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Comparing Surgical Frontiers in Neovascular Glaucoma: Insights from a Bangladeshi Experience

M N Islam[1]

Neovascular glaucoma (NVG) remains one of the most challenging forms of secondary glaucoma encountered in clinical practice. It often represents the end stage of ocular ischemia—most frequently secondary to proliferative diabetic retinopathy or central retinal vein occlusion—and is notoriously resistant to medical therapy. For decades, ophthalmic surgeons have searched for the ideal balance between intraocular pressure (IOP) control, visual preservation, and patient comfort in such cases.

In this issue, the study by S Abrar, Z Hassan, M J Kabir, S Manjur titled "Control of Intraocular Pressure with Glaucoma Drainage Devices and Transscleral Diode Laser Cyclophotocoagulation in Management of Neovascular Glaucoma" presents a valuable comparative evaluation of two commonly adopted surgical options: glaucoma drainage devices (GDDs) and diode laser cyclophotocoagulation (DLCP). Conducted at Ispahani Islamia Eye Institute and Hospital, Dhaka, this prospective study provides an important local perspective on treatment outcomes in NVG—an area where regional data remain limited.

The authors report significant IOP reduction in both groups, from approximately 40 mmHg at baseline to near-normal levels at three months post-intervention. Importantly, GDD implantation—using Ahmed or Aurolab drainage devices—was more likely to preserve residual visual acuity, while DLCP provided substantial pressure reduction and pain relief in eyes with poor visual potential. The overall success rates, both complete and qualified, were comparable, and the difference between the two techniques did not reach statistical significance.

What stands out is the pragmatic conclusion: the surgical choice in NVG should be guided not by the device or laser itself, but by the visual prognosis and ocular condition at presentation. This reinforces the principle of individualized glaucoma care—one that is not driven solely by technology, but by thoughtful patient selection and surgeon judgment.

As Bangladesh continues to strengthen its subspecialty services in glaucoma, such prospective local research is essential. It bridges the gap between global evidence and real-world patient care in our setting, where affordability, access, and postoperative compliance pose unique challenges. The inclusion of both Ahmed and Aurolab implants is particularly commendable, reflecting the practical diversity of options used across our tertiary centers.

Looking ahead, future studies with longer follow-up and larger cohorts will help clarify long-term success, endothelial safety, and cost-effectiveness of these interventions. Moreover, combining surgical data with systemic parameters—such as diabetic control and retinal ischemia status—could further enrich our understanding of NVG outcomes.

I congratulate the authors for their meticulous work and contribution to the growing body of Bangladeshi glaucoma research. Their study embodies the spirit of evidence-based, patient-centered practice that the Journal of the Bangladesh Glaucoma Society seeks to promote.

Let this serve as a reminder that even in the most refractory forms of glaucoma, thoughtful innovation and collaborative research can open new pathways toward preserving sight and improving quality of life for our patients.

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Original Article

Incidence, etiology, and risk factors for tube explantation in patients undergoing patch-free glaucoma drainage device

V A Senthilkumar[1], U S Akbar[2], S Rajendrababu[3]

Abstract

Purpose: To report the incidence, etiology, and risk factors for tube explantation in patients undergoing patch-free glaucoma drainage device (GDD).

Methods: Of the total 1303 patients who underwent patch-free GDD (703 non-valved GDD and 600 valved GDD) for refractory glaucoma during January 2020–October 2023, we identified five cases of postoperative complications following GDD that required tube or shunt removal.

Results: Median (IQR) age of our study cohorts was 54.5 (8–66) years. The incidence of tube exposure and tube explantation was 0.003% and 0.004%, respectively. The median time interval for tube or plate explantation from the time of GDD surgery was 11.5 (2–16) months. The diagnoses of refractory glaucoma for which GDD was performed were secondary glaucoma following multiple vitreoretinal (VR) surgery (60%), primary open-angle glaucoma (20%), and aphakic glaucoma (20%). Of these, two patients (40%) presented with recurrent tube exposures, two patients (40%) with tube exposure and early endophthalmitis, and one patient (20%) with persistent hypotony. Four patients (80%) had undergone non-valved Aurolab aqueous drainage implant and one underwent (20%) Ahmed glaucoma implant. Three patients (60%) had diabetes mellitus with a history of multiple VR surgical intervention. GDD explantation was done in three patients (60%), and the remaining two patients (40%) required only tube amputation. One patient presented with orbital cellulitis, and there was no culture growth seen in any of our study cohorts.

Conclusion: Tube and plate exposures pose a significant risk for potential infections and warrant prompt explantation of GDD to avoid endophthalmitis. Previous history of multiple VR surgeries, diabetes mellitus, and non-valved implants were the common risk associations noted for tube exposures in our retrospective study.

Key words: Ahmed glaucoma valve, Aurolab aqueous drainage implant, endophthalmitis, glaucoma drainage device, tube explantation

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Introduction

Glaucoma drainage devices (GDD), both valved and non-valved implants, are becoming increasingly popular in recent times in the management of complicated and refractory glaucoma where the previous trabeculectomy had failed and medical management was not responsive.[1] However, several tube-related devastating complications have already been reported in the literature, including ocular hypotony, endophthalmitis, tube exposure, migration or extrusion of the plate, and corneal decompensation. Tube or plate exposures have been reported to occur in 2%–7% of the patients undergoing GDD, with almost equal incidence of exposure in both early (less than 3 months) and late (more than 3 months) postoperative period.[2] Few patients may require removal of the GDD or tube amputation owing to tube/plate exposure, tube-related endophthalmitis, persistent hypotony, and corneal decompensation. The major purpose of our study was to report the incidence, etiology, and common risk associations for tube/ GDD explantation among patients undergoing patch-free GDD.

Methods

This was a retrospective case series. The study was approved by the institutional review board (RET202000454) and adhered to the tenets of the Declaration of Helsinki. In our tertiary center, all patients underwent superotemporal or inferonasal AADI implantation using a needle-generated scleral tunnel, without the patch graft in both adult and pediatric age groups. Of the total 1303 patients who underwent patch-free long scleral tunnel technique GDD (703 non-valved GDD and 600 valved GDD) during January 2020–October 2023, five eyes of five patients that required GDD tube amputation or plate explantation were included in the study. Furthermore, during our study period, 1004 patients were in the adult group and 299 patients were in the pediatric age group. Informed consent was obtained for all the patients before the scheduled surgery. Demographic details of the patients, including age, sex, type of glaucoma, previous surgical intervention, best corrected visual acuity (BCVA), intraocular pressure (IOP), type of GDD, clinical course of the patient, and details of tube amputation or GDD explantation, were extracted from the electronic medical records.

Results

In our retrospective study, we observed the incidence of tube exposure and tube amputation or GDD explantation to be 0.003% and 0.004%, respectively. The median (IQR) age of our study participants was 54.5 (8–66) years, and the median time interval for tube or plate explantation from the time of GDD surgery was 11.5 (2–16) months [Table 1].

The common diagnoses for which GDD was performed were secondary glaucoma following multiple vitreoretinal (VR) surgery (60%), followed by primary open-angle glaucoma (20%), and aphakic glaucoma (20%). Of these, two (40%) presented with recurrent tube exposure, two (40%) with tube exposure and early endophthalmitis, and one (20%) with persistent hypotony. Four patients (80%) had undergone non-valved Aurolab aqueous drainage implant (AADI), and one underwent (20%) Ahmed glaucoma implant (AGV). Three patients (60%) had diabetes mellitus with a history of multiple VR surgical intervention. GDD explantation was done in three patients (60%), and the remaining two patients (40%) required only tube amputation. We did not observe any bacterial or fungal growth on culture media from any of our study cohorts. Notably, none of our study cohorts required repeat GDD implantation.

Table 1: Clinical and demographic features of the study participants

Patient number	1	2	3	4	5
Age	66	8	58	51	47
Sex	M	F	M	M	M
Laterality	LE	RE	LE	LE	LE
Systemic illness	DM	Nil	DM	DM, HT	Nil
Type of glaucoma	POAG	Aphakic glaucoma	Secondary glaucoma following VR surgery	POAG	POAG
BCVA	5/60	1/60	6/36	6/9	6/24
IOP (mmHg)	32	40	36	26	36
Previous ocular surgery	PPV + PPL + SFIOL surgery	Cataract extraction	Nd: YAG LPI Micropulse cyclo G6	Trabeculectomy	Trabeculectomy ST AADI
Number of AGM	4	4	3	4	3
Type of GDD	AGV	AADI	AADI	AADI	IN AADI
Reason for GDD explantation	Recurrent tube exposure and early endophthalmitis	Tube exposure with pre-septal cellulitis and early endophthalmitis	Persistent CD	Tube exposure	IN AADI Tube exposure
Tube/plate explantation	Tube repositioning followed by tube amputation followed by plate explantation	Tube amputation	Tube amputation followed by plate explantation	Tube repositioning followed by tube amputation	Tube amputation followed by plate explantation
Culture	No growth	No growth	-	-	No growth
Time interval from surgery to explantation	7 months	2 months	4 months	1 month	16 months
Follow up after GDD explantation	3 months	6 months	8 months	1 year	2 years
Final BCVA	5/60	1/60	6/24	6/9	1/60
Final IOP (mmHg)	18	20	16	19	32

Furthermore, we did a subgroup analysis on the incidence of superotemporal versus inferonasal GDD exposure. During our study period, 1003 patients underwent superotemporal GDD implantation, and 300 patients underwent inferonasal GDD implantation. We did not observe a significant difference in the incidence of exposure between superotemporal (0.003% - 3 patients) versus inferonasal (0.003% - 1 patient) GDD location. Similarly, there was no difference in the incidence of tube exposures between the pediatric (0.003%) and adult (0.003%) groups.

Case-1

A 66-year-old diabetic male was diagnosed with advanced primary open-angle glaucoma in both eyes (BE) with a previous history of pars plana vitrectomy (PPV) + pars plana lensectomy (PPL) + scleral fixated intraocular lens (SFIOL) in the left eye (LE) for subluxated lens. He presented with an elevated intraocular pressure (IOP) of 32 mmHg resistant to maximal medical therapy and best-corrected visual acuity (BCVA) of 5/60. The patient had an AGV implant placed in the superotemporal quadrant. Seven months later, the patient developed a tube exposure with migration of the tube anteriorly, which was revised and repositioned. Two months after revision of the AGV tube, recurrent tube exposure was noticed with early signs of endophthalmitis such as localized conjunctival hyperemia and pus discharge around the tube exposure site and signs of uveitis [Fig. 1a–d]. A prompt decision to prevent worsening of infection was made, and tube amputation from the anterior chamber was performed.

M=male, F=Female, RE=Right eye, LE=Left eye, DM=Diabetes mellitus, HT=Hypertension, POAG=Primary open-angle glaucoma, VR=Vitreo= retinal, BCVA=Best corrected visual acuity, IOP=Intraocular pressure, GDD=Glaucoma drainage device, ST=Superotemporal, IN=Inferonasal, PPV + PPL + SFIOL=Pars plana vitrectomy + Pars plana lensectomy, Scleral fixed intraocular lens, Nd:YAG LPI=Neodymium: Yttrium Aluminium Garnet laser peripheral iridotomy, AADI=Aurolab aqueous drainage implant, AGV=Ahmed glaucoma valve, CD=Choroidal detachment.

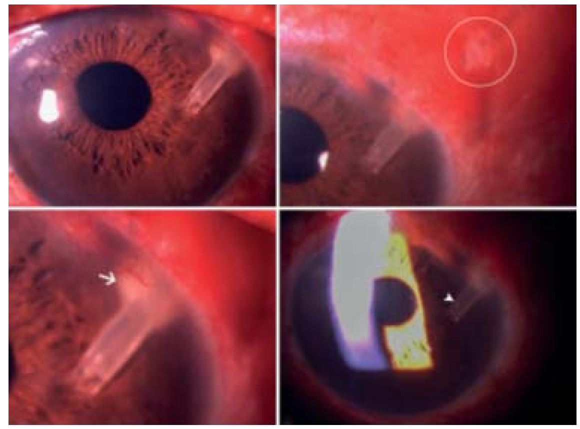

Figure 1: (a–d) Case 1: (a and b) Slit-lamp photograph of the left eye showing superotemporal AADI with the tube in the anterior chamber and diffuse circumcorneal congestion, localized conjunctival erosion with discharge and impending tube exposure (white circle), (c and d) Fibrinous growth around AADI tube in AC (white arrow) and exudates inside the tube lumen in AC (white arrowhead)

At the 1-month postoperative visit, the patient again developed early signs of endophthalmitis. Owing to recurrent infection, AGV plate explantation was performed under strict aseptic precautions. However, microbiological analysis of the explanted plate showed no bacterial growth. The patient was advised AGM and to review in 3 months after plate explantation. His BCVA was 5/60 and IOP was 18 mmHg at the final postoperative visit.

Case 2

An 8-year-old female child presented with bilateral aphakic glaucoma and bilateral failed trabeculectomy, refractory to maximal medical treatment (MMT). On examination, her BCVA was 1/60 in BE, and IOP was 40 mmHg in the right eye (RE) and 34 mmHg in LE. She underwent RE superotemporal AADI implantation with supramid (3-0 nylon) stenting. Two months later, she developed pre-septal cellulitis in the operated eye with no tube exposure and was managed conservatively with oral antibiotics. Ten days later, she presented with acute pain and redness and had tube exposure with features of early endophthalmitis [Fig. 2a and b]. Immediately, she was scheduled for surgery, and the AADI tube was amputated at the level of plate and sent for microbiological examination. The amputated AADI tube showed no growth. She was started on AGM, and

2 months later, she required partial diode laser cyclophotocoagulation for control of high IOP. At the 6-month follow-up visit, her IOP stabilized at 20 mmHg with a BCVA of 1/60.

Case 3

A 58-year-old male diagnosed with rhegmatogenous retinal detachment in LE underwent phacoemulsification and intraocular lens implantation combined with PPV and silicone oil injection (SOI). On the first postoperative follow-up visit, he developed a 360° iris bombe with an elevated IOP of 36 mmHg and a BCVA of 6/36. The IOP remained consistently high despite repeated Nd:YAG laser peripheral iridotomy (LPI).

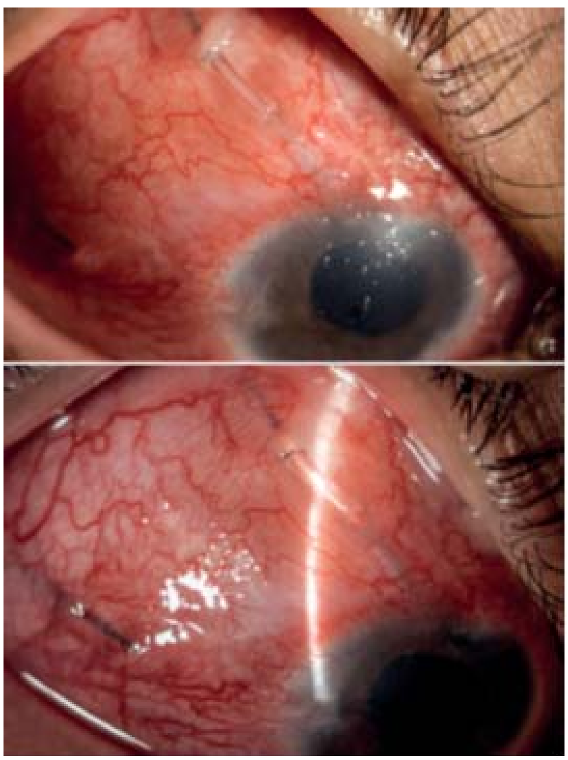

Figure 2: (a and b) Case 2: (a and b) Slit-lamp photograph of the right eye showing conjunctival ongestion with tube exposure and discharge around the tube exposure site IOP. However, the patient's IOP remained persistently high, necessitating AADI surgery along with silicone oil removal. Four months after AADI implantation, the patient's visual acuity reduced drastically from 6/36 to 4/60, with a low IOP of 4 mmHg. Anterior segment evaluation OS revealed 360° iris neovascularization, and B-scan showed 360° of choroidal detachment (CD). As his CD did not resolve with conservative management, the tube portion of the AADI was removed from the anterior chamber and amputated at the level of the plate and the conjunctival defect was closed with 8-0 Vicryl suture. The AADI plate was not removed at this time as the plate appeared adherent to the sclera and no infection appeared to be surrounding the plate. Following the tube removal, IOP increased to 8 mmHg with a BCVA of 6/36. Six months later, plate exposure was noted along with the anterior plate edge corner with an IOP of 26 mmHg. The AADI plate was explanted, and conjunctival closure was done. He was started on AGM, and 4 months later, his vision was 6/24 with good IOP control on fixed drug monotherapy and he had completely regressed iris neovascularization.

Case 4

A 51-year-old male was referred with advanced primary open-angle glaucoma and a history of bilateral trabeculectomy and LE intraocular lens implantation. The patient also had a history of diabetes mellitus and hypertension. On presentation, LE was 6/9 and denied perception of light (PL) in RE. On his follow-up visit, a drop in visual acuity of 6/36 was noted in LE with an IOP of 25 mmHg despite MMT. Due to the monocular status of the patient, GDD surgery was planned and a superotemporal AADI surgery was done. At the 1-month follow-up visit, the AADI tube was exposed posteriorly, which warranted tube repositioning along with conjunctival resuturing. Postoperatively, recurrent tube exposures were noted and hence amputation of the tube at the level of the plate was performed and started on AGM. One year following the tube removal, his BCVA was 6/9 with an IOP of 10 mmHg on combination therapy, and the AADI plate was noted to be in situ.

Case 5

A 47-year-old man presented with an elevated IOP of 36 mmHg and BCVA of 6/24 in LE after a prior superotemporal AADI implantation and failed trabeculectomy for primary open-angle glaucoma. A second AADI implant was placed inferonasally. At the 3-month postoperative visit, the patient was noted to have 360° CD, which was treated conservatively. Sixteen months after surgery, inferonasal tube exposure was noted. A decision was made to remove the tube from the anterior chamber and trim it at the level of the plate, and the same was done. Two years following the tube removal, inferonasal AADI plate exposure was noticed with a sudden decline in the vision from 6/12 to 1/60 and an IOP of 32 mmHg. The entire device was removed from the inferonasal quadrant and started on AGM. The patient was advised partial-diode cyclophotocoagulation, but he was lost to follow-up.

Discussion

Several complications have been reported following valved and non-valved glaucoma drainage implantation (GDD), such as early and late hypotony, choroidal detachment, hypotony maculopathy, suprachoroidal hemorrhage, capsule fibrosis around the plate, erosion and exposure of the tube or plate, extrusion of the implant, and endophthalmitis.[1-3] Among these complications, GDD tube erosion and plate exposure could be potentially vision-threatening owing to their propensity to cause infection and ultimately endophthalmitis.

Tube exposure can occur in the immediate postoperative period (less than 3 months) or later (more than 3 months). Early tube exposure usually results from improper surgical technique such as inadequate suturing of the implant leading to implant migration and extrusion, inadequate apposition of scarred or shortened conjunctiva, and tight conjunctival closure leading to pressure necrosis and conjunctival defect.[1] The major reasons for late tube exposures include local ischemia and apoptosis caused either by the conjunctival suture materials or immunological responses. In addition, improper or loose plate fixation could also lead to conjunctival erosion and ultimate extrusion of the plate. [2,3]

In our case series, two patients had tube exposures in the early postoperative period and two patients in the late postoperative period. Furthermore, we observed diabetes mellitus (3 patients), non-valved implant (4 patients), primary open-angle glaucoma (3 patients), male gender (4 patients), and previous ocular surgery (4 patients) as the common risk associations for tube exposure.

Stephen et al. observed diabetes mellitus, black race, number of pre-shunt glaucoma medications, previous glaucoma laser surgery, and combined primary implant and cataract surgery to be significant risk factors for tube exposure.[4] In our study participants, the mean number of AGM was 3.6, and almost all of them had a previous history of laser or surgical intervention prior to GDD. In a different study analyzing the risk factors for tube exposure, the authors observed no correlation with age, implant location, type of glaucoma, diabetes mellitus, and hypertension. However, the odds of exposure were nine times higher in eyes with at least one prior intraocular surgery. Moreover, the use of antimetabolites such ass mitomycin-C for the prior trabeculectomy surgery could also predispose to conjunctival necrosis and tube exposure.[5] Two of our study participants had undergone previous trabeculectomy with antimetabolites, and one patient had received micropulse therapy prior to GDD implantation.

