# WHEN GOOD RETINAL SURGERY MAKES GLAUCOMA GO BAD

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## FINANCIAL DISCLOSURES

- None.

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## GAME CHANGERS

- Patients with a history of retinal surgical procedures are common
  - Widening indications for vitrectomy
    - Retinal tear, detachment
    - Floaters
      - Vitreous hemorrhage, trauma, inflammation
      - PVD, myopic vitreopathy
  - Anti-VEGF injections are the cornerstone of medical retinal treatment
    - 6+ million injections per year in the USA

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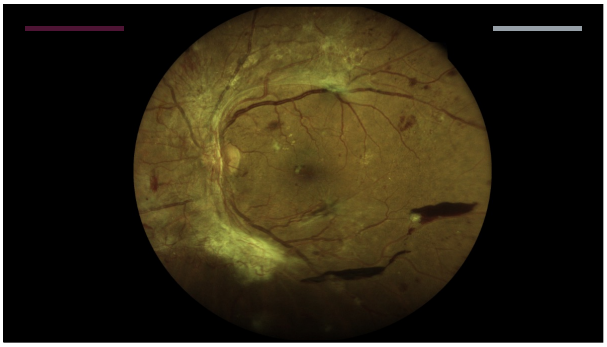

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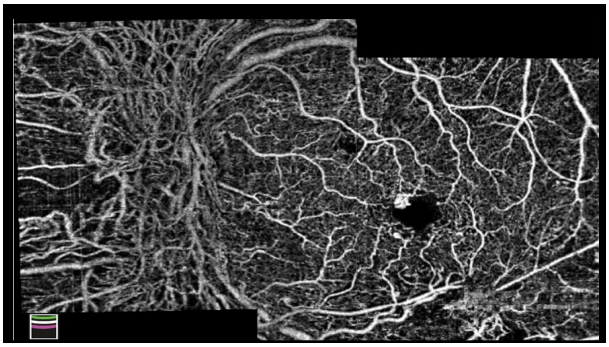

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## PROLIFERATIVE DIABETIC RETINOPATHY

- DRCRnet (Diabetic Retinopathy Clinical Research Network)
  - Protocol S:
    - 2 year results: Lucentis is non-inferior to PRP in PDR for maintenance of visual acuity in PDR
      - Less VF loss, fewer vitrectomies
    - Supported by CLARITY trial (RCT)
    - PRIDE: ranibizumab monotherapy = greater reduction of area of NV from baseline at 12 months vs. PRP
  - **THIS IS HUGE…**

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## WHAT DOES THIS MEAN FOR *US?*

- Immediate post-procedure complications are best managed by the operating physician
- **But what about long term complications?**
  - Cataract
  - Ocular surface disease
  - Cosmetic concerns
  - **Ocular hypertension and secondary glaucoma**

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## CASE 1

- 26 year old African American female
- NLP OD following complex retinal detachment repair
- Rhegmatogenous retinal detachment repaired in the **left eye**
  - PPV, silicone oil-20/40


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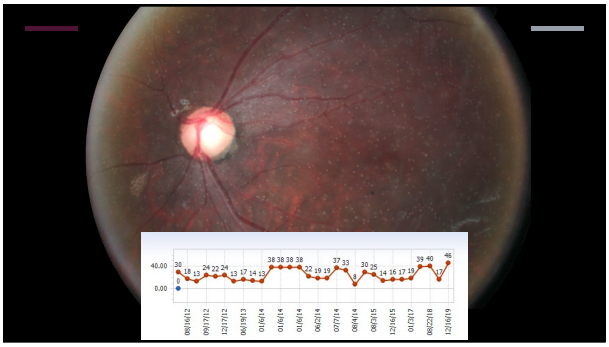


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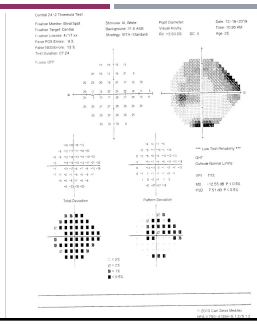
- POAG? JOAG?
  - Thick CCT
  - Unremarkable gonioscopy
- Is this elevated IOP and glaucomatous damage related to her vitreoretinal surgery?
  - Silicone oil?



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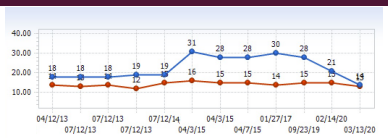
## CASE 2




- **What changed?**
  - Multiple IVI (approximately 6-9 per year) between 2014 and 2016 for macular edema secondary to CRVO
    - Avastin, Ozurdex

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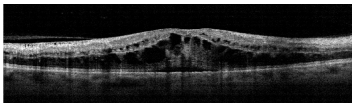
## HOW *COULD* IVI AND VITRECTOMY CAUSE ELEVATED IOP?!

