

Key Findings From the Tube Versus Trabeculectomy Study

BY STEVEN R. SARKISIAN JR, MD

In this installment of "Landmark Studies," Steven R. Sarkisian Jr, MD, reviews the data from the Tube Versus Trabeculectomy (TVT) Study. This study has significantly changed how many glaucoma surgeons choose between implanting a tube shunt and performing a trabeculectomy. I asked Dr. Sarkisian several important questions regarding this research, and I believe you will find his answers instructive.

—Section Editor Ronald L. Fellman, MD

WHAT QUESTION WAS THE TVT STUDY DESIGNED TO ANSWER?

The TVT Study was designed to compare the safety and efficacy of nonvalved tube shunt surgery to trabeculectomy with mitomycin C (MMC) in patients who had previously undergone intraocular surgery.

HOW WAS THE STUDY DESIGNED TO ANSWER THE QUESTION?

The TVT Study was a multicenter, randomized clinical trial that included 17 centers.¹ Participants were between 18 and 85 years of age; had previously undergone trabeculectomy and/or cataract extraction with the implantation of an IOL; and had uncontrolled glaucoma with IOPs ranging from 18 to 40 mm Hg on maximum tolerated medical therapy. Patients were randomized to receive a 350-mm² Baerveldt glaucoma implant (Abbott Medical Optics Inc; n = 107) or to undergo trabeculectomy with the application of MMC 0.4 mg/mL for 4 minutes (n = 105).

WHAT IS THE MOST IMPORTANT CLINICAL TAKE-HOME MESSAGE FROM THE TVT STUDY?

It is more efficacious to implant a glaucoma drainage device to control IOP than to perform a repeat trabeculectomy on patients who have previously had intraocular surgery, especially those who underwent trabeculectomy.

"The TVT Study ... [compared] the safety and efficacy of nonvalved tube shunt surgery to trabeculectomy with [MMC] in patients who had previously undergone intraocular surgery."

HOW HAS THE TVT STUDY CHANGED YOUR SURGICAL APPROACH TO CONTROLLING GLAUCOMA?

Most ophthalmologists desire to practice evidence-based medicine. For many of us, however, our surgical approaches are often predicated on biases established during our training, through our surgical experience, and from our patient population. I have routinely implanted primary glaucoma drainage devices in patients with refractory glaucoma and in all patients in whom previous glaucoma filtration surgery failed. The TVT Study affirmed my existing surgical approach to uncontrolled glaucoma, because it has never been my typical treatment paradigm to perform a second trabeculectomy after the first trabeculectomy has failed.

DOUBLE VISION IS A SIGNIFICANT PROBLEM AFTER TUBE SURGERY. WHAT HAS THE TVT STUDY TAUGHT US ABOUT DIPLOPIA?

Patients enrolled in the TVT Study underwent a formal motility examination during their initial screening for the study and at the 1-year follow-up visit.² The rate of new-onset, persistent diplopia was 5% in the tube group and 0% in the trabeculectomy group at the 1-year follow-up visit. Although the authors noted that the incidence of diplopia was not statistically significant, it is clinically important. It is likely that the rate of diplopia with glaucoma drainage

implants has decreased over the years, as the devices have been modified with fenestration holes. These holes anchor the implant and allow for lower blebs, which tend to be less likely to cause diplopia.

WHAT DO YOU TELL PATIENTS PRIOR TO TUBE SURGERY ABOUT DIPLOPIA AND EROSION OF THE TUBE?

It is important to inform patients about the possible complications associated with all glaucoma surgeries, although I generally only mention those that are most typical. I am more concerned about long-term tubal erosion of the Baerveldt device than with double vision, because often, the diplopia is mild and can be fixed via prismatic correction. The rate of both tubal erosion and diplopia was 5%, according to 3-year results of the TVT Study.³

MANY OPHTHALMOLOGISTS THOUGHT THE IOP WOULD BE HIGHER IN THE TUBE GROUP. WHY DO YOU THINK THIS WAS NOT THE CASE?

