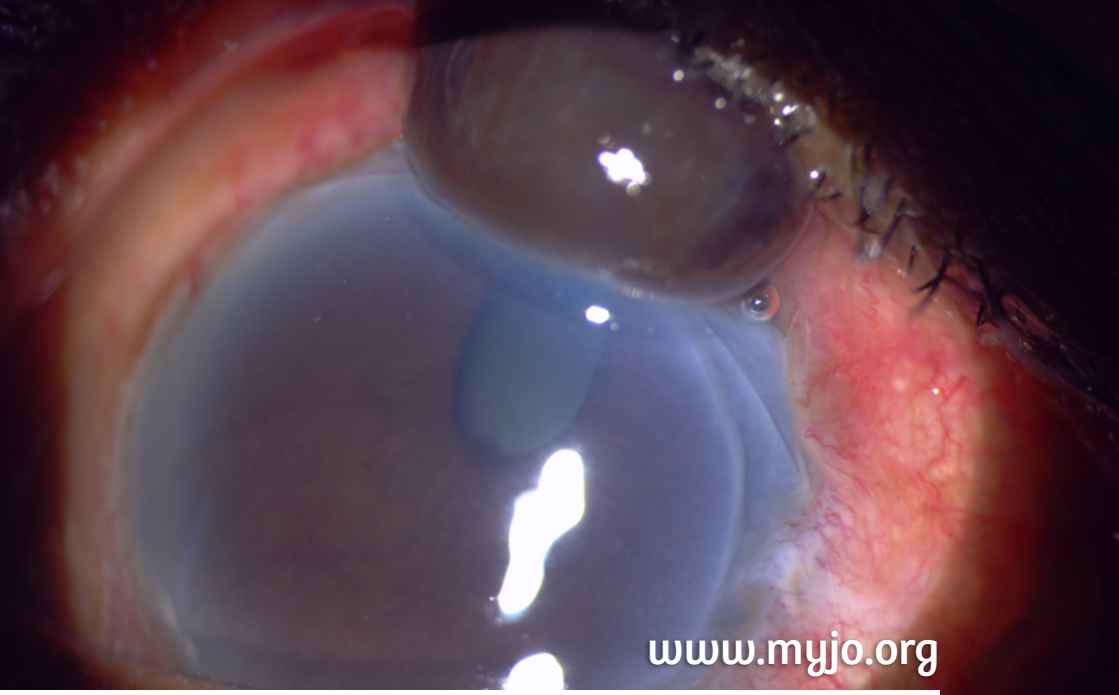


# Malaysian Journal of Ophthalmology

Volume 3 • Issue 2 • 2021

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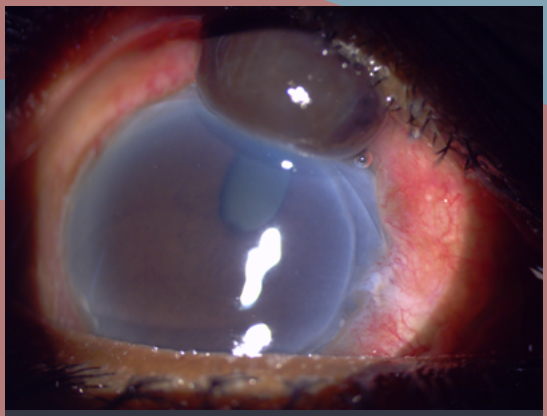

ABOUT THE COVER IMAGE

*Muffin top* features a spontaneous iris prolapse in an eye with peripheral ulcerative keratitis. The image is courtesy of Dr. Justin Yeak Dieu Siang, ophthalmologist at Hospital Tuanku Ampuan Rahimah Klang, Malaysia.

# Malaysian Journal of Ophthalmology

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**ISSN**
Online: 2665-9565
Print: 2665-9557

*Malaysia*
Online: 2716-5329
Print: 2716-5248

**Publisher**
Malaysian Society of Ophthalmology
Unit #UG33, PJ Midtown, Jalan Kemajuan, Seksyen 13, 46200 Petaling Jaya, Selangor
admin@mso.org.my

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Malaysian Journal of Ophthalmology


*Editorial*
*https://doi.org/10.35119/myjo.v3i1.153*

# From my laptop

It has been more than a year since I last penned "From my laptop". The Covid-19 pandemic is still very much present even amid the availability of vaccination. Malaysia is currently bracing the third wave, and so we find ourselves yet in another lockdown in what is becoming a never-ending series of lockdowns. Despite this dire situation worldwide, Malaysian Journal of Ophthalmology (MyJO) is thriving. In our third year running and publishing our third volume, we are going stronger.

I would like to take the opportunity to give a very warm welcome to our new editorial board! This fresh editorial board is a mixture of young and promising and more experienced members. Hopefully, the enthusiasm of the young members and the wisdom of the experienced members will spur MyJO's growth. We look forward to working together this year.

Change is the only constant in life; change is always for the better. We introduced two new sections: Artificial Intelligence and Innovation in Ophthalmology and Eye-quiz. In the era of the fourth industry revolution 4.0, the booming of connectivity, focusing on artificial intelligence and innovation in ophthalmology is almost mandatory. Eye-quiz is a didactic section comprising a short photo quiz, which aims to provide a clinical puzzle for ophthalmologists, optometrists, researchers, and trainees.

A technical review has now been introduced as part of MyJO's submission process, which involves checking that manuscripts adhere to MyJO's author guidelines and have all necessary components. Only manuscripts considered complete and in compliance with guidelines will be sent to review. Submissions with at least one Malaysian author are required to provide the article abstract in Bahasa Malaysia in addition to the English version. We kindly suggest you read more about the submission process and the new author guidelines before submitting your manuscript, as this will help processing your manuscript swiftly.

To honor our reviewers, who have a key role in increasing the scientific value of the articles, we have selected the 14 best reviewers for 2019 and 2020. The selection was based on the number of articles and the time taken to complete each review. A heartfelt thank you to all our reviewers. Coming up in the next issue is the best article for original article and case report, so stay tuned!

'Til we meet again, do take care, and stay safe.

Professor Dr. Liza Sharmini Ahmad Tajudin
Chief Editor

# Malaysian Journal of Ophthalmology

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Malaysian Journal of Ophthalmology


*Editorial*
*https://doi.org/10.35119/myjo.v3i2.232*

# Get a clear view on glaucoma: the BMO-MRW way

Victor **Koh**

*Department of Ophthalmology, National University Hospital, Singapore*

The association between glaucoma and myopia has been well established and there are multiple population-based studies supporting this association. The mechanisms explaining this association are still unclear and evidence seems to point towards the mechanical stretching of the posterior segment of the eye. This poses another diagnostic challenge to ophthalmologists, as the structural alteration of the optic nerve head (ONH) morphology in myopic eyes may mimic glaucomatous damage. Variations in the morphology include but are not limited to optic disc tilting, torsion, peripapillary atrophy, and enlargement of the optic disc. In addition, the presence of posterior staphyloma may degrade the quality of imaging modalities such as optical coherence tomography (OCT) or colour photographs. This applies to both OCT images of the ONH and macula. The current study has highlighted the challenges of obtaining good quality, focused, and segmentation error-free OCT scans of myopic eyes with glaucoma. To complicate matters, the aforementioned structural changes to the posterior pole of the eye are associated with visual field defects, which can overlap with glaucoma visual field changes. One of the differentiating features is that myopic visual field changes are less likely to progress compared to glaucoma visual field changes if left untreated.

It is important to recognize that surface landmarks of the optic disc and cup may not accurately represent neuroretinal structure for several reasons. First, the optic disc margin in highly myopic eyes may not be easy to delineate accurately due to variation in ONH morphology. Second, Chauhan *et al.* has shown that topographical landmarks may not approximate well with the true anatomical structures below the surface of the ONH.[1] In particular, the Bruch's membrane opening position may not coincide with the optic disc margin, which is commonly used in a slit lamp biomicroscopy examination. The deviation could be larger if the ONH morphology varies in eyes with high myopia. Bruch's membrane is a consistent landmark that is easily identifiable on the cross-sectional OCT imaging of the ONH, which remains stable over time. Third, the variation in ONH morphology makes it challenging to account for the orientation of the neuroretinal rim tissue from surface topography. Bruch's membrane opening-minimum rim width (BMO-MRW) measurements showed better diagnostic performance in detecting early glaucoma compared to peripapillary retina nerve fibre layer (pRNFL).[2] However, Zheng *et al.* also showed that in

highly myopic eyes (axial length of more than 26 mm), close to one-third of eyes will have indiscernible Bruch's membrane opening, which will affect the quality of this structural imaging modality.[3]

In this study by Ch'ng *et al.*,[4] the OCT image quality for BMO-MRW scans was better compared to pRNFL, which is clinically useful to know, especially in myopic eyes with glaucoma. This provides a more reliable trend-based monitoring of an objective measurement for this challenging group of patients. The lower image quality of the pRNFL scan could be attributed to a larger sampling area of the posterior pole resulting in a higher likelihood of a defocused field affected by the posterior staphyloma. After excluding poor quality scans, there was low agreement between pRNFL and BMO-MRW measurements, which again highlighted the unpredictable variation in the posterior pole anatomy of highly myopic eyes.

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Malaysian Journal of Ophthalmology

© Malaysian Journal of Ophthalmology 2021; 2:78-90
*Original article*
*https://doi.org/10.35119/myjo.v3i2.138*

# Bruch's membrane opening-minimum rim width and peripapillary retinal nerve fibre layer thickness measurement in myopic eyes with glaucoma

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## Abstract

*Introduction:* Optic nerve head imaging in myopic eyes with glaucoma is challenging due to atypical myopic optic disc morphology. Peripapillary retinal nerve fibre layer (pRNFL) and Bruch's membrane opening-minimum rim width (BMO-MRW) utilize different anatomical reference points to measure the retinal nerve fibre layer.
*Purpose:* To evaluate the diagnostic agreement between BMO-MRW and pRNFL in glaucomatous eyes with varying degrees of myopia.
*Design:* Prospective observational study.
*Methods:* Forty-three eyes diagnosed as primary open-angle glaucoma, normal-tension glaucoma, and primary angle-closure glaucoma with varying degrees of myopia were included in the study. Geometric measurement of the neuroretinal rim tissue was conducted with spectral domain optical coherence tomography (SD-OCT) using two different parameters: BMO-MRW and pRNFL. The classification of scan quality and diagnostic agreement between both methods were compared using an exact McNemar's test. The association between the summary classifications of quality

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scans with myopic degree was assessed with Fisher's exact test.
*Results:* BMO-MRW had a higher percentage of good quality image scans compared to pRNFL ($p = 0.004$). BMO-MRW was capable of obtaining equally good quality scans for glaucomatous eyes with various myopic degrees, whereas pRNFL demonstrated a significant statistical difference between mild, moderate, and high myopia ($p = 0.001$). pRNFL was difficult to identify in highly myopic eyes. By excluding poor quality scans, the diagnostic agreement between both modalities was 48.4% ($p = 0.002$). The observed agreement was higher in low myopia (66.7%), followed by moderate myopia (28.6%) and high myopia (16.7%).
*Conclusion:* Compared to pRNFL, BMO-MRW is a better diagnostic imaging modality in glaucoma, especially for eyes with high myopia. Scan quality must be considered when interpreting OCT result in daily clinical practice to yield more accurate and reliable results.

*Keywords:* Bruch's membrane opening-minimum rim width, glaucoma, myopia, optical coherence tomography, peripapillary retinal nerve fibre layer

## Pengukuran Bruch's membrane opening-minimum rim width (BMO-MRW) dan peripapillary retinal nerve fiber layer (pRNFL) pada mata rabun jauh dengan glaukoma

## Abstrak

*Pengenalan:* Pengimbasan pangkal saraf optik di kalangan mata rabun jauh dengan glaukoma adalah sukar disebabkan ciri-ciri pangkal saraf optik yang luar biasa. pRNFL dan BMO menggunakan rujukan anatomi yang berbeza untuk mengukur ketebalan lapisan saraf retina.
*Tujuan:* Untuk mengenalpasti keseirasan diagnostik antara BMO-MRW dan pRNFL di kalangan mata glaukoma yang berbeza status rabun jauh.
*Kaedah:* Kajian pemerhatian prospektif.
*Kaedah:* Empat puluh tiga mata merangkumi glaukoma prima sudut buka, glaukoma tekanan normal dan glaukoma prima sudut tutup dengan status rabun jauh yang berbeza termasuk dalam kajian. Pengukuran geometrik tisu rim neuroretina dilakukan dengan Spectral Domain Optical Coherent Tomography (SD-OCT) dengan dua cara pengukuran yang berbeza iaitu BMO-MRW dan pRNFL. Klasifikasi kualiti pengimbasan dan keseirasan diagnosis kedua-dua kaedah pegimbasan dibandingkan dengan ujian statistik McNemar's. Pengiraan statistik Fisher's dijalankan untuk meninjau hubungan klasifikasi kualiti pengimbasan dengan status rabun jauh.

*Hasil:* BMO-MRW mempunyai peratusan kualiti pengimbasan yang lebih tinggi berbanding pRNFL ($p = 0.004$). BMO-MRW boleh mendapatkan kualiti pengimbasan yang bagus untuk semua katogori rabun jauh yang mempunyai glaukoma. Sebaliknya, pRNFL menunjukkan perbezaan statistik antara rabun jauh paras rendah, serdahana and tinggi ($p = 0.001$). pRNFL sukar dikenalpasti pada mata yang mempunyai paras rabun jauh yang tinggi. Keserasian diagnosa antara dua cara pengimbasan adalah 48.4% ($p = 0.002$). Keserasian adalah tinggi pada mata rabun jauh paras rendah (66.7%), diikuti dengan rabun jauh paras sederhana (28.6%) dan rabun jauh paras tinggi (16.7%).
*Kesimpulan:* BMO-MRW mempunyai ciri-ciri pengimbasan diagnosa yang lebih jitu berbanding pRNFL. Kualiti pengimbasan perlu diambilkira semasa mentafsir keputusan OCT untuk mendapatkan keputusan yang lebih tepat.

