Light treatment for AMD and Retinart – pictures to admire and educate

Peter Simcock

The big bang





- Universe created 13.8 billion years ago
  - Initial hot plasma of protons and electrons
  - Photons could not travel as were deflected by free electrons

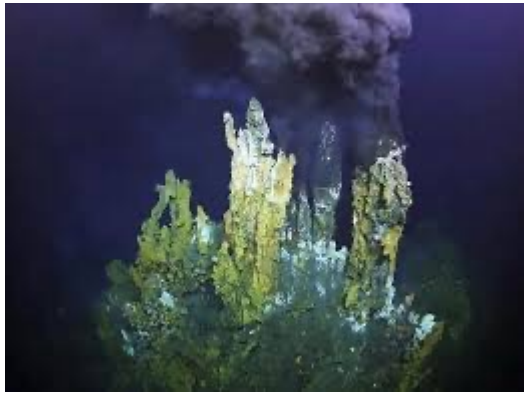
- First light travels freely across space 380,000 years after the big bang
  - Cooling allowed formation of Hydrogen and Helium atoms
  - Electrons now trapped in the atoms so light could travel between them
  - This first “light” we still seen as “ microwave background cosmic radiation”

The creation of the sun and earth



- First stars 100 million years after big bang
  - Gravity starts pulling matter together, nuclear fusion starts
  - First starlight ended the universe “dark age”
  - Our star the Sun is 4.6 billion years old
- Earth created 4.5 billion year ago
- First life on earth 4.2 billion years ago when oceans first formed?
- First life appears very early on in earths existence

First life on earth





- 4.2 billion years ago
  - Single cell, anaerobic
  - Energy from heat and chemicals
  - Near hydrothermal vents
  - That is how it was for almost half of earths history
- 2.4 billion years ago
  - Cyanobacteria evolved to photosynthesize. “The great oxidative event”
  - Oxygen allowed the earth to rust for the first time (“banded iron formations”)
  - Oxygen high in the atmosphere became Ozone and protected the earth from UV light
  - Resulted in the first “mass extinction” as oxygen toxic to the anaerobic life that went before

How multicellular life evolved

- Photosynthesis
  - Light from the sun (Energy) + Carbon dioxide + Water = Glucose + Oxygen
- Aerobic Respiration
  - Glucose + Oxygen = Energy (ATP) + Carbon dioxide + Water
- Aerobic Respiration
  - Very efficient at creating energy from glucose and oxygen
  - More bacteria evolved to use oxygen and become aerobic

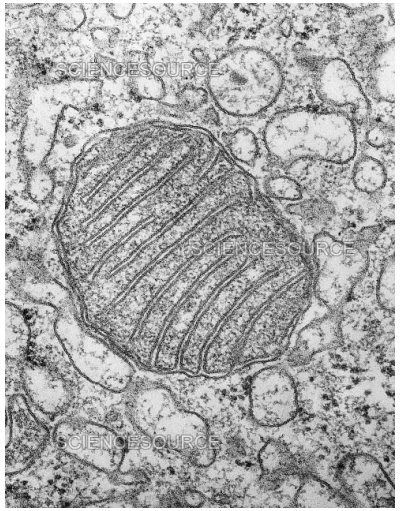
How multicellular life evolved

- First “take over” – 2 billion years ago
  - A small aerobic bacterium good at producing ATP was engulfed by a primitive larger single cell and a symbiosis occurred
  - Worked well for both as it gave extra energy to the larger cell and the engulfed bacterium then evolved into the mitochondrion
  - Now had massive surge in available energy needed to evolve complex life
- Second “take over” – 1.5 billion years ago
  - The primitive mitochondrion carrying large single cell engulfed a cyanobacterium
  - The cyanobacterium then evolved into the chloroplast
  - Plants then evolved to make more oxygen and sugar

Complex life arrived -800 million year ago (Cambrian explosion-540 million year ago)

- Ozone present to stop harmful UV light destroying DNA
- Plentiful oxygen in the atmosphere from photosynthesis
- Mitochondria available to provided extra energy needed for complex life
- Plants generating oxygen but also glucose for the animals to eat to provide energy indirectly from the sun
- Animals eat other animals in a “food chain”
- Survival of the fittest continues this evolutionary trend
- Homo sapiens – 300,000 years ago
- “Modern humans” taking over the world and messing things up – 60,000 years

What are mitochondria?



- Were primitive aerobic bacteria
- Engulfed by more complex cells
- Provided the host with reliable source of energy (ATP) with oxidative respiration rather than fermentation
- The cells “batteries”
- Have their own DNA inherited from the mother
- Mitochondrial eve – female in Africa living 100,000 to 200,000 year ago
- She is the woman from whom all living humans descend in an unbroken line purely through their mothers

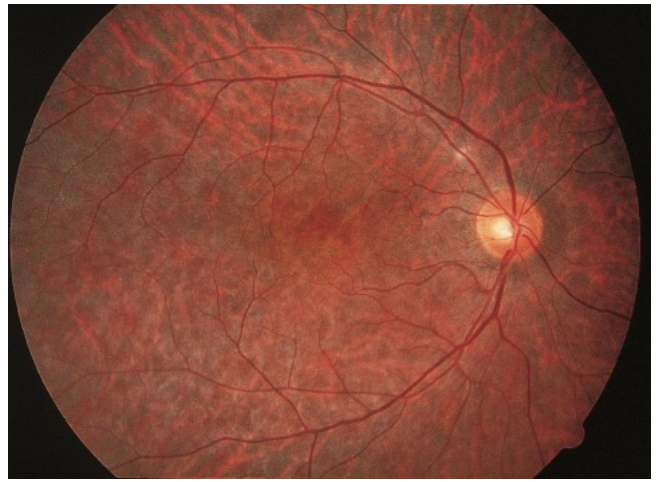
What about mitochondria and the eye?

- Photoreceptor / RPE complex the most metabolically active cells in the body
- Have a huge requirement for glucose and oxygen to allow the visual cycle to occur
- Have their own blood supply (choroid)
- Photoreceptors / RPE complex and ganglion cells have very dense mitochondria in order to provide sufficient energy to drive their visual functions
- Also orientated to help focus the light in squirrels !

Mitochondrial eye diseases



- Genetic
  - LHON (Leber's hereditary optic neuropathy)
  - CPEO (chronic progressive external ophthalmoplegia)
  - MELAS (mitochondrial encephalomyelopathy, lactic acidosis and stroke like episodes)
- Ageing
  - Glaucoma
  - Diabetes
  - Age related macular degeneration



Valeda Light Delivery System



- Latin *Valere* – to be strong and healthy
- FDA authorised not approved
- Photobiomodulation, low level laser light (red, yellow, near infrared)
- 15 min session x 9 over 3 to 5 weeks, then maintenance cycles every 3 to 4 months
- For early to intermediate dry AMD
- VA usually better than 6/36

Dry AMD Treatment with Valeda Light Therapy (FDA-Approved)
Available at our Central London and Manchester Eye Hospitals

Have you been diagnosed with early to mid-stage Dry Age-related Macular Degeneration (AMD) ?
Are you worried about your independence? Or your ability to drive, work or enjoy your retirement?
xxxxxxxxxx Opticians is proud to have introduced the first approved light delivery treatment – photobiomodulation – for Dry AMD

VALEDA
Light Delivery System

Valeda is the first FDA-approved device for dry AMD, and the first treatment for intermediate dry macular degeneration



ABOUT VALEDA LIGHT THERAPY

Valeda Light Therapy is the only FDA and CE marked device to treat Dry Macular Degeneration, a common eye condition after the age of 55 where cells in the middle of the retina (the light-sensitive layer at the back of your eye) die or are damaged

How does it work?

