

Original Research Article

Efficacy of topical glycerin in the management of post-phacoemulsification corneal edema and striations

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ABSTRACT

Background: Corneal edema and Descemet's membrane striations are common early complications after phacoemulsification that may delay visual recovery. As hypertonic saline/NaCl may have limited or delayed effects in marked postoperative corneal edema, topical glycerin may serve as a useful hyperosmotic alternative. This study assessed the effectiveness of topical glycerin in post-phacoemulsification corneal edema and striations.

Methods: This prospective observational study was conducted at Medical College for Women and Hospital, Dhaka, Bangladesh and Maleka Eye Hospital, Faridpur, Bangladesh, from January 2024 to February 2026. Sixty patients with corneal edema and Descemet's membrane striations on postoperative day 1 after phacoemulsification with posterior chamber intraocular lens implantation received topical glycerin and were followed on days 7 and 21. Visual acuity, corneal clarity and the severity of corneal edema and striations were assessed. Data were analyzed using SPSS version 26.

Results: Most patients were aged 60–69 years (41.7%). At baseline, moderate corneal edema and moderate Descemet's membrane striations were present in 51.7% and 48.3% of patients, respectively. Progressive improvement occurred during follow-up. By day 21, complete resolution was achieved in 63.3% of patients, while 73.3% attained normal to mildly impaired visual acuity (6/6–6/12). Overall, 83.3% responded positively. Diabetes mellitus ($p=0.041$), grade IV cataract, prolonged surgical time, high phaco energy exposure and severe baseline edema or striations were significantly associated with delayed or incomplete response.

Conclusions: Topical glycerin effectively improved postoperative corneal edema and Descemet's membrane striations after phacoemulsification, with most patients achieving good recovery within 2 weeks.

Keywords: Corneal clarity, Corneal edema, Descemet's membrane striations, Phacoemulsification, Topical glycerin

INTRODUCTION

Phacoemulsification has become the standard surgical procedure for cataract removal throughout the world, providing better visual results, faster recovery and smaller incisions than traditional extracapsular cataract extraction.¹ Although it is widely used, intra-operative corneal endothelial trauma is a known risk and can present as corneal edema and Descemet's membrane striations, which may cause patient distress and delay visual rehabilitation after surgery.² The corneal endothelium is a key component in maintaining corneal transparency, actively pumping fluid from the stroma. Any insult to

endothelial cell integrity during surgery, whether ultrasonic energy, irrigation turbulence, mechanical manipulation or viscoelastic retention, can compromise this pumping function, leading to stromal oedema and folds in Descemet's membrane.^{3,4} The clinical signs include decreased visual acuity, foreign body sensation and photophobia in the early postoperative period and reduced corneal clarity. Post-phacoemulsification corneal edema has been attributed to several patient-related and intraoperative factors. Intraoperative factors like high phaco energy exposure, long surgery time, excessive intraocular manipulation and posterior capsular rent have been linked to increased risk of postoperative corneal

decompensation and dense cataracts with high phaco energy exposure are especially associated with increased endothelial cell loss and risk of postoperative corneal edema.⁵⁻⁷ Hyperosmotic agents such as topical glycerin (glycerol) have been used for decades to temporarily remove corneal edema by drawing fluid out of the swollen stroma.⁸ Glycerin is an inexpensive, readily available and well-tolerated agent that has been used traditionally to improve corneal transparency for fundus visualization in acute corneal edema. It has been described in emergencies like acute angle-closure glaucoma, but not in a systematic way in the post-phacoemulsification setting.⁹

A cost-effective and readily available treatment for transient postoperative corneal edema is of practical relevance in resource-poor clinical settings, as found in South Asia. The use of topical glycerin could be used as an adjunct to standard postoperative treatment, which may help to speed up corneal recovery and visual restoration without the need for expensive pharmacological alternatives.¹⁰ Although topical glycerin has been used in the past and is theoretically useful, there is a lack of high-quality evidence specifically addressing the efficacy of topical glycerin in the treatment of post-phacoemulsification corneal edema and striations and structured clinical data describing the time course and extent of response are limited.¹¹ The purpose of this study was to assess the clinical effectiveness of topical glycerin in the resolution of corneal edema and Descemet's membrane striations after phacoemulsification.