- **Long and short term IOP rise possible**
- Development of OAG & progression of OAG



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## SHORT TERM

- We tend to think about the greatest risk of IVI to be endophthalmitis (1/2659)
- Immediately after injection: IOP rise to up to **87mmHg**
  - Most patients increase approximately 20mmHg-35mmHg
  - *Do most surgeons measure IOP after injections?*
- How does this happen?!
  - Increased intravitreal volume
    - 4-4.4mL average volume; most injections 0.05mL

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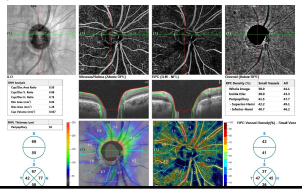
## WELL THAT CAN'T BE GOOD

- Risk of retinal artery occlusion (as high as 1/1389 Gao et al 2019)
- Repeated, sudden, **significant** IOP spike and temporary loss of perfusion



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## HOW CAN WE FIX THIS?

- **Treatment for elevated IOP vs. IOP spike-prevention**
  - Role of pre-procedure IOP lowering medication
  - Paracentesis
    - 32 gauge needle
    - Fluid balance

Anterior chamber paracentesis during intravitreal injections in observational trials: effectiveness and safety and effects

Sandeep Saxena[1], Timothy Y. Lai[2], Hideki Koizumi[3], Michel E. Farah[4], Daniela Ferrara[5], David Pelayes[6], Tomohito Sato[7], Carsten H. Meyer[8*], Timothy Murray[9] and for the International Pharmacokinetic Collaboration

International Journal of Retina and Vitreous

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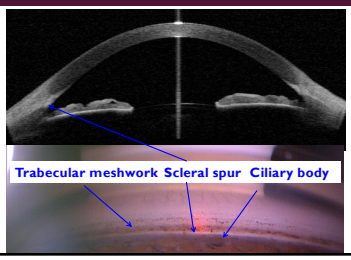
## HOW ABOUT LONG TERM IOP RISE?

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## ALL ABOUT OUTFLOW

- Reduced trabecular outflow:
  - 1) Direct toxicity of medication
  - 2) Inflammation
    - Trabeculitis
  - 3) Aggregation of particles
    - Silicone, protein in the TM
  - 4) Nitric oxide reduction

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## SILICONE?

- Medical grade silicone oil droplets
  - Barrel of the syringe
  - Hub of the needle
  - Tip of the plunger
  - Stopper of the medication vial
- *Silicone oil has the potential to be pro-inflammatory*

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## NITRIC OXIDE

- Nitric oxide is involved in the signaling pathway which leads to relaxation of trabecular beams
  - Leads to increased trabecular outflow
    - Latanoprostene bunod
      - Latanoprost acid + butanediol monohydrate
        - NO is a gas, so must be attached to another molecule
- VEGF upregulates nitric oxide synthase = increased nitric oxide
- *Effect of **anti-VEGF** medications?*

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## INTRAVITREAL STEROIDS

- Fluocinolone implant 0.19mg (Iluvien)
- Dexamethasone implant 0.7mg (Ozurdex)
- Intravitreal triamcinolone acetonide
  - Preservative-free Kenalog
  - Often used intraoperatively to delineate the ILM

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## HOW DO STEROIDS INCREASE IOP?!

- Decrease TM cell functions like phagocytosis
  - Accumulation of extracellular matrix
- Alters cell adhesion and cytoskeletal molecules

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## SO WHO IS MOST AT RISK?

- Greater number of injections (20+)
- Higher frequency of injections (7/year +)
  - Eadie et al 2017
- Younger patients
- Patients with shorter axial length

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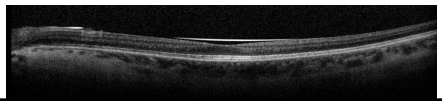
## VITRECTOMY & TAMPONADE AGENTS

- Long term potential for IOP rise
  - Oxidative stress-fluid/air exchange
- Tamponade agents
  - Sulfur hexafluoride ($SF_6$)
  - Perfluoropropane ($C_3F_8$)
  - Silicone oil-as high as 40%



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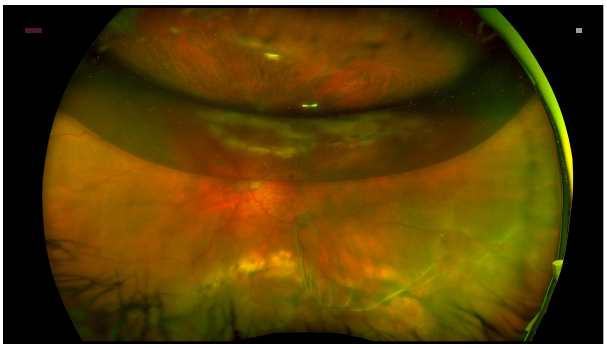

