

## Trends in Practice Patterns of General Ophthalmologists, Glaucoma and Retina Specialists on the Management of Neovascular Glaucoma in the Philippines

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### Abstract

**Purpose:** Neovascular glaucoma (NVG) is a dreaded form of secondary glaucoma characterized by neovascularization of the iris, the angle, or both, and elevation of intraocular pressure (IOP). Because of the complex nature of the disease, its treatment often warrants a multi-disciplinary approach that inevitably lead to variations in treatment protocols. In this research, we are interested in determining the different treatment practices in the management of NVG among general ophthalmologists, glaucoma specialists and retina specialists based on the presenting stage of the disease.

**Objective:** This study aimed to compare the different treatment practices among general ophthalmologists, glaucoma and retina subspecialists in the management of neovascular glaucoma.

**Methodology:** A cross-sectional survey study among general ophthalmologists, glaucoma and retina specialists who are members of the Philippine Academy of Ophthalmology (PAO) was conducted. The survey, drafted by a general ophthalmologist, a glaucoma specialist and a retina specialist, comprised of seventeen questions in multiple choice format with two parts. The first part included questions pertaining to participant demographics, while the second part consisted of questions pertaining to their NVG management practices.

**Results:** One hundred and sixty four (164) respondents were included in the survey comprising of 67 general ophthalmologists, 47 glaucoma specialists and 50 retina specialists. Most of the participants practice in an area with an available retina and glaucoma specialist, and have access to anti-vascular endothelial growth factor (anti-VEGF) medication or pan-retinal photocoagulation (PRP). The participants have varied years of practice or experience. On the average, general ophthalmologists and retina specialists (VRSP) are able to see less than 1 case of NVG per month; whereas glaucoma specialists (PGS and non-PGS) and retina specialists (non-VRSP) are able to see more than 1 case of NVG per month. The most common first line medication used by almost all subspecialty with an IOP between 30 and 40 mmHg is a beta blocker. On the other hand, the most common first line medication used by all subspecialty for IOP of more than 40 mmHg is an oral carbonic anhydrase inhibitor (CAI). The usual and preferred anti-VEGF drug used by all subspecialties is bevacizumab. All ophthalmologists perform and prefer to do IOP surgery within 7 days after anti-VEGF injection. During the early stage of the disease, majority of the respondents will either inject anti-VEGF or perform PRP. Forty percent of glaucoma specialists will refer the patient to a retina specialist. During the open angle stage, only 60% of general ophthalmologists will manage the disease on their own either with anti-VEGF injection or PRP. Forty percent of them will either refer to a glaucoma or a retina specialist. During the angle closure stage, majority of the respondents would inject anti-VEGF as their initial management. One-

third of general ophthalmologists will refer to either a glaucoma or a retina specialist. Twenty one percent of glaucoma specialists will immediately refer the patient to a retina specialist, while 12% of retina specialists will refer to a glaucoma specialist. Trabeculectomy was the IOP lowering surgery of choice of general ophthalmologists during this stage, whereas the glaucoma specialists preferred glaucoma drainage device (GDD) implantation.

**Conclusions:** The survey identified similarities and differences in practice patterns between specialist and non-specialists in our local setting. It highlighted the complexity of NVG management and the different treatment approach by different specialties. Although there was an agreement between both general and subspecialty practice for the use of anti-VEGF medication as first line treatment as shown in the study, differences exist within the practice regarding the next step in the management. Thus, a need for a consensus or society guidelines regarding NVG management may be necessary to reduce these discrepancies for the sake of a more prompt and efficient therapy.

**Keywords:** Neovascular Glaucoma; anti-VEGF; Pan-retinal Photocoagulation; Trabeculectomy; Glaucoma Drainage Device; Philippines

## Abbreviations

NVG: Neovascular Glaucoma; VEGF: Vascular Endothelial Growth Factor; PRP: Pan-retinal Photocoagulation; IOP: Intraocular Pressure; PAO: Philippine Academy of Ophthalmology; PGS: Philippine Glaucoma Society; VRSP: Vitro-Retina Society of the Philippines; GDD: Glaucoma Drainage Device; PDR: Proliferative Diabetic Retinopathy; CRVO: Central Retinal Vein Occlusion; VA: Visual Acuity

## Introduction

Neovascular glaucoma (NVG) is a dreaded form of secondary glaucoma characterized by neovascularization of the iris, the angle, or both, and elevation of intraocular pressure (IOP) [1]. It is a visually devastating condition where untimely diagnosis and management often leads to refractory medical and surgical outcomes that ultimately destroy the vision of affected patients [2]. Seventy percent of patients with NVG commonly have final visual acuity of hand movements or light perception only [1]. The main pathology involved is posterior segment ischemia which leads to the release of vascular endothelial growth factors that promote the proliferation of new blood vessels in the anterior segment. The newly formed blood vessels, accompanied by fibrovascular membrane formation and subsequent contraction, brings about the damaging complications of NVG.<sup>1</sup> The three most common causes include proliferative diabetic retinopathy (PDR), ischemic central retinal vein occlusion (CRVO), and ocular ischemic syndrome. Other less common causes are trauma, uveitis and ocular tumors [2,3].

