Subretinal Fluid Bleb After Successful Scleral Buckling and Cryotherapy for Retinal Detachment

SE WOONG KANG, JAE HUI KIM, WOO JAE SHIN, AND JONG IN KIM

• PURPOSE: To determine the characteristics of subretinal fluid (SRF) blebs after successful scleral buckling with cryotherapy as a treatment for rhegmatogenous retinal detachment (RD) and to investigate their possible origin.

• DESIGN: Retrospective case series.

• METHODS: The incidence of SRF bleb and the temporary aspects associated with the appearance and disappearance of the lesion were analyzed. Optical coherence tomography (OCT) was used to confirm SRF and indocyanine green angiography (ICGA) was carried out to evaluate choroidal circulation in some of the cases.

• RESULTS: SRF bleb was observed in 11 (9.3%) of 118 cases with the history of successful scleral buckling and cryotherapy. The lesions were detected 8.7 ± 5.5 (mean ± standard deviation [SD]) weeks after complete retinal reattachment, and the mean ± SD period required for the disappearance of the lesion was 4.7 ± 3.4 months. SRFs were verified by OCT in five cases of macular involvement. ICGA revealed choroidal vascular congestion and hyperpermeability near the lesion in three of four cases, and these vascular abnormalities remained unchanged after the removal of the scleral explant.

• CONCLUSIONS: SRF bleb after successful RD surgery disappears spontaneously within one year. The origin of the lesion may be associated with choroidal vascular changes resulting from cryotherapy. (Am J Ophthalmol 2008;146:205–210. © 2008 by Elsevier Inc. All rights reserved.)

RHEGMATOGENOUS RETINAL DETACHMENT (RD) IS A sight-threatening disease. The disease occurs in approximately one of 10,000 individuals per year, and severe loss of vision ultimately may occur in untreated cases. Scleral buckling procedure has been shown to be an effective method for the treatment of RD. Most cases of uncomplicated RD can be reattached successfully with this technique. If the macula is attached before surgery, postoperative vision of 20/50 or better may be achieved in more than 80% of the treated eyes.

However, in some cases, subretinal fluid (SRF) may be observed even after the adequate application of scleral buckling. Despite the solid occlusion of the retinal break, it occasionally takes several weeks to months for the complete reabsorption of SRF after surgery. This delayed absorption of SRF is a well-known phenomenon and was reported to be associated with the patient’s age, duration of RD, and the existence of subretinal precipitate. Persistent submacular SRF that cannot be observed on clinical examination was revealed after the introduction of optical coherence tomography (OCT), and an association between worse vision and residual SRF was reported.

There have been a few reports describing the SRF accumulations that had developed several days to weeks after complete retinal reattachment as a consequence of scleral buckling procedure (with or without cryotherapy). Unlike delayed absorption or persistent submacular SRF, this lesion can develop on the area of retinal reattachment or on the previously undetached retina. These lesions formerly were suspected as detachments of the retinal pigment epithelium (RPE). However, fluorescein angiography (FA) failed to show the typical fluorescein pooling of the classic RPE detachment. Further studies using OCT revealed that these lesions were localized RDs. The lesions have been described as pockets of SRF, lesions simulating the detachment of RPE, focal pockets of SRF, subretinal lesions, and SRF blebs. Most of these lesions were detected at the posterior pole and were associated with reduced visual acuity (VA). However, clinical characteristics and the developmental mechanism of the lesion have yet to be elucidated. The purpose of this study was to determine the characteristics of SRF accumulation after successful scleral buckling with cryotherapy and to elucidate its possible origin.

METHODS

WE CONDUCTED A RETROSPECTIVE ANALYSIS OF THE EYES that underwent scleral buckling and cryotherapy for primary RD at the Department of Ophthalmology at the Samsung Medical Center between January 1, 2003 and December 31, 2006. This study included only the eyes in which complete retinal reattachment initially was achieved with scleral buckling and cryotherapy. Thus, the eyes requiring reoperation as a result of primary failure or redetachment were excluded from this study. The eyes that...
RESULTS

ONE HUNDRED AND EIGHTEEN CASES OF SUCCESSFUL SCLERAL BUCKLING AND CRYOTHERAPY FOR PRIMARY RD were identified during the study period. Among them, the SRF bleb was observed in 11 eyes of 11 patients (11/118 eyes; 9.3%). The mean age ± standard deviation (SD) of those 11 patients was 51.2 ± 13.2 years (range, 18 to 63 years), and the mean follow-up period ± SD was 17.0 ± 7.2 months after surgery. The clinical characteristics of the cases are summarized in the Table. Four of the 11 patients (Cases 2, 8, and 11) had hypertension (Cases 2, 8, and 11) and one patient had hyperthyroidism (Case 6). Hypertensive retinal change was not noted in these patients. None of the 11 patients had any history of intraocular surgery or intraocular disease, including glaucoma and uveitis.