Similarly, in another retrospective study comparing scleral versus corneal patch grafts for GDD, the authors observed age as an important risk factor for conjunctival complications leading to tube exposure. The authors reported a 2.1% exposure rate in the age group of 18–40 years compared to 13.4% in the 40–60 years group. In our study, the median age was 51 years, with the youngest being 8 years.[6]

Tube or plate exposure was the most common reason for tube amputation or plate removal in our study. However, none of our study patients showed microbial growth in the culture medium. The tube exposure rate in the tube versus trabeculectomy (TVT) study was 5%, with all cases occurring after one month of surgery.[7] Untreated tube exposures could lead to endophthalmitis, and the most commonly reported organisms were streptococcus species and Hemophilus influenza, and rarely methicillin-resistant staphylococcus aureus.[8,9] Similarly, several studies have cultured the tube and/or plate and found that these were contaminated with the same organism isolated from vitreous aspirates. This supports the consensus that the GDD can be a nidus for infection and should be removed as part of endophthalmitis treatment.[7]

As opposed to the higher incidence (2%–7%) of tube exposure reported in the literature, we observed a very low incidence rate (0.003%).[2] Moreover, all our patients underwent a patch-free GDD, which signifies the crucial point that burying the tube in the patient's own sclera could lead to less elevation and a smoother ocular surface, thereby leading to lesser inflammation and better wound healing with a lower risk of tube exposures.[10] Nevertheless, it is imperative to cover the buried tube under Tenon's fascia with a good conjunctival cover to minimize the risk of tube exposure.

In a retrospective study comparing the outcomes of AADI with and without patch graft, the incidence of tube exposure was reported to be 1.4% versus 0 and 7% versus 0 in adult pediatric eyes, respectively.[10] Interestingly, eyes in the patch-free AADI group experienced no tube exposure, which was concordant with the low incidence of tube exposure rate observed in our study. Both for the right and left eyes, the needle-generated scleral track is always medial so that the tube enters the eye at around the 12 o'clock position. At this position there seems to be at least contact with the eyelid, thereby reducing the risk of tube exposure. Furthermore, Oscar et al. described a similar needle-generated technique of AGV implantation in a study on 106 eyes with refractory pediatric glaucomas and noticed no tube exposures in their study participants.[11] Few other studies have also reported a similar low (less than 1%) incidence of tube exposure rate. [12-15]

Published literature on outcomes of GDD has revealed a significantly higher incidence of tube exposure in the pediatric age group than in adults.[10,16-18] This could be attributed to differences in wound healing mechanism, the elasticity of sclera in children, and the tendency for them to rub their eyes. However, we did not observe any difference in tube exposure rate between the pediatric (0.003%) and adult (0.003%) group. Similarly, in a different study, the authors reported greater rates of tube exposure in the inferonasal GDD group than superotemporal implantation necessitating removal of the device.[19] The authors attribute this to the shorter recess of the inferior fornix with lesser conjunctiva and Tenon's capsule for implant coverage, leading to tube exposures. Nonetheless, we did not observe any significant difference in the tube exposure rate with respect to the site of GDD implantation.

Our study has several limitations. The major limitation is the retrospective nature of our study. The relatively small sample size limits the power to detect the common risk factors for GDD explantation. In addition, these small numbers reflect the relatively infrequent occurrence of tube or plate exposures that occur after GDD implantation. Postoperative intervention, need for use of antiglaucoma medications, and timing of tube amputation or plate explantation were left to the discretion of the surgeon as no standard protocols have been reported so far to guide in postoperative management. We do believe the possibility of some patients seeking help at other centers apart from our center, which could have possibly underreported these complications and the need for intervention.

Conclusion

As our study participants were managed appropriately by timely tube amputation or GDD explantation, about 80% of our patients had no decline in visual acuity at the final follow-up visit. Notably, only 40% required whole GDD explantation, which reemphasizes that all tube exposures need not require explantation of GDD and there may be some who may benefit from only tube amputation. Early recognition, awareness about the complications, preventive measures, and timely intervention may provide favorable outcomes and prevent postoperative infection.

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Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Management of Neovascular Glaucoma for Retinal Diseases at Bangladesh Medical University

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Abstract:

Background: Neovascular glaucoma (NVG) is a type of secondary glaucoma causing severe sight-threatening condition resulting from retinal ischemia, leading to neovascularization in the anterior segment of the eye. The burden of retinal diseases is particularly significant in low- and middle-income countries including Bangladesh due to limited access to early screening.

Aim: To determine the management practices among patients with neovascular glaucoma in retinal disease in a tertiary eye care center in Bangladesh.

Methods: This cross-sectional study was conducted at Bangladesh Medical University, Dhaka, Bangladesh, from October 2022 to November 2024. Patients aged ≥18 years with retinal diseases were included, while those with unrelated glaucoma or incomplete data were excluded. Data were collected using a pre-tested questionnaire and detailed ophthalmological evaluations, including gonioscopy and visual acuity assessments. Statistical analyses were performed using Statistical Package for Social Sciences (SPSS) version 26.0. Findings were presented by frequency and percent table.

Result: Among 38 respondents with retinal diseases, the prevalence of NVG was 97.4%, primarily linked to diabetic retinopathy 57.9% and central retinal vein occlusion 26.3%. Respondents had a mean age ± SD is 53.32 ± 9.433 years, with nearly equal gender distribution. Regarding management 39.5% patients were managed conservatively, 28.9% surgically. 28.9% received both and 2.6% had no specific management. 57.9% did not undergo surgery. Among those who did surgery Ahmed valve implantation and trabeculectomy with Mitomycin-C were the most common 10.5% each.

Conclusion: Neovascular glaucoma is highly prevalent among patients with retinal diseases, particularly those with diabetic retinopathy and retinal vein occlusion in Bangladesh. Early detection and comprehensive management are crucial to mitigating its impact and preventing blindness in resource-limited settings.

Keywords: Neovascular glaucoma; Retinal diseases; Diabetic retinopathy; Central retinal vein occlusion; onioscopy; Visual impairment.

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Introduction

It is a severe form of secondary glaucoma categorized by the proliferation of new blood vessels on the iris and within the anterior chamber angle, frequently important to significant visual impairment. This condition characteristically arises from retinal ischemia related with diseases such as proliferative iabetic retinopathy (PDR) and central retinal vein occlusion (CRVO)[1].

The prevalence of glaucoma in Bangladesh is 3.2% in 35-year-old individuals with older men most at risk. The majority (78%) had primary open-angle glaucoma (POAG), while angle closure was seen in 16% secondary glaucoma 5.5%, out of secondary glaucoma neovascular glaucoma occur in 24%.[2] Exact data on the prevalence of NVG in the Bangladeshi residents remain inadequate. Given the rising incidence of diabetes and associated problems in the region, it is believable that the prevalence of NVG is also growing.

Studies from adjacent countries provide some perceptions. For example, research from India designates that the prevalence of NVG among patients with PDR can be as high as 21.3%.[3]Moreover, a hospital-based study stated that retinal vein occlusion accounted for 53% of NVG cases, followed by proliferative diabetic retinopathy at 41%.[4]

Neovascular glaucoma is an upsetting difficulty of retinal ischemia, usually arising from complaints like proliferative diabetic retinopathy (PDR) or central retinal vein occlusion. It's characterized by the growth of new blood vessels in the iris and angle of the anterior chamber [5,6]. Though NVG accounts for a small proportion of all glaucoma cases worldwide, it significantly underwrites to blindness due to its rapid development and confrontation to conventional treatment.[7]

In Bangladesh, the burden of retinal diseases is increasing in tandem with growing rates of diabetes and hypertension. A recent population-based study originates that diabetic retinopathy (DR) affects nearly 12% of persons with diabetes, with proliferative stages being a major contributor to NVG growth.[8] Despite this, there is incomplete complete data on the prevalence of NVG among patients with retinal diseases in the country. Understanding these tendencies is vital for the deterrence of permanent visual damage and blindness.

Data from India, a bordering country with similar healthcare contests, highlight the significant influence of NVG on patients with progressive retinal circumstances. Studies have stated NVG prevalence rates of up to 18% in PDR cases and 20–30% in retinal vein occlusions.[9] Still, management consequences remain suboptimal due to late presentation and limited access to specialized care.[10]

This study aims to determine the management practices in a tertiary eye care center in Bangladesh.

Materials and Methods

This cross-sectional study was conducted at Bangladesh Medical University (BMU), Dhaka, Bangladesh, over a two-year period from October 2022 to November 2024. The study included patients aged 18 years and older diagnosed with retinal diseases and those with confirmed diagnoses of NVG or at risk of NVG due to underlying retinal conditions. Patients with incomplete clinical records, secondary glaucoma unrelated to neovascularization or retinal diseases, or those unwilling to provide informed consent were excluded. Ethical approval was obtained from the Institutional Review Board of BMU, and written informed consent was secured from all participants.

Data were collected using a pre-tested, semi-structured questionnaire that captured sociodemographic details, clinical history, visual status, and management practices. Data was analyzed by using SPSS software (version 26.0) and findings were presented by frequency and percent table. Comprehensive ophthalmological evaluations, including gonioscopy and visual acuity assessments using Snellen's chart, were conducted. Anterior and posterior segment findings were documented to identify features associated with NVG.

Descriptive statistics summarized categorical variables as frequencies and percentages, while continuous variables were expressed as means and standard deviations. Results are presented in tabular and graphical formats to ensure clarity and comprehensiveness.

Results

Among the 38 respondents, the mean age was 53.32 ± 9.433 years, ranging from 34 to over 65 years. Gender distribution was nearly equal, with 52.6% male and 47.4% female.

NVG was diagnosed in 97.4% of respondents. Diabetic retinopathy was the leading cause, accounting for 57.9% of cases, followed by central retinal vein occlusion 26.3%, old hemi-retinal vein occlusion 7.9%, and branch retinal vein occlusion 2.6%. Miscellaneous conditions were identified in 5.3% of cases.

The most frequent IOP reading for the right eye was 35 mm of Hg, observed in 10.5% of cases, while the left eye had the highest frequency at 20 mm of Hg, occurring in 13.2% of cases.

The post-surgical management of intraocular pressure in the cohort. A significant proportion, 34.2%, underwent post-surgical IOP monitoring, while 65.8% did not. Similarly, only 15.8% of patients received medications for IOP management post-surgery, indicating that the majority, 84.2%, did not require such intervention.

Anterior segment findings showed iris neovascularization in 78.9% of cases, with flare, pupil reactivity, and surface abnormalities each reported in 5.3%. Posterior segment findings included hemorrhages along the disc or elsewhere in 34.2% of cases, macular edema in 10.5%, and retinal detachment in 10.5%.

Gonioscopy findings revealed that 63.2% of respondents had an open angle, while 15.8% had a closed angle with new vessel growth. New vessels in the angle were observed in 7.9%, and narrow angles with new vessels in 5.3%.

Visual acuity assessments revealed that 6/60 was the most common in the right eye 28.9% and the left eye 26.3%. Severe impairments, such as no perception of light (NPL), were noted in 15.8% of the right eyes and 2.6% of the left.

Management strategies were diverse, with 39.5% receiving conservative treatment, 28.9% undergoing surgical interventions, and 28.9% receiving a combination of both.

Table 1: Distribution of the respondents by Socio Demographic Variables

Age	Frequency	Percent
34-44	5	13.2
45-54	17	44.7
55-64	12	31.6
65+	4	10.5
Total	38	100.0
Mean±SD	53.32±9.433	
Gender		
Male	20	52.6
Female	18	47.4
Total	**38**	**100.0**

Table 1. The age of the respondents ranged from 34 to 65 years and above, with a mean age of 53.32 ± 9.433 years. The majority 44.7% were aged between 45 and 54 years. The gender distribution was nearly equal, with 52.6% male and 47.4% female.

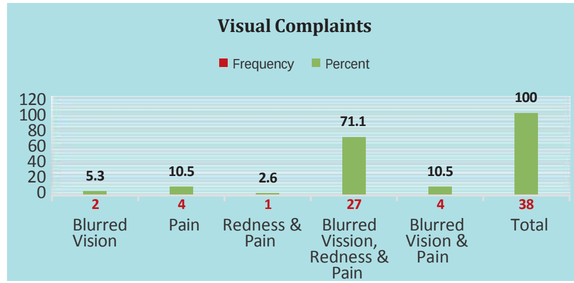

Figure 1: Distribution of Respondents by Visual Complaints

Figure 1 highlights the visual complaints reported by the 38 respondents. The majority (71.1%) experienced a combination of blurred vision, redness, and pain. Blurred vision and pain together were reported by 10.5%, while 5.3% had only blurred vision. Pain alone accounted for 10.5% of cases, and 2.6% reported redness and pain.

Table 2: Distribution of Respondents by Family and Personal History of Other Comorbidities

Family History				Personal History			
Comorbidities	N	Percent	Percent	Comorbidities	N	Percent	Percent
Other disease	20	40.00%	87.00%	Other diseases	1	1.70%	2.70%
Diabetes	20	40.00%	87.00%	Diabetes	28	47.50%	75.70%
Hypertension	12	24.00%	52.20%	Hypertension	25	42.40%	67.60%
Total	50	100.00%	217.40%	Cardiovascular	5	8.50%	13.50%
				Total	59	100%	159.50%

* Dichotomy group tabulated at value 1. Multiple response.

Table 2 shows the prevalence of comorbidities among respondents, considering both family and personal medical histories. In family history, 40% reported eye diseases and diabetes, 24% hypertension, with a total exceeding 100% due to multiple responses. For personal medical history, diabetes 47.5% was most common, followed by hypertension 42.4%, cardiovascular disease 8.5%, and other eye diseases 1.7%. Again, the total percentage exceeded 100% due to multiple comorbidities.

Table 3: Distribution of Respondents by Anterior and Posterior Segment Findings

Anterior Segment	Frequency	Percent	Posterior	Frequency	Percent
Corneal Opacity	1	2.6	Macular Edema	4	10.5
Flare	2	5.3	Hemorrhages	1	2.6
Pupil Reactivity	2	5.3	Retinal	4	10.5
Iris	30	78.9	Disc or else where	8	21.1

Surface	2	5.3	Hemorrhages &	13	34.2
Anterior Chamber Cell,					
Flare, Pupil Reactivity &	1	2.6	Macular Edema,	1	2.6
Iris Neovascularization			Hemorrhages & Disc		
margin			or else where		
			Exudates,	2	5.3
			Retinal	2	5.3
			Hemorrhages,	1	2.6
			Other	2	5.3
Total	**38**	**100**	**Total**	**38**	**100**

Table 3 summarizes the anterior and posterior segment findings among the 38 respondents. Most respondents 97.4% had a retinal disease, with diabetic retinopathy being the most prevalent 39.5%. Central retinal vein occlusion 28.9% was the second most common. Most respondents suffered for 1-3 years 84.2%. Anterior segment findings primarily included iris neovascularization at the margin 78.9%, while posterior segment findings were more diverse, with hemorrhages along with disc or elsewhere being the most common 34.2%.

Table 4: Diagnosis and Causes of Neovascular Glaucoma among Respondents

Neo-vascular glaucoma diagnosed by healthcare professional	Frequency	Percent
Yes	37	97.4
No	1	2.6
Total	**38**	**100.0**
Cause of your neo-vascular glaucoma		
Diabetic Retinopathy	22	57.9
Central Retinal Vein Occlusion	10	26.3
Old Hemi retinal vein Occlusion	3	7.9
Other	2	5.3
Brach retinal vein occlusion	1	2.6
Total	**38**	**100.0**

Table 4 shows the diagnosis and underlying causes of neovascular glaucoma among 38 respondents. Almost 97.4% were diagnosed, while 2.6% were not. Diabetic retinopathy was the most common cause 57.9%, followed by central retinal vein occlusion 26.3%, old hemi-retinal vein occlusion 7.9%, branch retinal vein occlusion 2.6%, and other miscellaneous causes 5.3%.

Table 5: Distribution of types of Retinal Diseases among Respondents

Any retinal diseases	Frequency	Percent
Yes	37	97.4
No	1	2.6
Total	**38**	**100.0**
Type of retinal disease		
Diabetic Retinopathy	15	39.5
Retinal Detachment	3	7.9
Central Retinal Vein Occlusion	11	28.9
Old Hemi retinal vein occlusion	4	10.5
Other	3	13.2
Total	**38**	**100.0**

Table 5 shows the prevalence and types of retinal diseases among 38 respondents. The vast majority, 97.4%, reported having a retinal disease. Diabetic retinopathy was the most prevalent at 39.5%, followed by central retinal vein occlusion 28.9%, old hemi-retinal vein occlusion 10.5%, retinal detachment 7.9%, and other 13.2%.

Table 6: Distribution of Respondents by Visual Acuity in Right and Left Eyes

Right Eye: (Snellen Chart Notation)	Frequency	Percent	Left Eye: (Snellen Chart Notation)	Frequency	Percent
6/60	11	28.9	3/60	1	2.6
6/36	4	10.5	6/60	10	26.3
6/00	2	5.3	CF1ft	3	7.9
6/12	2	5.3	6/12	5	13.2
3/60	2	5.3	6/36	2	5.3
NPL (No	6	15.8	6/18	3	7.9
CF1ft	2	5.3	6/24	2	5.3
6/18	2	5.3	CF2ft	1	2.6
CF2ft	3	7.9	2/60	1	2.6
CF3ft	3	7.9	CF3ft	3	7.9
			CF5ft	1	2.6
			6/90	3	7.9
			4/60	1	2.6
Hand Movement	1	2.6	Hand Movement	1	2.6
			NPL	1	2.6
Total	**38**	**100.0**	**Total**	**38**	**100.0**

Table 6 shows the distribution of visual acuity for the right and left eyes of 38 respondents, based on Snellen Chart Notation. For the right eye, 6/60 was the most common acuity 28.9%, followed by

NPL 15.8%. Other acuities like CF3ft, CF2ft, and Hand Movement were less frequent. For the left eye, 6/60 was also the most prevalent 26.3%, followed by 6/12 13.2% and 6/90 (7.9%). Other acuities like CF3ft and NPL were less common.

Table 7: Distribution of most recent intraocular pressure reading status of right and left eye.

Most recent reading status Right eye (mm of Hg)	Frequency	Percent	Most recent reading status Left eye (mm of Hg)	Frequency	Percent
10	1	2.6	11	1	2.6
12	2	5.3	12	3	7.9
15	3	7.9	15	1	2.6
18	3	7.9	16	2	5.3
20	1	2.6	17	2	5.3
21	2	5.3	18	3	7.9
22	3	7.9	19	1	2.6
24	1	2.6	20	5	13.2
25	2	5.3	21	2	5.3
27	2	5.3	22	1	2.6
28	2	5.3	23	1	2.6
30	3	7.9	24	2	5.3
32	1	2.6	25	2	5.3
35	4	10.5	26	1	2.6
40	2	5.3	27	1	2.6
42	1	2.6	29	1	2.6
45	3	7.9	30	2	5.3
50	1	2.6	35	3	7.9
52	1	2.6	36	1	2.6
			40	1	2.6
Total	**38**	**100.0**	45	2	5.3
			Total	**38**	**100.0**

Table 7 presents the distribution of most recent readings for right and left eyes, measured in millimeters of Hg. Both eyes exhibited a range of readings, with the right eye showing a slightly wider range than the left. The most frequent reading for the right eye was 35 mm of Hg, observed in 10.5% of cases, while the left eye had the highest frequency at 20 mm of Hg, occurring in 13.2% of cases.

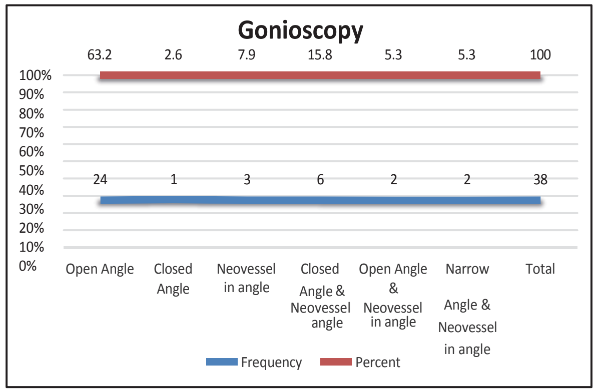

Figure 2: Distribution of Respondents by Gonioscopy Findings

Figure 2 presents the majority 63.2% had an open angle, while 7.9% showed neo vessel growth. Other findings included combinations of closed angle and neo vessel growth 15.8%, open angle with new vessels 5.3%, and narrow angle with new vessels 5.3%. Only 2.6% had a closed angle without additional findings.

Table 8: Distribution of Respondents by type of Management

Type of management		
Conservative (medications, lifestyle modifications)	15	39.5
Surgical	11	28.9
Both	11	28.9
N/A	1	2.6
Total	**38**	**100.0**

Table 8 details regarding management, 39.5% were managed conservatively, 28.9% surgically, 28.9% received both, and 2.6% had no specific management.