- Red light (660 – 670nm)
  - Stimulates ATP production in the mitochondria
  - Stimulates cytochrome c oxidase
- Yellow light (590nm)
  - Inhibits inflammation and reduces oxidative stress
  - Reduces the expression of VEGF
- Near infrared (850nm)
  - Gets to deeper layers to reduce inflammation and improve circulation

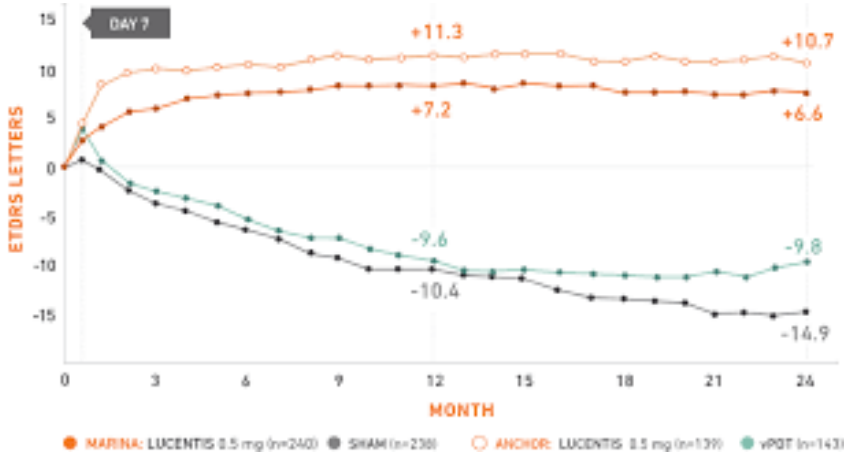
Lightsite III

- 13-Month Efficacy and Safety Evaluation of Multiwavelength Photobiomodulation in Nonexudative (Dry) Age-Related Macular Degeneration Using the Lumithera Valeda Light Delivery System
- Boyer, David MD; Hu, Allen MD; Warrow, David MD; Xavier, Samantha et al
- *Retina* 44(3):p 487-497, March 2024
- Total of 100 patients with 148 eyes

Lightsite III results

- 100 patients
- Patients in the treatment arm could see on average 5 more letters on the chart after 13 months treatment
- Patients in the placebo arm could see on average 3 more letters on the chart after 13 months treatment
- Patients in the treatment arm slightly less prone to developing GA but slightly more prone to getting wet AMD

Marina and Anchor studies



- **Gain or loss of ≥15 ETDRS letters** (~3 lines on the ETDRS chart) is the most commonly accepted threshold for a *clinically meaningful improvement or deterioration* in visual acuity. This equates roughly to a doubling or halving of the minimum angle of resolution and reflects a change that patients typically notice functionally

Lightsite IIIB extension study

- Presented at ARVO May 2025
- Smaller numbers – 70 patients
- 20-month gap between the trials
- Review up to 4.5 years since first treatment
- 60% of subjects receiving treatment across both trials had a visual benefit of 5 letters
- Patients with early to intermediate dry AMD did best
- Less progression to GA in treated patients

Meta-analysis

- **Is Multiwavelength Photobiomodulation Effective and Safe for Age-Related Macular Degeneration? A Systematic Review and Meta-Analysis**
  - Open access
  - Published: 16 March 2025
  - Volume 14, pages 969–987, (2025)
- Still small numbers: 360 patients and 477 eyes
- Conclusion: This meta-analysis suggests that, to date, there are no significant clinical benefits of PBM therapy for patients with AMD. Further long-term studies are needed to establish its clinical relevance and safety profile.

Dry AMD treatment costs

- Initial consultation: £300
- First treatment cycle: £1,300
- Includes nine Valeda light therapy sessions over a three to five-week period.
- Subsequent treatment cycles: £1,450
- Cost of transport to and from the clinic needs to be included

Eurolight study

- Europe based
- Valeda light delivery system
- Estimated completion end of 2026
- Estimated enrolment 500
- Watch this space
- Hopefully results soon

Current situation in 2026

- Is it safe? – good evidence to suggest it is safe (FDA authorised)
- Is it effective? – limited evidence to date to show this
- Needs further larger studies to provide clinically significant outcomes
- The statistics and outcomes on small numbers of eyes do not provide the quality of evidence needed to say that it works
- End points for these studies is visual acuity
  - Not the best way of assessing visual function in patient with AMD
  - Reading speed
  - Microperimetry
  - AI assisted high resolution assessment of photoreceptors and RPE

Retina Image bank

- American Society of Retina Specialists
- Open access
- 30,000 retinal images
- Top rated
- Most viewed
- Images of the week
- Images of the year

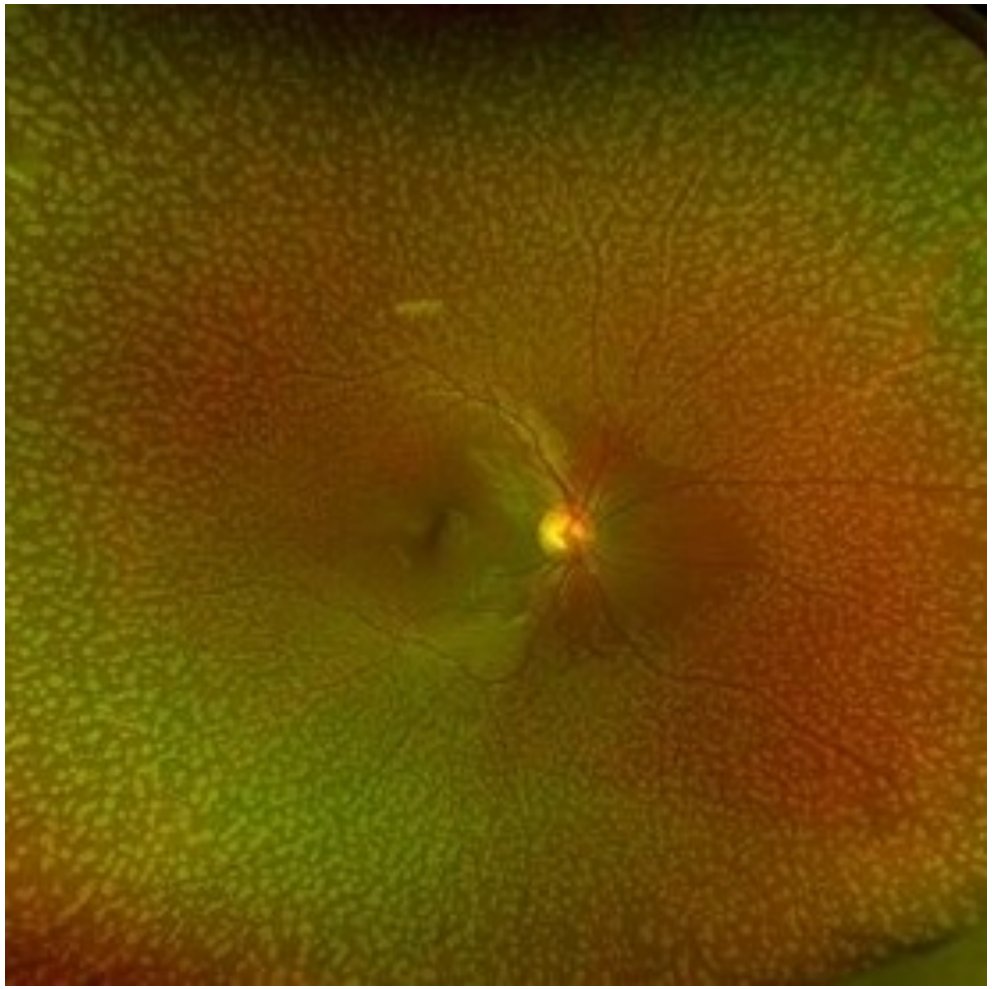
What is the diagnosis and how may it happen?



Pre retinal haemorrhage

- Likely Valsalva haemorrhage associated with raise venous pressure
- Haemorrhage often beneath the ILM, and break thought into vitreous cavity
- Severe cough
- Severe constipation
- Sexual intercourse
- Blowing musical instruments
- Usually improves spontaneously

Possible causes of flecked retina?



