The role of SD- OCT in the diagnosis and management of a solitary choroidal granuloma

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Abstract:

An atypical presentation of a solitary choroidal granuloma in a young man with systemic sarcoidosis whose management was dependent on the imaging of inflammatory activity in the RPE/PR layer using SD-OCT (Spectralis, Heidelberg). The patient presented with minor visual distortions and no other visual symptoms. His anterior and posterior segment had no other sign of inflammation. The lesion’s initial response to oral steroid treatment and the recurrence of the lesion when the steroid was tapered was imaged using SD-OCT.

Identify
I. Case History

• Patient demographics:
The case report is about a 34 year old man of from Germany (NF) with a history of a solitary unilateral choroidal granuloma. He was diagnosed as having a choroidal granuloma in Germany and subsequently, a diagnosis of Sarcoidosis was made based on other laboratory tests.

• Chief complaint:
He presented to the Ocular Health Clinic at the University of Waterloo reporting mild distortion to his vision in the right eye. He describes a “bubble” slightly adjacent to fixation. No flashes or floaters.
He had no history of episodes of redness, pain, photophobia, intermittent blur, or other symptoms indicating past anterior or posterior segment inflammation.

He also reports that he is noticing some difficulty with respiration which is a new finding for him.

• Ocular and Medical History:
Unremarkable until 6 months prior when he developed mild distortion to the right eye with mild ocular pain. He had presented to an ophthalmologist in his home town of Germany who diagnosed two confluent choroidal granulomas in the right eye. He had been treated with 25 mg decortin (prednisone) po which quickly resolved the subretinal edema. The ophthalmologist did a fast taper of the prednisone after two months, the granulomas started to become edematous again after the taper began so a sub-Tenon triamcinolone injection was given. Four months later he had been tapered off the steroid completely. He had not had a follow up on the granulomas in two months because he was immigrating to Canada. At the time he left Germany two months prior he had been told his choroidal granulomas were stable and flat with no subretinal edema.
He was subsequently worked up for systemic associations causing choroidal granulomas and was diagnosed with systemic sarcoidosis. The diagnosed was confirmed by the presence of biliary adenopathy in the lungs and a positive ACE serology.

- Medications
  Reported no medications.

- Other salient information
  Pertinent family history: paternal father had

II. Pertinent findings
- Clinical:
  - First visit (Nov.4):
    - BCVA: 6/7.5 OD 6/6 OS (+) Amsler distortion OD
    - Pupils: PERRL (-) APD
    - EOMs: Unrestricted (-) pain, diplopia
    - Intraocular pressure: 15 mmHg OD; 15 mmHg OS
    - Anterior Segment:
      - External adnexa, lids/lashes, cornea, conjunctiva all within normal limits. (-) keratic precipitates on corneal endothelium OU
      - Anterior chamber: (-) cells and flare, no signs of inflammation OU
    - Posterior Segment
      - Lens: cl OU
      - Vitreous: cl OU (-) cells
      - Optic nerve: 0.60 OU healthy colour, healthy rim tissue, borders distinct (+) SVP
      - Macula: flat (+) foveal reflex seen OU
      - Posterior Pole OD (2 DD from the optic nerve, off the superior arcades): 2 elevated coalesced choriotinal lesions, creamy yellow in colour, with indistinct borders. Trace pigmentation around the borders. Edge of the lesion encroached the superior-temporal edge of the macula causing sectoral elevation of the macula.
      - Vessels: 2/3 normal caliber OU, no change in vasculature around the lesions. (-) vasculitis
      - Periphery: (-) holes/tears/detachments 360 OU
  
- Imaging:
  - B-scan: flat
  - OCT (see image)
    - Elevation in superior temporal macula
    - Granulomatous material seen (iso-reflective) within RPE causing elevation
    - No serous retinal detachment
    - Scattered RPE mottling and proliferation around areas of lesion
  - Fundus Photos
Management:
  • Started on 25 mg qd po of cortisone
  • Was sent for chest x-ray and additional laboratory work up
  • Referral to ophthalmologist for opinion on additional treatment

  o Second Visit (Nov.11):
    • Improvement in vision, no longer seeing the “bubble” in his vision, respiration improved, peri-orbital pain improved, respiratory issues mostly resolved
    • BCVA: **improved** to 6/6 OD; stable 6/6 OS
    • Pupils, EOMs, confrontation fields wnl OU
    • Anterior segment: without inflammation OU
    • Posterior segment: without inflammation OU
      • (+) choroidal granulomas; resolving, more granular and flat appearance
    • Imaging:
      • SD-OCT (grayscale): There was less iso-reflective material seen in RPE layer of 2-D scan. Macular change analysis showed reduction in thickness, suggesting improvement in lesion
    • Management
      • Continue with 25 mg qd po cortisone

