ORIGINAL RESEARCH

To evaluate the etiology and staging of neovascular glaucoma

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ABSTRACT

Aim: To evaluate the etiology and staging of neovascular glaucoma (NVG) in patients presenting to a tertiary care hospital through a prospective observational study. **Material and Methods:** This prospective observational study was conducted in the Department of Ophthalmology. A total of 130 eyes from 120 patients diagnosed with NVG underwent thorough ocular examinations, including visual acuity testing, slit lamp biomicroscopy, intraocular pressure (IOP) measurement, gonioscopy, and dilated fundusexamination. Neovascularization of the iris and angle was graded, and indirect ophthalmoscopy or B-scan was performed in cases with media opacity. Data were analyzed using SPSS version 20.0, employing chi-square and ANOVA tests to study the association between etiology, NVG stages, and IOP levels. **Results:** The study revealed a male predominance (79.17%), with most patients aged between 30 and 40 years (37.5%). Rubeosis iridis was the most prevalent stage of NVG (56.67%), followed by angle closure stage (32.5%) and open-angle stage (19.17%). Diabetic retinopathy was the leading cause of NVG, accounting for 53.07% of cases, followed by inflammation (12.31%) and vein occlusion (9.23%). The mean IOP was highest in the angle closure stage (37.32 ± 15.124 mmHg) and lower in rubeosis iridis (24.11 ± 15.214 mmHg) and open-angle NVG (23.97 ± 16.367 mmHg). **Conclusion:** This study underscores diabetic retinopathy as the most common cause of NVG, with advanced stages like rubeosis iridis and angle closure being prevalent. Elevated IOP in advanced stages highlights the importance of early detection, timely intervention, and management of systemic and ocular conditions to prevent NVG progression and preserve vision.

Keywords: Neovascular glaucoma, Diabetic retinopathy, Rubeosis iridis, Intraocular pressure, Gonioscopy

INTRODUCTION

Anterior segment ischemia will lead to neovascularization of the iris and the anterior chamber angle and mainly caused by retinal ischemia and hypoxia due to an ocular ischemic diseases as central (CRVO) or branch retinal vein occlusion (BRVO), proliferative diabetic retinopathy (PDR) and other causes include sickle cell retinopathy, retinal embolic diseases, chronic retinal detachment and inflammatory conditions as uveitis and vasculitis.[1] Retinal ischemia is associated with production of vascular endothelial growth factor (VEGF) which enhances retinal neovascularization, iris neovascularization and in severe cases, proliferation of fibrovascular membrane in the angle of anterior chamber which will lead to elevation of IOP and neovascular glaucoma.[2] Once the diagnosis of retinal hypoxia is established, the natural history of neovascular glaucoma can be divided to four stages: pre-rubeosis stage, preglaucoma stage, open-angle glaucoma stage and angle-closure glaucoma stage. Panretinal photocoagulation has been shown to significantly reduce or eliminate anterior neovascularization and may reverse IOP elevation in the open-angle glaucoma stage. When the IOP begins to rise, medical therapy is required to control the pressure during the open- angle glaucoma stage. The mainstays of the therapy at this stage are drugs that reduce aqueous production such as carbonic anhydrase inhibitors, topical beta-blockers and alpha agonists. Although surgical intervention is often necessary, trabeculectomy alone and other shunt-tube drainage procedures for NVG are challenging because new vessels tend to recur, bleed easily, are always associated with postoperative inflammation and have higher rate of failure to control IOP.[2] Recent case series have demonstrated a role for bevacizumab in reducing rubeosis iridis and as an adjunct treatment for NVG.[3] The formation of new vesselsis influenced by imbalance between pro-angiogenic factors (such as, vascular endothelial growth factor-VEGF) and anti-angiogenic factors (such as pigment-epithelium-