Benign familial fleck retina

- Patient asymptomatic
- Autosomal recessive
- Macular sparing
- Normal ERG and Visual acuity
- No night blindness

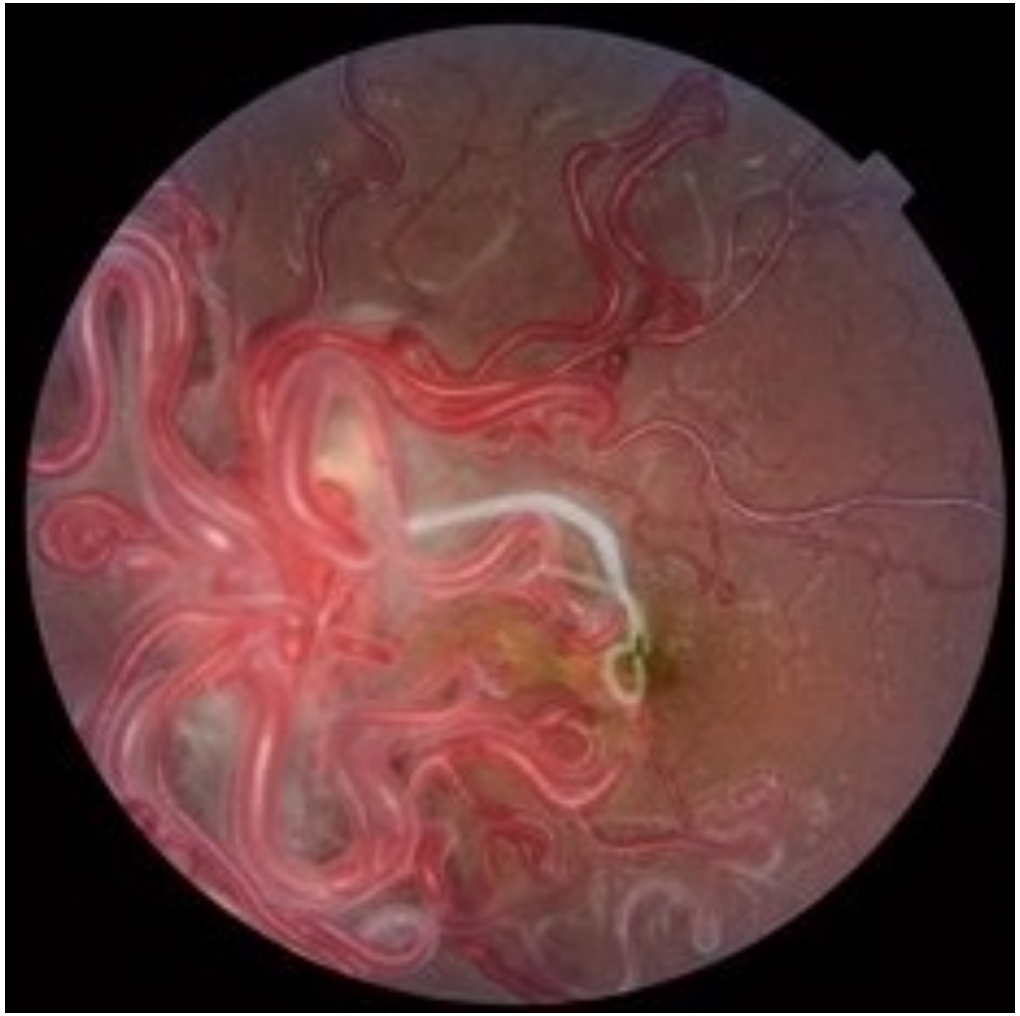
A rare bite!



Lava from botfly - ophthalmomyiais

- Maggot visible in retina with tracks left showing where it has moved
- Mainly Southern Mexico to South America
- Sometimes seen in North America and Europe and can be worldwide
- From rodents, rabbits, deer sheep and goats
- If you see the larva – laser it!

What important test would be ordered?



Wyburn Mason syndrome

- Rare, non-hereditary congenital disorder
- Arterio-venous malformations in retina
- Called a retinal racemose haemangioma
- Needs Neuroimaging
- May be AVM in the brain on the same side

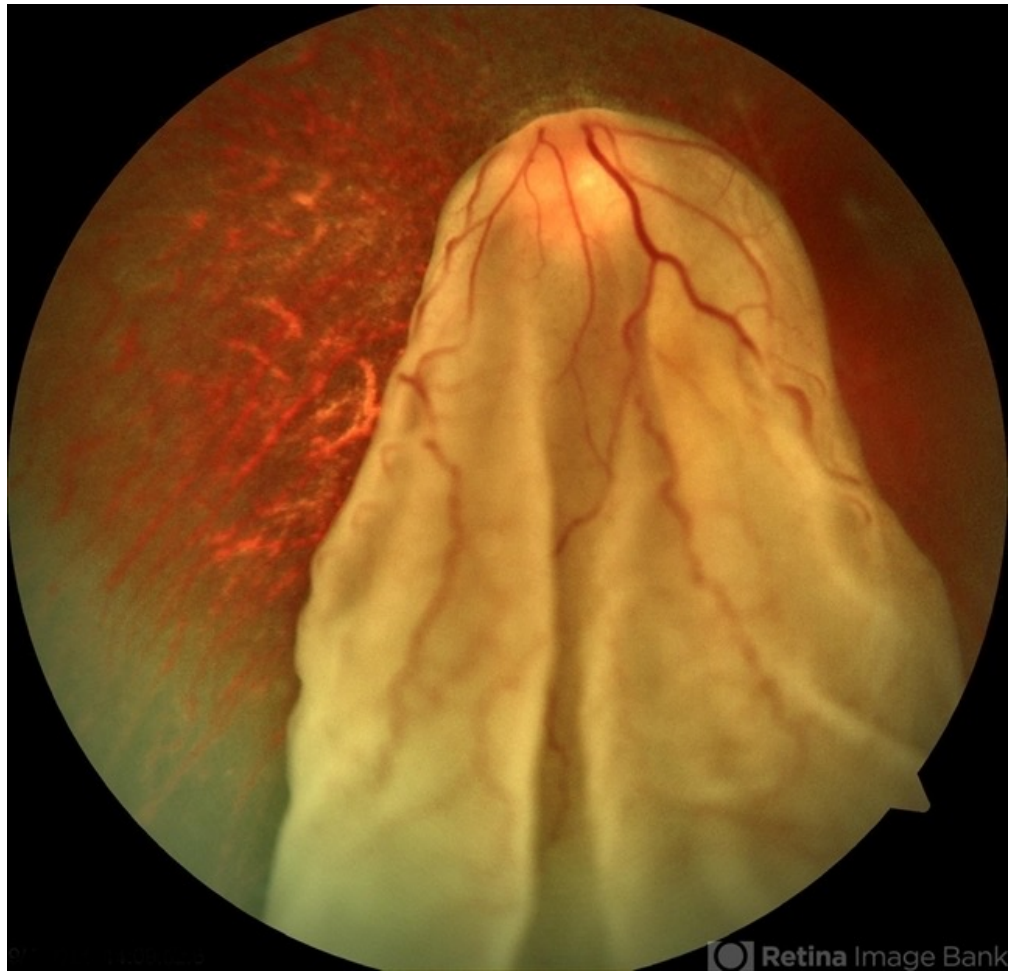
What is the “give away” sign?



“Light bulb” dilation of vessels

- Coat’s disease
- Usually unilateral, male
- Retinal vessels leak
- Swelling of the retina
- In severe cases (as in this picture) exudative retinal detachment

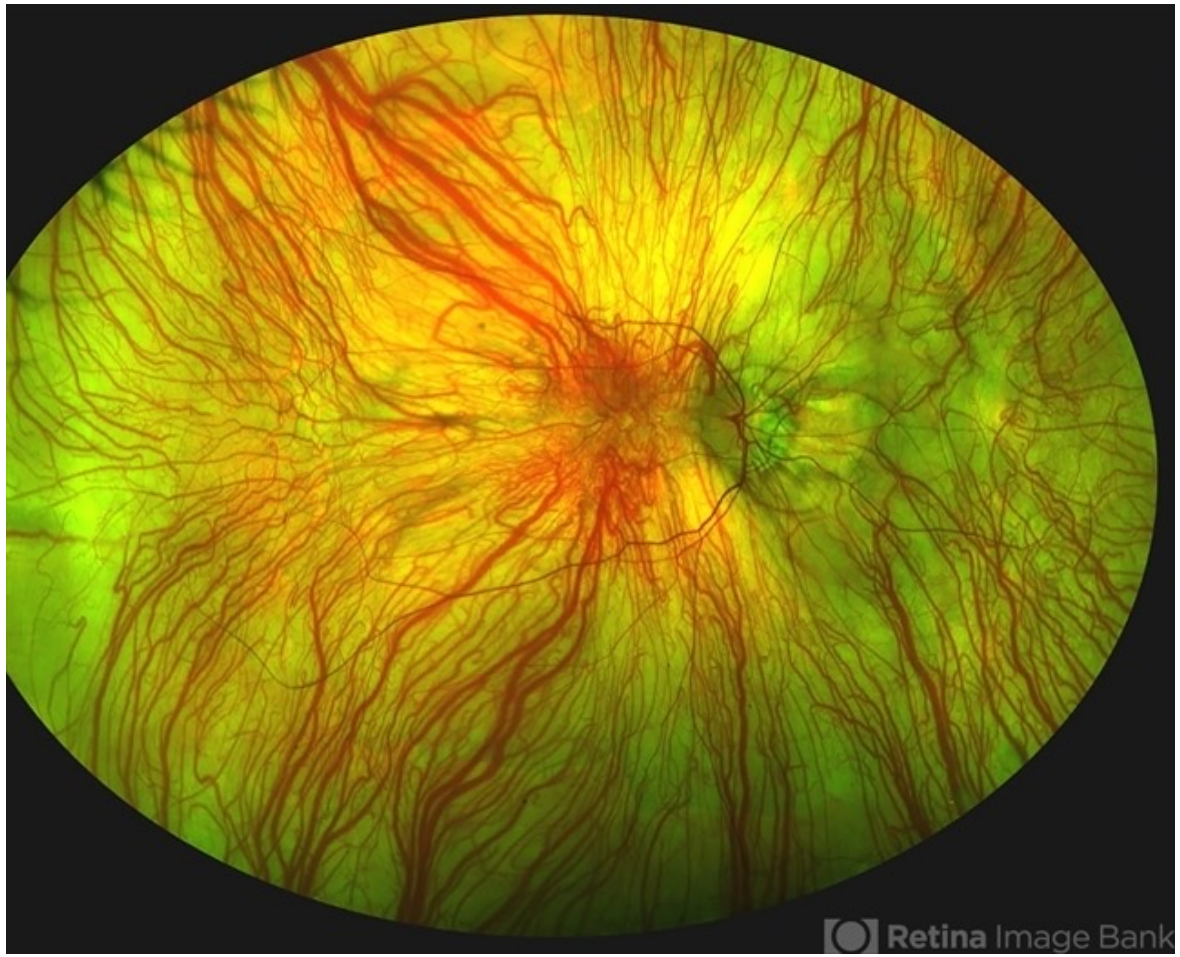
This really is not good for the eye!



