Glaucoma Drainage Device Technique in a Cohort of Experienced Glaucoma Surgeons in Australia and New Zealand

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**Précis:** Glaucoma drainage devices (GDD) by Australian and New Zealand glaucomatologists are implanted superotemporally under a peribulbar anaesthesia without the use of mitomycin C. Intraluminal stents and tube fenestration are utilized and covered with a scleral graft.

**Purpose:** To evaluate current practice patterns of surgical techniques for GDD among Australia and New Zealand Glaucoma Society members routinely performing GDD surgery.

**Methods:** Survey of surgeons who performed more than 20 GDD in past 5 years.

**Results:** Surgeon participation rate was 31/32 (96.8%). The most common surgical techniques were Baerveldt GDD (24/32, 77.4%), superotemporal placement (31/31, 100%), and peribulbar anaesthesia (21/31, 67.7%). Mitomycin C antimetabolite was used routinely by 9/31 surgeons (29.0%). Most surgeons employed intraluminal stents (23/31, 74.2%) with tube fenestrations (19/31, 61.3%). GDD was placed behind the recti muscles (27/31, 87.1%) and secured with nylon (8/0, 9/0 or 10/0) by 29/31 (93.6%). Most of the tube was most commonly covered with a full-thickness scleral patch graft (21/31, 67.7%). Majority of surgeons (21/31, 67.7%) reviewed patients 3 to 4 times in the first month.

**Conclusions:** Although a wide range of practice patterns for GDD implantation exists among Australia and New Zealand Glaucoma Society surgeons, there are consistent techniques currently in use to optimize patient outcomes. This report can help surgeons seeking to improve outcomes and minimize complications when trialing different surgical options.

**Key Words:** glaucoma drainage device, glaucoma surgery, surgical technique, Baerveldt tube

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Data were collected and analyzed anonymously. Respondents reported their technique of choice for each
surgical step. These data were collated for all respondents. The total number of responses and percentage are presented. Data from the returned questionnaires was tabulated and analyzed using Microsoft Excel (Microsoft Corporation, Seattle, WA).

RESULTS

Thirty-one surgeons (24 M: 7 F) participated in the study. Most surgeons were aged 51 to 60 years old (17/31, 54.8%) with the rest, 41 to 50 years old (12/31, 38.7%) and above 60 years old (2, 6.7%). The majority did glaucoma fellowships in United Kingdom (28, 93.3%) with the rest in the United States (2, 6.5%) or elsewhere (1, 3.2%). The number of years in practice was 20 or more for 19 (61.3%) of the surgeons. Collectively this represented over 650 GDDs inserted over the past 5 years. All questions of the survey were answered by all the participants.

The devices used were the Baerveldt (BG 101-350, BG 103-250, or pars plana BG 102-350) (24/31, 77.4%) (Johnson & Johnson, New Brunswick, NJ) or Molteno (single, double plate, or 3 versions) (IOP Inc., Costa Mesa, CA, and Molteno Ophthalmic Limited, Dunedin, New Zealand) (7/31, 22.6%). Although not specifically surveyed, generally these procedures were done as a secondary procedure following failure of trabeculectomy. The vast majority of surgeons were performing the surgery with a peribulbar block (21/31, 67.7%) or subtenons (6/31, 19.4%) although some surgeons routinely preferred a general anesthetic (3/31, 9.7%).

Surgical Technique

Supplemental Table 1. Supplemental Digital Content 1 (http://links.lww.com/IJG/A451) provides a summary of the preferred practice steps in performing GDD surgery. A corneal traction suture 6-7/0 polygalactin or silk was used to infact the eye for superotemporal conjunctival exposure (24/31, 77.4%). Other techniques were to use a squint hook to rotate the eye down when needed (3/31, 9.7%) or a superior rectus suture (2/31, 6.5%). The conjunctival flap was fornix-based either with relaxing incisions (21/67.7%) or without relaxing incisions (9/31, 29.0%) at the limbs. A variation was to perform a short limbs-based flap (21/31, 67.7%) or subtenons (6/31, 19.4%) although some surgeons preferred a general anesthetic (3/31, 9.7%).

The choice to tie off the tube depended on the type of stent, with surgeons using 6-7/0 polygalactin (28/31, 90.3%) or nylon (3/31, 9.7%) to be released by laser suture lysis or through an external loop. The Sherwood slit technique to allow early flow of aqueous was used by most surgeons (19/31, 61.3%). This was performed with a blade (vertical slit) or needle puncture of the tube. A variation was a 9/0 polygalactin wick (3/31, 9.7%) through the tube and left long beyond the scleral patch under the conjunctiva, so as to be potentially removable. Some surgeons using 3/0 intraluminal stents did not feel the need for slits (8/31, 25.8%) as the lumen was already fully occluded (although personal observations were that both the suture diameter and tube lumen diameter was observed to be variable, leading to different flow rates in different cases around the stent).

