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Incidence and risk factors for macular oedema after primary rhegmatogenous retinal detachment surgery: a prospective single-centre study

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ABSTRACT.
Purpose: **To assess the incidence of cystoid macular oedema (CME) diagnosed by spectral domain optical coherence tomography (SD-OCT) after primary rhegmatogenous retinal detachment (RRD) surgery.**
Methods: **From April 2016 to October 2017, 150 eyes of 150 patients presenting with primary RRD were included consecutively in this prospective single-centre study. Patients with the following characteristics were excluded: previous vitreoretinal surgery, combined cataract surgery, preoperatively presentation with any intraocular or systemic inflammatory condition, visible macular oedema or epiretinal membrane (ERM) on funduscopy. SD-OCT (Spectralis, Heidelberg Engineering) was conducted 3 and 6 weeks after surgery.**
Results: **One hundred and twenty-eight of the 150 patients completed the study, of whom 107 (age: 61.7 ± 11.5 years, mean ± SD) showed successful retinal attachment during follow-up visits. The most frequent operation method was scleral buckling (54.2%), followed by vitrectomy (25.2%) and the combination of both techniques (20.6%). Postoperative SD-OCT revealed CME, neurosensory detachment and ERM in 18.7, 31.8 and 32.7% of all cases, respectively. The risk of postoperative CME was significantly elevated in patients with ERM (42.9 versus 6.9%, $p < 0.001$). In addition, patients with initial detachment of the macula had more postoperative CME (26.5 versus 11.1%, $p = 0.044$). BCVA improvement was significantly lower in patients with CME compared to patients without 6 weeks after surgery for macula-on RRD.**
Conclusions: **This prospective study confirmed that postoperative CME is a frequent complication after RRD surgery; we identified ERM and macula-off RRD as potential risk factors. As CME potentially delays visual recovery, postoperative follow-ups should include SD-OCT.**

Key words: buckling surgery – cystoid macular oedema – retinal detachment – vitrectomy

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Introduction

Cystoid macular oedema (CME) is one of the most common postoperative complications after intraocular surgery, potentially delaying visual recovery with a frequency peak of 4–12 weeks (Wolfensberger 1999; Loewenstein & Zur 2010). According to published reports, postoperative incidence of CME after rhegmatogenous retinal detachment (RRD) falls within a wide range of 3–43% (Lobes & Grand 1980; Meredith et al. 1980; Ackerman & Topilow 1985; Sabates et al. 1989; Ahmadieh et al. 2005; Benson et al. 2006; Tunc et al. 2007; D'Amico 2008; Benson et al. 2009; Lai et al. 2017). However, these previous studies have varied widely in their study designs, inclusion and exclusion criteria, surgical methods and diagnostic tools. Most data on the incidence of CME following RRD surgery are based on fluorescein angiography (FAG) (Lobes & Grand 1980; Meredith et al. 1980; Ackerman & Topilow 1985; Sabates et al. 1989; Tunc et al. 2007). Studies investigating CME by optical coherence tomography (OCT) mainly focused on scleral buckling and reported a low incidence of postoperative CME of 5 and 6.9% (Benson et al. 2009; Lai et al. 2017). Another study, which reported on the incidence of subretinal fluid on OCT after vitrectomy for RRD, even showed that CME occurred in only three of 100 patients (Benson et al. 2006). Of the mentioned studies, only Lai et al. (2017) used spectral domain optical coherence tomography (SD-OCT). Altogether, prospective data on the incidence of postoperative CME after RRD surgery diagnosed by SD-OCT and compared between different surgical methods are very limited. However, more data on this subject would be valuable, as SD-OCT has considerable advantages over FAG in terms of speed and non-invasiveness, making SD-OCT particularly suitable for assessing the macular oedema in the postoperative course after RRD surgery. Therefore, the objective of our study was to assess prospectively the frequency of postoperative CME diagnosed by SD-OCT after vitrectomy, scleral buckling or the combination of both procedures in one cohort and to detect risk factors associated with the incidence of CME following RRD surgery. Compared to previous studies, we aimed to define a more precise study set-up based on inclusion and exclusion criteria.

Methods

From April 2016 to October 2017, 150 eyes of 150 patients presenting with primary RRD were enrolled in this prospective monocentric study. All patients signed an informed consent, and the study protocol was implemented in accordance with the Helsinki Declaration after approval by our local ethics committee.

