Improvements in Small-gauge Vitrectomy May Reduce Potential Complications

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Small-gauge vitrectomy system (25-gauge and 23-gauge) use has increased rapidly since 2002 due to its advantages of decreased surgical time, reduced postoperative inflammation, and faster visual recovery compared with 20-gauge vitrectomy.\(^1\)\(^-\)\(^5\) The 2009 Preferences and Trends (PAT) Survey from the American Society of Retina Specialists reported that nearly 80% of respondents commonly employ small-gauge systems. Recently, however, concerns have arisen that use of small-gauge systems may increase the risk of endophthalmitis.\(^6\)\(^-\)\(^9\) Proper preoperative sterilization techniques along with improved methods in entry, exit, and surgical technique should decrease these risks. This article highlights some of these methods.

POTENTIAL RISKS OF SMALL-GAUGE SYSTEMS

The risk of endophthalmitis in 20-gauge systems has been previously reported to be 0.03% to 0.05%.\(^10\)\(^-\)\(^13\) Retrospective reviews of 25-gauge endophthalmitis data have reported conflicting information: As compared with 20-gauge studies, Kunimoto et al\(^1\) reported a 12-fold increased risk, Scott et al\(^1\) reported a 28-fold increased risk, but Hu et al\(^1\) reported no statistically significant difference (a 0.07% [1/1424] rate for the 25-gauge cases).

Several hypotheses have been proposed to explain why 25-gauge vitrectomy may lead to a higher rate of postoperative endophthalmitis: Complete wound closure may not be achieved;\(^15\) unsutured wounds may lead to early...
postoperative hypotony, allowing an intraocular influx of extracellular fluid and microorganisms;1-4,10,16,17 lower infusion rates with reduced influx and efflux of fluid may allow a greater bacterial inoculum to remain in the eye;1-3 residual vitreous skirt may facilitate bacterial adherence and sequester bacteria from normal immunologic factors and extraocular antibiotics;18 vitreous wick prolapse through the sclerotomy site may create a potentially open conduit through the conjunctival and scleral wound that may facilitate entry of bacteria into the eye.19

IMPROVEMENTS IN ENTRY TECHNIQUE

Successful outcomes in small-gauge vitrectomy are highly dependent upon preoperative preparation and entry technique. Preoperatively, the use of povidone-iodine along the lid margin and/or perioperative area significantly reduces bacterial flora, thus decreasing the risk of endophthalmitis. Furthermore, placing povidone-iodine for a few seconds near entry sites may further lower the risk, as direct application has been demonstrated in well-controlled studies to decrease the microbiologic flora before intraocular surgery.20,21

Modifications in entry technique have also decreased complication risk. Original 25-gauge surgical systems employed a direct perpendicular entry through intact
conjunctiva without displacement. This allowed a direct opening to the vitreous cavity, thus increasing the risks of endophthalmitis, hypotony, and choroidal detachment in early studies. Lakhanpal et al reported no cases of endophthalmitis, but did report incidence of 4% of hypotony and persistent choroidal detachments associated with small blebs. Gupta et al reported hypotony within the first 24-hour period in numerous eyes as well.

Such complications necessitated the following improvements in entry technique (Figure 1): First, the conjunctiva and sclera should be flattened in order to allow entry more parallel to the limbus; next, the conjunctiva should be displaced laterally in order to prevent communication between this incision and the scleral incision; third, rather than a perpendicular incision, a two-step incision should be used, in which an oblique, beveled incision parallel to the limbus through the conjunctiva and sclera is followed by a perpendicular tunnel entry, thus creating a self-sealing wound. In one study, angled incisions were associated with significantly lower risk for external communication as opposed to straight incisions.

Flattening and displacing the conjunctiva in order to create a self-sealing incision was an important development. This may be performed with a variety of instru-
ments, such as a cotton-tip applicator, 0.3 forceps, or plug-pulling forceps. Another option is the Dugel End Plate (Peregrine Surgical, New Britain, PA): This instrument simultaneously flattens and displaces the conjunctiva, then designates the angle of entry, and finally aids in trocar removal (Figures 3 and 4).

**IMPROVEMENTS IN SURGICAL PROCEDURE AND CANNULA REMOVAL**

A variety of techniques may be employed during small-gauge vitrectomy in order to decrease the risks of hypotony and endophthalmitis. Previous studies have postulated that insufficient vitreous removal during 25-gauge vitrectomy may provide an area for bacterial adherence. Thus, performing a more complete vitrectomy, particularly with triamcinolone staining near the sclerotomy sites, is a simple way to correct this problem. Another potential issue is that prolapse of a vitreous wick through the sclerotomy site may create a potentially open conduit through the conjunctival and scleral wound that may facilitate entry of bacteria into the eye. Once again, more complete vitrectomy at or near the sclerotomy sites decreases this risk. Also, the use of air tamponade at the conclusion of surgery may act as both a barrier to bacterial inoculation and a way to prevent hypotony.

Improvements in cannula removal and appropriate use of subconjunctival antibiotics near the sclerotomy sites may reduce potential complication risks. Vitreous wick prolapse may be prevented during closure by simply placing the light pipe through the microcannula during removal (Figure 5). This prevents the suction-like effect that can occur during cannula removal. This mechanism of cannula removal with air tamponade may allow air rather than vitreous to seal the sclerotomy site wound. Finally, injection of subconjunctival antibiotics adjacent to the sclerotomy sites may decrease bacterial entry through sclerotomy sites. Some authors have recently proposed that there is a correlation between...
relative hypotony at the conclusion of surgery and the influx of bacteria through sclerotomy sites, increasing the risk of endophthalmitis.26, 27 Air tamponade and relatively higher intraocular pressure may be a deterrent to bacterial influx.27 Extra insufflation of air may also be necessary if the intraocular pressure is deemed to be too low. Many of these recommendations for small-gauge surgery improvements have been proposed by the Microsurgical Safety Task Force at the most recent meeting of the American Society of Retina Specialists.28

CONCLUSIONS

Small-gauge vitrectomy systems have been in widespread use since 2002. For experienced surgeons, there has been a steep learning curve in terms of entry techniques, surgical technique and instrumentation, and microcannula removal. These improvements have decreased the relative risk of endophthalmitis, but longer-term study must be done. Hu et al14 determined that there is no statistically significant difference in endophthalmitis rates between 20-gauge and 25-gauge systems, directly contradicting two previous studies.7, 8

Currently, the prevailing evidence emphasizes the importance of the following measures to reduce endophthalmitis risk: Infection prevention measures, including lid scrubbing and direct povidone-iodine application; conjunctival displacement and angled/beveled incision; more complete vitreous removal adjacent to the sclerotomies; air tamponade; repositioning potential extracapsular vitreous wick with light-pipe assisted cannula removal and subconjunctival antibiotic injection; and extra insufflation of air/gas, if necessary, to stabilize intraocular pressure. Having performed thousands of small gauge vitrectomies since 2002 without a case of endophthalmitis, I believe that the increased risk is largely technique-dependent. The documented risk modifications described above should decrease the endophthalmitis risk dramatically. ■

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