*Kata kunci:* Bruch's membrane opening-minimum rim width, glaukoma, optical coherence tomography, peripapillary retinal nerve fibre layer, rabun jauh,

## Introduction

Medical imaging technology has advanced dramatically in recent years and enables improvement in non-invasive microscopic visualization of the ocular structures. These additional data can help clinicians in understanding the disease in more depth and aid in diagnosing glaucoma and providing better clinical care for patients. The impact of medical imaging in clinical practice is evidenced by the significant increased application of medical imaging in diagnosing and monitoring of glaucoma since the last decade.[1] Therefore, accuracy and measurement reproducibility of retinal nerve fibre layer (RNFL) measurement is crucial.

Myopia is a known risk factor for glaucoma.[2,3] The risk of developing glaucoma in myopia increases up to three-fold as the degree of myopia increased.[2,3] In addition, it is a challenge to diagnose glaucoma in myopic eyes due to atypical myopic optic disc morphology and myopic visual field defect. A study using optical coherence tomography (OCT) also revealed that the average RNFL thickness decreased with increasing ocular axial length and negative refractive power.[4] These myopic changes may mimic changes of the optic disc, visual field defects, and RNFL thickness in glaucoma. For these reasons, it is important for clinicians to be able to differentiate glaucoma progression from pure ocular myopic changes, especially in glaucoma patients with myopia. It has been shown that OCT technology is more accurate than conventional clinical assessment of optic disc margins in identifying glaucomatous optic discs in myopic eyes.[5]

Anatomically, Bruch's membrane is essential for the presence of retinal pigment epithelium cells and choriocapillaris. Bruch's membrane opening-minimum rim width (BMO-MRW) measures the minimum distance between Bruch's membrane

opening (BMO) and the internal limiting membrane (ILM) at the cross-section image of the optic nerve head.[6-9] On the other hand, peripapillary retinal nerve fibre layer (pRNFL) measures the peripapillary thickness of the uppermost hyper-reflective retinal layer, which represents the unmyelinated axons of ganglion cells. Studies have shown that both BMO-MRW and pRNFL are comparable in diagnostic performance.[10] However, we have observed a slight discrepancy, especially in highly myopic discs. The aim of this study was to evaluate the diagnostic agreement between BMO-MRW and pRNFL in glaucomatous eyes with varying degrees of myopia.

## Materials and methods

### Patients

This cross-sectional, observational study was conducted at the eye clinic, Department of Ophthalmology, Hospital Sultanah Bahiyah, Alor Setar, Malaysia. Inclusion criteria were myopic patients with primary open-angle glaucoma (POAG), normal-tension glaucoma (NTG), and primary angle-closure glaucoma (PACG). Exclusion criteria were concomitant ocular disease other than glaucoma and eyes with history of ocular surgery other than cataract surgery. pRNFL defect was classified according to OCT artefact as described by Liu *et al.*[12] This study was approved by the Ministry of Health Malaysia Medical Research Ethic Committee (identifier: NMRR-17-87834292). Written informed consent was obtained from all subjects and the study adhered to the tenets of the Declaration of Helsinki.

### Diagnosis of glaucoma

In this study, glaucoma was defined clinically by documented evidence of progression in characteristic glaucomatous changes in the optic nerve head and visual field. Visual field assessment was performed with the Swedish Interactive Threshold Algorithm (SITA) program 24-2 standard automated perimetry using the Humphrey Field Analyzer (Humphrey Instruments Model Model 740; Carl Zeiss Meditec, Dublin, CA, USA). The visual field changes were considered to be glaucomatous if the changes fulfilled the Anderson criteria and the criteria were met on at least two consecutive visual field tests.[29] The three criteria were Glaucoma Hemifield Test (GHT) outside normal limits; a cluster of three or more non-edge points in a location typical for glaucoma, all of which were depressed on the pattern deviation plot at a $p < 5\%$ level and one of which was depressed at a $p < 1\ \%$ level; and a corrected pattern standard deviation (PSD) $p < 5\ \%$. Patients with visual field defects due to other ocular pathologies were excluded from the study. Findings were verified independently by two fellowship-trained glaucoma consultants (AMS and CTW). We excluded patients with vision worse than 6/12 and epiretinal membrane as these are associated with OCT segmentation artefacts.[12]

**Myopic status**

Myopic status was defined as low myopia (-0.5 D to < -3.0 D), moderate myopia (-3.0 D to -6.0 D), and high myopia (> -6.0 D).

**Optic nerve head RNFL measurement**

The thickness of optic nerve head RNFL was measured by spectral domain optical coherence tomography (SD-OCT) (Spectralis with Glaucoma Module Premium Edition Software; Heidelberg Engineering, Heidelberg, Germany) with two different methods of scanning: BMO-MRW and pRNFL thickness at the same visit. A single experienced operator measured pRNFL and BMO-MRW. Pharmacology pupillary dilatation was not required, and the scanning room was darkened for mydriatic pupillary effect. Participants had a short break of 10 minutes between sessions. pRNFL was measured in a 6° peripapillary circle with radial pattern comprising 24 angularly equidistant, high-resolution 15° B-scan, centred on the optic disc centre and aligned with the fovea. Meanwhile, the BMO-MRW scan was done around the optic disc area with autodetection of BMO by the OCT software. As variation in relative foveal position would affect the sectoral neuroretinal rim analysis,[13] foveal positioning and eye tracking systems were activated as a reference to minimize intra-individual and inter-individual variability.[6,8,14] Variation of optic nerve head global thickness for each modality was compared to determine the agreement between both modalities. The entire OCT scans were checked for accuracy of segmentation results using the Heidelberg Eye Explorer Software tool (Software version 6.0.11.0, Heidelberg Engineering, Heidelberg, Germany). Segmentation errors were manually refined to achieve an accurate delineation of the anterior RNFL border (between the ILM and vitreous) and posterior border of the RNFL (between the ganglion cell layer and RNFL). OCT artefacts that required manual correction were: incorrect segmentation of the anterior RNFL; posterior RNFL misidentification; incomplete segmentation; and decentred scan where the optic nerve head was 10% off-centre of the peripapillary circular scan. The BMO point at each segmentation was examined to ensure the correct location was measured. Incorrect locations were manually realigned. The OCT glaucoma classification for each scan (normal, borderline, or abnormal) was subsequently exported. Global OCT glaucoma classification was used for analysis.

Poor quality scans in our study were defined as error of RNFL layer delineation where manual correction was impossible. The errors were: a portion of RNFL across its entire thickness was completely black or indistinguishable from background noise; cut edge artefact was defective where lateral edge of RNFL was truncated abruptly; peripapillary atrophy-associated artefacts; or any condition where identification of the RNFL layer was impossible. Motion artefacts attributed to patient movement during scanning and poor signal defined as quality score less than 15 were excluded from our study. In addition, failing to identify three consecutive BMO points was defined as poor quality of BMO in our study.

**Statistical analysis**

The comparison of scan quality classification, as well as the diagnosis classification by pRNFL thickness and BMO-MRW were performed using exact McNemar's test. Fisher's exact test was used to assess the association between the summary of scan quality classification with the patient's myopic status. A generalized McNemar or Stuart–Maxwell test was used to determine whether the classification of the optic discs (*i.e.*, within normal limits, borderline, or outside normal limits) among glaucoma patients with myopia by BMO-MRW and pRNFL thickness had the same distribution. All *p*-values reported were two sided, and a *p*-value of less than 0.05 was considered significant. Data were analysed using Stata software (Stata/SE 14, College Station, TX, USA).

## Results

A total of 43 eyes, of which 26 (60.5%) were POAG, 12 (27%) were NTG, and 5 (11.6%) were PACG, were included in our study. Mean age of patients was 63 ± 12.9 years of

*Table 1.* Demographic data

| | **Degree of myopia, *n* (%)** | | | ***p*-value**[a] |
|---|---|---|---|---|
| | **Low (*n* = 19)** | **Moderate (*n* = 8)** | **High (*n* = 16)** | |
| **Age, years*** | 70.16 (7.70) | 50.38 (16.20) | 60.88 (11.09) | < 0.001b |
| **Gender** | | | | |
| Female | 6 (31.6) | 5 (62.5) | 6 (37.5) | 0.390 |
| Male | 13 (68.4) | 3 (37.5) | 10 (62.5) | |
| **Ethnicity** | | | | |
| Malay | 11 (57.9) | 5 (62.5) | 5 (31.3) | 0.269 |
| Chinese | 8 (42.1) | 3 (37.5) | 9 (56.3) | |
| Siamese | 0 (0.0) | 0 (0.0) | 2 (12.5) | |
| **Glaucoma** | | | | |
| POAG | 9 (47.4) | 6 (75.0) | 12 (75.0) | 0.237 |
| NTG | 6 (31.6) | 1 (12.5) | 4 (25.0) | |
| PACG | 4 (21.1) | 1 (12.5) | 0 (0.0) | |

NTG: normal-tension glaucoma; PACG: primary angle closure glaucoma; POAG: primary open-angle glaucoma

*Numerical data reported as mean (standard deviation)

[a]Fisher's exact test

[b]One-way ANOVA. Post-hoc Bonferroni tes

age. Twenty-six (60%) males and 17 (40%) females were included in the study. There was no statistically significant difference between the study group (Table 1).

**Scan quality**

BMO-MRW had a higher percentage of good quality scans compared to pRNFL. Up to three-quarters of the eyes with poor quality scans using pRNFL obtained good quality scans when performed with BMO-MRW. However, there were no poor quality scans in BMO-MRW for eyes with good quality scans with pRNFL. Only three eyes were classified as poor quality with both modalities. There was a statistically significant different in image quality obtained using BMO-MRW and pRNFL ($p$ = 0.004) (Table 2).

On further analysis, all three poor quality scans with both modalities were highly myopic eyes. BMO-MRW obtained equally good quality scans for different myopic degrees. On the other hand, 10 out of 12 cases of poor-quality scans using pRNFL occurred in highly myopic eyes. pRNFL demonstrated a significant statistical difference between different myopic degrees ($p$ = 0.001) (Table 3). However, there was no difference between myopic degrees when using BMO-MRW (Table 3). Hence, good quality scans were able to be obtained by using BMO-MRW in glaucomatous eyes with different degrees of myopia (Table 3). RNFL was difficult to identify in highly myopic glaucoma eyes as compared to low and moderately myopic glaucomatous eyes by pRNFL. pRNFL failed to obtain a good quality scan in 12 cases. However, good quality scans were obtained in 9 of 12 cases by BMO-MRW.

*Table 2.* Scan quality: pRNFL and BMO-MRW

| | | BMO-MRW, n (%) | | *P*-value[b] |
|---|---|---|---|---|
| | | **Good quality** | **Poor quality** | |
| **pRNFL** | **Good quality** | 31 (72.1) | 0 (0.0) | 0.004 |
| | **Poor quality** | 9 (20.9) | 3 (7.0) | |

BMO-MRW: Bruch's membrane opening-minimum rim width; pRNFL: peripapillary retinal nerve fibre layer
[b]Exact McNemar's test

*Table 3.* pRNFL and BMO-MRW: scan quality by myopic degree

| **Parameter** | **Scan quality** | **Myopic status, I (%)** | | | ***P*-value[c]** |
|---|---|---|---|---|---|
| | | **Low** ($n$ = 19) | **Moderate** ($n$ = 8) | **High** ($n$ = 16) | |
| **pRNFL** | Good | 18 (41.9) | 7 (16.3) | 6 (14.0) | 0.001 |
| | Poor | 1 (2.3) | 1 (2.3) | 10 (23.2) | |
| **BMO-MRW** | Good | 19 (44.2) | 8 (18.6) | 13 (30.2) | 0.129 |
| | Poor | 0 (0.0) | 0 (0.0) | 3 (7.0) | |

BMO-MRW: Bruch's membrane opening-minimum rim width; pRNFL: peripapillary retinal nerve fibre layer
[c]Fisher's exact test

*Table 4.* Agreement between BMO-MRW and pRNFL*

| | | | BMO-MRW *n* (%) | | | Observed agreement[d] | Kappa, *K* (SE)[d] | *p*-value[d] |
|---|---|---|---|---|---|---|---|---|
| | **Myopic status** | | | | | | | |
| | | IN | 5 (27.8) | 3 (16.7) | 0 (0.0) | | | |
| | Low | BL | 0 (0.0) | 1 (5.6) | 0 (0.0) | 66.7% | 0.48 (0.16) | 0.001 |
| | | OUT | 2 (11.1) | 1 (5.6) | 6 (33.3) | | | |
| | | IN | 1 (14.3) | 1 (14.3) | 0 (0.0) | | | |
| **pRNFL** | Moderate | BL | 1 (14.3) | 0 (0.0) | 0 (0.0) | 28.6% | 0.03 (0.20) | 0.445 |
| | | OUT | 1 (14.3) | 2 (28.6) | 1 (14.3) | | | |
| | | IN | 1 (16.7) | 0 (0.0) | 0 (0.0) | | | |
| | High | BL | 0 (0.0) | 0 (0.0) | 0 (0.0) | 16.7% | 0.09 (0.08) | 0.137 |
| | | OUT | 2 (33.3) | 3 (50.0) | 0 (0.0) | | | |

*Twelve cases of pRNFL were excluded due to poor quality and unable to be identified, either with one parameter or both (missing in myopic degree of 1 low case, 1 moderate case, 10 high cases). The frequencies and percentages are reported based on available information.
IN: Within normal limits (above the 5$^{th}$ percentile of eyes in the reference database).
BL: Borderline (between 1$^{st}$ and 5$^{th}$ percentile of eyes in the reference database).
OUT: Outside normal limits (below the 1$^{st}$ percentile of eyes in the reference database).
[d] Kappa (*K*) was interpreted as poor agreement: < 0.00; slight agreement: 0.00–0.20; fair agreement: 0.21–0.40; moderate agreement: 0.41–0.60; substantial agreement: 0.61–0.80; almost perfect agreement: 0.81–1.00, according to Landis and Koch (1977).

