Neovascular glaucoma

Pitfalls and pearls

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- Neovascular glaucoma (NVG): is an aggressive sight-threatening secondary glaucoma characterized by appearance of new vessels over the iris and proliferation of fibrovascular tissue in the anterior chamber angle.
- Common causes of NVG include: proliferative diabetic retinopathy (PDR), central retinal vein occlusion (CRVO), ocular ischemic syndrome and chronic uveitis.
- The diagnosis of NVG is mainly **clinical**. Therefore, a careful and complete ophthalmologic examination is critical.

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- NVG requires a unique treatment paradigm involving not only the control of elevated intraocular pressure (IOP), but also the control of proangiogenic conditions that promote neovascularization.
- Early recognition and treatment of underlying Retinal etiologies may prevent the development of NVG, or arrest and reverse the process at its earliest stages. However, the disease remains difficult to treat in spite of these advances and ocular morbidity from NVG remains significant.

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- A thorough systemic and medical history is critical to identify possible etiologies for the development of NVG. This includes assessing for vascular risk factors (diabetes, hypertension, hyperlipidemia, coronary artery disease, cerebro-vascular accident, and carotid occlusive disease), coagulopathies, and vasculitides.
- It is also critical to assess the patient's symptoms as well as their onset and duration. History of sudden onset unilateral vision loss a few months prior to presentation with NVG may raise CRVO higher on the differential, while episodes of transient vision loss (amaurosis fugax) may suggest ocular ischemic syndrome as an underlying etiology.

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- In the early stages of NVG, patients may be asymptomatic. So, it is crucial to assess the diabetic retinopathy carefully and perform gonioscopy to assess for early NVAs in Proliferative diabetic retinopathy patients and in CRVO Patients (100 – days glaucoma). And prompt treatment with pan-retinal photocoagulation (PRP) at this stage would save the angle.
- Conversely, patients who present in the angle-closure stage with acute elevations in IOP typically have associated eye pain, decreased vision, headaches, nausea/vomiting, and halos around lights.

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Systemic work-up

- Blood glucose or hemoglobin HbA1c to evaluate for diabetes and the level of glycemic control if unknown
- Baseline blood pressure.
- Renal function test.
- Hypercoagulable workup and carotid doppler ultrasound to evaluate for carotid occlusive disease or

stenosis are indicated in young patients with CRVO and no vascular risk factors, ocular ischemic syndrome, or when no retinal etiology is identified.

- Workup may be coordinated with the patient's primary care provider or performed in the emergency room depending on the clinical urgency.

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NVG staging:

- standardized and appropriate staging of NVG can improve diagnosis, guide treatment options, treatment goals, and overall prognosis.
- NVG can be divided into three clinical stages:

- NVG stage I: (Pre-glaucoma) NVI +/- NVA, normal IOP and angle.

- NVG stage II: Reversible secondary open-angle glaucoma.

- NVG stage III: Irreversible secondary angle-closure glaucoma.

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Appendix (3): Table : The clinical stages of NVG:

NVG Stages	NVG Stage I Pre-Glaucoma (Rubeosis iridis)	NVG Stage II Reversible Open-Angle Glaucoma	NVG Stage III Irreversible Closed-Angle Glaucoma
Clinical findings	Tiny tufts of new vessels appear first at the pupillary margin (NVI) and less commonly at the angle (NVA), which cross the SS to arborize over the TM	Development of a fibrovascular membrane on anterior surface of the iris and angle of anterior chamber, blocks the TM, obstructs aqueous outflow in an open□angle manner	Contracture of fibrovascular membrane pulls the iris over the TM forming PAS
NVI	Present (Tiny tufts)	Prominent	Prominent +/- ectropion uveae
IOP	Normal IOP	Elevated IOP	Elevated IOP
Gonioscopy	Open angles +/- NVA	Open angles +/- NVA	Closed angles + PAS +/- NVA
Prognosis	Good with timely intervention	Good with timely intervention	Usually guarded

IOP=Intraocular pressure, NVA=New vessels of the angle, NVI=New vessels of the iris, PAS=Peripheral anterior synechiae, TM=Trabecular meshwork.