The patient's gender and age, length of follow-up period, the period from the onset of the patient's subjective symptoms to the initial surgery, the period for retinal reattachment after the surgery, the period of SRF bleb observed after the surgery, the best-corrected visual acuity (BCVA) when the lesion was observed, the period required for the disappearance of the lesion, and the BCVA after the lesion disappeared were included in the clinical data for the study. The results of fundus photography (TRC-50IX; Topcon, Tokyo, Japan), indocyanine green angiography (ICGA) (HRA-I; Heidelberg Engineering, Heidelberg, Germany), and OCT were used as reference materials.

TABLE. Clinical Characteristics of Patients with Subretinal Fluid Blebs after Scleral Buckling and Cryotherapy for Retinal Detachment

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Gender</th>
<th>Age (yrs)</th>
<th>Duration of Symptoms (days)</th>
<th>BCVA before Surgery (Snellen)</th>
<th>Period of Retinal Reattachment (days)</th>
<th>Appearance of the Subretinal Bleb-like Lesion after Retinal Reattachment (wks)</th>
<th>BCVA When the Lesion was Observed (Snellen)</th>
<th>Foveal Involvement of the Lesion</th>
<th>Period Required for the Disappearance of the Lesion (mos)</th>
<th>Follow-up after Initial Surgery (mos)</th>
<th>BCVA at Final Follow-up (Snellen)</th>
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BCVA = best-corrected visual acuity; F = female; HM = hand motions; M = male; mos = months; – = no; wks = weeks; + = yes; yrs = years.
The extent of RRD before operation in the 11 eyes was 2.1 ± 0.9 quadrants (mean ± SD). The number of retinal breaks in those eyes was 1.7 ± 0.8 (mean ± SD). In one eye (Case 11), the retinal break in the attached retina was sealed via intraoperative laser indirect ophthalmoscopy. Segmental scleral explants were oriented circumferentially in eight eyes and were oriented radially in three eyes. Any significant intraoperative or immediate postoperative complications were not observed in the 11 eyes.

The mean ± SD admission period was 3.4 ± 1.2 days (range, two to five days) after the surgery. After discharge from the hospital, the first visit to the outpatient clinic was scheduled at 6.7 ± 2.1 days (range, four to 12 days), and then the next visit was scheduled according to the patient’s state. Complete retinal reattachment was observed in a mean ± SD of 4.7 ± 3.8 days (range, one to 12 days) after surgery. SRF bleb was observed after the complete reattachment of the entire retina in all 11 eyes. SRF bleb was detected at a mean ± SD of 8.7 ± 5.5 weeks (range, three to 22 weeks) after retinal reattachment. The mean (±SD) logarithm of the minimum angle of resolution (logMAR) BCVA was 0.29 ± 0.35 (20/39 Snellen equivalent) at the time of the detection of SRF bleb. All lesions except those in one eye (Case 9) appeared within the extent of the previously detached retina. The appearances of the lesions were elliptical, round, or spindle-shaped in most cases. A total of 35 blebs were observed in 11 eyes (mean, 3.3 blebs per eye). Most eyes evidenced no more than three blebs. However, more than 10 blebs were noted in two cases (Figure 1). The lesions involved the center of

![FIGURE 1. Subretinal fluid (SRF) blebs after scleral buckling and cryotherapy for retinal detachment (RD). Fundus photographs and optical coherence tomography (OCT) findings of SRF blebs (black arrows) that developed after successful scleral buckling and cryotherapy for treatment of rhegmatogenous RD (the white line indicates the OCT scanning line). Various appearances of SRF blebs are noted.](image)
the fovea in four eyes (Cases 8 through 11) and the parafoveal area in one eye (Case 7). In the other six eyes, the lesions were detected in the outside of retinal vascular arcade (Cases 1 through 6). Three patients (Cases 7, 10, and 11) reported visual disturbances when the lesion was observed. OCT, which was conducted in five eyes (Cases 7 through 11) with the involvement of the posterior pole, revealed an optically empty space located between the neurosensory retina and the RPE. This finding was consistent with the accumulation of SRF.