**Diagnostic agreement**

Further analysis was performed after excluding poor quality scans and including only good quality scans. The diagnostic agreement between BMO-MRW and pRNFL which adhered to the criteria of "above 5th percentile", "between 1st and 5th percentile", and "below 1st percentile" of the reference database as interpreted by OCT was 48.4% (15/31) ($p$ = 0.002) (Table 4). By reconsidering only "below the 1st percentile" of eyes in the reference database as abnormal, as has been practiced clinically, the diagnostic agreement increased to 67.8% (21/31) ($p$ = 0.754). The observed agreement was higher in low myopia (66.7%), followed by moderate myopia (28.6%), and high myopia (16.7%) (Table 4).

## Discussion

SD-OCT technology allows good visualization of the optic nerve head. Termination of Bruch's membrane can be easily identified in most cases. This is because the axons of the optic nerve exit the eye through the BMO. Thus, BMO is the best reference point for RNFL measurement.[15] BMO-MRW measures the shortest distance between BMO and ILM, allowing measurement of the oblique insertion of RNFL regardless of the severity of tilted optic disc in myopic eyes. On the contrary, pRNFL measures RNFL thickness at a fixed circumference around the optic disc. In our study, we found some differences between the two modalities according to degree of myopia.

**Scan quality**

We observed better quality imaging of RNFL in glaucomatous optic disc of varying myopic degrees using BMO-MRW as compared to pRNFL, especially in highly myopic patients. pRNFL failed to obtain a good quality scan in the 12 cases. However, good quality scans were obtained in 9 of 12 cases by BMO-MRW. Both modalities produced poor quality scans in the same three highly myopic eyes. Hwang *et al.* found that 7% of detected BMO locations were not consistent, which was associated with high myopia.[16] Inconsistency was found at the beta zone of the peripapillary zone of the optic disc. This was due to neural retinal thinning secondary to both glaucomatous changes and high myopia. For the same reason, high myopia was associated with failed accurate delineation of retinal layers of pRNFL automated scans.[12,17] Furthermore, advanced stage of glaucoma was shown to be associated with artefacts in RNFL scans.[12] This is likely due to reduced RNFL refractivity, which leads to algorithm failures.[12]

**Diagnostic agreement**

The observed diagnostic agreement was higher in low myopia, followed by moderate myopia and high myopia in our study. Normal eyes with high myopia of -6 D and greater have been shown to have a substantial proportion of false positive

errors.[18] A previous study demonstrated lower sensitivity of both BMO-MRW and pRNFL thickness in myopic eyes (71% at 90% specificity).[10] Sensitivity was higher after excluding subjects with myopia exceeding -6 D.[10] The reported area under the curve for pRNFL in myopic eyes ranges from 0.84 to 0.98.[19-22] Shoji *et al.* found that pRNFL measurement was significantly related to refractive error and glaucoma.[20] However, BMO-MRW showed a lower rate of false positives compare to pRNFL.[23] In our study, the lowest agreement was observed in highly myopic eyes.

**Causes of poor quality scans**

Two major factors contribute to the difference in the quality of scan obtained. The first factor is the variation in scanning technology. The second factor is the anatomical variation of optic discs due to degree of myopia.

**Scanning method**

BMO is a stable fixed opening through which all axons exit the eye. BMO-MRW precisely determined the BMO at each point of the optic nerve head margin. Conversely, pRNFL measures RNFL in a fixed circular peripapillary area. Although circular scans can be done in three different circular areas in a pRNFL scan, inter-circular variations occur due to anatomical variations in myopic eyes.

**Anatomical variation and changes in myopic eye**

Anatomically, the optic nerve head can be regarded as an aperture with three-layers: the innermost aperture of Bruch's membrane, a central aperture in the choroid bordered by the peripapillary border tissue, and an external aperture of peripapillary sclera covered by fenestrated lamina cribrosa. These three apertures fit perfectly with each other. However, the position of these three apertures moves as the globe elongates in axial myopia. Thus, tilting of the optic nerve is observed in myopic eyes where the temporal portion of the optic nerve has a greater rotation compared to the nasal portion in the process of globe elongation. Rotation of the optic nerve causes shifting of the RNFL entering the optic nerve head. In addition, high myopia of -8.0 D or more has been shown to have larger optic disc size with increasing myopia.[24] This is due to enlargement of the optic nerve head as a result of the expansion and stretching of the optic nerve canal and lamina cribrosa.

Th peripapillary region of highly myopic optic discs shows prominent peripapillary atrophy involving the outer retina, retinal pigment epithelium, and choroid. Therefore, evaluation of glaucoma in myopic eye is challenging as the measurement of RNFL thickness in this area is not accurate.[25-27] RNFL distribution is thinner on average in the superior, nasal, and inferior sectors of highly myopic eyes. The temporal RNFL is thicker, with temporal shift in superior and inferior peak area [27].

Conus temporalis or myopic crescent is a moon-shaped feature that develops at the temporal disc border of myopic eyes due to atrophic changes and elongation of the eye.

The limitation of normative data in myopic eyes in commercially available OCT must be considered. As such, the eye with and without myopia cannot be compared with the same set of normative references.

**Limitations**
There are limitations in our study. A larger sample size would have provided a better overview of the results presented. However, we were unable to proceed further due to various technical issues. The study was conducted in a limited time frame due to financial and resource constraints. Secondly, there were no normal controls in our study. We may extend our study to include normal myopic subjects in the future. Third, the current inclusion of refractive error in our study was based on objective refraction. It would be desirable to include axial length in future studies.

## Conclusion

BMO-MRW is a better diagnostic imaging modality than pRNFL for glaucoma, especially for highly myopic eyes. Scan quality must be considered when interpreting OCT results in our daily clinical practice.

## Declarations

**Authors' contributions**
CTW: study design, data collection, article writing, critical revision, final approval; TJP: proofreading; THA: statistics; FJ: supervision, AMS: supervision.

**Ethics approval and consent to participate**
This study was approved by the Ministry of Health Malaysia Medical Research Ethic Committee (identifier: NMRR-17-87834292). Written informed consent was obtained from all subjects and the study adhered to the tenets of the Declaration of Helsinki.

**Consent for publication**
None.

**Competing interests**
None.

**Funding**
None.

**Acknowledgements**
None.

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Malaysian Journal of Ophthalmology

© Malaysian Journal of Ophthalmology 2021; 2:91-100
*Original article*
*https://doi.org/10.35119/myjo.v3i2.174*

# Non-compliance among diabetic macular oedema patients on anti-vascular endothelial growth factor therapy in Malaysia

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## Abstract

*Introduction:* Diabetic macular oedema (DMO) is a major cause of visual loss in the diabetic population. There are several treatment options for DMO, including intravitreal anti-vascular endothelial growth factor (anti-VEGF) injections, which have been shown to improve visual outcomes. Good compliance to treatment regimens is associated with greater visual benefit.
*Purpose:* To estimate dropout rates and the associated reasons among DMO patients on three different anti-VEGF treatments.
*Study design:* A retrospective review of patients with DMO who were on bevacizumab, ranibizumab and aflibercept therapy from January 2014 to December 2016.
*Materials and methods:* Patients with DMO on anti-VEGF treatment in a private ophthalmology center were identified via an electronic database. Data on Malaysian residents aged 18 years or older were included. Foreign residents, the deceased, and those whose care had been transferred to another center were excluded from further analysis. Telephone interviews were then conducted with these patients based on a standard questionnaire to identify reasons for non-compliance.
*Results:* This study included 134 patients. The overall lost to follow-up rate was 56.0% (75/134). After excluding the deceased, those who opted for treatment at an alternative center, and uncontactable patients, 47 (35.1%) were then identified as drop-outs. Financial constraint was the most common reason cited by 38.3% patients (18/47) and was highest in the bevacizumab group (88.9%, 16/18). The second most common reason was lack of perceivable change in vision (25.5%). In

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addition, 19.1% opted to stop treatment due to logistical difficulties and 12.8% of patients were satisfied with their stable visual acuity. Lastly, 4.3% were unable to continue with treatment due to poor general health.
*Conclusion:* The dropout rate of 35.1% is higher than in previous publications from other countries. This study clarifies the challenges face by some Malaysian patients in seeking treatment for what is often a chronic disease. These results have implications on designing ways to assist patients' cooperation with the standard of care.

*Keywords:* anti-VEGF therapy, diabetic macular oedema, dropout rate, intravitreal injections, Malaysia, patient compliance

# Abstrak

*Pengenalan:* Edema makula diabetes (DMO) merupakan salah satu punca kemerosotan daya penglihatan dalam kalangan pesakit diabetes. DMO boleh dirawat dan suntikan faktor pertumbuhan endotel anti-vaskular intravitreal (anti-VEGF) merupakan salah satu cara perawatan DMO yang sudah terbukti keberkesanannya dalam usaha pemulihan daya penglihatan. Sesungguhnya, pematuhan rapi rejimen rawatan amat penting dan berkait rapat dengan usaha pemulihan daya penglihatan seseorang.
*Objektif kajian:* Menganggar kadar dan sebab-sebab pemberhentian rawatan dalam kalangan pesakit DMO bagi tiga cara perawatan anti-VEGF yang berbeza.
*Reka bentuk kajian:* Kajian retrospektif terhadap pesakit-pesakit DMO yang mendapatkan rawatan DMO melalui suntikan bevacizumab, ranibizumab, dan aflibercept dari Januari 2014 sehingga Disember 2016.
*Instrumen dan kaedah kajian:* Pesakit-pesakit DMO yang mendapatkan rawatan anti-VEGF di sebuah pusat rawatan oftalmologi swasta telah dikenal pasti melalui akses kepada pangkalan data elektronik yang sedia ada. Pesakit-pesakit yang telah dikenal pasti merangkumi warganegara Malaysia yang berumur 18 tahun dan ke atas. Warganegara asing, pesakit-pesakit yang telah meninggal dunia, dan pesakit-pesakit yang telah dipindahkan ke pusat rawatan yang lain telah dikecualikan daripada kajian ini. Pesakit-pesakit yang telah dikenal pasti kemudiannya telah ditemu ramah berpaksikan soalan-soalan yang telah ditetapkan dalam kajian ini bagi memahami sebab-sebab permberhentian rawatan.
*Hasil kajian:* Bagi menjayakan kajian ini, seramai 134 pesakit telah dikenal pasti. Daripada 134 pesakit tersebut, 75 pesakit (56.0%) telah dikenal pasti sebagai pesakit yang telah menghentikan rawatan. Setelah mengecualikan pesakit-pesakit yang telah meninggal dunia, pesakit-pesakit yang telah menukar pusat rawatan dan pesakit-pesakit yang gagal dihubungi, 47 pesakit (35.1%) telah disahkan sebagai pesakit yang telah menghentikan segala rawatan. Masalah kewangan merupakan antara sebab utama bagi pemberhentian rawatan dengan kadar sebanyak 18 pesakit

(38.3%) dan masalah ini paling ketara dalam kalangan pesakit yang mendapatkan suntikan bevacizumab (88.9%, 16/18). Antara sebab lain ialah kurang perubahan dalam daya penglihatan (25.5%) dan kekangan logistik (19.1%). Selain itu, sesetengah pesakit (12.8%) telah menghentikan segala rawatan kerana berpuas hati dengan daya penglihatan yang sedia ada. Akhir sekali, sesetengah pesakit (4.3%) telah menghentikan segala rawatan kerana masalah kesihatan.
*Kesimpulan:* Kadar pemberhentian rawatan sebanyak 35.1% yang telah direkodkan adalah lebih tinggi berbanding penerbitan negara-negara lain. Kajian ini menjelaskan kekangan yang dihadapi oleh warganegara Malaysia dalam usaha merawat penyakit kronik ini. Hasil kajian ini mempunyai implikasi dalam usaha menggalakkan kerjasama pesakit.

*Kata kunci:* anti-vaskular intravitreal, edema macula diabetes, kadar pemberhentian, suntikan intravitreal, Malaysia, pematuhan rejimen rawatan

## Introduction

Diabetic macular oedema (DMO) is a major cause of visual loss in the diabetic population.[1] The global prevalence of DMO is estimated to be about 7.48% among diabetic patients.[2] In Southeast Asia, the prevalence has been estimated at 1.4–7.2%.[3] Especially in developing countries, patient education and awareness of diabetic eye diseases is still limited.[4-6]

Specifically in Malaysia, there has been an increase in the prevalence of diabetes among Malaysian adults, with the national prevalence estimated at 18.3% in 2019.[7] The 2007 Diabetic Eye Registry reported the latest known national data on diabetic eye diseases, where 38.2% of diabetic Malaysians had some form of diabetic retinopathy, while an estimated 11.9% had evidence of diabetic maculopathy.[8] The Malaysian National Eye Survey (NES II) in 2014 reported that diabetic retinopathy was the second most common cause of blindness.[9]

Current treatment options for DMO include intravitreal anti-vascular endothelial growth factor (anti-VEGF) injections, intravitreal steroid implants or injections, and laser photocoagulation. Anti-VEGF agents have been shown to improve visual outcomes.[10] The types of anti-VEGF agents available for DMO treatment at the time of this study were bevacizumab (Avastin®; Roche, Basel, Switzerland), ranibizumab (Accentrix®; Alcon Novartis, Mumbai, India), and aflibercept (Eylea®; Bayer, Berlin, Germany). It has also been shown that compliance to anti-VEGF agents is associated with an improvement in clinical outcome.[11] It is therefore important to identify potential barriers that may hinder patients from achieving optimal visual recovery. The most cited reason for non-compliance to anti-VEGF therapy is lack of funding.[11-14] Other reasons include disease chronicity and lack of commitment in attending injection clinics,[11] other illnesses,[12] the psychological burden from the stress of

receiving intravitreal injections,[13] and decreasing baseline vision.[14]

The aim of this study is to evaluate reasons for patients dropping out of an anti-VEGF treatment regimen in a private ophthalmology center in Malacca, Malaysia. Identifying the causes of non-compliance will facilitate the formulation of appropriate patient-assistance strategies.

