Endoscopic cyclophotocoagulation (ECP) for childhood glaucoma: a large single-center cohort experience

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PURPOSE To assess the factors associated with successful outcomes in the management of childhood glaucoma treated with endoscopic cyclophotocoagulation (ECP) as both primary and adjunctive surgery.

METHODS The medical records of consecutive children with glaucoma treated by a single surgeon at a single center over a 17-year period using ECP procedures were reviewed retrospectively. Treatment failure was defined as (1) intraocular pressure (IOP) >24 mm Hg at two consecutive examinations despite maximal medical treatment, (2) any additional glaucoma surgery, (3) sight-threatening complications, or (4) progression to no light perception visual acuity. Success was defined as the absence of treatment failure.

RESULTS A total of 107 ECP procedures on 80 eyes of 70 children were included. Glaucoma diagnoses included: following-cataract-surgery (60%), anterior segment dysgenesis (13%), primary congenital (9%), and other (19%). Most eyes (67 [84%]) had prior glaucoma surgery, and 73 (91%) were aphakic or pseudophakic at first ECP. Median follow-up was 2.2 years (IQR, 1.1-3.5) after initial ECP; mean number of ECP treatments per eye was 1.3 (range, 1-3). Success for a single ECP treatment at 1, 3, and 5 years (Kaplan-Meier analysis) was 64% (95% CI, 54-76), 36% (26-50), and 16% (7-37), respectively. Cumulative success (≥1 ECP) at 5 years was 34% (23-50). In multivariable analysis, of many risk factors considered, only a preoperative IOP of <32 mm Hg was significantly associated with treatment success.

CONCLUSIONS ECP represents a modestly effective long-term therapy for childhood glaucoma and may be most successful in patients with preoperative IOP of <32 mm Hg. (J AAPOS 2019;23:84.e1-7)

Childhood glaucoma accounts for 2%-13% of blindness in children[1,2] and includes both primary and secondary diseases.[3,4] For cases unresponsive to medical management and that fail or cannot undergo angle surgery, the remaining treatment options include trabeculectomy, glaucoma drainage device (GDD) surgery, and cycloablation. More invasive surgical interventions carry significant risk of procedural complications, such as bleb-related infection after trabeculectomy, and tube- or plate-related complications, including ocular motility problems after GDD surgery.[5]

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Although most glaucoma procedures aim to improve aqueous outflow, only cycloablation decreases aqueous production by targeting the ciliary processes.[4] External approaches to ciliary body destruction, though technically easier, lack accuracy in targeting the desired tissue and cause more structural damage.[6] Unlike cyclocryotherapy and transscleral cyclophotocoagulation, endoscopic cyclophotocoagulation (ECP) offers direct visualization of the ciliary processes, thereby allowing more accurate laser delivery, localization of the ciliary processes in cases of abnormal anatomy, and reduced total energy delivery.[7-9]

ECP has been studied as both a primary surgical procedure and in combination with other surgeries. Case series are small, with success rates ranging from 17% to 62%.[7-13] Factors associated with enhanced or diminished success from ECP have remained elusive in the pediatric population, with severe anterior segment abnormalities cited as a possible risk for poorer success.[9] Across all studies, complication rates for ECP are relatively low and related largely to inflammation, although rare but devastating complications have occurred, including retinal detachment and chronic hypotony.[11,13,14] The purpose of the present study was to assess the success, complications, and factors associated with favorable

outcomes from ECP in a large cohort of childhood glaucoma cases performed at a single referral center under one attending surgeon.

Subjects and Methods

With approval of the Duke University Health System Institutional Review Board, we retrospectively reviewed the medical records of all children who underwent ECP at Duke University Eye Center under a single attending surgeon (SFF) from December 1999 to December 2017. Our cohort was identified through an automated electronic medical record query by the Duke Enterprise Data Unified Content Explorer platform. Inclusion criteria were clearly defined childhood-onset glaucoma, age <23 years, and minimum 3 months' follow-up. ECP was performed when intraocular pressure (IOP) was clinically uncontrolled (as determined by the attending physician). Treatment failure was defined as (1) IOP >24 mm Hg on two consecutive visits despite maximal medical therapy, (2) any additional glaucoma surgery, (3) sight-threatening complications, or (4) progression to no light perception (NLP) visual acuity. Treatment was considered successful if none of the failure criteria was met during the follow-up period. Since ECP was performed conservatively at the first session to reduce the risk of hypotony, we separately analyzed our outcomes for one or more sequential ECP sessions, where additional sequential ECP treatments did not constitute failure.

