

Trans-scleral dye injection during vitreous surgery to identify clinically undetectable retinal breaks causing retinal detachment

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CLINICAL STUDY

Abstract

Background/aims Finding all retinal breaks is a critical step in rhegmatogenous retinal detachment (RRD) surgery in order to prevent persistent/recurrent retinal detachment (RD). We describe a technique of trans-scleral dye injection into the subretinal fluid under the detached retina in the context of recurrent/persistent RD in vitrectomized eyes, in order to determine the location of clinically unidentified (occult) retinal breaks causing RD.

Methods Retrospective consecutive single-surgeon case-series analysis of patients presenting with a repeat RRD after having been treated with pars plana vitrectomy (PPV) as the method of primary RRD repair. Trans-scleral injection of subretinal vision blue (TSVB) was used to help identify retinal breaks during repeat vitrectomy. **Outcome measures:** successful detection of a break; location of breaks; persistent retinal attachment; final visual acuity (VA); complications.

Results There were 395 cases of RRD during the 3-year period reviewed. TSVB was used for eight instances in seven eyes. All eight instances were repeat RRD. TSVB facilitated occult break detection in 7/8 instances of use. Breaks were at or adjacent to the previous cryo site in three instances. Persistent retinal attachment was achieved in 5/7 cases. Final VA increased in 5/7 cases. There was no evidence of complications as a result of TSVB injection.

Conclusions TSVB coupled with indentation to vent a plume of dye through an occult break during vitreous surgery is a relatively simple technique that may facilitate the identification

of occult retinal breaks and help achieve anatomical success and functional success.

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Introduction

Identification of all retinal breaks is a critical step in rhegmatogenous retinal detachment (RRD) repair. An unsealed break will allow trans-retinal fluid flow into the subretinal space and cause a re-detachment. Despite a thorough pre- and intra-operative search, a break may remain elusive. We describe the result of a single-surgeon series to identify clinically undetected retinal breaks by trans-scleral injection of Vision Blue (0.006% version of Trypan blue, DORC, Zuidland, The Netherlands) during vitreous surgery for persistent/recurrent retinal detachment (RD).

Materials and methods

The vitreo-retinal surgery records of the senior author (RLB) were reviewed for the past 3 years (from beginning of 2007 to end of 2009) at the Norfolk and Norwich University Hospital, UK (university teaching hospital). There were 395 cases of retinal detachment from 1 January 2007 to 31 December 2009. All patients had undergone a standard 3-port pars plana vitrectomy (PPV) as the primary technique to repair RRD.

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Seven patients presented with repeat RRD in which the site of the break causing the RD could not be clinically identified. Trans-scleral vision blue (TSVB) was used to aid occult break detection. The case notes of these patients were reviewed retrospectively. Case histories are summarized in Table 1.

In these cases, patients were carefully examined using indentation with 20D lens pre-operatively but a break could not be found. Intra-operatively, during repeat vitreous surgery, a microscope-mounted binocular indirect viewing system fitted with a stereoscopic inverter (BIOM, Germany) was used combined with repeat indentation to identify the break.

Technique

When a break was not found, VB was injected trans-sclerally using a 30-gauge needle mounted on an 1-ml syringe. The tip of the needle was applied to the globe tangentially (bevel-away-from-sclera so that when the needle is in the subretinal space, the bevel is away from the retina) and used in a manner similar to an indenter. Pressure was exerted, under observation using the microscope, until internal distortion of the globe was visible. The needle was positioned where the depth of the subretinal fluid (SRF) was greatest (most bullous RD). Pressure was exerted on the globe using the needle until

Table 1 Case histories of patients with clinically unidentified retinal breaks causing RD

