Abstract: Type 2 DM patient s/p CVA secondary to complete carotid occlusion with ipsilateral midperipheral retinal hemorrhages and asymmetric IOP developing into (+)NVI/NVA. Higher contralateral IOP not indicative of glaucomatous etiology. NVA indicated need for PRP.

Case history:
- 60 year old white male
- No visual/ocular complaints
- (+)DM type 2 x 2 years; (+)Cholesterol; Current smoker: 1 pack/day for the past 42 years.
- Simvastatin 80mg; Lisinopril 20mg; HCTZ 25mg; Glipizide 10mg

Pertinent findings:

Clinical

- Subjective
  - (-)Periorbital pain/transient vision loss or visual obscurations; (-)bright-to-dark or dark-to-bright adaptation problems.
- Acuity
  - BVA OD: 20/20; OS: 20/25; (-)confrontation field defects;
- Entrance testing
  - PERRL (-)APD;
- SLE
  - (-)KPs, (-)cells/flare,
  - (+)NVI 360, OS;
  - Gonioscopy OS: mild NVA temporally.
  - Goldmann Tonometry: OD: 21mmHg, OS: 12mmHg;
- DFE
  - C/D: OD: 0.45/0.45, OS: 0.30/0.30; (-)NVD; (-)pallor, (-)collateral vessels
  - Fundus: OD: Clear; OS: diffuse midperipheral retinal blot hemorrhages (-)NVE

Physical

- Residual hemiparesis of right arm, improving by patient report. Poor balance due to numbness in right heel (noted by neurology)
- Good facial symmetry without asymmetry on puffing out cheeks, furrowing brow or smiling.

- Laboratory studies
  - Cholesterol: Last Chol: 163; Trig: 314; HDL: 27; LDL: 73
  - Blood glucose: Last HBA1c: 7.2, Last FBS: 129
  - Last BP: 134/70 (03/19/10)

- Radiology
  - Doppler:
    - RICA peak systolic (PS) velocity: 79cm/sec; RICA end diastolic (ED) velocity: 33cm/sec
    - LICA peak systolic (PS) velocity: 0cm/sec; LICA end diastolic (ED) velocity: 0cm/sec
    - Impression: Complete LICA occlusion; hyperechoic plaque at RICA with 1-15% stenosis.
  - MRA:
- **Others**
  - **HVF:**
    - OD: FL: 0/18, FP: 1%, FN: 5%, MD: -4.11, PSD: 4.17 GHT: Outside normal limits. Superior defects (rim artifacts)
    - OS: FL: 1/16, FP: 0%, FN: 0%, MD: -5.10, PSD: 5.02, GHT: Outside normal limits. Superior and inferior nasal defects
  - **OCT:**
    - OD: Avg thickness: 79; Superior flagged region (<5% of normals) @ 1:00
    - OS: Avg thickness: 106; no flagged defects

**Differential diagnosis**
- **Primary:** Ocular ischemic syndrome due to complete occlusion of LICA complicated by diabetes and with concurrent ocular hypertension, OD and 45% symmetry in IOPs.
- **Secondary:** PDR with anterior segment neovascularization with grossly asymmetric retinopathy and ocular hypertension, OD.
- **Tertiary:** s/p ischemic CRVO without collateral vessels, with anterior segment neovascularization, atypical retinopathy and decreased IOP in the ischemic eye. Ocular hypertension, OD.

