Tips for Capsular Staining

Using VisionBlue improves the safety of cataract surgery and aids in achieving the perfect capsulorhexis.

BY MINAS CORONEO, MD, MS, MSc, FRACS, FRANZCO

The development of VisionBlue capsular dye (Dutch Ophthalmic Research Corporation International BV, Zuidland, the Netherlands) represents a significant advance in capsular staining, and, as a consequence, the safety of cataract surgery. As a result, usage has gained in popularity with sales of approximately 2 million units to date in mid-2007. The superior capsular visualization achieved with this dye was noted in its development and was later confirmed by other investigators.[1,2] Several techniques for the application of VisionBlue have been described;[3-5] however, my minimalist technique[6,7] is effective and adds little time to the procedure.

STAINING TECHNIQUE

I drain a small amount of aqueous from the eye via the paracentesis port before injecting the dye. This action induces a relative pupillary block that confines the dye to the pupillary area, minimizing the risk of dye passing into the posterior segment.[8-10] Thirty seconds after I inject the dye, I introduce an ophthalmic viscosurgical device (OVD) into the anterior chamber via a cannula while placing pressure on the posterior lip of the paracentesis port. Dyed aqueous humor exits the anterior chamber through the port. To minimize the risk of the cannula's tip damaging the anterior capsule, I initially inject a small amount of OVD just inside the paracentesis. This method obviates the need to take an additional step to remove dye and/or OVD from the anterior chamber.

Figure 1. When displaced with an OVD, air bubbles serendipitously placed in the anterior chamber for 30 seconds during surgery leave areas of the anterior capsule unstained in the sections covered by the bubbles on instillation, demonstrating that air retards capsular staining by trypan blue.

Because I avoid using air in the anterior chamber, I reduce the risk of potential toxicity to the endothelium and infection that can occur with unfiltered air. I have observed that air actually retards capsular staining (unpublished data, 2007)(Figure 1). Additional instrumentation, such as a specific cannula designed for "painting" dye onto the capsule is not required.[11]

INDICATIONS FOR CAPSULAR STAINING

Although the initial ophthalmic application for VisionBlue was to improve the visualization of mature cataracts during phacoemulsification, its indications have expanded to include any eyes with compromised red reflex and less obvious conditions such as:

- White/brown cataract or cortical cataract with a predilection for the nasal quadrant
- Corneal opacity[1-3] or ocular surface disease[3,4]
- Vitreous opacity[5]
- Pigmented fundus
- Traumatic cataract[6]

VisonBlue is also useful for:

- Creating anterior and posterior capsulorhexes in pediatric cases[7-9]
- Training residents[10-12] and assisting surgeons as they transition to advanced procedures such as phaco chop (the identification of the capsulorhexis' edge is important during these procedures)
- High-risk cases including pseudoexfoliation and true exfoliation[13]
- Cases in which the zonules are compromised or when a surgeon is operating on a patient's second eye after his first eye developed an intraoperative complication (VisionBlue can assist in identifying anteriorly inserted zonules)[14]
- Open-sky techniques[15]
- The removal of capsular plaque[16]
- Resolving complications such as "lost" or errant capsulorhexes[17]
- Managing miscellaneous difficult cases[18]

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PRINCIPAL OPHTHALMIC USES

VisionBlue's ability to stain connective tissue and basement membranes is expanding[12-14] its ophthalmic uses and indications (See *Indications for Capsular Staining*). During cataract surgery, it (1) enhances capsular visualization for the safe completion of the capsulorhexis (the critical step in cataract surgery); (2) stains the anterior capsule, highlights the capsulorhexis, and provides a landmark during the remainder of the procedure; and (3) helps surgeons achieve a perfectly centered capsulorhexis that overlaps the IOL's optic by 0.5 to 1 mm[15] or to create a "re-rhexis"[16] in cases of severe capsular phimosis.

Apart from issues relating to decentration, a perfect capsulorhexis may be a critical determinant of final IOL power,[17] because the IOL's final position in the capsular bag is determined in part by the size of the capsulorhexis.[18] These days, in part due to technological advances, patients do not just desire highly accurate refractive outcomes, but they also expect them. The simple "low-tech" method of achieving a perfectly sized capsulorhexis with the aid of VisionBlue is a very effective strategy for meeting patients' expectations.