METHODS

This prospective observational study was carried out at Medical College for Women and Hospital, Dhaka, Bangladesh and Maleka Eye Hospital, Faridpur, Bangladesh, from January 2024 to February 2026. The study comprised 60 adult patients who underwent phacoemulsification and received posterior chamber intraocular lens (PCIOL) implantation and developed corneal edema and Descemet's membrane striations on postoperative day 1. Patients with pre-existing corneal pathology (e.g., Fuchs' endothelial dystrophy or corneal scarring), known intraocular infection or inflammatory conditions, prior ocular surgery on the same eye and those who were unable to provide informed consent or follow-up were excluded from the study.

The following variables were evaluated sociodemographic factors (age, sex, residence, occupation), systemic and ocular factors (diabetes mellitus, hypertension, cataract type, cataract density, preoperative endothelial risk and preoperative best corrected visual acuity), surgical factors (type and duration of surgery, phaco energy exposure, intraoperative manipulation and surgical complications) and postoperative clinical findings (severity and distribution of corneal edema, Descemet's membrane striation grading, corneal clarity and visual acuity). Hypertonic saline/NaCl preparations are commonly used as hyperosmotic therapy for postoperative corneal edema;

however, their clinical response may be limited or delayed in patients with marked corneal edema and Descemet's membrane striations during the early postoperative period.^{6,9} Based on this clinical consideration, topical glycerin was used directly as the primary hyperosmotic treatment after confirmation of corneal edema and striations on postoperative day 1, rather than being reserved only for patients who failed to respond to hypertonic saline. All patients were treated with topical glycerin if they were diagnosed with corneal edema on day 1 and were followed up at day 7 and day 21 post-treatment. Graded resolution of corneal edema and striations, improvement of unaided visual acuity and final treatment response (favorable or delayed/incomplete) were outcome measures. The data were analyzed with SPSS version 26.0. The relationship between baseline factors and treatment outcome was assessed by a chi-square test and $p < 0.05$ was considered statistically significant.

RESULTS

The sociodemographic profile of the 60 study patients is given in Table 1. The largest age group was 60-69 years, comprising 41.7% of participants, followed by 50-59 years (26.7%), ≥ 70 years (21.7%) and 40-49 years (10%). The study population consisted of 56.7% males and 43.3% females. 63.3% were urban residents. The most common occupation was homemakers (30.0%), followed by business persons (20%), retired/unemployed (18.3%), service holders (16.7%) and farmers/day laborers (15%).

Baseline systemic and ocular parameters are shown in Table 2. Forty percent (40.0%) of patients had diabetes mellitus and 46.7% had hypertension. In 53.3% of cases, the right eye was operated. The most common type of cataract was nuclear sclerosis (61.7%) and the most common density was Grade III (51.7%). Thirty percent of patients had a preoperative endothelial risk of suspected low endothelial reserve. As far as the preoperative best corrected visual acuity is concerned, 41.7% had severe visual impairment ($< 6/60$ - $3/60$), 36.7% had moderate impairment and 21.7% had blindness.

The surgical and immediate postoperative features are summarized in Table 3. Phacoemulsification with PCIOL implantation was performed in all 60 patients (100%) and foldable IOL was used in 81.7% of cases. The most common duration of surgery was 16-25 minutes (48.3%). Phaco energy exposure was moderate in 51.7%, low in 28.3% and high in 20%. In 63.3%, there was little manipulation during the surgery. There were no intraoperative complications in 63.3% of patients. On the first postoperative day, 56.7% had a mild anterior chamber reaction and 10% had a severe reaction. The baseline clinical characteristics of corneal edema and Descemet's membrane striations on postoperative day 1 are described in Table 4. The most common severity grade was moderate (51.7%), followed by mild (30.0%) and severe (18.3%). Central distribution was most common (43.3%). In 48.3% of cases, moderate Descemet's membrane striations were