## Materials and methods

All patients with DMO on anti-VEGF therapy from January 2014 to December 2016 at Southern Specialist Eye Centre (SSEC), a private eye center in Malaysia were identified from an electronic database. Institutional Review Board approval for the study was granted by the International Specialist Eye Centre (Reference No: 1/2020).

The socioeconomic factors affecting foreign residents may be significantly different and would require a separate study to investigate. Therefore, in order to reflect the local health care context, only Malaysian patients aged 18 years and older were included. Those who failed to attend review and/or treatment appointments for 6 months were identified as lost to follow-up (LTF) [15]. However, to determine the number of dropouts (*i.e.*, those who should have been but were not under ongoing ophthalmic care), deceased patients, those whose care was transferred to another center or who were uncontactable, were excluded from further analysis.

A telephone interview was conducted with these patients based on a standard questionnaire to identify reasons for non-compliance. It was carried out by a single state registered nurse fluent in Malay, English, and Chinese. She was therefore able to conduct the interview in the patient's language of choice. Informed consent was obtained verbally at the start of the phone conversation. After a brief introduction to the study, the patient or a caretaker was asked an open-ended question

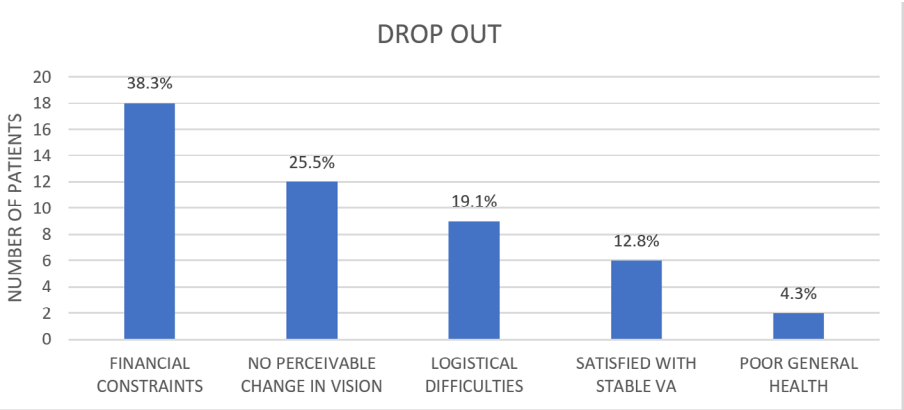


*Fig. 1.* Reasons for dropout.

as to why they had stopped attending for treatment. Their responses were then classified under the following categories: financial constraints, poor general health, no perceivable change in vision, change of treatment center, logistical difficulties, satisfaction with stable or improved vision, or deceased.

The medical charts of these patients were reviewed to obtain data on gender, age, laterality, visual acuity, anti-VEGF agent, number of injections administered, and duration of treatment. Statistical analysis was performed using the one-way ANOVA and unpaired t-test where appropriate.

## Results

From January 2014 to December 2016, there were 162 patients at SSEC who were identified as being on anti-VEGF therapy for DMO. One hundred thirty-four patients were Malaysians and included for analysis. Patient demographics are summarized in Tables 1 and 2.

A total of 75 patients (56.0%) were found to have been LTF. Twelve of 75 patients (16.0%) opted to continue treatment at an alternative center, where an eye center closer to home was a more convenient option. Eight patients (10.7%) were reported deceased and a further eight (10.7%) were uncontactable. These three groups were not considered for further analysis. The final result for the remaining 47 (35.1%), the

*Table 1.* Patient demographics relative to gender

| Gender | Number of patients who continued treatment | Number of patients lost to follow-up | Total number of patients |
|---|---|---|---|
| Female | 29 (29.2%) | 48 (64%) | 77 (57.5%) |
| Male | 30 (50.8%) | 27 (36%) | 57 (42.5%) |
| Total | 59 | 75 | 134 |

*Table 2.* Patient demographics relative to age group

| Age group | Number of patients who continued treatment | Number of patients lost to follow-up | Total number of patients |
|---|---|---|---|
| 31–40 | 2 | 9 | 11 |
| 41–50 | 4 | 12 | 16 |
| 51–60 | 15 | 22 | 37 |
| 61–70 | 23 | 23 | 46 |
| 71–80 | 15 | 9 | 24 |
| Total | 59 | 75 | 134 |

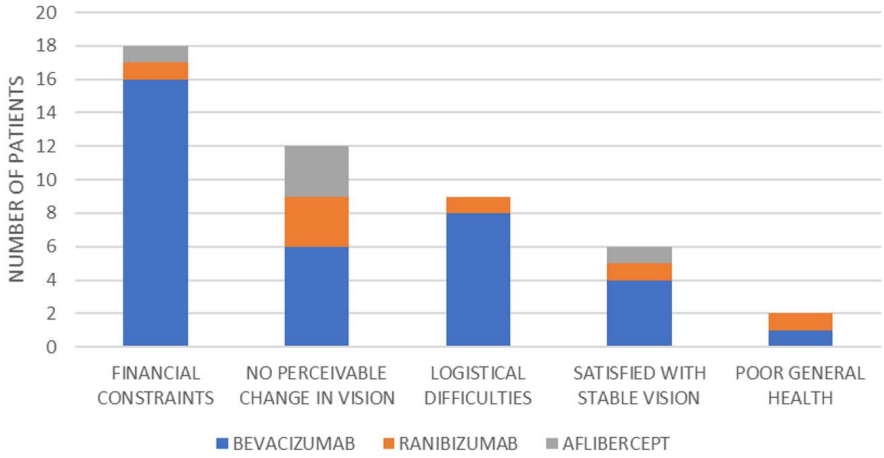


*Fig. 2.* Reasons for dropout relative to anti-VEGF agents.

*Table 3.* Number of injections and duration (months) of treatment by group

| Reason for dropout | Number of injections (mean ± SD) | Treatment duration (mean ± SD) |
|---|---|---|
| Financial constraints | 5.0 ± 2.8 | 9.4 ± 7.3 |
| No perceivable change in vision | 6.9 ± 3.6 | 9.9 ± 7.1 |
| Logistical difficulties | 2.7 ± 2.9 | 7.2 ± 6.8 |
| Satisfied with stable visual acuity | 5.3 ± 1.6 | 12.0 ± 5.9 |
| Poor general health | 2.5 ± 0.7 | 4.0 ± 2.0 |

dropouts, is illustrated in Figure 1. Every patient was treatment naïve. The overall mean duration of treatment was 9.9 months (SD 7.1).

Financial constraint was the most common reason for not continuing with treatment. The average number of injections before dropout is shown in Table 3 and the differences between groups were statistically significant ($p = 0.0262$).

The overall percentages of dropouts relative to drug types were 74.5% (35/47) for bevacizumab, 14.9% (7/47) for ranibizumab, and 10.6% (5/47) for aflibercept. Figure 2 illustrates the reasons for dropping relative to anti-VEGF agent. These differences were statistically significant ($p = 0.0275$). This was determined based on the medication that the patient had received at the last visit.

The finding that stands out is that among those who cited financial constraints as their reason for withdrawing from the course of treatment, 88.9% (16/18) were

*Table 4.* Visual acuity (EDTRS) change by group

| Reason for drop-out | Baseline VA | Final VA | Change in VA | *p*-Value |
|---|---|---|---|---|
| Financial constraints | 26.69 ± 26.77 | 38.65 ± 29.68 | 11.96 ± 14.51 | 0.0086 |
| No perceivable change in vision | 35.38 ± 24.89 | 38.63 ± 21.72 | 2.63 ± 13.91 | 0.3484 |
| Logistical difficulties | 32.27 ± 32.74 | 27.5 ± 34.03 | -11.00 ± 14.32 | 0.3067 |
| Satisfied with stable VA | 60.00 ± 25.90 | 74.44 ± 7.68 | 14.44 ± 27.23 | 0.0642 |
| Poor general health | 60.00 ± 7.07 | 62.50 ± 3.54 | 2.50 ± 3.54 | 0.3492 |

on bevacizumab. The mean number of injections before dropout was 6.2 injections. The remaining two patients on aflibercept and ranibizumab had received three injections each. The majority (15 patients) were self-funded, whilst the rest had medical insurance cover. Also of note, two patients were switched from ranibizumab to bevacizumab for financial reasons. In addition, one patient whose vision did not improve with bevacizumab was switched to aflibercept.

## Discussion

In this study, just over a third of patients on anti-VEGF regimens for DMO did not sustain treatment as advised. This is higher than previously reported rates ranging from 15–25% in studies conducted in Cairo, Paris, Munich, and Pennsylvania.[11-14]

Several reasons could account for this higher-than-expected number. In Malaysia's dual-tier healthcare system, private specialist centers such as SSEC are not funded by the government. Medical expenses are largely covered by private medical insurers or out-of-pocket spending.[16] It is therefore no surprise that the reason for a third of patients giving up on treatment was financial. Where there is out-of-pocket expense, high drug cost is associated with lower treatment compliance.[17-19] Furthermore, 16 of 18 of these patients were on bevacizumab, which is the most affordable anti-VEGF agent available. It is likely that those in lower socioeconomic brackets opted for bevacizumab and found it difficult to maintain therapy even at the reduced price point. In order to encourage such patients to persevere, the cost of bevacizumab would have to be lowered even further. This is especially needful since, as a group, there was significant improvement in vision.

One-quarter of patients assumed that anti-VEGF therapy had failed due to a lack of visual acuity improvement. They arrived at this conclusion after an average of 6.9 injections and did not consider it worthwhile to persevere. On the other hand, over a tenth were satisfied with their visual gains and thought that subsequent review or treatment was no longer necessary. This may reflect the general popu-

lation's understanding of DMO and its management. The former should be aware that, in the absence of other factors such as macular ischemia, functional and anatomical improvement may take more time. The latter need to understand that maximum benefit may have not been achieved and there is a possibility of regression if not adequately treated. More effective patient education might lead to improved motivation to continue with treatment. It is therefore important to note that compliance and awareness of DMO management is associated with the patient's views and behavior towards the management of diabetes.[20] This is where more rigorous clinical counselling including the distribution in up-to-date patient information on various media platforms may prove helpful. Perhaps another approach towards improving compliance in DMO patients would be to encourage multidisciplinary collaboration between ophthalmologists and other healthcare professionals involved in the care of diabetic patients.[21] Adequately trained retinal counsellors made up of nurses, optometrists, and other paramedical professionals could lend ongoing support to patients along their treatment journey.

Being an ambulatory ophthalmology center that receives many out-of-state patients, it is expected that among those who reported logistical difficulties, 10 out of 12 live between 40 and 190 km away. Longer-acting agents such as steroid implants should alleviate the burden of frequent visits if there are no contraindications.[22-23] Shared care between retinal specialists and local general ophthalmologists may also be considered. It is of concern that this group had lost vision during the course of therapy. Although not statistically significant, it does raise the point that easier accessibility to treatment should be considered in any effort to improve outcomes.

To date, this is the only known study analyzing reasons for non-compliance with anti-VEGF therapy among patients with DMO in a private health care setting in Malaysia. The information gained should be helpful in formulating strategies for assisting individuals with DMO to persevere with therapy.

There are a few limitations to this study. First, this is a single-center study covering the southern region of Malaysia and the results may not be representative of the whole nation. Second, 15% of patients were not contactable because telephone numbers held on the electronic medical records were invalid. However, an 85% response rate was considered by the authors to be sufficient for useful conclusions to be drawn.

Malaysia comprises people from a wide range of cultural and socioeconomic backgrounds. For future study, it would be important to note how such factors are associated with treatment compliance. Optimal ophthalmic care is vital as part of the ongoing effort to reduce morbidity among the diabetic population of Malaysia.

## Declarations

**Ethics approval and consent to participate**
International Specialist Eye Centre Institutional Review Board approval for the study was granted by the International Specialist Eye Centre (Reference No: 1/2020). Informed consent was provided by the patients at the start of the telephone interview.

**Consent for publication**
Not required.

**Competing interests**
None.

**Funding**
None.

**Acknowledgements**
We would like to acknowledge Dr. Robert Yeo Kim Chuan and Dr. Liu Han Seng, who cared for some of the study patients, and staff nurse Angeline Goh Xue Ning for conducting the telephone interviews.

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Malaysian Journal of Ophthalmology

© Malaysian Journal of Ophthalmology 2021; 2:101-106
*Case report*
*https://doi.org/10.35119/myjo.v3i2.150*

# Red herring unmasked: the trail leading to retinoblastoma

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## Abstract

This case series highlights the possibility of retinoblastoma in children with a history of trauma. Retinoblastoma commonly presents with leukocoria. In our series, the history of blunt trauma led to a misdiagnosis. The delay in correctly diagnosing retinoblastoma was made more difficult with hyphaema and vitreous haemorrhage obscuring the fundus view. Hyperdensities in imaging tests were mistaken for intraocular foreign bodies and post-trauma insult rather than calcification of an intraocular tumour. Both patients underwent anterior chamber washout. The patients were referred to our centre when their condition worsened. Retinoblastoma was highly suspected and confirmed from histopathological examination after enucleation. An accurate diagnosis can only be achieved by exercising a high index of suspicion. Misdiagnosis and mismanagement will lead to poor prognosis.