Exclusion criteria contained

1 history of vitreoretinal surgery;
2 scheduled vitrectomy combined with cataract surgery;
3 preoperative visible CME (due to, e.g., age-related macular degeneration, diabetic retinopathy, retinal vein occlusion, uveitis or pseudophakic CME);
4 epiretinal membrane (ERM) formation or proliferative vitreoretinopathy grade C if preoperatively visible on ophthalmoscopy;
5 findings compatible with current or pre-existing intraocular inflammation or a history of systemic or local inflammatory disorders;
6 a history of retinopathy of prematurity, hereditary retinal diseases or vitreoretinal dystrophies;
7 history or presence of any macular disorder potentially compromising visual outcome (e.g. macular hole);
8 and significant opacification of optical media.

Patients with retinal re-detachment observed at 3 or 6 weeks postoperatively were subsequently excluded from the study. The following preoperative parameters were documented: age, gender, lens status and duration of visual complaints. Refraction, ETDRS best-corrected visual acuity (ETDRS-BCVA) and intraocular pressure were measured at all visits. Furthermore, slit-lamp examination and dilated ophthalmoscopy were performed at each visit: preoperatively, to determine initial macular involvement and the number and distribution of retinal holes by clock hours, and to rule out any intraocular or retinal disorder listed within the exclusion criteria, during follow-up visits, to verify postoperative retinal attachment.

The following surgical characteristics were documented: surgical method (scleral buckling, vitrectomy or combination), presence of a giant retinal tear or retinal dialysis, method of retinopexy (cryopexy or laser photocoagulation), type of endotamponade (SF_6, C_2F_6, oil or none) and number of retinal holes by clock hours. Furthermore, we verified intraoperatively whether the macula at onset of surgery was still attached if initial macular involvement was not present preoperatively.

SD-OCT (Spectralis, Heidelberg Engineering, Heidelberg, Germany) was performed 3 and 6 weeks after surgery. We diagnosed CME, neurosensory detachment or ERM if these pathologies were visible in at least one of the OCT slices (25 horizontal OCT slices per examination covering 6 × 6 mm of the macula region) and during at least one follow-up visit. We defined CME, neurosensory detachment and ERM on SD-OCT as cystoid spaces within the inner or outer retina, subretinal fluid between the photoreceptor layer and the retinal pigment epithelium, and hyper-reflective tissue layer attached to the retinal surface, respectively (Benson et al. 2006; Heimes et al. 2016). Furthermore, central retinal thickness (CRT) was measured.

For statistical evaluation, we ran a t-test to compare the means of non-categorical parameters. To identify potential risk factors for postoperative CME, Pearson's chi-squared test and logistic regression were applied for categorical parameters. Fisher's exact test was used instead of Pearson's chi-squared test if the expected frequency was <5 in more than 20% of cells of the contingency table or if one or more cells had expected frequency <1.

A multivariate analysis using mixed model for repeated measurements (MMRM) was applied to analyse the impact of several parameters on visual outcome including initial macular detachment, CME, ERM, postoperative neurosensory detachment, remaining gas in the vitreous cavity, oil endotamponade and phakic patients treated with vitrectomy and potentially developing postoperative cataract formation. The global significance level $\alpha = 0.05$ was adjusted for both bivariate and multivariate analyses using the Bonferroni–Holm correction to avoid type 1 error, and α was stated when $p < 0.05$.

The sample size calculation for this prospective study was based on an incidence of primary RRD of 17 patients per month in our clinic estimated on a previous trial (Bemme et al. 2020). Because the study was planned to enrol patients over a period of approximately 18 months, the anticipated population size during this period was N = 306. The population proportion was empirically set at 16% (p = 0.16) as the incidence of postoperative CME after RRD surgery ranged from 3 to 43% (median 16%) in other studies (Lobes & Grand 1980; Meredith et al. 1980; Ackerman & Topilow 1985; Sabates et al. 1989; Ahmadieh et al. 2005; Benson et al. 2006; Tunc et al. 2007; Benson et al. 2009; Lai et al. 2017). Sample size n was calculated using the following formula:

$$n = \frac{\frac{z^2 p(1-p)}{e^2}}{1 + \left(\frac{z^2 p(1-p)}{e^2 N}\right)}$$

Consequently, a sample size of n = 124 patients was required for the true CME incidence to be within ±5% (e = 0.05) of the incidence observed in this study at the 95% confidence level (z-score $z = 1.96$). We extended the number of enrolments to 150 expecting a reduction due to retinal re-detachment or participation dropouts.