All procedures were performed under general anesthesia using the microendoscope (Endo Optiks Inc, Little Silver, NJ) to perform ECP. Depending on the desired approach, a 19-gauge microvitreoretinal blade was used to enter either the posterior surgical limbus or pars plana. Using a setting of 100–300 mW (usually 150) on continuous mode, visible, untreated ciliary processes were treated to produce gradual blanching and shrinkage of the entire ciliary process, including the pars plicata "tail." Generally, eyes with preexisting GDD underwent 6 clock hours of treatment; otherwise, 9 clock hours were ablated, including processes treated with prior external cycloablation. A detailed description of our standard surgical technique has been reported elsewhere.[9] Patients were examined postoperatively at 1 day, 1 week, 1 month, 3 months, and every 3-4 months (or more often) thereafter, as needed.

Data compiled for analysis included patient age at ECP, sex, laterality, glaucoma diagnosis, prior surgical procedures, pre- and postoperative IOP, number of glaucoma medications, and visual acuity. Procedure-related data included the number of clock hours treated, surgeries after treatment failure, complications, and length of follow-up. Follow-up was recorded from first ECP to time of failure or until the last visit for the successes. IOP measurements were obtained either in clinic immediately preceding surgery or in the operating room using Goldmann applanation (clinic only), pneumatonometry (Paradigm Medical Industries, Salt Lake City, UT), Icare rebound tonometry (TA01i, Tiolat Oy, Helsinki, Finland) (clinic only), or the Tonopen (Mentor Inc, Norwell, MA). When available, Goldmann applanation IOP measurements were preferred. When multiple IOP values were recorded, the average value was used for analysis.

Demographic data are reported for the entire cohort at time of first ECP. The cohort was subsequently examined for differential patient factors pre- and post-ECP. Paired *t* tests were performed to ascertain the objective changes associated with ECP. The cohort was then stratified by response to one or more ECP treatments. Kaplan-Meier estimates of survival to the composite treatment failure endpoint were constructed following a single primary ECP treatment, and following ≥1 ECP treatments.

To identify factors associated with treatment failure, univariate Cox proportional-hazards models were constructed for clinically significant factors as well as those identified in the review of demographic characteristics. Factors with a *P* value of <0.5 were selected for inclusion in a multivariable cox proportional hazards model. Data are presented as the mean with standard deviation (or median with range or IQR) unless otherwise stated. Analyses were performed using R version 3.4.1 (R Core Team, Vienna, Austria) with a *P* value <0.05 indicating statistical significance.

Results

A total of 80 eyes of 70 patients were included in the final analysis. Mean patient age was 9.5 ± 6.0 years (range, 0.2 to 22.9); 7 patients were >18 years at initial ECP. Median follow-up time was 2.2 years (IQR, 1.1-3.5). Preoperative patient characteristics are given in Table 1. Ten patients were treated bilaterally. Most eyes (67 [83%]) had prior glaucoma surgery. The most common glaucoma diagnoses were glaucoma following cataract surgery (60%), anterior segment dysgenesis (13%), and primary congenital glaucoma (9%). The majority of eyes were aphakic (45 [56%]) or pseudophakic (28 [35%]). Corneal pathology obscured the visual axis in 33 eyes (42%). Thirty-two percent of surgeries were performed concurrently with other ocular surgeries (Table 2).

Kaplan-Meier survival analysis after a single ECP (Figure 1) demonstrated a median time to failure of 2.0 years. The number of clock hours treated at first ECP was 7.0 ± 1.4. Twenty-three eyes (29%) received more than 1 ECP treatment, with 4 eyes (5%) undergoing ECP 3 times (mean, 1.3 ECP treatments). Kaplan-Meier survival analysis after 1-3 ECP treatments showed improved success, with median time to failure 2.9 years; 1-, 3-, and 5-year success (95% CI) was 81% (73%-90%), 49% (38%-62%), and 34% (23%-50%).