*Keywords:* hyphaema, retinoblastoma, trauma

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# Abstrak

Siri kes klinikal ini menunjukkan kemungkinan diagnosa retinoblastoma pada kanak-kanak yang mempunyai sejarah trauma. Retinoblastoma lazimnya menunjukkan simptom keputihan anak mata putih (leucokoria). Dalam kajian siri ini, adanya sejarah kecederaan tumpul telah menyimpang ketepatan diagnosa. Ini menjadi lebih sukar kerana pendarahan pada gelemair dan gelemaca menghalang pemeriksaan retina. Penemuan ujian pengimbasan imej disalah-tafsir sebagai benda asing intraokular dan komplikasi dari kecederaan, dan bukannya kalsifikasi tumor intraokular. Kedua-dua pesakit menjalani pembedahan pembuangan darah gelemair dan dirujuk ke pusat kami apabila keadaan mereka bertambah teruk. Retinoblastoma telah disyaki dan disahkan dengan histopatologi bola mata. Diagnosa yang tepat hanya dapat dicapai sekiranya mempunyai indeks kecurigaan yang tinggi. Kesalahan dalam diagnosa dan rawatan boleh menyebabkan prognosis yang buruk.


*Kata kunci:* pendarahan gelemair, retinoblastoma, trauma

## Introduction

Retinoblastoma commonly presents as leukocoria (71.8%).[1] However, there have been a few reported cases which presented as hyphaema.[2-3] We report two cases of retinoblastoma that were initially thought to be traumatic hyphaema but eventually led us to a more sinister diagnosis. We aim to remind the importance of being vigilant when treating young children.

## Case presentation

### Case 1

A 3-year-old girl presented with conjunctival redness for a month in her left eye. Her mother attributed it to frequent falls and therefore did not seek treatment. On examination, visual acuity in the left eye was light perception with grade 3 hyphaema, dense cataract, phacodonesis, and intraocular pressure (IOP) of 42 mmHg. As there was no fundus view, B-scan ultrasonography (USG) was done and showed vitreous haemorrhage. The right eye was unremarkable. Anterior chamber washout was performed on the left eye. However, she developed eyelid swelling and worsening of conjunctival injection with fixed and dilated pupil 2 weeks later. Computed tomography (CT) of the orbit was ordered (to rule out orbital cellulitis), showing hyperdensity with calcification within the vitreous with peripheral enhancement of the left orbit and probable endophthalmitis (Fig. 1). She was referred to Hospital Kuala Lumpur. Retinoblastoma was suspected during

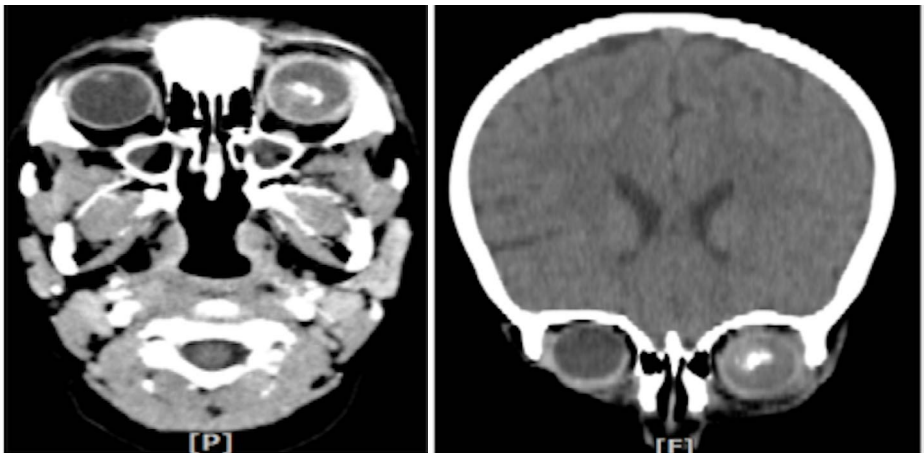

*Fig. 1.* Computed tomography of the orbit showing intraocular hyperdensities in the left eye.

examination under anaesthesia. B-scan USG showed vitreous opacity with calcification. The left eye was enucleated. The histopathological examination reported a solitary, endophytic tumour measuring 15 mm with intrascleral invasion, confirming the diagnosis of retinoblastoma.

**Case 2**

A 2-year-old boy presented with conjunctival redness in the right eye after being hit by an umbrella 1 day prior. Visual acuity of the right eye was light perception. On examination, there was an abrasion over the right lower lid, conjunctival injection, and total hyphaema with IOP of 31 mmHg. B-scan USG showed vitreous haemorrhage. Orbital CT reported irregular hyperdensity and probable intraorbital haemorrhage. However, a foreign body could not be excluded (Fig. 2). Anterior chamber washout was done in the right eye for non-resolving total hyphaema, but the eye remained injected and the vitreous haemorrhage persisted after the washout. Thus, he was referred to Hospital Kuala Lumpur. On examination, the right eye had exotropia, florid rubeosis iridis with shallow anterior chamber and dilated pupil. There was a retrolental mass with vessel engorgement underlying the vitreous haemorrhage. B-scan USG showed diffuse vitreous haemorrhage with central calcification. Retinoblastoma was highly suspected. RE enucleation was performed and HPE reported a single, 15 mm endophytic tumour not involving Bruch's membrane.

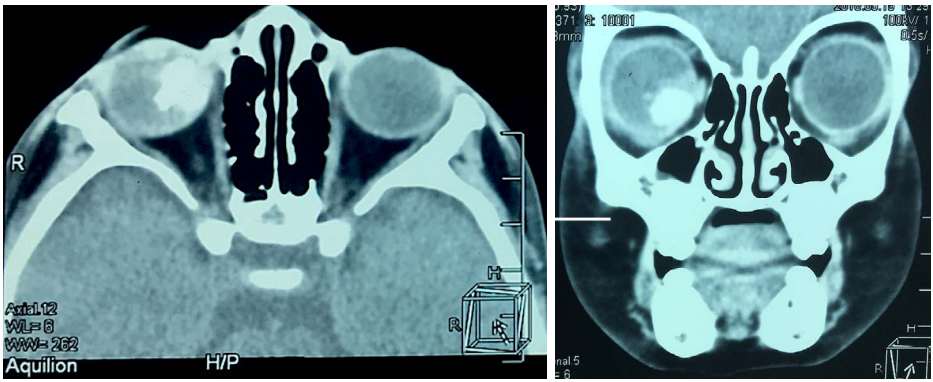


*Fig. 2.* Computed tomography of the orbit showing an irregular, hyperdense lesion in the vitreous of the right globe with surrounding periorbital fat streakiness.

## Discussion

Hyphaema as the first presentation of retinoblastoma is rare. In a review by Balasubramanya, hyphaema was reported in only 0.25% of patients out of 392 retinoblastoma cases.[2] In our local population of retinoblastoma, associated hyphaema is similarly uncommon (4.6%).[1]

As children are prone to falls and injuries, it is common to attribute their eye pathology to trauma. Having a clear-cut history of trauma misled the treating ophthalmologists as seen in our reports. Misdiagnosis may lead to deadly consequences. Murthy *et al.* reported on a girl with total hyphaema following a trivial trauma in which the ultrasound finding was consistent with vitreous haemorrhage. She died from metastatic extraocular retinoblastoma despite intensive chemotherapy after hyphaema drainage.[3] Kaliki *et al.* reported on 14 patients with retinoblastoma who were initially misdiagnosed and intraocular procedures were inadvertently performed. Treatment was initiated and, of the 14, eight had progressive disease and died before completion of treatment.[4] In another study, ten patients presented with a history of trauma with three patients undergoing intraocular surgery before the diagnosis of retinoblastoma. Treatment was given and two patients died despite adjuvant therapy.[5]

Our cases posed a diagnostic dilemma, as there was no fundus view. Accurate diagnosis in such situations can only be made by means of a high index of suspicion of malignancy. Thus, we need to correlate the minimal findings found with the history given. In both cases the history was insufficient. When deemed suspicious, a thorough and detailed history taking is needed. For example, presence of other retinoblastoma features prior to trauma should be asked. If necessary, an examination under anaesthesia should be performed to ensure no crucial findings leading to diagnosis are missed, especially in uncooperative children.

USG is safe, cost effective, non-invasive, and easy to use to look for hyperechoic tumours with calcifications. Precise interpretation, however, may be blinded by the history given. Although imaging can aid in the diagnosis of retinoblastoma, this case series shows that radiological interpretation is influenced by the clinical information available. In addition to retinoblastoma, there can be other causes of intraocular calcification, including intraorbital foreign body. The appearance of calcification and foreign body can be indistinguishable. Glass and silicone may have similar Hounsfield units to calcification.[6] Clinicians also should be more meticulous in identifying imaging features that may indicate retinal tumours in children with history of trauma because of its similar characteristics to foreign bodies.

## Conclusion

There needs to be a high index of suspicion of malignancy when dealing with cases of hyphaema following minor trauma in children. Retinoblastoma needs to be ruled out in young children with unexpected ocular findings, be it clinically or on imaging despite a history of trauma. Surgical intervention needs to be delayed, and prompt appropriate treatment is required in order to avoid a life-threatening outcome.

## Declarations

**Ethics approval and consent to participate**
None.

**Consent for publication**
The authors certify that they have obtained all appropriate consent from the guardians. In the consent forms, the guardians have given their consent for the images and other clinical information to be reported in the journal.

**Competing interests**
None.

**Funding**
None.

**Acknowledgements**
The authors would like to thank the Director General of Health Malaysia for permission to publish this paper.

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Malaysian Journal of Ophthalmology


*Case report*
*https://doi.org/10.35119/myjo.v3i2.182*

# A case of air pollution-induced Valsalva retinopathy

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## Abstract

This is a case of Valsalva retinopathy during the season of annual transboundary haze pollution in Sarawak. A 22-year-old man with no known medical illness developed sudden onset of painless visual acuity loss preceded by persistent cough. Left eye fundus showed dense preretinal haemorrhage covering optic disc extending inferiorly with breakthrough vitreous haemorrhage. The patient underwent pars plana vitrectomy, endolaser, and fluid gas exchange in view of persistent dense vitreous haemorrhage after a month of conservative management. In conclusion, pars plana vitrectomy can be considered as a safe and effective treatment option for patients with Valsalva retinopathy developing extensive premacular haemorrhage.

*Keywords:* haze, pars plana vitrectomy, premacular haemorrhage, Valsalva retinopathy

## Abstrak

Ini merupakan kajian kes mengenai retinopati Valsalva yang berlaku pada musim jerebu tahunan di negeri Sarawak. Seorang lelaki dewasa yang berumur 22 tahun tanpa kormobiditi dirujuk dengan masalah pengaburan penglihatan yang akut selepas mengalami batuk yang teruk. Fundus mata kiri pesakit menunjukan pendarahan preretinal yang padat meliputi cakera optik dan sambungan di bawahnya dengan pendarahan vitreous. Pendarahan vitreous pesakit didapati berterusan selepas rawatan konservatif selama sebulan. Oleh sebab itu, pesakit menerima rawatan pembedahan pars plana vitrectomy, endolaser dan fluid gas

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exchange. Kesimpulannya, rawatan pars plana vitrectomy boleh dilihat sebagai salah satu pilihan rawatan yang selamat dan berkesan untuk pesakit yang mengalami retinopati Valsalva dengan pendarahan premakula.

*Katakunci:* jerebu, pars plana vitrectomy, pendarahan premakula, retinopati Valsalva

## Introduction

With the increase of global demand for agricultural and urban spaces, slash-and-burn deforestation has become a popular method to clear forests for cultivable land. In September 2019, Sarawak suffered a rather critical transboundary haze that reached a hazardous level of 402 in the Air Pollutant Index as a result of rampant forest fires. Haze has been known to cause significant impact on respiratory and ocular health.

A rare condition, Valsalva retinopathy case is scarcely reported during the haze season. Valsalva retinopathy is an induced premacular retinal haemorrhage due to increased pressure on the retinal venous system caused by sudden increases in intrathoracic pressure. The Valsalva manoeuvre, a forcible exhalation effort against a closed glottis causing a sudden rise in intrathoracic pressure, was first described by 17$^{th}$ century physician Antonio Maria Valsalva. There are no valves in the venous system rostral to the heart hence causing a sudden surge of reflux venous pressure in the head and neck region. Common causes of Valsalva retinopathy include vomiting, weightlifting, vigorous sexual activity, and coughing. Here, we report a case of Valsalva retinopathy with dense preretinal haemorrhage induced by air pollution.

## Case presentation

A 22-year-old working class man with no known medical illness presented with painless sudden onset of acute visual loss in the left eye preceded by a bout of cough. Visual acuity in the left eye was hand movement, the anterior segment was unremarkable, and intraocular pressure was 14 mmHg. Fundus examination showed dense preretinal haemorrhage covering the optic disc extending inferiorly with breakthrough vitreous haemorrhage (Fig. 1). B scan showed subhyaloid blood tracking inferiorly and anteriorly to the ora serrata. After 1 month, visual acuity remained hand movement and the fundus revealed extensive vitreous haemorrhage (Fig. 2). Full blood count /peripheral blood film, coagulation profile, blood urea, serum electrolytes, erythrocyte sedimentation rate, and autoimmune workup were done and yielded normal results. Pars plana vitrectomy, endolaser,

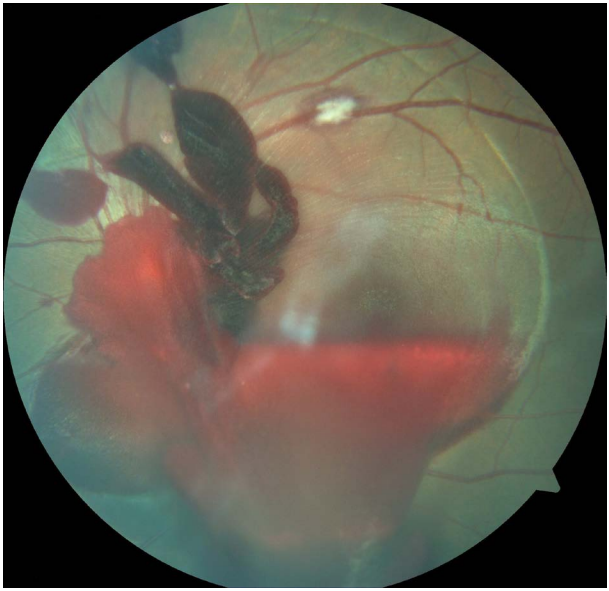

*Fig. 1.* Left eye fundus with dense preretinal haemorrhage with breakthrough vitreous haemorrhage inferiorly obscuring optic disc and posterior pole during presentation.