Its incidence is similar in both sexes, with a slight predilection in males. It most commonly affects elderly patients, with an average onset between 60 and 79 years old [1]. It accounts to approximately 3.9% of all glaucoma cases in Europe where an estimate of 75,000 to 113,000 individuals are affected [4]. In two retrospective studies done in Metro Manila, NVG was found to be the second most common type of secondary glaucoma, next to post-traumatic or post-surgical glaucoma [5,6]. A recent study done by Dr. Leuenberger, *et al.* showed NVG to be the most common subtype of secondary glaucoma among the government institutions included in the study.<sup>7</sup> NVG is a potentially devastating type of glaucoma, where untimely diagnosis or inadequate management can lead to severe or even complete loss of vision [1].

Neovascular glaucoma can be divided into 3 stages. The first stage is the pre-clinical or pre-glaucoma stage where fine, very minute vessels or rubeosis appear at the pupillary margin. The intraocular pressure during this stage is still within normal limits. This is followed by the open-angle stage, where fine neovascularizations appear at the angle. These neovascularizations are accompanied by fibrovascular membranes and tend to block aqueous outflow. The third stage is the angle-closure stage which occurs when the fibrovascular membranes begin to contract and form broad synechiae, ultimately closing the angle. It is during this stage that intraocular pressures are expected to be significantly elevated.

In general, the management of NVG is geared towards the normalization of IOP - either medically, surgically or both, and

the reduction, if not elimination, of retinal ischemia that brings about the anterior segment neovascularization. Because of the complex nature of the disease, its treatment often warrants a multi-disciplinary approach that inevitably lead to variations in treatment protocols. IOP lowering medications and surgeries, along with pan-retinal photocoagulation (PRP) has long been the standard treatment of NVG. However, with the advent of anti-vascular endothelial growth factor (anti-VEGF) agents, clinicians are given another treatment option [8].

To the knowledge of the author, there is no existing local guidelines on the management of NVG. The purpose of this study is to determine treatment practices in the management of different presentation of NVG among glaucoma specialists, retina specialists and general ophthalmologists, recognize treatment gaps, and possibly serve as a forerunner in the creation of a clinical practice guideline in the management of NVG. Findings of the study will hopefully determine treatment variations and possible treatment gaps on how different specialties manage NVG. Long term utilization of the study can help in establishing preferred practice patterns or treatment guidelines tailor fitted to our local setting, and in setting a consensus between the two involved subspecialties.

## Objectives

This study aimed to compare the different treatment practices among general ophthalmologists, glaucoma and retina subspecialists in the management of neovascular glaucoma in the Philippines.

Specifically, this study aimed to:

- Compare the management patterns for NVG among general ophthalmologists, glaucoma and retina specialists.
- Compare the initial IOP lowering medication/s among general ophthalmologists, glaucoma and retina specialists in the management of NVG.
- Compare the routine and preferred anti-VEGF in the management of NVG.
- Compare routine and preferred timing of glaucoma surgery post anti-VEGF injection.
- Compare the management patterns of general ophthalmologists, glaucoma and retina specialists based on the presenting disease stage of NVG patients.

## Methods

This study is a cross-sectional survey study. The study participants were general ophthalmologists, glaucoma and retina specialists who are members of the Philippine Academy of Ophthalmology (PAO), and were invited through convenient sampling.

Inclusion criteria were the following: (1) general ophthalmologists who are PAO members, glaucoma specialists who are both Philippine Glaucoma Society (PGS) members and non-PGS members, and retina specialists who are Vitreo-Retina Society of the Philippines (VRSP) members and non-VRSP members, and (2) able to handle neovascular glaucoma in their practice. Exclusion criteria include (1) ophthalmologists who are non-PAO members, and (2) ophthalmologists who are not able to handle neovascular glaucoma in their practice.

A survey comprising of seventeen questions in multiple choice format was drafted by a general ophthalmologist, retina specialist, and glaucoma specialist (see Appendix C). The survey form is comprised of vignettes based on actual cases encountered in our institution, and it encompasses questions regarding initial therapy and next best step in the management of NVG.