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Treatment:

- NVG requires close collaboration between the Retina and Glaucoma specialists.
- Control the IOP via: topical and oral medications.
- Control or reduce associated ocular inflammation and pain via: topical
- steroids, e.g., prednisolone acetate eye drops 1% q1–6h.
- Treatment and control of underlying systemic disease, especially blood sugar, blood pressure and cardiovascular diseases.

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Treatment:

- PRP and anti-VEGF injections are generally considered the mainstay of treatment for NVG.
- Combination treatment strategy: initial prompt intravitreal anti-VEGF injection followed by early PRP within 2-4 weeks of the anti-VEGF injection has a promising role for treating patients with high-risk PDR and NVG.
- If the ocular media is clear with good dilation: PRP can be performed at the time of initial presentation.
- If macular edema is present, a pretreatment of intravitreal anti-VEGF injection is preferred, followed by PRP within 2-4 wks.

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- If the view of the fundus is insufficient for PRP:
  - Posterior pole pathologies (e.g. tractional retinal detachment) must be ruled out with a B-scan ultrasound first.
  - Followed by serial intravitreal anti-VEGF agents (every 4-6 weeks).
  - Treatment of underlying ocular media opacity:
    - Treat secondary corneal edema.
    - Cataract extraction.
    - Pars plana vitrectomy (PPV) + Endo laser for vitreous hemorrhage.

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- Given the high IOP in NVG eyes, it is often advisable to perform anterior chamber paracentesis at the time of intravitreal injection to prevent central retinal artery occlusion and further optic nerve compromise (away from the NVIs).
- Augmentation with PRP should be considered as needed whenever the causative factor of ocular media opacity is eliminated.

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- Anti-VEGF therapeutic effect:
- Usually rapid onset after anti-VEGF injections compared to PRP.
- Intravitreal anti-VEGF agents result in complete neovascular regression in > 80% of high-risk PDR eyes within 48-72 hours.
- These eyes then might have recurrence of neovascularization between 2 and 4 weeks after the initial injection.
- PRP therapeutic effect:
- It takes weeks for neovascularization to regress after PRP.

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- Treatment based on NVG stage, level of optic nerve damage and IOP control:

- NVG -I: Anti-VEGF + PRP.
- NVG - II: Anti-VEGF + PRP +/- IOP lowering meds +/- Glaucoma surgery.
- NVG - III: Anti-VEGF + PRP +/- IOP lowering meds +/- Glaucoma surgery.

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- Treatment of uncontrolled IOP with **Good Visual Potential:**
- Eyes with functional visual potential should be treated with prompt and aggressive anti-neovascular and IOP-lowering treatment, including surgery if necessary.
- Trabeculectomy:

was historically used in the treatment of NVG eyes. However, with mounting evidence that failure rates are higher in NVG, trabeculectomy is no longer a common surgery in this setting, unless it is the only available option for urgent cases.

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- Treatment of uncontrolled IOP with **Good Visual Potential:**

❖ Minimally-invasive glaucoma surgery (MIGS):

the concept of angle surgery in NVG has not been formally studied yet and must be carefully weighed against the theoretically increased risk of hyphema if occult NVA remains.

❖ Glaucoma drainage devices (Aqueous shunts):

A current and common surgical strategy in NVG eyes with good visual potential, and both valved and non-valved aqueous shunts can be used.

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- Disease stage and response to topical IOP-lowering medications can further help determine an appropriate surgical strategy. As previously mentioned, NVG eyes with elevated IOP and partially open angles typically respond well to medical IOP-lowering therapy.