present. The clarity of the cornea was hazy in 55.0% of patients and fundus glow was seen in 55.0%. Blurring of vision was the most common presenting symptom (71.7%). 48.3% of patients had severe impairment and 28.3% had blindness or profound impairment in their baseline unaided visual acuity. The visual acuity results at each follow-up visit following topical glycerin treatment are shown in Table 5. None of the patients had normal to mildly impaired vision on day 1. At day 7, 46.7% attained 6/6-6/12 acuity. By day 21, 73.3% had normal to mildly impaired vision (6/6-6/12), 21.7% had moderate impairment, 5% had severe impairment and none of the patients had been classified as blind. Table 6 shows that corneal edema and Descemet's membrane striations resolved progressively during the course of treatment. Complete resolution was achieved in 41.7% by day 7 and 63.3% by day 21. Near-complete resolution was

additionally seen in 20.0% at day 21. At day 21, 13.3% had mild residual edema/striations and 3.3% had moderate residual findings. The overall treatment response was favorable in 83.3% and delayed or incomplete in 16.7% of patients. The association between baseline variables and final treatment response is shown in Table 7. Delayed or incomplete response was significantly associated with diabetes mellitus ($p=0.041$), with 29.2% of diabetic patients having an unfavourable response compared to 8.3% of non-diabetic patients. A treatment response delay or incomplete response was significantly associated with cataract density Grade IV ($p<0.001$), surgical duration >25 minutes ($p<0.001$), high phaco energy exposure ($p<0.001$), severe baseline corneal edema ($p<0.001$) and severe baseline Descemet's membrane striations ($p<0.001$). The age group was not statistically significant ($p=0.218$).

Table 1: Sociodemographic characteristics of the study patients (n=60).

Variables	Category	N (%)
Age group (in years)	40-49	6 (10.0)
	50-59	16 (26.7)
	60-69	25 (41.7)
	≥ 70	13 (21.7)
Sex	Male	34 (56.7)
	Female	26 (43.3)
Residence	Urban	38 (63.3)
	Rural	22 (36.7)
Occupation	Service holder	10 (16.7)
	Business	12 (20.0)
	Homemaker	18 (30.0)
	Farmer/day laborer	9 (15.0)
	Retired/unemployed	11 (18.3)

Table 2: Baseline systemic and ocular characteristics of the study patients (n=60).

Variables	Category	N (%)
Diabetes mellitus	Present	24 (40.0)
	Absent	36 (60.0)
Hypertension	Present	28 (46.7)
	Absent	32 (53.3)
Operated eye	Right eye	32 (53.3)
	Left eye	28 (46.7)
Cataract type	Nuclear sclerosis	37 (61.7)
	Posterior subcapsular cataract	9 (15.0)
	Cortical cataract	8 (13.3)
	Mature cataract	6 (10.0)
Cataract density	Grade II	13 (21.7)
	Grade III	31 (51.7)
	Grade IV	16 (26.7)
Preoperative endothelial risk	No apparent risk	42 (70.0)
	Suspected low endothelial reserve	18 (30.0)
Preoperative best corrected visual acuity	6/18-6/60 (moderate visual impairment)	22 (36.7)
	$<6/60$ -3/60 (severe visual impairment)	25 (41.7)
	$<3/60$ (blindness/profound visual impairment)	13 (21.7)

Table 3: Surgical and immediate postoperative characteristics (n=60).

Variables	Category	N (%)
Type of surgery	Phacoemulsification with PCIOL	60 (100.0)
Type of intraocular lens	Foldable IOL	49 (81.7)
	Rigid PMMA IOL	11 (18.3)
Duration of surgery	≤15 minutes	20 (33.3)
	16-25 minutes	29 (48.3)
	>25 minutes	11 (18.3)
Phaco energy exposure	Low	17 (28.3)
	Moderate	31 (51.7)
	High	12 (20.0)
Intraoperative manipulation	Minimal	38 (63.3)
	Moderate	17 (28.3)
	Excessive	5 (8.3)
Intraoperative complication	None	38 (63.3)
	Posterior capsular rent	13 (21.6)
	Iris trauma	4 (6.7)
	Wound leakage requiring hydration	5 (8.3)
Postoperative day-1 anterior chamber reaction	Mild	34 (56.7)
	Moderate	20 (33.3)
	Severe	6 (10.0)

Table 4: Baseline clinical profile of corneal edema and striations on postoperative day 1 (n=60).