Case history	Presenting VA (at re-detachment)	Final VA
1 A 59-year old underwent PPV + cryo + 20% C ₂ F ₆ for mac-on RD. After 6-months he presented with a mac-off RRD. TSVB was used to identify the occult break. He was discharged from the hospital service 5 months later with a flat retina.	HM	6/12
2 A 74-year old underwent PPV + cryo + C ₃ F ₈ for RRD. The retina was flat at 1-week follow-up. After 2-months he presented with a total RD. TSVB was injected and an occult break was identified near the edge of the previous cryo site. PPV + cryo + silicone oil fill was performed. After 2-weeks a further break was noted adjacent to the new area of cryo with a RD under the oil involving the macula. No further attempts at surgery were made. CE + IOL was performed 1 year later.	CF	6/60
3 A 48-year old underwent PPV + cryo + 22% C ₂ F ₆ for mac-off RRD. He represented later with a RD. No break could be identified. TSVB showed leakage at the original site and at one site adjacently. PPV + cryo + 18% C ₂ F ₆ was performed. He was discharged from the hospital service after 7-months follow-up with a flat retina.	CF	6/18
4 A 45-year old high myope presented with a RD, and underwent PPV + cryo + C ₂ F ₆ 18%. He had uncomplicated CE + IOL 4 months later. After 3 months he re-presented with a shallow mac-on RD. TSVB identified a new break infero-temporally. He underwent PPV + cryo + 18% C ₂ F ₆ . He was discharged from the hospital service 2 months later with a flat retina.	6/12	6/6
5 A 74-year old presented with a mac-off RRD. Surgery with PPV + cryo + 18% C ₂ F ₆ injection was performed. After 2 weeks peripheral SRF was noted and he underwent further PPV + cryo + C ₂ F ₆ 22%. After 2 weeks he represented with a mac-off RD. PPV + cryo and C ₂ F ₆ 18% was performed. After 1 month persistent SRF was noted with no obvious break. TSVB was employed to find the break. He underwent PPV + silicone oil tamponade. After 4 months oil removal was performed with endolaser and encircling band with 20% C ₂ F ₆ . Despite achieving a flat retina after four interventions, on follow-up, a sub-total RD was noted. Patient declined further surgery.	6/36	6/60
6 A 62-year old with mac-on RRD and had PPV + cryo + 20% SF ₆ . After 3 months he represented with a re-detachment. TSVB used to identify a repeat break at the original site. PPV + cryo + 20% SF ₆ was performed. On follow-up, there was residual SRF, which increased during later visits. The patient underwent further surgery. TSVB was used and did not identify any breaks. PPV and encircling band was performed. The patient was returned 10 days later with a GRT, retinal hole and a choroidal fold with macula-off RRD. He underwent PPV with silicone oil tamponade. The hole remained open with localized PVR inferiorly. The macula remained on and retina flat. Follow-up continues.	6/6	6/15
7 A pseudophakic patient presented with a mac-off RD. He underwent PPV + cryo + 22%SF ₆ . He presented 1 month later with a total RD and underwent PPV + cryo + 18% C ₂ F ₆ . After 2 weeks he presented with a mac-on inferior RD. A further PPV and TSVB indicated leakage from the cryo scar. Further cryo was performed and silicone oil tamponade was used. He has a flat retina and remains under glaucoma follow-up.	CF	6/12

Abbreviations: CE + IOL, cataract extraction and intraocular lens implant; CF, counting fingers; cryo, cryotherapy; GRT, giant retinal tear; HM, hand movements; Mac, macula; PPV, 3-port pars plana vitrectomy; PVR, proliferative vitreoretinopathy; RD, retinal detachment; RRD, rhegmatogenous retinal detachment; SRF, subretinal fluid; TSVB, trans-scleral (subretinal) vision blue; VA, visual acuity.

the needle tip penetrated the globe. Once the tip of the needle was just visible intra-ocularly, the dye was injected carefully into the subretinal space (Figure 1). Sufficient volume of dye was injected such that the SRF was stained. The needle was then removed. Dynamic scleral depression (DSD) using an indenter with endo-illumination was performed to encourage the dye to vent out of the undetected break. When successful, a plume of dye was visible in the vitreous infusate (Figure 2). If no plume was seen then the heavy oil (perfluorodecalin) could be used, in conjunction with globe rotation, to encourage expression of dye. Once it was determined that there were no other breaks, the dye was drained through the break site. A drainage retinotomy was required on one occasion where no break was identified (see case 6). Cryotherapy (cryo) was applied to the new-found break and surgery was then completed in a standard manner.

