Case Series

Surgical technique for removing vitreous cortex remnants using a diamond-dusted membrane scraper

Francesco Sartini, Martina Menchini, Pasquale Loiudice, Marco Nardi, Michele Figus and Giamberto Casini

Ophthalmology, Department of Surgical, Medical, Molecular Pathology and of Critical Area, University of Pisa, Pisa, Italy

ABSTRACT.

Purpose: The purpose of this paper is to present a new surgical technique to remove vitreous cortex remnants.

Methods: Non-consecutive retrospective interventional case series.

Results: When the posterior vitreous is split, its outermost layer may remain attached to the retina, developing vitreoschisis-induced vitreous cortex remnants (VCR). Their role in macular pathology etiopathogenesis has been well documented; however, recently, it has been proposed that VCR also play a crucial role in proliferative vitreoretinopathy and consequent retinal redetachment. The prevalence of VCR is underestimated because triamcinolone acetonide is not routinely used for vitreous staining. Vitreous cortex remnants (VCR) removal is challenging, and several surgical techniques have been proposed. However, they require sclerotomy enlargement, material that may not be readily available, and manual fashioning. Alternatively, a diamond-dusted membrane scraper (DDMS), already widely used in macular pathology treatment, can follow the contour of the retina, as it is a silicone tube, and remove VCR with its abrasive tip. A DDMS may also be introduced in the vitreous cavity through a standard trocar. Finally, the use of a DDMS provides predictable feedback, making the learning curve short. In this case series, 34 eyes affected by primary rhegmatogenous retinal detachment were enrolled. The retinal redetachment rate was 2.9% at six months of follow-up, below the average literature value of 21%. No adverse events were reported.

Conclusion: A DDMS can be suitable for use in VCR removal, although further studies are warranted to understand the indications and extent of this surgical technique for improving the management of rhegmatogenous retinal detachment.

Key words: diamond-dusted membrane scraper – pars plana vitrectomy – retinal detachment – triamcinolone acetonide – vitreous cortex remnants – vitreous staining

Acta Ophthalmologica

2021 The Authors. Acta Ophthalmologica published by John Wiley & Sons Ltd on behalf of Acta Ophthalmologica Scandinavica Foundation.

This is an open access article under the terms of the Creative Commons Attribution License, which permits use, distribution and reproduction in any medium, provided the original work is properly cited.

doi: 10.1111/aos.14933

Introduction

Vitreoschisis is a consequence of anomalous posterior vitreous detachment (PVD), in which the posterior vitreous cortex splits into two layers, and its outermost sheet remains attached to the retina, forming so-called vitreoschisis-induced vitreous cortex remnants (VCR) (Sebag 2008). This process may occur spontaneously or be induced during surgery. Vitreous cortex remnants are associated with macular diseases, such as macular holes or macular puckers (Sonoda et al. 2004; Sebag et al. 2007). Notably, a recent theory by van Overdam proposed that VCR are present in many cases of primary retinal detachment (RD) and play a crucial role in retinal redetachment (van Overdam 2020). In particular, VCR, by becoming a scaffold for cell proliferation, might promote the development of proliferative vitreoretinopathy (PVR) (Sebag 2008). As the vitreous is transparent, VCR may be better visualized with triamcinolone acetonide (TA) staining, even if this procedure is not routinely performed during pars plana vitrectomy. Consequently, the prevalence of VCR is probably underestimated. Reported VCR prevalences range from 67% to 75% in the macular area (Kimura et al. 2004; Chen et al. 2006; Cho et al. 2018), and 29% to 44% in the extra-macular area (van Overdam 2020).

Once visualized, the removal of VCR is challenging due to the risk of damaging the underlying retina. Several techniques have been reported to remove VCR using different instruments, such as vitreous cutters, nitinol loops (i.e. Finesse Flex Loop, Alcon, Fort Worth, TX, USA), end-gripping forceps, silicone brushes and tissue manipulators (van Overdam et al. 2019), van Overdam et al. (2019) proposed “vitreous wiping” using a polyvinyl alcohol (PVA) piece held in place.
by end-gripping forceps. They reported safe removal of VCR over both attached and detached retina, also under perfluorocarbon liquid (PFCL). Nevertheless, introducing the PVA piece required sclerotomy enlargement, and it was manually fashioned from an Eyetece™ PVA Instrument Wipe (van Overdam et al. 2019). The authors did not observe any microscopic fragmentation after shaping and trimming of the PVA piece. Polyvinyl alcohol (PVA) may not be readily attainable in all operating theatres, although cheaper alternatives such as Merocel™ are available (Shanmugam et al. 2019).

To overcome these issues, we propose an alternative technique to remove VCR using the Tano Diamond-Dusted Membrane Scraper (DDMS) (Synergetics, O’Fallon, MO, USA).