All surgeons (31/31, 100%) preferred superotemporal placement in the case of a primary tube. As the larger Baerveldt plates (BG 101-350) were used in the majority of cases, most surgeons (27/31, 87.1%) placed the plate behind the superior and lateral recti, 8 to 10 mm behind the limbus. One surgeon placed the plate >10 mm behind the limbus deliberately to achieve a more posterior bleb, however this technique required longer conjunctival relaxing incisions and conjunctival retraction sutures. The plate was secured to the sclera with 8/0 nylon (27/31, 87.1%) by most surgeons, although other sutures were also used—9—10/0 nylon (2/31, 6.5%), 9/0 silk (1/31, 6.3%), 7/0 polygalactin (1/31, 6.5%), or fibrin glue alone (1/31, 6.5%) (Fig. 2).

There were many differences in terms of tube insertion. The most popular technique to create a sclerostomy was using a 23-G needle ab externo (18/31, 58.1%), with other surgeons opting for a smaller 25-G needle (7/31, 22.6%). A less common technique, but useful, was to place the tube in a plane parallel and close to the iris by an ab interno approach with either a 23-G needle (2/31, 6.5%) or a 25-G needle (2/31, 6.5%) (Fig. 3).

In the pseudophakic eye, there were a number of choices aimed to prevent the tube causing endothelial and iris damage. Surgeons were divided on the length of tube placed in the anterior chamber, either to peripheral iris (11/31, 35.5%) or to mid-iris (7/31, 22.6%), in contrast to sulcus placement behind the iris at the pupil margin (11/31, 35.5%) (Fig. 4).
Most surgeons agreed that the tube needed to be covered by a full-thickness scleral patch graft (21/31, 67.7%). Other techniques included a partial thickness (lamellar) scleral graft (3/31, 9.7%), a scleral flap similar to a trabeculectomy trapdoor (2/31, 6.5%), and other types of patch material such as dehydrated pericardium (Tutoplast; Katena Products Inc., Parsippany, NJ) (2/31, 6.5%). Closure of the conjunctival flap was by various options of nylon (7/31, 22.6%), polygalactin (14/31, 45.2%), fibrin glue alone (2/31, 6.5%), or a combination of fibrin glue with suture closure (8/31, 25.8%) (Fig. 5).

The majority of surgeons (21/31, 67.7%) saw their routine patients 3 to 4 times in the first month, however postoperative visits were as few as 1 or 2 visits for some surgeons (10/31, 32.3%).

**DISCUSSION**

Although the practice patterns for trabeculectomy have been studied by surveys in the United States, to our knowledge, current practice preferences regarding surgical techniques for GDD have not been reported in detail. This study aimed to evaluate current practice patterns for GDD implantation among Australian and New Zealand glaucoma specialists. Although the results of this survey demonstrate a wide range of practice patterns in GDD implantation among Australian and New Zealand glaucoma surgeons, it also suggests there are many consistent features in surgical technique that are undertaken by the majority of surgeons. This group of surgeons practice mainly in private clinics, but have some public clinics and/or academic positions. According to Australian Medical Beneﬁt Scheme numbers, there were 270 GDD performed in 2017. The numbers in this survey were not sufﬁcient to evaluate varying practices according to number of GDD inserted.

A previous study explored the type of implant utilized by Australia and New Zealand surgeons in 2012. Non-ﬂow-restricted GDDs, in particular Molteno implants (69%), were the most commonly used in 2012, however, 77.5% of surgeons are now using Baerveldt GDD. This represents a dramatic shift in surgeon preference. The current consensus group was of the opinion that the Baerveldt GDD provides a posteriorly draining lower proﬁle bleb, allows for modiﬁcation of ﬂow with
suture ligation and intraluminal stenting and has a long-term safety profile. The Ahmed valve (New World Medical, Rancho Cucamonga, CA) is available for use in Australia, but has not been widely used. The use of MMC has remained stable with 21% usage with GDD in 2012 compared with 29% in the current survey. Evidence in the literature does not suggest that the use of MMC improves outcomes.10,11

GDD implantation requires careful attention to detail at every step of the procedure to improve results and minimize postoperative complications. Areas of the surgical procedure where surgeons had overwhelming consistency (>75%) included position of the implant, with 100% placing the implant superotemporally as their first option. Options for secondary placement were also discussed, with the inferotemporal and superonasal quadrants favored over the inferonasal quadrant. The majority of surgeons (87.1%) placed the implant behind the rectus muscles. The most common suture to secure the plate to the sclera was nylon, typically either 8/0 to 10/0 nylon (93.6%). Drainage through a nonvalved device can be regulated in the early postoperative period by passing an intraluminal stent such as (3-4/0 polypropylene or nylon suture) through the lumen of the implant.7,12 Once the fibrous capsule around the plate has formed, depending on the IOP, the stent suture may be removed at the slit lamp, or in a procedure room, or in theater under topical or local anesthesia. In our study, intraluminal stents were typically used by nearly three quarters of the respondent surgeons (74.2%).