In my opinion, it is possible to create a properly sized and centered capsulorhexis by using the position of the IOL's edge in the capsular bag to execute a "re-rhexis" after the IOL's placement. This step is greatly facilitated by staining the capsule with trypan blue, because the stain increases the contrast between the IOL's and the capsulorhexis' edges.

As we begin to perform refractive lensectomies on younger patients and implant more multifocal and accommodating IOLs, we need to be aware that long-term capsular contraction can affect the results of these procedures. Creating optimally sized capsulorhexes during the initial surgery can reduce the risk of poor outcomes.

Figure 2. The capsulorhexis is being stretched with a vernier caliper in a cadaveric eye. The capsulorhexis can be stretched from approximately 4 to 10 mm before it ruptures. VisionBlue has no effect on the capsulorhexis' ability to be stretched.

I believe that VisionBlue can be used in every surgery and have made this approach my standard practice. Cataract surgery is a critical lifetime event for patients that can be compared with flying. A take-off into a clear sky does not necessarily mean the continuation of good weather. Similarly, corneal haze or other complications can make an apparently routine surgery technically demanding. Although skill and experience usually result in a safe outcome, staining the capsule blue makes the procedure safer. Introducing VisionBlue during cataract surgery takes little time and adds relatively minimal cost to the procedure.

SAFETY ISSUES

In the initial search for a safe dye for intraocular use, investigators quickly determined that anionic (acidic) dyes such as trypan blue are less injurious to ocular tissue than cationic (basic) dyes.[19] This inherent safety factor should be remembered in a commercial climate in which claims of toxicity are sometimes poorly documented.

The safety of trypan blue has been demonstrated by long-term studies[20] as well as by its use in eye bank

corneas to determine endothelial cell viability prior to transplantation. For more than 30 years, the exclusion of trypan blue has remained a standard test of cellular viability and is used extensively in ophthalmic research.[21]

Although some investigators have suggested that trypan blue decreases the tear strength of the capsulorhexis,[22] no data exist to support this claim. The stiffness of porcine capsules may increase after photosensitization in the presence of trypan blue;[23] however, this effect is unlikely to be clinically significant. My colleagues and I recently demonstrated[24] that VisionBlue does not decrease the tear strength of the capsulorhexis' margin in an in vitro human eye model (Figure 2). There was no significant difference in the "stretchability" of the capsulorhexis' opening with or without VisionBlue.

Of interest was a 4-mm capsulorhexis that could be stretched to approximately 10 mm before it ruptured.[24] One report suggests the dye had in vitro toxicity to porcine endothelial cells,[25] but controls for the solution's toxicity were inadequate, and the postmortem time for eyes used was not reported. Endothelial safety is consistent with clinical experience and earlier clinical studies.[26] Keep in mind that there is also a report of permanent staining of a hydrogel IOL.[27]

Recent outbreaks of Toxic Anterior Segment Syndrome remind us that we need to be vigilant about the potential toxicity of the agents we introduce into the eye.[28] VisionBlue, however, appears to have an excellent track record. Some patients developed marked intraocular inflammation after they were exposed to trypan blue,[29] but in these cases, the surgeons used generic preparations of the dye. According to Dutch Ophthalmic Research Corporation International BV, VisionBlue is currently the only ophthalmic dye produced following the FDA's good manufacturing practices and is the only one that contains a highly purified form of trypan blue. The literature reports contamination in dyes prepared in eye banks[30] and compounding pharmacies, which suggests that surgeons should avoid using trypan blue from these sources. For additional safety, surgeons should know that VisionBlue has a shelf life of 2 years.

CONCLUSION

Using VisionBlue to stain the capsule during cataract surgery improves the procedure's safety. The technique described herein is safe, easy, effective, does not require extra instrumentation, and adds minimal time to the procedure. VisionBlue also helps surgeons create "perfect" capsulorhexes, conferring short- and long-term benefits on the outcome of cataract surgery. ■

Minas Coroneo, MD, MS, MSc, FRACS, FRANZCO, is Director of Ophthalmic Surgeons and of Sydney Biotech in Sydney, Australia. He has patent rights in relation to trypan blue as well as a licensing agreement with Dutch Ophthalmic Research Corporation International BV. Dr. Coroneo may be reached at + 61 2 93 99 9211; coroneom2@optusnet.com.au.

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