The majority of eyes that failed because of inadequate IOP control underwent GDD placement (n = 29), tube revision (n = 2), or bleb needling (n = 1). Four eyes underwent additional ECP, but these treatments had inadequate follow-up and were considered failures. Complications were noted in 8 eyes (Table 3), 4 of which would have failed because of inadequate IOP and required additional surgery. Of the remaining 4 eyes, only 1 complication seemed procedure-related; the other 3 were felt to be disease-related complications. There were no cases of hypotony or severe persistent inflammation related to ECP.

Mean baseline IOP was reduced from 30.8 ± 7.9 mm Hg before ECP to 24.4 ± 10.7 mm Hg after more than 1 ECP

Table 1. Patient and eye characteristics at first endoscopic cyclophotocoagulation (ECP) surgery

Characteristic	Value[a]
Patients	70
Age at first ECP, years, mean ± SD	9.5 ± 6.0
Sex	
Female	32 (45.7)
Male	38 (54.3)
Eyes	80
Right eyes	42 (52.5)
Left eyes	38 (47.5)
Prior glaucoma drainage device (GDD)	
No	26 (32.5)
Yes	54 (67.5)
Prior cycloablative procedure (excluding ECP)	
No	66 (82.5)
Yes	14 (17.5)
Any prior glaucoma surgery (excluding ECP)[b]	
No	13 (16.2)
Yes	67 (83.8)
Glaucoma type	
Glaucoma following cataract surgery	48 (60.0)
Anterior segment dysgenesis	10 (12.5)
Primary congenital glaucoma	7 (8.8)
Lowe syndrome	5 (6.2)
Microspherophakia	3 (3.8)
Persistent fetal vasculature	2 (2.5)
Axenfeld-Rieger syndrome	2 (2.5)
Other[c]	3 (3.8)
Cornea	
Clear	44 (55.0)
Clinically significant corneal opacity[d]	33 (41.2)
Unknown	3 (3.8)
Lens status at time of surgery	
Aphakic	42 (52.5)
Congenital aphakia	3 (3.8)
Phakic	7 (8.8)
Pseudophakic	28 (35.0)
Total number of ECP procedures	107
No. of ECP sessions, mean	1.3 (1-3)
Follow-up, years, median	2.2 (1.1-3.5)

	Pre-op	Post-op	*P* value
Visual acuity			
LogMAR	1.01 ± 0.59	1.05 ± 0.66	0.23
Snellen	20/204	20/222	
IOP, mm Hg	30.8 ± 7.9	24.4 ± 10.7	<0.0000002

GDD, glaucoma drainage device; *IOP*, intraocular pressure; *IQR*, interquartile range (25th percentile, 75th percentile); *SD*, standard deviation.
[a]Parenthetical values are percent, range, or IQR.
[b]Including cycloablation (except ECP), trabeculotomy, goniotomy, trabeculectomy, and GDD.
[c]Other: trauma (1 eye), retinopathy of prematurity (1 eye), and Sturge-Weber (1 eye).
[d]Clinically significant opacity: significant corneal haze or edema, central corneal scar, severe Haab striae, neovascularization of the cornea, band keratopathy, other central opacification.

Table 2. Concurrent procedures performed with ECP, by eye

Concurrent surgeries	N
Anterior vitrectomy only	63
PPV	10
Bleb needling	6
EDTA chelation	2
GDD removal ± PPV	2
Pupillary membrane removal ± PPV	4
GDD tube trimming ± PPV	3
Strabismus surgery	2
Lensectomy	3
Lensectomy + IOL insertion	5
Lensectomy + IOL insertion + bleb needling	1
Lensectomy + IOL insertion + GDD tube trimming	1
Lensectomy + tube trimming	1
Peripheral iridectomy	1
PPV + posterior capsulotomy	1
Tarsorrhaphy + conjunctival autograft	1
Repair of corneal perforation + Gunderson flap	1

ECP, endoscopic cyclophotocoagulation; *GDD*, glaucoma drainage device; IOL, intraocular lens; *PPV*, pars plana vitrectomy.