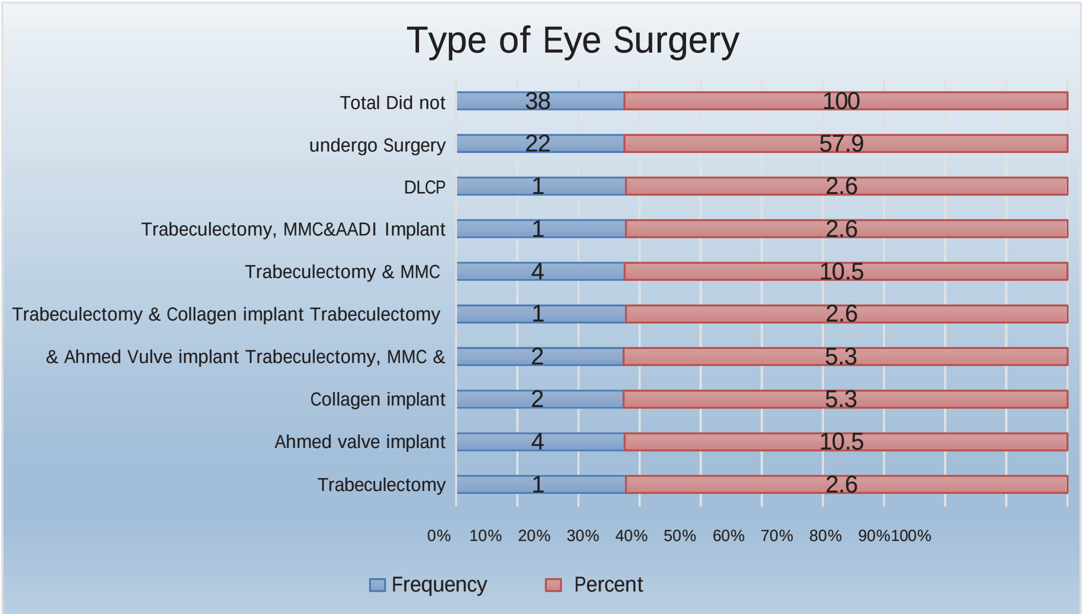

Figure 3: Distribution of Respondents by Type of Eye Surgery related to NVG

Figure 3 displays the types of eye surgeries related to NVG's performed on 38 respondents. 57.9% did not undergo surgery. Among those who did, Ahmed valve implant and trabeculectomy with Mitomycin C (MMC) were the most common 10.5% each. Other procedures included trabeculectomy with various combinations and implants, as well as Diode laser cyclophotocoagulation (DLCP).

Table 9: Distribution of Post-Surgical Intraocular Pressure Monitoring and Medication Management

Pressure Monitoring and Medication Management	Intraocular pressure measure since surgery		Medication for IOP management	
	Frequency	Percent	Frequency	Percent
Yes	13	34.2	6	15.8
No	25	65.8	32	84.2
Total	**38**	**100.0**	**38**	**100.0**

Table 9 summarizes the post-surgical management of IOP in a cohort of 38 patients. A significant proportion, 34.2%, underwent post-surgical IOP monitoring, while 65.8% did not. Similarly, only 15.8% of patients received medications for IOP management post-surgery, indicating that the majority 84.2% did not require such intervention.

Discussion

This study investigated the prevalence of neovascular glaucoma among patients with retinal diseases at a tertiary eye care center in Bangladesh. The findings revealed a remarkably high prevalence of NVG 97.4%, underscoring the significant burden of this sight-threatening condition in this population. This study aligns with previous studies conducted in developing countries, which have similarly reported high NVG prevalence among patients with retinal diseases[5]

The high prevalence of diabetic retinopathy 57.9% as the causing of NVG is uniform with the rising incidence of diabetes in Bangladesh[6] and its well-established correlation with NVG development.[7] The predominance of NVG in patients with DR 57.9% mirrors current literature, which identifies proliferative PDR as a major risk factor for NVG due to ischemia-induced angiogenesis.[8,11] Likewise, CRVO accounted for 26.3% of cases, reliable with Indian studies that characteristic a significant percentage of NVG cases to retinal vein occlusion.[12] These data highlight the importance of addressing complete comorbidities like diabetes and hypertension, which were prevalent in 47.5% and 42.4% of respondents, consistently, and are known to worsen retinal vascular circumstances.

Visual acuity assessments exposed severe damage in many patients, with 15.8% of right eyes showing NPL. These findings focus on the overwhelming impact of NVG on vision and excellence of life. Prior studies have equally recognized high rates of vision loss in NVG, mainly in patients awarding late or with progressive disease.[10,13]

Management strategies for NVG in this cohort diverse, with 39.5% receipt conservative treatment and 28.9% undergoing surgical interventions. The difficulty of NVG needs a multimodal method, frequently combination medical therapy, laser treatment, and surgery.

The management of NVG secondary to DR is a real challenge with a high failure rate.[14] NVG usually requires not only medication but also surgery to control the sustained elevated IOP. In adults, bilateral NVG is mostly due to DR.[15]

Current progressions in anti-VEGF therapies and minimally invasive glaucoma surgeries (MIGS) have prolonged treatment choices, contribution possible assistances in governing intraocular pressure and neovascularization.[16]

The considerable prevalence of NVG amongst patients with retinal diseases in Bangladesh underlines the necessity for improved screening and management protocols. Applying monotonous ophthalmic evaluations for persons with DR and CRVO, attached with timely therapeutic interventions, could mitigate the development to NVG. Public health initiatives concentrating on the management of systemic risk issues, such as diabetes and hypertension, are also authoritative in dropping the incidence of NVG.[17]

The study also highlighted the significant visual impairment experienced by patients. Visual acuity ranged from 6/60 to no light perception, emphasizing the severe impact of NVG on vision. This aligns with the known pathophysiology of NVG, where improved IOP and retinal ischemia can lead to irreversible vision loss.[18]

Conclusion

Neovascular glaucoma is a challenging refectory glaucoma. Management of neovasular glaucoma is tough but not never impossible. Different management protocol have been introduced for different causes of neovascular glaucoma. Proper diagnosis in time with identify the causes and as well as appropriate treatment in time is mandatory for neovascular glaucoma management.

Declaration of Interest Statement

The authors report no conflict of interest.

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Original Article

Demographic Profiles of Examination Under Anesthesia in a Glaucoma Clinic of a Tertiary Centre in Bangladesh

M Z Hassan[1], S Sharmin[2], T R Chhara[3], M I Iqbal[4], S J Kabir[5]

Abstract

Background: This study evaluates the demographic and clinical characteristics of children undergoing EUA in a tertiary glaucoma clinic in Bangladesh.

Methods: A retrospective descriptive study was conducted at the glaucoma clinic of Ispahani Islamia Eye Institute and Hospital (IIEI&H), Dhaka, between May 2025 and September 2025. Fifty consecutive children undergoing EUA for suspected glaucoma were included. Demographics, presenting complaints, ocular signs, corneal diameter, intraocular pressure (IOP), cup–disc ratio, diagnosis, and management were collected from EUA record sheets.

Results: Of 50 patients, 35 (70%) were male and 15 (30%) were female. Age at presentation was 2–6 months in 14 (28%), 7–11 months in 11 (22%), 1–3 years in 20 (40%), and 4–6 years in 5 (10%). Primary congenital glaucoma (PCG) was seen in 27 cases (54%; unilateral 7, bilateral 20). Secondary glaucoma occurred in 15 cases (30%; unilateral 8, bilateral 7). Eight (16%) had no glaucoma. Photophobia, watering, blepharospasm, and enlarged eyeball were most frequent presenting complaints. Corneal scar, buphthalmos, raised IOP and increased cup–disc ratio were noted. Haab's striae were present in 23 cases .In children less than 1 year, 29 eyes had corneal diameters more than 12 mm. In more than 2 years, 12 eyes had diameters more than 13 mm.IOP was not significantly elevated, as intraocular pressure tends to decrease after induction of general anesthesia.Cup/disc ratio was 0.2–0.4 in 7 eyes, 0.5–0.9 in 30 eyes and unviewable in 13 eyes. Trabeculectomy with or without trabeculotomy was performed in 28 cases . Other were treated with antiglaucoma medication or only observation.

Conclusion: Most children requiring EUA in this series were male, presented before 3 years of age and had bilateral disease with primary congenital glaucoma being the leading diagnosis. Corneal enlargement and optic disc cupping were the main indicators. Surgical management was the mainstay of treatment. These findings emphasize the importance of early EUA in suspected pediatric glaucoma cases to prevent irreversible visual loss.

Keywords: Pediatric glaucoma, Primary congenital glaucoma, Examination under anesthesia, Demography.

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Introduction

Childhood glaucoma is a rare but sight-threatening condition, with an incidence ranging from 1 in 10,000 to 1 in 20,000 live births, depending on ethnicity and region.[1,2] It is a potentially blinding disease that often requires early diagnosis and intervention. The incidence and clinical characteristics vary geographically, influenced by genetic and environmental factors.[1-5] Primary congenital glaucoma (PCG) is the most frequent form, usually presenting within the first year of life with classic features such as photophobia, epiphora, blepharospasm, corneal haze and buphthalmos.[3,4] Secondary glaucoma may arise from developmental anomalies, trauma, aphakia or systemic syndromes.[5]

Accurate diagnosis in children is often difficult due to poor cooperation and limited clinical examination in outpatient settings. Examination under anesthesia (EUA) is therefore indispensable, allowing precise assessment of intraocular pressure (IOP), corneal diameter, anterior segment anomalies and optic disc cupping.[6-8] In addition, EUA facilitates appropriate surgical planning, which is critical for preserving vision.

While data from India, the Middle East, and Western populations are available,[1,2,7,9] there is limited published evidence from Bangladesh. To address this gap, this study analyzed the demographic and clinical characteristics of children undergoing EUA for suspected glaucoma in a tertiary eye hospital in Dhaka. This study aims to describe the patterns in a tertiary glaucoma clinic to aid in service planning and highlight the burden of disease.

Materials and Methods

Study design: Retrospective descriptive study.

Study period: May 2025 – September 2025

Setting: Glaucoma clinic, Ispahani Islamia Eye Institute and Hospital, Dhaka, Bangladesh

Participants: Fifty consecutive pediatric patients undergoing EUA for suspected glaucoma.

Procedure

- EUA was indicated in very young or uncooperative children.
- Anesthesia: Combining Ketamine and Propofol (Ketofol) with spontaneous ventilation.
- IOP: Measured with Perkins handheld applanation tonometer following endotracheal intubation of anesthesia.
- Data recorded: Age, sex, presenting complaints, corneal diameter, Haab's striae, iris/lens anomalies, cup–disc ratio (when corneal clarity allowed), IOP,final diagnosis and management.
- Management modalities: antiglaucoma medications, trabeculotomy–trabeculectomy, trabeculectomy alone, observations or referral.
- Informed consent: Obtained from parents prior to EUA and any surgical intervention.

Figure-1: A - Child undergone EUA, B - Haab's Striae, C - Cloudy Cornea, D - Microspherophakia with Aniridia with Retinal detachment.

Exclusion: Family and consanguinity history not documented.

Analysis: Descriptive statistics (frequencies, percentages).

Results

Table 1. Demographic profile of children undergoing EUA (n = 50)

Characteristic	Number (%)
Gender:	
Male	35 (70)
Female	15 (30)
Age distribution:	
2–6 months:	14 (28%)
7–11 months:	11 (22%)
1–3 years:	20 (40%)
4–6 years:	5 (10%)
Diagnosis:	

Table 2. Final diagnosis in children undergoing EUA

Diagnosis	Total cases (%)	Unilateral	Bilateral
Primary congenital glaucoma	27 (54)	7	20
Secondary glaucoma	15 (30)	8	7
No glaucoma	8 (16)	-	-

- Secondary etiologies: microspherophakia (4), aphakia (3), subluxated intraocular lens (1), subluxated crystalline lens (1), posterior subcapsular cataract (1), aniridia (3), trauma (3), Axenfeld–Rieger anomaly (2), ectopia lentis (1), other syndromes (5), retinopathy of prematurity (2), retinal surgery (2), corneal surgery (2), megalocornea (1).

Presenting complaints: photophobia, watering, blepharospasm, enlarged eyeball.

Signs: corneal scar, buphthalmos, raised IOP, increased cup–disc ratio.

Table 3. Corneal diameter in eyes examined under anesthesia

Age group	Corneal diameter	Number of eyes
3 months–1 year	9–11 mm	4
	>12 mm	29
>2 years	9–12 mm	5
	>13 mm	12

Table 4. Intraocular pressure (IOP) findings

Age group	IOP (mmHg)	Number of eyes
≤2 years	≤12	22
	>12	23
>2 years	≤13	3
	>14	2

Table 5. Optic disc and corneal findings

Finding	Number of eyes
Cup–disc ratio 0.2–0.4	7
Cup–disc ratio 0.5–0.9	30
No disc view (opaque cornea)	13
Haab's striae (bilateral)	12
Haab's striae (unilateral)	11

Table 6. Management patterns

Management modality	Number of patients
Trabeculectomy ± trabeculotomy	28
Single antiglaucoma medication	8
Multiple medications	3
Observation only	5
Referred elsewhere	7

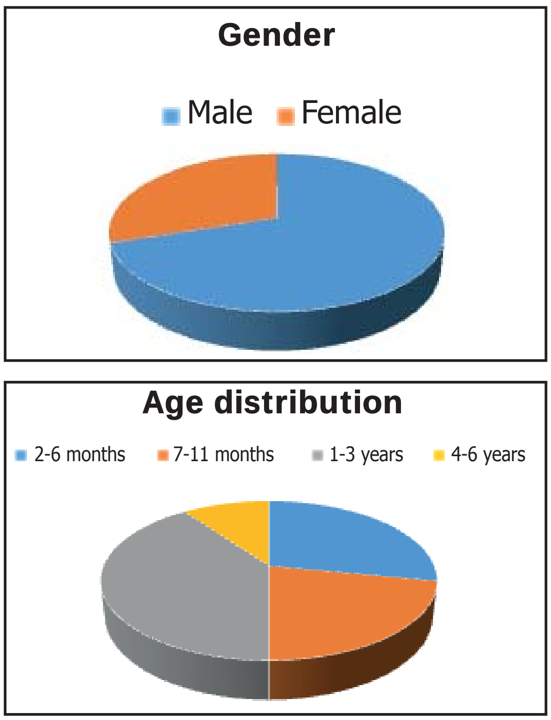
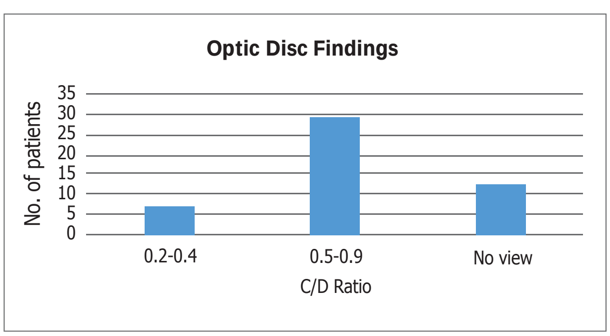


Figure- 2: Gender and Age distribution of EUA patients.



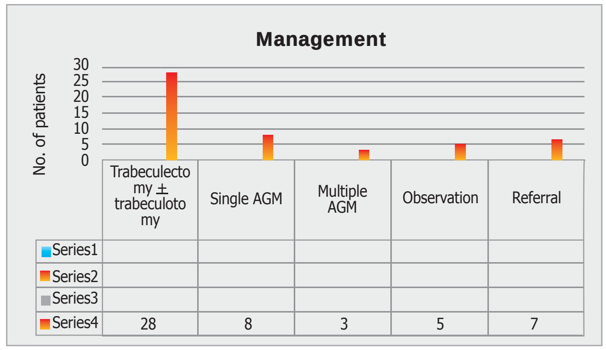


Figure- 3: Cup/Disc ratio and Management pattern of EUA patients.

Discussion

- Male predominance (70%) similar to reports from India and the Middle East.[1,2,8]
- Majority presented <3 years of age, comparable to the British Infantile and Childhood Glaucoma (BIG) Eye Study.[3]
- PCG was the leading diagnosis (54%), in line with Indian [1] and Saudi Arabian series.[8]
- High bilaterality rates reflect genetic contribution, though consanguinity data were not available in this study.
- Corneal enlargement (>12 mm in 29 eyes under 1 year) and optic nerve cupping were common, consistent with classical features of PCG.[4,6]
- Surgery was the mainstay of treatment, particularly combined trabeculotomy–trabeculectomy, as advocated in similar populations.[1,7]

Limitations: single-center, small sample, lack of genetic/family data and may had false low IOP as IOP measurements were not performed just after induction of anesthesia; before endotracheal intubation.

Conclusion

Most children undergoing EUA for suspected glaucoma were male, presented before 3 years and had bilateral disease. PCG was the predominant diagnosis. Corneal enlargement and disc cupping were key findings. Surgical management remains essential. Early EUA is crucial for preserving vision in pediatric glaucoma in Bangladesh.

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Post-traumatic Angle Recession Glaucoma : A Tertiary Care Analysis of Treatment Outcomes and Predictive Factors

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Abstract

Purpose: The purpose of this study is to compare the results of three different drainage procedures performed for uncontrolled post-traumatic angle recession glaucoma.

Methods: A retrospective analysis was conducted on 33 patients of post traumatic angle recession glaucoma. Among the 33 patients, 18 patients received medical management for IOP control & rest of the 15 patient underwent drainage procedures associated with or without phacoemulcification & posterior chamber intraocular lens implantation. The 15 cases of filtration procedure included 10 cases of trabeculectomy; 05 cases of combined trabeculectomy with phacoemulcification & posterior chamber intraocular lens implantation. The study spanned over an 5-year period from March 2017 to February 2022. All the cases of trabeculectomy received an intraoperative application of 0.3% mitomycin C to the trabeculectomy site. The visual acuity, gonioscopy finding, intraocular pressure and glaucomatous change of the optic nerve head were documented pre and postoperatively. The success of the technique was analyzed by using a Kaplan-Meier cumulative survival curve.

Results: Intraocular pressure was controlled at target range till the last follow up visit without topical treatment in 64.52% (10/15 eyes).The visual acuity was same or better in 73.33% (11/15 eyes), since the surgery till the last follow up visit . Cumulative probability of success was 88.24 % at 6 months, 76.47 % at 1 years, 64.69 % at 3 years and thereafter. Of concern were 01 case of hypotony, 01 case of late bleb infection & 2 cases of late bleb failure were observed in post operative follow up that were managed accordingly.

Conclusions: Medically uncontrolled post-traumatic angle recession glaucoma, trabeculectomy with antimetabolite therapy is an effective surgical procedure with an acceptable complication rate. Satisfactory level of intraocular pressure control and preservation of vision in most patients were observed.

Introduction

Glaucoma is a disease in which the optic nerve is damaged, leading to progressive and irreversible loss of vision. Glaucoma can develop at any intraocular pressure (IOP), but elevated intraocular pressure is one of the major risk factors for the development and progression of glaucoma. Most treatments for glaucoma are targeted at lowering the intraocular pressure, either by decreasing the formation of aqueous fluid in the eye, or, as in the case of glaucoma filtration surgery, by increasing the outflow of fluid from the eye. Trabeculectomy is a filtering surgery where an ostium is created into the anterior chamber from underneath a partial thickness scleral flap to allow for aqueous flow out of the eye. The aqueous flows into the subconjunctival space, usually leading to an elevation of the conjunctiva, referred to as a filtering bleb.[1] There are several suggested routes for the aqueous after reaching the filtering bleb. These routes include filtration through the conjunctiva into the tear film, absorption by vascular or perivascular conjunctival tissue, flow through lymphatic vessels near the margins of the surgical area, and drainage through aqueous veins.[2]

Trabeculectomy is performed for treatment of glaucoma inadequately controlled by maximally tolerated medical therapy. This review will discuss careful patient selection through history and clinical examination, surgical technique of trabeculectomy with potential advantages and disadvantages of antifibrosis drugs commonly employed at the time of filtration surgery, and management of complications in the early postoperative period.

In evaluating a patient for glaucoma filtration surgery, it is important to take a detailed medical and surgical

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history. Particular points of importance include:History of prior ocular inflammation or infection;prior ocular procedures or ocular trauma etc. since these factors influence the outcome of surgery directly. A thorough ophthalmological examination is also recommended prior to trabeculectomy surgery. Important aspects of the physical examination to note include: Visual acuity; conjunctival or scleral scarring, hyperemia; Gonioscopic findings; Intraocular pressure; intraocular inflammation; glaucomatous optic nerve damage & field loss; presence of cataract which may mandate a combined procedure etc.

Angle recession glaucoma (ARG) is a secondary open angle glaucoma that is associated with ocular trauma. Recession of the anterior chamber angle is a common slit lamp and gonioscopic finding following concussive ocular trauma. A small percentage of these people go on to develop glaucomatous optic neuropathy and vision loss days, months or even years later.[1] There are reports of glaucoma developing up to 50 years after the injury.[2] The main risk factor for angle recession is trauma. Girkin, et al. used the United States Eye Injury Registry to demonstrate that 3.39% of people go on to develop ARG at 6 months following blunt ocular trauma.[8] A 10 year prospective study of 31 eyes by Kaufmin and Tolpin reported that 6% with angle recession will go on to develop glaucoma.[1] Since it appears that angle recession per se does not always lead to glaucoma, there may be other factors at play that have not yet been discovered. Several publications have demonstrated that the greater the number of clock hours of angle recession, the greater the likelihood of developing elevated pressures and glaucoma. Authors have reported varying amounts ranging from 180 to 240 degrees as "at high risk," but most studies confirm that greater than 180 degrees of recession makes glaucoma more likely.[9,6,10] Interestingly, one study reported 50% of ARG patients will go on to develop open angle glaucoma in the contralateral eye.[11] This has led to the hypothesis that angle recession does not directly cause elevated IOP, but may accelerate the process in an already at risk eye. Conversely, this could point to complex factors in glaucomatous pathophysiology with the trauma leading to future bilateral glaucomatous risk. Very recently, Sihota, et al. found increased pigmentation at the angle, elevated baseline IOP, hyphema, lens displacement, and angle recession of more than 180° were significantly associated with the occurrence of chronic glaucoma after closed globe injury[12] Treatment for ARG is generally the same as for primary open angle glaucoma save for a few exceptions noted below.

