49)	35 (61.40)	34 (68.00)		
Age, mean ± SD (range)	59.70 ± 12.33 (19–86)	56.56 ± 11.42 (21–83)	63.28 ± 12.46 (19–86)	−6.72 (−11.30, −2.14)	***0.004****
Duration of symptoms (days), mean ± SD (range)	6.79 ± 5.06 (1–25)	5.68 ± 4.66 (1–25)	8.04 ± 5.25 (1–21)	−2.36 (−4.26, −0.46)	***0.016****
BCVA (logMAR), mean ± SD (range)	1.12 ± 0.84 (0–2.3)	0.82 ± 0.75 (0–2.3)	1.45 ± 0.82 (0–2.3)	−0.63 (−0.93, −0.33)	<***0.001****
AXL (mm), mean ± SD (range)	24.47 ± 1.49 (21.3–33.7)	24.54 ± 1.06 (21.3–26.1)	24.40 ± 1.87 (21.4–33.7)	0.13 (−0.44, 0.71)	*0.648*
IOP (mmHg), mean ± SD (range)	14.13 ± 2.48 (8–20)	14.42 ± 2.30 (10–18)	13.80 ± 2.66 (8–20)		*0.144*
Macula-off RRD, n (%)	75 (70.09)	37 (64.91)	38 (76.00)		*0.290*
Phakic eyes, n (%)	75 (70.09)	45 (78.95)	30 (60.00)		***0.037****
RRD extent > 2 quadrants, n (%)	48 (44.86)	25 (43.86)	23 (46.00)		*0.848*
Multiple retinal breaks, n (%)	42 (39.25)	20 (35.09)	22 (44.00)		*0.428*
Inferior retinal breaks, n (%)	26 (24.30)	15 (26.32)	11 (22.00)		*0.656*
Phacovitrectomy, n (%)			30 (60.00)		
PPV + scleral encircling, n (%)			37 (74.00)		
External drainage, n (%)		34 (59.65%)			

Differences between groups were analyzed using Fisher exact test, unpaired *t*-test, or Mann–Whitney *U* test, as appropriate.
**P*-values < 0.05 are given in bold-italic entries.
AXL, axial length; IOP, intraocular pressure.

In the linear panel regression analysis, the estimated value of BCVA obtained as marginal effect improved from 0.82 logMAR (20/132 Snellen; 95% CI, 0.63–1.02) at baseline to 0.09 logMAR (20/25 Snellen; 95% CI, 0.04–0.13) at the end of follow-up in the SB group; similarly, in the PPV group, BCVA improved from 1.45 logMAR (20/564 Snellen; 95% CI, 1.23–1.68) before surgery to 0.20 logMAR (20/32 Snellen; 95% CI, 0.13–0.28) at the end of follow-up. Overall, BCVA improvement was greater in PPV eyes than in SB eyes: 1.25 ± 0.74 versus 0.74 ± 0.71 logMAR, respectively (P <0.001). Margins plot of BCVA over time stratified by the surgical technique is shown in Figure 2.

During the follow-up period, we recorded 16 patients (14.95%) with at least one occurrence of CME and 33 patients (30.84%) with ERM. Compared with the SB group, CME was significantly more frequent in the PPV procedure either alone, in pseudophakic eyes (P = 0.025), or combined with phacoemulsification (P = 0.005). Further, comparing phacovitrectomy and PPV alone, there were no observed differences in the onset of CME (P = 1.000). No differences were found regarding the development of ERM between the groups. Detailed data of the complications over time are shown in Table 2.

To compare SB versus PPV group for the differences in the onset of CME by accounting for preoperative selection bias, a propensity score matching model was applied. After adjustment, the incidence of CME remained consistently higher in PPV eyes (P = 0.021) and in the PPV alone (P = 0.027). Detailed outcomes of the matching models are shown in Table 3.

Overall, no differences were found within the CME and ERM eyes when considering all the preoperative factors, except for the patient's age and the development of ERM (P = 0.025) as summarized in Table 4.

After logistic regression analysis (pseudo R^2 = 0.19), PPV was found to be the only factor associated with the onset of CME in all treated eyes (P = 0.001). Similarly, in an analogous model including SB eyes and PPV in pseudophakic eyes (pseudo R^2=0.18), PPV turned out to be the only factor associated with the onset of CME (P = 0.011). Finally, a last model (pseudo R^2=0.04) was run to test for factors associated with the development of ERM, and a correlation with the patient's age was found (P = 0.028). Detailed outputs of these three analyses are reported in Table 5.