Giant retinal tear

- Retinal tissue has torn from the periphery almost 360 degrees
- Most of what is being seen is the bare retinal pigment epithelium
- The white tissue draped inferiorly is the neuroretina
- The neuroretina still remains attached at the edges of the optic disc
- Not a good prognosis for surgery!

What is the likely diagnosis



Albino fundus

- Ocular albinism
- X linked so affects males
- Female carriers may have mild signs in the retina
- Foveal hypoplasia

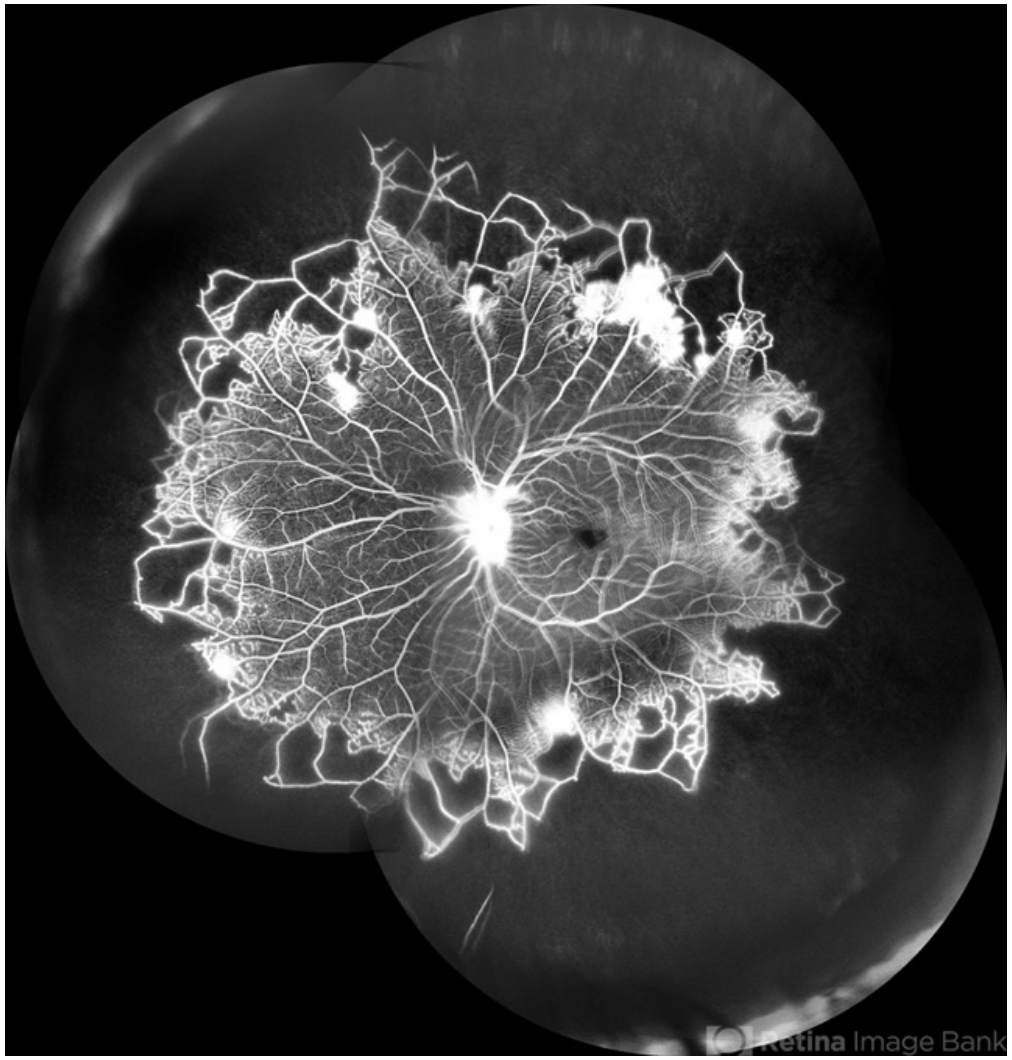
Finger poking – what has happened?



Avulsion of the optic nerve

- Often associated with severe trauma
- Finger poking
- Direct blow to the eye
- Permanent visual loss
- Retina infarcted

What general health issues does this patient have?



Severe diabetes

- Severe proliferative diabetic retinopathy is the most likely diagnosis
- Ocular ischemia syndrome
- Retinal vasculitis (Behcet’s)
- Sickle cell disease
- Familial exudative vitreoretinopathy
- Retinopathy of prematurity

What physician is this sign named after?



Roth’s Spots

- Retinal haemorrhage with pale center
- White center represents fibrin or platelet material
- Historically linked to infective endocarditis but rare
- Not specific to any one disease
- Leukaemia
- Anaemia
- Thrombocytopenia
- Diabetic or hypertensive retinopathy

Kittens are not always cute and cuddly!



Cat scratch

- Often Kittens
- Bartenella (gram negative bacillus)
- Produces small papule
- Flu like illness
- Parinaud’s oculoglandular syndrome with conjunctivitis and lymphadenopathy
- Neuroretinitis with macular star (photo)