Medical therapy for ARG includes topical aqueous suppressants,that are effective including beta-blockers, carbonic anhydrase inhibitors and alpha agonists. Prostaglandin analogues should be avoided in the acute phase of trauma because of their potential to be pro-inflammatory. However prostaglandin analogues have a theoretical benefit of bypassing the dysfunctional trabecular meshwork by increasing uveoscleral outflow and can be used after the acute phase is over. Pilocarpine should be avoided as it has been reported to exacerbate angle recession.[14] If pupillary block is present from lens dislocation, cycloplegics may be helpful until surgery is performed.

Surgical management includes Argon laser trabeculoplasty in small case series,but has yielded rather unsatisfactory results and fails to lower the IOP long term in this group of patients.[15] An analysis of Selective Laser Trabeculoplasty among 560 patients in the IRIS registry found the failure rate was 48% at 18 months, whereas the failure rate overall was 41%.[16] Trabeculectomy with MMC has shown to be successful in lowering IOP in ARG.[17] However, patients with ARG have demonstrated an increased risk of failure after trabeculectomy.[18] Glaucoma drainage devices have demonstrated some benefit, though their success rates are lower than with other types of glaucomas. Cyclodestructive procedures may be an alternative option for eyes with limited visual potential.

Angle recession glaucoma are generally more difficult to control medically and surgically than other types of glaucoma. Therefore patients are counseled and kept on regular, long term follow-up examinations should be performed regularly.

Methods

This was a this was a retrospective study. A single surgeon, multi center study extending over 5 years timespan, from March 2017 to February 2022. It included cases from National Institute of Ophthalmology and Hospital (NIO&H); Bangladesh Eye Hospital, Zigatola Ltd. and BIRDEM General Hospital, of glaucomatous damage of the optic nerve head were documented pre and post operatively. Dhaka.

Both male and female cases were included in the study.

Analysis included 31 patients of post traumatic angle recession glaucoma. Among the 33 patients, 18 patients received medical management for IOP control & rest of the 15 patients underwent drainage procedures associated with or without phacoemulcification & posterior chamber intraocular lens implantation. The 15 cases of filtration procedure included 10 cases of trabeculectomy & 05 cases of combined trabeculectomy with phacoemulcification & PCIOL implantation .

All the patients received per operative application of 0.3% mitomycin C to the trabeculectomy site. In combined cases after phacoemulcification, foldable intra ocular lens was implanted as per biometric measurement.

Most of the surgeries (11 cases) were performed under local anesthesia except 04 cases; those required general anesthesia considering patients age and level of co-operation.

The visual acuity, intraocular pressure, gonioscopy and evaluation Biometry, color fundus photography and OCT (RNFL & ONH) were performed for all the patient included in the study.

The success of the techniques were analyzed by using Kaplan-Meier cumulative survival curve.

Results

significant number of cases belonged to 13 to 22 years age range ; meanwhile predominantly male cases were more in number compared to that of the female cases. 22 patients were male whereas 9 patients were female. Statistically both findings were significant considering our socio economic structure.

Intraocular pressure appeared to be satisfactorily controlled till the end of the study's last follow up without topical treatment or surgical re-exploration in 64.52% cases (10/15 eyes) and the visual acuity was the same or better The in 73.33 % cases (11/15 eyes) since the surgey to last last follow up visit

Among all the cases, of concern were 01 case of hypotony & 01 case of late bleb infection following surgery. The patient developing hypotony following required exploration and re-suturing to ensure proper drainage. Late bleb infection was managed as per standard protocol.

Whereas, 02 cases of late bleb failure was observed among the patients who underwent trabeculectomy with anti metabolite .However, those 2 cases with late bleb failure from trabeculectomy group required 01 or more anti glaucoma medication with bleb revision or repeat trabeculectomy procedure performed for IOP control at later part of the follow ups .

Cumulative probability of success was 88.24 % at 6 months follow up, 76.47 % at 1 years, and 64.69 % at 3 years and thereafter. Hence, trabeculectomy with antimetabolite appeared to be comparatively safer procedure in post traumatic angle recession glaucoma management as per the outcome of our study.

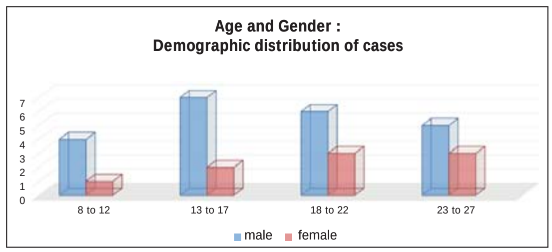

Fig :1 Demographic distribution of cases according to age and gender

Table :1 Survival probability rate of drainage procedures performed

Kaplan-Meier Survival Curve for Drainage Procedure Success

Time Post-Surgery	Failures (di)	At Risk (ni)	Survival Probability S(t)
3 months	1	17	0.9412 (or 94.12%)
6 months	1	16	0.8824 (or 88.24%)
1 year (12 months)	2	15	0.7647 (or 70.47%)
3 years (36 months)	2	13	0.6469 (or 64.69%)

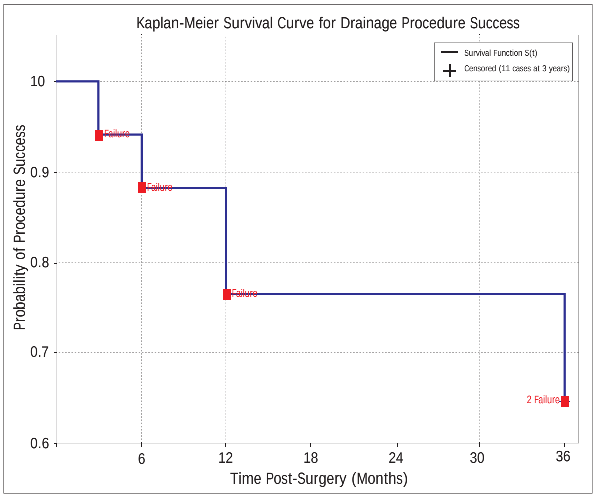

Fig : 2 Kaplan – Meier survival curve for cumulative success rate of drainage procedures

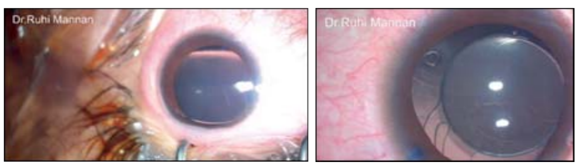

Fig :3 & 4 Pre and post operative appearance of angle recession glaucoma cases

Table: 2 Rate of post operative complications after drainage surgery

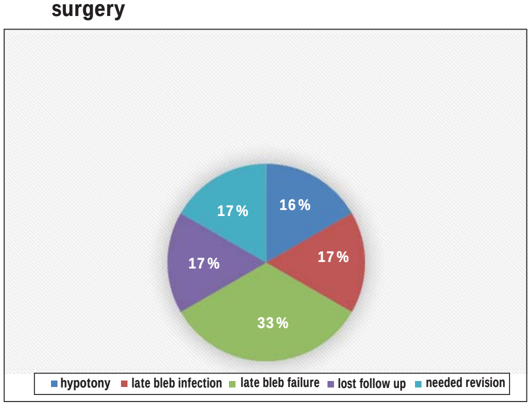

Table : 3 distribution of patients timing of surgery after trauma & post operative visual acuity.

Discussion

In our study, intraocular pressure appeared to be satisfactorily controlled till the end of last follow up without topical treatment or surgical re-exploration in 64.52% cases (10/15 eyes) and the visual acuity was the same or better The in 73.33 % cases (11/15 eyes) since the surgey to last last follow up visit.

Among all the cases, of concern were 01 case of hypotony & 01 case of late bleb infection following surgery. The patient developing hypotony following required exploration and re-suturing to ensure proper drainage. Late bleb infection was managed as per standard protocol.

Whereas, 02 cases of late bleb failure was observed among the patients who underwent trabeculectomy with antimetabolite. However, those 2 cases with late bleb failure from trabeculectomy group required 01 or more anti glaucoma medication with bleb revision or repeat trabeculectomy procedure performed for IOP control at later part of the follow ups.

Cumulative probability of success was 88.24 % at 6 months follow up, 76.47 % at 1 years, and 64.69 % at 3 years and thereafter. Hence, trabeculectomy with antimetabolite appeared to be comparatively safer procedure in post-traumatic angle recession glaucoma management as per the outcome of our study.

According to.Manners, T., Salmon, JF, Barron, A., Willies, C., Murray, ADN et al The intraocular pressure was successfully controlled at last follow up without topical treatment in 77% (33/43 eyes) and the visual acuity was the same or better in 81% (35/43 eyes). Cumulative probability of success was 85% at 1 year follow up, 81% at 2 years, and 66% at 3 years and thereafter.[16]

According to Mermoud A, Salmon JF, Straker C, et al The reason for the poor success rate of trabeculectomy in post-traumatic angle recession glaucoma in unknown. Bleeding during surgery was postoperative hyphaema. No difference was found between the groups in terms of postoperative inflammation or other operative complications. Their results could be explained by the early active fibroblast proliferation that occurs after filtering surgery in post- traumatic angle recession glaucoma. The mean Success time between surgery and bleb failure was significantly shorter in the. Angle recssion group range 06-24 months than in the primary open angle glaucoma.[17]

Therefore in comparison to other studies the findings of our study appears to be consistent with them considering pre and post operative parameters.

Conclusions

For medically uncontrolled post-traumatic angle recession glaucoma, trabeculectomy with antimetabolite therapy is a safe & effective surgical procedure with an acceptable complication rate. Satisfactory level of intraocular pressure control and preservation of vision in most patients were observed following such filtration procedure. Despite the results, there are still the scope and necessity of scientific approaches involving larger number of cases with more closer observations to evaluate the outcome efficiently.

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Outcome of filtration surgery in advanced POAG in Patients attending Glaucoma Clinic at BMU (Bangladesh Medical University)

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Abstract

Background: Glaucoma remains a leading cause of irreversible blindness worldwide. Surgical management is indicated when intraocular pressure (IOP) cannot be adequately controlled by medical therapy. This study aimed to evaluate the visual acuity (VA) and intraocular pressure outcomes following trabeculectomy in patients with advanced glaucoma.

Materials and Methods: This retrospective interventional study was conducted at the Glaucoma Clinic of Bangladesh Medical University (BMU) from April 2017 to April 2022. A total of 51 patients with advanced glaucomatous cupping ($\geq$0.8:1) and significant visual field loss (PSD $>$20 dB, MD $>$10 dB) were included. Preoperative assessment included Snellen visual acuity, slit-lamp and fundus examination with 78D Volk lens, Goldmann applanation tonometry, and OCT of the optic disc and RNFL. Standard trabeculectomy under peribulbar anesthesia was performed in all cases. Postoperative VA and IOP were recorded on postoperative day (POD) 1, day 10, one month, three months, and six months. Data were analyzed using SPSS.

Results: The mean age of the patients was 59.4 ± 8.6 years (range: 42–72), with 31 males (61%) and 20 females (39%). Preoperative mean VA was 6/36 (range: HM–6/6), improving to 6/24 on POD 1 and 6/18 by day 30, with 50% of patients showing improvement maintained up to six months. Mean preoperative IOP was 23.2 ± 3.5 mmHg, which significantly decreased to 11.5 ± 2.3 mmHg on POD 1 and remained stable through day 180 ($p < 0.001$). The mean vertical cup-to-disc ratio was 0.82 ± 0.06, and mean HVFA MD was −7.5 ± 2.1 dB, consistent with moderate glaucomatous damage.

Conclusion: Trabeculectomy resulted in a significant and sustained reduction in intraocular pressure with corresponding stabilization or improvement in visual acuity among patients with advanced glaucoma. The procedure was effective in maintaining long-term intraocular pressure control and preventing further visual deterioration in this population.

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Keywords: Glaucoma, Trabeculectomy, Intraocular Pressure, Visual Acuity, Optic Nerve Damage.

Introduction

Glaucoma is a progressive optic neuropathy characterized by structural damage to the optic nerve head and corresponding visual field loss, often associated with elevated intraocular pressure (IOP)[1]. It remains one of the leading causes of irreversible blindness globally, affecting an estimated 76 million people in 2020, with projections suggesting an increase to over 111 million by 2040[2]. The disease burden is particularly high in developing countries, where limited access to screening and treatment contributes to late presentations and advanced disease stages at diagnosis[3]. The primary goal in glaucoma management is to prevent further optic nerve damage and preserve functional vision, primarily through sustained reduction of IOP, the only modifiable risk factor identified to date[4]. IOP reduction can be achieved via medical, laser, or surgical means. While topical medications and laser trabeculoplasty are often first-line interventions, many patients eventually require surgical procedures to achieve target IOP levels, especially in advanced cases or those with poor medication adherence[5]. Trabeculectomy, first described by Cairns in 1968, remains the gold standard surgical treatment for medically uncontrolled glaucoma[6]. The procedure involves creating a fistula between the anterior chamber and the subconjunctival space, allowing aqueous humor to drain externally, thereby lowering IOP[7]. Despite the emergence of newer surgical techniques such as non-penetrating deep sclerectomy and minimally invasive glaucoma surgeries (MIGS), trabeculectomy continues to offer superior long-term pressure control, especially in resource-limited settings[8]. Visual outcomes following trabeculectomy are influenced by multiple factors, including preoperative optic nerve status, postoperative complications, and the degree of IOP reduction achieved[9]. Although the primary aim of trabeculectomy is to control IOP, visual acuity (VA) may also improve due to reduction of corneal edema or reversal of transient glaucomatous effects on the visual axis[10]. However, in some cases, postoperative fluctuations in VA may occur due to shallow anterior chamber, hypotony, cataract progression, or bleb-related issues[11]. In Bangladesh, glaucoma is a significant public health concern, with late presentation and advanced cupping commonly observed at tertiary care centers[12]. Few local studies have systematically analyzed postoperative visual acuity and IOP trends following trabeculectomy in such populations. Therefore, it is crucial to evaluate the effectiveness of trabeculectomy in terms of both pressure reduction and functional visual outcomes to establish evidence-based management strategies for advanced glaucoma in this setting. This retrospective interventional study was designed to assess the visual acuity and intraocular pressure outcomes following trabeculectomy in patients with advanced glaucoma managed at the Glaucoma Clinic of Bangladesh Medical University (BMU). The findings aim to contribute to the existing body of evidence supporting trabeculectomy as a safe and effective surgical intervention in preserving vision and controlling IOP among patients with severe glaucomatous optic nerve damage.

Materials and Methods

Study Design and Setting: This was a retrospective interventional study conducted at the Glaucoma Clinic, Department of Ophthalmology, Bangaldesh Medical University (BMU), Dhaka, Bangladesh. The study period extended from April 2017 to April 2022. Ethical approval was obtained from the Institutional Review Board, and all procedures adhered to the tenets of the Declaration of Helsinki.

Study Population: A total of 51 patients diagnosed with advanced primary open-angle glaucoma were included in the study. Inclusion criteria comprised patients with glaucomatous optic disc cupping ≥0.8:1 in one or both eyes, corresponding visual field defects on Humphrey Visual Field Analyzer (HVFA SITA FAST 24-2) showing pattern standard deviation (PSD) >20 dB and mean deviation (MD) >10 dB. Exclusion criteria included previous intraocular surgery (except uncomplicated cataract extraction), secondary glaucomas, uveitic or neovascular glaucoma, and patients lost to follow-up before six months.

Preoperative Assessment: Each patient underwent comprehensive ophthalmic evaluation, including slit-lamp biomicroscopy, fundus examination with a 78D Volk lens, and intraocular pressure (IOP) measurement using Goldmann Applanation Tonometry (GAT). Optic disc and retinal nerve fiber layer (RNFL) thickness were assessed using spectral-domain optical coherence tomography (OCT). Visual acuity (VA) was measured with Snellen's chart and converted to the nearest Snellen equivalent for analysis. Preoperative counseling was provided regarding the surgical procedure, expected outcomes, and possible complications.

Surgical Procedure: Trabeculectomy was performed under peribulbar anesthesia by experienced surgeons. After fixation of the globe with a superior rectus suture, a fornix-based conjunctival flap was fashioned. A triangular or quadrilateral partial-thickness scleral flap (3 × 4 mm) was created. Deep sclerectomy was carried out using Kelly's punch, followed by a peripheral iridectomy with Wicker's scissors. The scleral flap was secured with single or multiple sutures to maintain anterior chamber depth. The conjunctiva was closed with 10-0 nylon sutures. Subconjunctival injection of antibiotic-steroid was administered, and a pad bandage was applied for 24 hours.

Postoperative Follow-up: Postoperative assessments were done on day 1, day 10, 1 month, 3 months, and 6 months. Visual acuity and IOP were recorded at each visit. Antiglaucoma medications were adjusted as required based on IOP control.

Data Analysis: All data were recorded and analyzed using SPSS (version 25.0). Descriptive statistics (mean ± SD, range, and percentage) were used for continuous and categorical variables. A p-value <0.05 was considered statistically significant.

Results

1. Patient Demographics

A total of 51 patients were included in the study, with ages ranging from 42 to 72 years and a mean age of 59.4 ± 8.6 years. Among them, 31 (61%) were male and 20 (39%) were female. Most patients were in the 55–65 years age group, representing the majority of the study population.

Table 1: Demographics of the Study Population

Characteristic	Number (%) / Mean ± SD	Range
Total patients	51	–
Age (years)	59.4 ± 8.6	42–72
Sex – Male	31 (61%)	–
Sex – Female	20 (39%)	–

2. Visual Acuity Outcomes

Preoperatively, patients presented with varying degrees of visual impairment. The mean preoperative visual acuity was approximately 6/36, with several patients as low as hand motion (HM) or 1/60. Postoperatively, a significant improvement was observed as early as Day 1, with continued gradual improvement until Day 30, which was maintained through Day 180.

- At Day 1, 30% of patients demonstrated improvement, 60% remained stable, and 10% experienced slight worsening.
- By Day 30, 50% of patients showed improvement, with 45% stable and only 5% worsened.

Table 2: Visual Acuity Outcomes (Snellen)

Timepoint	Mean VA	Range	Improvement %	Stable %	Worsened %
Preop	6/36	HM–6/6	–	–	–
Day 1	6/24	HM–6/6	30	60	10
Day 7	6/18	1/60–6/6	45	50	5
Day 30	6/18	1/60–6/6	50	45	5
Day 90	6/18	1/60–6/6	50	45	5
Day 180	6/18	1/60–6/6	50	45	5

Visual acuity improved mainly in patients with moderate preoperative impairment; severe preoperative cases (HM/1/60) showed slower recovery.

3. Intraocular Pressure (IOP) Outcomes

Preoperative IOP ranged from 15 to 28 mmHg with a mean of 23.2 ± 3.5 mmHg. Postoperatively, a significant reduction was observed on Day 1 (mean 11.5 ± 2.3 mmHg), which remained stable through Day 180.

Table 3: Intraocular Pressure Outcomes (mmHg)

Timepoint	Mean ± SD	Range
Preop	23.2 ± 3.5	15–28
Day 1	11.5 ± 2.3	10–15
Day 7	12.0 ± 2.8	10–19
Day 30	11.5 ± 2.3	10–12
Day 90	11.5 ± 2.4	10–12
Day 180	11.8 ± 2.7	10–12

The postoperative reduction in IOP was clinically significant, suggesting effective surgical management.

4. Other Ophthalmic Parameters

The vertical cup-to-disc (c:d) ratio ranged from 0.7 to 0.9, with a mean of 0.82 ± 0.06, indicating moderate glaucomatous optic nerve damage. Humphrey visual field mean deviation (HVFA MD) averaged –7.5 ± 2.1 dB, reflecting mild-to-moderate visual field loss. RNFL data were incomplete but aligned with the observed optic nerve damage.

Table 4: Ophthalmic Parameters

Parameter	Mean ± SD	Range
Vertical c:d ratio	0.82 ± 0.06	0.7–0.9
HVFA MD (dB)	–7.5 ± 2.1	–10 to –5
RNFL (µm)	–	–

5. Summary

In this cohort of 51 patients:

- Visual acuity improved in most patients, particularly by Day 30, and remained stable up to Day 180.
- Intraocular pressure decreased significantly postoperatively and remained within normal limits through follow-up.
- Cup-to-disc ratio and HVFA MD indicate moderate glaucoma in the majority of patients, consistent with the severity of optic nerve damage.

Overall, the surgery demonstrated effective VA improvement and sustained IOP reduction in this population.

