

Case Report

Peripheral Retinal Ischemia and Secondary Neovascular Glaucoma after Cerclage for Retinal Detachment: A Case Report

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Keywords

Retinal detachment · Retinal cerclage · Peripheral retinal ischemia · Secondary neovascular glaucoma

Abstract

Introduction: Various surgical techniques, including 360° buckling surgery with a retinal cerclage, have been employed to achieve retinal reattachment. Although retinal cerclage is generally effective, long-term complications can arise. Peripheral retinal ischemia and secondary neovascular glaucoma are rare, but serious complications can occur even years after successful retinal reattachment. **Case Presentation:** We report a rare case of a 79-year-old woman who underwent 360° buckling surgery with cerclage for retinal detachment 10 years ago. Although the initial surgery successfully reattached the retina, she later developed a complication characterized by peripheral retinal ischemia and secondary neovascular glaucoma. **Conclusion:** Early detection and prompt management of such complications are crucial to prevent irreversible visual impairment.

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Introduction

Retinal detachment (RD) is a sight-threatening condition requiring prompt intervention to prevent permanent visual impairment [1]. Various surgical techniques, including 360° buckling surgery with a retinal cerclage, have been employed to achieve retinal reattachment.

The aim of the cerclage is to close tears and release vitreous traction. Proposed by Schepens in the 1950s, then modified by Arruga and others, the cerclage procedure was

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introduced to treat RD without draining the subretinal fluid [2]. Circumferential indentation on 360° was thought to reduce the volume of the eye, mechanically closing the retinal holes, reduce vitreoretinal traction, and maintain intraocular tension [3].

Although retinal cerclage is generally effective, long-term complications can arise. Peripheral retinal ischemia and secondary neovascular glaucoma are rare, but serious complications can occur even years after successful retinal reattachment [4].

Case Presentation

A 79-year-old woman presented to our clinic with a complaint of gradual visual field loss in her left eye over the past 6 months. She had a history of RD in the left eye 10 years ago, for which she underwent retinal cerclage surgery elsewhere. Postoperatively, her retina was successfully reattached, and her vision improved to 20/30 with correction.

On examination, her best-corrected visual acuity was 20/50 in the left eye. Intraocular pressure was measured at 30 mm Hg in the left eye. Slit-lamp examination and gonioscopy showed rubeosis iridis. Posterior segment examination showed an attached retina with diffuse retinal arteriolar narrowing, increased vascular tortuosity, and multiple dot and blot retinal hemorrhages (Fig. 1). Fluorescence angiography was performed, and it revealed peripheral retinal ischemia characterized by avascular areas at the retinal periphery, in the absence of signs of retinal vein occlusion (RVO) (Fig. 2, 3).

All the laboratory tests and cardiovascular risk factor check-up including carotid duplex ultrasound and magnetic resonance angiography were conducted to rule out the possibility of ocular ischemic syndrome. Optical coherence tomography (OCT) of the left eye showed the presence of cystoid macular edema and subretinal fluid (Fig. 4). We tried to perform OCT on the ischemic area in order to show and detect the level of ischemia, but it could not be performed due to the very peripheral location.

Given the findings of peripheral retinal ischemia and elevated IOP due to secondary neovascular glaucoma, the patient was diagnosed with a late complication following retinal cerclage. She was started on topical antiglaucoma medication to lower the IOP, and a therapy with intravitreal injections of ranibizumab was initiated.

Due to failure to respond to local and systemic glaucoma therapy, the patient subsequently underwent surgery with a Preserflo MicroShunt, after which her eye pressure returned to normal. Iris rubeosis and anterior segment ischemia are critical indications for cerclage removal and peripheral laser treatment. Removing the cerclage helps alleviate pressure and inflammation, while peripheral laser treatment can address retinal ischemia and prevent progression of disease [5].

However, in our patient's case, despite these indications, there were mitigating factors. The patient, due to advanced age, was not willing to undergo additional surgery. This reluctance, combined with the very peripheral location of the retinal ischemia and the doubt about possible reperfusion after removal of the cerclage after so much time, made laser treatment and cerclage removal technically unfeasible.