At 12 months, regression of CME was recorded in 66.7% of SB eyes (1 eye at 3 months and one at 12 months) and in 76.92% of PPV eyes (3 eyes at 3 months and seven eyes within 12 months). Persistent CME was observed in only four patients (1 eye in the SB and three eyes in the PPV group). At 12 months of the 33 ERM cases, 25 eyes (75.76%) had stage 1 ERM, 13 eyes in the SB and 12 in the PPV group;

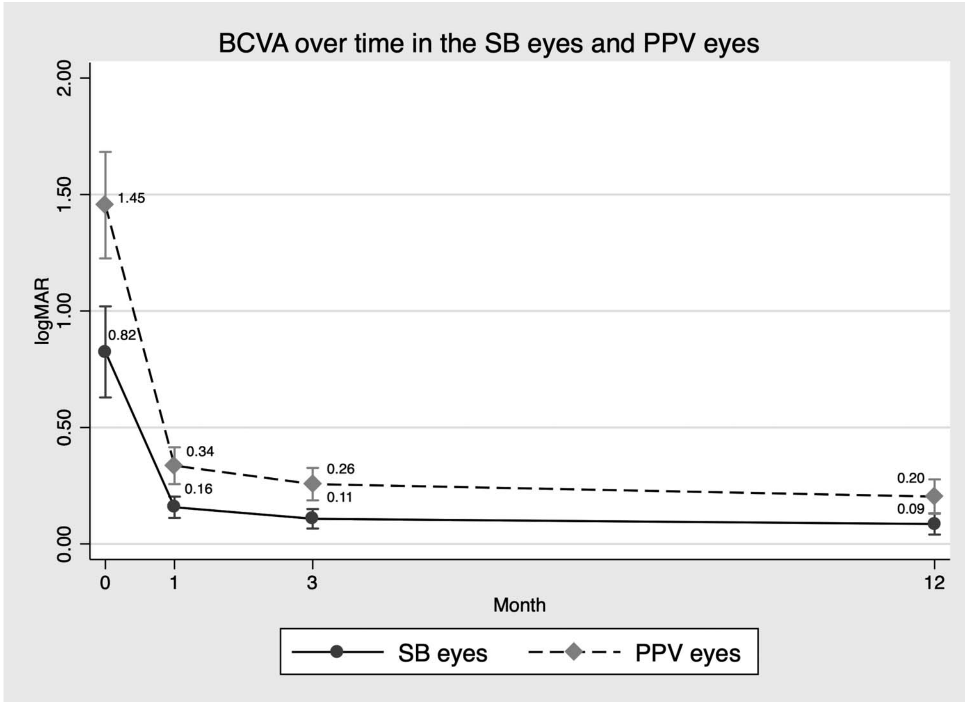

Fig. 2. Margins plot of BCVA in logMAR over time in patients who underwent retinal detachment repair with SB or PPV.

seven eyes (21.21%) had stage 2 ERM, three eyes in the SB and four in the PPV group; and one eye (3.03%) in the PPV group showed stage 3 ERM.

Discussion

We showed that the development of CME, even after propensity score matching, was more common in patients who underwent PPV, either alone or combined with phacoemulsification, than in those treated with SB. Postoperative CME was an early, predominantly transient complication and regressed in most patients within 12 months after surgery. No differences were found regarding the ERM incidence between groups. Visual acuity at 12 months did not show any significant difference when comparing eyes with and without the complications.

Table 2. Rate of CME and ERM Over Time in Patients Who Underwent Retinal Detachment Repair With SB or PPV, With a Subgroup Analysis Accounting for PPV Alone (in Pseudophakic Eyes)

	CME, n (%)				ERM, n (%)			
	1 Month	3 Months	12 Months	At Least 1 Occurrence During FU	1 Month	3 Months	12 Months	At Least 1 Occurrence During FU
SB eyes (n = 57)	1 (1.75%)	2 (3.51%)	1 (1.75%)	3 (5.26%)	6 (10.53%)	10 (17.54%)	16 (28.07%)	16 (28.07%)
PPV eyes (n = 50)	7 (14.00%)	10 (20.00%)	3 (6.00%)	13 (26.00%)	5 (10.00%)	6 (12.00%)	17 (34.00%)	17 (34.00%)
Total occurrence (%), *P*-value*				16 (14.95%), ***0.005***§				33 (30.84%), 0.536
PPV in pseudophakic eyes (n = 20)	3 (15.00%)	3 (15.00%)	1 (5.00%)	5 (25.00%)	2 (10.00%)	2 (10.00%)	7 (35.00%)	7 (35.00%)
P-value†				***0.025***§				0.580
P-value‡				1.000				1.000