Variables	Category	N (%)
Severity of corneal edema	Mild (Grade I)	18 (30.0)
	Moderate (Grade II)	31 (51.7)
	Severe (Grade III)	11 (18.3)
Distribution of corneal edema	Central	26 (43.3)
	Paracentral	21 (35.0)
	Diffuse	13 (21.7)
Descemet's membrane striations	Mild (Grade I)	20 (33.3)
	Moderate (Grade II)	29 (48.3)
	Severe (Grade III)	11 (18.3)
Corneal clarity	Hazy, but fundus glow is visible	33 (55.0)
	Moderately hazy fundus view	19 (31.7)
	Markedly hazy/no clear fundus view	8 (13.3)
Main presenting symptom	Blurring of vision	43 (71.7)
	Foreign body sensation	8 (13.3)
	Photophobia	5 (8.3)
	Ocular discomfort/pain	4 (6.7)
Baseline unaided visual acuity	6/18-6/60 (moderate visual impairment)	14 (23.3)
	<6/60-3/60 (severe visual impairment)	29 (48.3)
	<3/60 (blindness/profound visual impairment)	17 (28.3)

Table 5: Visual outcome after topical glycerin treatment (n=60).

Follow-up time	Visual acuity category	N (%)
Postoperative day 1	6/18-6/60 (moderate visual impairment)	14 (23.3)
	<6/60-3/60 (severe visual impairment)	29 (48.3)
	<3/60 (blindness/profound visual impairment)	17 (28.3)
Day 7 after treatment	6/6-6/12 (normal to mild visual impairment)	28 (46.7)
	6/18-6/60 (moderate visual impairment)	24 (40.0)

Continued.

Follow-up time	Visual acuity category	N (%)
Day 21 after treatment	<6/60-3/60 (severe visual impairment)	7 (11.7)
	<3/60 (blindness/profound visual impairment)	1 (1.7)
	6/6-6/12 (normal to mild visual impairment)	44 (73.3)
	6/18-6/60 (moderate visual impairment)	13 (21.7)
	<6/60-3/60 (severe visual impairment)	3 (5.0)
	<3/60 (blindness/profound visual impairment)	0 (0.0)

Table 6: Clinical improvement of corneal edema and Descemet's membrane striations after topical glycerin treatment (n=60).

Follow-up time	Clinical status	N (%)
Postoperative day 1	Mild edema/striations	18 (30.0)
	Moderate edema/striations	31 (51.7)
	Severe edema/striations	11 (18.3)
Day 7 after treatment	Complete resolution	25 (41.7)
	Mild residual edema/striations	25 (41.7)
	Moderate residual edema/striations	9 (15.0)
	Severe residual edema/striations	1 (1.7)
Day 21 after treatment	Complete resolution	38 (63.3)
	Near-complete resolution	12 (20.0)
	Mild residual edema/striations	8 (13.3)
	Moderate residual edema/striations	2 (3.3)
Final treatment response	Favorable response	50 (83.3)
	Delayed/incomplete response	10 (16.7)

Table 7: Association between baseline factors and final treatment response.

Variables	Category	Favorable response, N (%)	Delayed/incomplete response, N (%)	P value
Age group (in years)	<60	20 (90.9)	2 (9.1)	0.218
	≥60	30 (78.9)	8 (21.1)	
Diabetes mellitus	Present	17 (70.8)	7 (29.2)	0.041
	Absent	33 (91.7)	3 (8.3)	
Cataract density	Grade II-III	44 (100.0)	0 (0.0)	<0.001
	Grade IV	6 (37.5)	10 (62.5)	
Duration of surgery	≤25 minutes	46 (93.9)	3 (6.1)	<0.001
	>25 minutes	4 (36.4)	7 (63.6)	
Phaco energy exposure	Low/moderate	46 (95.8)	2 (4.2)	<0.001
	High	4 (33.3)	8 (66.7)	
Baseline corneal edema	Mild/moderate (Grade I/Grade II)	48 (98.0)	1 (2.0)	<0.001
	Severe (Grade III)	2 (18.2)	9 (81.8)	
Baseline striations	Mild/moderate (Grade I/Grade II)	47 (95.9)	2 (4.1)	<0.001
	Severe (Grade III)	3 (27.3)	8 (72.7)	