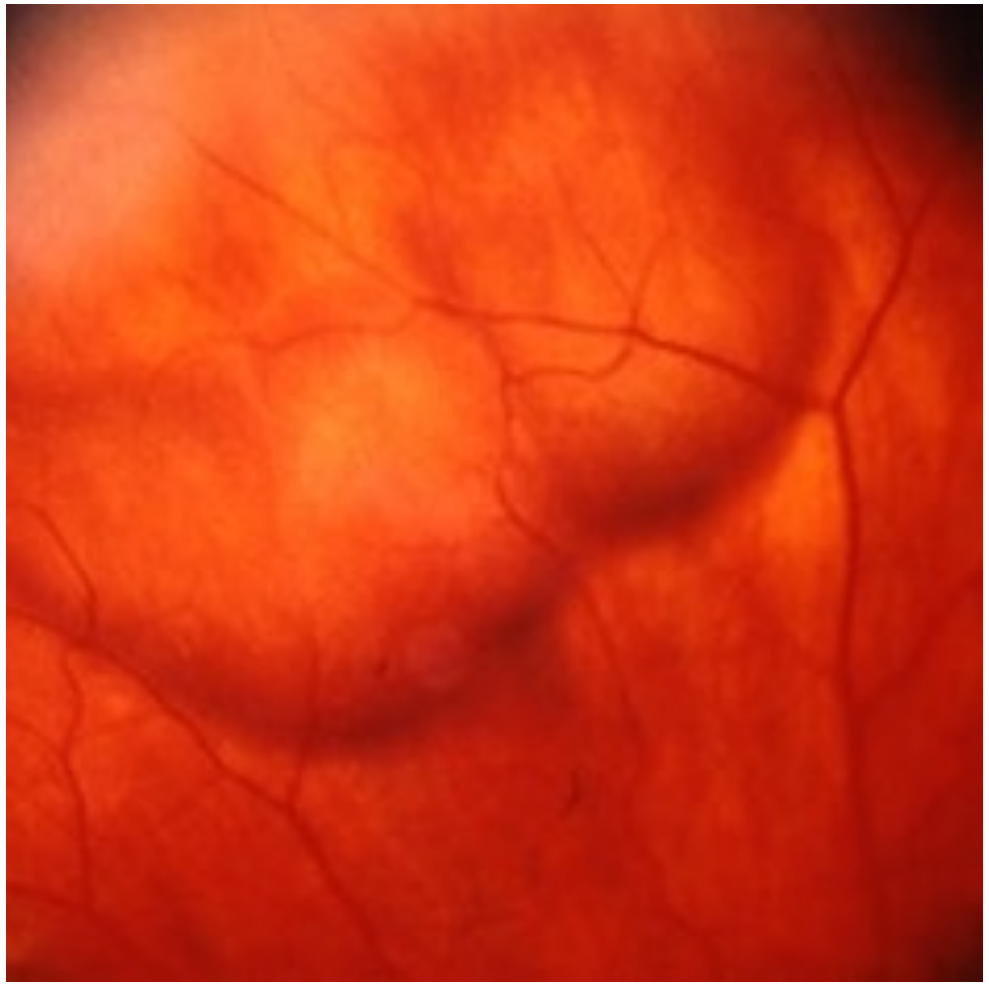
Sinking ships?



Torpedo maculopathy

- Rare
- Often asymptomatic
- Slightly temporal to the central macula (fortunately!)
- Due to temporary “bulge” in the development of the eye at 4 to 6 months gestation

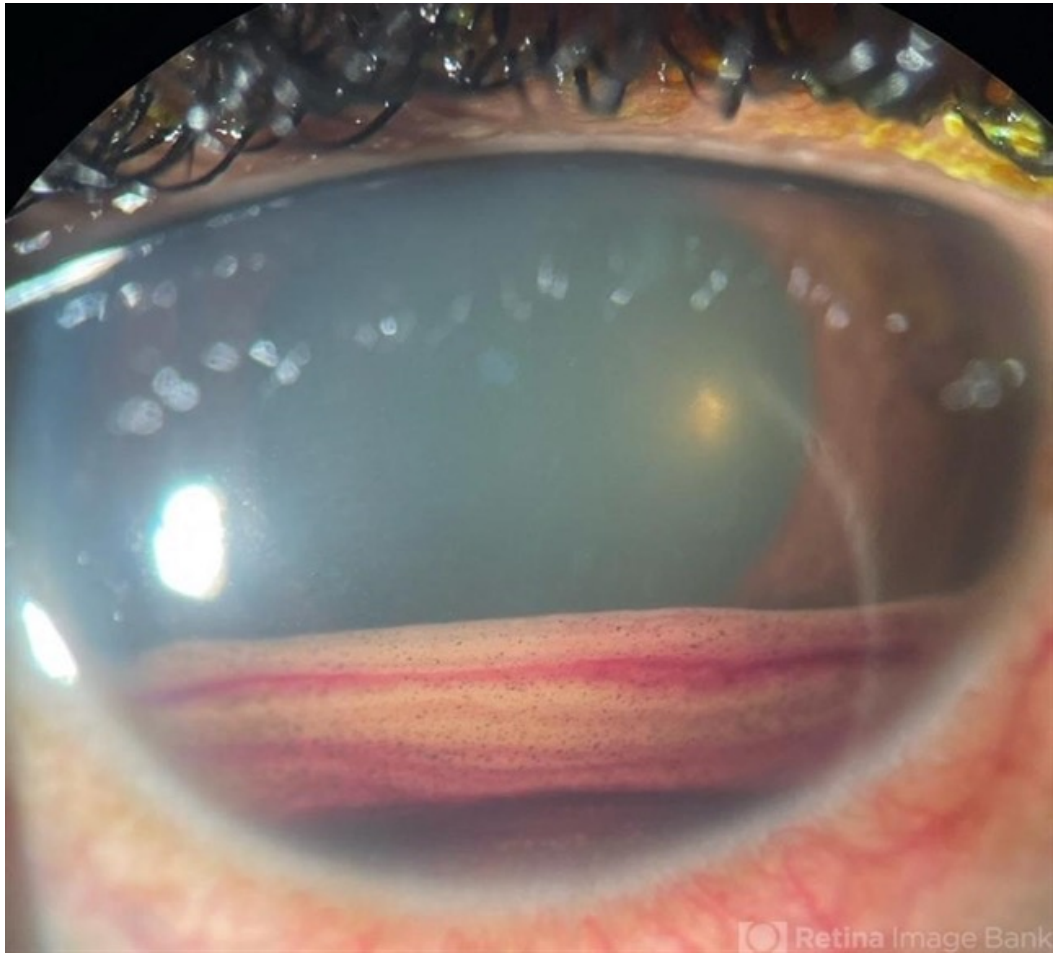
Are you worried and what should you do?



Vortex Varix

- No need to be worried
- Often seen without underlying pathology
- Press on the eye whilst looking at the varix and it should disappear

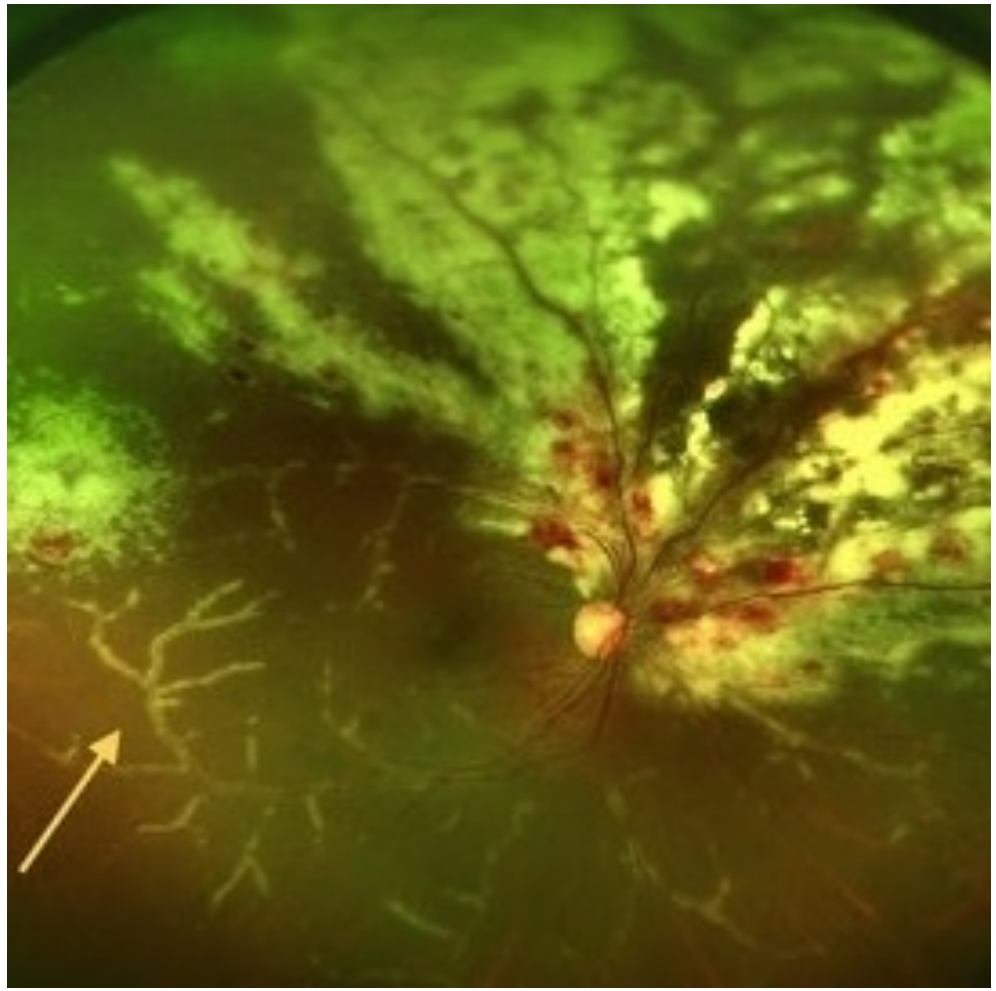
The candy stripe – what causes it?