Results

Baseline characteristics and frequency of surgical methods

One hundred and twenty-eight of 150 patients completed the study with 107

Table 1. Risk factors for postoperative CME after RRD surgery

	Total study population N = 107	Patients with CME N = 20 (18.7%)	p
Population characteristics			
Gender			
Female	N = 47 (43.9%)	N = 8 (17.0%)	0.695[a]
Male	N = 60 (56.1%)	N = 12 (20.0%)	
Age [years]			
Mean ± SD	61.7 ± 11.5	62.2 ± 11.2	0.838[c]
Range	23 – 86	47 – 86	
Eyes			
Right	N = 57 (53.3%)		
Left	N = 50 (46.7%)		
Duration of symptoms			
≤3 days	N = 44 (41.1%)	N = 13 (29.5%)	0.062[a]
>3 days	N = 45 (42.1%)	N = 6 (13.3%)	
Missing data	N = 18 (16.8%)		
Lens status			
Phakic	N = 63 (58.9%)	N = 10 (15.9%)	0.427[a]
Pseudophakic	N = 31 (29.0%)	N = 7 (22.6%)	
Missing data	N = 13 (12.1%)		
Retinal status before surgery			
Mean number of retinal holes			
Preoperatively	2.2, N = 83	2.8, N = 15	0.287[c]
Intraoperatively	2.3, N = 81	2.7, N = 14	
Initial macular detachment			
Present	N = 49 (45.8%)	N = 13 (26.5%)	0.044[a]
Not present	N = 54 (50.5%)	N = 6 (11.1%)	(α = 0.006)
Missing data	N = 4 (3.7%)		
Giant retinal tear or retinal dialysis			
Present	N = 3 (2.8%)	N = 1 (33.3%)	0.466[b]
Not present	N = 104 (97.2%)	N = 19 (18.3%)	
Surgical methods			
Operation type			0.494[a]
Scleral buckling	N = 58 (54.2%)	N = 12 (20.7%)	
Vitrectomy	N = 27 (25.2%)	N = 3 (11.1%)	
Combined	N = 22 (20.6%)	N = 5 (22.7%)	
Retinopexy method			
Cryopexy	N = 84 (78.5%)	N = 19 (22.6%)	0.077[b]
Laser	N = 16 (15.0%)	N = 0 (0%)	
Combined	N = 7 (6.5%)	N = 1 (14.3%)	
Endo-tamponade			
SF_6	N = 55 (51.4%)	N = 11 (20.0%)	0.223[b]
C_2F_6	N = 18 (16.8%)	N = 4 (22.2%)	
Oil	N = 14 (13.1%)	N = 0 (0%)	
No tamponade	N = 20 (18.7%)	N = 5 (25.0%)	
SD-OCT findings			
Neurosensory detachment			
Present	N = 34 (31.8%)	N = 5 (14.7%)	0.471[a]
Not present	N = 73 (68.2%)	N = 15 (20.5%)	
ERM			
Present	N = 35 (32.7%)	N = 15 (42.9%)	**<0.001**[a]
Not present	N = 72 (67.3%)	N = 5 (6.9%)	(α = 0.005)

The second column lists the number of patients with the characteristic indicated by the first column, and the rate displayed in brackets refers to a total of 107 patients. The third column contains the number of patients with CME, and the rate displayed in brackets refers to the number of patients in the second column within the same row. [a], [b] and [c] indicate p value of chi-squared test, Fisher's exact test and t-test, respectively. Significance level α = 0.05 was adapted applying the Bonferroni–Holm correction to prevent type 1 error, and α was stated when p < 0.05.

patients displaying retinal attachment at follow-up visits. 101 of those 107 patients attended both follow-up visits, while 2 and 4 patients missed the follow-up after 3 and 6 weeks, respectively. Table 1 displays baseline characteristics including general demographics and preoperative retinal status, and the frequency of applied surgical techniques.

Our final, analysed study population consisted of 47 female and 60 male patients aged a mean of 61.7 ± 11.5 years (range: 23–86). Pseudophakia was present in about one-third of patients. The number of patients whose visual complaints were of brief duration (≤3 days) almost equalled the number of those whose symptoms lasted longer (44 versus 45 patients). The macula was involved in retinal detachment in 49 patients (45.8%). The average number of retinal holes identified preoperatively and intraoperatively was 2.2 and 2.3, respectively. A giant retinal tear or retinal dialysis occurred rarely (three patients, 2.8%).