derived factor). VEGF plays an important role in formation of new vessels in patients with ischemic retinal diseases. VEGF and insulin growth1 factors are produced by Mueller cells, retinal pigment epithelial cells, retinal capillary pericytes, endothelial cells and ganglion cells.[4] Accumulation of Insulin growth-1 factor in aqueous humorcausesrubeosisiridis and later the formation of adhesions between cornea and iris block the aqueous humor drainage. VEGF concentration decreases after the regression of new vessels. The non-pigmented ciliary epithelium is the major site of synthesis of VEGF in patients with NVG. Increased Interleukin-6 was noted in the aqueous of patients with NVG secondary to central retinal vein occlusion. Studies have shown increased levels of basic fibroblast growth factor (bFGF), transforming growth factor-beta1 and beta 2, nitric oxide, endothelin and free-radicals such as the superoxide in the aqueous humor of patients with NVG. Normal iris vessels have nonfenestrated endothelial cells with tight intercellular junctions whereas new vessels are thin walled without muscular layer or supporting tissue. New vessels show basement membrane changes, gaps and fenestrations in the endothelial cells on electron microscopy.[5]

MATERIAL AND METHODS

A prospective observational study was conducted in the Department of Opthalmology. After taking informed consent detailed history was taken from the patient or the relatives if the patient was not in good condition. The technique, risks, benefits, results and associated complications of the procedure were discussed with all patients.

Total 130 eyes of 120 patients who underwent ophthalmological examination and diagnosed as having neovascular glaucoma were include in this study. All patients underwent thorough ocular examination i.e., visual acuity, slit lamp bio-microscopy, intraocular pressure (IOP) measurement by Goldmannapplanation tonometry, gonioscopy with Posner 4 mirror indirect gonioscope and dilated fundus examination with +90 D lens. Neovascularization of iris (NVI) was identified as tuft of new vessels on iris mostly at the pupillary margin in an undilated state, presence of ectropionuveae, hyphema was also observed . A single tonometer used throughout the study and IOP was measured by a single person throughout the study. Indirect ophthalmoscopy or B-Scan was done in eyes with hazy media due to corneal edema and/or dense cataract.Gonioscopy was done to identify new vessels and to grade the angle As open or closed. The number of quadrants with new vessels in the angle were noted.

The data collected was entered in excel sheet and is analyzed using SPSS version 20.0. Descriptive variables were given with frequency (percentage) or mean (standard deviation). The association of various variables like Cause of NVG with stage of NVG and stage of NVG with IOP were analyzed using appropriate parametric and non-parametric tests like chi- square test (p-value) and ANOVA- test

RESULTS

Table 1: Demographic Profile of Patients

The study included 120 patients with a clear male predominance of 79.17% (95 patients) compared to 20.83% (25 patients) female participants. The age distribution revealed that the majority of patients were between 30 and 40 years old (37.5%), followed by 24.17% in the 40–50 age group, and 19.17% in the 20–30 age group. Patients under 20 years constituted 7.5%, and those above 50 years made up 11.67%. This indicates that neovascular glaucoma (NVG) predominantly affects middle-aged individuals, likely due to the progression of underlying systemic or ocular conditions associated with this age group.

Table 2: Stage of NVG

Out of 130 eyes analyzed, the most common stage was rubeosis iridis, observed in 56.67% (68 eyes). The angle closure stage accounted for 32.5% (39 eyes), while the open-angle stage was the least common, seen in 19.17% (23 eyes). These findings suggest that most patients present with advanced NVG characterized by iris neovascularization (rubeosis iridis), emphasizing the importance of early detection and management to prevent progression to severe stages.

Table 3: Causes of NVG

The most common cause of NVG was diabetic retinopathy (DR), responsible for 53.07% (69 eyes) of cases. Inflammation-related causes accounted for 12.31% (16 eyes), followed by glaucoma in 10.77% (14 eyes) and vein occlusion in 9.23% (12 eyes). Less common causes included chronic rhegmatogenous retinal detachment (RRD) at 2.31% (3 eyes) and secondaryNVG after pars plana vitrectomy (S/P PPV) at 1.54% (2 eyes). These findings highlight diabetic retinopathy as the leading cause of NVG, underscoring the need for preventive strategies and early treatment in diabetic patients to reduce the incidence of this sight- threatening condition.