Differences were analyzed using Fisher exact test.
*Differences between SB and PPV groups.
†Differences between SB eyes and PPV alone.
‡Differences between phacovitrectomy and PPV in pseudophakic eyes.
§*P*-values < 0.05 are given in bold-italic entries.

Table 3. Propensity Score Matching Models to Test for the Difference Between SB and PPV and the Difference Between SB and PPV Alone (in Pseudophakic Eyes) in the Onset of CME

	Difference Between SB (n = 57) and PPV Eyes (n = 50)*		Difference Between SB (n = 57) and PPV in Pseudophakic Eyes (n = 20)†	
	Radius Caliper at Level 0.050		Radius Caliper at Level 0.045	
Matching Method	Before Matching	After Matching	Before Matching	After Matching
Pseudo R^2	0.180	0.005	0.234	0.008
LR chi-square	26.58	0.53	20.61	0.24
Mean bias	48.7	4.2	63.7	6.6
Median bias	47.4	1.4	63.3	6.9
Rubins' R	1.44	2.01	1.76	0.34
Rubins' B	104.6	16.0	118.5	19.7
CME in SB eyes	5.26%	7.29%	5.26%	4.56%
CME in PPV eyes	26.00%	29.27%	25.00%	45.45%
T-stat	3.11	2.61	2.56	2.53
P-value	0.005	0.021	0.025	0.027

Rubins' R ratio of PPV to SB variances of the propensity score index; Rubins' B absolute difference of the mean values of the linear index of the propensity score in the PPV and SB group.

*Variables included in the matching model: patient's age, duration of symptoms before surgery, lens status, multiple retinal breaks, and preoperative BCVA.

†Variables included in the matching model: patient's age, duration of symptoms before surgery, multiple retinal breaks, and preoperative BCVA.

LR, likelihood ratio.

In the literature, studies investigating the incidence of CME and ERM after RRD surgery are difficult to compare as they have a wide variability in design, follow-up, inclusion criteria, surgical techniques, and even in the detecting tools used to identify complications. Indeed, SD-OCT has improved the rate of detection of microstructural retinal alterations that may be underestimated by clinical examination or the use of the earlier time-domain OCTs. In the present series, the incidence of CME was 26.0% after PPV and 5.3% after SB surgery. Our results differ from those of some recent reports in this setting. Specifically, in a 6-week prospective study, Gebler et al[4] reported a CME rate of 16.3% for the PPV and 20.7% for the SB patients and found no differences between the procedures.[4] Overall, considering the short follow-up, the

Table 4. Risk Factors for Postoperative CME and ERM After Retinal Detachment Repair in the Whole Study Cohort