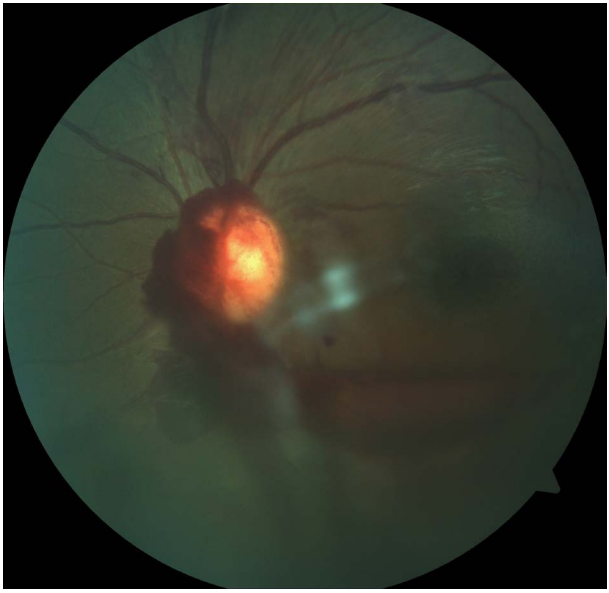

*Fig. 2.* Left eye fundus showing persistent vitreous haemorrhage after 1 month of conservative management with visual acuity of hand movement.

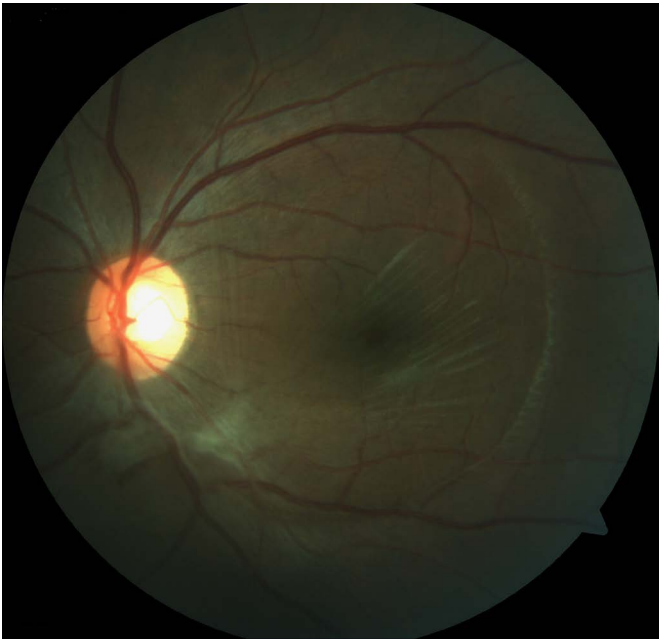

*Fig. 3.* Left eye fundus at the 2-month postoperative review.

and fluid gas exchange were performed in view of persistent vitreous haemorrhage. Postoperative follow-up at 2 months revealed best-corrected visual acuity of 6/7.5. Fundus examination revealed minimal old vitreous haemorrhage with flat posterior pole (Fig. 3). However, the patient developed early cataract as the complication of the surgery.

## Discussion

Vitreous haemorrhage is a common sign of various ocular diseases. It is known to cause permanent visual damage such as haemosiderosis bulbi, proliferative vitreoretinopathy, and ghost cell glaucoma. Hence, our management aim was to restore vision and expedite the patient's recovery with minimal complications. Many procedures have been reported, such as puncturing the posterior hyaloid face with Nd-YAG,[1] pneumatic displacement of the haemorrhage with an intravitreal injection of gas with or without recombinant tissue plasminogen activator,[2] and pars plana vitrectomy.[3]

García *et al.*[3] reported six cases of Valsalva retinopathy in which five required pars plana vitrectomy after 3–4 weeks of observation, whereas one patient recovered without intervention as the haemorrhage was minimal with a diameter of one

disc. One of the cases that underwent pars plana vitrectomy developed cataract postoperatively and required cataract surgery. Successful Nd:YAG laser hyaloidotomy for Valsalva premacular haemorrhage with the size of more than three disc diameters and enough haemorrhage pocket depth was also been reported by Mehdi *et al.*[4] However, the challenge of performing Nd: YAG laser hyaloidotomy is the proximity to the retinal surface, which may cause macular hole[5], retinal detachment, and epiretinal membrane formation. Our patient was treated with pars plana vitrectomy as his vitreous and preretinal haemorrhage was noted to be more than one disc diameter which did not resolve after 1 month. However, he developed early cataract postoperatively, which may require cataract surgery later.

## Conclusion

Pars plana vitrectomy is the more effective and safer treatment for extensive premacular haemorrhage compared to other treatment modalities. However, known surgical associated complications such as cataract may develop, as reported in our case.

## Declarations

**Ethics approval and consent to participate**
Not required.

**Consent for publication**
The patient provided informed consent for the publication of this case report.

**Competing interests**
None.

**Funding**
None.

**Acknowledgements**
None.

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Malaysian Journal of Ophthalmology


*Case report*
*https://doi.org/10.35119/myjo.v3i2.186*

# Central retinal vein occlusion as the initial presentation of isolated optic nerve sheath metastasis from breast cancer

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## Abstract

*Background:* Isolated metastasis to the optic nerve (ON) and its sheath from breast cancer (BC) without involvement of other ocular structures is extremely rare. However, it is a pivotal diagnosis to rule out as it is a both sight- and life-threatening condition. We report a case of isolated ON sheath metastasis from BC presenting with central retinal vein occlusion (CRVO).
*Case presentation:* A 47-year-old woman with known metastatic BC presented with painless, progressive vision loss in the left eye. Visual acuity was hand movement with ipsilateral relative afferent pupillary defect. Fundal features suggested CRVO. Atypical rapid resolution of these features led to suspect ON metastasis. Magnetic resonance of the brain showed perineural enhancement of the optic nerves. Vision improved with radiotherapy.
*Conclusion:* Isolated ON sheath metastasis from BC is rare and may present with CRVO. High degree of suspicion is warranted in patients with metastatic disease and atypical findings.

*Keywords:* breast cancer, metastasis, neoplasms, optic disc, retinal vein occlusion

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# Abstrak

*Latar belakang:* Kes metastatik kepada saraf optik dan sarungnya daripada kanser payudara tanpa penglibatan struktur okular yang lain jarang berlaku. Akan tetapi, pengecualian penyakit kanser metastatik adalah penting untuk megelak daripada ancaman nyawa dan penglihatan. Kami melaporkan satu kes luarbiasa di mana kanser payudara metastatik hanya merebak kepada saraf optik beserta sarungnya dan menunjukkan ciri-ciri 'central retinal vein occlusion' (CRVO).
*Kes:* Seorang wanita yang berumur 47 tahun dengan kanser payudara metastatik mengadu bahawa penglihatan mata kirinya semakin merosot. Tahap penglihatannya cuma 'hand movement' dan terdapat 'relative afferent pupillary defect' pada mata tersebut. Pemeriksaan funduskopi menunjukkan ciri-ciri CRVO. Walaubagaimanapun, ciri-ciri ini semakin pudar dengan tempoh yang pendek tanpa apa-apa rawatan. Kadar resolusi yang pantas ini menjadikan metastatik saraf optik disyaki sebagai punca. Pengimejan otak menunjukkan tanda-tanda penglibatan saraf optik. Dengan rawatan radioterapi, tahan penglihatannya berunsur baik.
*Konklusi:* Meskipun jarang, kanser payudara metastatik boleh merebak kepada saraf optik sahaja tanpa penglibatan struktur mata yang lain dan boleh menunjukkan ciri-ciri CRVO.


*Kata kunci:* kanser payudara, metastatik, ketumbuhan, saraf optik, retinal vein occlusion

## Introduction

Metastatic disease to the eye is uncommon, with an incidence ranging from 0.07% to 12 %.[1] The commonest primary tumour site was found to be breast cancer (BC).[2] Metastases from BC usually involve the uveal tract or orbital structures in these cases. However, isolated metastases to the optic nerve (ON) and ON sheath without involvement of other ocular or orbital structures are extremely rare. As the clinical signs associated with ON metastasis are not pathognomonic, the diagnosis may be easily overlooked. We report a case of isolated ON sheath metastasis from BC presenting with central retinal vein occlusion (CRVO).

## Case presentation

A 47-year-old woman presented with painless and progressive visual loss in her left eye for 11 days. She denied having eye redness, eye swelling, diplopia, floaters, or light flashes. There was no history of headache, nausea, vomiting, numbness, or weakness of the body. She had underlying right BC, which was diagnosed in 2012, when breast conserving surgery with axillary clearance was performed, followed by

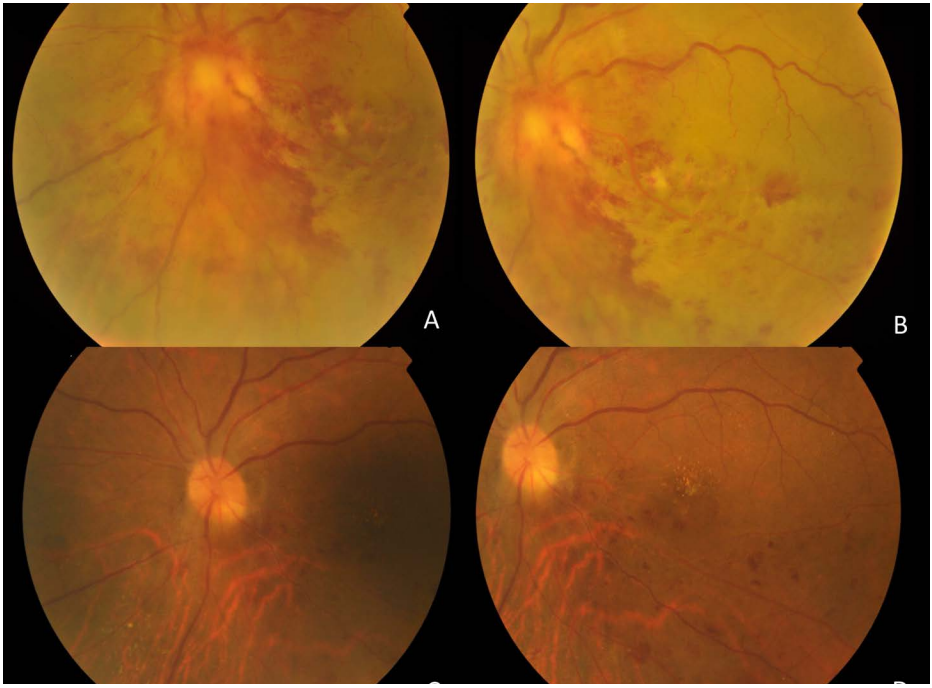


*Fig. 1.* (*A-B*) Fundus images of the left eye demonstrating marked disc swelling, flame haemorrhages, multiple intraretinal haemorrhages with tortuous retinal vessels. (*C*) Spontaneous partial resolution of retinal haemorrhages and macula oedema. (*D*) Four weeks later, with blurring of inferior optic disc margin remaining.

adjuvant chemotherapy and radiotherapy. Unfortunately, she defaulted treatment after 1 year of tamoxifen. In 2015, she presented with symptoms of local recurrence and lung metastasis; thus, another cycle of chemotherapy was given, and tamoxifen was recommenced. Her disease was stable until March 2018, when she developed supraclavicular lymph node enlargement. Core biopsy of the lymph node revealed metastatic BC. She refused further chemotherapy and was started on anastrozole, an anticancer hormone therapy. Four months later, she presented with the ocular symptoms. She denied having any other significant medical illnesses.

On examination, there was no obvious proptosis, lid swelling, or ophthalmoplegia. Her blood pressure was 136/86. There were no significant findings of the anterior segments of both eyes and the intraocular pressures were normal. Visual acuity was 6/6 in the right eye but reduced to hand movement in the left eye with ipsilateral relative afferent pupillary defect. Fundus examination of the left eye revealed a swollen optic disc with peripapillary haemorrhages. The retinal veins appeared dilated and tortuous. There were flame-shaped haemorrhages and intraretinal haemorrhages in all quadrants but denser in the inferotemporal region (Fig.1A-B).

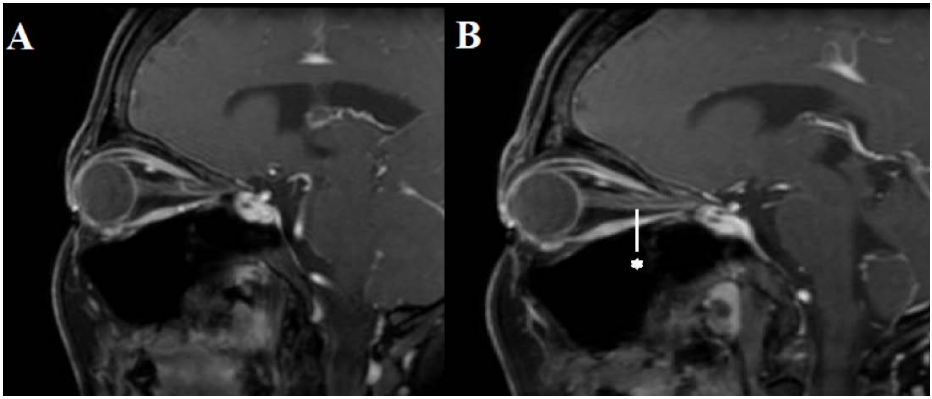


*Fig. 2.* Right eye (*A*) and left eye (*B*) sagittal views of orbit MRI with post-contrast fast spoiled gradient echo sequences. The left optic nerve (*B*) demonstrates increased perineural enhancement (asterisk) compared to the right optic nerve (*A*). No mass seen within both intraconal structures.