The most frequent surgical method was scleral buckling (58 patients/54.2%), followed by vitrectomy (27 patients/25.2%) and both techniques combined (22 patients/20.6%). Regarding endotamponades, gas was injected in 73 patients (SF_6: 55 patients/51.4%; C_2F_6: 18 patients/16.8%), oil was used in 14 patients (13.1%), and endotamponade was avoided in 20 patients (18.7%). The most frequent retinopexy method was cryopexy (84 patients/78.5%), while laser photocoagulation (16 patients/15.0%) or both techniques combined (7 patients/6.5%) were less frequent. We did not perform a primary internal limiting membrane peeling in any of the cases.

Anatomical outcome

In 99 of 107 included patients, SD-OCT examination could be performed at both visits at 3 and 6 weeks. Reasons for missing OCT examinations were not attended follow-up visits (N = 6), remaining gas of >1/3 of the vitreous cavity inhibiting visualization of the complete macula region (N = 1) and technical difficulties (N = 1). Table 1 illustrates the frequency of SD-OCT findings, namely neurosensory detachment in 34 patients (31.8%), ERM in 35 patients (32.7%) and CME in 20 patients (18.7%). Based on 107 patients, the true CME incidence is within ±5.65% of the incidence observed in this study at the 95% confidence level, that is between 17.64 and 19.75%.

CRT (mean ± SD, μm) in patients with postoperative CME (316.7 ± 75.5 at 3 weeks; 337.9 ± 92.8 at 6 weeks) was significantly higher to CRT in patients without CME (291.8 ± 55.5 at 3 weeks; 285.6 ± 43.8 at 6 weeks) after 6 weeks ($p = 0.023$). Of 20 patients with CME, CRT measured ≤ 350 µm in 18 patients and ≥428 µm in only two patients. For more details on CRT, see Table S1.

A CME was visible on SD-OCT at 3 weeks in 14 patients, of whom the CME was resorbed in seven patients, while six patients showed new-onset CME after 6 weeks. Six of the 13 patients with persistent or new-onset CME at 6 weeks received further control visits after completion of our trial. Four of those six patients showed CME persistence at 3–6 months with CRT ranging from 266 to 361 µm. CME was resorbed in 1 of 2 treated patients and in 1 of 4 untreated patients. In our trial, a total of four patients received treatment for CME, all of whom were treated with nepafenac 0.1% eye drops three times daily over 4–6 weeks. One patient who developed very prominent CME after 6 weeks additionally received topical steroids and acetazolamide per os dosed 125 mg two times daily for 4 weeks. An ERM was present in two of four patients with long-term persisting CME and in those two patients with CME resorption after 3 months.

Functional outcome

ETDRS-BCVA (mean ± SD, logMAR) averaged over all patients improved from 0.98 ± 0.90 at baseline to 0.33 ± 0.37 and 0.29 ± 0.30 at 3 and 6 weeks, respectively. A multivariate analysis using mixed model for repeated measures (MMRM) with multiple imputation on the entire study population showed a significant impact of initial macular detachment ($p < 0.001$, $\alpha = 0.007$) on visual outcome. Other included factors such as remaining gas in the vitreous cavity ($p = 0.011$, $\alpha = 0.008$) and postoperative neurosensory detachment ($p = 0.027$, $\alpha = 0.010$) missed statistical significance after the Bonferroni–Holm correction. CME, ERM, oil endotamponade and vitrectomy in phakic patients showed no significant impact on postoperative BCVA.

To assess further the effect of postoperative CME on visual outcome, we performed a subgroup analysis for macula-on and macula-off RRD (Figure 1). Improvement of BCVA was most prominent in patients with an initially detached macula due to lower preoperative values. Note that the change in BCVA was statistically significant within all subgroups, except after 6 weeks within the macula-on subgroup plus postoperative CME. A significantly lower improvement of BCVA in patients with CME compared to those without CME could be shown only within the macula-on subgroup after 6 weeks (mean ± SD, logMAR: −0.09 ± 0.10 versus −0.36 ± 0.53, $p = 0.009$), although there was no significant difference in absolute postoperative BCVA. A MMRM applied to the subgroup of macula-on RRD confirmed the significant impact of CME on postoperative BCVA change ($p = 0.016$, $\alpha = 0.025$). For more details on BCVA, see Table S1.