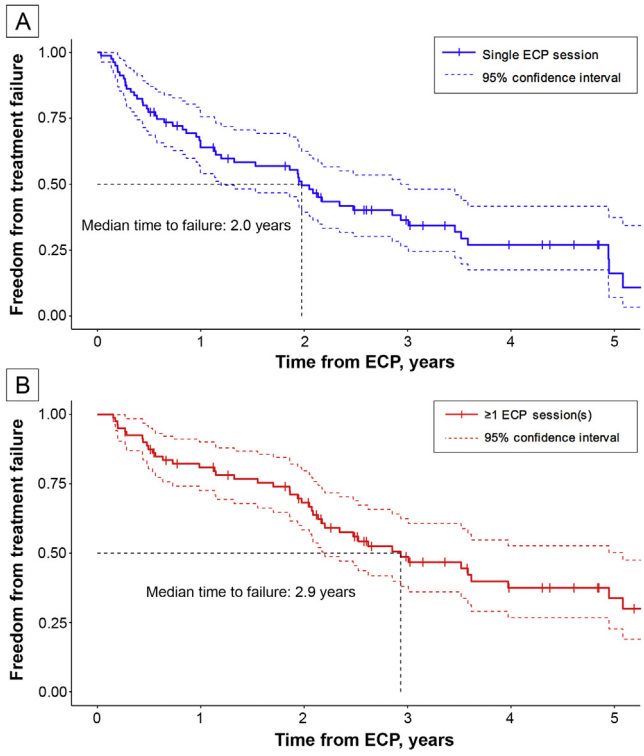

FIG 1. Kaplan-Meier survival curve and survival analysis showing success after a single endoscopic cyclophotocoagulation (ECP) session (A) and after more than 1 ECP session (B). The success rate at 1 year was 81%; at year 3, 49%; and at year 5, 34%.

treatment ($P < 0.0000002$), with final IOPs taken at either the last follow-up examination or at time of failure (Table 1). This represents an overall IOP reduction of 19%. Vision remained stable over the course of the study, with mean baseline vision of 20/204 (LogMAR 1.01) and mean vision at last follow-up of 20/222 (LogMAR 1.05; $P = 0.23$). Poor vision precluded optotype visual acuity in 6 eyes preoperatively and 9 eyes at last follow-up. Young age precluded optotype testing in 23 eyes preoperatively and 9 eyes at last follow-up.

Table 3. Serious complications after endoscopic cyclophotocoagulation (ECP), by eye

Number	Considered failure	Complication	Details
1	Yes	Progression to NLP	VA, 20/400 pre-op; patient lost to follow-up for 2 years after ECP; when next examined, VA was NLP and IOP was uncontrolled (38 mm Hg)
2	Yes	Progression to NLP	Wince to light pre-op vision, progressed to NLP 2 years after 3rd ECP, no evidence of phthisis (IOP, 9 mm Hg)
3	Yes	Progression to NLP	Fix and follow vision pre-op, light perception VA until post-op year 2, when VA declined to NLP and IOP poorly controlled (29 mm Hg)
4	Yes	Progression of exposure keratopathy	Pre-op exposure keratopathy with progression and need for near complete tarsorrhaphy, unable to obtain IOP, likely unrelated to ECP treatment
5	No	Macula-on RD	Noted at post-op month 3 requiring repair; VA 7 years after repair, 20/70; ultimately required GDD for IOP control (final IOP, 22 mm Hg, failed ECP)
6	Yes	Macula-off RD	Fix-and-follow pre-op VA; RD at post-op month 1 requiring repair; VA at post-op year 6, light perception; IOP at time of failure, 8 mm Hg
7	Yes	Enucleation	Ruptured globe at birth; eye developed repeat ruptured globe due to corneal melt and required enucleation; IOP prior to enucleation, 13 mm Hg
8	Yes	VH/high IOP	Uncontrolled IOP (52.3 mm Hg) after a dense VH occurring >2 years after ECP and likely unrelated to ECP treatment

GDD, glaucoma drainage device; *IOP*, intraocular pressure; *NLP*, no light perception; *RD*, retinal detachment; *VA*, visual acuity; VH, vitreous hemorrhage.