  o One month visit (Dec.2):
    • Improvement noted overall (vision and systemic symptoms)
    • Ophthalmologist report: Declared lesion “inactive”
      • Suggested tapering the steroid slowly
      • Decreased steroid dosage to 15 mg qd po because lesion appeared stable
    • BCVA: 6/6 OD, 6/6 OS
    • Pupils, EOMs, confrontation visual field wnl
    • Anterior segment: without inflammation
    • Posterior segment: vitreous clear, optic nerve and retinal vasculature within normal limits
    • Imaging
      • SD-OCT (grayscale): reduction in thickness and iso-reflective material in RPE layer, consistent with reduction in edema and improvement in vision
    • Management
      • Based on appearance of SD-OCT and evidence of granulomatous material in RPE; suggested oral steroid be raised to 20 mg qd OD

  • F/U 6 weeks later (Dec.16)
    o Bubble was returning, peri-orbital pain was returning
    o Feeling generally unwell
    o BCVA: 6/7.5 OD; 6/6 OS; (+) amsler distortion OD
    o Pupils, EOMs, confrontation fields wnl OU
    o Anterior segment: without inflammation
    o Posterior segment:
      • Vitreous clear, optic nerve and retinal vasculature within normal limits
      • Posterior pole: (+) choroidal granulomas
• Larger area of choroidal involvement, elevated
  o Imaging:
    ▪ SD-OCT (grayscale): macula showed elevation and thickening of granulomatous material in the RPE, iso-reflectivity in the area of granulomatous material
    ▪ Photos: showed enlargement of area choroidal granulomas
  o Management
    ▪ Increased cortisone back to 25 mg po

• F/U 7 weeks later (Dec.23)
  o Bubble gone, pain improved
  o BCVA: 6/6 OD; 6/6 OS; (-) amsler distortion OD
  o Pupils, EOMs, confrontation fields wnl OU
  o Anterior segment: without inflammation
  o Posterior segment:
    ▪ Vitreous clear, optic nerve and retinal vasculature within normal limits
    ▪ Posterior pole: (+) choroidal granulomas
      ▪ Larger area of choroidal involvement, resolving, less elevation
  o Imaging:
    ▪ SD-OCT (grayscale): macula showed less elevation and thickening of granulomatous material in the RPE layer, macular change analysis confirms improvement and continued resolution of
  o Management
    ▪ Continue cortisone back to 25 mg po
    ▪ Slow taper to be initiated after lesion is flat on OCT

• Physical
  o Lung Function test: normal values with good lung-volume and no obstruction. Normal diffusion capacity.

• Laboratory studies
  o Elevated ACE and interleukin-2 receptor; differential blood count with lymphopenia.
  o Liver enzyme, creatinine, calcium and c-reactive protein normal.

• Radiology studies
  o Chest x-ray and CT Thorax: bihilar lymphadenopathy and nodular lung lesions suggestive of Sarcoidosis (see image)
  o Bronchoscopy with lavage and biopsies: granulomas in the mediastinal lymph-nodes without necrosis. Lavage revealed lymphocytic alveolitis and elevated CD4/8 quotient. Both characteristic for Sarcoidosis

III. Differential diagnosis

• Primary:
  o Solitary choroidal granuloma s
    ▪ Seen with ocular Sarcoidosis, tuberculosis and toxocarasis. Laboratory studies reveal specific cause.
  o Choroidal Metastasis/Solitary Lymphoma lesion
    ▪ Associated with history of other primary tumors, rapid growth and a poor prognosis. Characteristics are creamy yellow-white lesions with mottled pigment
clumping, low – medium elevation, and an overlying SRD. May be multifocal and bilateral

- Lymphoma lesion: Appears similar to choroidal metastasis and usually occurs in patients who have concurrent systemic lymphoma
- Differentiation: tend to have less distinct margins, do not produce inflammation or exudation. Have more extensive retinal detachment and shows less fluorescence on angiography.