Materials

The technique was applied to patients affected by primary rhegmatogenous retinal detachment (RRD) referred to our clinic between January 2020 and June 2020. The exclusion criteria were prior vitreoretinal surgery; RRD caused by giant retinal tears; undetected retinal breaks after either dynamic scleral depression or scrupulous vitreous base shaving; PVR grade C (Macjemer et al. 1991) or worse; and ocular disorders that could interfere with visual recovery (e.g. age-related macular degeneration, diabetic retinopathy, or glaucoma). Patients were included once the surgery started, and the presence of VCR was confirmed by TA staining. Demographic data are reported in Table 1. The study was conducted in adherence to the tenets of the Declaration of Helsinki.

A standard 3-port vitrectomy with chandelier illumination was performed using the Constellation Platform (Alcon, Fort Worth, TX, USA), and a complete vitrectomy with shaving of the vitreous base was performed. Vitreous visualization was enhanced with TA (Kenacort-A, 40, Bristol-Myers Squibb Srl, Anagni, Italy) after removing the suspension’s preservatives. The TA concentration was 20 mg/mL. The extent of VCR was highlighted by injecting the TA in the vitreous cavity towards the retinal surface. Perfluorocarbon liquid was injected to secure the retina at the posterior pole.

Table 1. Demographic and preoperative features.

| Sex      | Number |
|----------|--------|
| Male     | 19     |
| Female   | 15     |
| Eye      | 4      |
| Right    | 20     |
| Left     | 14     |
| Age (years) | 66.4 ± 11.8 |
| Number of retinal breaks | 1.7 ± 0.8 |
| Lens status | Phakic | 13 |
| PVR      | 5      |
| No PVR   | 28     |
| PVR A    | 5      |
| PVR B    | 1      |

Results

Subsequently, the DDMS was introduced into the vitreous cavity, and VCR were gently removed from the detached retina. The manoeuvre started by sweeping with the DDMS over the retinal surface until a free edge of the vitreous cortex was created in the mid-periphery.

When the vitreous cortex’s flap was obtained, it was enlarged first in a centripetal way (towards the posterior pole) then in a centrifugal way (towards the vitreous base) and circumferentially. The vitreous cortex was meticulously removed in all quadrants from the detached retina. It is essential to note that a concentric ring of VCR was left on the retina’s surface, central to the point where the free edge was initiated.

Once the detached vitreous cortex was lifted sufficiently, it was gently aspirated by the vitreous cutter (Fig. 1). Triamcinolone acetonide (TA) was readministered to check for any persistent VCR. Finally, endorser was applied around the retinal breaks and air tamponade was performed. Video S1 displays a case treated with 23-gauge vitrectomy, although this technique was also suitable for 25-gauge vitrectomy, as DDMS is available in different diameters. In addition, Video S2 shows the same case of VCR removal with three-dimensional resolution.

Discussion

We agree with the theory proposed by van Overdam that highlighted the role of VCR as a scaffold for fibrocellular proliferation with consequent PVR development (van Overdam 2020). Consequently, we agree with the benefits of removing VCR in the mid-periphery to improve surgical success in RRDs. However, we believe that the vitreous wiping technique has some drawbacks. First, manual cutting of
the PVA piece is required; thus, dimensional variability can influence the elastic properties and alter the instrument’s feedback. Second, Eyetec™ PVA may not be readily available in all hospital facilities. Third, vitreous wiping requires enlargement of the sclerotomy to introduce the PVA piece into the vitreous chamber.

To overcome the abovementioned issues, we decided to remove VCR with a DDMS. This device was introduced in 1997 to create a free edge of the epiretinal membrane, helping the surgeon remove it (Lewis et al. 1997). Later, internal limiting membrane peeling with a DDMS was also proposed; however, the manoeuvre was prone to damage the underlying neurosensory retina; thus, it is not currently recommended (Kuhn et al. 1998; Hirakata et al. 2010; Leung et al. 2016).

Nevertheless, a DDMS can easily follow the contour of the retina without requiring sclerotomy enlargement. It also provides predictable feedback, improving the surgeon’s learning curve. We intend to investigate the redetachment rate after VCR removal with DDMS in vitrectomy for RRD and to compare it with those obtained from other techniques, such as vitreous wiping.

We acknowledge that this technique has some limitations. First, very gentle wiping with the DDMS is needed to avoid intraoperative retinal tears. However, the learning curve is short due to predictable feedback, and PFCL provided countertraction. Second, investigations (micropereimetry, static visual field) of retinal toxicity are warranted to understand the impact of the manoeuvre on retinal function. In particular, postoperative micropereimetry results from two groups of patients affected by RRD of similar duration, one group with and one without VCR removal, should be compared. Third, the extent and indications for VCR removal remain to be determined. Is it advisable to perform VCR removal only on the detached retina, or should it also be performed on attached retina? May it be suggested in all cases or only in selected ones, in particular cases with known risk factors for PVR, such as large retinal breaks or giant tears, vitreous haemorrhage associated with retinal tears, multiple previous eye surgeries, previous trauma to the posterior segment, or preexisting signs of localized PVR such as fixed folds?

