Management Patterns and Visual Outcomes of Endophthalmitis After Glaucoma Drainage Device Placement: A Case Series

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Purpose: To describe clinical presentation, management, and outcomes of eyes with endophthalmitis related to glaucoma drainage device (GDD) placement.

Patients and Methods: Retrospective chart review of patients diagnosed with GDD-related endophthalmitis at Duke Eye Center from 2009 to 2018.

Results: Six eyes of 6 patients had endophthalmitis related to a GDD (2 Ahmed, 4 Baerveldt). The mean time from surgery to presentation was 22.7 months. Five of 6 cases (83%) had culture-proven infectious endophthalmitis. Eyes undergoing GDD explantation (n = 2) had better visual acuity at 6 months compared with those without hardware removal (20/11,314 vs. 20/358). Visual acuity at 6 months was hand motion (20/8000) or worse in 3 of 6 cases (50%).

Conclusions: GDD-related endophthalmitis often leads to poor visual outcomes. Hardware removal may lead to improved visual outcomes; a multicenter prospective study assessing the benefit of hardware removal may be warranted.

Key Words: endophthalmitis, glaucoma, glaucoma drainage device, Ahmed, Baerveldt, ocular infection

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Endophthalmitis is a sight-threatening complication of intraocular surgery that is defined by a significant inflammatory response in the vitreous body. Endophthalmitis is often caused by pathogenic microbes, which may enter the eye following ocular trauma, surgery, or any other process that exposes the immune-privileged intraocular space to the outside environment. This severe condition must be recognized and treated promptly to minimize the chance of vision loss.

A glaucoma drainage implant (GDD) is indicated in certain patients with moderate to severe glaucoma in order to lower intraocular pressure (IOP). In GDD placement, a synthetic plate is placed underneath the conjunctiva with a tunneled tube tunneled into the anterior chamber or vitreous cavity to provide an alternative aqueous outflow pathway. Studies have demonstrated that GDDs confer decreased IOP in individuals with intractable glaucoma.1,2

The 2 major GDDs used today are the Ahmed glaucoma valve (New World Medical Inc.; Rancho Cucamonga, CA) and the Baerveldt glaucoma implant (Abbott Laboratories Inc.; Abbott Park, IL). There is a persistent risk of endophthalmitis in eyes that have undergone GDD placement.3–9 Eyes with implanted GDDs may develop late-onset endophthalmitis even years after surgery due to the presence of the tube shunt between the intraocular environment and the subconjunctival space. The tunneled tube may also erode through the overlying conjunctiva, which increases the likelihood of endophthalmitis and often necessitates repair with a conjunctival graft. Studies have shown that female sex, white race, younger age, and history of concomitant eye surgery may predispose to tube-related erosions.10–13 Endophthalmitis related to the presence of a GDD often results in poor visual outcomes and frequently necessitates removal of the device.1 To date, there has been limited prospective data to guide management of endophthalmitis related to a GDD.

The Endophthalmitis Vitrectomy Study (EVS) was a seminal prospective study that showed improved visual outcomes for endophthalmitis patients that underwent initial pars plana vitrectomy (PPV) if the presenting corrected visual acuity (VA) was light perception or worse.14 However, the EVS only evaluated cases of endophthalmitis following cataract surgery and secondary intraocular lens implantation. Unfortunately, similar prospective studies have not been performed for endophthalmitis due to other etiologies, including that related to GDDs. As a result, many physicians may extrapolate results from the EVS to guide treatment decisions in GDD-related endophthalmitis, however, guidelines for management and expected outcomes largely remain unclear.

This study aims to assess the clinical characteristics, treatment choices, and clinical outcomes in cases of endophthalmitis associated with GDDs at a tertiary academic medical center over a 9-year period.

PATIENTS AND METHODS

Prior approval for this study (Pro00091062) was obtained from the Duke University Health System Institutional Review Board and the requirement for informed consent was waived. This study complied with the Health Insurance Portability and Accountability Act of 1996 and followed the tenets of the Declaration of Helsinki.

Patient Identification and Data Collection

Patients presenting to the Duke University Eye Center between January 1, 2009 and January 1, 2018 with a diagnosis of endophthalmitis related to a GDD were identified through chart review of all patients evaluated for endophthalmitis following cataract surgery or glaucoma drainage device placement. Of the 24 cases of endophthalmitis evaluated (16 with GDD and 8 with cataract surgery), 6 (25%) were identified as GDD-related endophthalmitis. This study excluded misdiagnosed cases of endophthalmitis or patients who underw
of endophthalmitis due to GDD placement were identified using the Duke Enterprise Data Unified Content Explorer (DEDUCE, Duke University Health System). Included patients were at least 18 years of age and had at least 6 months of follow-up from initial presentation. These eyes had no history of trauma or cataract surgery within 3 months before presentation with endophthalmitis. IOP and VA before endophthalmitis were assessed. In addition, we evaluated patient presentation, treatment decisions, microbiologic culture yield, and visual outcomes.

Statistical analyses were performed using XLSTAT (Addinsoft, Paris). Descriptive statistics were performed to describe baseline characteristics.

**RESULTS**

Over the 9-year study period, 133 eyes of 133 patients were identified that had a diagnosis of endophthalmitis and 6-month follow-up. Of these 133 eyes, 6 eyes of 6 patients had developed GDD-related endophthalmitis based on initial clinical examination and assessment by an experienced retina specialist. Of the 1896 tube shunt surgeries performed at our institution over the same 9-year period, 2 patients developed GDD-related endophthalmitis. The other 4 patients with GDD-related endophthalmitis in our series of 6 had their initial tube shunt surgery at other institutions and were referred to our institution for management after primary tube exposure and vitreous opacities were noted. The mean follow-up for the 6 eyes after initial presentation was 2.84 years. All cases received intravitreal antimicrobials following initial diagnostic testing with aqueous tap, needle vitreous tap, and/or PPV with mechanical vitreous biopsy.