- Others:
  - Primary Intraocular Lymphoma
    - Creamy yellow pigment epithelial detachments, hypopigmented RPE lesions with overlying SRD and disc edema. Less distinct borders. Usually bilateral and associated with anterior uveitis, vitritis, retinal vasculitis, cystoid macular edema. Usually presents with decreased acuities and floaters.
    - Solitary lesion in this case did not have accompanying overlying inflammation, disc edema, or indistinct inflammation
  - Amelanotic choroidal melanoma
    - Different from choroidal granulomas because usually larger in diameter and thickness and often has visible blood vessels within mass. Has less distinct margins, no yellow exudation, and overlying drusen over the lesion.
  - Choroidal Hemangioma
    - Usually a red colour with ill-defined margins, and no yellow exudation
  - Choroidal osteoma
    - More common in younger patients. Slightly elevated, well-circumscribed, peri-papillary, orange-red (early) to cream-colored (late). Will have small vascular networks on the surface. High reflectivity on B scan. Irregular and scalloped borders
  - Idiopathic polypoidal choroidal vasculopathy
    - Orange-red serosanguinous detachments of the neurosensory retina and RPE with subretinal hemorrhage. Normally has associated bleeding. Will not respond to corticosteroids.

IV. Diagnosis and discussion

- Main differentials include solitary choroidal granulomas (usually from infectious/inflammatory cause) and choroidal metastasis/lymphoma lesion
  - Active lesion
    - Dull-yellow lesion with ill-defined border
    - Yellow Intraretinal exudation
    - Localized subretinal fluid
    - Occasional retinal vascular dilation and focal hemorrhages
    - Fluorescein angiography: hypofluorescence in vascular filling phases and progressive hyperfluorescence in later stages. Will have poorly defined margins from leakage into subretinal fluid and vitreous.
    - As inflammation subsides, margins become better defined; exudation, hemorrhage, subretinal fluid and vascular abnormalities disappear
  - Inactive lesion
    - Discrete, nummular, yellow-white lesions
May have ill-defined red-orange halo that surrounds the lesion
Minimal RPE abnormalities: hyperplasia, atrophy
Retinochoroidal shunt vessels may be present
Fluorescein angiography: early hypofluorescence and intense late staining with clearly defined margins

• Important to make the distinction since they have very different prognosis and one can be life threatening
  o Presence of exudation, response to steroid treatment, laboratory tests led to diagnosis of choroidal granulomas related to Sarcoidosis

• Etiology of solitary choroidal granulomas was made from laboratory work up
  o Chest X-Ray: bihilar lymphadenopathy and nodular lung lesions
  o Bronchoscopy with lavage and biopsies: Granulomas in mediastinal lymph-nodes without necrosis. Lavage with lymphocytic alveolitis and elevated CD4/8 quotient (characteristic of sarcoidosis)
  o Lab: elevated ACE and interleukin-2 receptor. 15% lymphopenia. Normal liver enzymes, creatinine, calcium, C-Reactive P protein.
  o Lung function. Normal values with good lung volume and no obstruction, normal diffusion capacity.
  o Multi-system chronic inflammatory disorder of unknown etiology
  o Characterized by noncaseating granulomatous inflammation composed of epithelioid cells and Langerhans giant cells
  o Most frequently involves lungs, liver, skin, central nervous system, and eyes
  o 30-60% develop ocular manifestations, most common being bilateral granulomatous inflammation (usually anterior uveitis)
  • Posterior segment involvement occurs approximately 25% of the time and usually includes vitritis, retinal vasculitis, chorioretinitis, and granulomas of the retina, optic nerve, or choroid

• 5.5% of patients with ocular Sarcoidosis will have solitary choroidal granulomas, anterior uveitis only present 10% of the time
  o Common location of lesions: most will be posterior to equator
    ▪ 1/3 macular area, 1/5 will be peripapillary, and the remainder between posterior pole and equator, most commonly inferior quadrant, then superior, nasal, temporal
    ▪ Size: base mean: 4 mm, thickness mean 2 mm

Choroidal granulomas and SD- OCT.

• Granulomatous exudation is seen as iso-reflective (gray) material at the level of the RPE and PR on the SD-OCT
• Limited reports in the literature on the features of the OCT in choroidal granulomas from Sarcoidosis
• Iso-reflective material in the deeper retinal areas increases and decreases depending on growth of lesion: suggestive of inflammatory infiltrates
• Thickness of the deeper retinal inflammatory material is monitored over time in this patient, slight increases in iso-reflective material was seen each time patient lowered his steroid medication – and in contrast, it decreased every time he increased the anti-inflammatory
steroid which highly supports that the iso-reflective material is inflammatory and indicative of disease activity
  