	CME			ERM		
Characteristics	Yes (n = 16)	No (n = 91)	*P*	Yes (n = 33)	No (n = 74)	*P*
Age, mean ± SD	61.5 ± 9.9	59.4 ± 12.7	*0.530*	63.7 ± 10.7	57.9 ± 12.6	***0.025****
Duration of symptoms (days), mean ± SD	5.4 ± 2.5	7.0 ± 5.4	*0.229*	7.2 ± 5.9	6.6 ± 4.7	*0.563*
AXL (mm), mean ± SD	24.79 ± 1.29	24.42 ± 1.52	*0.361*	24.22 ± 2.09	24.59 ± 1.13	*0.233*
Initial BCVA (logMAR), mean ± SD	0.99 ± 0.80	1.14 ± 0.85	*0.496*	1.32 ± 0.85	1.03 ± 0.83	*0.106*
Final BCVA (logMAR), mean ± SD	0.14 ± 0.22	0.14 ± 0.23	*0.989*	0.18 ± 0.24	0.12 ± 0.22	*0.194*
RRD extent > 2 quadrants, n = 48 (%)	5 (31.25%)	43 (47.25%)	*0.284*	15 (45.45%)	33 (44.60%)	*1.000*
Multiple retinal breaks, n = 42 (%)	6 (37.50%)	36 (39.56%)	*1.000*	13 (39.39%)	29 (39.19%)	*1.000*
Inferior retinal breaks, n = 26 (%)	4 (25.00%)	22 (24.18%)	*1.000*	8 (24.24%)	18 (24.32%)	*1.000*
Phakic eyes before surgery, n = 75 (%)	10 (62.50%)	65 (71.43%)	*0.556*	22 (66.67%)	53 (71.62%)	*0.651*
Macula-off RRD, n = 75 (%)	9 (56.25%)	66 (72.53%)	*0.238*	26 (78.79%)	49 (66.22%)	*0.254*
SB with external drainage, n = 34 (%)	2 (12.50%)	32 (35.17%)	*1.000*	9 (27.27%)	25 (36.49%)	*0.771*
PPV + scleral encircling, n = 37 (%)	10 (62.50%)	27 (29.67%)	*1.000*	11 (33.33%)	26 (35.14%)	*0.322*
Phacovitrectomy, n = 30 (%)	8 (50.00%)	22 (24.18%)	*1.000*	10 (30.30%)	20 (27.03%)	*1.000*
CME, n = 16 (%)	—	—	–	6 (18.18%)	10 (13.51%)	*0.564*

Differences between groups were analyzed using Fisher exact test or unpaired *t*-test, as appropriate.

**P*-values < 0.05 are given in bold-italic entries.

AXL, axial length.

Table 5. Results of Stepwise Logistic Regression Analyses Assessing the Correlation Between Preoperative Factors and Postoperative CME or ERM After Retinal Detachment Repair

Dependent Variable	Independent Variables	Coeff.	SE	z	*P*	95% CI	Pseudo R^2
Occurrence of CME in all eyes	Constant	−1.60	0.76	−2.10	***0.035****	−3.08 to −0.11	0.188
	PPV technique	2.40	0.74	3.26	***0.001****	0.96 to 3.84	
	Macula-off RRD	−0.96	0.63	−1.52	*0.129*	−2.20 to 0.28	
	Duration of symptoms	−0.17	0.10	−1.75	*0.080*	−0.35 to 0.02	
Occurrence of CME in SB and in pseudophakic PPV eyes	Constant	−2.07	0.66	−3.15	***0.002****	−3.36 to −0.78	0.181
	PPV technique	2.42	0.95	2.55	***0.011****	0.56 to 4.28	
	Macula-off RRD	−1.80	0.95	−1.89	*0.058*	−3.75 to 0.06	
Occurrence of ERM in all eyes	Constant	−3.41	1.22	−2.79	***0.005****	−5.80 to −1.01	0.041
	Age	0.04	0.02	2.20	***0.028****	0.01 to 0.08	

**P*-values < 0.05 are given in bold-italic entries.
SE, standard error.

rate of CME in this study is higher than in our findings, especially in the SB cases. This discrepancy could be attributed to the extensive use of gas tamponade, injected in 65.5% of their SB procedures, as an adjunctive tool to achieve retinal reattachment. In addition, different criteria of CME definition may account for some of the discrepancies among studies. For example, we identified CME by the presence of cystoid spaces independently from retinal thickness, and we demonstrated that the rate of CME increased until 3 months after surgery and consistently decreased thereafter, regressing at 12 months in 75% of eyes. In contrast to our findings, a recent 12-month prospective series, the DOREFA study, evaluating outcomes after primary RRD repair found a CME rate of 8% at 1 month after surgery that remained stable during follow-up. In the DOREFA study, CME was defined as intraretinal cystic spaces in association with an increase of central foveal thickness of at least 320 μm.[7] Thus, by using this thickness cut-off, the true CME incidence could have been misinterpreted because retinal thickness is often reduced after RD, and in some eyes (e.g., myopic eyes), the retina is physiologically thinner. Indeed, at the end of follow-up, the 12-month rate of CME is comparable with our series.