Discussion

Posterior segment peripheral retinal ischemia is a rare but serious complication following retinal cerclage surgery. It has been described as a very rare late postoperative complication, diagnosed by pigment epithelial irregularities posterior to the encircling band with constriction of visual field and diminished electroretinogram amplitudes. It is thought to be

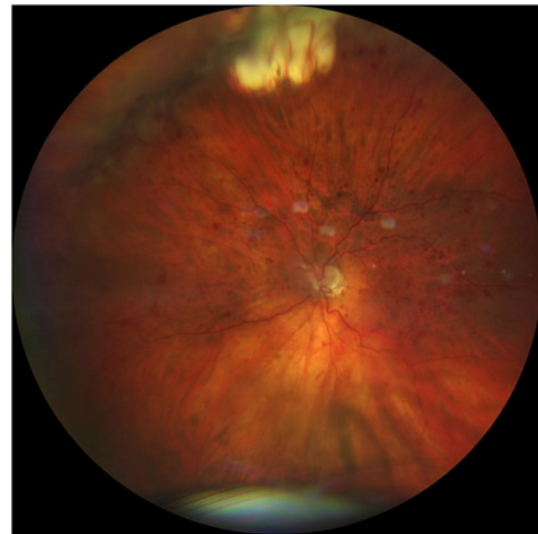


Fig. 1. Color fundus photos at presentation showed in the left eye diffuse retinal arteriolar narrowing, increased vascular tortuosity, multiple dot and blot retinal hemorrhages.

caused by choroidal venous obstruction or vascular compromise secondary to scleral indentation or ischemia from previous RD. Elevated IOP can exacerbate retinal ischemia by further compromising retinal blood flow [4].

Scleral indentation can lead to decreased perfusion of the posterior ciliary arteries and the long posterior ciliary arteries, which supply the posterior and peripheral retina. This results in hypoperfusion of the retinal periphery, increasing the risk of ischemia, retinal neovascularization, and proliferative vitreoretinopathy (PVR) [6]. The encircling scleral buckle may cause venous stasis by obstructing the venous drainage of the retina, especially in the peripheral retinal veins. Venous stasis, in turn, can cause ischemic damage and lead to retinal edema, hemorrhages, and eventually the formation of neovascular tissue in response to hypoxia [6]. In a review of scleral buckling procedures, Nagpal and Gopal [7] discussed the risk of ischemic complications following scleral buckling surgery, particularly with the encircling buckle technique. They emphasized that excessive tightening of the buckle can lead to retinal venous obstruction and subsequent ischemic changes. Eyes with underlying retinal vascular disease (e.g., diabetic retinopathy, RVO, or vascular retinopathy) are more prone to developing ischemic changes after scleral buckling surgery. The additional mechanical stress from the encircling buckle can exacerbate existing vascular insufficiencies and lead to worsening of ischemic areas, which can contribute to new areas of ischemia or neovascularization [8]. Other tests for sickling disorders or causes of hyperviscosity, which might predispose the eye to ischemia from scleral indentation or posterior retinal vascular occlusion, could be performed as needed to assess the risk of retinal ischemia and related complications.

Unfortunately, we have no information on the type of cerclage used as the patient was operated elsewhere. A well-designed scleral buckle should prevent both internal and external erosions. A narrow buckle that is too tightly placed can eventually lead to internal erosion [9]. This can disrupt blood supply to the periphery of the retina, causing ischemia. A variety of buckling elements were used based on the specifics of the RD [10]. The narrower bands (such as #40 or #240) and tight suturing techniques posed a higher risk of internal erosion, leading to retinal ischemia and other complications [11]. Modern practice tends to use broader, well-designed encircling bands, such as the #42 encircling band, which are less likely to erode internally. The geometry and placement of the buckle are critical to ensure effective retinal reattachment while minimizing risks. The silicone tire should cover the retinal breaks, extending anteriorly to the ora serrata and posteriorly twice as far as the most posterior retinal break. This ensures that the retinal breaks are situated in the middle of the buckle, providing



Fig. 2. Fluorescein angiogram of the left eye of the patient showing nasal und superior peripheral area of ischemia.