For the 6 eyes with GDD-related endophthalmitis, 67% were right eyes, 67% were female, mean age was 66 (range, 45 to 81 y), and mean time from surgery to presentation was 22.7 months (SD ± 21.1 mo). Five of 6 eyes (83%) had endophthalmitis at least 6 months after initial GDD placement. All 6 patients developed endophthalmitis in the setting of primary tube exposure.

Four eyes had open angle glaucoma at baseline, 1 eye had juvenile glaucoma and 1 eye had uveitic glaucoma. Two eyes had Ahmed glaucoma valves and 4 eyes had Baerveldt GDDs. Of the 4 Baerveldt devices, 3 were the larger 350 mm² model and 1 was the smaller 250 mm² model. Five of 6 devices were placed superotemporally and 1 device (Baerveldt 350 mm²) was placed inferonasally. All 6 eyes received a scleral patch graft at the time of initial surgery (Supplemental Table 1, Supplemental Digital Content 1, http://links.lww.com/IJG/A459).

Two eyes (33%) had elevated IOP on presentation (>21 mm Hg) and 2 eyes (33%) had decreased IOP on presentation (<9 mm Hg) with endophthalmitis. Hypopyon was observed in 4 of 6 eyes (67%). All patients received intravitreal vancomycin (1 mg/0.1 mL) and ceftazidime (2.25 mg/0.1 mL) on the day of presentation. For diagnosis, 3 eyes (50%) underwent aqueous tap, 3 eyes (50%) underwent needle vitreous tap (2 were “dry” and did not yield adequate sample for microbiologic processing), and 4 eyes (67%) underwent PPV on presentation. Two of 6 eyes (33%) underwent GDD removal at the time of initial PPV. No eyes underwent subsequent PPV for persistent endophthalmitis. One of 2 aqueous taps (50%), 1 nondry needle vitreous tap (100%), and 3 of 4 PPV specimens (75%) yielded a positive microbiologic culture. Of the 5 culture-positive cases, *Streptococcus pneumoniae* was identified in 2 cases, *Haemophilus influenzae* was identified in 2 cases, and coagulase-negative *Staphylococcus* was identified in 1 case.

At the most recent visit before developing endophthalmitis, mean VA for these 6 eyes was 20/2125 and mean IOP was 10.3 mm Hg. Mean VA on presentation with endophthalmitis was 20/10,079, and 5 of 6 cases had hand motion vision (defined as 20/80000) or worse. Mean IOP at presentation with endophthalmitis was 14.0. At 6 months, mean VA was 20/3578, with a mean improvement of ~4.5 Early Treatment Diabetic Retinopathy Study (ETDRS) lines. At 6 months, VA was hand motion or worse in 3 of 6 cases (50%). Of these, 1 eye had light perception only (20/16,000), and 1 eye had no light perception (20/32,000). VA at 6 months was better in those that underwent hardware removal compared with those that did not (20/358 vs. 20/11,314).

After resolution of endophthalmitis, the 2 eyes which underwent hardware removal had repeat tube shunt surgery without incident, and IOP was well-controlled in these 2 eyes during the study period. Of the other 4 eyes, 2 eyes discontinued treatment due to poor visual outcomes (1 no light perception, 1 phthisical), and 2 eyes had no additional glaucoma surgery over the study period (IOP well-controlled with prior tube and drops).

**DISCUSSION**

The management of endophthalmitis unrelated to cataract surgery or secondary intraocular lens implantation is not well established. In our cohort of GDD-related endophthalmitis, all eyes received intravitreal vancomycin and ceftazidime for broad-spectrum antimicrobial coverage, and at least 1 diagnostic procedure was performed for microbiologic identification. Vitreous tap and injection of antimicrobials are commonly performed in the management of endophthalmitis.9 However, in GDD-related endophthalmitis, vision loss is often profound, and initial PPV or hardware removal is often considered.8,9

In our cohort, the 4 eyes that underwent initial PPV had VA of 20/8000 (1 eye) or 20/16,000 (3 eyes). Due to the retrospective nature of our study, we are unable to determine whether patients who received initial PPV would have had significantly worse VA at 6 months without this intervention. In addition, we do not have similar eyes with presenting VA between 20/8000 and 20/16,000 that did not undergo PPV for outcome comparison.

Primary tube erosion may be a predisposing risk factor for GDD-related endophthalmitis. In our cohort, 6 of 6 eyes presented with tube-related endophthalmitis in the setting of primary tube exposure due to erosion through the overlying conjunctiva. Future studies should assess potential risk factors for tube erosion in a large cohort to develop best practices for prevention of tube erosion and the eventual complication of GDD-related endophthalmitis.

Previous studies have suggested that early hardware removal in GDD-related endophthalmitis may confer improved long-term visual outcomes.8,9 Eyes in our cohort that underwent hardware removal had significantly better VA at 6 months. This finding is limited by our small sample size; however, it is meaningful in that it corresponds with existing evidence that hardware removal may lead to improved visual outcomes.

Limitations of this study include its retrospective nature and small sample size. Future directions for research should include larger retrospective data sets, case-control studies, or multi-institutional prospective trials in order to establish more robust clinical guidelines and delineate expected outcomes in the management of GDD-related
endophthalmitis. Prospective trials assessing the impact of hardware removal on visual outcomes would be beneficial.

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