Assessment of risk factors for postoperative CME

Table 1 (third column) and Figure 2 display the incidence of CME according to various parameters including population characteristics, preoperative retinal status, surgical methods and postoperative SD-OCT findings. None of the parameters such as gender, age, duration of symptoms, lens status, number of retinal holes, presence of a giant retinal tear or retinal dialysis, operation type, retinopexy method and type of endotamponade were revealed as a risk factor for CME. However, patients with initially detached macula

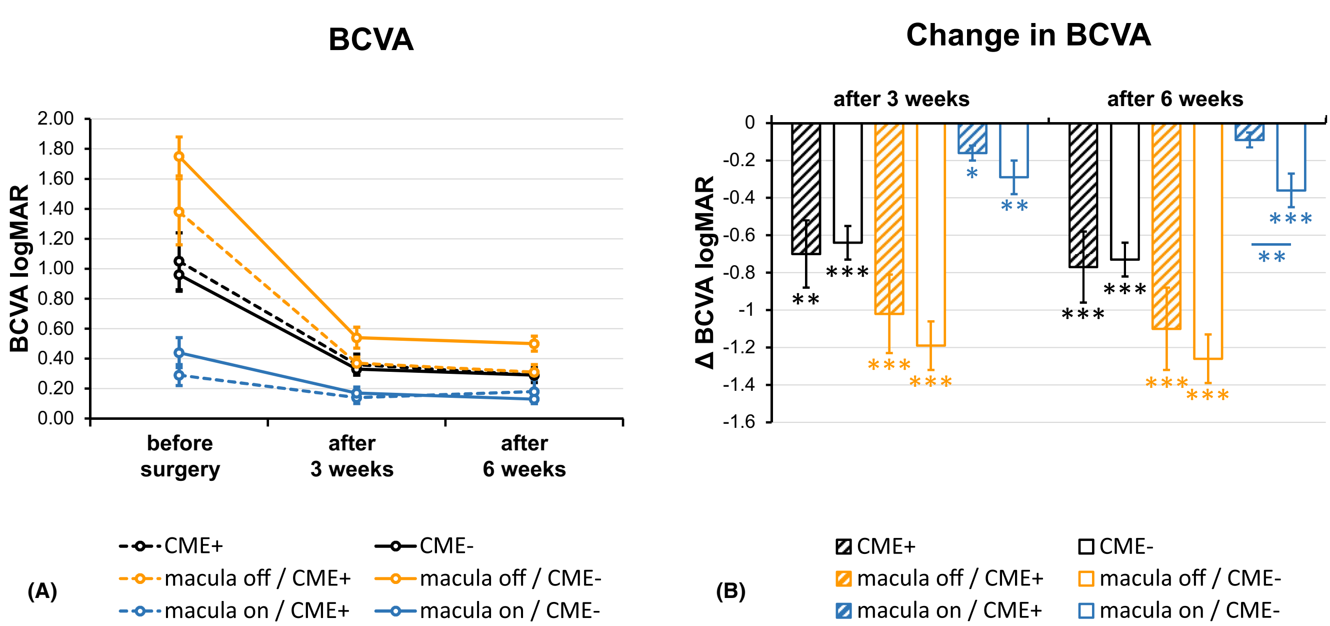

Figure 1. BCVA (A) and change in BCVA from baseline (B): before, 3 and 6 weeks after RRD surgery; in patients with (dashed line, hatched bars) and without (not dashed, empty bars) postoperative CME; for all patients (black) as well as shown separately for patients with (orange) and without (blue) initial macula detachment. Change in BCVA (B) was significant within each subgroup comparing the difference in BCVA (Δ BCVA, logMAR) after 3 weeks and after 6 weeks to baseline (see asterisks below each bar; *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$), except in the macula-on plus CME subgroup after 6 weeks. The difference in BCVA comparing patients with and without CME became significant after 6 weeks in patients with macula-on RRD (B: see the two outermost right bars, $p = 0.009$).

showed an increased rate of postoperative CME (26.5% versus 11.1%, p = 0.044), which did not reach significance after the Bonferroni–Holm correction (α = 0.006). Amongst postoperative SD-OCT findings, only ERM formation was significantly associated with postoperative CME (42.9 versus 6.9%, p < 0.001, α = 0.005), which was confirmed by multivariate analysis using logistic regression (p < 0.001, α = 0.005). Examining ERM formation in relation to macula involvement, macula-off RRD showed a higher rate of ERM (61.8 versus 38.2%) compared with macula-on RRD (p = 0.043, chi-squared test).