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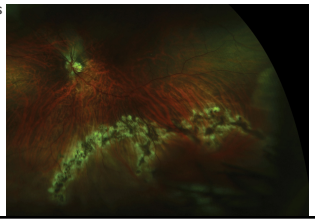
## SILICONE OIL

- Typically reserved for complex retinal detachments, patients with post-operative positioning concerns
  - Or who have air travel necessities…
- Long term tamponade
- Non-resorbable



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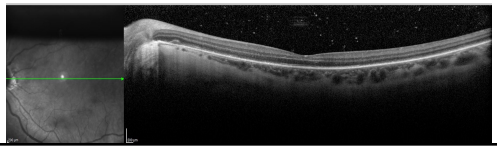
## SILICONE OIL

- Potentially pro-inflammatory
  - Trabeculitis & vitritis
- Microemulsification and migration into the anterior chamber
- IOP lowering medication of choice?



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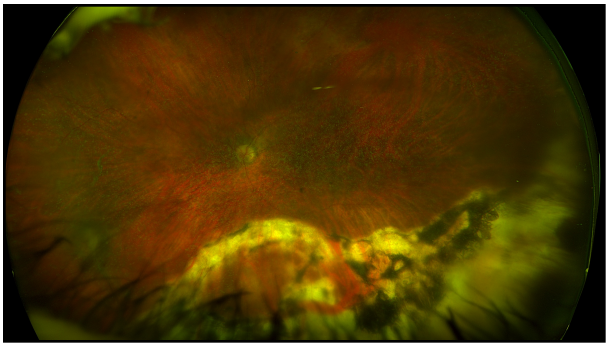

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## CASE

- 70 year old Hispanic female
- History of POAG OU; medically managed
- Underwent combined procedure: macular hole repair (PPV with membrane peel OS) with cataract extraction/PCIOL
  - Intravitreal triamcinolone intraoperatively

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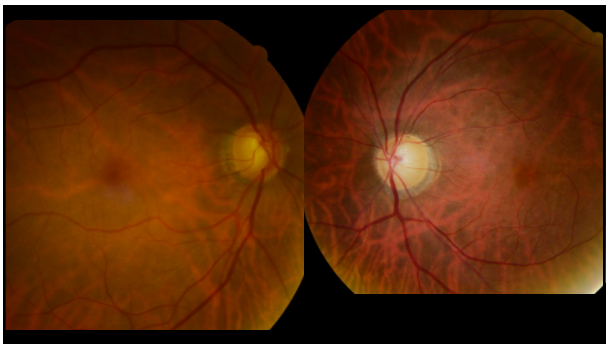

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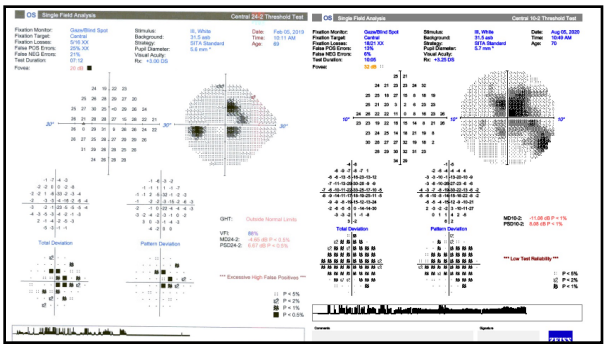

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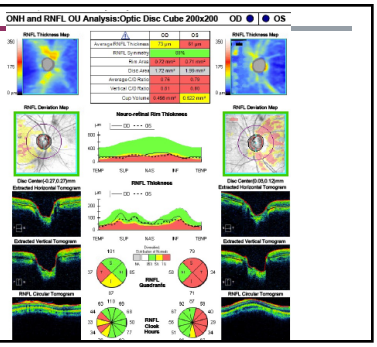
- Progression OS noted since vitreoretinal procedure
  - Without significant IOP increase
  - Stable OD

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## HOW DO WE MANAGE THIS PATIENT?

- Lower target pressure OS based on progression
- Well managed on topical medications:
  - Latanoprost QHS OU
  - Brimonidine BID OS added when progression was determined

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## BOTTOM LINE

- Intravitreal biologic agents and advancements in retinal surgery have greatly improved the prognosis of many retinal conditions
- Ocular hypertension leading to secondary open angle glaucoma is not an uncommon complication following IVI and PPV
  - Especially patients who undergo frequent injections and who have pre-existing ocular hypertension or open angle glaucoma
  - Especially when silicone oil is used as a tamponade agent

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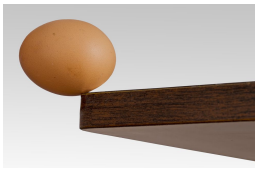
## BOTTOM LINE

- **Monitor intraocular pressure in patients undergoing IVI or who have a history of PPV**



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## THANK YOU!


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