Additional treatment was attempted for the SRF bleb involving macula in three eyes (Cases 8, 10, and 11). An eye with SRF bleb (Case 10) involving the macular area underwent an intravitreal injection of 0.3 ml perfluoropropane gas to displace SRF from the fovea. The disappearance of SRF blebs was observed two weeks after the

FIGURE 2. SRF blebs after scleral buckling and cryotherapy for RD. The indocyanine green angiography (ICGA) findings of three cases (Cases 1, 7, and 11) in which SRF blebs developed after successful scleral buckling and cryotherapy for the treatment of RD. Note that the choroidal vascular alterations are conspicuous in the quadrant to which scleral buckling and cryotherapy were applied. (Top left) Choroidal vascular congestion (short arrows) and hyperpermeability near the SRF bleb (long arrow) are observed (Case 1). (Top right) Choroidal vascular hyperpermeability (arrows) is observed (Case 7). (Bottom left) Choroidal vascular congestion and hyperpermeability (arrows) are noted in the eye involving a subfoveal fluid bleb (Case 11). (Bottom right) The previous choroidal vascular alterations are stationary, even after the removal of the scleral explant (Case 11). buckle = scleral buckle; CTx = cryotherapy.
intravitreal injection of gas. Suspecting circulatory derangement associated with scleral buckling as a cause of SRF bleb, we removed the scleral explant in two eyes (Cases 8 and 11). Although no remarkable changes on indocyanine angiography were appreciated one month (Case 8) and two months (Case 11) after the removal of explant, the disappearance of SRF blebs was observed two and nine months after the removal of explant, respectively.

In nine eyes, the disappearance of SRF blebs was noted a mean ± SD of 4.7 ± 3.4 months (range, one to 12 months) after the initial presentation. Mean (±SD) logMAR BCVA improved to 0.17 ± 0.19 (20/30 Snellen equivalent) after the disappearance of the lesion.

Indocyanine green angiography was carried out in four eyes (Cases 1, 5, 7, and 11) to evaluate choroidal circulation. Choroidal vascular congestion posterior to the scleral buckle site and choroidal vascular hyperpermeability near the SRF bleb was detected in two eyes (Cases 1 and 11). In one eye (Case 7), mild choroidal vascular hyperpermeability near the SRF bleb was observed despite the absence of prominent vascular congestion. ICGA, which was conducted after the removal of scleral explant in one eye (Case 11), revealed the persistence of the choroidal vascular alterations (Figure 2).

DISCUSSION

AS IN PREVIOUS STUDIES, OCT EXAMINATION REVEALED A low reflectivity area of SRF accumulation between the sensory retina and the RPE. The incidence and possible cause of the SRF bleb was addressed in this study.

The accumulation of SRF after a successful scleral buckle procedure is not a frequently observed phenomenon. According to the report of Avins and Hilton, the occurrence rate was only 2.3% (three of 130 cases). In this study, the lesions were observed in 11 (9.3%) of 118 cases, which was a higher incidence rate than had been expected. The reasons that SRF bleb has been observed at a rate as high as 9.3% after successful scleral buckling and cryotherapy are presumed to be as follows. First, because our clinic was located within a highly populated region, most patients resided near the hospital. Therefore, relatively regular postoperative examinations at short-term intervals were possible, and this also may be related to more frequent detection of these lesions. Second, we conducted detailed examinations of the entire fundus using a 90-diopter lens focusing on the possibility of the occurrence of SRF blebs. Third, this also may be associated with the surgeon’s preference for scleral buckling operation as a therapeutic method for RD. Although vitrectomy can be considered in cases involving multiple or large breaks, scleral buckling and cryotherapy were the preferred methods in our clinic to avoid vitrectomy-related problems, including postoperative posturing and the occurrence of lens opacity. In the present study, the mean number of retinal breaks was 1.7. In the cases involving multiple or large breaks, the application of explants and cryotherapy to a relatively large area was inevitable, and this can be postulated as one reason for the noted increase in the prevalence of SRF blebs.