A web-based anonymous survey, using Survey Monkey, was coursed through the president of the Philippine Academy of Ophthalmology. After gaining approval from the council of the Academy, a link of the survey questionnaire was sent to the members of the Academy by the secretariat. The survey took 10-15 minutes to answer. Participants who consented by willingly answering the survey (implied consent) were included for data analysis. Responses were collected via SurveyMonkey's software.

Any online data gained from the survey were transferred and stored in an external hard drive and were encrypted and password protected. Only the principal investigator had access to the data. All electronic data were erased from its external disk drives with guidance from University of the Philippines Manila's Information Technology office.

The primary outcome measures were the different management of the 3 groups on the different clinical vignettes given. The answers of each ophthalmologists were recorded and tabulated.

IBM SPSS v23 was used for statistical analysis. Descriptive statistics particularly cumulative incidences per subspecialty group was determined to summarize demographic data and the answers

of each ophthalmologist. Analysis of variance (ANOVA) was used to determine significant differences among the three groups. A post-hoc analysis was done to determine the group with the significant difference. A p-value of less than 0.05 was considered statistically significant for this study.

## Results

There were a total of 164 respondents included in this study comprising of 67 general ophthalmologists, 36 glaucoma specialists (PGS), 11 glaucoma specialists (non-PGS), 47 retina specialists (VRSP), and 3 retina specialists (non-VRSP). The demographics of each participants are summarized in table 1. Most of the participants practice in an area with an available retina and glaucoma specialist, and most of them have access to anti-VEGF medication and PRP. The participants have varied years of

practice or experience. On the average, general ophthalmologists and retina specialists (VRSP) are able to see less than 1 case of NVG per month; whereas glaucoma specialists (PGS and non-PGS) and retina specialists (non-VRSP) are able to see more than 1 case of NVG per month. The most common first line medication used by almost all subspecialty, except glaucoma specialists (PGS), for IOP between 30 and 40 mmHg is beta blockers. On the other hand, the most common first line medication used by all subspecialty for IOP of more than 40 mmHg is oral carbonic anhydrase inhibitor. The usual and preferred anti-VEGF drug used by all subspecialties is bevacizumab, except for retina specialists (non-VRSP) who preferred aflibercept. All ophthalmologists perform and prefer to do IOP-lowering surgery within 7 days of diagnosis. Lastly, all glaucoma specialists and majority of general ophthalmologists and retina specialists perform gonioscopy.

Demographic factors	General Ophthalmologist (n = 67)	Glaucoma specialist (PGS) (n = 36)	Glaucoma specialist (non-PGS) (n = 11)	Retina specialist (VRSP) (n = 47)	Retina specialist (non-VRSP) (n = 3)	p-value
Access to a Retina or a Glaucoma specialist						<0.001*
With retina and glaucoma specialist	57 (85.1%)	35 (97.2%)	8 (72.7%)	44 (93.6%)	2 (66.7%)	
With only glaucoma specialist	3 (4.5%)	1 (2.8%)	3 (27.3%)	0	0	
With only retina specialist	5 (7.4%)	0	0	3 (6.4%)	0	
Without retina/glaucoma specialist	2 (3%)	0	0	0	1 (33.3%)	
With access to anti-VEGF or PRP in area of practice	58 (86.6%)	36 (100%)	9 (81.8%)	47 (100%)	2 (66.7%)	0.004*
Years of practice						0.026*
<5 years	27 (40.3%)	8 (22.2%)	1 (9.1%)	11 (23.4%)	2 (66.7%)	
6-10 years	9 (13.4%)	4 (11.1%)	3 (27.3%)	7 (14.9%)	0	
11-15 years	20 (29.9%)	8 (22.2%)	6 (54.5%)	11 (23.4%)	1 (33.3%)	
>15 years	11 (16.4%)	16 (44.4%)	1 (9.1%)	18 (38.3%)	0	
Average NVG cases seen						0.176
>1 per month	22 (32.8%)	18 (50%)	6 (54.5%)	14 (29.8%)	2 (66.7%)	
<1 per month	24 (35.8%)	13 (36.1%)	5 (45.5%)	25 (53.2%)	1 (33.3%)	
<1 per 6 months	18 (26.9%)	5 (13.9%)	0	8 (17%)	0	
<1 per year	3 (4.5%)	0	0	0	0	
First line medication for IOP 30-40 mmHg						0.056
Beta blockers	60 (89.6%)	30 (83.3%)	8 (72.7%)	37 (78.7%)	3 (100%)	
Prostaglandin analogue	6 (9%)	5 (13.9%)	1 (9.1%)	8 (17%)	0	
Alpha agonist	32 (47.8%)	28 (77.8%)	4 (36.4%)	21 (44.7%)	0	
Topical carbonic anhydrase inhibitor	20 (29.9%)	15 (41.7%)	4 (36.4%)	15 (31.9%)	0	
Oral carbonic anhydrase inhibitor	24 (35.8%)	19 (52.8%)	3 (27.3%)	21 (44.7%)	1 (33.3%)	
First line medication for IOP >40 mmHg						0.001*
Beta blockers	57 (85.1%)	27 (75%)	10 (90.9%)	34 (72.3%)	2 (66.7%)	
Prostaglandin analogue	6 (9%)	7 (19.4%)	0	12 (25.5%)	1 (33.3%)	
Alpha agonist	29 (43.3%)	30 (83.3%)	2 (18.2%)	28 (59.6%)	1 (33.3%)	
Topical carbonic anhydrase inhibitor	18 (26.9%)	14 (38.9%)	3 (27.3%)	16 (34%)	1 (33.3%)	
Oral carbonic anhydrase inhibitor	66 (98.5%)	35 (97.2%)	10 (90.9%)	43 (91.5%)	2 (66.7%)	