Discussion

The present study evaluated the outcomes of trabeculectomy in 51 patients with advanced primary open-angle glaucoma, focusing on changes in visual acuity (VA) and intraocular pressure (IOP) over a six-month follow-up period. The findings demonstrated a significant reduction in IOP and stabilization or improvement in VA, consistent with previously published literature supporting trabeculectomy as an effective surgical intervention for glaucoma management[1,2]. In this study, the mean preoperative IOP was 23.2 ± 3.5 mmHg, which decreased to 11.5 ± 2.3 mmHg on the first postoperative day and remained stable through six months. This represents an approximate 50% reduction in IOP, aligning with the results of Gedde et al. (2012), who reported a similar magnitude of IOP control following trabeculectomy in the Tube Versus Trabeculectomy (TVT) study[3]. The sustained reduction observed in this study underscores the efficacy of the procedure in achieving long-term aqueous outflow and pressure regulation. Maintaining IOP within the low-teens range is critical for halting or slowing the progression of glaucomatous optic neuropathy, particularly in advanced stages where visual reserve is limited[4]. Visual acuity improvement was observed in 50% of patients by postoperative day 30, with stability maintained up to day 180. Improvement in VA following trabeculectomy may result from reduced corneal edema, improved ocular perfusion, and decreased optic nerve head stress [5]. However, not all patients experienced improvement; some demonstrated stable or slightly worsened vision, likely due to pre-existing optic nerve damage or transient postoperative inflammation[6]. Similar findings were noted by Lichter et al. (2001), who reported that visual outcomes post-trabeculectomy often depend more on the preoperative optic nerve condition than on the surgery itself[7]. The mean cup-to-disc (C:D) ratio in this study was 0.82 ± 0.06, reflecting advanced glaucomatous damage at presentation. This pattern is common in developing countries like Bangladesh, where delayed diagnosis and limited access to regular eye care contribute to late-stage disease[8]. Early detection and timely surgical intervention are therefore essential to preserve remaining visual function. The mean visual field mean deviation (MD) of −7.5 ± 2.1 dB in our cohort indicates moderate functional impairment, which, although irreversible, can be stabilized through effective pressure control[9]. Postoperative complications such as hypotony, shallow anterior chamber, or bleb-related issues were not systematically recorded in this analysis; however, intraoperative maintenance of anterior chamber depth and proper scleral flap suturing likely contributed to favorable outcomes. Previous studies have emphasized that meticulous surgical technique and careful postoperative monitoring are critical determinants of trabeculectomy success[10,11]. The results of this study are consistent with regional findings. Islam et al. (2018) reported that trabeculectomy performed at tertiary centers in Bangladesh significantly reduced IOP and preserved visual function in the majority of patients[12]. Although newer minimally invasive glaucoma surgeries (MIGS) offer faster recovery and fewer complications, their long-term IOP-lowering efficacy in advanced cases remains inferior to trabeculectomy[13]. In summary, this study reinforces the role of trabeculectomy as a reliable, cost-effective, and sustainable option for managing advanced glaucoma in resource-limited settings. The procedure achieved substantial IOP reduction and visual stability in the majority of patients, demonstrating its continued relevance despite evolving surgical technologies. Future prospective studies with larger sample sizes and longer follow-up periods are recommended to assess the long-term visual field stability and bleb morphology associated with trabeculectomy outcomes in the Bangladeshi population.

Conclusion

This study demonstrated that trabeculectomy remains a highly effective and reliable surgical procedure for managing advanced primary open-angle glaucoma. A significant and sustained reduction in intraocular pressure (IOP) was achieved, with mean postoperative values maintained within the low-normal range throughout the six-month follow-up period. This reduction is crucial in halting or slowing further glaucomatous optic nerve damage.

Visual acuity (VA) outcomes were favorable, with half of the patients showing measurable improvement and most others maintaining stable vision postoperatively. These findings indicate that effective IOP control not only preserves but may also enhance visual function in selected cases, particularly those with moderate preoperative visual impairment.

The mean cup-to-disc ratio and visual field indices observed in this cohort reflect the advanced disease stage at presentation, a common feature in developing countries like Bangladesh where late diagnosis remains a major challenge. Nonetheless, the study highlights that timely surgical intervention, meticulous surgical technique, and consistent postoperative care can yield satisfactory visual and pressure outcomes even in severe cases.

In conclusion, trabeculectomy continues to serve as a cornerstone in glaucoma management, particularly in resource-limited settings where access to newer minimally invasive glaucoma surgeries is restricted. The procedure provides durable intraocular pressure control, prevents further visual deterioration, and offers a cost-effective solution for patients with advanced glaucoma. Long-term, multicenter studies with larger sample sizes are recommended to further validate these findings and to explore strategies that optimize postoperative visual outcomes and minimize complications.

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Original Article

Retinal nerve fiber layer (RNFL) thickness before and after trabeculectomy in primary open angle glaucoma

F Aktar[1], S A Wadud[2], S M Noman[3], H Mandal[4], E Saha[5]

Abstract

Background: Primary open-angle glaucoma (POAG) is a leading cause of irreversible blindness, characterized by progressive optic neuropathy and retinal nerve fiber layer (RNFL) thinning. Trabeculectomy, a common surgical intervention to lower intraocular pressure (IOP), aims to slow disease progression. Evaluating RNFL thickness before and after trabeculectomy using OCT is crucial to understanding the surgery's impact on optic nerve health.

Aim: This study aims to assess the RNFL thickness in primary open-angle glaucoma (POAG) before and one month after trabeculectomy surgery using optical coherence tomography (SD-OCT).

Method: A group of patients aged 40-60 years who attended the Department of Ophthalmology at BMU and were diagnosed with POAG comprised the study patients. 20 eyes of 16 patients were selected for the study group. The study duration was one year. A complete clinical evaluation was conducted, including intraocular pressure (IOP) measurement before and one month after surgery. Optical coherence tomography (OCT) RNFL was performed preoperatively and postoperatively in the ophthalmology department. Statistical analysis of the results was conducted using computer-based software, SPSS 22. A probability 'P' value of 0.05 or less was considered significant.

Results: It was observed that most of the patients (90%) belonged to the age group of 51–60 years, mean age was 57.1±4.12 years. More than half of the study patients were male (55.0%), while 45.0% were female. In terms of glaucoma severity, 60.0% had severe glaucoma, remaining had mild and moderate glaucoma. The mean preoperative intraocular pressure (IOP) was 18.9±3.73 mmHg, while the mean postoperative IOP was 14.2±2.1 mmHg. A significant ($p<0.05$) reduction in IOP was observed postoperatively compared to the preoperative period. Regarding retinal nerve fiber layer (RNFL) thickness, the superior RNFL thickness was 75.2±23.7 preoperatively and 81.6±25.29 postoperatively. The mean overall RNFL thickness was 60.65±10.34 preoperatively and 63.85±12.74 postoperatively. A significant (<0.05) increase was observed in superior and mean RNFL thickness postoperatively compared to the preoperative period. But in other quadrants, there were changes in RNFL thickness, but the changes weren't statistically significant (>0.05).

Conclusion: This study assessed RNFL thickness changes before and after trabeculectomy in primary open-angle glaucoma. A significant reduction in IOP was observed postoperatively. Superior and mean RNFL thickness increased notably, while inferior, nasal, and temporal regions showed mild changes.

Keywords: Retinal nerve fiber layer thickness (RNFL), trabeculectomy, primary open-angle glaucoma (POAG), intraocular pressure, optic nerve, optical coherence tomography

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Introduction

Glaucoma is a progressive optic neuropathy characterized by irreversible damage to the optic nerve, leading to visual loss and potential blindness.[1] The optic nerve head is the primary site of glaucomatous damage and is characterized by clinically detectable tissue loss in RNFL.[2,3] It primarily includes primary open-angle glaucoma and angle-closure glaucoma.[4]

The global prevalence of glaucoma is estimated at 3.5% among individuals aged 40 to 80 years, with projections indicating that the number of affected individuals will increase from 76.0 million in 2020 to 111.8 million by 2040.[5]

Primary Open-angle glaucoma (POAG) is a chronic and progressive optic neuropathy that is distinguished by an open anterior chamber angle, characteristic alterations in the optic nerve head, thinning of the retinal nerve fiber layer, and a gradual decline in peripheral vision.[6,7] It is primarily associated with elevated intraocular pressure (IOP), although some cases occur with normal IOP, highlighting the involvement of vascular and neurodegenerative mechanisms.[8]

The worldwide prevalence of POAG accounts for 8% of all blindness.[9] Among those diagnosed, primary open-angle glaucoma (POAG) accounts for 74% of cases, with nearly 80% of glaucoma cases in the United States classified as POAG. The global prevalence of all forms of glaucoma is expected to increase.[7] In Bangladesh, POAG is also a growing concern. A population-based study found that the prevalence of glaucoma in individuals aged 35 and above is 3.2%, with POAG accounting for approximately 78% of all glaucoma cases.[8] Another study in a tertiary hospital in Bangladesh reported that POAG constitutes around 32% of all glaucoma cases diagnosed.[10] Early diagnosis and management are crucial in preventing vision loss and reducing the socioeconomic burden associated with POAG.

The pathogenesis of POAG includes mechanosensitive ion channel dysfunction, oxidative stress, retinal ganglionic cell degeneration, and impaired axonal transport at the optic nerve head leading to irreversible vision loss.[11,12] Genetic susceptibility plays a crucial role, with mutations in genes such as MYOC and OPTN being linked to familial cases.[13] Elevated intraocular pressure (IOP) remains the most significant risk factor, contributing to mechanical stress and vascular dysfunction within the optic nerve head.[14] Recent studies suggest that decreased choroidal blood flow and neurotrophic factor deficiency contribute to disease progression, emphasizing the need for early diagnosis and effective management strategies.[8]

POAG is considered a heritable and polygenic disease.[12] It has multiple contributing factors including elevated intraocular pressure (IOP), genetic predisposition, age, ethnicity, and vascular dysfunction.[15,16] Increased IOP remains a significant risk factor as it contributes to optic nerve damage, leading to progressive vision loss.[13] Vascular risk factors, mainly HTN and blood pressure dipping, play an important role in the pathogenesis and progression of glaucoma.[17]

Retinal nerve fiber layer (RNFL) thickness is a critical biomarker for evaluating glaucoma progression, as it reflects the structural integrity of retinal ganglion cell axons.[18] Retinal nerve fiber layer (RNFL) thickness measurement using optical coherence tomography (OCT) is a critical tool in glaucoma diagnosis and monitoring.[19] It is the common non-invasive tool used in the diagnosis of glaucoma.[20] OCT enables high-resolution, cross-sectional imaging of the retina, allowing early detection of structural damage before significant visual field loss occurs.[15] The precision of OCT in segmenting and quantifying RNFL thickness provides valuable insights into disease progression and treatment efficacy.[21]

Trabeculectomy is a gold-standard surgical procedure for reducing intraocular pressure (IOP) in glaucoma patients by creating a drainage channel to allow aqueous humor outflow thereby preventing optic nerve damage.[22] By lowering IOP it causes slowing down apoptosis of retinal ganglionic cells and halt glaucoma progression.[23] It's a common approach to glaucoma treatment when not controlled by conservative measures.[24]

Reduction in intraocular pressure (IOP) post-surgery significantly impacts the optic nerve head (ONH) and retinal nerve fiber layer (RNFL), often leading to structural and functional improvement.[25] Lower IOP mitigates mechanical stress, reducing ONH deformation and preserving capillary density, which is crucial for maintaining visual function.[26] Additionally, RNFL thinning stabilizes, potentially slowing glaucoma progression.[27]

Trabeculectomy significantly influences retinal nerve fiber layer (RNFL) thickness over time, with early post-surgical reductions in intraocular pressure (IOP) stabilizing RNFL integrity.[28] Long-term RNFL preservation may be influenced by surgical techniques, adjunctive treatments, and patient-specific factors.[29]

Variability in retinal nerve fiber layer (RNFL) changes post-surgery includes initial thickening due to rapid intraocular pressure (IOP) reduction, followed by long-term revert to preoperative stage.[25] Understanding this variability is essential for refining post-surgical monitoring and optimizing glaucoma management.[30] These insights can guide clinical decision-making, ensuring personalized treatment strategies to balance IOP control with RNFL integrity.[31]

Evaluation of retinal nerve fiber layer (RNFL) thickness before and after trabeculectomy and assessing structural changes over time. Additionally, it seeks to analyze the correlation between intraocular pressure (IOP) reduction and RNFL alterations to determine the impact of surgical intervention on neuroretinal integrity.

Materials and Methods

For this observational, Cross-sectional study, 20 eyes of 16 patients were recruited from the Institute of Bangladesh Medical University (BMU), Department of Ophthalmology, from December 2023 to November 2024.

Diagnosed cases of POAG with medication undergoing trabeculectomy, aged 40-60 years of both sexes were included but patients having other ocular comorbidities affecting the optic nerve head, previous ocular surgery, trauma, and significant media opacities were excluded from the study sample.

Complete clinical evaluations include history, physical examination, relevant ocular examinations, fundus examination, and some special ocular examinations, like IOP, visual field analysis, and gonioscopy were done.

Slit lamp examination of the anterior segment.

The fundus examination was done with the help of a +90D condensing lens.

IOP was measured by a Goldman applanation tonometer.

Angle assessment (by Sussman Four Mirror Gonioscope) was done under low ambient illumination.

The study participants were selected for trabeculectomy, and surgery was done by single surgeon, all patients were treated postoperatively with moxifloxacin 0.5% eye drop and difluprednate 0.05% eye drop. OCT RNFL thickness was done postoperatively after one month with the help of a technician in the Department of Ophthalmology, BMU.

Both eyes of each participant were dilated with tropicamide 1% eye drop 10 -15 minutes before OCT scanning by NIDEK RS 330 (software version 1.6.0.0.).

Statistical analysis of the results was done by using computer-based software, SPSS 22 (SPSS Inc, Chicago, IL, USA)

The paired t-test was used to see the difference in RNFL thickness with IOP before and after trabeculectomy.

A probability P value of 0.05 or less was considered as significant.

Ethical Considerations

Prior approval regarding the research protocol was taken from the IRB of BMU before the commencement of this study. All information collected in this study was kept strictly confidential, except as may be required by law. All the investigations & procedures used in this research study were strictly supervised by supervisor, reviewed periodically (after every 05 patients) & stored with a confidential code.

Results

Table I: Distribution of the study patients according to demographic information (n=20)

Demographic information	Number of study patients	Percentage (%)
Age (in years)		
41-50	2	10.0
51-60	18	90.0
Mean±SD	57.1±4.12	
Range(min-max)	48,60	

Table I shows the distribution of the study patients according to demographic information. It was observed that the majority (90.0%) population belonged to age 51-60 years and 2(10.0%) 41-50 years. The mean age was 57.1±4.12 years with ranged from 48 to 60 years.

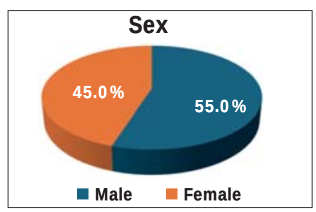

Figure 1: Pie chart shows the sex of study patients

More than half (55.0%) of the study patients were male and (45.0%) were female.

Table II: Distribution of the study patients according to BCVA (n=20)

BCVA	Number of study patients	Percentage (%)
0	2	10.0
0.18	9	45.0
0.3	7	35.0
0.48	1	5.0
0.78	1	5.0
Mean±SD	0.2±0.17	
Range (min, max)	0,0.78	

Table II shows the distribution of the study patients according to BCVA. It was observed that almost half (45.0%) of the study population BCVA had found 0.18, 7(35.0%) 0.3, 2(10.0%) 0, 1(5.0%) 0.48 and 1(4.0%) 0.78. The mean BCVA was 0.2±0.17 ranging from 0 to 0.78.

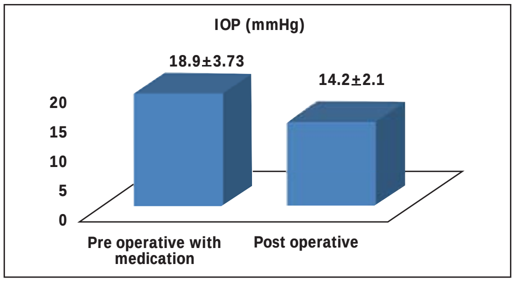

Figure 2: Bar diagram shows the IOP level of study patients

Figure 2 shows the distribution of the study patients according to IOP. The mean pre-operative IOP was 18.9±3.73 mmHg with ranging from 10 to 24 mmHg. The mean post-operative IOP was 14.2±2.1 mmHg with ranging from 10 to 18 mmHg. The mean IOP level significantly declined in the postoperative period compared to the preoperative period.

Table III: Distribution of the study patients according to VCDR (n=20)

VCDR	Number of study patients	Percentage (%)
0.6	4	20.0
0.7	1	5.0
0.8	7	35.0
0.9	8	40.0
Mean±SD	0.8±0.12	
Range (min, max)	0.6,0.9	

Table III shows the distribution of the study patients according to VCDR. It was observed that more than one third (40.0%) population VCDR had 0.9, 7(35.0%) 0.8, 4(20.0%) 0.6, and 1(5.0%) 0.7. The mean VCDR was 0.8±0.12 with ranged from 0.6 to 0.9.

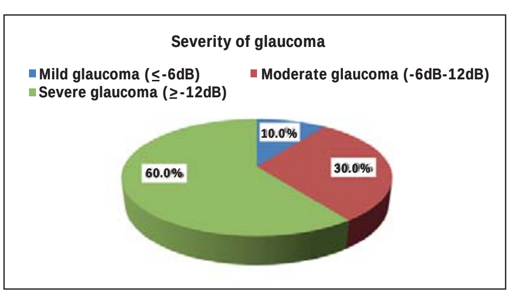

Figure 3: Pie chart shows the severity of glaucoma

Figure 3 shows the distribution of the study patients according to MD. It was observed that almost two thirds (60.0%) patients had severe glaucoma, 6(30.0%) moderate glaucoma, and 2 (10.0%) mild glaucoma. The mean MD was 16.5±9.01 dB ranging from -3.6 to -31.54 db.

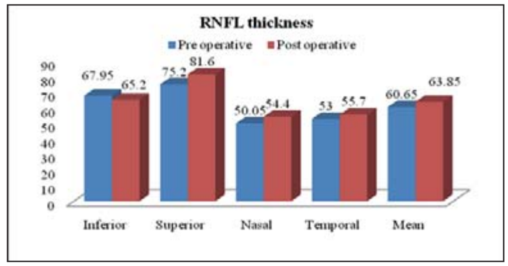

Figure 4: Bar diagram shows the change in RNFL thickness

Figure 4 shows the distribution of the study patients according to RNFL thickness. The mean inferior RNFL thickness was 67.95±13.82 in pre-operative and 65.2±15.86 post-operative. The mean superior RNFL thickness was 75.2±23.7 in pre-operative and 81.6±25.29 post-operative. The mean nasal RNFL thickness was 50.05±10.59 in pre-operative and 54.4±12.88 post-operative. The mean temporal RNFL thickness was 53±13.71 in pre-operative and 55.7±10.94 post-operative. The mean RNFL thickness was 60.65±10.34 in pre-operative and 63.85±12.74 post-operative. Superior and mean RNFL thickness levels were significantly increased during the postoperative period compared to the preoperative period.

Table IV: Relation of RNFL thickness with severity of glaucoma (n=20)

RNFL thickness	n	Pre-operative Mean±SD	Post operative Mean±SD	P-value
Mean				
Mild glaucoma	2	66.5±12.02	69±4.24	0.728^{ns}
Moderate glaucoma	6	66.33±10.01	71.17±13.24	0.139^{ns}
Severe glaucoma	12	56.83±9.28	59.33±11.94	0.242^{ns}

ns=not significant

P value reached from Paired t-test

In mild glaucoma cases, 2 (10%) patients had a preoperative RNFL thickness of 66.5±12.02 µm, which increased to 69±4.24 µm postoperatively (P=0.728, ns). Among 6 (30%) patients with moderate glaucoma, the mean RNFL thickness was 66.33±10.01 µm preoperatively and 71.17±13.24 µm postoperatively (P=0.139, ns). In 12 (60%) patients with severe glaucoma, the mean RNFL thickness improved from 56.83±9.28 µm to 59.33±11.94 µm after surgery (P=0.242, ns). Despite an observed increase in RNFL thickness postoperatively in all severity groups, the changes were not statistically significant (P>0.05).

Discussion

Trabeculectomy has been shown to influence RNFL thickness, particularly in the inferior and superior quadrants. Changes in RNFL thickness may result from transient edema or relief of mechanical stress following intraocular pressure reduction. The procedure is associated with early postoperative fluctuations, followed by stabilization over time.[23] The nasal and temporal quadrants exhibit minimal variation, suggesting that trabeculectomy has a localized impact on certain retinal areas. Structural changes in RNFL thickness postoperatively highlight the importance of monitoring glaucoma progression. Trabeculectomy remains a key intervention in reducing intraocular pressure and preserving optic nerve function, though long-term effects on RNFL require further evaluation.