The macula appeared oedematous, but no hard exudates or cotton wool spots were visualised. The vitreous was clear and no neovascularization was seen at the disc or elsewhere. The fundus of the right eye was unremarkable.

A diagnosis of left CRVO with macular oedema was made. Preliminary blood investigations such as full blood count, coagulation profile, renal profile, and fasting blood glucose were normal. Fundus fluorescein angiography (FFA) was scheduled for a later date, to avoid the inaccuracy of capillary non-perfusion evaluation from the masking effect by the haemorrhages. Options for intravitreal anti-vascular endothelial growth factor injection were given but deferred due to financial constraints. However, upon review 4 weeks later, we observed marked spontaneous improvement of the disc swelling, retinal haemorrhages, and macular oedema with only blurring of the inferior optic disc margin remaining (Fig.1C-D). This unusual phenomenon triggered the suspicion of ON metastasis. Urgent contrasted magnetic resonance imaging (MRI) of the brain revealed perineural enhancement of both optic nerves, which was more prominent on the left, with no intraconal or extraconal mass (Fig. 2). The oncology team was alerted, and third-line hormonal therapy, exemestane was commenced. She was also given radiotherapy, 20 grays in 5 fractions with 6-MV photons to the orbit bilaterally. Eight months later, visual acuity in the left eye was limited to counting fingers due to a superior altitudinal defect, but she was able to achieve vision of 6/45 in a chin up position. Further resolution of the disc swelling and retinal haemorrhages was observed. The right eye retained visual acuity of 6/6 with a normal ocular examination.

## Discussion

The most common site for intraocular metastasis is the uveal tract, likely attributed to its rich vascular supply. BC is the most frequent source of ocular metastases (43%), followed by lung cancer (27%).[2] Even so, ocular metastases is uncommon with bone, brain, liver, and lung being the usual sites of distant BC metastasis.[3]

Isolated ON and/or ON sheath metastasis from BC without the involvement of other ocular or orbital structures is very rare. Metastatic cancer to the optic nerve can occur as a direct hematogenous spread to the neural tissue or to the overlying meninges.[2] Optic nerve metastases from BC in general exhibit abnormalities of the optic disc such as pallor or oedema. However, our patient presented with CRVO.

Features of CRVO include dilation and tortuosity of all branches of the central retinal vein, retinal haemorrhages scattered throughout all four quadrants, and optic disc oedema, all of which were present in our patient. CRVO has only been reported in one case[4] before, although the temporal relationship between the two was unclear, as CRVO was noted 7 months prior to the diagnosis of metastatic disease.

Although the exact pathogenesis remains elusive, occurrence of CRVO is thought to follow the principles of the Virchow's triad of thrombogenesis, including venous stasis, hypercoagulability, and vessel damage. In malignancies, CRVO is regarded as a paraneoplastic process where a complex interplay between tumour cells, leucocytes, platelets, coagulation system, and vascular endothelium contribute to the pathogenesis of CRVO.[5] Certain therapeutic agents for the treatment of BC such as tamoxifen have also been associated with retinal vaso-occlusive disease, such as branch retinal vein occlusion.[6] In our case, this could have been compounded by the impediment of venous outflow from the compression by the ON sheath metastases itself.

Surprisingly, marked spontaneous partial resolution of the retinal haemorrhages, optic disc swelling, and macular oedema was observed within 4 weeks without any change in systemic hormonal therapy or chemotherapy. This atypical rapid improvement was an unusual observation in CRVO considering the median time to resolution of retinal haemorrhages was reported to be 9.5 months in the posterior pole and 20.7 months in the peripheral retina for non-ischemic CRVO.[7] This duration was even longer for ischemic CRVO. We postulate that perhaps the occlusion site of the central retinal vein was more posterior, where a greater number of tributaries anterior to the occlusion allowed re-establishment of collateral flow leading to a transient, yet significant disturbance of the retinal circulation.

The prognosis of patients with metastasis to the ocular structures is poor, with a mean survival of 9–13 months in those with metastasis to the retina and ON. [2,4] Our patient remains a cancer survivor at the time of writing, 14 months since the diagnosis of CRVO was made.

## Conclusion

Isolated ON sheath metastasis of BC is extremely rare and may present with CRVO. Although CRVO is not an unusual occurrence in the context of systemic malignancies, the presence of atypical features and/or optic neuropathy with a background history of metastatic BC should alert the clinician with the possibility of this grave diagnosis.

## Declarations

**Ethics approval and consent to participate**
Not required.

**Consent for publication**
Informed consent was obtained from the patient for publishing this case report.

**Competing interests**
None.

**Funding**
None.

**Acknowledgements**
The authors would like to thank the clinicians from the Department of Clinical Oncology, University of Malaya who were involved in the management of this case.

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Malaysian Journal of Ophthalmology


*Case report*
*https://doi.org/10.35119/myjo.v3i2.190*

# Perfluorocarbon liquid-assisted intraocular foreign body removal

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## Abstract

Traumatic ocular injury is an uncommon yet leading cause of monocular blindness among the working-age group. Retained intraocular foreign body (IOFB) are associated with 41% of open globe injuries. Pars plana vitrectomy is often required for posterior segment IOFB removal. Advances in vitreoretinal surgical techniques and instrumentation have resulted in better treatment outcomes with reduced ocular morbidity. We report a case of modified ILM forceps with perfluorocarbon liquid-assisted non-magnetic IOFB removal in a young man after a motor vehicle accident with zone one open globe injury and a large glass IOFB in the right eye. We describe the use of perfluoro-N-octane to slide the IOFB extramacularly and reorient the IOFB plane for stable and safe retrieval by ILM end-gripping forceps. The modified design of the ILM end-gripping forceps with adjunctive use of perfluorocarbon liquid in pars plana vitrectomy reduces slippage during IOFB extraction and prevents collateral iatrogenic retinal injury.

*Keywords:* intraocular foreign body, open globe injury, perfluorocarbon liquid, trauma

## Abstrak

Kecederaan traumatik okular adalah penyebab kebutaan yang jarang berlaku, tetapi penyebab utama kebutaan dalam golongan pekerja. Bendasing di dalam bebola mata dikaitkan dengan 41% kecederaan mata terbuka. Pembedahan vitrektomi pars planar sering diperlukan untuk membuang bendasing dari bahagian belakang mata.

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Kemajuan teknik dan alatan pembedahan vitreoretinal telah menghasilkan rawatan yang lebih bagus dengan kadar penurunan morbiditi mata. Kami membentangkan satu kes berkenaan penggunaan ILM forceps dan cecair perfluorokarbon untuk menyinkirkan bendasing bukan magnetik dari bebola mata iaitu serpihan kaca, yang melibatkan seorang pemuda yang terbabit dalam kemalangan jalan raya dan megalami kecederaan mata terbuka zon satu. Kami menghuraikan penggunaan perfluoro-N-octane untuk mengalihkan bendasing dari makula dan mengorientasikan semula bendasing bagi memudahkan penekstrakan bendasing dengan lebih stabil dan selamat dari bebola mata dengan menggunakan ILM forceps. Fungsi ILM forceps yang diubahsuai dengan bahan tambahan, iaitu cecair perfluorokarbon semasa pembedahan vitrektomi pars plana, akan mengurangkan gelinciran bendasing semasa pengekstrakan, seterusnya mencegah kecederaan retina secara iatrogeik.

*Kata kunci:* bendasing di dalam bebola mata, cecair perfluorokarbon, kecederaan mata terbuka, trauma

## Introduction

Open globe injuries are often associated with a retained intraocular foreign body (IOFB). IOFBs are seen in 18–41% of open globe injuries, with a majority of cases occurring in men younger than 40 years of age.[1-3] Ocular injuries with retained IOFB pose serious threats to vision due to mechanical damage to intraocular structures, introduction of infection, and chemical reaction of foreign body with resultant retinal toxicity. The momentum of the object at the time of impact will determine the location of the IOFB either in the anterior chamber, and/or crystalline lens, and/or posterior chamber, and/or even orbit in case of perforating injury. Accurate localisation of the IOFB and determination of its composition during examination are mandatory for surgeons to decide on the surgical approach for IOFB extraction.[2] Currently, pars plana vitrectomy and IOFB removal with magnet or forceps is widely practised by surgeons in removal of posterior segment IOFBs.[1] However, this method presents some drawbacks. Non-metallic IOFBs preclude the use of magnetic intraocular probes or the Bronson rare earth magnet. Forceps use has resulted in collateral damage associated with iatrogenic injury and slippage of IOFB during extraction.

We describe the benefits of perfluoro-N-octane (PFO), a perfluorocarbon liquid (PFCL), in the removal of a non-magnetic IOFB from the macula and posterior segment. In this case report, we demonstrate that PFO can be a useful adjunct to pars plana vitrectomy by facilitating the removal of a glass IOFB from the posterior segment and protecting the macula from iatrogenic damage.

## Case presentation

A 21-year-old male presented to the emergency department after a motor vehicle accident with a zone one open globe injury in the right eye. His visual acuity was light perception in the right eye and 6/6 in the left eye. The right eye was soft on palpation. Slit lamp examination of the right eye showed a superotemporal curvilinear corneal laceration with uveal prolapse. The lens was cataractous with anterior capsule breech. The fundus view was obscured secondary to traumatic cataract. The patient underwent a primary open globe repair and lens aspiration.

When reassessed postoperatively, dilated fundus examination revealed a glass IOFB in the posterior segment with inferior retinal detachment and vitreous haemorrhage. The patient was referred to a vitreoretinal surgeon for IOFB removal. He underwent 23-gauge pars plana vitrectomy (Constellation®; Alcon, Fort Worth, TX, USA). Intraoperatively, there was a large glass foreign body located in the posterior pole. After core vitrectomy, IOFB removal was attempted to no avail using a modified 23-gauge-ILM forceps (Grieshaber Revolution® DSP ILM Forceps; Alcon). The forceps was unable to grasp the glass IOFB securely given its orientation, large size, and smooth, slippery edges. One mL of PFO was then injected over the macula, displacing the IOFB extramacularly in order to protect the macula during removal. The glass piece was reoriented to incline against the PFO bubble using a vitrectomy cutter on aspiration. Repositioning of the glass piece enabled a stable forceps grip during removal. The IOFB was successfully removed from the anterior chamber via previously initiated corneal paracentesis wound with the modified ILM forceps forceps (Fig. 1). Ultimately, secondary implantation of a scleral-fixated intraocular lens was performed. At the 1-year postoperative follow-up, the patient had best-corrected visual acuity of 6/12 in the right eye in the context of corneal scarring. Video 1 demonstrates the IOFB removal technique.

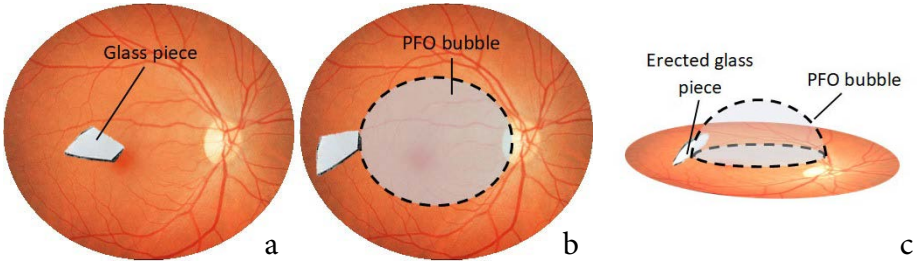


*Fig 1.* Schematic illustration of perfluorocarbon liquid-assisted intraocular foreign body removal. (*a*) Large piece of glass in the macula. (*b*) One ml of perfluoro-N-octane (PFO) (as outlined by black dashed line) displaced the glass extramacularly. (*c*) The foreign body was reoriented vertically against the PFO bubble (as outlined by black dashed line) to facilitate forceps grip and foreign body removal.

*Video 1.* This video demonstrates the use of perfluoro-N-octane (PFO), a perfluorocarbon liquid, in the removal of a large glass piece from the macula and posterior segment. PFO was injected to displace the foreign body extramacularly. The plane of the glass piece was reoriented to facilitate its removal using a modified ILM forceps. The glass piece was then removed from the anterior chamber using the modified ILM forceps. Note the secure grip of the glass piece by the ILM forceps despite its large size and smooth, slippery edges.

## Discussion

Ocular trauma is the leading cause of monocular blindness, especially in the working-age population. Traumatic mechanical eye injury can be classified as either open globe or closed globe injury. IOFBs are associated with penetrating or open globe ocular trauma cases. The surgical approach and timing is case-dependent and must take into account the location, size, shape, IOFB composition, and presence of other associated injuries. The general principles of surgery are: timely closure of entry wound, IOFB removal, and prevention/treatment of endophthalmitis.[4] Advances in vitreoretinal surgical techniques and instrumentation have allowed greater success in treating ocular injuries with retained IOFBs, thereby improving visual outcomes.[1]

This report presents a case of successful extraction of retained posterior segment glass IOFB in a young man after motor vehicle accident with good postoperative visual outcome. Posterior segment IOFBs pose challenges in treatment and tend to have worse visual prognosis, as they are commonly associated with vitreous haemorrhage, retinal tears, retinal detachment or dialysis, choroidal detachment, sclopetaria, etc. Profound visual loss that ensues from iatrogenic retinal injury is also common, as the IOFB may inadvertently fall posteriorly,

striking the optic nerve or fovea, during surgical extraction.[2,4] Thus, successful IOFB removal without collateral damage is an important indicator for recovery and visual prognosis.