- In areas of resolved inflammation, RPE is mottled and appears irregular on OCT.
- SD-OCT can be used to aid in diagnosis of solitary choroidal granulomas and can be an important imaging tool in monitoring the disease and the diseases response to treatment

 Treatment and response to treatment
  
- Cortisone 25 mg po was given initially
- Baseline bone mineral density to follow him and ensure bone mass is not being lost since long term steroid dose
- Good response to corticosteroid treatment which is very suggestive of being choroidal lesions from Sarcoidosis rather than a different infiltrative disease such as lymphoma which would not respond to treatment
- Choroidal granulomas would return when taper of oral steroid was initiated (lung granulomas did not change in size with treatment but remained asymptomatic throughout)
- Ocular Sarcoidosis Management:
  - Systemic corticosteroids and immunosuppressant medications are the standard
  - Treatment dosages tend to be in the range of 40 to 100 mg per initial dose
  - Sarcoidosis choroidal granuloma lesions usually respond well to prednisone within first 4 months but are recurrent in nature: dosages should be tapered over the course of 3-6 months depending on clinical response

 VI. Conclusion and uniqueness of the case presentation
  
- Systemic Sarcoidosis may present in the eye without an anterior/posterior inflammatory response
- Main differential is choroidal metastasis and distinction is important before diagnosis can be confirmed
- Choroidal granulomas from Sarcoidosis respond very well to steroids but have a tendency to recur
- Peri-orbital pain may be associated with active choroidal granulomas and appear to respond well to an oral steroids
- SD-OCT can be very beneficial in the diagnosis and monitoring of the condition because of it’s ability to image the inflammatory material and the response to treatment

UNIQUENESS OF THIS CASE PRESENTATION:
  
- Iso-reflective inflammatory material seen in the RPE/PR layer when the choroidal granuloma was ‘active’
- SD-OCTs ability to image inflammatory material’s response to treatment

VII. References:


Image: OCT with deep retinal inflammation seen in the choroidal granuloma
ABSTRACT:

This case highlights the challenges of clinical diagnosis of sarcoidosis when atypical ocular findings are evident in the absence of pulmonary involvement. The differential diagnosis, topical and medical treatment, and therapeutic outcome will be presented.

Case History:

MB is a 37 yo BM referred to clinic for evaluation of dry eye by his primary care provider. He states he has been experiencing a gritty feeling in both eyes for 6 months and has noticed a few bumps inside his lower right eyelid since that time.

He also states he was diagnosed with the mumps by his outside provider around the time his ocular symptoms started. He had enlarged parotid glands with the right side more involved than the left side. He was treated with an oral antibiotic for 2 weeks and told that the mumps would go away over time.

His primary care provider in the hospital feels that the enlarged parotid gland on the right side may be a carcinoma and he is being evaluated for surgical biopsy.

He has used OTC Visine intermittently with no relief of his ocular symptoms. He denies any epiphora, discharge or previous injury, infection or inflammation.

His medical history and medications include:
Sleep apnea

Chronic sinusitis

Seasonal allergic rhinitis

GERD

Restless leg syndrome

Hypertension

Chronic shoulder pain

Nonspecific malaise and joint pain x 1.5 yrs

Treatment for gonorrhea at age 18

**Pertinent findings:**

BVA 20/20 OD/OS

Pupils/EOMS/Confrontation unremarkable

BP 141/84

SLE

Lids clear OU

Conj OD: 2 cystic lesions on inferotemporal palpebral conjunctiva (photos taken)

OS: clear

OU: enlarged firm lacrimal glands (photos taken)

Cornea OU: mild SPK OD>OS c <5 sec BUT OU

AC Clear OU

TA 16 OD

14 OS

DFE:
Pt diagnosed with dacryoadenitis with conjunctival lesions of potential granulomatous etiology. Pt placed on topical lubricant drops and UNG for bedtime to decrease symptoms. Pt was set up for lacrimal gland biopsy with oculoplastics 3 weeks after initial visit.

