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Long-Term Outcomes of Trabeculectomy Augmented with Mitomycin C Undertaken within the First 2 Years of Life

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Purpose: To evaluate the long-term effectiveness and safety of mitomycin C (MMC)–augmented trabeculectomy undertaken within the first 2 years of life for the surgical management of glaucoma.

Design: Retrospective, consecutive, noncomparative case series.

Participants: All children who underwent MMC-augmented trabeculectomy within 2 years of birth between May 2002 and November 2012.

Methods: The medical records of 40 consecutive eyes of 26 children who underwent surgery by a single surgeon were reviewed. Data collected during routine clinical care were analyzed.

Main Outcome Measures: Assessment of clinical outcomes included intraocular pressure (IOP), final visual acuity, bleb morphology, surgical complications (early and late), postoperative interventions, and further glaucoma surgery performed. Surgical success was defined as final IOP of 5 mmHg or more and of 21 mmHg or less, with anti-glaucoma medications (qualified success) and without (complete success), stable ocular dimensions and optic disc cupping, and no further glaucoma surgery (including needling) or loss of light perception. Surgical outcomes were evaluated using Kaplan-Meier life table analysis.

Results: Forty eyes of 26 children were studied over a mean follow-up period of 62.8 months. Most cases (80%) were of primary congenital glaucoma after failed goniotomy surgery. Cumulative probabilities of survival at 1, 5, and 7 years were 78%, 67%, and 60%, respectively. Of eyes regarded as successful, 96% (25/26 eyes) had controlled IOP without topical medication and 44% achieved visual acuity of 20/40 or better. In only 1 of the 40 eyes did a cystic avascular bleb develop, with all the other eyes being non-cystic in nature (diffuse and elevated or flat) at final follow-up. Sixty-four percent (9/14 eyes) of cases regarded as failures ultimately underwent glaucoma drainage device implantation.

Conclusions: A contemporary pediatric trabeculectomy technique augmented with MMC is an effective procedure in the management of glaucoma within the first 2 years of life, as shown by the successful long-term outcomes and low incidence of sight-threatening complications. Trabeculectomy after failed goniotomy surgery or as a primary surgical intervention may offer a phakic infant with glaucoma an excellent opportunity to achieve long-term control of IOP without medications and may be associated with optimal visual outcomes. *Ophthalmology 2015;■:1–7 © 2015 by the American Academy of Ophthalmology.*

Childhood glaucoma is an uncommon disorder characterized by elevated intraocular pressure (IOP)–related damage to the eye that can be caused by a diverse group of conditions. The ultimate therapeutic goal in children with glaucoma is to provide a lifetime of vision, for which successful control of IOP is crucial. Medical therapy plays an important role in controlling IOP, but the mainstay of treatment is surgery, which usually needs to be repeated.[1–4] Surgical intervention often is the case for glaucoma presenting in infancy, that is, within the first 2 years of life. The surgical procedure of choice is largely determined by the type of glaucoma and may be influenced further by factors such as corneal clarity and the surgeon's experience and practice. The outcomes and longevity of surgical interventions may have a significant impact on the future quality of life of both children and their families.[5]

Primary congenital glaucoma (PCG) is the most common glaucoma in infancy,[1,4] for which angle surgery (goniotomy or trabeculotomy) is widely regarded as the primary surgical intervention of choice[6] because of reported successful outcomes.[7–9] Poorer outcomes resulting from angle surgery usually are reported for secondary childhood glaucomas.[10,11] Traditionally, trabeculectomy was indicated after failed angle surgery. However, trabeculectomy in children is especially challenging as it is less successful when compared with outcomes in adults[12,13] because of a vigorous healing response.[14] This has necessitated the use of adjunctive antiscarring agents such as mitomycin C (MMC), but at the cost of an increased risk of potentially serious complications such as hypotony and bleb-related problems.[15–19] However, even with MMC, the literature suggests disappointing outcomes for trabeculectomy in infants

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(especially younger than 1 year) when compared with older children[15,16,18,20] and also when compared with glaucoma drainage devices (GDDs).[21] Glaucoma drainage devices in children carry a significant risk of tube-related problems such as tube−cornea touch in up to 26% cases[21−23] and tube migration or extrusion, often necessitating the need for further tube-related surgery in up to one third of cases.[3,21] Consequently, there is no consensus on the optimum surgery after failed angle surgery.[6]

Contemporary trabeculectomy technique involving fornix-based conjunctival dissection, releasable sutures, and a wide area of anti-scarring application (a technique often described as the Moorfields Safer Surgery System)[24,25] has evolved over the past 15 years with the aim of encouraging posterior aqueous flow and the development of diffuse drainage blebs. These changes were developed to reduce the high incidence of sight-threatening complications, particularly bleb-related problems, in children and subsequently applied to adult surgery.[26,27] The aim of this study therefore was to evaluate the long-term safety and effectiveness of this surgical technique in infants undergoing trabeculectomy within the first 2 years of life.