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- Although NVG eyes often require urgent surgical intervention to lower the IOP and prevent optic nerve damage; however, it is important to treat these eyes preoperatively with anti-VEGF therapy as early as possible and maximize IOP lowering medications as tolerated.

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- Planned postponement of aqueous shunt surgery until regression of active neovascularization (NVA / NVI) is recommended, usually after 48-72 hours.

- To prevent aqueous shunt failure.

- To lower the risk of significant anterior chamber bleeding (hyphema) at the time of aqueous shunt insertion, and/or a blood clot formation, secondary to active anterior segment neovascularization, which can complicate the condition by occluding the drainage tube lumen, resulting in an IOP spike.

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- Combined Glaucoma surgery with cataract surgery and / or PPV with Endolaser:

-for patients with associated ocular media opacity.

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- Treatment of uncontrolled IOP with **poor Visual Potential:**

-It is imperative to perform a thorough assessment prior to determining that an eye has poor visual potential and pursuing a corresponding treatment strategy.

-Eyes with irreversible poor visual potential may not require such aggressive anti-neovascular and IOP-lowering treatment. The goal in these eyes is to relieve pain and keep the eye comfortable. Although optimizing the visual outcome is still desirable, the risks of incisional glaucoma surgery may not outweigh the benefits of aggressive IOP reduction.

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- Treatment of uncontrolled IOP with **poor Visual Potential:**

❖ Laser Cyclophotocoagulation (CPC):

it is often preferred over an aqueous shunt in NVG eyes with very poor visual potential, since it is a much less invasive procedure and can help achieve acceptable IOP reduction with resolution of pain.

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- In eyes confirmed to have **No light perception (NLP)**vision, the goal of treatment is pain control.

- Topical IOP-lowering medications are occasionally sufficient,

  - Topical steroid eye drops.
  - Topical cycloplegic eye drops.

- If medical IOP-lowering therapy does not adequately address the pain, other options for pain control include:

- Injection of retrobulbar alcohol or chlorpromazine (less invasive) by an oculoplastic surgeon.