The characteristics of successfully and unsuccessfully treated eyes following ≥1 ECP treatments are summarized in Table 4. Age, sex, surgical approach, lens status, corneal status, prior cycloablation, and GDDs were similar between the successfully and unsuccessfully treated eyes. Significant differences were found in the both the preoperative IOP and the IOP at failure or last follow-up. Mean clock hours of ECP treatment at first ECP (7 ± 1.4) was similar between both groups.

Unadjusted hazard ratios for age, sex, lens status, clock hours ablated, preoperative vision, corneal status, prior surgeries, and surgical approach were not associated with success (Table 5). Variables with P values of ≤0.5 were included in the multivariable regression model. Preoperative IOP as a continuous variable was significant in univariate analysis and in the multivariable model. For clinical utility and interpretability, IOP was treated as a categorical variable of greater or less than 32 mm Hg, which was also significant in the multivariable model. The results of the multivariable regression model are shown in Figure 2. After adjustment, only preoperative IOP of <32 mm Hg was associated with survival (HR, 2.95; $P = 0.001$).

Discussion

In a mixed population of eyes with childhood glaucoma, success rates for single ECP at 1, 3, and 5 years were 64%, 36%, and only 16%, respectively, with a median time to failure of 2.0 years. Allowing additional sequential ECP, as is routinely performed in our clinical practice, improved 1-, 3-, and 5-year success to 81%, 49%, and 34%, with a median time to failure of 2.9 years. These rates are comparable to prior published studies.[11-13] Plager and Neely[12] reported a 50% success rate of ECP eyes with refractory aphakic or primary congenital glaucoma. Their follow-up study[11] included 36 eyes with a median time to failure after initial ECP of about 12 months. Although 1-, 3- and 5-year success rates were not reported, the success rate of single ECP was 34% and improved to 43% after additional treatments. Reported severe complications were rare (4/36 eyes) and included retinal detachment, visual loss, hypotony, and phthisis. We similarly observed few complications, the most common of which was progression to visual acuity of no light perception (n = 3) and retinal detachment (n = 2). There were single cases of worsening exposure keratopathy (1), enucleation (1), and vitreous hemorrhage (1), which were not felt to be attributable to ECP.

Subsequent studies assessed factors that might lead to more or less favorable outcomes with ECP. Carter and colleagues[10] evaluated longer-term results of ECP in aphakic and pseudophakic eyes (n = 26) of the 36 eyes originally described by Neely and colleagues,[11] of which 82% underwent ECP as a primary surgical procedure.[10] In aphakic and pseudophakic eyes, the median time to failure for the first treatment was 25.8 months and, after the second treatment, 11.9 months, with a cumulative success rate after 1 or more ECP treatments of 53%.[10] This is qualitatively better (though no statistical analysis was performed) than the 43% success rate for all eyes, which was initially reported.[11] Of note, the original study by Plager and colleagues[12] had a stricter definition of failure (>21 mm Hg vs >24 mm Hg used by Carter and colleagues) and found an equal number of aphakic eyes in the success and failure groups. More recently, Cantor and colleagues[13] published on the long-term efficacy of ECP in the management of glaucoma

Table 4. Characteristics of eyes treated successfully and unsuccessfully (failure) following one or more ECP procedures and comparison of pre- and postoperative VA and IOP

	Success,[a] no.	Failure,[a] no.	*P* value
Eyes	36	44	
Age, years, mean ± SD	10.9 ± 6.2	8.4 ± 5.5	0.06
Sex			
Female	15 (41.7)	20 (45.5)	0.80
Male	21 (58.3)	24 (54.5)	
Lens status			
Aphakic (surgically)	15 (41.7)	27 (61.4)	0.29
Congenitally aphakic	2 (5.6)	1 (2.3)	
Phakic	3 (8.3)	4 (9.1)	
Pseudophakic	16 (44.4)	12 (27.3)	
Cornea			
Clear	17 (47.2)	27 (61.4)	0.07
Significant corneal disease	19 (52.8)	14 (31.8)	
Prior cycloablative procedure (excluding ECP)			
No	31 (86.1)	35 (79.5)	0.64
Yes	5 (13.9)	9 (20.5)	
Prior GDD			
No	10 (27.8)	16 (36.4)	0.56
Yes	26 (72.2)	28 (63.6)	
Any prior glaucoma surgery[b]			
No	5 (13.9)	8 (18.2)	0.83
Yes	31 (86.1)	36 (81.8)	
Surgical approach to ECP			
Anterior	15 (41.7)	16 (36.4)	0.80
Pars plana	21 (58.3)	28 (63.6)	
No. of clock hours treated, mean ± SD	6.9 ± 1.3	7.0 (1.6)	0.59
IOP, mm Hg, mean ± SD			
Pre-treatment	28.0 ± 7.3	33.0 ± 7.8	0.005
Final	16.0 ± 3.6	31.2 ± 9.6	<0.001
Follow-up time, years, median	2.8 (2.0-4.7)	1.9 (0.6-2.5)[c]	