The present analysis revealed that the majority (90.0%) of the study patients belonged to the 51-60 years age group, with a mean age of 57.1±4.12 years, ranging from 41 to 60 years. Comparatively, [31] reported a lower mean age of 51.83±16.24 years. Similarly, [33] found a mean age of 54.47±5.38 years in the trabeculectomy group and 55.80±6.94 years in the medication group. [32]reported a mean age of 53.93±13.92 years. These findings indicate that the mean age in the present study is relatively higher than in the referenced studies, suggesting an increased prevalence of primary open-angle glaucoma among older individuals**.**

The study patients exhibited a higher proportion of males (55.0%) compared to females (45.0%). This aligns with findings from[18] who reported a male predominance (66.9%) in primary open-angle glaucoma (POAG) cases, emphasizing potential gender-related susceptibility factors. Similar trends were observed by[34] who noted a higher prevalence of POAG in males aged 45–60 years**.**

The present analysis found that the mean BCVA was 0.2±0.17, ranging from 0 to 0.78. Nearly half (45.0%) of the study population had a BCVA of 0.18, followed by 35.0% with 0.3, while lower percentages were found for BCVA values of 0, 0.48, and 0.78. **[30]**also measured BCVA in glaucoma patients undergoing trabeculectomy, recording values using LOGMAR. Their study emphasized comprehensive ophthalmic evaluation, including BCVA assessment before and after surgery. The present findings indicate a wide variability in BCVA, which may be attributed to the different stages of glaucoma progression among patients. The lower BCVA values observed in some individuals could suggest advanced glaucomatous damage, while higher values may indicate cases with better-preserved visual function**.**

The present analysis revealed a significant reduction in intraocular pressure (IOP) following trabeculectomy, with the mean preoperative IOP recorded at 18.9±3.73 mmHg and the mean postoperative IOP at 14.2±2.1 mmHg (p<0.05). This decline is consistent with findings reported by[26] who observed a greater IOP reduction, from a preoperative mean of 28.55±8.47 mmHg to 14.8±5.97 mmHg at three months postoperatively. Similarly**, [25]**reported a preoperative IOP of 30.23±9.02 mmHg, which significantly decreased to 9.52±2.42 mmHg at one week, 12.35±4.59 mmHg at one month, and 13.6±2.31 mmHg at three months. The IOP reduction in the present study, though significant, appears to be lower in magnitude, possibly due to variations in baseline IOP, surgical techniques, or population characteristics. Nevertheless, these findings reinforce the effectiveness of trabeculectomy in achieving sustained IOP control in primary open-angle glaucoma**.**

The findings indicate that a significant proportion of study patients exhibited a vertical cup-to-disc ratio (VCDR) of 0.9 (40.0%), followed by 0.8 (35.0%), 0.6 (20.0%), and 0.7 (5.0%). The mean VCDR was 0.8±0.12, with a range of 0.6 to 0.9. This aligns with prior studies demonstrating an association between elevated VCDR and glaucomatous optic neuropathy. **[35]**reported that VCDR correlates with visual field defects**.**

The present analysis indicated that 60.0% of the study patients had severe glaucoma, 30.0% had moderate glaucoma, and only 10.0% had mild glaucoma. The mean deviation (MD) was recorded at 16.5±9.01 dB, ranging from 3.6 to 31.54 dB. The high percentage of severe glaucoma cases suggests that many patients seek treatment at an advanced stage, which may be attributed to delayed diagnosis or a higher level of deprivation and lack of awareness regarding early disease symptoms.[36] The variation in MD values reflects differing levels of glaucomatous damage among patients, with more negative MD values indicating greater visual field loss. [36] The earlier stage of glaucoma intervention is related to the reversal of ONH cupping.[25] Trabeculectomy, by lowering intraocular pressure, aims to slow down further visual field deterioration, highlighting its role as a crucial surgical approach in managing advanced primary open-angle glaucoma**.**

The present analysis demonstrated that the inferior RNFL thickness was 67.95±13.82 μm preoperatively and 65.2±15.86 μm postoperatively, with no statistically significant increase observed postoperatively (p>0.05). [21] reported a similar trend, where the mean inferior quadrant thickness was 63.3±8.978 μm preoperatively and increased significantly to 69.48±9.002 μm at one week postoperatively (p=0.000). Compared to the present findings, the early increase in inferior RNFL thickness in the referenced study might be attributed to transient postoperative edema, which subsequently stabilized**.**

The present analysis demonstrated a significant increase in superior RNFL thickness following trabeculectomy, with the mean preoperative thickness at 75.2±23.7 μm and postoperative thickness at 81.6±25.29 μm (p<0.05). This finding aligns with[15] who reported a superior quadrant mean RNFL thickness of 61.60±15.80 μm preoperatively, increasing to 71.50±18.10 μm (p=0.001) at one month postoperatively. [3] show a significant increase in RNFL thickness from 85.8±25.1 μm to six months postoperatively 96.7±23.2 μm (p=0.0210. While both studies observed a significant increase in superior RNFL thickness postoperatively, the magnitude of change in the present study appears more pronounced. This could be attributed to differences in baseline RNFL values, and surgical techniques**.**

The present analysis indicated that the mean nasal RNFL thickness increased from 50.05±10.59 μm preoperatively to 54.4±12.88 μm postoperatively; however, this increase was not statistically significant (p>0.05). [24] also reported a similar trend, with the mean nasal quadrant thickness measuring 61.41±15.88 μm preoperatively and increasing to 62.86±15.25 μm at one month postoperatively (p=0.45). While both studies observed a postoperative increase in nasal RNFL thickness, the lack of statistical significance suggests that trabeculectomy does not induce major structural changes in this quadrant. Differences in baseline RNFL thickness and follow-up duration could explain the variations in postoperative measurements**.**

The present analysis demonstrated that the mean temporal RNFL thickness increased from 53±13.71 μm preoperatively to 55.7±10.94 μm postoperatively, but this increase was not statistically significant (p>0.05). [21] reported similar findings, with a mean temporal RNFL thickness of 50.81±9.915 μm preoperatively and a slight increase to 51.85±10.117 μm at three months postoperatively (p=1.000). Both studies indicate that trabeculectomy does not significantly impact the temporal quadrant, possibly due to its relatively lower susceptibility to glaucomatous damage compared to the superior and inferior quadrants. The observed numerical increase in temporal RNFL thickness may be attributed to transient postoperative changes, such as mild edema or reduced mechanical compression of nerve fibers following intraocular pressure reduction.

The present analysis revealed a significant increase in mean RNFL thickness following trabeculectomy, with values rising from 60.65±10.34 μm preoperatively to 63.85±12.74 μm postoperatively (p<0.05). This finding aligns with[30], who reported an increase in mean RNFL thickness from 52.56±17.40 μm preoperatively to 58.48±20.20 μm postoperatively (p<0.0001). Both studies indicate that trabeculectomy contributes to RNFL thickening, potentially due to reduced mechanical stress on retinal nerve fibers following intraocular pressure reduction**.**

Regarding the relation of RNFL thickness with severity of glaucoma in this study it was observed that mild cases, comprising 10%, exhibited a preoperative RNFL thickness of 66.5±12.02 μm, increasing to 69±4.24 μm postoperatively (P=0.728, ns). Among 30% with moderate glaucoma, RNFL thickness rose from 66.33±10.01 μm to 71.17±13.24 μm post-surgery (P=0.139, ns). In 60% with severe glaucoma, RNFL thickness improved from 56.83±9.28 μm to 59.33±11.94 μm postoperatively (P=0.242, ns).

Despite these observed increases, the changes were not statistically significant (P>0.05), suggesting trabeculectomy did not significantly enhance RNFL thickness within the study period. Similar findings were reported by[23], who observed a significant RNFL thickness reduction from 67.8±2.6 μm to 62.9±2.6 μm at 12 months post-trabeculectomy (P<0.01), indicating continued RNFL thinning despite effective intraocular pressure reduction.

Conclusion

This study evaluated changes in retinal nerve fiber layer (RNFL) thickness before and after trabeculectomy in patients with primary open-angle glaucoma. Superior and mean RNFL thickness showed a significant increase after surgery, while inferior, nasal, and temporal RNFL thickness exhibited mild changes. The results suggest that trabeculectomy effectively reduces IOP and may contribute to structural changes in RNFL thickness.

Limitations

The study did not consider the impact of systemic and vascular diseases like DM and HTN on RNFL thickness. We didn't stratify the sample according to glaucoma severity as a result, the variation in disease stage may have influenced the RNFL measurements and affected the uniformity of findings.

Recommendations

Future research should conduct multicenter studies with extended follow-up periods with larger sample sizes to assess long-term changes in RNFL thickness and glaucoma progression after trabeculectomy. Further research should analyze the impact of systemic diseases on RNFL thickness changes post-trabeculectomy. Future research should evaluate the correlation between RNFL changes and functional visual outcomes over an extended period.

Conflicts Of Interest

All the authors declare no conflict of interest.

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Association between Platelet Parameters and Primary Open Angle Glaucoma

S Akhter[1], S A Wadud[2], S M Noman[3]

Abstract

Background: Primary open-angle glaucoma (POAG) is a progressive optic neuropathy associated with vascular dysfunction. Platelet parameters, including platelet count (PLT), mean platelet volume (MPV), and platelet distribution width (PDW) provide insights into platelet activity and function. There is growing evidence, that elevated MPV and PDW suggest increase platelet activation, which may contribute to microvascular dysfunction.

Aims: To assess the association between platelet parameters (PLT, MPV, PDW) with primary open angle glaucoma and its severity.

Methods: This cross sectional comparative study was carried out into Department of Ophthalmology, Bangladesh Medical University (BMU) during November, 2023 to October, 2024. A total of 40 diagnosed cases of Primary open angle glaucoma were taken for the case group and 40 patients were selected considering similar age group as comparison group without glaucoma. Complete clinical evaluation was done. Visual field analysis, color fundus photography (CFP), optical coherence tomography (OCT) Retinal nerve fibre layers (RNFL) were done in Ophthalmology department and CBC with platelet parameters (PLT, MPV, PDW) were measured in the Department of Laboratory Medicine, BMU. Statistical analyses of the results were obtained by using Statistical Packages for Social Sciences (SPSS-22).

Results: The mean PLT was 219.95±32.59 (10^9/L) in the POAG group and 281.4±49.4 (10^9/L) in the control group. The mean MPV was 10.51±0.73 ft in the POAG group and 8.92±0.39 ft in the control group. The mean PDW was 14.69±1.48 fl in the POAG group and 11.74±1.17 fl in the control group. The differences were statistically significant ($p < 0.05$) between two groups. Among patients with POAG, 60.0% had severe glaucomatous damage, 25.0% had moderate glaucomatous damage and 15.0% had mild glaucomatous damage, on the basis of mean deviation (MD) of visual field analysis. The mean PLT was 237.5±39.47 (10^9/L) in mild glaucomatous damage, 218±35.84 (10^9/L) in moderate glaucomatous damage and 216.38±29.4 (10^9/L) in severe glaucomatous damage. The mean MPV was 10.1±0.66 ft in mild glaucomatous damage, 10.34±0.6 ft in moderate glaucomatous damage and 10.7±0.75 ft in severe glaucomatous damage. The mean PDW was 13.7±2.06 fl in mild glaucomatous damage, 14.72±0.94 fl in moderate glaucomatous damage and 14.91±1.46 fl in severe glaucomatous damage. The differences among the three groups were not statistically significant ($p > 0.05$). Pearson's correlation coefficient test showed no statistically significant ($p > 0.05$) correlation between platelet parameters and severity of POAG.

Conclusion: Platelet count was lower, while mean platelet volume and platelet distribution width were higher in POAG patients compared to control. However, there was no correlation between platelet parameters and the severity of POAG.

Keywords: Platelet parameters, mean platelet volume, platelet distribution width, Primary open angle glaucoma.

Introduction

Glaucoma is a progressive optic neuropathy causing irreversible vision loss due to retinal ganglion cell degeneration, often linked to increased intraocular pressure, genetic predisposition, vascular dysfunction, and neuroinflammation.[1-4]

Glaucoma is a leading cause of irreversible blindness, affecting approximately 3.5% of the global population aged 40 to 80 years.[5] The number of individuals affected by glaucoma is projected to rise from 76 million in 2020 to 111.8 million by 2040.[6] In 2022, the estimated prevalence of glaucoma in the United States was 2.56% among individuals aged 40 years or older, with African Americans experiencing higher rates at 3.15% compared to White Americans at 1.42%.[7] The burden of primary open-angle glaucoma (POAG) is particularly significant, with a prevalence of 2.4% worldwide, increasing with age and disproportionately affecting populations in Africa (4.0%).[8] In lower-income regions, the prevalence of glaucoma- related blindness is also significantly higher due to limited access to healthcare services.[9]

The prevalence of glaucoma in Bangladesh among individuals aged ≥35 years is estimated to be 3.2% (95% CI: 2.79%-3.64%), with approximately 2 million people affected.[10] Among glaucoma cases, 78% are

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classified as primary open-angle glaucoma (POAG), while 16% have angle-closure glaucoma.[10] A study from a tertiary eye hospital in Bangladesh found that primary angle-closure glaucoma (PACG) accounts for 45% of cases, followed by POAG at 32%.[11]

Primary open-angle glaucoma (POAG) is associated with multiple risk factors, including advanced age, elevated intraocular pressure (IOP), family history, thin cornea.[12] Systemic conditions such as hypertension, diabetes further increase susceptibility to POAG.[13] The primary mechanism involves elevated intraocular pressure (IOP) due to impaired trabecular meshwork outflow, causing optic nerve head ischemia and axonal damage.[14]

Vascular dysregulation and oxidative stress are key contributors to primary open- angle glaucoma (POAG) pathophysiology. Impaired blood flow and endothelial dysfunction reduce oxygen supply to the optic nerve, exacerbating neurodegeneration.[14] Oxidative stress plays a pivotal role by damaging retinal ganglion cells and increasing trabecular meshwork resistance, leading to elevated intraocular pressure.[14, 15]

Platelets play a fundamental role in vascular homeostasis, thrombosis, and inflammation, serving as immune regulators beyond their hemostatic function.[16] The activation of Platelets in conjunction with the vascular endothelium and plasma components, plays a vital role in the pathophysiology of thrombosis and microvascular processes impacting ocular microcirculation.[3]

Mean platelet volume (MPV) and platelet distribution width (PDW) are frequently used as markers of platelet activation and function in the circulation.[17, 18] MPV shows the average platelet size, whereas PDW shows the variation in platelet size.[18] Greater amounts of thromboxane A2 are released by larger, more active platelets with elevated MPV and PDW levels, which promote platelet aggregation in vitro.[17, 18]

Platelet activation and altered platelet indices have been implicated in retinal microvascular damage and optic nerve ischemia. Activated platelets contribute to thromboinflammation, leading to vascular occlusions that impair optic nerve perfusion.[3,19] Elevated platelet distribution width (PDW) and mean platelet volume (MPV) in POAG patients indicate increased platelet activation and aggregation, which can exacerbate ischemic damage.[20] Several studies confirm the role of oxidative stress in POAG progression, with mitochondrial dysfunction and lipid peroxidation as contributing factors.[21, 22] Platelet activation and oxidative stress may offer new therapeutic approaches for POAG.[23, 24] A study provide additional evidence of vascular dysregulation in POAG, suggesting that modulating platelet activation could serve as a potential therapeutic approach.[20]

Current literature on platelet parameters in primary open-angle glaucoma (POAG) remains inconclusive. Some studies suggest increased platelet activation in POAG, reflected by elevated mean platelet volume (MPV) and platelet distribution width (PDW).[19, 20] while others found no significant correlation between platelet indices and disease severity.[24, 25]

This study investigate the association between platelet parameters including platelet count (PLT), mean platelet volume (MPV), platelet distribution width (PDW) and primary open angle glaucoma (POAG). Investigating platelet parameters in POAG is crucial, as platelet activation may exacerbate retinal microvascular damage and optic nerve ischemia, influencing disease progression.

Materials and method

A cross sectional comparative study was carried out in Bangladesh Medical University, Shahbag, Dhaka, from November 2023 to October 2024. Patients attended in the glaucoma clinic and out patient department of Department of Ophthalmology, BMU, were the study population. There were two groups: Case group (POAG): Patients who came to Glaucoma clinic, age between 40-70 years of both genders, IOP ≥21mm of Hg or ≤21mm of Hg having definite glaucomatous optic nerve head damage, receiving anti glaucoma medications, glaucomatous optic nerve head changes and visual field defect, open irido-corneal angle assessed with gonioscopy and normal anterior chamber depth were diagnosed as POAG and considered as case group. Control group: Patients without POAG were selected from Ophthalmology Out Patient Department. Patients who have secondary glaucoma, congenital glaucoma, angle closure glaucoma, patients having systemic and hematological diseases that affect platelet parameter, patients with abnormal coagulation function, patients taking antiplatelets /anticoagulants were excluded from the study. As well as patients having autoimmune diseases, renal diseases, hepatic, acute infectious diseases, thyroid dysfunction and cancer were excluded from the study. The purposive sampling technique was applied to collect sample from the study population. As elevated blood glucose level altered the platelet parameters that's why RBS was done. Participants who had abnormal RBS level were excluded from the study. Complete clinical evaluation including history, clinical examination, relevant ocular examinations, fundus examination, some special ocular examination like IOP, visual field analysis, gonioscopy were done in Ophthalmology department, Bangladesh Medical University. Ocular examinations includes: BCVA, Pupillary light reaction, Color vision test, Slit lamp examination of anterior segment & fundus examination was done with the help of + 78 D condensing lens. Intraocular pressure was measured by Goldmann applanation tonometer. Normal value is 10-21 mm of Hg. Angle assessment by gonioscopy (Sussman four mirror diagnostic gonioscope) was done under low ambient illumination. CBC with platelet parameters, Color fundus photography (CFP)- B/ E, Humphrey visual field analysis 24-2 B/E, Optical Coherence Tomography ONH and RNFL B/E. CBC with platelet parameters were measured in Department of Laboratory Medicine, BMU by using SYSMEX XN 2000 (6 part) automated hematology analyzer. The reference ranges of platelet count (PLT): 150-450 × 10^9 /L, mean platelet volume (MPV): 7.2-9.2 fl, platelet distribution width (PDW): 9-17 fl. RBS level was measured in Department of Laboratory Medicine, BMU by using SIEMENS automated biochemistry analyzer. The reference range of RBS: 4.4-7.8 mmol/L

Statistical Analysis

The demographic information, relevant history, examination findings, investigation report, of all the study subjects was recorded in the data collection sheet. After compilation, the data was presented in the form of tables, figures and graphs, as necessary. Statistical analysis of the results was done by using computer-based software, SPSS version 22 (SPSS Inc, Chicago, IL, USA). Descriptive statistics were expressed as Mean, Standard deviation, frequency, percentage. Un-paired t-test was used to compare two means of two groups, chi-square test was used to measure the association between two qualitative variables, ANOVA test was used to compare three means of three groups. Pearson's correlation coefficient test was done to see the correlation. 'P' value of 0.05 or less was considered as significant.

Table I: Distribution of the study patients according to age (n=80)

Age (years)	Case group (n=40)		Control group (n=40)		P value
	n	%	n	%	
40-50	8	20.0	14	35.0	
51-60	18	45.0	17	42.5	
61-70	14	35.0	9	22.5	
Mean±SD	57.6±7.9		54.4±7.36		0.064[ns]
Range (min,max)	40,70		40,68		

ns=not significant
P value reached from unpaired t-test

Table I shows the distribution of the study patients according to age. It was observed almost half (45.0%) of patients belonged to age 51-60 years in case group and 17(42.5%) in control group. The mean age was 57.6±7.9 years in case group and 54.4±7.36 years in control group. The difference was statistically not significant (p>0.05) between two groups.

Table II: Distribution of the study patients according to gender (n=80)

Gender	Case group (n=40)		Control group (n=40)		P value
	n	%	n	%	
Male	28	70.0	21	52.5	0.108ns
Female	12	30.0	19	47.5	

ns=not significant
P-value obtained from the Chi-square test

Table II shows the distribution of the study patients according to gender. It was observed almost three fourth (70.0%) of patients were male in case group and 21(52.5%) in control group. The difference was statically not significant (p>0.05) between two groups.

Table III: Distribution of the study patients according to platelet parameters (n=80)

Platelet parameters	Case group (n=40) Mean±SD	Control group (n=40) Mean±SD	P value
PLT (10^9/L)	219.95±32.59	281.4±49.4	0.001[s]
Range (min,max)	160,280	200,400	
MPV (ft)	10.51±0.73	8.92±0.39	0.001[s]
Range (min,max)	9.2,12.1	8.4,9.7	
PDW (fl)	14.69±1.48	11.74±1.17	0.001[s]
Range (min,max)	10.1,16.9	9.7,15.7	

s=significant
P value reached from unpaired t-test

Table III shows the distribution of the study patients according to platelet parameters. The mean PLT was 219.95±32.59 (10^9/L) in case group and 281.4±49.4 (10^9/L) in control group. The mean MPV was 10.51±0.73 ft in case group and 8.92±0.39 ft in control group. The mean PDW was 14.69±1.48 fl in case group and 11.74±1.17 fl in control group. The difference was statistically significant (p<0.05) between two groups.