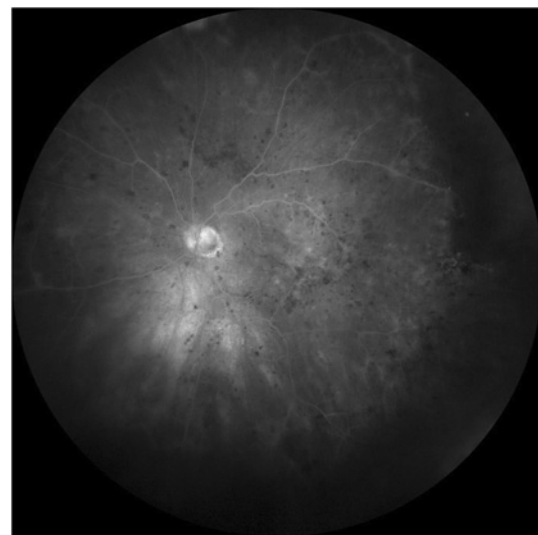


Fig. 3. Fluorescein angiogram of the left eye of the patient showing also temporal and inferior peripheral area of ischemia.

sufficient indentation and preventing fluid migration anterior to the break, which could lead to redetachment [12]. The sutures securing the silicone tire should be placed 2 mm apart from the width of the tire itself to ensure proper indentation without excess pressure that could lead to internal erosion [13]. An encircling band (such as a #42 band) is often used to maintain the height of the buckle and prevent external erosion through the conjunctiva. The #42 encircling band scleral buckle is a commonly used, effective option for repairing RD, particularly in cases with multiple breaks or extensive detachments. Its moderate width (4 mm) provides an optimal balance between effective retinal support and minimizing the risk of complications, such as internal scleral erosion or vascular compromise [14].

The incidence of cerclage however is decreasing for several reasons: technical advances in minimal invasive small gauge vitrectomies combined with the use of heavy liquids and modern endotamponades make the classic buckling surgery less attractive to younger surgeons. In many clinics, it is not even possible to learn buckling surgery anymore due to a loss of skills, despite the fact that in certain cases, buckling surgery might be beneficial especially for younger patients with phakic lens status [15]. The introduction of vitrectomy has considerably reduced

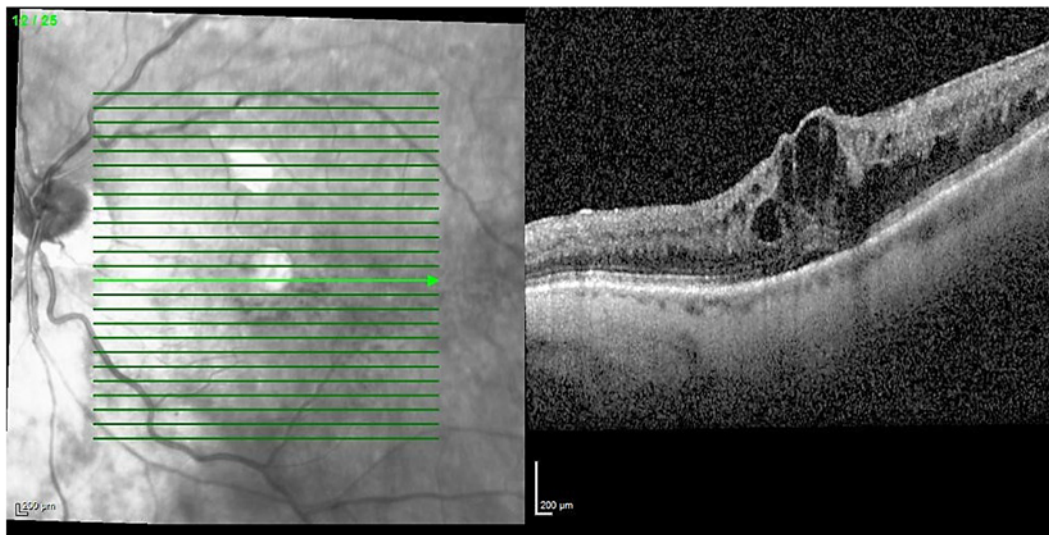


Fig. 4. OCT of the left eye of the patient showing the presence of CME with associated subretinal fluid. CME, cystoid macular edema.

