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Diplopia in Medically and Surgically Treated Patients with Glaucoma

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Purpose: To report the prevalence, type, and cause of diplopia in medically and surgically treated patients with glaucoma.

Design: Cohort study.

Participants: A total of 195 adult patients with glaucoma treated in a glaucoma referral practice.

Methods: A total of 195 adult patients with glaucoma who had undergone surgical or medical management were prospectively enrolled. Forty-seven patients had undergone glaucoma drainage device (GDD) surgery (Baerveldt 350, Baerveldt 250 [Abbott Medical Optics, Abbott Park, IL], or Ahmed FP7 [New World Medical Inc, Rancho Cucamonga, CA]), 61 patients had undergone trabeculectomy, and 87 patients were medically treated. All patients completed the Diplopia Questionnaire to assess diplopia. We defined the presence of diplopia as "sometimes," "often," or "always" in distance straight ahead or reading positions on the Diplopia Questionnaire. A chart review was performed jointly by a strabismus specialist and a glaucoma subspecialist to characterize the type and cause of the diplopia.

Main Outcome Measures: Frequency, type, and cause of diplopia.

Results: Diplopia was reported in 41 of 195 medically and surgically treated patients (21%) with glaucoma. Binocular diplopia due to the glaucoma procedure was present in 11 of 47 patients (23%) after GDD (95% confidence interval, 12−38), which was significantly greater than in patients after trabeculectomy (2/61 [3%]; 95% confidence interval, 0.4−11; $P = 0.002$). The most common type of strabismus associated with binocular diplopia due to glaucoma surgery was hypertropia (10/11 GDD cases, 2/2 trabeculectomy cases). Monocular diplopia was found in a similar proportion of medically treated, post-trabeculectomy, and post-GDD cases (4/87 [5%], 4/61 [7%], and 2/47 [4%], respectively). Binocular diplopia not due to surgery was found in similar proportions of GDD, trabeculectomy, and medically treated cases (3/47 [6%], 5/61 [8%], and 10/87 [11%], respectively).

Conclusions: Diplopia may be under-recognized in medically and surgically treated patients with glaucoma, and standardization of ascertaining patient symptoms using the Diplopia Questionnaire may be useful in these patients. Diplopia was more commonly seen after GDD than trabeculectomy, typically a noncomitant restrictive hypertropia. The prevalence of monocular diplopia and binocular diplopia unrelated to glaucoma surgery was similar among medical and surgical groups. It is important to counsel patients on the higher occurrence of diplopia associated with GDD surgery. *Ophthalmology 2016;■:1−6 © 2016 by the American Academy of Ophthalmology*

Diplopia has been reported as a complication of glaucoma treatment[1−12] but has not been rigorously studied across the spectrum of medically and surgically treated patients with glaucoma, nor has it been assessed prospectively with an instrument specifically designed to assess diplopia. The Diplopia Questionnaire[13] was specifically designed as a patient-reported outcome measure to assess symptoms of diplopia in specific gaze positions and has been used as an outcome measure for previous studies.[14−16]

The purpose of our prospective study was to report the prevalence of diplopia and describe its causes after glaucoma drainage device (GDD) surgery, trabeculectomy, and medical treatment in patients with glaucoma, and to characterize the specific types and causes of diplopia.

Methods

Approval was obtained from the Institutional Review Board of Mayo Clinic, Rochester, Minnesota, and each patient gave informed consent before participating. All procedures and data collection were conducted in a manner compliant with the Health Insurance Portability and Accountability Act.

Patients

Over an 8-month period (August 2014 to April 2015), 108 patients with glaucoma who underwent surgery were prospectively enrolled at a regularly scheduled follow-up glaucoma visit, which was their most recent follow-up examination. Eighty-seven medically treated patients were consecutively enrolled during the same time period. Patients were classified as GDD (N = 47), trabeculectomy (N = 61), or medically treated (N = 87). Surgical patients were enrolled only if it had been at least 1 month after glaucoma surgery. In the surgical groups, patients with multiple tubes (N = 10), previous cataract or failed glaucoma surgery, scleral buckle (N = 4), penetrating keratoplasty (N = 4), or Descemet's stripping endothelial keratoplasty (DSEK) (N = 4) were not excluded. Some of the surgically treated patients (N = 108) had been treated by other and multiple ophthalmologists. Medically treated patients consisted of patients who received neither tube nor trabeculectomy for their

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glaucoma, but included patients who had underwent selective laser trabeculoplasty, trabectome, iStent (Glaukos, San Clemente, CA), or cataract surgery. Patients were not recruited if they could not read or understand English or if they had severe cognitive impairment prohibiting completion of surveys.