Table IV: Distribution of the study patients having POAG by severity of glaucomatous damage graded according to mean deviation in visual field (MD) (n=40)

MD(db)	Number of patients (n)	Percentage (%)
Mild POAG (≤ -6DB)	6	15.0
Moderate POAG (>-6 to ≤- 12 DB)	10	25.0
Severe POAG (> -12 DB)	24	60.0
Mean±SD	-15.95±9.01	
Range (min,max)	-1.73, -32.23	

Table IV shows the arrangement of participants having POAG by severity of glaucomatous damage graded according to mean deviation in visual field (MD). It was viewed that nearly 2/3rd (60.0%) patients had severe POAG (> -12 DB), 10(25.0%) had moderate POAG (>-6 to ≤ -12 DB) and 6(15.0%) had mild POAG (≤ -6DB). The mean MD was -15.95±9.01 DB with ranged from -1.73 to -32.23 DB.

Table V: Comparison between platelet parameters of different grading of primary open angle glaucoma (POAG) based on severity of the glaucomatous damage graded according to mean deviation (MD) of visual field (n=40)

Parameters	Mild POAG (n=6)	Moderate POAG (n=10)	Severe POAG (n=24)	P-value
PLT (10^9/L)	237.5±39.47	218±35.84	216.38±29.4	0.365[ns]
MPV (ft)	10.1±0.66	10.34±0.6	10.7±0.75	0.127[ns]
PDW (fl)	13.7±2.06	14.72±0.94	14.91±1.46	0.202[ns]

ns= not significant

P value reached from ANOVA test

Table V shows the comparison between platelet parameters of different grading of primary open angle glaucoma (POAG) based on severity of the glaucomatous damage graded according to mean deviation (MD) of visual field. The mean PLT was 237.5±39.47 (10^9/L) in mild POAG, 218±35.84 (10^9/L) in moderate POAG and 216.38±29.4 (10^9/L) in severe POAG. The mean MPV was 10.1±0.66 ft in mild POAG, 10.34±0.6 ft in moderate POAG and 10.7±0.75 ft in severe POAG. The mean PDW was 13.7±2.06 fl in mild POAG, 14.72±0.94 fl in moderate POAG and 14.91±1.46 fl in severe POAG. The difference was statistically not significant (p>0.05) among three groups.

Table VI: Correlation between platelet parameters and severity of POAG based on the mean deviation (MD) of the visual field (n=40)

Platelet parameters	Mean Deviation (MD) of visual field	
	Correlation Coefficient (r)	P value
PLT (10^9/L)	0.047	0.774[ns]
MPV (ft)	0.125	0.443[ns]
PDW (fl)	0.076	0.642[ns]

ns= not significant

Pearson's correlation coefficient test

Table VI shows the correlation between platelet parameters and severity of POAG based on the mean deviation (MD) of the visual field. PTL, MPV and PDW were not significantly correlated with severity of POAG based on the mean deviation (MD) of the visual field.

Discussions

This cross-sectional comparative study was conducted to compare between platelet parameters, including platelet count (PLT), mean platelet volume (MPV), and platelet distribution width (PDW), in primary open-angle glaucoma (POAG) patients and in individual without primary open-angle glaucoma and to compare the platelet parameters including platelet count (PLT), mean platelet volume (MPV) and platelet distribution width (PDW) in between two groups and also to assess the association between platelet parameters and severity of primary open angle glaucoma (POAG) as well as to see the demographic variables of those patients. The study included 80 patients, comprising individuals diagnosed with POAG and those without glaucoma, who attended the Department of Ophthalmology at Bangladesh Medical University (BMU) from November 2023 to October 2024 were included in this study. Among them 40 patients with POAG were considered as case group and rest 40 participants were normal control group. All participants were selected based on specific inclusion and exclusion criteria to ensure the accuracy of the findings. As elevated blood glucose level altered the platelet parameters that's why RBS was done. Participants who had abnormal RBS level were excluded from the study.

In this study the age distribution analysis indicated that 45.0% of POAG patients were between 51-60 years, with a mean age of 57.6±7.9 years, while 42.5% of the control group fell within the same range, with a mean age of 54.4±7.36 years. The difference was not statistically significant ($p>0.05$). Similar trends reported a mean age of 55.73±13.09 years in POAG cases and 43.27±7.74 years in controls, though their control group had a slightly lower mean age.[3] Another study documented higher mean ages of 59.9±10.9 years in POAG cases and 56.6±10 years in controls, which aligns closely with the findings of the present study.[19]

In the present study, it was observed that almost 70.0% of patients in the primary open-angle glaucoma (POAG) group were male, whereas 52.5% of individuals in the control group were also male. However, the difference was statistically not significant ($p>0.05$). This finding aligns with another study which reported that 53.3% of POAG patients were male, while 43.3% of the control group consisted of males, showing no statistically significant gender-based difference ($p>0.505$).[3] Similar observation regarding the gender distribution were also noted in other studies.[19, 24]

Visual field mean deviation (MD) is a key parameter in assessing the severity of primary open-angle glaucoma (POAG). In the present study, 60.0% of POAG patients had severe glaucomatous damage (> -12 dB), 25.0% had moderate glaucomatous damage (-6 to -12 dB), and 15.0% had mild glaucomatous damage (< -6 dB). The mean MD was -15.95±9.01 dB, ranging from -1.73 to -32.23 dB. Another study found that 53.3% of POAG patients had advanced visual field loss, 20.0% had moderate damage, and 26.7% had early-stage disease.[3] Another research reported that 73.3% of cases exhibited early changes in visual fields, 16.7% had paracentral scotoma, and 10.0% had end-stage visual fields defects,[24] indicating variation in POAG severity across populations.

Platelet parameters, including platelet count (PLT), mean platelet volume (MPV), and platelet distribution width (PDW), are emerging as potential indicators of vascular involvement in primary open-angle glaucoma (POAG). In the present study, the mean PLT was significantly lower in POAG patients (219.95±32.59 × 10^9/L) compared to the control group (281.4±49.4 × 10^9/L), while MPV was significantly higher ($p<0.05$) in POAG patients (10.51±0.73 fl) compared to controls (8.92±0.39 fl) and PDW was significantly higher ($p<0.05$) in POAG patients (14.69±1.48 fl) compared to controls (11.74±1.17 fl). These findings are consistent with another study that reported a significantly lower PLT count in POAG patients (207.08±54.70 × 10^9/L) compared to controls (220.46±55.85 × 10^9/L), with significantly elevated MPV (10.46±1.32 fl) compare to control (10.13±1.10 fl) and significantly elevated PDW (13.76±3.16 fl) compared to control (11.82±2.44 fl).[20] Another study found that lower PLT count in POAG patients (276.1±43.5 × 10^9/L) compared to controls (291.2±53.0 × 10^9/L) with no statically significant difference ($p>0.05$). But significantly elevated MPV (8.48±0.83fl) and PDW (16.29±1.10 fl) compared to control MPV (8.17±0.76fl), PDW (15.85±0.74 fl).[19] Another study revealed a significantly lower PLT count ($p=0.037$) and significantly elevated PDW ($p<0.001$) and MPV ($p=0.038$) compared to control.[18] The observed increase in MPV and PDW suggests enhanced platelet activation, which may contribute to microvascular dysfunction and insufficient blood supply to the optic nerve, aligning with the vascular theory of glaucoma.[20]

Platelet parameters have been explored as potential indicators of vascular dysfunction in primary open-angle glaucoma (POAG). In the present study, the mean platelet count (PLT) was higher in mild POAG (237.5±39.47 × 10^9/L) compared to moderate (218±35.84 × 10^9/L) and severe cases (216.38±29.4 × 10^9/L). Conversely, mean platelet volume (MPV) and platelet distribution width (PDW) showed an increasing trend with disease severity, with MPV values of 10.1±0.66 fl in mild POAG, 10.34±0.6 fl in moderate POAG, and 10.7±0.75 fl in severe POAG. Similarly, PDW increased from 13.7±2.06 fl in mild cases to 14.72±0.94 fl in moderate cases and 14.91±1.46 fl in severe cases. However, the differences among the three groups were not statistically significant ($p>0.05$).

The linear correlation was calculated based on the mean deviation of the visual field of the POAG patients and their corresponding platelet parameters and no statistical significance was found ($p>0.05$). This implies that, there was no statistical linear correlation of platelet parameters with severity of POAG. These findings are in line with a study that reported a non-significant variation in PLT across different POAG severities, with platelet aggregation parameters not showing a clear correlation with disease progression.[3] Similarly, Another study did not find a direct correlation between platelet parameters and POAG severity,[24] indicating that while platelet dysfunction may play a role in glaucoma pathogenesis, additional systemic or local vascular factors may also contribute to disease progression.

The lack of statistical significance in platelet parameter variations across POAG severity groups may indicate that platelet activation plays a role in glaucoma pathogenesis rather than its progression.[19] However, another study found that PDW and MPV were significantly elevated in POAG and PDW was positively associated with POAG severity.[20] These findings highlight the need for further studies to explore the complex interactions between platelet function and glaucoma severity.

Conclusion

This cross sectional comparative study was undertaken to assess the association between platelet parameters and primary open-angle glaucoma (POAG). Platelet count was lower, while mean platelet volume and platelet distribution width were higher in POAG patients compared to controls, indicating possible alterations in platelet function and vascular dysregulation. However, platelet parameters did not significantly associated with POAG severity levels. These findings suggest that warranting further research to explore its potential role in disease progression and management.

Recommendations

Prospective studies are needed to assess changes in platelet parameters over time and their role in POAG progression. Future studies should assess the clinical utility of platelet parameters as biomarkers for early POAG detection and risk stratification.

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Authors Contributions

All authors contributed to the article's drafting, revision, drafting and finalizing to fulfill authorship criteria.

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Conflict of interest

The author has no conflict of interest to declare.

Ethical Approval

The institutional review board has approved this research protocol, on 29th October 2023 before starting this study.

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Control of Intraocular Pressure with Glaucoma Drainage Devices and Transscleral Diode Laser Cyclophotocoagulation in Management of Neovascular Glaucoma

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Abstract

Purpose: To compare the short-term outcomes of glaucoma drainage device (GDD) implantation and diode laser cyclophotocoagulation (DLCP) in the management of neovascular glaucoma (NVG).

Methods: A prospective interventional study was conducted at the Glaucoma Department of Ispahani Islamia Eye Institute and Hospital, Dhaka, from June to December 2024. Forty-eight NVG patients were enrolled: 24 underwent GDD implantation (Ahmed Glaucoma Valve [AGV] or Aurolab Aqueous Drainage Implant [AADI]) and 24 underwent DLCP. Intraocular pressure (IOP), visual acuity (VA), and surgical success were evaluated preoperatively and at 1-week, 1-month, and 3-month follow-ups. Statistical analyses included chi-square tests and Two One-Sided Test (TOST) procedures for equivalence.

Results: Baseline mean IOP was 39.79 ± 3.57 mmHg (AADI), 34.80 ± 7.43 mmHg (AGV), and 40.04 ± 5.74 mmHg (DLCP). At 3 months, IOP reduced to 13.68 ± 8.13 mmHg, 13.20 ± 3.03 mmHg, and 13.46 ± 6.83 mmHg, respectively. VA remained stable in the GDD group (5.6% improvement) but poor in DLCP eyes. Complete surgical success occurred in 50% of GDD and 41.7% of DLCP cases; qualified success in 45.8% and 33.3%, respectively. One GDD failure was observed. Differences between groups were not statistically significant ($p = 0.405$). Equivalence testing showed visual outcome equivalence ($p > 0.999$), but IOP equivalence did not reach significance ($p = 0.08$).

Conclusion: Both GDD implantation and DLCP effectively reduced IOP with minimal complications. GDD preserved vision in eyes with useful potential, while DLCP provided effective pressure control and pain relief in eyes with poor prognosis. Surgical choice should be guided by baseline visual status and overall ocular condition.

Keywords: Neovascular glaucoma, Ahmed Glaucoma Valve, Aurolab Aqueous Drainage Implant, diode laser cyclophotocoagulation, intraocular pressure.

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Introduction

Neovascular glaucoma (NVG) is a secondary glaucoma, often refractory in nature, characterized by the formation of new vessels in the iris and anterior chamber angle.[1] This neovascularization leads to elevated intraocular pressure (IOP) and progressive vision loss.[2] Due to its aggressive course, the primary challenge in the NVG. management lies in achieving effective IOP control to prevent rapid optic nerve damage, visual deterioration, and to alleviate ocular pain. This study was conducted to evaluate the effectiveness of glaucoma drainage device implantation and diode laser cyclophotocoagulation (DLCP) in controlling IOP in patients with NVG and to compare their outcomes.

Materials and Methods

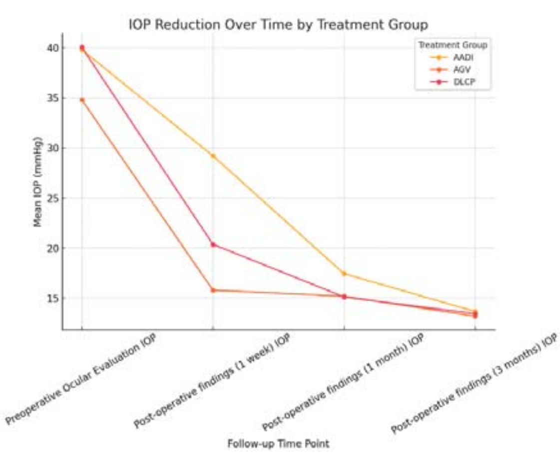
A prospective interventional study at the Department of Glaucoma, Ispahani Islamia Eye Institute & Hospital, Dhaka, from June to December 2024. Forty-eight consecutive NVG eyes were enrolled after informed consent. Assignment to GDD (AGV or AADI) or DLCP was based on clinical indication and visual prognosis. Inclusion criteria comprised clinical NVG with elevated IOP and iris/angle neovascularisation in adults (≥18 years). Exclusion criteria included untreated ischaemic retinopathy (no prior PRP/anti-VEGF), good visual potential (≥6/60) when considering DLCP, recent ocular surgery or infection. GDD implantation followed standard techniques under peribulbar or general anaesthesia. DLCP was performed by transscleral application avoiding the 3 and 9 o'clock meridians. Postoperative care included topical steroids, cycloplegics and IOP-lowering agents as required. Primary outcome was mean IOP at 3 months. Secondary outcomes included BCVA (LogMAR), surgical success (complete, qualified, failure) and complications. Complete success was defined as IOP ≤ 21 mmHg or ≥20% reduction without major complications; qualified success denoted IOP control with medications and/or complications; failure represented uncontrolled IOP with pain or need for re-intervention. Descriptive statistics were generated; Chi-square compared categorical outcomes. Two One-Sided Tests (TOST) assessed equivalence with ±3 mmHg (IOP) and ±0.2 LogMAR (VA) margins. The protocol received institutional ethics approval and adhered to the Declaration of Helsinki.

Results

Forty-eight NVG eyes were analysed: 24 underwent GDD (12 AADI, 12 AGV) and 24 underwent DLCP. Baseline mean IOPs were 39.79±3.57 mmHg (AADI), 34.80±7.43 mmHg (AGV), and 40.04±5.74 mmHg (DLCP). At 3 months, IOP reduced to 13.68±8.13, 13.20±3.03, and 13.46±6.83 mmHg, respectively. Visual acuity remained stable or modestly improved in GDD eyes and remained poor in DLCP eyes, consistent with baseline prognosis. Surgical outcomes: in the GDD arm, 18 complete successes, 5 qualified successes and 1 failure; in the DLCP arm, 16 complete and 8 qualified successes; no failures. Outcome distribution differences were not statistically significant (χ^2=1.81, p=0.405). TOST indicated equivalence for VA (p>0.999) and borderline equivalence for IOP (p=0.08).

Table 1: Intraocular Pressure (IOP) Reduction:

Treatment Group	Pre-op IOP	1 Week IOP	1 Month IOP	3 Month VA
AADI	39.79 ± 3.57	29.21 ± 7.38	17.44 ± 5.49	13.68 ± 8.13
AGV	34.80 ± 7.43	15.80 ± 1.64	15.20 ± 1.79	13.20 ± 3.03
DLCP	40.04 ± 5.74	20.38 ± 8.56	15.12 ± 5.86	13.46 ± 6.83



Discussion

This prospective interventional study compared the outcomes of glaucoma drainage device (GDD) implantation and diode laser cyclophotocoagulation (DLCP) in patients with neovascular glaucoma (NVG) treated at Ispahani Islamia Eye Institute & Hospital. Forty-eight patients were enrolled—24 in each group—and followed for three months to evaluate intraocular pressure (IOP) control, visual acuity (VA) trends, and surgical success.

The mean age was 54.8 years, aligning with other NVG cohorts, where elderly diabetic males predominate due to proliferative diabetic retinopathy (PDR) or central retinal vein occlusion (CRVO). In this study, diabetic retinopathy was the leading cause, consistent with previous reports by Sivak-Callcott et al.[5]

All interventions achieved significant IOP reduction by three months. AGV showed the fastest early decline (34.8 → 13.2 mmHg), attributable to its valved mechanism allowing immediate outflow, consistent with Olmos et al.[7]

Baseline VA was markedly poorer in the DLCP group (LogMAR 2.73) compared with GDD (1.08), reflecting appropriate patient selection. GDD eyes maintained stable vision, with mild improvement (to LogMAR 1.02, +5.6%), echoing Iliev et al.'s[5] findings of visual stability after AGV implantation. In contrast, DLCP patients maintained poor vision, consistent with the palliative nature of this treatment, as noted by Moraczewski et al.[4]

Complete success occurred in 50% of GDD and 41.7% of DLCP cases; qualified success in 45.8% and 33%, respectively. Only one GDD failure was recorded, and no patient required re-intervention. The difference between groups was not statistically significant (χ^2 = 1.81, p = 0.405), similar to success distributions reported by Tokumo et al.[6]

Mild hypotony occurred in two AADI and two DLCP patients without serious sequelae. Complication rates were lower than in previous DLCP series such as Schmack et al.[5], which reported hypotony in up to 20% of cases. No re-interventions further underscore the safety of both procedures.

Equivalence testing showed VA equivalence within ±0.2 LogMAR (p > 0.999) but IOP equivalence did not reach statistical significance (p = 0.08). This aligns with Olmos et al. and Schmack et al., who also found comparable long-term IOP control between modalities despite different mechanisms.

Conclusion

In this Bangladeshi cohort, both GDD and DLCP provided effective short-term IOP control in NVG with acceptable safety. GDD should be prioritized in eyes with salvageable vision, whereas DLCP remains valuable for poor-vision or palliative indications. Larger multicenter studies with extended follow-up are warranted.

Ethical Approval: Approved by the Institutional Review Board of IIEI&H; informed consent obtained.

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When Migraine Drugs Trigger Glaucoma: A Case Series of Drug-Induced Angle Closure

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Abstract

This case series describes three instances of drug-induced secondary angle closure glaucoma. Two young female patients (aged 13 and 32 years) developed acute bilateral angle closure with myopic shift shortly after starting Topiramate for headache, while a third 19-year-old female experienced a similar presentation following Zolmitriptan use. All presented with marked intraocular pressure elevation, corneal edema, shallow anterior chambers, and refractive changes. Gonioscopy and anterior segment OCT confirmed narrow angles, while visual fields were preserved. In every case, discontinuation of the offending drug with appropriate medical therapy resulted in normalization of intraocular pressure and full visual recovery without glaucomatous damage. These cases underscore the need to consider migraine medications such as Topiramate and Triptans as potential causes of acute bilateral angle closure, especially in young patients without predisposing risk factors.

Keywords: Secondary angle closure, Topiramate, Zolmitriptan, Myopic shift

Introduction

Drug-induced secondary angle-closure glaucoma is a rare but important cause of acute bilateral ocular hypertension. Unlike primary angle closure, it usually results from ciliochoroidal effusion with forward displacement of the lens–iris diaphragm, often producing a myopic shift. Various different medications can cause secondary angle closure in susceptible individuals. Prompt recognition and drug withdrawal are essential to prevent irreversible glaucomatous damage.

We report three cases of drug induced secondary angle closure, all of which resolved with early diagnosis and appropriate management.

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Case 1:

Thirteen years old female with no known comorbidities presented to local eye hospital with complaints of headache for 1 month and sudden onset pain, blurring of vision and colored halos in both eyes for 1 day. There was no history of trauma, uveitis or spectacle use. For 1 week prior to the onset of ocular symptoms, she had been taking oral Topiramate 25 mg twice daily for headache.

On initial examination, her visual acuity (VA) was 6/18, and bilateral corneal edema was noted. Intraocular pressure (IOP) measured 29 mmHg in the right eye and 34 mmHg in the left eye. She was started on oral Acetazolamide 125 mg twice daily with potassium supplementation. After 2 days, her IOP reduced to 12 mmHg and topical steroid was added. At 1 week, she had IOP of 22mmHg in both eyes while on antiglauoma medications (AGMs). Topical Brinzolamide–Brimonidine combination was subsequently initiated.

On presentation to our out patient department (OPD), her Best Corrected Visual Acuity (BCVA) was 6/6 in both eyes with refraction of -0.75/-0.50x20 in the right eye and -1.00/-0.50x160 in the left eye. Corneas were clear with deep central anterior chamber. Gonioscopy revealed Shaffer's grade 1 angle in all the quadrants bilaterally. IOP measured by Goldmann Applanation Tonometry (GAT) was 12mmHg in both eyes while on topical Antiglaucoma Medications (AGMs). Fundus examination showed healthy optic discs with cup–disc ratio of 0.2 (right eye) and 0.3 (left eye) (Figure 1A). Anterior segment Optical Coherence Tomography (AS OCT) confirmed peripheral narrow angles, and visual fields (Figure 1B) were essentially normal (Figure 1B). She was advised to continue Brinzolamide-Brimonidine eye drop and to avoid Topiramate tablets.