the use of cerclage. A systematic review by Abdulla et al. [16] compared the visual outcomes of scleral buckling and vitrectomy for rhegmatogenous RD and concluded that vitrectomy was associated with better visual outcomes in cases with macular involvement and more complex detachments. They observed a higher rate of anatomical success (retinal reattachment) and better functional vision recovery in patients undergoing vitrectomy, especially for those with PVR or posterior retinal tears. A meta-analysis by Browning et al. [17] found that vitrectomy provided superior outcomes in terms of retinal reattachment and visual acuity, particularly in eyes with PVR and macular involvement. However, scleral buckling still had comparable outcomes in patients with uncomplicated RD and those with fewer risk factors (e.g., absence of PVR or significant proliferative disease). A large multicenter trial by McDonald et al. [8] demonstrated that vitrectomy offers superior anatomical success for complicated RD (e.g., with PVR, macular detachment, or posterior segment tears). The study reported reattachment rates of around 90–95% for vitrectomy, compared to 75–85% for scleral buckling in cases with significant complications. However, for simple RD without PVR or macular involvement, scleral buckling had a comparable anatomical success rate (80–90%), which suggests that scleral buckling remains an effective option for low-complexity RDs [8]. A common complication after vitrectomy is cataract formation, particularly in older patients. According to Sivaprasad and Oyetunde [18], vitrectomy increased the risk of cataracts (up to 50% within 5 years), especially in eyes with preexisting. In contrast, scleral buckling has a lower cataract rate, making it a better option for younger patients or those with significant lens opacity risk. A longitudinal study by Barkana et al. [19] showed that vitrectomy provides better long-term visual outcomes for complex RDs, particularly when combined with tamponade agents like silicone oil. The study observed that recurrent detachments were more common in scleral buckling cases, particularly in eyes with PVR or those requiring multiple surgeries.

Comparing techniques at the same center 20 years apart, Minihan et al. [15] observed that vitrectomy was the primary procedure in 63% of cases of RD in 1999 but in only 1% of cases in 1979–1980. Numerous studies in the literature highlight the potentially disastrous consequences of cerclage on the physiology of the globe. The complications described include perforations of the globe by the indentation material [20]; reduced aqueous humor flow [21]; significant increase in axial myopia [22]; ischemia of the anterior segment [23]; ocular pain,

scleral necrosis, and gross visual field reduction [24]. Retrospective series have reported complications of cerclage, most commonly extrusion and infection, in 1.3–24.4% of eyes [25, 26]. Complications of a cerclage may present up to decades after surgery without an age predilection, and their manifestation can be protean. The decision to remove a cerclage can be challenging, as each RD and patient are unique. Patient characteristics such as age, status of the other eye, reliability, and overall health should be considered. Cerclage removal can be considered medically necessary if signs and symptoms are progressive or risk progression (e.g., endophthalmitis, scleral necrosis). If signs and symptoms are chronic and stable (e.g., extrusion), cerclage removal is elective [27]. Iris rubeosis and anterior segment ischemia are also indications for cerclage removal [28]. The various theories about the etiology of anterior segment ischemia after cerclage include nonperfusion originating from the posterior ciliary arteries, the anterior ciliary arteries, or even the retinal vasculature. Systemic factors such as age, atherosclerosis, and hematologic disorders likely contribute as well [29].

Several recent non-randomized studies suggest that vitrectomy is the best approach for pseudophakic RD [30] despite the specific complications of this technique (secondary cataract, tears at the entry points, secondary intraocular hypertension, endophthalmitis) and that 360° retinal indentation is not essential in most cases to ensure anatomical success [31]. However, in phakic eyes, cerclage might still be a valuable treatment option, saving the patients lens by not invasively opening the globe.

In case of complications after cerclage, timely diagnosis and management are essential to prevent irreversible vision loss. Retinal ischemia after scleral buckling surgery can lead to complications such as macular edema, retinal neovascularization, and further RD. The prognosis varies based on the location and extent of the ischemia [32]. Retinal hemorrhages are supposed to be a consequence of ischemia-induced vascular damage and leakage of blood from weakened retinal vessels [33]. Macular edema occurs due to the breakdown of the blood-retina barrier and the release of factors like VEGF in response to ischemia [34]. It might be also discussed that elevated intraocular pressure due to iris neovascularization can lead to a RVO and that might explain the posterior hemorrhages.