Candy strip sign

- Usually long standing haemorrhage
- Pale layer, ghost cells that have lost haemoglobin
- Red layer, fresh haemorrhage
- Associated with trauma, eye surgery, vitreous haemorrhage
- Often raised eye pressure

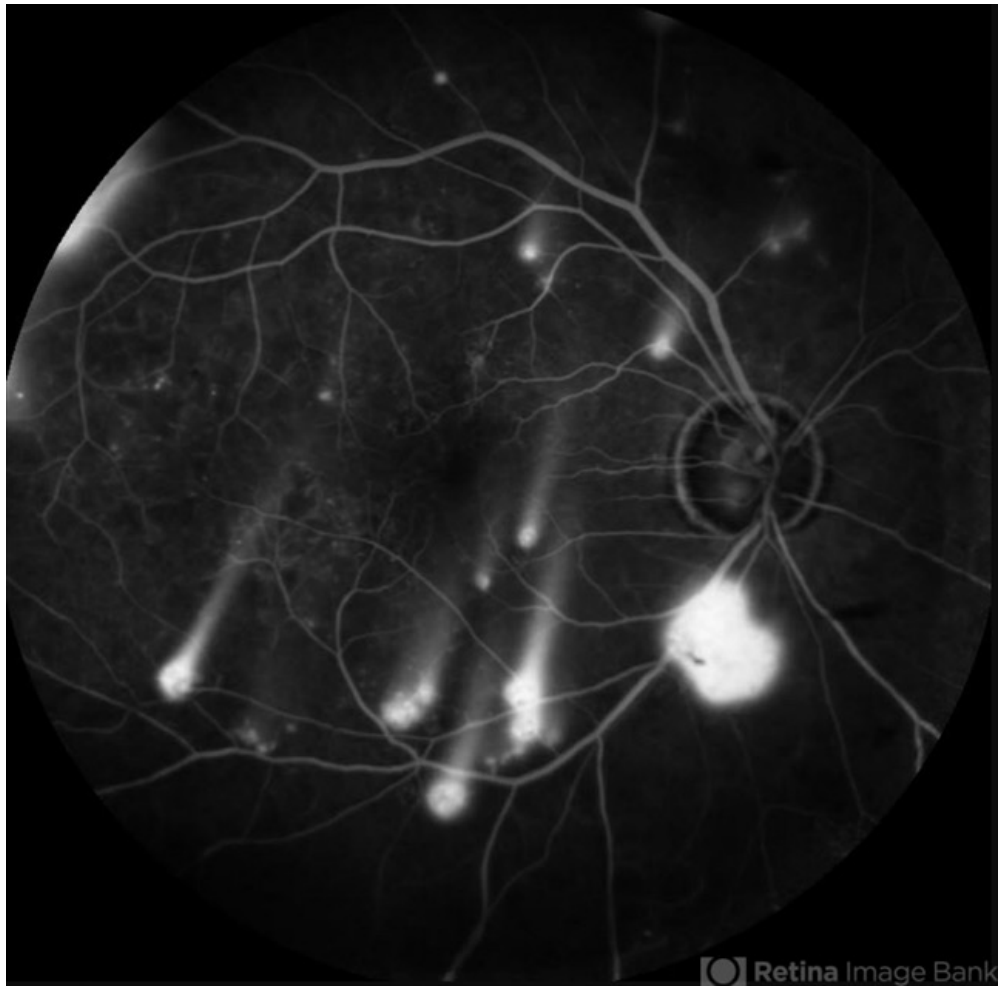
Anyone for pizza?, its cold outside!



CMV retinitis with frosted angiitis

- Yellow white areas are retinal necrois
- Associated with haemorrhage
- “pizza pie retinopathy”
- Perivascular sheathing causing “frosted angiitis”

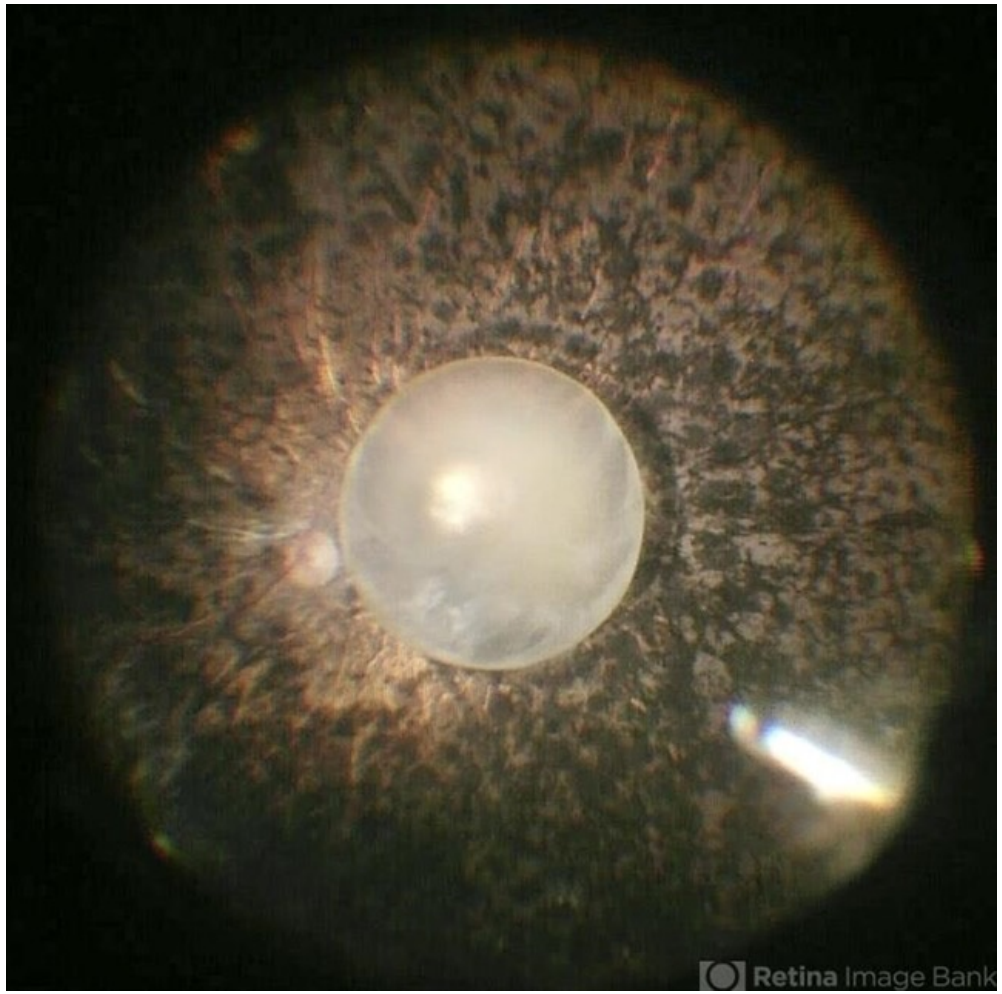
What form of heat transfer has caused this?



Convection

- FFA in patient with proliferative diabetic retinopathy
- Dye leaking from retinal neovascular nets
- Retina warm so convection currents cause dye to rise up
- Opposite of KP’s on cornea which are usually at the bottom of the cornea due to cornea being up against the colder outside environment causing the aqueous next to the cornea to flow down