**Differential diagnosis**

Initial differential included Parinaud's oculoglandular syndrome, mumps, Bartonella henselae, sarcoidosis and tuberculosis. The following studies/consults obtained over 2-week period:

- **CBC** norm
- **ACE** 65
- **IgG/IgM** neg
- **PPD** neg
- **Chest x-ray** neg
- **Pulmonary bronchoscopy** neg
- **Rheumatology** for associated malaise and intermittent arthralgia's
  
  Ordered Chest CT- neg

Conjunctival/lacrimal biopsy cancelled by oculoplastics surgeon due to lack of radiographic evidence
Parotid gland biopsy right side: non-caseating granulomas -likely chronic
Neg for acid-fast organisms and fungi

Diagnosis and discussion
- Non pulmonary sarcoidosis with bilateral dacrtyoadenitis and conjunctival granulomas OD
- Mumps/ Bartonella/TB/Parinaud's Oculoglandular Syndrome ruled out due after laboratory testing and studies were performed in conjunction with physical examination and history
- Coordinated care with pulmonologist and rheumatologist was instrumental in diagnosis and initiating appropriate treatment plan
- Oral steroid and methotrexate treatment initiated and managed by rheumatology

Elaborate on the condition
- Incidence of 40/100,000 with slight F>M
- Blacks 20x>non Black
- Usually remit <2 years but can be chronic in 30% of cases
- Morbidity most commonly from pulmonary disease
- 5-10% of sarcoid patients have no pulmonary involvement
- Etiology of sarcoidosis not definitively determined however infectious agents, aberrant autoimmune responses, environmental agents are all implicated as triggers for poorly modulated granuloma
- The non-pulmonary manifestations of lymph node, mucous membrane, dermatologic, articular, neurologic, muscular, cardiac, gastrointestinal and ocular are well documented
- Ocular findings in approximately 25% of sarcoidosis patients (17-64% range)
- Neither uveitis (reported in 50-85% of cases with ocular findings) nor retinal phlebitis were present in this case
- Conjunctival lesions are reported in 44-56% of cases with ocular involvement
- Lacrimal gland involvement reported from 4-66% of patients with sarcoidosis
- Lacrimal gland involvement reported from 4-66% of patients with sarcoidosis
- Initial high normal range ACE with co-existing lacrimal and parotid gland involvement with co-existing conjunctival lesions consistent with, but not necessarily diagnostic of, sarcoidosis
- The ocular findings and pathology confirmed caseating granuloma of the parotid gland were instrumental in determining the appropriate diagnosis and treatment for this patient

Treatment/management
- Pt did not return for f/u in eye clinic for 3 mos after initiating lubricant tx.
- Topical FML was used BID OU only for 3 mos to maximize patient comfort while the efficacy of systemic treatment was being determined
- 30 mg oral prednisone daily x 1 week followed by 20 mg for 1 month with planned taper as clinically indicated
- 10 mg methotrexate once a week increasing to 15 mg after 4 weeks of treatment
- Treatment titration by rheumatology based on ACE levels, which peaked at 78 and dropped to 10 with treatment.
- Oral steroids stopped after 6 mos of tx – with 2 episodes of recurrence requiring short term steroid use
- Pt primarily managed on MTX only at 6 years after treatment initiated
- Resolution of conjunctival lesions and softening of lacrimal glands with initial steroid treatment
- Exacerbations in the severity of dry eye symptoms with relapses of sarcoid inflammation warranting short term topical steroid use
- Punctal plug insertion for greatest symptomatic relief of dry eye
- Resolution of bilateral parotid gland enlargement although pt left with persistent gustatory sweating around incision site from parotid biopsy (Frey’s Syndrome) on the right side as well as hypaesthesia to the preauricular area of the right side of his face

References


Conclusion
- This case is an example of significant ocular manifestations of sarcoidosis in the absence of radiographic confirmed pulmonary involvement

- Surgical pathology may be of paramount importance in the accurate diagnosis and treatment of sarcoid patients.

- Diagnosis may have been expedited if conjunctival and/or lacrimal gland biopsy was acquired as opposed to the waiting for the parotid gland biopsy (with resulting Frey’s syndrome and hypaesthesia)