Discussion

Incidence and risk factors for postoperative CME after RRD surgery

In this prospective study, we detected postoperative CME after primary RRD via SD-OCT in 18.7% of patients, which is close to the median of the frequencies reported in the literature with a wide range of 3–43% (Lobes & Grand 1980; Meredith et al. 1980; Ackerman & Topilow 1985; Sabates et al. 1989; Tunc et al. 2007; Benson et al. 2009; Lai et al. 2017).

In our study, we evaluated CME on SD-OCT, which enables a more reliable detection of cystoid spaces compared with time domain-OCT (TD-OCT) and therefore may explain the lower incidences in studies using TD-OCT (Benson et al. 2006; Benson et al. 2009). Another possible reason for lower CME rates is differences in timing of follow-up visits after RRD surgery. A pseudophakic CME usually develops 4–12 weeks after cataract surgery, peaking at weeks 4–6. We therefore scheduled postoperative visits after 3 and 6 weeks (Wolfensberger 1999; Loewenstein & Zur 2010; Scholl et al. 2010). In another study reporting a low CME rate of 6.9% following buckling surgery, the first follow-up visit was after 8–12 weeks; thus, they might have missed early resolved oedemas (Lai et al. 2017). In line with this hypothesis, the half of our patients with CME detected after 3 weeks already showed CME resorption after 6 weeks.

Furthermore, differences regarding preoperative parameters such as age and lens status might explain the high variance reported on CME incidence after RRD surgery. A significantly higher risk of postoperative CME in older patients was shown after scleral buckling, which was attributed to age-related changes in stability and permeability of retinal vessels, making it more vulnerable to surgical manipulation with consecutive extravasation of fluid, although this remains hypothetic (Meredith et al. 1980; Lai et al. 2017). Another study reporting a CME rate of 5% after scleral buckling included younger patients on average, which might explain the low CME incidence (Benson et al. 2009). At a young age, the vitreous body is not yet completely detached, thus potentially inhibiting the dissemination of inflammatory mediators towards the posterior pole. However, neither Sabates et al. (1989) nor our study could verify any association between postoperative CME and age.

Regarding lens status, studies reporting a markedly higher incidence of postoperative CME after RRD compared with our results included aphakic patients, which developed CME more frequently than phakic patients after scleral buckling (Lobes & Grand 1980; Meredith et al. 1980). In contrast, the influence of pseudophakia on CME after RRD surgery remains questionable. One-third of our patients, which were pseudophakic, showed no significantly increased incidence of CME. Another study with a similar ratio of pseudophakic to phakic patients and a population size of 175 patients reported pseudophakia as a risk factor for postoperative CME following RRD surgery, however attributed it to the inclusion of patients with anterior chamber implants (Sabates et al. 1989).

Macular involvement is one of the most important preoperative factors influencing visual outcome after RRD surgery. We detected macular involvement through RRD in almost half of our study population. Our data showed that initial macular detachment tended to be a risk factor for postoperative CME as association of both parameters only narrowly did not achieve significance. Lai et al. demonstrated a significant association between macula-off RRD and postoperative CME (Lai et al. 2017). Preoperative parameters, which are crucial for anatomical success after RRD surgery, include number, size and location of retinal tears. The average number of retinal breaks counted in our trial hardly differed