It is important to point out that the patients in the TVT Study were not undergoing primary glaucoma surgery. Moreover, all patients with refractory glaucoma were ineligible for the study. Essentially, the participants in the TVT Study were the patients who typically do the best with a glaucoma drainage implant in my practice. These “easier” or less refractory glaucoma patients fall into one of two groups. The first includes individuals who underwent cataract surgery and who had a previous scleral tunnel incision with conjunctival scarring. The second comprises patients in whom previous trabeculectomy failed. None of the patients in the study had congenital, neovascular, traumatic, or uveitic glaucoma. I think this largely explains the slight edge that tube shunts had over trabeculectomy in the TVT Study, and the older age of this patient population might skew the results. One of the great things about the investigation, however, is the primary take-home message that patients in whom previous trabeculectomy failed and who need further surgery to lower their IOP should have a tube shunt rather than another trabeculectomy.

ALL OF THE PATIENTS HAD PRIOR SURGERY, AND MOST HAD PRIOR CONJUNCTIVAL MANIPULATION. THE FAILURE RATE FOR A TRABECULECTOMY IN A PSEUDOPHAKIC EYE WAS 59%. SHOULD FILTRATION DEVICES NOT BE USED IN THESE EYES?

We should not abandon the use of filtration devices in pseudophakic eyes. In a 2009 study of 345 eyes, many of which were pseudophakic, my colleagues

“Patients in whom previous trabeculectomy failed and who need further surgery to lower their IOP should have a tube shunt rather than another trabeculectomy.”

and I reported a 95% success rate when an Ex-Press Glaucoma Filtration Device (Alcon Laboratories, Inc.) was implanted under a partial-thickness scleral flap as a single procedure or in combination with cataract surgery.⁴ Additionally, the rate of hypotony in our study was lower than that of the TVT Study.

The complications of greatest concern that would be associated with trabeculectomy versus the Ex-Press include hypotony, hyphema, choroidal effusions, and suprachoroidal hemorrhage. In the TVT Study, the rate of choroidal effusions in both the tube and trabeculectomy groups was 14% and 13%, respectively, and the rate of flat chambers was 10% in both groups. The rate of hyphema was 2% in the tube group and 8% in the trabeculectomy group, and the rate of suprachoroidal hemorrhage was 2% in the tube group and 3% in the trabeculectomy group. The rate of hypotony and its associated complications is significantly lower with the Ex-Press compared with the trabeculectomy group.⁵ Due to its safety profile, therefore, I prefer the Ex-Press to traditional trabeculectomy in almost all cases. Many surgeons prefer to implant the device in pseudophakes or in patients on anticoagulants, because the rate of hyphema is low, and an iridectomy is not needed.

I have placed an Ologen Collagen Matrix Implant (Optous) with the majority of my Ex-Press implants during the past several years, and I reported at the Annual Meeting of the American Glaucoma Society 2 years ago that the success rate is similar between an Ologen implant and MMC.⁵ Regarding efficacy, there is no statistically significant difference between the Ex-Press with MMC and an Ex-Press with Ologen, assuming the latter implant is used properly. Also, the long-term complications should be less with an Ologen implant, because, in my experience, the blebs are not thin and avascular like they are after the application of MMC.

DOES THE TVT STUDY ADDRESS VIRGIN EYES?

The goal of the TVT Study was not to address the effects of the two surgical approaches on virgin eyes. The

investigators are conducting a primary tube versus trabeculectomy study, however, that will attempt to answer this question.

MOST OF THE FILTRATION DEVICES IN THE TVT STUDY WERE LIMBUS BASED. CONSIDERING WHAT IS KNOWN ABOUT WOUND HEALING, DO YOU TEACH YOUR RESIDENTS TO PERFORM A LIMBUS- OR FORNIX-BASED CONJUNCTIVAL INCISION? DOES THE APPROACH MATTER IF THE PATIENT HAS HAD A PRIOR CONJUNCTIVAL INCISION?

The trend in glaucoma filtration surgery has been toward fornix-based incisions due to the low, diffuse blebs associated with this approach. A fornix-based incision lends itself to better visibility and exposure of the scleral flap and involves less dissection. The “ring of steel” typically seen around an avascular bleb is far more common with a limbus-based incision. The phenomenon of bleb overhang is also more frequent with limbus-based conjunctival incisions. I teach my fellows and residents fornix-based conjunctival incisions. It is also much easier to teach a fornix-based incision due to the issue of exposure.