In summary, the prevalence of VCR is underestimated, and questions have been raised regarding whether the risks of VCR removal outweigh the benefits. However, in our opinion, VCR plays a crucial role in the success of RRD surgery, as well as complete vitrectomy with vitreous base shaving. Notably, TA should be routinely introduced in vitrectomy for RRD to understand the true prevalence of VCR. Following van Overdam, we suggest removing the VCR to improve the retinal detachment success rate (van Overdam 2020). We understand that this manoeuvre is challenging regardless of the instrument used. Nevertheless, we propose a new technique to achieve this goal. A DDMS can easily follow the contour of the retina without requiring sclerotomy enlargement. It also provides predictable feedback, improving the surgeon’s learning curve. We intend to investigate the redetachment rate after VCR removal with DDMS in vitrectomy for RRD and to compare it with those obtained from other techniques, such as vitreous wiping.

References
Chen TY, Yang CM & Liu KR (2006): Intravitreal triamcinolone staining observation of residual undetached cortical vitreous after posterior vitreous detachment. Eye 20: 423–427.
Cho EH, Ku HC, II W & Lee EK (2018): Residual vitreous cortex at the fovea during vitrectomy for primary rhegmatogenous retinal detachment repair. Retina 38: 1549–1555.
Hirakata A, Inoue M, Oshitari K, Okada AA, Nagamoto T & Tano Y (2010): Histopathological examination of internal limiting membrane surface after scraping with diamond-dusted membrane scraper. Acta Ophthalmol 88: e293–e294.
Kimura H, Kuroda S & Nagata M (2004): Premacular cortical vitreous in patients with a rhegmatogenous retinal detachment. Retina 24: 329–330.
Kuhn F, Mester V & Berta A (1998): The Tano Diamond Dusted Membrane Scraper: indications and contraindications. Acta Ophthalmol Scand 76: 754–755.

Leung EH, Flynn HW Jr & Rosenfeld PJ (2016): Crescent-shaped retinal defects associated with membrane peeling with a diamond-dusted membrane scraper. Ophthalmic Surg Lasers Imaging Retina 47: 90–93.

Lewis JM, Park I, Ohji M, Saito Y & Tano Y (1997): Diamond-dusted silicone cannula for epiretinal membrane separation during vitreous surgery. Am J Ophthalmol 124: 552–554.

Loiudice P, Montesel A, Sartini F, Morganti R, Posarelli C, Nardi M, Figus M & Casini G (2021): Localized versus 360 degrees intraoperative laser retinopexy in cases of rhegmatogenous retinal detachment with mild-to-moderate grade proliferative vitreoretinopathy. Eye 35: 786–790. https://doi.org/10.1038/s41433-020-0950-9

Machemer R, Aaberg TM, Freeman HM, Irvine AR, Lean JS & Michels RM (1991): An updated classification of retinal detachment with proliferative vitreoretinopathy. Am J Ophthalmol 112: 159–165.

Sebag J (2008): Vitreoschisis. Graefes Arch Clin Exp Ophthalmol 246: 329–332.

Sebag J, Gupta P, Rosen RR, Garcia P & Sadun AA (2007): Macular holes and macular pucker: the role of vitreoschisis as imaged by optical coherence tomography/scanning laser ophthalmoscopy. Trans Am Ophthalmol Soc 105: 121–129; discussion 129–131.

Shanmugam MP, Ramanjulu R, Mishra D & Simakurthy S (2019): Vitreous Wiping, a new technique for removal of vitreous cortex remnants during vitrectomy. Acta Ophthalmol 97: e1151-e1152.

Sonoda KH, Sakamoto T, Enaida H et al. (2004): Residual vitreous cortex after surgical posterior vitreous separation visualized by intravitreous triamcinolone acetonide. Ophthalmology 111: 226–230.

van Overdam K (2020): Vitreoschisis-induced vitreous cortex remnants: missing link in proliferative vitreoretinopathy. Acta Ophthalmol 98: e261–e262.

van Overdam KA, van Etten PG, van Meurs JC & Manning SS (2019): Vitreous Wiping, a new technique for removal of vitreous cortex remnants during vitrectomy. Acta Ophthalmol 97: e747–e752.

Znaor L, Medic A, Binder S, Vucinovic A, Marin Lovric J & Puljak L (2019): Pars plana vitrectomy versus scleral buckling for repairing simple rhegmatogenous retinal detachments. Cochrane Database Syst Rev 3: CD009562.

Received on November 2nd, 2020. Accepted on May 20th, 2021.

Correspondence: Francesco Sartini, MD Department of Surgical, Medical, Molecular Pathology and of Critical Area University of Pisa Via Savi, 10 - 56126 Pisa Italy Tel: +39 050 997675 E-mail: sartini.f@gmail.com

Supporting Information

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

Video S1. A primary rhegmatogenous retinal detachment treated with 23-gauge Pars Plana Vitrectomy and VCR removal using the Tano Diamond-Dusted Membrane Scraper (DDMS).

Video S2. The VCR removal with three-dimensional resolution.