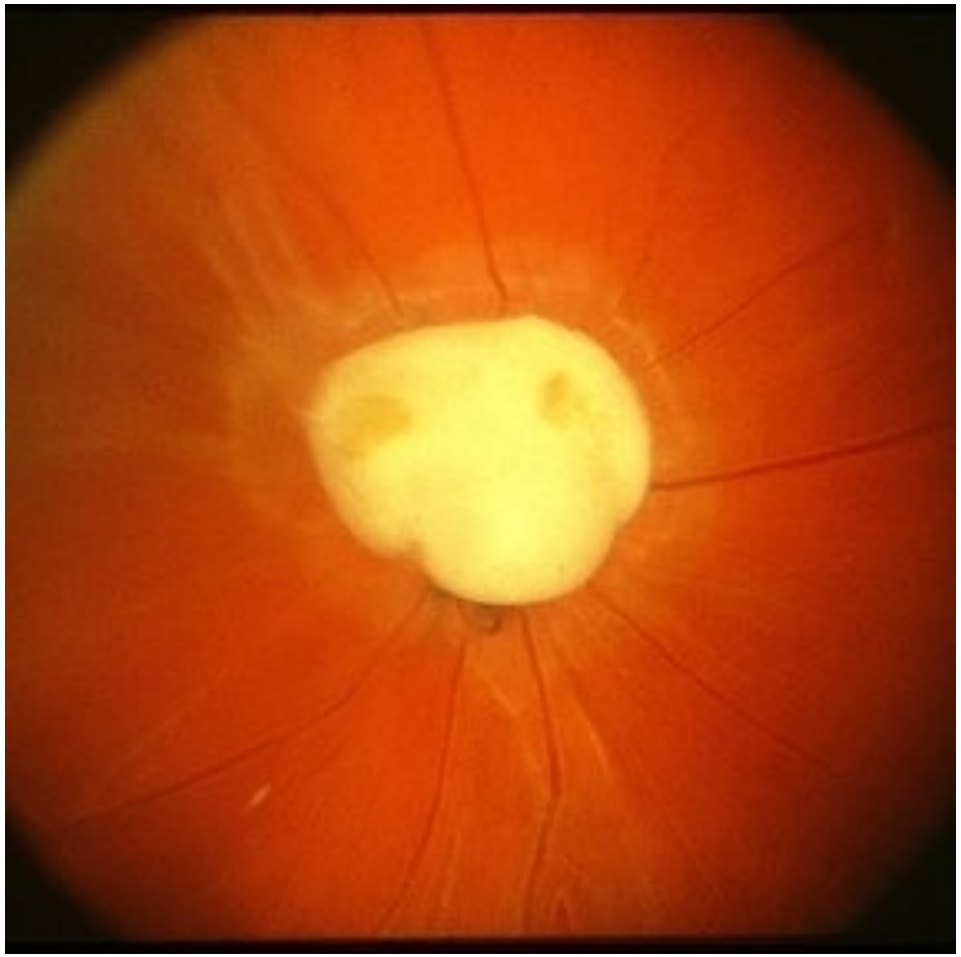
What has happened here?



This is a rare one!

- Patient has congenital rubella, hence the salt and pepper pigmentary retinopathy
- Also has a spontaneously dislocated crystalline lens visible on the surface of the retina

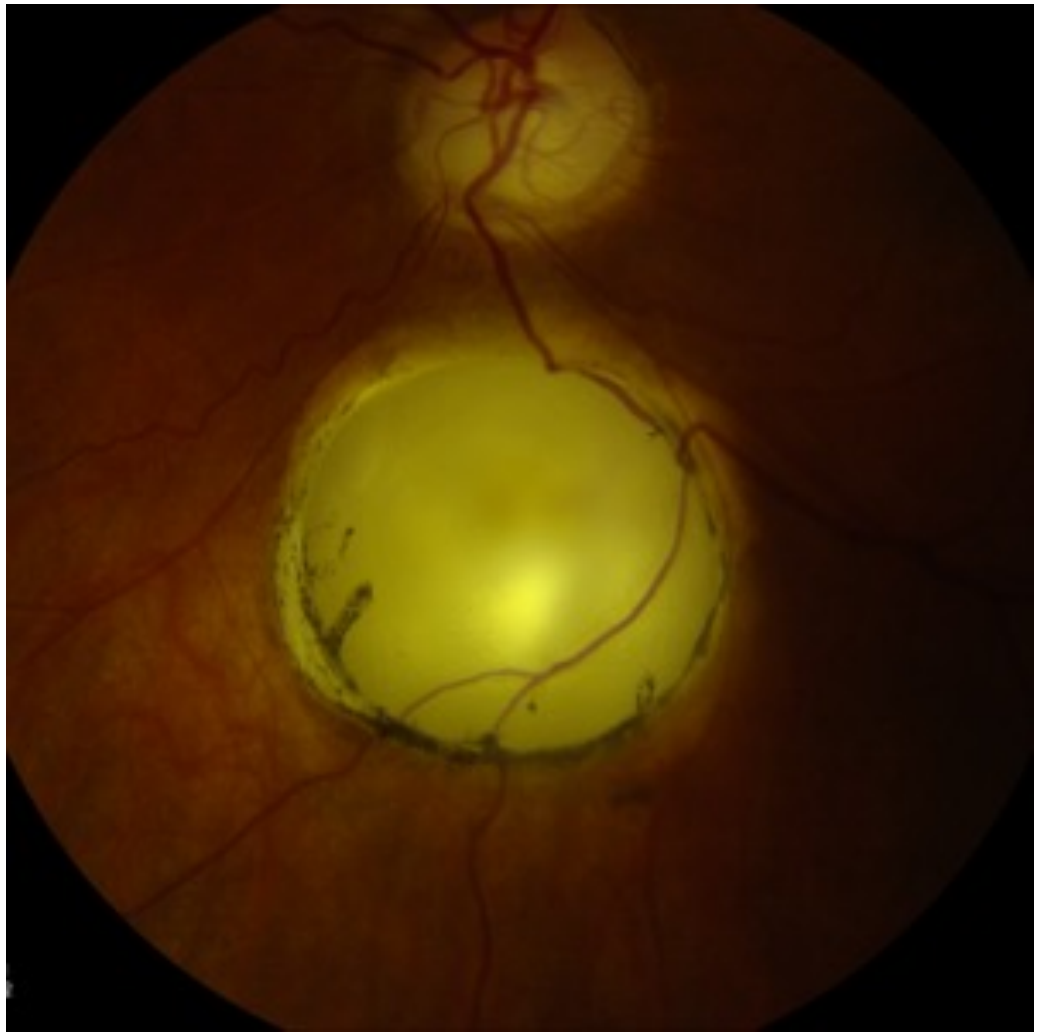
Dogs and cats this time!



Toxocara granuloma

- Ingestion of eggs in contaminated soil, food or contact with infected dogs or cats
- Eggs hatch into larvae, migrate to eye
- Inflammatory granuloma created around the larva

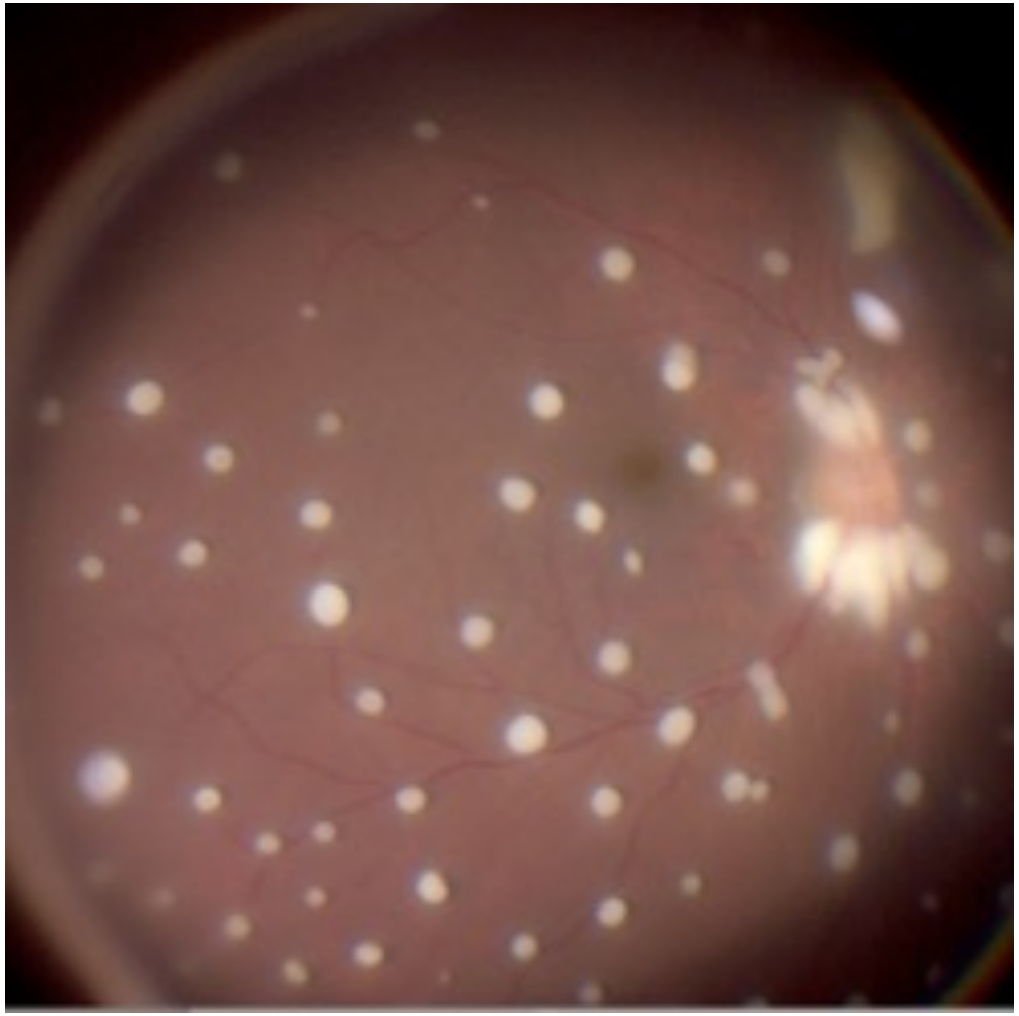
Anything to do here?