- Sarcoidosis associated dry eye may parallel disease activity
Case Report
I. Case History
   a. Patient demographics: 73 year-old Filipino male
   b. Chief complaint: not sure if vision better since cataract surgery; poor historian
   c. Ocular, medical history
      i. Phaco IOL OD 3 months ago, cataract OS, mild NPDR OU 2.5 years ago, PED superior temporal to macula OD, few macular drusen OS
      ii. Type 2 diabetes mellitus x 28 years, hypertension, hyperlipidemia, anemia in CKD, secondary (renal) hyperparathyroidism, ESRD, diabetic nephropathy, hearing loss, paralysis of the popliteal nerve, paralysis of the median nerve, bursitis, varicose veins, depression, atrial flutter, coronary artery disease s/p CABG, hepatitis B, quit smoking >30 years ago
   d. Medications
      i. Oral: allopurinol, ASA 325mg, bisacodyl, calcium acetate, carvedilol, docusate, guaifenesin, metoclopramide, nitroglycerin, renal-tab, temazepam, valsartan
      ii. Inhaled: albuterol/ipratropium
      iii. IV: ferric sodium gluconate, paricalcitol, epoetin alfa
   e. Other salient information: dialyzes on Monday, Wednesday, and Friday; not candidate for kidney transplant
II. Pertinent findings
   a. Clinical
      i. BCVA: 20/100 OD, 20/50-1 OS
      ii. Cover test, motilities, confrontation fields, and pupils: normal
      iii. Slit Lamp Exam: non-contributory
      iv. IOP: 13 OD, 15 OS
      v. DFE:
         1. PC IOL centered slightly inferior with clear capsule OD and nuclear/cortical/posterior subcapsular cataract OS
         2. PVD OS
         3. Large subretinal hemorrhage in temporal posterior pole extending to macula OD and small hard drusen in macula OS
      vi. Macula OCT: large elevated subretinal hemorrhage in macula and temporally OD and few small hard drusen OS
   b. Physical
      i. Vitals: BP: 188/86, Pulse: 54, Respiration: 18, Temperature 96.8 F, Pain: 0
      ii. Weight: 137 lbs., Height: 69 inches
   c. Laboratory studies
i. HbA1C 5.9% H, FBG 153 H
ii. Metabolic panel: EGFR 6 L, BUN 39 H, Creatinine 8.42 H, Chloride 97 L, Calcium 10.7 H, Albumin 3.3 L; all else normal
iii. CBC w/diff: RBC 2.90 L, HGB 9.8 L, HCT 30.7 L, MCV 106 H, MCH 34 H, MCHC 32 L, RDW 147 H; all else normal
iv. Lipid panel: all normal except HDL 30.2 L
v. Other: TIBC 210 L, Ferritin 345.0 H
d. Radiology studies: “stenosis of ICAs 0-39%, normal to mild” per carotid ultrasound 6 years s/p CABG
e. Others
  i. Optical Coherence Tomography: “large thick submacular hemorrhage with small pigment epithelial defect OD”
  ii. Fluorescein angiography:
     1. OD: “blockage of NaFl by blood, significant capillary dropout in macula and periphery, some hyperfluorescence in late frames with leakage in irregular pattern immediately superior to fovea”
     2. OS: “staining of drusen in macula OS, significant capillary dropout in periphery but no neovascularization”
  iii. Indocyanine green angiography: “no hot spots or polyps in macula” OD (i.e., no choroidal neovascular membrane under the blood)

III. Differential diagnosis
   a. Primary/leading: Foveal neovascularization
   b. Others: Choroidal neovascular membrane

IV. Diagnosis and discussion
   a. Elaborate on the condition
      i. First described by Finkelstein in 1981
      ii. Unilateral or bilateral
      iii. Asymptomatic to severely decreased vision
      iv. All reported cases related to insulin-dependent diabetes mellitus
      v. Caused by impaired blood flow in choriocapillaris from significant retinal ischemia
      vi. Rare; few reported cases (12) in literature
   b. Expound on the unique features
      i. Minimal fundus signs to large subretinal, pre-retinal, or vitreous hemorrhage
      ii. Diagnosed with fluorescein angiography
      iii. Indocyanine green angiography used to differentiate from choroidal neovascular membrane and to determine what’s beneath the obscuring blood if present
      iv. Rare due to protection from rich oxygen supply from choriocapillaris

V. Treatment, management
   a. Treatment and response to treatment:
      i. PRP, anti-VEGF intravitreal injection, macular grid laser
      ii. Undetermined response to treatment due to few case reports
   b. Refer to research where appropriate
c. Bibliography, literature review encouraged
   Arend O, Ruffer M, Remky A. Macular circulation in patients with
diabetes mellitus with and without arterial hypertension. Br J
   Joondeph BC, Joondeph HC, Flood TP. Foveal neovascularization in
   Kurz PA, Nguyen H, Cooney MJ. Bilateral foveal neovascularization in
a patient with insulin-dependent diabetes mellitus. Arch
   neovascularisation in diabetic retinopathy: case report and review
   Sawa M, Tamaki Y, Klancnik JM, et al. Intraretinal foveal

VI. Conclusion
   a. Clinical pearls, take away points if indicated
      i. May not be obvious on DFE, need FA
      ii. May be more prevalent than thought, need FA
      iii. May be reason for decreased VA in absence of significant macular
           findings, need FA
      iv. Importance of good blood glucose control