A small SRF bleb that lasts for a relatively short period may remain undetected on routine clinical examination. Thus, it seems possible that the actual incidence rate of the lesion may be higher than that determined in our study.

In nine eyes, the lesions disappeared after a mean of 4.7 months, which was similar to what was reported in a previous study conducted by Theodossiadis and associates. After the complete disappearance of the lesion, recurrence was not observed until the final follow-up. The clinical significance of SRF bleb is attributed to the relatively high rate of macular involvement. Our study showed that the foveal center was involved in approximately one-third of the cases with SRF bleb. Foveolar detachment, albeit shallow, for several months may exert adverse effects on final visual outcomes.

Many factors have been suggested to exert an influence on the development of SRF blebs. The accumulation of the SRF was thought to be associated with the proximity of the RD to the fovea. A breakdown of the blood-retinal barrier as a result of surgery that allowed an excessive quantity of protein to enter the SRF and surgical trauma to the RPE–Bruch membrane complex may contribute to the development of the SRF accumulation.

Most of the lesion appeared at the site of previously detached retina in this study. The preponderance of SRF blebs that developed within the extent of previous RD strongly suggests that the lesion may develop as a result of intervention to the retinal break. Both scleral buckling and cryotherapy, interventions directly imposed to retinal break, may induce the choroidal vascular alteration near the quadrant of retinal break after surgery. FA and ICGA, which were conducted to reveal the characteristics of the lesion, showed no evidence of fluorescein leakage, but rather, only an obscuration of the usual appearance of the lamina choriocapillaris. In this study, however, choroidal vascular congestion posterior to the area of scleral buckling and choroidal vascular hyperpermeability near the SRF bleb was observed on ICGA. We removed scleral explant in some of the eyes, suspecting these vascular abnormalities were caused by the pressure effect of the explant. However, there was no change in choroidal vascular congestion or hyperpermeability on ICGA even after the removal of scleral buckle. In addition, the temporal aspect of the incidence of SRF bleb seems to bear implications with regard to the mechanisms of SRF bleb development. We detected SRF bleb approximately nine weeks after retinal reattachment. This was the point at which the height of the scleral buckle was declining gradually and cryotherapy-induced mature chorioretinal scars were forming. Thus, the influence of cryotherapy, rather than a pressure effect of the scleral explant, was suspected as the cause of these choroidal vascular changes noted on ICGA.
After freezing is applied to both the RPE and overlying retina, cellular connections and adhesions are formed between two layers. Because of the effective pigment epithelial–retinal adhesion and minimal alteration of the sclera, cryotherapy is a widely used technique for the treatment of RD. However, the potential disadvantages of cryotherapy such as dispersion of viable pigment epithelial cells, which may produce proliferative vitreoretinopathy, breakdown of the blood–ocular barrier, cystoid macular edema, and exudative RD, also have been reported. In addition, although cryotherapy does not damage the choroids permanently, our results suggest that cryotherapy may complicate the postoperative development of SRF bleb.

There were limitations in our attempt to clarify the pathogenesis of SRF bleb development, largely because the occurrence of SRF bleb after scleral buckling and cryotherapy is a relatively rare condition. Additionally, this was a retrospective study. Choroidal vascular congestion and hyperpermeability as a pathogenic factor in SRF bleb was predicated on the ICGA findings of only four eyes, and thus it cannot be construed as anything more than a suggestion, and further supportive data are required.

In conclusion, newly developed SRF accumulation after successful scleral buckling and cryotherapy was detected in 9.3% of patients in our series. The subfoveal accumulation fluid was confirmed via OCT in approximately one-third of the cases. Stereoscopic fundus examination revealed various appearances of the lesions, and half of them persisted for more than six months. ICGA revealed choroidal vascular congestion and hyperpermeability near the lesion, which may account for the development of these lesions.

REFERENCES

Se Woong Kang, MD, PhD, is a Retina Specialist and a Professor in the Samsung Medical Center, Sungkyunkwan University School of Medicine, Seoul, Korea. He is currently the General-Secretary of the Korean Ophthalmological Society. Dr Kang did his postgraduate training at Seoul National University, and obtained retina research fellowship training at Bascom Palmer Eye Institute, Miami, Florida. His areas of interest include surgical retina, diabetic macular edema, and age-related macular degeneration. Dr Kang received several researcher awards in his country.