Routine anti-VEGF used						<0.001*
Bevacizumab	44 (65.7%)	18 (50%)	9 (81.8%)	40 (87%)	2 (66.7%)	
Ranibizumab	1 (1.5%)	0	0	6 (13%)	0	
Aflibercept	0	1 (2.8%)	0	3 (6.5%)	0	
None (referred to retina specialist)	19 (28.4%)	17 (47.2%)	2 (18.2%)	1 (2.2%)	1 (33.3%)	
Preferred anti-VEGF						<0.001*
Bevacizumab	37 (55.2%)	16 (44.4%)	10 (90.9%)	32 (68%)	1 (33.3%)	
Ranibizumab	10 (14.9%)	0	0	7 (14.9%)	0	
Aflibercept	6 (9%)	4 (11.2%)	0	8 (17%)	2 (66.7%)	
None (referred to retina specialist)	11 (16.4%)	16 (44.4%)	1 (9.1%)	0	0	
Routine time to do Glaucoma surgery after anti-VEGF injection						0.056
Within 7 days	34 (50.7%)	21 (58.3%)	8 (72.7%)	22 (46.8%)	1 (33.3%)	
After 7 days	28 (41.8%)	10 (27.8%)	3 (27.3%)	15 (31.9%)	1 (33.3%)	
After 14 days	2 (3%)	5 (13.9%)	0	8 (17%)	0	
Preferred time to do Glaucoma surgery after anti-VEGF injection						0.449
Within 7 days	35 (52.2%)	20 (55.6%)	9 (81.8%)	24 (51.1%)	2 (66.7%)	
After 7 days	27 (40.2%)	11 (30.6%)	2 (18.2%)	16 (34%)	1 (33.3%)	
After 14 days	2 (3%)	5 (3.9%)	0	6 (13%)	0	
Performs gonioscopy	40 (59.7%)	36 (100%)	11 (100%)	32 (68.1%)	2 (66.7%)	0.006*

**Table 1:** Demographic factors and usual practices of each participant specialty.

The trends in the practices of different specialties given the different scenarios are summarized in table 2. The questionnaire was divided into two—the ones who does gonioscopy and the ones who do not. For those who perform gonioscopy, in the first given scenario where a case of NVG secondary to PDR in a setting of good visual acuity and normal IOP (visual acuity (VA) of 20/70 or better with normal IOP, with presence of neovascularization of the iris (NVI) and open angles), most general ophthalmologists (40%)

would perform PRP on the patient, some would also perform anti-VEGF injection (25%). Most glaucoma specialists, both PGS (33.3%) and non-PGS (63.6%) will refer the patient to a retina specialist; while retina specialists, both VRSP (50%) and non-VRSP (100%) members will perform intravitreal anti-VEGF and PRP on the patient. Since the intraocular pressure is still normal, none of the general ophthalmologists and retina specialists referred to a glaucoma specialist.