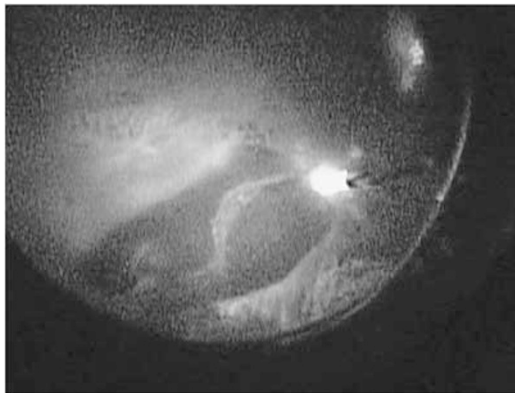


Figure 1 Trans-scleral vision-blue injected into subretinal space, staining the sub-retinal fluid.



Figure 2 Dynamic scleral depression venting a plume of vision blue through a previously undetectable break.

Illustrative cases

Case 4

A 45-year-old high-myope presented with a RRD with a visual acuity (VA) of 6/12. He underwent a standard 3-port PPV with cryo and 18% C₂F₆ injection. He had uncomplicated cataract extraction and intra-ocular lens implant 4 months later. After 3 months he represented with a shallow macula-on RRD. Despite a thorough pre-operative and intra-operative search using indentation, the break could not be identified. TSVB injection identified a new break infero-temporally. He underwent a repeat PPV + cryo + 18% C₂F₆ injection. He was discharged 2 months later with a flat retina. VA at discharge was 6/6.

Case 5

A 74-year-old man presented with a macula-off RRD and VA of 6/36. Surgery with PPV + cryo + 18% C₂F₆ injection was performed. The retina was flat at the post-operative review. After 2 weeks peripheral SRF was noted and he underwent further PPV + cryo + C₂F₆ 22%, again with a flat retina the following day. After 2 weeks he re-presented with a macula-off RRD. PPV + cryo and C₂F₆ 18% was performed, with a flat retina noted at the 2-week follow-up. Persistent SRF was noted 1-month later, with no obvious break. TSVB was used and identified a break. He had PPV + silicone oil tamponade with a flat retina after surgery. After 4 months oil removal was performed with endolaser and encircling band, with 20% C₂F₆. On follow-up, a sub-total RD was noted and a causative break could not be clinically identified. Patient declined further surgery. The final VA was 6/60. In this case, either a new break was responsible for the repeat RD or the original break identified with VB was not responsible for the preceding RD.

Results

Case summaries with visual outcomes are presented in Table 1. There were no instances of undetected breaks in primary repair. There were eight instances of sub-retinal vision blue use in seven eyes in that time period. The use of VB was successful in 7/8 instances for the purposes of locating the clinically unidentified retinal break. All cases that required VB were retinal re-detachments. One case was macula on; the remainder were macula off. Four of our patients were pseudophakic. Clinically undetectable breaks were at or adjacent to the previous cryo site in three instances. At final review, five patients had an increase in VA. Persistent retinal attachment was achieved in five out of seven cases; one case had a subtotal persistent detachment. Silicone oil was used in three cases and SB in one. Final VA increased by two

Snellen lines in 4/7 cases. There was no evidence of complications as a result of TSVB injection.

Discussion

The identification of all retinal breaks is an important step in the management of RRD. Estimates regarding unidentified breaks complicating RRDs vary from 6–13%.^{1–3}

A meticulous pre-operative examination must be performed using binocular indirect ophthalmoscopy with indentation, regardless of whether PPV or SB is planned.

