**SURGEON’S CORNER**

**Treatment of Proliferative Diabetic Retinopathy Using Viscosurgery With Vital Dye**

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Viscosurgery is a surgical procedure based on the injection of viscoelastic material between the retinal surface and the fibrovascular tissue in proliferative diabetic retinopathy (PDR), with the aim of separating these structures to facilitate their dissection. We describe a modified viscosurgical technique in which the viscoelastic material is combined with a vital dye (trypan blue), which allows us to determine the degree of adhesion between the structures. Viscosurgery with vital dye has advantages compared with conventional viscosurgery and constitutes a useful surgical approach in complicated cases of severe PDR, enhancing efficiency and safety in the dissection of fibrovascular proliferations and minimizing iatrogenic damage to the underlying retina. We used trypan blue viscosurgery in 8 eyes of 8 patients with severe PDR; in all cases, a satisfactory outcome was obtained without evidence of any complications.

**SURGICAL TECHNIQUE**

One milliliter of 1% sodium hyaluronate is mixed with 0.1 mL of trypan blue dye in a 2-mL syringe until a homogenous mixture containing no air bubbles is obtained. This result is achieved by a simple technique of stirring with circular motions using a 30-gauge needle in a horizontal position within the syringe. Then, the stained viscoelastic material is returned to the original injector, which is connected to a 30-gauge curved cannula with a bayonet fitting to prevent accidental ejection when pressing the plunger.

After standard vitrectomy with a 23-gauge 3-port system, we remove the microcannula and introduce the 30-gauge curved cannula through the sclerotomy opening. The stained viscoelastic solution is injected between the posterior hyaloid–fibrovascular proliferation complex and the retinal surface to separate these structures. Viscoelastic staining with try-
pan blue allows us to obtain a retinal elevation map and to visualize the degree of adhesion between the structures. The darkest areas correspond to regions with less adhesion because the dye tends to accumulate in larger spaces between the structures; the lighter areas with less dye correspond to areas with greater adherence and less separation (Figure 1).

After the dissection, vitrectomy is completed, the viscoelevated fibrovascular membranes are dissected with the vitrectomy probe or with forceps and scissors if necessary, and all traces of viscoelastic material are removed by aspiration. Finally, the remaining procedures are completed in each case for posterior segment stabilization (subretinal fluid drainage, exchange of fluid to gas or silicone oil, and photocoagulation). A video of the surgical procedure is available at http://www.archophthalmol.com.

**COMMENT**

The use of viscoelastic materials in vitreoretinal surgery was first described by Stenkula and Torngquist in 1983. The authors demonstrated the usefulness of sodium hyaluronate to facilitate the dissection of epiretinal fibrovascular and fibrogial membranes in severe PDR, elevating and separating them from the surface of the retina. Years later, Stenkula et al used yellow-stained sodium hyaluronate with sodium fluorescein to enhance visualization and injection under the membranes and to simplify the removal of the substance at the end of surgery. They also reported the possibility of using a type of sodium hyaluronate that is 10-fold more viscous (Healon-GV; Abbott Medical Optics, Inc, Abbott Park, Illinois), which facilitated safer dissection in cases of membranes firmly attached to the retina. In 1988, McLeod and James showed the usefulness of retinal viscoelamination with methylcellulose or 1% sodium hyaluronate to separate the vitreous cortex and the epiretinal fibrovascular membranes in 40 eyes with severe PDR. The authors stated that this technique was especially useful in cases of poorly vascularized membranes with combined tractional and rhegmatogenous retinal detachment but that it entailed a significant risk of iatrogenic retinal breaks and increased bleeding in cases of highly vascularized and adherent membranes. Also, they reported postoperative recurrences of epiretinal proliferation, which they attributed to residual viscoelastic material that proved difficult to remove entirely, with preretinal retention of growth factors. For these reasons, the authors indicated that the technique had been abandoned in favor of purely mechanical methods that minimized the risk of proliferation.

More recently, Grigorian et al compared the conventional technique of dissection using forceps and scissors with viscodissection and concluded that the latter was a safe and equally effective alternative for surgical management of PDR. In contrast to the experience of McLeod and James, these authors did not observe an increase in intraoperative bleeding or difficulty in the removal of viscoelastic material. In their view, the viscoelastic material helps maintain transparency during surgery by limiting diffusion of blood into the vitreous cavity.

We present a modified technique of vicosurgery in which viscoelastic material is combined with a vital dye (trypan blue) in complicated cases of severe PDR. Viscoelastic material is most useful for separating the posterior hyaloid–fibrovascular membrane complex from the retinal surface. At the same time, the vital dye allows for a topographic elevation map of these membranes owing to the variable color intensity of the underlying viscoelastic material, as mentioned in the “Surgical Technique” section of the text. The darker the shade, the greater the separation; this allows fast and safe dissection of the proliferations. In contrast, the lighter shades reflect a much smaller space between the retinal surface and the membranes, implying greater adhesion between them, so the dissection procedure must be performed with extreme care to avoid iatrogenic damage to the retina (Figure 2). Also, the clearly visible color of the viscoelastic material facilitates its complete removal, minimizing the risk of residue at the end of surgery, as established by Stenkula et al. In the technique we describe, the viscoelastic material is not actually used for dissecting the fibrovascular proliferations, as in conventional viscosurgery, but for defining their epicenters and the correct plane for fast and safe dissection. This, along with the enhanced visual advantage provided by its combination with the vital dye, makes it a useful procedure in complicated cases of PDR.
Regarding the potential toxic effects of trypan blue in vitreoretinal surgery, 2 consecutive clinical studies have shown no signs of retinal toxic effects or alteration of the retinal pigment epithelium associated with the dye. Experimental studies using animal models show more conflicting results, which may be due partly to methodological differences. Luke at al. observed irreversible retinal damage due to 0.15% trypan blue. Veckeneer et al. reported signs of retinal toxic effects after prolonged exposure to 0.2% trypan blue, although a concentration of 0.06% proved to be safe. In contrast, Jackson et al. demonstrated the safety of the dye with concentrations as high as 0.2% in retinal pigment epithelium cell culture and glial cells. In our surgical experience, we have observed no alterations or signs suggestive of toxic effects of the dye.

We used trypan blue viscosurgery in 8 eyes of 8 patients with severe PDR and fibrovascular proliferations that firmly adhered to the retina; in all cases, a satisfactory outcome was obtained without evidence of iatrogenic retinal breaks, leakage of viscoelastic material into the subretinal space, or any other complications. We have extensive experience in conventional viscosurgery and have observed a stronger definition of the epicenters and of the correct plane for dissection with trypan blue viscosurgery. This technique can improve the ability of surgeons to visualize surgical planes and may enhance efficiency and safety.

CONCLUSIONS

Viscosurgery with vital dye offers advantages compared with traditional viscosurgery because the intensity of the dye color provides an indication of the degree of fibrovascular membrane adherence to the retinal surface. Therefore, we believe this technique constitutes a safe and useful surgical approach in complicated cases of severe PDR, allowing for precise and rapid membrane dissection and minimizing the risk of iatrogenic damage to the underlying retina.

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