Scenario (performs gonioscopy)	General Ophthalmologist (n = 40)	Glaucoma specialist (PGS) (n = 36)	Glaucoma specialist (non-PGS) (n = 11)	Retina specialist (VRSP) (n = 32)	Retina specialist (non-VRSP) (n = 2)	p-value
Treatment recommendation for NVG secondary to PDR with VA of 20/70 or better; normal IOP with presence of NVI and open angles						<0.001*
Intravitreal anti-VEGF	10 (25%)	6 (16.7%)	2 (18.2%)	7 (21.9%)	0	
PRP	16 (40%)	7 (19.4%)	1 (9.1%)	9 (28.1%)	0	
IOP lowering medications	0	0	0	0	0	
IOP lowering surgery	0	0	0	0	0	
Refer to glaucoma specialist	0	0	0	0	0	
Refer to retina specialist	5 (12.5%)	12 (33.3%)	7 (63.6%)	0	0	
Intravitreal anti-VEGF + PRP	9 (22.5%)	7 (19.4%)	1 (9.1%)	16 (50%)	2 (100%)	
Intravitreal anti-VEGF + PRP + IOP lowering drugs	0	4 (11.1%)	0	0	0	
Intravitreal anti-VEGF + PRP + IOP drugs and surgery	0	0	0	0	0	



Initial treatment of NVG secondary to PDR with VA 20/70 or better; IOP 38 mmHg that improves to 20 either on topical or oral IOP lowering medications with presence of NVA						<0.001*
Intravitreal anti-VEGF	13 (32.5%)	13 (36.1%)	6 (54.5%)	18 (56.3%)	0	
PRP	13 (32.5%)	5 (13.9%)	4 (36.4%)	12 (37.5%)	2 (100%)	
Trabeculectomy	0	3 (8.3%)	0	0	0	
GDD implantation	0	2 (5.6%)	0	0	0	
TSCP	0	0	0	0	0	
Refer to glaucoma specialist	8 (20%)	0	0	2 (6.2%)	0	
Refer to retina specialist	6 (15%)	13 (36.1%)	1 (9.1%)	0	0	
Next step of the above patient (NVG secondary to PDR with VA 20/70 or better; IOP 38 mmHg that improves to 20 either on topical or oral IOP lowering medications with presence of NVA) after anti-VEGF injection						<0.001*
PRP	25 (62.5%)	23 (63.9%)	7 (63.6%)	29 (90.6%)	2 (100%)	
Trabeculectomy	11 (27.5%)	7 (19.4%)	4 (36.4%)	3 (9.4%)	0	
GDD implantation	4 (10%)	6 (16.7%)	0	0	0	
TSCP	0	0	0	0	0	
Initial management of NVG secondary to CRVO with VA worse than 20/400; IOP 42 mmHg that decreased to 30mmHg on max topical and oral IOP lowering drugs, with NVI and closed angles						<0.001*
Intravitreal anti-VEGF	22 (55%)	17 (47.2%)	3 (27.3%)	27 (84.4%)	0	
PRP	6 (15%)	2 (5.6%)	1 (9.1%)	3 (9.3%)	2 (100%)	
Trabeculectomy	2 (5%)	1 (2.8%)	3 (27.3%)	0	0	
GDD implantation	1 (2.5%)	4 (11.1%)	3 (27.3%)	0	0	
TSCP	0	(8.3%)	0	0	0	
Refer to glaucoma specialist	5 (12.5%)	0	0	2 (6.3%)	0	
Refer to retina specialist	4 (10%)	9 (25%)	1 (9.1%)	0	0	
NVG secondary to CRVO with VA worse than 20/400; IOP 42 mmHg that decreased to 30mmHg on max topical and oral IOP lowering drugs, with NVI and closed angles. Next step after treated with either PRP or anti-VEGF with noted regression.						<0.001*
Trabeculectomy	17 (42.5%)	13 (36.1%)	4 (36.4%)	5 (15.6%)	0	
GDD implantation	2 (5%)	21 (55.6%)	7 (63.6%)	2 (6.3%)	0	
TSCP	2 (5%)	0	0	0	0	
Refer to glaucoma specialist	15 (37.5%)	0	0	25 (78.1%)	2 (100%)	
Refer to retina specialist	4 (10%)	2 (5.6%)	0	0	0	