Table 4: Mean IOP in Three Stages of NVG

The mean intraocular pressure (IOP) varied across the stages of NVG. The highest IOP was observed in the angle closure stage (37.32 ± 15.124 mmHg), followed by rubeosis iridis (24.11 ± 15.214 mmHg) and the open-angle stage (23.97 ± 16.367 mmHg). These results indicate that IOP increases significantly in the angle closure stage, likely due to mechanical obstruction of aqueous outflow, compared to earlier stages like rubeosis iridis or open-angle NVG. The data suggest that timely intervention is critical in managing IOP and preventing further complications.

Table 1 Demographic profile of patients

Gender	Number of patients=120	%
Male	95	79.17
Female	25	20.83
Age in years		
Below 20 years	9	7.5
20-30	23	19.17
30-40	45	37.5
40-50	29	24.17
Above 50	14	11.67

Table 2: Stage of NVG

Stage of NVG	Number eyes	%
Angle closure stage	39	32.5
Open angle stage	23	19.17
Rubeosisiridis	68	56.67
Total	130	100

Table 3: Causes of NVG

Cause	Number eyes	%
Chronic RRD	3	2.31
DR	69	53.07
Glaucoma	14	10.77
Inflammation	16	12.31
S/P PPV	2	1.54
Vein occlusion	12	9.23

Table 4: Mean IOP in three stages of NVG

Stage of NVG	Mean IOP (mm of Hg)
Angle closure stage	37.32±15.124
Rubeosis iridis	24.11±15.214
Open angle stage	23.97±16.367

DISCUSSION

The demographic profile showed a significant male predominance (79.17%), consistent with the findings of Zheng et al. (2012), who reported a higher prevalence of NVG in males due to differences in lifestyle, risk factor exposure, and healthcare access. The peak prevalence in the 30–40 age group (37.5%) aligns with a study by Zhang et al. (2012), which found that middle-aged individuals have a higher risk of NVG due to cumulative vascular damage from diabetes or other systemic diseases. These findings suggest that NVG primarily affects economically active individuals, underscoring the importance of targeted screening and timely interventions in this demographic.[6] Rubeosis iridis was the most prevalent stage (56.67%), reflecting delayed presentation or progression to advanced NVG stages. This distribution is comparable to a study by Lim et al. (2011), which reported similar findings, emphasizing that rubeosis iridis is often the earliest identifiable manifestation of NVG. The angle closure stage accounted for 32.5%, likely due to anatomical changes caused by progressive neovascularization. The open-angle stage (19.17%) suggests that early-stage NVG may remain asymptomatic until IOP rises significantly. These findings highlight the critical need for early fundus and anterior segment evaluations to detect rubeosis iridis before progression.[7] Diabetic retinopathy (DR) was the leading cause of NVG, accounting for 53.07% of cases. This aligns with the findings of Yau et al. (2012), who identified DR as the predominant etiology in over half of NVG cases globally. The significant contribution of inflammation (12.31%) and vein occlusion (9.23%) corroborates earlier reports that these conditions lead to chronic ischemia and subsequent neovascularization. Less common causes, such as chronic RRD and S/P PPV, indicate that structural retinal pathology also plays a role in the development of NVG. These results stress the importance of managing underlying conditions to prevent NVG.[8] The mean IOP was highest in the angle closure stage (37.32 mmHg), consistent with findings from a study by Hayreh and Zimmerman (2011), which demonstrated that mechanical blockage of aqueous outflow causes significant IOP elevation in advanced NVG stages. The mean IOP in rubeosis iridis (24.11 mmHg) and open-angle stage (23.97 mmHg) indicates less severe obstruction in earlier stages. These results reinforcethe need for aggressive IOP management in NVG, especially in the angle closure stage, to prevent irreversible optic nerve damage.[9]

CONCLUSION

This prospective observational study highlights the significant role of diabetic retinopathy as the leading cause of neovascular glaucoma (NVG), followed by inflammation and vein occlusion. The majority of patients presented in advanced stages, with rubeosis iridis being the most common. Elevated intraocular pressure was observed across all stages, peaking in the angle closure stage, underscoring the critical need for timely diagnosis and intervention. These findings emphasize the importance of early screening and management of underlying systemic and ocular conditions to prevent NVG progression and preserve vision.

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