DISCUSSION

In this prospective observational study, the clinical efficacy of topical glycerin was systematically evaluated in 60 patients with post-phacoemulsification corneal edema and Descemet's membrane striations, with 83.3% showing a good response to treatment and 63.3% showing complete resolution by day 21. The results provide

important clinical evidence in a field that has traditionally been based on sparse empirical evidence. The age distribution of the study population (41.7% in the age group 60-69 years) is consistent with the known epidemiology of age-related cataract, which is mainly seen in the sixth and seventh decades of life, as reported by Bourne et al.¹² The results have a near-equal gender distribution, which is similar to the regional trends in

uptake of cataract surgery in South Asian countries.¹³ The main cause of early postoperative corneal edema is corneal endothelial trauma during the phacoemulsification procedure. The endothelial cell loss and temporary pump dysfunction are caused by a combination of ultrasonic energy, irrigation-aspiration turbulence and mechanical contact with intraocular structures.¹⁴ In the study, 20% of patients received high phaco energy and high energy exposure was significantly correlated with delayed treatment response ($p<0.001$), which is consistent with the reports of higher endothelial cell loss with higher cumulative dissipated energy values.¹⁵

The significant association of Grade IV cataract density with poor treatment response ($p<0.001$) is an important finding. The higher the energy needed for phacoemulsification and the longer the operating time, the greater the intraoperative corneal stress, especially in the case of dense cataracts, which need more energy for phacoemulsification and more operating time to emulsify the nucleus.¹⁶ In the cohort, 26.7% had Grade IV cataracts and the poor response rate in this subgroup was 62.5%, highlighting the clinical significance of pre-surgical counselling on longer recovery times for dense nuclear cataracts.¹⁷

Delayed or incomplete glycerin response ($p=0.041$) is biologically plausible and associated with diabetes mellitus. Diabetic patients may also have a decrease in the number of endothelial cells, changes in endothelial cell shape and impaired corneal wound healing responses, making the endothelium more susceptible to surgical trauma and less responsive to healing.¹⁸ This finding is consistent with the idea of using endothelial cell counts as a preoperative tool to guide surgery in diabetic patients.¹⁹

The visual acuity trend seen in this study is clinically significant. At day 1, none of the patients had normal to mildly impaired vision, but 73.3% had 6/6-6/12 vision at day 21 and no patient was in the blindness category at the last visit. This temporal improvement pattern is consistent with the kinetics of osmotically mediated corneal dehydration, which involves the removal of excess fluid from the corneal stroma via the hyperosmotic gradient created by the presence of glycerin.²⁰ The hyperosmotic effect of topical glycerin has been demonstrated in the setting of acute angle closure glaucoma and bullous keratopathy, where its ability to temporarily decrease the stromal and epithelial edema is well documented.²¹

This study is clinically unique, however, because it is structured data that shows its role specifically in the post-phacoemulsification setting, including the pattern of Descemet's membrane striation resolution, which is reported by Zhou et al.²² In this study, the severity of corneal edema and striations at baseline was a strong predictor of treatment response. The response rate was not favorable for patients with severe baseline edema (81.8%) or severe striations (72.7%), both of which were statistically significant ($p<0.001$). This indicates that early

treatment with glycerin before the edema becomes severe (grades 3 and 4) may be best. Treatment should be started at the first postoperative examination if corneal edema is detected.^{23,24}

The study was limited by the small sample size and the lack of a control arm, limiting the generalizability of the results and making it difficult to compare the study results with other treatment modalities for post-phacoemulsification corneal oedema.

CONCLUSION

Topical glycerin is clinically effective in the treatment of corneal edema and Descemet's membrane striations after phacoemulsification cataract surgery and has a good treatment response rate of 83.3%. Corneal clarity and visual acuity improved over time at each visit and with 73.3% of patients attaining normal to mildly impaired visual acuity and 63.3% achieving complete resolution of edema and striations by day 21. Diabetes mellitus, high density of cataract, long operative time, high phacoemulsification energy and severe baseline corneal involvement were found to be significant factors for delayed or incomplete response. The results justify the use of topical glycerin as a readily available and effective adjunct in post-phacoemulsification corneal management, especially in resource-poor environments. In patients with high-risk intraoperative profiles, clinicians should be alert and inform patients that the recovery course may be longer.

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