Methods

The protocol for this project was granted institutional review board approval by the Clinical Audit Assessment Committee of Moorfields Eye Hospital. A retrospective case note review was performed on the records of all children 2 years of age or younger who underwent MMC-augmented trabeculectomy by a single surgeon (M.P.) between May 2002 and November 2012. Some children underwent sequential surgery to both eyes, but no simultaneous bilateral surgery was performed. In these situations, each individual eye was regarded as a separate data entity for the purpose of analysis. All cases had a minimum of 12 months of follow-up.

Standard Surgical Technique

The surgical procedure involved the creation of a superior fornix-based conjunctival peritomy and a rectangular (5×4mm) lamellar scleral flap with a crescent blade at the 12-o'clock position. Because of the very elastic nature of the infantile sclera, only short radial cuts were made, which enabled tight closure without the need to suture the radial edge of the flap while also encouraging posterior aqueous flow. A wide area of subconjunctival space (approximately 3 clock hours) then was treated with MMC-soaked Merocel corneal shields (Beaver Visitec, Abingdon, UK), as was the undersurface of the scleral flap with a tear film strip (Sno-strips; Chauvin Pharmaceuticals Limited, Kingston-Upon-Thames, UK) cut to size. Mitomycin C was applied at concentrations varying between 0.1 and 0.5 mg/ml (at the surgeon's discretion, depending on risk factors for failure) for 3 minutes before irrigation with 20 ml balanced salt solution. Intralamellar scleral sutures using 10-0 nylon (Alcon, Camberley, UK), were pre-placed with a fixed suture at each corner and 2 releasable sutures at the posterior edge of the scleral flap. After insertion of an anterior chamber (AC) maintainer (Lewicky; Beaver Visitec), the AC was entered at the anterior edge of the scleral bed. A 500-μm sclerostomy was created with a Khaw Descemet membrane punch 7-101 (Duckworth & Kent, Baldock, UK), followed by a surgical iridectomy. Further sutures were placed in the scleral flap, only as required, with the aim of achieving no aqueous flow through the flap at the end of procedure. Tenonectomy was not performed. The conjunctiva was closed with 10-0 nylon sutures, and in most cases a small volume of viscoelastic (usually Provisc [Alcon]) and sterile air were injected into the AC. Subconjunctival injections of steroid (betamethasone) and antibiotic (cefuroxime) were administered at the end of the surgical procedure. All eyes were patched overnight.

After surgery, all patients received daily intensive steroid drops (dexamethasone 0.1%) every 2 to 3 hours and ointment at night (Maxitrol, Alcon Laboratories; dexamethasone, neomycin sulfate, and polymyxin B sulfate ointment). Topical steroids were weaned gradually over 3 to 5 months as dictated by the degree of conjunctival inflammation. Antibiotic drops (chloramphenicol) 4 times daily usually were stopped within 2 to 3 weeks after surgery after all exposed sutures were removed. Cycloplegics were not administered routinely. Parents were advised to tape a plastic shield over the operated eye at night for the first month after surgery.

Postoperative Management

All children were examined at 1 day, 1 week, 3 weeks, and 6 weeks after surgery, with subsequent outpatient visits dependent on clinical progress. Examination under anesthesia (EUA) with ketamine took place 1, 3, and 6 weeks after surgery when releasable sutures were loosened or removed and subconjunctival steroid, 5-fluorouracil (5-FU) injections (0.2−0.3 ml of 50-mg/ml solution), or both, were administered, depending on the characteristics of the bleb and the degree of bleb inflammation. Corneal diameter and axial length also were measured. Subsequently, additional glaucoma surgery was undertaken in eyes uncontrolled by glaucoma medications.

Visual acuity, IOP, slit-lamp biomicroscopy examining bleb morphology, AC depth, wound status, and lens clarity were measured or performed routinely along with evaluation of the optic nerve and retina at each postoperative visit. Quantitative visual acuity was measured when the child's age and developmental abilities allowed. Intraocular pressure measurements were obtained using either Perkins applanation tonometry under ketamine anesthesia, rebound tonometry (Icare; Helsinki, Finland), or Goldmann applanation tonometry as the children became older. Amblyopia was treated appropriately with refractive correction and a patching regimen.

Outcome Measures

Surgical success was defined as IOP of 21 mmHg or less and 5 mmHg or more either with (qualified success) or without (complete success) topical glaucoma medications, no further glaucoma surgery (including bleb needling, which was considered a failure), no devastating complications or the loss of light perception vision, and stable ocular dimensions (axial length, corneal diameter) and optic disc cupping. Manipulation of the scleral flap (bleb massage) and removal or adjustment of releasable sutures were not considered to be criteria for failure because these compose routine post-surgical care with the technique used. Complications and details of post-operative interventions after the initial trabeculectomy were noted.

Statistical Methods

Data analysis was performed using Graphpad Prism (San Diego, CA) software (Graphpad). Demographic data were reported as the mean ± standard error with the range specified. Surgical success was evaluated by Kaplan-Meier life table analysis. Survival curves between subgroups were compared using the log-rank (Mantel-Cox) test with the chi-square significance test. Parameters between the groups designated success and failure were compared using either a 2-tailed unpaired t test with Welch's correction or by a Mann−Whitney U test, depending on whether the populations fitted a Gaussian distribution as shown by the D'Agostino and