In regard to the type and number of GDDs, 35 patients had a Baerveldt (Abbott Medical Optics, Abbott Park, IL) (consisting of 29 Baerveldt 350, 3 Baerveldt 250, and 3 Baerveldt unspecified) and 16 patients had an Ahmed FP7 (New World Medical Inc, Rancho Cucamonga, CA). In regard to the laterality of GDDs, 23 patients had a unilateral Baerveldt 350, 4 patients had a bilateral Baerveldt 350, 2 patients had a bilateral Ahmed/unilateral Baerveldt unspecified, 2 patients had a unilateral Ahmed and unilateral Baerveldt unspecified, 3 patients had a unilateral Baerveldt 250, 1 patient had a unilateral Baerveldt unspecified, 10 patients had a unilateral FP7 Ahmed, and 2 patients had bilateral Ahmed devices.

In regard to plate location of the GDDs, 45 of 47 patients had GDD in the superior temporal quadrant. Two patients had the GDD placed in other quadrants; 1 had a right inferior nasal GDD (with left superior temporal GDD), and 1 had an inferior temporal GDD.

Diplopia Assessment by Diplopia Questionnaire

The Diplopia Questionnaire assesses diplopia by asking whether the patient has experienced double vision during the past week in each position of gaze (reading, distance straight ahead, right, left, down, and up) and asks the patient to indicate the frequency of diplopia in each position as "never," "rarely," "sometimes," "often," or "always." Because diplopia in distance and straight ahead or reading positions has the most profound effect on health-related quality of life,[13] we defined diplopia as experiencing symptoms of diplopia within the past week with a frequency of "sometimes," "often," or "always" specifically in distance straight ahead or reading positions. Patients wearing prism at the time of Diplopia Questionnaire assessment (3 GDD, 4 trabeculectomy, and 7 medically treated) were counted as diplopic because without prism they would have had diplopia, and the cause of that diplopia was evaluated as described next.

Evaluation of Cause and Type of Diplopia

A glaucoma specialist (C.L.K.) and a strabismus specialist (J.M.H.) determined the type and cause of diplopia by joint review of the entire medical record with specific attention to the characteristics and the time course of diplopia and strabismus. Measurements of strabismus (simultaneous prism and cover test and prism and alternate cover tests) had been recorded as part of routine care, and these measurements along with all historical data were reviewed to assign the cause of diplopia. On chart review, the location of the GDD also was noted. Additional data extracted from the medical record were patient demographics (i.e., age, sex, race), comorbidities, and operative characteristics (e.g., laterality, type of tube, preexisting strabismus/diplopia). Diplopia was classified as 1 of 3 primary types: binocular diplopia due to glaucoma surgery, binocular diplopia not due to glaucoma surgery, and monocular diplopia. A judgment was made on the basis of the joint review of the entire medical record as to whether the diplopia was caused by or exacerbated by the glaucoma procedure or was preexisting.

Statistical Analysis

Patient demographics and clinical data (visual acuity, mean deviation, age, race, gender) were compared among medical, trabeculectomy, and GDD groups using analysis of variance for continuous data or the Fisher exact test for dichotomous data. Frequency and type of diplopia were compared between groups using the Fisher exact test.

Results

Patient Demographics

Patient demographics (age, gender, race/ethnicity) were similar across the 3 groups (Table 1), with the exception of the median time from surgery to evaluation of diplopia, which was longer in the trabeculectomy group (17 months; range, 1 month to 19 years) compared with the GDD group (9 months; range, 1 month to 9 years; $P = 0.03$) (Table 1).

Table 1. Patient Demographics Based on Glaucoma Treatment

	Treatment Group		
	GDD (N = 47)	*Trabeculectomy (N = 61)*	*Medically Treated (N = 87)*
Age, yrs (mean ± SD)	66±17	74±9	69±13
Gender, no. (%)			
Male	20 (43%)	27 (44%)	28 (32%)
Female	27 (57%)	34 (56%)	59 (68%)
Race, no. (%)			
White	44 (94%)	59 (96%)	84 (97%)
African American	1 (2%)	1 (2%)	0 (0%)
Asian	0 (0%)	1 (2%)	2 (2%)
Native American	1 (2%)	0 (0%)	0 (0%)
Unknown	1 (2%)	0 (0%)	1 (1%)
Months from surgery to completing questionnaires, median (range)	9 (1–113)	17 (1–229)	N/A
Visual acuity, median (range)			
Best eye	20/30 (20/20–20/400)	20/30 (20/20–20/63)	20/25 (20/15–20/63)
Worst eye	20/80 (20/25 to LP)	20/50 (20/20 to LP)	20/30 (20/20 to HM)
Deviation: (dB), median (range)			
Best eye	−4 (−29 to 3)	−3 (−24 to 3)	−1 (−29 to 3)
Worst eye	−20 (−32 to −3)	−14 (−32 to 1)	−4 (−31 to 2)

dB = decibels; GDD = glaucoma drainage device; HM = hand motions; LP = light perception; N/A = not applicable; SD = standard deviation.