Scenario (does not perform gonioscopy)	General Ophthalmologist (n = 27)	Glaucoma specialist (PGS) (n = 0)	Glaucoma specialist (non-PGS) (n = 0)	Retina specialist (VRSP) (n = 15)	Retina specialist (non-VRSP) (n = 1)	p-value
Treatment recommendation of NVG secondary to PDR with VA of 20/70 or better; normal IOP, with deep anterior chamber with presence of NVI						0.169
Intravitreal anti-VEGF	3 (11.1%)	0	0	1 (6.7%)	0	
PRP	5 (18.5%)	0	0	4 (26.6%)	0	
IOP lowering medications	0	0	0	0	0	
IOP lowering surgery	0	0	0	0	0	
Refer to glaucoma specialist	0	0	0	0	0	
Refer to retina specialist	4 (14.8%)	0	0	3 (20%)	0	
Intravitreal anti-VEGF + PRP	14 (51.9%)	0	0	6 (40%)	1 (100%)	
Intravitreal anti-VEGF + PRP + IOP lowering drugs	1 (3.7%)	0	0	1 (6.7%)	0	
Intravitreal anti-VEGF + PRP + IOP drugs and surgery	0	0	0	0	0	
Initial treatment for NVG secondary to PDR with VA 20/70 or better with deep anterior chamber; IOP 38 mmHg that improves to 20 on either topical or oral anti-glaucoma drugs, with NVI						<0.001*
Intravitreal anti-VEGF	6 (22.2%)	0	0	5 (33.3%)	0	
PRP	8 (29.6%)	0	0	8 (53.3%)	1 (100%)	
Trabeculectomy	0	0	0	0	0	
GDD implantation	0	0	0	0	0	
TSCP	0	0	0	0	0	
Refer to glaucoma specialist	0	0	0	2 (13.4%)	0	
Refer to retina specialist	13 (48.2%)	0	0	0	0	
Next step of the above patient (NVG secondary to PDR with VA 20/70 or better with deep anterior chamber; IOP 38 mmHg that improves to 20 on either topical or oral antiglaucoma drugs, with NVI) after anti-VEGF injection						0.001*
PRP	22 (81.5%)	0	0	14 (93.3%)	1 (100%)	
Trabeculectomy	5 (18.5%)	0	0	1 (6.7%)	0	
GDD implantation	0	0	0	0	0	
TSCP	0	0	0	0	0	

Initial management of NVG secondary to CRVO with VA worse than 20/400, IOP 42 mmHg that decreases only to 30mmHg even on max topical and oral IOP lowering medications with NVI and shallow chamber						<0.001*
Intravitreal anti-VEGF	4 (14.8%)	0	0	10 (66.7%)	1 (100%)	
PRP	2 (7.4%)	0	0	1 (6.7%)	0	
Trabeculectomy	7 (26%)	0	0	0	0	
GDD implantation	0	0	0	0	0	
TSCP	0	0	0	0	0	
Refer to glaucoma specialist	4 (4.8%)	0	0	4 (26.6%)	0	
Refer to retina specialist	10 (37%)	0	0	0	0	
NVG secondary to CRVO with VA worse than 20/400, IOP 42 mmHg that decreases only to 30mmHg even on max topical and oral IOP lowering medications with NVI and closed angles. Next step after PRP or anti-VEGF injection with regression						0.001*
Trabeculectomy	16 (59.2%)	0	0	3 (20%)	1 (100%)	
GDD implantation	0	0	0	1 (6.7%)	0	
TSCP	0	0	0	1 (6.7%)	0	
Refer to glaucoma specialist	6 (9%)	0	0	10 (66.6%)	0	
Refer to retina specialist	5 (18.5%)	0	0	0	0	
VA – Visual Acuity; IOP – Intraocular Pressure; PDR – Proliferative Diabetic Retinopathy; CRVO – Central Retinal Vein Occlusion; NVI – Neovascularization of the Iris; NVA – Neovascularization of the Disc; TSCPC – Transscleral Cyclophotocoagulation; GDD – Glaucoma Drainage Device						

**Table 2:** Trends in practices of different specialties given different scenarios.

For the second case wherein the NVG was secondary to PDR with VA of 20/70 or better, with high IOP (38 mmHg) that decreases to 20 mmHg either on topical or oral IOP lowering medications with presence of NVA, one-third of general ophthalmologists (32.5%) would perform intravitreal anti-VEGF injection, one-third (32.5%)

would perform PRP and one third (35%) would refer the patient to either a glaucoma or a retina specialist. Majority of the glaucoma specialists, both PGS (36.1%) and non-PGS (54.5%) would inject intravitreal anti-VEGF, while a considerable percentage of PGS members (36.1%) would refer to a retina specialist. Retina



specialists (VRSP) (56.3%) would inject intravitreal anti-VEGF; whereas retina specialists (non-VRSP) (100%) would do PRP. In a follow-up case where the patient already underwent anti-VEGF injection, the next step for all subspecialties is to perform PRP.

For the third case wherein the NVG was secondary to CRVO with in a setting of poor visual acuity and high IOP despite on maximal topical and oral IOP lowering drugs, with NVI and closed angles, (VA worse than 20/400, IOP of 42 mmHg that decreased only to 30 mmHg on maximal topical and oral IOP lowering drugs with NVI and closed angles), most general ophthalmologists (55%), glaucoma specialists, both PGS (47.2%) and non-PGS (45.4%) and retina specialists (VRSP) (84.4%) will perform anti-VEGF intravitreal injection, while retina specialists (non-VRSP) will perform PRP. In the same case where the patient was already treated with either PRP or anti-VEGF, the next step for most general ophthalmologists (42.5%) is trabeculectomy; whereas the next step for glaucoma specialists (PGS and non-PGS) (58.3% and 63.6%, respectively) is GDD implantation. On the other hand, retina specialists (VRSP and non-VRSP) will refer the patient to a glaucoma specialist.