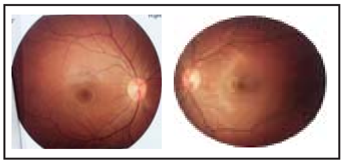

Figure 1A: Fundus Photo of both eyes with normal disc

During subsequent follow-ups, her VA remained 6/6 unaided, with deepening of the peripheral anterior chamber and low IOP. At the final visit, her IOP was 12 mmHg without AGMs, with no structural or functional glaucomatous damage.

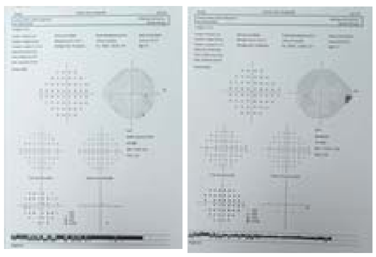

Figure 1B: Visual fields

Case 2

A 32-year-old female presented to local eye hospital with sudden, painful blurring of vision in both eyes for 1 day. On examination, her BCVA was counting fingers close to face in both eyes. The cornea was cloudy with shallow anterior chambers and mid-dilated, sluggishly reacting pupils. IOP by GAT was 42mmHg in the right eye and 46mmHg in the left eye. Retrospective history revealed recent use of tablet Topiramate for headache. Hence, diagnosis of Topiramate-induced secondary angle closure was made and tablet Topiramate was stopped. The patient was started on topical Brimonidine-Brinzolamide combination and oral Acetazolamide 250mg three times daily with potassium supplementation.

On follow-up the next day, her visual acuity improved to 6/60 in right eye and 3/60 in left eye, with IOP reduced to 20 mmHg in both eyes on antiglaucoma medications (AGMs). ASOCT demonstrated narrow angles (Figure 2A).

Figure 2A: AS OCT of right eye (above) and left eye (below)

Two days later, at our outpatient department, her BCVA had further improved to 6/12 with -2.25 D spherical correction in the right eye and 6/18 with –3.50 D spherical correction in the left eye, with a +2.00 D near add for reading. Corneas were clear, and gonioscopy revealed Shaffer's grade 2 angles bilaterally. IOP by GAT was 10 mmHg in both eyes with topical AGMs. She was advised to continue the two topical AGMs and discontinue oral Acetazolamide.

At two weeks, her VA had improved to 6/9 in both eyes with mild refractive correction of -0.25x10° in the right eye and -0.50x150° in the left eye). IOP was 08mmHg (right eye) and 09mmHg (left eye) on AGMs. Dilated fundus examination showed healthy posterior segments with cup–disc ratio of 0.5 in the right eye and 0.4 in the left eye (Figure 2B). Visual fields were normal. On later follow-up, her IOP remained within normal limits even after discontinuing AGMs, with stable optic discs and preserved visual function.

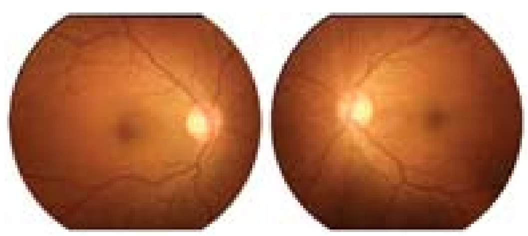

Figure 2B: Fundus photo of both the eyes

Case 3

A 19-year-old female presented to a local eye hospital with severe headache, ocular pain, blurring of vision, and redness for 10 days. On presentation, her visual acuity (VA) was 2/60 in both eyes. Examination revealed corneal edema, shallow anterior chambers, and IOP of 40 mmHg (right eye) and 45 mmHg (left eye) by GAT. With a presumptive diagnosis of acute angle closure crisis in Primary Angle Closure Glaucoma (PACG), she was treated with intravenous Mannitol 20% (200 ml, slow IV) and prescribed topical Brimonidine-Timolol combination, Latanoprostene Bunod 0.024%, Pilocarpine 2%, topical steroids, and oral Acetazolamide 250 mg three times daily with potassium supplementation.

At presentation to our outpatient department four days later, her BCVA had improved to 6/12 with -5.00 D spherical correction in both eyes. The anterior chambers remained shallow, with Shaffer's grade 2 angles in all quadrants bilaterally. Pupils were constricted pharmacologically. IOP was 08 mmHg in both eyes while on antiglaucoma medications (AGMs). On further history, the patient disclosed use of oral Zolmitriptan 2.5 mg one day prior to the onset of visual symptoms. Based on this temporal association and clinical findings, a diagnosis of Zolmitriptan-induced secondary angle closure with myopic shift was made and it was stopped.

She was advised to continue Brimonidine 0.2%, Timolol 0.5%, Latanoprostene Bunod 0.024% with topical steroids and reviewed after two weeks. At follow-up, she reported having discontinued AGMs three days earlier, with IOP measured at 15 mmHg in both eyes. Optical coherence tomography (OCT) of the optic disc and RNFL (Figure 3A) and visual fields (Figure 3B) were normal. Anterior segment OCT revealed deepened anterior chamber angles in both eyes (Figure 3C).

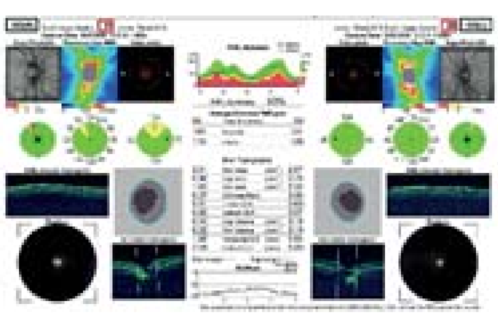

Figure 3A: OCT optic disc and RNFL

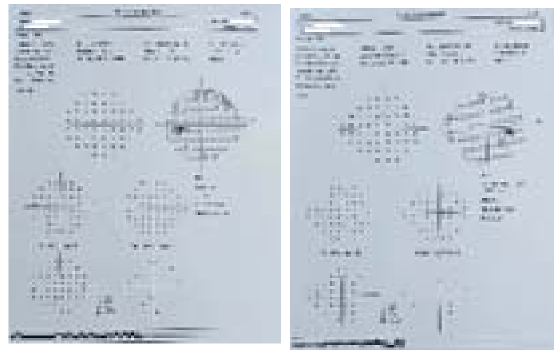

Figure 3B: Visual Fields

She was continued on Brimonidine–Timolol combination drops for a few weeks, after which all medications were stopped. On final review, her IOP remained stable at 12 mmHg in both eyes without AGMs, with no structural or functional glaucomatous damage.

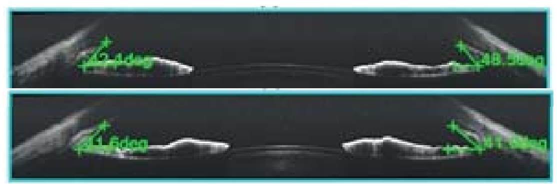

Figure 3C: AS OCT of right eye (Above) and left eye (below) on follow-up visit

Discussion

These three cases highlight drug-induced secondary angle-closure glaucoma in young females associated with Topiramate (Cases 1 & 2) and Zolmitriptan (Case 3). One-third of acute angle closure glaucoma is estimated to be triggered by over-the-counter or prescription medications.[1] Similar to prior reports, the onset in our patients were acute and bilateral, occurring within days of initiating the offending medication. Literature reviews confirm that Topiramate is one of the most frequent culprits, with most cases appearing within two weeks of therapy, while triptans such as Sumatriptan and Zolmitriptan have also been implicated, though less frequently.[2–6] Apart from migraine medications, those with potential to incite angle closure glaucoma include antipsychotics, sulpha drugs, anticoagulants, etc.

The pathophysiology involves ciliochoroidal effusion and anterior displacement of the lens–iris diaphragm, leading to shallow anterior chambers, narrow angles, and a myopic shift, rather than pupillary block.[1,3] This explains the refractive changes seen in our patients and the lack of benefit from laser iridotomy reported in similar cases.

The clinical patterns observed in these cases include young female predominance, bilateral presentation with marked IOP elevation, shallow anterior chambers and reversible myopia, which resolved after discontinuing the offending medication. Management requires immediate discontinuation of the causative drug, topical/systemic antiglaucoma medications, cycloplegics, and sometimes steroids. Unnecessary laser or surgical interventions are avoided in drug induced angle closure as the mechanism is not pupillary block.

All three of our patients had favorable outcomes, with normalization of IOP, resolution of anatomical changes, and no glaucomatous optic nerve or visual field damage on follow-up, consistent with published evidence that prognosis is excellent when the condition is recognized promptly.[1–4]

Conclusion

Drug-induced secondary angle closure, as seen with Topiramate and Zolmitriptan, can cause acute bilateral ocular hypertension with myopic shift in young patients. Early recognition, discontinuation of the offending drug, and timely medical management usually lead to full visual recovery and prevention of irreversible glaucomatous damage.

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Ocular Surface Disease Associations of Topical Anti-Glaucoma Medications in a Tertiary Eye Hospital in Bangladesh: A Case Series

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Abstract

The main focus in glaucoma management is the reduction of intraocular pressure while the ocular surface effects of topical anti-glaucoma medications often remain unaddressed. This case series presents a range of ocular surface complications associated with topical AGM use, depicting the need for comprehensive ocular surface evaluation in patients undergoing glaucoma therapy. Early recognition and management of these adverse effects are crucial for optimizing both ocular surface health and overall treatment outcomes.

Keywords: ocular surface disease; topical medications; glaucoma

Introduction

Glaucoma is the second most common cause of irreversible blindness globally.[1] The standard approach to manage this condition involves reducing intraocular pressure (IOP) through the use of topical anti-glaucoma medications (AGMs). These eye drops typically require multiple dosing and prolonged use. However, their extended use is associated with significant ocular surface toxicity and disturbances in the tear film, affecting various components of the ocular surface including the conjunctiva, cornea and eyelids.[2-7] Such complications can lead to serious outcomes, including the risk of vision impairment due to ocular surface deterioration, reduced patient adherence to treatment and potential progression of glaucoma. Studies have reported the prevalence of ocular surface disease (OSD) in patients on topical AGMs to range between 49% and 59%.[8,9]

Symptoms of ocular surface disease (OSD) caused by anti-glaucoma medications (AGMs) can be both nonspecific and specific. Nonspecific symptoms include dryness, stinging, burning, tearing, foreign body sensation in the eye while more specific symptoms may present as redness, periocular dermatitis or blurred vision.

The signs may range from tear film abnormalities, conjunctival congestion, follicular reaction, fibrosis, cicatrization, symblepharon formation, corneal superficial punctate keratitis, vascularization, and scarring.[3,6,10,11] These adverse effects may result from either the pharmacologically active ingredient or the preservatives contained in the eye drops.[12]

Ocular surface disease (OSD) can reduce treatment adherence and negatively affect outcomes of glaucoma filtration surgery by promoting inflammation and scarring leading to bleb failure.[10-13] Recognizing the association between glaucoma medications and OSD is essential for effective patient management. Therefore, the purpose of this case series is to increase awareness regarding OSD association in topical AGM among general ophthalmologists and support evidence-based treatment strategies.

Case Description

Three patients undergoing topical anti-glaucoma medications and diagnosed with OSD at the glaucoma department of Ispahani Islamia Eye Institute and Hospital, Bangladesh from March 2025 to August 2025 were included in this case series. All the patients had comprehensive ophthalmic evaluation by experienced glaucoma specialists. Details of the individual cases are as follows.

Case 1

A 54 years old Bangladeshi woman presented to our center with complaints of redness, itching, watery discharge and foreign body sensation in both eyes. There was no previous history of trauma, surgery or family history of blindness. She was a diagnosed case of primary angle closure glaucoma both eyes with S/P bilateral patent Laser peripheral iridotomy and nuclear sclerosis Grade I cataract.

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Review of systems was not contributory and there was no history of allergy to any specific food or environmental object. Drug history yield use of Brimonidine eye drop two times daily for last 1 year.

Figure: Brimonidine induced blepharo-conjunctivitis demonstrating bilateral conjunctival injection, chemosis and mild lid oedema

Slit lamp examination revealed matted eyelashes, lid margin swelling, crusted debris along lash follicles, conjunctival congestion, mild chemosis and papillary hypertrophy of tarsal conjunctiva in both eyes.

Her BCVA was 6/12 and 6/18 in right and left eyes respectively. The intraocular pressure (IOP) was 16 mmHg in both eyes. Fundal evaluation revealed cup-disc ratio (CDR) of 0.7 and 0.8 in the right and left eyes respectively.

Patient was advised to discontinue her present medication (Brimonidine) and got switched to other group of AGM (Timolol) two times daily. Topical steroid eyedrop (loteprednol) prescribed in tapering manner, and steroid-antibiotic combination ointment (dexamethasone-tobramycin) prescribed once daily at bed time with further follow up scheduled 2 weeks later to review mitigation of symptoms and IOP control. Follow-up visit showed resolving conjunctival congestion and chemosis, lid margin swelling was also reduced and IOP was found 16 and 18 mmHg in right and left eyes respectively.

Case 2

The patient was a 28 years old Bangladeshi man who came to our hospital with complaints of gradual onset of skin excoriation and discoloration in periocular region of both eyes for last 2 months. In addition, he complained of mild itching and redness of both eyes for same duration.

No antecedent history of trauma or surgery in the eye or head region was found. Moreover, there was no relevant history of bleeding disorder, similar family history or systemic illness recorded. Review of system was not contributory. He was diagnosed as steroid responder and received Brinzolamide three times daily for last 4 months.

Figure: Brinzolamide associated periocular dermatitis showing periocular skin pigmentation and excoriation with bilateral mild conjunctival injection

Slit lamp examination revealed bilateral upper and lower eyelid excoriation and periocular skin discoloration. There was mild bilateral conjunctival congestion. The anterior segments findings were normal in both eyes. Gonioscopy revealed angles were open in both eyes.

He had visual acuity of 6/6 unaided in both eyes. The intraocular pressure (IOP) was 18 mmHg in both eyes. Dilated fundal evaluation revealed cup-disc ratio (CDR) of 0.5 in both eyes.

The patient underwent routine glaucoma investigations, namely, Visual field test (24-2), OCT ONH & RNFL and Central corneal thickness. All the findings were within normal range.

The AGM (Brinzolamide) was withdrawn and patient was treated conservatively only for symptom relief. Steroid (loteprednol) eye drop prescribed in tapering manner and loteprednol eye gel given to apply on excoriated periocular skin. In next follow-up visit scheduled 2 weeks later IOP was 18 mmHg in both eyes & skin excoriation and conjunctival injection was found to be resolved though there was remaining periocular skin pigmentation for which he was counselled for dermatologist consultation and referred accordingly.

Case 3

A 45 years old woman diagnosed with asymmetric primary open angle glaucoma (R>L), was on a unilateral trial of netarsudil in the right eye along with oral acetazolamide prescribed for 3days. Initially, her VA was 6/36 and IOP was 38□mm Hg. At follow-up 2 weeks later, in the right eye IOP had improved to 15□ mmHg, the cornea remained clear. Patient was advised to continue netarsudil once daily in right eye. 3 months after starting netarsudil in the right eye, it was found to develop diffuse reticular corneal oedema with fine microcystic pattern honeycomb appearance. VA worsened to 6/60 though IOP was 16□mm Hg in right eye. Netarsudil was discontinued, and the patient got switched on timolol and brimonidine combination eye drop. At follow-up visit 2 weeks later, after stopping netarsudil, the reticular corneal epithelial edema had nearly completely resolved. VA improved to 6/36 with pinhole to 6/18 and IOP was 18□mm Hg in right eye. There was no predisposing history of prior corneal edema or damage prior to the development of the reticular corneal epithelial edema.

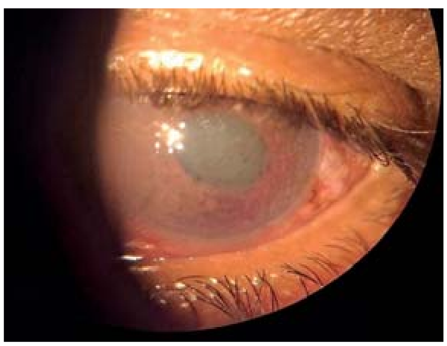

Figure: Netarsudil associated Reticular Corneal Epithelial Oedema

Discussion

Topical antiglaucoma medications with and without their preservatives can induce severe ocular surface and periorbital changes. Long-term use of these medications has deleterious effects on the conjunctiva, cornea, eyelids, and periocular tissues like trichiasis, entropion, symblepharon, forniceal shortening, punctate keratopathy, non-healing epithelial defects and pannus. Treatment requires drug withdrawal or substitution by oral or topical non-preserved and less toxic preparations of AGMs. The ocular surface and symptoms can improve if the condition is diagnosed early and after drug withdrawal in over 90% of eyes. However, stopping or changing AGMs can often present with its own unique set of challenges in intra-ocular pressure control which may often need glaucoma surgery in close to 20% of eyes for IOP control.[14]

Alpha-adrenergic agonists (brimonidine) are selective sympathetic agonists of the α2 receptor and thus have multiple effects including decreased AH production, increased uveoscleral outflow & increased trabecular meshwork (TM) outflow. Research has shown that the common follicular conjunctivitis may result from alpha adrenergic agonists' effect on reducing the volume of conjunctival cells, thereby widening intracellular spaces and permitting potential allergens to penetrate subepithelial tissue.[15]

Brimonidine causes conjunctival hyperemia and allergic conjunctivitis in 11.0–13.9% of subjects using this agent, often resulting in discontinuation of the drug by them.[16] Other common adverse effects include conjunctival follicular reaction and chemosis.[17] These adverse effects occur several months to years after initiation of the drug and stopping the offending drug helps to resolve the condition. Here in this study, we can see our first case to develop the above-mentioned features after one year of initiating treatment with Brimonidine.

Carbonic anhydrase inhibitors (CAIs i.e., Brinzolamide, Dorzolamide) can adversely affect tear film stability, with surface conditions such as hyperemia, blepharitis, dry eyes, and tearing occurring in less than 3% of cases.[18,19] Terai and colleagues discovered that brinzolamide reduced basal tear secretion, although it did not significantly affect TBUT. Specifically, dorzolamide was found to reduce basal tear secretion by 14.3% at 60 min and by 17.3% at 90 min post-application.[19] CAIs are generally avoided in patients who have sulfa allergies.

Our second case depicts that brinzolamide can induce periorbital or periocular allergic contact dermatitis.□ This rare side effect has been confirmed by case reports showing a positive patch test for brinzolamide sensitivity in patients who develop the rash.□ The condition is likely an allergic reaction to the brinzolamide itself or its preservatives. Recent literature reports two cases of contact dermatitis in patients treated unilaterally with carbonic anhydrase inhibitors for glaucoma. Periocular contact dermatitis caused by□brinzolamide□was noted in the right eye of a 52-year-old female patient who had been treated in the right eye with brinzolamide/brimonidine tartrate (Simbrinza) for 3 years (Navarro-Triviño & Ruiz-Villaverde, 2021).[20]

Netarsudil is a rho-associated kinase (ROCK) inhibitor and a norepinephrine transporter (NET) inhibitor. It has a tri-faceted mechanism of action as it increases the TM outflow, decreases episcleral venous pressure and decreases AH production.[21] Furthermore, it may decrease RGC loss by improving optic nerve head perfusion by its effect on endothelin 1. Common side effects include conjunctival hyperemia, subconjunctival bleeding, SPK, corneal edema and whorl or honeycomb keratopathy.[22] In this series the 3rd case incidence is supported by Bhargava et al. who also found that netarsudil may result in reticular epithelial corneal edema.[23]

Conclusion

This case series emphasizes the significance to recognize the strong association and high incidence of ocular surface disease (OSD) in patients undergoing topical glaucoma treatment. If not properly addressed, OSD can lead to reduced quality of life and poor adherence to therapy, ultimately compromising glaucoma management.

In spite the fact that antiglaucoma medications (AGMs) remain the cornerstone of glaucoma management, it is essential to carefully evaluate the ocular surface, medication tolerability and potential side effects before initiating treatment. The use of combination therapies and preservative-free formulations can help reduce both the frequency of dosing and exposure to preservatives, thereby minimizing associated side effects. Regular follow-up is important not only to monitor intraocular pressure (IOP) control but also to evaluate patient compliance and identify any adverse effects. If side effects are observed, switching to a different drug class, using short-term anti-inflammatory treatments such as corticosteroids, adding lubricants or reducing preservative exposure may help to alleviate inflammation and prevent scarring. In cases where OSD is resistant to treatment or intraocular pressure (IOP) remains uncontrolled, surgical options may be considered. These measures can enhance patient adherence, improve quality of life, and support long-term vision preservation. To sum up a holistic, multi-pronged treatment plan is vital to maintain ocular surface integrity while ensuring effective glaucoma control.

Conflict of Interests

The authors have no financial or proprietary interests related to this paper.

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