No

- It’s a retinal coloboma
- Usually inferiorly situated as this is where the retina zips up during embryological development with closure of the embryonic (optic) fissure.

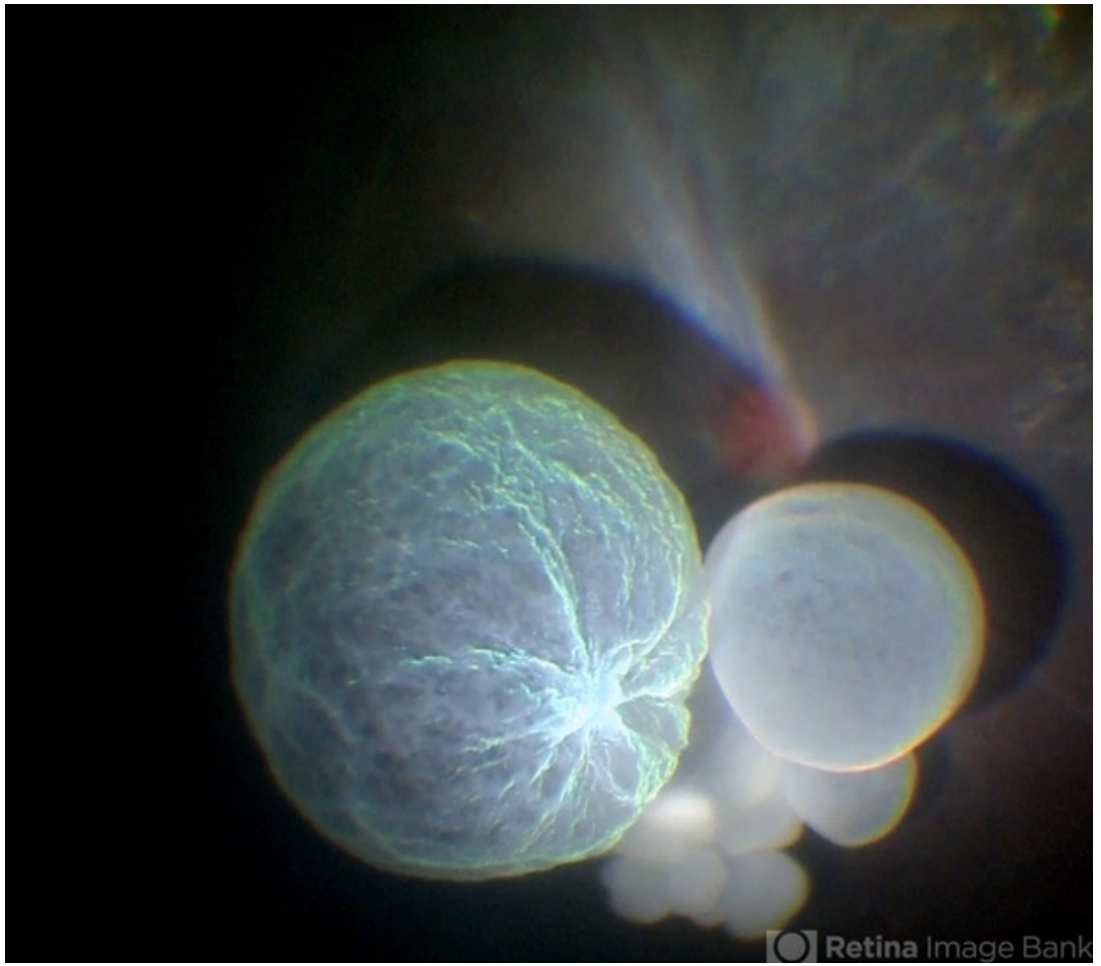
Drug abuse – what has happened?



Drug abuse

- Fungal endophthalmitis
- Likely candida as has the ”string of pears” appearance
- Retinal involvement near the optic disc

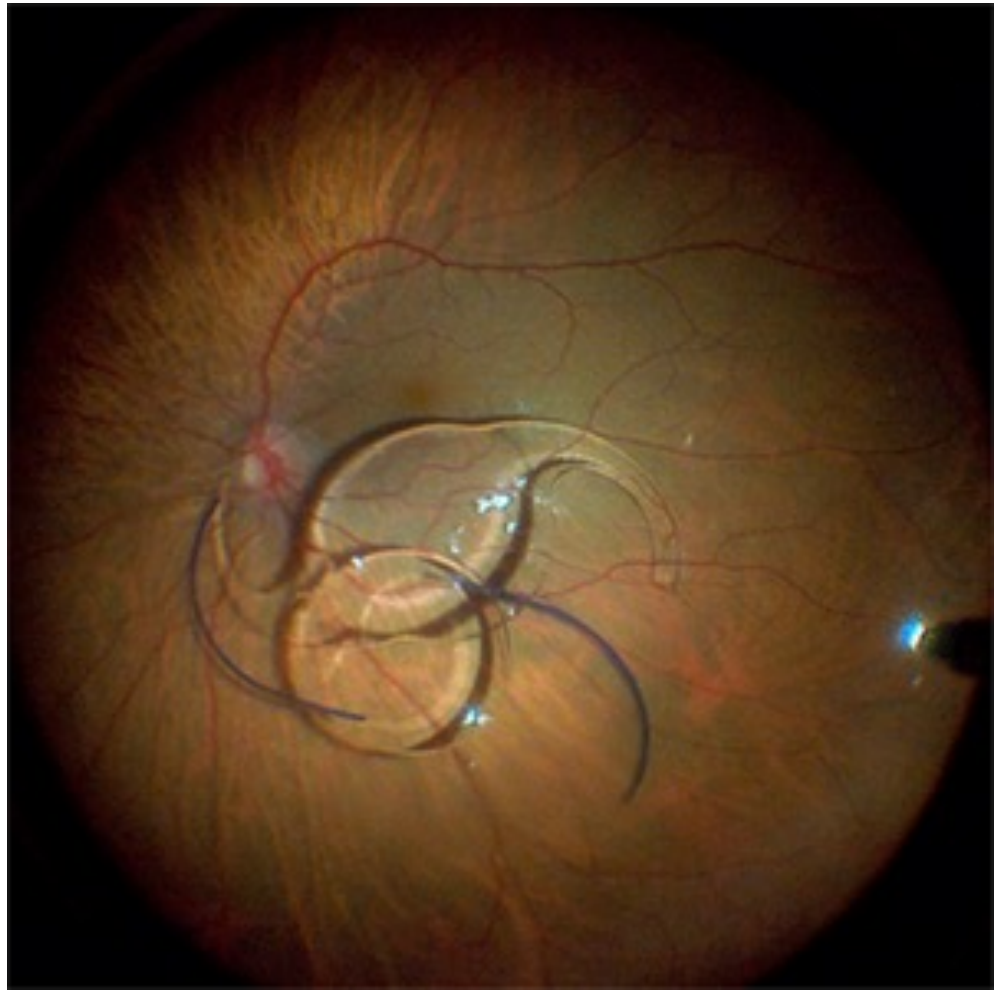
Don’t forget to cook your meat!



Cysticercosis

- Pork tape worm larva
- Undercooked meat
- The cyst is a single invaginated tapeworm head or scolex with hooks

Am I seeing double?



Two IOL's on the retina!

- Rather foolish surgeon
- Had zonular weakness or capsule rupture during cataract surgery
- Placed one IOL in sulcus but dislocated into vitreous cavity
- Please stop and get your friendly VR surgeon to sort it out
- No, lets have another go and put it in a different orientation
- Oops!
- Where is that VR surgeon?