For participants who do not perform gonioscopy, they were asked about the following cases: the first case is where NVG was secondary to PDR, having VA of 20/70 or better, normal IOP, with deep anterior chamber and presence of NVI, most general ophthalmologists (51.9%), retina specialists (VRSP and non-VRSP) (40% and 100%, respectively) will give intravitreal anti-VEGF injection and do PRP.

For the second case, the initial treatment of general ophthalmologists (48.2%) for patients with NVG secondary to PDR with VA of 20/70 or better with deep anterior chamber and IOP of 38 mmHg that improves to 20 mmHg on either topical or oral antiglaucoma drugs with NVI is to refer to a retina specialist. In turn, retina specialists (VRSP and non-VRSP) (53.3% and 100%, respectively) will perform PRP. In cases where the patient underwent anti-VEGF injection, most general ophthalmologists (81.5%) and retina specialists (VRSP and non-VRSP) (93.3% and 100%, respectively) will perform PRP.

For the last case where NVG was secondary to CRVO with VA worse than 20/400, IOP of 42 mmHg that decrease only to 30 mmHg even on maximal topical and oral IOP lowering medications

with NVI and closed angles, most general ophthalmologists (37%) will refer the patient to a retina specialist, while retina specialists (VRSP and non-VRSP) (66.7% and 100%, respectively) will inject intravitreal anti-VEGF. In cases where patients underwent PRP and anti-VEGF injections, with noted regression, most general ophthalmologists (59.2%) and retina specialists (non-VRSP) (100%) will perform trabeculectomy, while retina specialists (VRSP) (66.6%) will refer the patient to a glaucoma specialist.

## Discussion and Conclusion

NVG is a complex and visually threatening ophthalmologic condition that requires a deliberate or tailored treatment approach. Every effort should be made to decrease IOP in aid of preservation or improvement of visual function. On the other hand, the primary retinal pathology should be addressed to prevent further retinal ischemia. Preserving the maximal extent of the patient's visual capacity is the main purpose of NVG management [5-7,9].

This web-based survey was designed to gain a contemporary insight into the practice patterns for the management of NVG in our local setting. The initial findings of this survey demonstrated how general ophthalmologists, glaucoma and retina specialists manage neovascular glaucoma in general. At the early stage of the disease, 89% of general ophthalmologists will try to manage the disease on their own either with anti-VEGF or PRP. Eleven percent (11%) will refer to a retina specialist, and none will refer to a glaucoma specialist during this stage. On the other hand, 40% of glaucoma specialists will immediately refer the patient to a retina specialist, while the rest will perform either anti-VEGF injection or PRP. All the retina specialists will perform anti-VEGF or PRP during this stage. During the open angle stage of the disease, only 60% of general ophthalmologists will manage the disease on their own. Forty percent (40%) of them will either refer to a glaucoma or a retina specialist. As for glaucoma specialists, 40% will inject anti-VEGF, 20% will perform PRP and 30% will refer to a retina specialist. For retina specialists, 8% of them will refer the patient to a glaucoma specialist. Late in the disease, during angle closure stage, majority of the respondents would inject anti-VEGF as their initial management. One-third of general ophthalmologists will refer to either a glaucoma or a retina specialist. Twenty one percent (21%) of glaucoma specialists will immediately refer the patient to a retina specialist, while 12% of retina specialists will

refer to a glaucoma specialist. As for the surgical intervention during this stage, general ophthalmologists preferred to do trabeculectomy, whereas the glaucoma specialists preferred GDD implantation.

This study also demonstrated the pivotal role of anti-VEGF medication in the management of NVG. In every scenario, the majority of both general ophthalmologists, as well as glaucoma and vitreoretinal subspecialty practitioners, choose a therapeutic option that includes anti-VEGF administration.