The approach matters if the patient has already had a conjunctival incision and if there is significant scarring. For example, an eye that underwent phacoemulsification with an extracapsular cataract extraction wound or a scleral tunnel can have significant conjunctival scarring. If there is room on either side of the scleral cataract incision, a fornix-based conjunctival incision is advantageous, because it is easy to avoid the scarring from previous surgery and prevent a buttonhole. In cases of significant scarring, however, I prefer a glaucoma drainage implant in most eyes that have undergone extracapsular cataract extraction. I usually do not attempt a trabeculectomy on these eyes. Typically, I evaluate the superior conjunctiva preoperatively with a cotton-tipped swab at the slit lamp to assess which surgery will be better.

MMC 0.4 mg/mL WAS USED FOR 4 MINUTES IN THE FILTRATION ARM OF THE TVT STUDY. THE HYPOTONY RATE WAS 13% COMPARED WITH 9% IN THE COLLABORATIVE INITIAL GLAUCOMA TREATMENT STUDY. HAS THE USE OF MMC CHANGED, AND WHAT DO YOU CURRENTLY RECOMMEND?

I use MMC 0.4 mg/mL for eyes that have a very thick Tenon capsule. To my knowledge, few surgeons currently use MMC for 4 minutes. This length of application may

account for the long-term hypotony rate reported in the TVT Study. I no longer use sponges or cut Weck-Cel spears (Beaver-Visitec International) to apply MMC, and I typically inject the antifibrotic agent before the start of the case. If I am not using an Ologen implant, I inject a mixture of MMC 0.4 mg/mL with 2% lidocaine and epinephrine. First, I make a small snip at the limbus. Next, with a 27-gauge cannula, I inject approximately 0.2 mL of this mixture 10 to 15 mm posterior to the limbus and then massage it forward.

DID THE TVT STUDY PROVIDE INFORMATION ABOUT VISUAL FIELD OUTCOMES OR OPTIC NERVE CHANGES? IF NOT, IS IT FORTHCOMING?

The outcome measures for the TVT Study primarily looked at IOP, vision, the reoperation rate for glaucoma, the use of supplemental medical therapy, surgical complication rates, visual field outcomes, and quality of life. Interestingly, in the published TVT analysis of surgical failure, the primary outcome measurements were IOP and vision. There was no visual field criterion used to define failure. In my careful review of the multiple TVT publications, there has not been any discussion of the visual fields for these patients. The TVT Study team is preparing a manuscript on visual field outcomes as well as quality of life. Other articles related to cost analysis and glaucoma reoperations in the TVT Study are forthcoming (Steven Gedde, MD, personal communication, September 2012). ■

Section Editor Ronald L. Fellman, MD, is a glaucoma specialist at Glaucoma Associates of Texas in Dallas and clinical associate professor emeritus in the Department of Ophthalmology at UT Southwestern Medical Center in Dallas. Dr. Fellman may be reached at (214) 360-0000; rfellman@glaucomaassociates.com.

Steven R. Sarkisian Jr, MD, is the director of the glaucoma fellowship at the Dean A. McGee Eye Institute, and he is a clinical associate professor of ophthalmology at the University of Oklahoma College of Medicine in Oklahoma City, Oklahoma. Dr. Sarkisian may be reached at (405) 271-1093; steven-sarkisian@dmei.org.



1. Gedde SJ, Schiffman JC, Feuer WJ, et al. Treatment outcomes in the Tube Versus Trabeculectomy (TVT) Study after five years of follow-up. *Am J Ophthalmol*. 2012;153(5):789-803.
2. Rauscher FM, Gedde SJ, Schiffman JC, et al; Tube Versus Trabeculectomy Study Group. Motility disturbances in the Tube Versus Trabeculectomy Study during the first year of follow up. *Am J Ophthalmol*. 2009;147(3):458-466.
3. Gedde SJ, Schiffman JC, Feuer WJ, et al. Three-year follow-up of the Tube Versus Trabeculectomy Study. *Am J Ophthalmol*. 2009;148(5):670-684.
4. Kanner E, Netland PA, Sarkisian SR, Du H. Ex-Press miniature glaucoma device implanted under a scleral flap alone or in combination with phacoemulsification cataract surgery. *J Glaucoma*. 2009;18(6):488-491.
5. Sarkisian SR. Ologen. Paper presented at: the Annual Meeting of the AGS; March 2, 2011; Dana Point, CA.