Several steps in the surgery are similarly performed by half to two thirds of surgeons. Tube fenestrations are commonly used to provide IOP reduction immediately after nonvalved tube-shunt implantation.13 In the Tube versus Trabeculectomy (TVT) Study, a multicenter randomized clinical trial based in the United States/United Kingdom comparing the safety and efficacy of tube-shunt implantation and trabeculectomy, fenestrations were performed by 77% of surgeons.13 Among our cohort of Australian and New Zealand surgeons two thirds (61.3%) performed tube fenestrations. Creating access for the tube into the anterior chamber was accomplished using 23-G needle ab externo approach by most surgeons (58.1%).

A very important step in GDD surgery is to cover the tube (particularly close the limbus) to prevent its erosion through the conjunctiva.14 Patch graft materials which have been used include dehydrated pericardium, sclera, fascia lata, dura, or cornea. In our study, surgeons predominantly covered the tube with a full-thickness scleral patch graft (67.7%). One advantage of cornea and pericardium donor tissue is that it may provide better cosmesis being less clearly white than donor sclera. Most surgeons covered the whole tube to the plate, whereas some left a small segment of tube uncovered at the superior edge adjacent to the plate to provide exposure of the tie around the tube for potential argon laser suture lysis. A corneal patch also has the advantage of a translucent medium to enable visualization of a suture tying off the tube and facilitating laser suture lysis (Fig. 6).

The difficulty of obtaining donor corneal material which is in high demand for keratoplasty procedures is a relative disadvantage. There was also consistency regarding follow-up visits with most surgeons (67.7%) performing 3 or 4 postoperative assessments in the first month.

There are several areas where there is significant variability. The most variable step in GDD technique was the placement of the tube into the eye. Traditionally the tube is placed by a needle sclerostomy passed ab externo, through the sclera behind the limbus into the anterior chamber, keeping the tip of the tube parallel to the iris plane, not touching the iris and or the endothelium. The bevel is cut facing forwards to reduce the risk of iris occlusion and situated peripheral or mid-iris. The risk of endothelial damage with the tube anterior to the iris, has led to development of other techniques such as sulcus placement in pseudophakic eyes. This can be done with a variety of techniques including ab interno, ab externo, 23-, 24-, or 25-G needle, with tip of the tube cut flush or reverse bevel, so that it is just visible at the pupillary margin. The Troxler effect results in the tube not being seen by the patient,13 but readily seen by the examining physician. In pseudophakic eyes, the tube was either placed in the anterior chamber with a shorter tube at the peripheral iris (35.5%), a longer tube to mid-iris in the anterior chamber (22.6%) or sulcus placement (35.5%). Placing the tube in the sulcus has the potential benefit that there is less risk for corneal endothelial damage than anterior chamber tubes. Inevitably patients tend to rub their eyes and this can move the tip forwards to impinge on the endothelium. However, potential risks of sulcus placement and creating a sclerostomy “unsighted” behind the iris,16 include hemorrhage and damage to the iris base, zonules, capsule, and/or ciliary processes.

Closure of the conjunctiva depends on the original incision and the extent of the relieving incisions. There were several options for closure utilized including polyglactin (45.2%), nylon (22.6%), fibrin glue (6.5%), or a combination of these (25.8%). Nylon closure similar to trabeculectomy has been used for many years, however absorbable 9/0 polygalactin is becoming popular with proponents reporting no increased inflammatory response. Fibrin glue has been a more recent innovation and can be used to fix the plate, scleral patch, and/or conjunctival flap.17 There are some concerns that the glue may block drainage from the Sherwood slits or impede drainage around the plate, however the advantage is less risk of peritubular and conjunctival leakage and has not specifically been observed to reduce the volume of the bleb. The number of sutures for closure also is less, reducing operative time. In terms of follow-up post-GDD, there are generally fewer postoperative visits than for routine cases of trabeculectomy. There is less manipulation usually required following a GDD, with the intraluminal stent left in situ for at least 3 weeks and thus some surgeons only feel the need to see routine patients for 1 to 2 visits in the first month.

FIGURE 6. Corneal patch with good visualization of the underlying tube. A 10/0 nylon suture can be seen just visible at tube exit from the sclerostomy. Figure 6 can be viewed in color online at www.glaucomajournal.com.
There are several limitations of this survey. A multiple-choice format may introduce bias by limiting possible responses to the options offered. However, the choices were carefully designed to include the most common techniques for each step as pilot surveys evolved in discussion with the authors. Furthermore, answers given by some respondents may not accurately reflect their actual clinical practice because of errors in recall. Although, given the results were anonymously collected, this would be unlikely. The study included most of the higher volume GDD surgeons in Australia and New Zealand, although it was not possible to obtain the opinions of every experienced GDD surgeon in the region.

The significant variations in practice preferences of GDD implantation among Australian and New Zealand ophthalmologists reflect a lack of good evidence to guide practice. Although the optimal clinical practice is poorly defined, the results of this survey provide a means for ophthalmologists to critically examine their own clinical preferences through comparison with those of their colleagues. This survey also provides a baseline against which clinical trends can be identified and assessed in future. It may stimulate consideration of registry based and potential randomized controlled trials which could lead to surgical techniques to improve success rates, ultimately reducing the complications of this highly effective surgical procedure.

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