The trend of CME rate over time observed in the present study is similar to that already described after other kinds of intraocular surgeries. Therefore, CME after RRD surgery may be related to iatrogenic damage to the ocular BRBs as a result of cytotoxic insult secondary to intraocular inflammation.[16–18]

Overall, data comparing postoperative CME incidence between SB and PPV are scant. In our findings, the incidence of CME after PPV was significantly higher compared with that after SB. This was observed either in patients with phakic eyes who underwent phacovitrectomy or in patients with pseudophakic eyes who underwent vitrectomy alone. Although we cannot exclude that phacoemulsification, when combined with vitrectomy, might have a role in CME onset, we speculate that also the lack of vitreous could represent an important trigger for the cascade of events leading to the onset of macular edema. Indeed, the presence of vitreous may potentially inhibit the dissemination of inflammatory mediators toward the posterior pole. In addition, there is evidence that vitreous humor plays a role in providing a neuroprotective environment to surrounding ocular tissues and in maintaining biochemical homeostasis, consuming molecular oxygen and protecting retinal cells from oxidative damage.[14,19–23] Recently, Ankamah et al[19] postulated that reattachment of the neurosensory retina after RD repair can trigger hyperoxia and increased free radical generation, culminating in reperfusion injury as in CNS stroke.[19] Vitreous antioxidant activity could mitigate the reperfusion injury effects, unless depleted.[23] Furthermore, several potential intraoperative traumatizing factors could increase the risk of CME development during vitrectomy: variation of ocular perfusion pressure and/or retinal ischemia because of elevated intraocular pressure, retinal dehydration, use of perfluorocarbon liquid, and gas or light toxicity; all these factors may potentially trigger an inflammatory reaction within the retina and eventually favor the onset of macular edema.[24–27]

These abovementioned mechanisms could also, while only partially, explain the development of ERM in eyes after RRD surgery. Indeed, we suppose that although CME mostly represents an iatrogenic effect specifically linked to the inflammation induced by the surgical procedure, ERM is induced primarily by RRD itself. In our series, the incidence of ERM did not vary between the surgical techniques, and older age was the only factor associated with the development of ERM after surgery. Epiretinal membrane formation after RRD repair is thought to be because of proliferation and transdifferentiation to myofibroblast of various precursor cells including retinal pigment epithelium. In RRD, retinal pigment epithelium cells migrate in the vitreous cavity through the retinal breaks, and further migration of detached retinal pigment epithelium cells may be induced by cryo-application in SB surgery or internal drainage in the vitrectomy procedure.[8,28,29] It is known that increasing age is the most consistent risk factor for idiopathic ERM; therefore, it is not surprising that it also may concur to ERM formation after either RRD or surgery.[28] In our results, neither the combination with SB nor with phacoemulsification increased the risk of ERM development in eyes that underwent vitrectomy. Conversely, Banker et al, evaluating 587 eyes after RRD repair, found that the incidence of ERM was higher after combined PPV and scleral encircling compared with PPV alone (48.4% vs. 31.2%, respectively).[5] However, in the data analysis, the authors did not account for the potential selection biases that could have directed the surgeon toward the choice of combining scleral encircling. For instance, in their cohort, the percentage of patients with phakic eyes was significantly higher in the SB + PPV group compared with the PPV alone group. Similarly, Kim et al in a recent retrospective study comparing lens-sparing vitrectomy and phacovitrectomy for primary RRD found an increased rate of both postoperative CME and ERM in the latter group (0% vs. 12.2% for CME and 8.1% vs. 28% for ERM, respectively).[30] Nonetheless, their results should be interpreted with caution because OCT was not used to detect complications, and no adjustments for potential selection biases were carried out despite, among others, patients in the lens-sparing group were younger and had significantly longer axial length compared with the phacovitrectomy group.

The shortcomings of this study are the retrospective, nonrandomized design and the relatively small sample size. One strength of this study is the comparative design, given that data comparing CME and ERM rates between SB and PPV are limited. Further strengths are the application of a strict protocol of inclusion and exclusion criteria, the employment of a propensity score matching model to minimize potential preoperative selection bias, and the use of SD-OCT that showed excellent sensitivity and repeatability.

Conclusion

Our study showed that the incidence of CME was higher after PPV (alone or combined with phacoemulsification) than SB, even after adjusting for potential selection bias. Macular edema is an early, predominantly transient adverse event, and its trend is similar to that observed in other intraocular surgeries. ERM was the most common adverse event, regardless of the surgical technique, and was associated with older age.

Key words: complications, cystoid macular edema, epiretinal membrane, pars plana vitrectomy, phacovitrectomy, propensity score matching, retinal detachment, scleral buckling, spectral-domain optical coherence tomography.

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