**Diagnosis and discussion**
- Ocular ischemic syndrome can result from any significant chronic decrease in perfusion to the eye, be it from occlusion at the level of the bifurcation of the internal carotid artery from the common carotid artery (most common) or closer to the end target tissue, such as bifurcation of the ophthalmic artery from the ICA (less common)\(^1\). This poor flow leads to a decrease in ocular perfusion pressure, manifesting itself as midperipheral blot hemorrhages (due to progressive decreasing vessel diameter and perfusion pressure toward the peripheral retina). This poor perfusion leads to the release of VEGF and other angiogenic factors from the target tissue and results in anterior segment neovascularization. Typically, NVI and NVA are the first presenting form of neovascularization\(^7\). Decreased perfusion to the ciliary body also commonly causes decreased IOP before the IOP spikes and glaucomatous damage from NVI occluding the trabecular meshwork. Most patients with OIS and NVI present with IOP <22mmHg\(^3\)\(^4\)\(^5\).
- Hemodynamically significant carotid artery disease:
  - CE is indicated in any symptomatic, carotid-related TIA with stenosis of >70% to clear the pathway for blood to perfuse target tissues. Symptomatic patients with 50-69% stenosis benefit modestly from CE surgery. Symptomatic patients with <50% stenosis are recommended to be on ASA or antiaggregant therapy\(^7\). Asymptomatic patients with >60% occlusion who receive surgery only reduce their CVA risk by 1% per year, and CE is only considered in patients who are healthy enough to receive elective surgery.\(^3\)\(^4\)\(^7\) MRA and US are both accurate ways of detection of carotid stenosis. Some studies show that ultrasound tends to ‘undercall’ hemodynamically significant carotid stenosis, and should be confirmed with MRA.\(^8\)
- Duplex ultrasonography has been proven to have very high sensitivity and specificity for detecting occlusion of the internal carotid artery,\(^9\) yet MRA has yielded an even higher specificity (nearing 100%) and sensitivity (100%) when occlusion is in the 70-99% range\(^10\).
- FFA showed delayed choroidal, arterial and venous filling, OD. Hyperfluorescence was consistent with mild NPDR, OD and PDR, OS. Late stage hyperfluorescence may be suggestive of macular edema, OS.

**Treatment**
o Anterior segment evaluation, retina evaluation and FFA indicated the need for treatment with PRP, OS. IOP lowering drops will be considered, OU after PRP therapy to treat ocular hypertension, OD and to improve ocular perfusion, OS.

o Unique features of this case include the following:
  - Left eye is affected by the ocular ischemia (including ischemia to the ciliary body, producing less IOP in the affected eye), and the right eye IOP is in ocular hypertensive range with significantly more cupping. HVF, OD shows no glaucomatous pattern and HVF, OS shows defects that may be consistent with OIS11.
  - Some studies have given some credence to decreased perfusion leading to normal tension glaucomatous damage in the ischemic eye12, however, NTG secondary to carotid occlusion has been dismissed by other reports13.
  - Late stage venous leakage, causing parafoveal edema on FFA that some reports found in only 14% of carotid occlusion cases studied14.

**Treatment options:**
- PRP: only proven to be effective at regressing NV membranes in 36% of OIS patients15
- Intravitreal avastin has also been utilized as a therapy providing improvement in regression of neovascular membranes and visual outcome16
- Carotid artery stenting is a recent development that is currently being explored as an alternative for patients for whom CEA is not indicated17
- Treatment response unavailable at time of writing, but will be available by poster/paper publication time.

**Conclusion and pearls. Take away points.**
- Anterior segment sequelae:
  - Dilated episcleral vessels, corneal edema with/without bullous keratopathy, scleral melt, Iris atrophy and neovascularization of the iris, anterior chamber angle neovascularization, (+)APD, PAS, hyphema
- Posterior segment sequelae:
  - Macular edema, retinal A/V communication, CRAO, CWS, retinal emboli, retinal arterial pulsations, wedge-shaped chorioretinal atrophy in peripheral retina (choroidal ischemia), AION, glaucomatous damage in the ischemic eye (Neovascular or normal tension), mid-peripheral (typically outside of major retinal arcades) blot hemorrhages
- Workup for unconfirmed cases of OIS:
  - Sent to a well-trained carotid doppler technician and radiologist for evaluation of carotid occlusive disease. This test is highly sensitive and specific, but only if completed properly (very technician-dependent). Questionable results should be evaluated with MRA, if indicated.
  - Patient history should include information regarding episodes of loss of speech, expressive aphasia, amaurosis, limb weakness or forgetfulness. Any positive symptoms, especially those of amaurosis, in the setting of the associated anterior segment (most notably NVI and NVA) and posterior segment findings (most notably asymmetric mid-peripheral blot hemorrhages) and carotid occlusive disease of >50% occlusion confirms OIS and requires prompt referral to vascular surgeon for evaluation of TIA symptoms and candidacy for CE.
- Confirmed OIS patients require prompt notification of primary care and referral to ophthalmology for evaluation of need for PRP or Avastin to preserve vision in the ischemic eye and co-management by vascular surgery for carotid endarterectomy or carotid stenting evaluation.
- Importance of anterior segment analysis and gonioscopy in patients with asymmetric IOPs, history of hemodynamically significant carotid artery disease or asymmetric diabetes.