Treatment options for peripheral retinal ischemia include laser photocoagulation to ischemic areas and anti-vascular endothelial growth factor (anti-VEGF) therapy for neovascularization and macular edema [35]. Peripheral laser treatment can help reduce the risk of further RD by addressing ischemic areas, but this is often difficult in very peripheral retinal locations. If laser is not feasible, intravitreal anti-VEGF injections may be considered to reduce neovascularization [36].

Treating peripheral ischemia is crucial in order also to avoid rebound macular edema. Rebound edema was first described by Matsumoto et al. [37] after an observation that patients who were treated for RVO with anti-VEGF injections developed increased edema on OCT after anti-VEGF therapy was discontinued. The authors postulated that rebound edema was due to untreated peripheral ischemia, which caused VEGF production, leading to ischemia. It was shown that the use of anti-VEGF agents causes a decrease in the amount of ischemia [38]. In a prospective cohort study, mean ischemic index was reduced from 14.8% on initial presentation to 10.3% following treatment with anti-VEGF agents and the level of nonperfusion correlates with the severity of macular edema [35].

The visual prognosis after scleral buckling surgery in the presence of significant posterior ischemia is often poor, particularly if the ischemic area involves the macula or if there is extensive neovascularization [39]. Studies have shown that eyes with significant preoperative retinal ischemia tend to have worse visual outcomes postoperatively, especially if the ischemia extends to the macular region [40].

Neovascularization of the retina and iris and consecutive neovascular glaucoma is a common consequence of chronic retinal ischemic diseases. The new vessels grow at the

pupillary border and iris surface (neovascularization of the iris) and over the iris angle (neovascularization of the angle) [41]. The new vessels can obstruct the trabecular meshwork, leading to elevated intraocular pressure. If untreated, this can result in irreversible vision loss. However, early intervention with medications, laser therapy, or surgery (e.g., cyclophotocoagulation) can help manage intraocular pressure and improve outcomes [42]. Intraocular pressure management often requires both topical and systemic medications initially, and ultimately surgical management is often necessary. Topical beta-blockers, alpha-agonists, and carbonic anhydrase inhibitors are frequently used in the management of IOP in eyes with NVG. Prostaglandin analogs can increase inflammation but are still often used as maximum medical treatment may be necessary. Systemic carbonic anhydrase inhibitors are also useful in the short-term management of IOP but must be used cautiously in patients with renal impairment. Surgical management of IOP is indicated where the maximal medical management fails to control the IOP. Surgical management of high IOP in the eyes with NVG includes trabeculectomy or glaucoma drainage device [43].

In recent years, there is an increasing preference for vitrectomy over scleral buckling: while cerclage (scleral buckling) remains a valuable option for simple, peripheral RDs, vitrectomy has increasingly become the procedure of choice for more complex cases, particularly those involving macular detachment, PVR, or posterior segment tears. The long-term visual outcomes, higher anatomical success rates, and ability to manage complicated cases have driven the shift toward vitrectomy. However, scleral buckling continues to be a safer and effective alternative in noncomplicated RD and offers the benefit of fewer systemic complications. The optimal choice depends on the specific nature of the detachment, patient factors, and surgeon expertise.

Conclusion

Peripheral retinal ischemia and secondary neovascular glaucoma can occur as late complications following retinal cerclage for RD. Ophthalmologists should be vigilant in monitoring patients with a history of retinal cerclage for signs of peripheral retinal ischemia and elevated IOP. Early detection and prompt management are vital to preserving visual function and preventing irreversible vision loss. Long-term follow-up of these patients is recommended to detect and manage late complications effectively.

Statement of Ethics

Ethical approval is not required for this study in accordance with local or national guidelines. Written informed consent was obtained from the patient for publication of the details of their medical case and any accompanying images. The CARE Checklist has been completed by the authors for this case report, attached as online supplementary material (for all online suppl. material, see <https://doi.org/10.1159/000543239>).

Conflict of Interest Statement

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article. The authors have no proprietary or commercial interest in any materials discussed in this article. No conflicting relationship exists for any author. No competing interests among authors.

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Author Contributions

Feliciano Menna: design of the work, acquisition, and analysis of data for the work. Markus Tschopp: review of the work and ensuring questions related to the accuracy or integrity of any part of the work. Marcel Menke: review of the work and final approval of the version to be published.

Data Availability Statement

All data generated or analyzed during this study are included in this article and its online supplementary material files. Further inquiries can be directed to the corresponding author.

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