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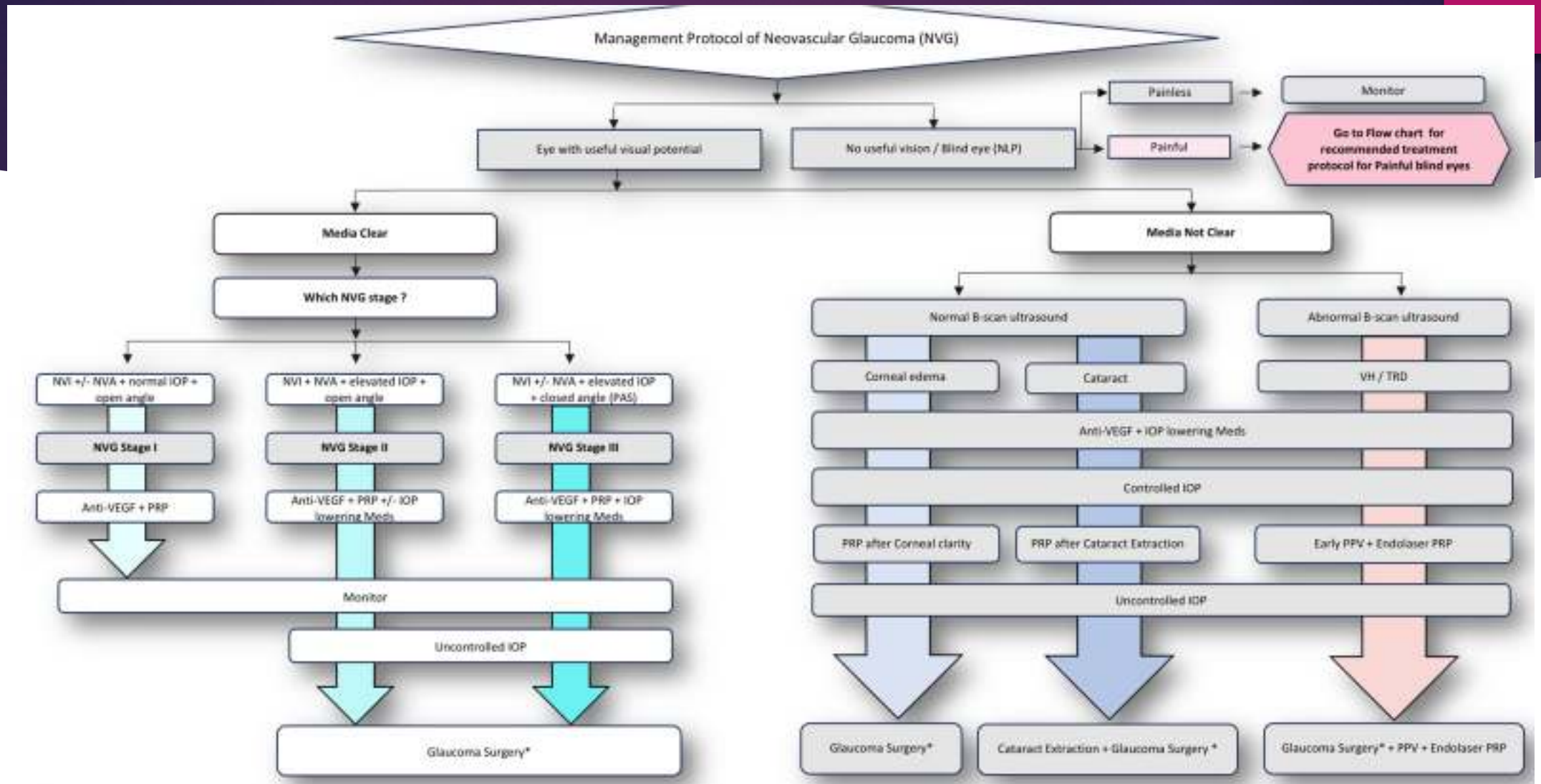
- CPC: may be reserved as a (more invasive) option in these eyes of refractory glaucomas with poor visual prognosis if the pain is thought to be a result of the elevated IOP, or to reduce long-term dependence
- Evisceration or Enucleation: is typically reserved as the last resort for refractory cases.e on oral carbonic-anhydrase inhibitors.



- Glaucoma surgery: Trabeculectomy with antimetabolite, Glaucoma Drainage Devices , Minimally invasive Glaucoma surgeries (MIGS), or Cyclodestructive procedures e.g: trans-scleral cyclophotocoagulation (TS CPC), Micropulse CPC & endocyclophotocoagulation (ECP)
- NVA= neovascularization over angle, NVI=neovascularization over iris, IOP= intraocular pressure, PAS= peripheral anterior synechiae, VEGF= vascular endothelial growth factor, PRP= panretinal photocoagulation, VH= vitreous hemorrhage, TRD= tractional retinal detachment, PPV= pars plana vitrectomy.

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- References:
- 5.1. Ferrara N. Vascular endothelial growth factor: basic science and clinical progress. Endocr
- Rev. 2004;25(4):581-611. doi:10.1210/er.2003-0027.
- 5.2. Essentials in Ophthalmology Series. Neovascular Glaucoma Current Concepts in Diagnosis
- and Treatment. Editors: Arun D. Singh, Mary Qiu. Springer, 2022.
- 5.3. The Wills eye manual: office and emergency room diagnosis and treatment of eye disease,
- Eighth edition, Wolters Kluwer, Philadelphia, 2022.
- 5.4. Senthil S, Dada T, Das T, et al. Neovascular glaucoma - A review. Indian J Ophthalmol.
- 2021;69(3):525-534. doi:10.4103/ijo.IJO_1591_20.
- 5.5. European Glaucoma Society: Terminology and Guidelines for Glaucoma, 5th edition.2020

THANK YOU