An internal search for retinal breaks using indentation microsurgery was first described by McLeod, using PPV.⁴ This has been further elaborated to a dye extrusion technique,^{5,6} involving injection of sub retinal trypan blue, using a 41-gauge needle, into the SRF. Extrusion of the dye is encouraged through the presumed break using perfluorocarbon liquid to fill the eye and systematic rotation of the globe, with the aim of seeing a plume of dye venting out of the break. The use of a dye provides color contrast that aids detection and is an advantage over the use of heavy liquid alone. In some instances, the dye stains the devitalized tissue of the break itself. This was reported in the context of both primary and repeat RD repair.^{5,6}

Our technique of trans-scleral injection of VB was successful in 7/8 attempts to identify the clinically undetected retinal breaks in the setting of retinal re-detachments. Persistent retinal attachment was achieved in five out of seven cases. Final VA increased by two Snellen lines in 4/7 cases. We experienced no complications related to the dye use. The advantage of this technique over trans-retinal injection is that iatrogenic break creation is avoided. For posterior breaks, the technique can still be employed: the dye is injected and an air exchange carried out encouraging the dye posteriorly.

Theoretically, possible complications of trans-scleral injection include hypotony, choroidal hemorrhage, retinal hemorrhage,⁷ and retinal and vitreous incarceration. Iatrogenic break creation is a possibility and would render the technique less effective if it occurs. Retinal toxicity remains a potential complication, especially as some may be left in the subretinal space. Efforts to remove the dye by internal drainage, would only debulk rather than completely protect the tissues. However, VB is a lower concentration of Trypan blue, the use of which has been described safely before in the sub-retinal dye extrusion technique.^{5,6} It can be argued that the loss in VA of some of the patients was potentially due to dye toxicity. However, Veekeneer *et al*,⁸ investigating toxicity of Trypan blue at various

concentrations (0.2 and 0.06%) found that only at 0.2% did Trypan blue show any signs of toxicity, manifest as damaged photoreceptors and marked disorganization with light and electron microscopy and reduced immunohistochemical staining for rhodopsin. At 0.06% concentration of Trypan blue (the concentration of Trypan blue available as VB) was concluded to be harmless. However, VB is licensed for use in cataract surgery by the Food and Drug Administration and not for subretinal dye, at this time. Finally, although controversy remains, one could argue that use of a buckle during the initial or subsequent surgeries would have achieved a better anatomical outcome preventing the need for the use of the dye. Overall, this was a small study and additional larger-scale studies on this technique would be useful.

The technique that the surgeon opts for will depend on their analysis of the literature of various techniques to manage unidentified breaks, their surgical experience, surgical preferences, and patient considerations (age, phakic status, and VA in contralateral eye). Studies analyzing vitreo-retinal surgeons' current practice would be useful as there does not appear to be a consensus in the literature with respect to the best technique. Our results suggest that trans-scleral injection of dye coupled with DSD is a relatively simple technique that can facilitate the identification of clinically undetectable retinal breaks and can result in anatomical success. In our case series, the technique was applied in the setting of re-detachments; however, the same technique can be used in cases of primary repair if necessary. In this small case series it is not possible to rule out the risk of dye toxicity. An alternative to VB can be used employing the same technique where this particular dye is not licensed for vitreo-retinal use.

The use of trans-scleral VB can be one additional option in vitreo-retinal surgeons' armamentarium of surgical techniques dealing with unidentified retinal breaks.

Summary

What was known before

- The identification of all retinal breaks is an important step in the management of retinal detachment.
- A number of management techniques and strategies are available for treating retinal detachments in which the breaks are undetected pre-operatively.

What this study adds

- The use of trans-scleral vision blue is an additional method of managing retinal detachments where retinal breaks remain undetected.
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Conflict of interest

The authors declare no conflict of interest.

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