Multiple publications have studied the role of anti-VEGF as a form of adjunctive treatment to PRP in the NVG management approach [1,3,9-12]. This practice was clearly sought and addressed in our clinical scenario questions. As a primary therapeutic mainstay, PRP has demonstrated its effective role in the regression of iris neovascularization and IOP reduction [9]. Ehlers and colleagues had investigated the combined efficacy of anti-VEGF therapy and PRP. Their results showed a statistically significant difference in the rate and frequency of neovascular regression in the combination group but with no differences in visual acuity (VA) or IOP reduction [10]. Moreover, a study conducted by Olmos, *et al.* concluded that PRP was the most important factor reducing the need for IOP lowering surgery and found no significance in the long-term outcome between those patients who received anti-VEGF medication and those who did not [11]. Our study also revealed composite statistically significant differences between specialist preferences for sole anti-VEGF therapy versus combined anti-VEGF and tube shunt surgery. Although multiple studies investigating the role of anti-VEGF as an adjunct to shunt procedures exist, the results were still inconclusive regarding its long-term benefits in terms of VA and surgical outcomes [12].

The study also noted a significant variation in responses whether to do a trabeculectomy or GDD implantation to control the IOP in an angle-closure-type of NVG patients. General ophthalmologists preferred to do trabeculectomy, while glaucoma specialists preferred to do GDD implantation.

The strengths of this survey study include a relatively well-balanced group of respondents among general ophthalmologists as well as glaucoma and retina specialists, the use of case-based scenarios; and the well-homogenized distribution of the survey to ophthalmologists in all practice settings across the three local

societies. The anonymity of the survey did not allow for answers to be viewed by other participants of the study. Limitations of the study include the imbalance in the distribution of the survey to society members versus non society members, the lack of homogeneity regarding the case volumes of participants (majority of them handled 1 NVG case per month), and the survey completion rates are less than initiation rates in all groups. The multiple-choice setup of the survey creates a non-random sample and bias in favor of motivated responders, in addition to limiting response and choices through a simplistic view of complex case scenarios. A higher response rate would have added further data, but we believe that the overall number of participants did fairly provide a perspective into real management trends. The results of this survey identify similarities and differences in practice patterns between specialist and non-specialized in our local setting. It also highlights the complexity of NVG management and how it is approached from different views or angles by different specialties. Certainly, in our local setting, patient's attitudes towards the disease, skill-set or capabilities of participants, and accessibility to specialists limit daily practices and influence clinical decision-making. Overall, although there was an agreement between both general and subspecialty practice for the use of anti-VEGF medication as first line treatment as shown in the study, differences exist within the practice regarding the next step in the management. Thus, a need for a consensus or society guidelines regarding NVG management may be necessary to reduce these discrepancies for the sake of a more prompt and efficient therapy.

### Disclaimer

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### Bibliography

1. Rodrigues G., *et al.* "Neovascular glaucoma: a review". *International Journal of Retina and Vitreous* 2 (2016): 26-35.
2. Yang H., *et al.* "Neovascular glaucoma: Handling in the future". *Taiwan Journal of Ophthalmology* 8.2 (2018): 60-66.
3. Allingham R., *et al.* "Shields' Textbook of Glaucoma, ed. 5". Lippincott Williams and Wilkins, Philadelphia, 2005. Glaucomas Associated with Disorders of the Retina, Vitreous, and Choroid (2005): 328-341.
4. Havens S and Gulati V. "Neovascular Glaucoma". *Developments in Ophthalmology* 55 (2016): 196-204.

5. Florcruz N., *et al.* "Profile of Glaucoma Cases Seen at a Tertiary Referral Hospital". *Philippine Journal of Ophthalmology* 30.4 (2005): 161-165.
6. Martinez J and Hosaka M. "Clinical Profile and Demographics of Glaucoma Patients Managed in a Philippine Tertiary Hospital". *Philippine Journal of Ophthalmology* 40 (2015): 81-87.
7. Leuenderger A., *et al.* "Comparison of the Clinical Profile of Patients with Glaucoma Between Private and Government Clinics in the Philippines". *Philippine Journal of Ophthalmology* 44.2 (2019): 45-53.
8. Olmos L C and Lee RK. "Medical and Surgical Treatment of Neovascular Glaucoma". *International Ophthalmology Clinics* 51.3 (2011): 27-36.
9. Aref A. "Management of immediate and sustained intraocular pressure rise associated with intravitreal anti vascular endothelial growth factor injection therapy". *Current Opinion in Ophthalmology* 23 (2012): 105-110.
10. Aref A. "Current management of glaucoma and vascular occlusive disease". *Current Opinion in Ophthalmology* 27 (2016): 140-145.
11. Olmos LC., *et al.* "Long-term outcomes of neovascular glaucoma treated with and without intravitreal bevacizumab". *Eye* 30 (2015): 460-472.
12. Tang M., *et al.* "Efficacy of intravitreal ranibizumab combined with Ahmed glaucoma valve implantation for the treatment of neovascular glaucoma". *BMC Ophthalmology* 16 (2016): 17.