ECP, endoscopic cyclophotocoagulation; *GDD*, glaucoma drainage device; IOP, intraocular pressure; *IQR*, interquartile range (25th percentile to 75th percentile); *SD*, standard deviation; *VA*, visual acuity.
[a]Parenthetical values are percent, range, or IQR.
[b]Including cycloablation (except ECP), trabeculotomy, goniotomy, trabeculectomy, and GDD.
[c]For treatment failures, follow-up time indicates time to failure.

following cataract surgery. They reported a 54% success rate, which was similar between aphakic and pseudophakic eyes. Similarly, our series showed no significant difference in success between pseudophakic, aphakic, and phakic eyes.

ECP allows visualization of the anterior segment and ciliary processes, even in eyes with corneal opacity and other anterior segment abnormalities. Despite this advantage, Haddad and colleagues[9] reported poor success after first ECP, with 1-, 2- and 3-year success rates of 50%, 33%, and 22%, respectively. In the present, larger series, corneal disease was not associated with lower rates of ECP success.

Prior work has suggested that the combination of decreased aqueous production and increased aqueous outflow can lead to improved and prolonged IOP reduction. Englert and colleagues[15] reported that Ahmed placement was highly successful in the 10 of 27 eyes in their series with prior cycloablation (2-year success, 100%). We were therefore interested to evaluate the relationship between prior GDD and subsequent ECP in our larger series but noted no preferential success in the 68% of eyes with GDD prior to ECP. Similarly, prior glaucoma surgery did not improve the success of ECP. Neely and colleagues[11] likewise found no difference in ECP success between eyes undergoing ECP as adjuvant therapy or as primary treatment.

Contrary to prior studies,[11] we found a significant difference between the preoperative IOP in successfully versus unsuccessfully treated eyes and found that preoperative IOP of ≥32 mm Hg was associated with higher risk of ECP failure. In a multivariable analysis, this relationship persisted following adjustment for other clinically relevant variables. Cantor and colleagues[13] noted that eyes with higher IOP at time of glaucoma following cataract surgery diagnosis were more likely to fail ECP treatment. Pathology from enucleated eyes has shown that the ciliary epithelium can proliferate and regenerate following cyclodestruction.[16] Perhaps the amount of cyclodestruction needed to achieve IOP control is larger in eyes with higher IOP or severely limited aqueous outflow.

There are several limitations to our study, including the possibility of selection bias, given its retrospective nature. Our minimum follow-up 3 months is short; however, of the 36 eyes successfully treated, only 5 had follow up

Table 5. Results of univariate analysis for possible risk factors for failure after ECP

Factor	Univariate hazard ratio	Confidence interval		*P* value[a]
		Lower 95%	Upper 95%	
Age, per year	0.97	0.92	1.03	0.3
Sex				
Female (reference)	1			
Male	1.02	0.56	1.85	0.9
Lens Status				
Aphakic (ref)	1			
Phakic	1.10	0.38	3.17	0.9
Pseudophakic	0.66	0.33	1.30	0.2
No. clock hours ablated	1.18	0.96	1.46	0.1
Pre-op IOP (continuous)	1.07	1.03	1.11	<0.001
Pre-op IOP				
<32 mm Hg (ref)	1			
≥32 mm Hg	2.98	1.59	5.59	<0.001
Cornea				
Clear (ref)	1			
Corneal disease	0.75	0.39	1.44	0.4
Prior cycloablative procedure (excluding ECP)				
No (ref)	1			
Yes	1.28	0.61	2.66	0.5
Any prior glaucoma surgery[b]				
No (ref)	1			
Yes	0.71	0.33	1.53	0.4
Prior glaucoma drainage device				
No (ref)	1			
Yes	0.84	0.45	1.56	0.6
Surgical approach to ECP				
Anterior (ref)	1			
Pars Plana	1.10	0.59	2.07	0.8
Preintervention VA (snellen)	1.45	0.67	3.15	0.3