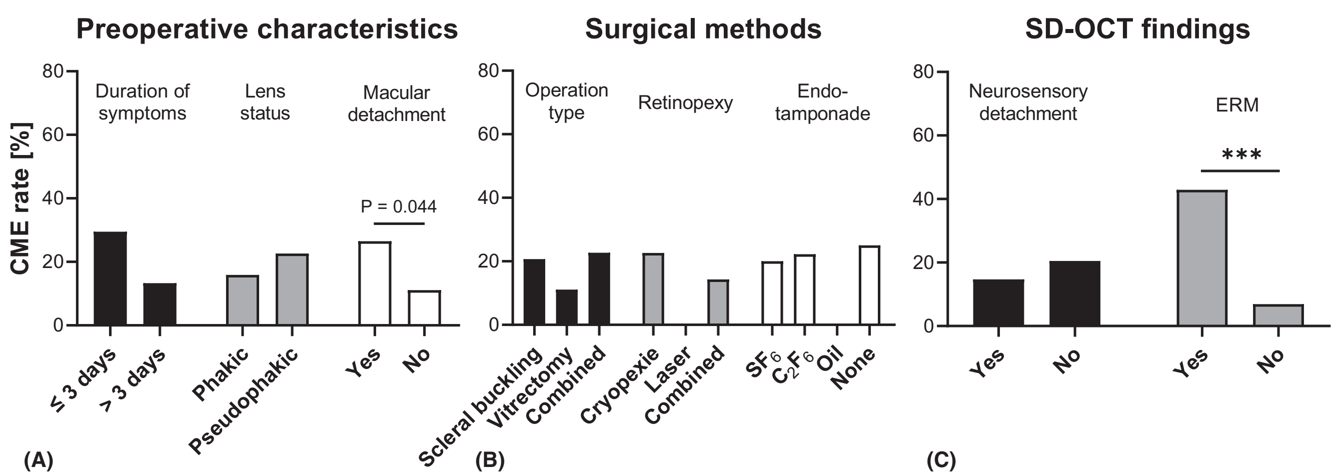

Figure 2. Rate of CME regarding preoperative characteristics (A), surgical methods (B) and SD-OCT findings (C). p values in A and C (***p < 0.001) refer to bivariate analysis by chi-squared test (Bonferroni-Holm correction: ERM, α = 0.005; initial macular detachment, α = 0.006).

from other studies and revealed no association with CME formation (Benson et al. 2006; Feltgen et al. 2007; Lai et al. 2017). We diagnosed a giant retinal tear or retinal dialysis very seldom (in only three patients, one of whom developed CME).

Regarding intraoperative parameters, none of the surgical procedures applied in our study – operation type, retinopexy method or type of endotamponade – demonstrated a significant association with postoperative CME development, a finding in line with a prospective trial comparing scleral buckling and primary vitrectomy for RRD repair (Ahmadieh et al. 2005). Moreover, another recent retrospective study reported no increased CME risk in association with the use of gas endotamponade in patients undergoing buckling surgery (Lai et al. 2017).

Amongst postoperative OCT findings, ERM formation is a frequent complication after RRD; we detected it in every third patient in our study, a rate similar to that in a study by Wakabayashi et al. (2009) In contrast, Sabates et al. (1989) reported a much lower frequency of ERM formation after RRD, a discrepancy possibly related to an improvement in the SD-OCT detection of ERM. In our study, ERM formation was significantly associated with CME. Besides exudation, traction forces on the retinal surface can cause CME (Govetto et al. 2020). However, our data allow no statement about the direct patho-mechanism of CME after RRD surgery. In five of 20 CME patients, no ERM was visible on SD-OCT rather indicating an exudative CME in those cases. Moreover, an ERM itself can cause both types of CME, tractional and exudative, by traction forces not only on the retinal surface but also on the retinal vasculature. In 6 other patients, CME spontaneously resorbed already after 6 weeks despite simultaneously present ERM formation on SD-OCT, also indicating an exudative pathogenesis as the ERM remained. Assessing SD-OCT scans with prominent CME and ERM, we detected cross-sectional features of both CME subtypes, exudative and tractional, according to Govetto et al. (2020; Figure 3). Sabates et al. (1989) described that prolonged detachment of the macula was significantly associated with increased development of ERM. A subgroup analysis of our data verified a higher incidence of ERM formation in macula-off RRD, which is in line with a recent study and might explain the higher rate of CME in macula-off RRD (Cacioppo et al. 2019). Although over one-third of our study patients exhibited neurosensory detachment on SD-OCT postoperatively, there was no association with CME development. Primary internal limiting membrane peeling has been suggested during vitrectomy for RRD repair to reduce postoperative ERM formation (Yannuzzi et al. 2018). However, whether that strategy lowers the risk of postoperative CME remains controversial and needs further investigation through prospective randomized trials.