ECP, endoscopic cyclophotocoagulation; *GDD*, glaucoma drainage device; IOP, intraocular pressure; *VA*, visual acuity.
[a]Factors with *P* value of <0.5 were included in the multivariable model.
[b]Including cycloablation (except ECP), trabeculotomy, goniotomy, trabeculectomy, and GDD.

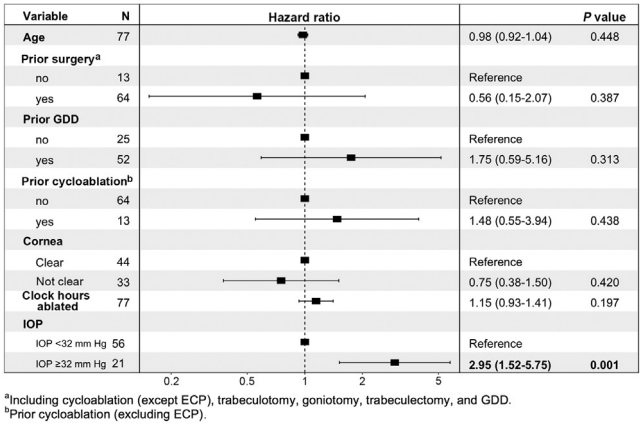

FIG 2. Multivariable analysis showing that preoperative IOP of ≥32 mm Hg is significantly associated with ECP treatment failure ($P = 0.001$). *GDD*, glaucoma drainage device.

time of <1 year. The definition of success was less strict than some prior studies, because we included patients with final IOPs of >21 mm Hg if they were clinically stable and postoperative IOP met the preoperative goal (n = 2). However, as prior authors have noted, a higher IOP cut-off for children is reasonable due to fluctuations in IOP over serial measurements.[10] Fifteen eyes had a preoperative IOP <21 mm Hg (mean, 17.6; range, 12–20.5 mm Hg), of which 9 eyes were successfully treated. These eyes had variable IOP measurements over the 6 months preceding surgery. For standardization, the most recent IOP at time of surgery was used, which, in these cases, likely underestimated the true preoperative IOP. Three patients had postoperative IOPs equal to or greater than their preoperative IOPs (≤3 mm Hg difference), which was attributed to IOP variability and improved testing with increasing age. We had strict failure criteria and generously included complications; thus, we may have failed several eyes for non-ECP related issues. Lastly, we had a limited sample size, with a heterogeneous group of patients and glaucoma subtypes, likely limiting our power to assess multiple risk factors for ECP success or failure.

To our knowledge, the current study represents the largest series of childhood glaucoma cases managed with ECP. Our cohort represents a diverse group of childhood glaucoma patients receiving both primary or adjuvant treatment with ECP with success and complication rates comparable to previous studies. Clinical characteristics, such as corneal opacity, aphakia, and prior glaucoma

surgery, as well as ECP parameters, such as number of clock hours ablated, were not statistically associated with ECP treatment success; however, eyes with preoperative IOP of <32 mm Hg were more likely to be successfully treated with ECP. Perhaps eyes with a higher IOP have poorer outflow and may benefit from surgery that targets aqueous outflow such as GDDs as opposed to ECP, which targets aqueous production. While there is no uniform strategy for managing childhood glaucoma, ECP remains a relatively safe and modestly effective treatment option that may be useful for patients with moderately uncontrolled IOP.

Literature Search

PubMed was searched on April 5, 2018, without date or language restriction, using the following search terms: *endoscopic cyclophotocoagulation* OR *endocyclophotocoagulation* OR *cyclophotocoagulation* OR *cyclodestruction* OR *cycloablation* OR *pediatric glaucoma*. Of the 33 results retrieved, none were larger than our case series.

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