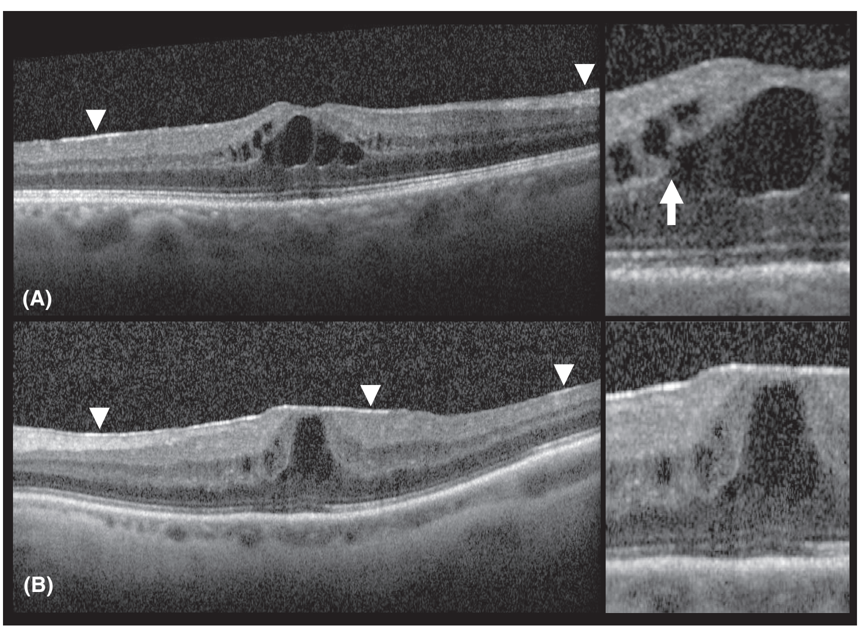

Figure 3. SD-OCT scans of two patients with postoperative CME and ERM (arrowheads). (A) OCT B scan with merging cystoid spaces between inner and outer nuclear layers (white arrow) indicating exudative CME. (B) Morphology of tractive CME without fusing of cystoid spaces located in different retinal layers.

Clinical relevance of postoperative CME following RRD

As macular detachment showed a high significant impact on visual outcome in our study, we analysed the impact of CME on BCVA performing a subgroup analysis for macula-on and macula-off RRD separately. Postoperative CME restricted improvement of BCVA after 6 weeks in patients with macula-on RRD. However, our BCVA data have to be carefully interpreted, as one would expect no postoperative increase in BCVA without initial macula involvement. The subtle improvement of BCVA in the macula-on subgroups might be attributed to possible underestimation of preoperative BCVA due to limited testing conditions in an emergency like macula-on RRD (e.g. dilated pupils). Altogether, the effect of postoperative CME on visual outcome was only marginal, probably due to the rather slight to moderate retinal swelling. Patients with CME presented increased CRT at both control visits compared to patients without CME. However, this difference did attain significance only after 6 weeks, as discrete cystoid changes also diagnosed as CME do not necessarily affect retinal thickness. Due to the minimal CRT in most of our patients together with the high probability of spontaneous CME resolution after RRD surgery, only four patients received treatment for CME in our trial. Seven of our patients showed spontaneous CME resorption already at 6 weeks. In addition, spontaneous resolution of CME could be observed during the long-term course. After completion of our trial, CME was resorbed in 1 of 4 untreated patients (25%) at 3–6 months, a rate of limited relevance due to the low number of patients with long-term follow-up. However, Bonnet et al. reported spontaneous resolution of CME following RRD surgery in 50 and 75% of eyes within 12 and 18 months, respectively (Bonnet 1986).

Conclusions, features and limitations

Our study prospectively assessed the incidence of postoperative CME by SD-OCT in a cohort including different surgical methods for RRD repair. With a rate of 18.7%, we demonstrated that postoperative CME is a frequent complication after RRD surgery. As CME might delay visual recovery in patients with macula-on RRD, SD-OCT is mandatory during postoperative follow-up. We identified ERM formation and macula-off RRD as risk factors. Our strict inclusion and exclusion criteria enabled us to rule out previous diseases frequently associated with CME. Although preoperative OCT imaging would have facilitated the exclusion of pre-existing CME and/or ERM, it was usually not feasible as our outpatient clinic and vitreoretinal surgery department are located in distant facilities or it was not possible for technical reasons due to bullous retinal detachment. Therefore, further prospective studies are warranted to investigate the risk of postoperative CME in relation to preoperative macular changes – potentially facilitated by the use of intraoperative OCT in certain cases.

Ethical approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent

Informed consent was obtained from all individual participants included in the study.

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Supporting Information

Additional Supporting Information may be found in the online version of this article:

Table S1. Functional outcome and retinal thickness.