IOFB removal from the posterior segment of the eye is challenging. Specific instrumentation is required to remove the IOFB depending on its size and magnetic nature. Small metallic IOFBs can be removed using intraocular rare earth magnets, but manoeuvring metallic IOFBs larger than 3 mm and non-metallic IOFBs such as stones or large glass fragments require specialised grasping forceps for removal. Various authors have described a snare or loop design made of thick sutures and nitinol loops that can hold irregular IOFBs. Snare design devices are not suitable for large spherical IOFBs because they are prone to repeated slippage of IOFB, leading to inadvertent iatrogenic retinal trauma. The use of different types of forceps have also been described by other surgeons in IOFB retrieval. Hicking-botham *et al.* have described a diamond-coated forceps to hold the IOFB in the vitreous cavity. However, the opening of the prongs is not wide enough to hold large IOFBs and the two prongs make removal of spherical IOFBs challenging.[3] Liang *et al.* discussed the use of a microalligator forceps for removal of large IOFBs. The potential drawbacks of this instrument are the very large sclerotomy wound required to introduce the forceps and the potential crushing force of the forceps, which may splinter the IOFB.[5] Acar has described a basket-shaped design of IOFB forceps made from nitinol. This basket is wide enough to extract large IOFBs, but its manipulation is technically difficult.[6] The novel design IOFB forceps "the claw" (Epsilon, Chino, CA, USA) by Bapaye, consisting of four retractable prongs made of nitinol wire, offers a very secure grip without crushing the IOFB, thereby reducing the risk of IOFB slippage and iatrogenic retinal trauma.[7]

Liquid materials such as silicone oil, PFCLs, and viscoelastic liquids have been developed as adjunctive agents to facilitate vitreoretinal surge.[8-10] In the present study, we reported the use of PFO to realign the IOFB into the vertical plane and enable a stable hold of the object with the forceps, thus protecting the macula from secondary intraoperative retinal injury. Many studies have reported the application of PFCLs to protect the macula and to float IOFBs that are less dense than PFCLs into the vitreous body, but so far none have reported the role of PFCLs in reorienting an IOFB to facilitate a stable IOFB forceps grip for successful removal.[11,12]

PFCLs are low viscosity, low surface tension (14–16), optically clear compounds with refractive indices of 1.27–1.33 but high specific gravity (1.76 – 2.3), nearly twice that of water.[8,9,13] These properties make PFCLs a useful adjunct intraoperatively. PFCLs do not cause optical aberrations to surgeons because of their almost-similar-to-water-refractive index. The high specific gravity of PFCLs enables flattening of detached retinas and positioning of the foreign body away from the retina and into the vitreous body. The cohesiveness and low viscosity of PFCLs allow easy introduction and complete removal of the liquid intraoperatively. In this report,

the IOFB was a glass piece with a greater specific gravity (2.0–2.5) than PFO; however, PFO could still be used to displace and reorient the IOFB extramacularly. This scenario is possible; a study evaluated and showed that PFCLs may be used to manipulate IOFBs with specific gravities higher than PFCLs after taking into account factors such as the PFCL's surface tension and buoyancy, in addition to the relative specific gravity of the IOFB to the PFCL.[14]

The special forceps for IOFB removal discussed above are not readily available to most of the ophthalmologists in our context. Thus, the modified ILM end-gripping forceps, which is designed for fine membrane grasping and maculorhexis, was used to remove the IOFB in this case. This instrument is inexpensive and readily available in our local context. In addition, we used PFO to erect the position of the IOFB, facilitate gripping, and minimize collateral retinal trauma, which is one of the determining factors in postoperative recovery and visual prognosis.

## Conclusion

In this report, we describe the modified ILM end-gripping forceps with PFO-assisted removal of a large non-metallic IOFB. The intraoperative use of a modified ILM forceps and PFO facilitate IOFB removal by enabling reorientation of the IOFB for stable forceps grip in addition to its role in protecting the macula from iatrogenic retinal injury.

## Declarations

**Ethics approval and consent to participate**
Not required.

**Consent for publication**
The patient provided informed consent for the publication of the clinical data and images contained in this case report.

**Competing interests**
None.

**Funding**
None.

**Acknowledgements**
None.

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Malaysian Journal of Ophthalmology


*Case report*
*https://doi.org/10.35119/myjo.v3i2.209*

# *Bacillus* endophthalmitis after cataract removal surgery following initial ocular trauma: a case report

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## Abstract

Infectious endophthalmitis is an ocular infection caused by bacterial or fungal organisms involving intraocular tissues, aqueous, and vitreous humour. *Bacillus* sp. is an uncommon microorganism causing endophthalmitis. We describe a teenager who presented with a self-sealed corneal laceration, cataractous lens, and evidence of a breach in the anterior capsule. The eye was initially quiet and stable. The event started 1 day after uncomplicated cataract surgery. The patient developed fulminant postoperative endophthalmitis with a fatal final visual outcome. A high index of suspicion is mandatory, and more aggressive treatment may be able to improve the final outcome.

*Keywords: Bacillus* sp. infection, endophthalmitis, postcataract surgery, self-sealed corneal laceration

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# Abstrak

Jangkitan endophthalmitis adalah penyakit jangkitan mata yang disebabkan oleh mikroorganisma seperti bakteria atau kulat yang melibatkan tisu intraokular, cecair aqueous, dan gel vitreous. Bacillus sp. adalah mikroorganisma yang sangat jarang ditemui sebagai penyebab jangkitan endophthalmitis. Kami ingin berkongsi mengenai seorang remaja dengan kecederaan kornea mata (luka mata) yang stabil, katarak, dan kapsul anterior kanta yang terkoyak akibat trauma. Kecederaan mata pesakit setelah mendapatkan rawatan awal bagi mengawal keradangan mata pada mulanya adalah stabil. Walaubagaimanapun keadaan mata yang cedera semakin teruk secara tiba-tiba selepas sehari pembedahan katarak dilakukan ke atas pesakit. Pesakit di diagnosakan sebagai jangkitan endophthalmitis selepas pembedahan dan boleh menyebabkan kadar penglihatan yang teruk atau kebutaan disebabkan oleh Bacillus sp. bakteria. Keadaan prasangka yang tinggi dan rawatan yang lebih agresif dalam merawat pesakit seperti ini mungkin boleh merubah keadaan kecederaan mata dan penglihatan pesakit selepas rawatan akhir.


*Kata kunci:* jangkitan Bacillus sp., jangkitan endophthalmitis, laserasi kornea yang tertutup sendiri, selepas pembedahan katarak

## Introduction

Postoperative endophthalmitis is an ocular infection following intraocular surgery. The incidence following cataract surgery ranges from 0.08% to 0.7%.[1] Although bacteria are the most commonly isolated microorganisms in postoperative endophthalmitis, isolating *Bacillus sp.* is rare, and most cases are related to trauma. In this case report, we describe a case of *Bacillus sp.* postoperative endophthalmitis in a boy with a history of ocular trauma.

## Case presentation

A 17-year-old teenager presented to the casualty with alleged trauma of the right eye pricked by metal wire while repairing a motorbike. He sustained sudden onset of blurred vision and came to the hospital within hours of the trauma.

Visual acuity on presentation was hand movement in the right eye and 6/6 in the left eye. Slit lamp ocular examination revealed a 1 mm, self-sealed, full-thickness corneal laceration at the 7 o'clock peripheral cornea. The anterior chamber was deep with a mild degree of inflammation; no hyphaema or vitreous were seen in the anterior chamber. The lens was cataractous with evidence of anterior capsule breach and limited fundus view. The intraocular pressure was normal.

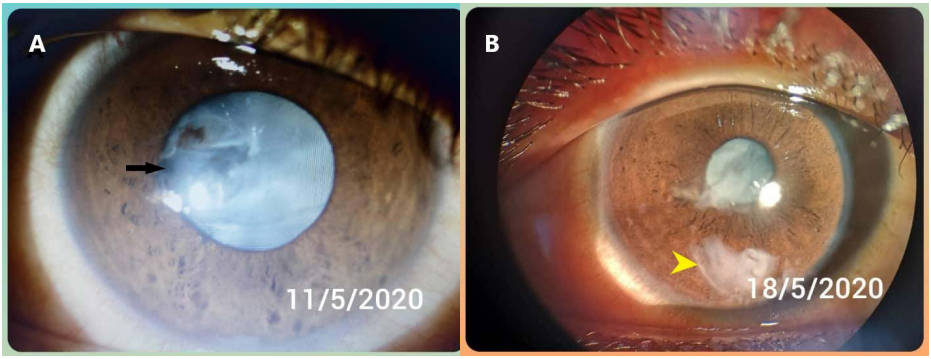


*Fig. 1.* (*A*) Post-traumatic penetrating injury with cataractous lens and anterior capsule breach. (*B*) Review 1 week after the initial trauma.

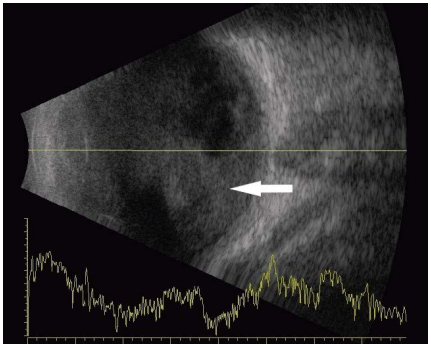

*Fig. 2.* B scan ultrasonography at day 1 postoperatively showing dense vitreous opacity.

Skull X-ray revealed absence of intraocular foreign body. He was admitted and started with intravenous ciprofloxacin 200 mg every 12 hours. Gutt prednisolone acetate 1% and gutt moxifloxacin 0.5% were prescribed every 4 hours. At the 1-week review, cortical matter was spotted in the inferior anterior chamber (Fig. 1).

The patient underwent uneventful phacoemulsification surgery. There was a breach in the anterior and posterior capsules with anterior capsular fibrosis from 10 to 3 o'clock. During review at postoperative day 1, the cornea was oedematous and hypopyon was present with fibrin plaque covering the visual axis. B-scan ultrasonography showed dense vitreous opacity; thus, he was diagnosed with acute postoperative endophthalmitis (Fig. 2).

An emergency intravitreal injection of vancomycin 1 mg/0.1 ml and ceftazidime 2 mg/0.1 ml was performed. Anterior chamber washout was performed given a poor window for the posterior segment. The vitreous sample was taken for microscopic examination and culture.

Hourly Gutt moxifloxacin 0.5% and gutt ceftazidime 5% as well as oral ciprofloxacin 500 mg every 12 hours were started postoperatively. The intravitreal antibiotics were repeated three times at 72-hour intervals. The vitreous sample grew *Bacillus* sp. He was closely monitored during the postoperative period. Despite treatment and close observation, two months after the surgery the eyeball was phthisic with no light perception.

## Discussion

Endophthalmitis is a potentially devastating ocular infection complication. The incidence of postoperative *Bacillus sp.* endophthalmitis is rare and mostly seen in traumatic cases.[2] Table 1 summarizes the published cases on *Bacillus sp.* postoperative endophthalmitis from 1997 to 2021, including our case.

Contamination of viscoelastic substances was reported in 14 patients with *Bacillus* sp. endophthalmitis by Roy *et al.* in 1997.[3] Orsi *et al.* reported four cases with environmental contamination as the probable cause.[4] Chan *et al.* described a similar case, but the cause of infection was unknown.[5] We report one case of *Bacillus* sp. endophthalmitis with prior history of penetrating injury to the eye in which the endophthalmitis developed soon after cataract removal, which was performed 2 months after the initial injury. Our patient exhibited signs of anterior capsule breach after the initial injury. We postulate that *Bacillus* sp. may have lied dormant within the lens fibres after the initial injury and did not elicit moderate to severe inflammation.

The patients in the aforementioned studies were all treated with pars plana vitrectomy and intravitreal combination of tobramycin and vancomycin.[3-5] In contrast, our patient received three intravitreal injections of vancomycin and ceftazidime. Pars plana vitrectomy was not performed due to corneal haziness. Endoscopic vitrectomy has a role in hazy cornea cases, allowing early intervention and obviating the need for evisceration, but not statistically significant in case of *Bacillus sp.* infection.[6,7] As a complication, all the above patients developed profound visual loss due to the endophthalmitis.[3-5] This may suggest that this particular microorganism is highly virulent and provokes severe retinal necrosis. However, this postulation warrants histological confirmation and diagnosis.

## Conclusion

In conclusion, *Bacillus* sp. is a rare causative microorganism in postoperative endophthalmitis. There is a possibility that it may lie dormant within the lens fibres after breaching the lens capsule. The final visual outcome is devastating. Prompt and aggressive treatment is necessary to treat this difficult eye condition.

*Table 1.* Published case studies of *Bacillus* spp. postoperative endophthalmitis (1997-2021)

| Author (Year) | Number of cases | Risk factors/ Causes of infection | Treatment | Final BCVA | Outcomes |
|---|---|---|---|---|---|
| Roy *et al.*[3] (1997) | 14 | Contaminated viscoelastic | 11 cases underwent pars plana vitrectomy<br>3 cases treated as mild, not medicated<br>Intravitreal tobramycin 0.1 mg/0.1 ml and vancomycin 0.1 mg/0.1 ml<br>Topical fortified vancomycin 50 mg/ml and tobramycin 14 mg/ml | 1: No light perception<br>13: 20/100 or better | 1: Phthisis bulbi |
| Orsi *et al.*[4] (1999) | 4 | Contaminated environment | 4 cases done pars plana vitrectomy<br>Intravitreal tobramycin 0.1mg/0.1ml and vancomycin 0.1 mg/0.1 ml<br>Topical fortified vancomycin 50 mg/ml and tobramycin 14 mg/ml | 4: No light perception | 2: Enucleation<br>2: Phthisis bulbi |
| Chan *et al.*[5] (2003) | 1 | Unknown | Pars plana vitrectomy performed<br>Intravitreal tobramycin 0.1 mg/0.1 ml and vancomycin 0.1 mg/0.1 ml<br>Topical fortified vancomycin 50 mg/ml and tobramycin 14 mg/ml | No light perception | Evisceration |
| Khairil-Ridzwan *et al.* (2021) | 1 | History of 2-month ocular trauma with self-sealed, full thickness corneal laceration with capsular lens breach | Pars plana vitrectomy not performed<br>Intravitreal ceftazidime 0.1 mg/0.1 ml and vancomycin 0.1 mg/0.1 ml<br>Topical moxifloxacin 0.5% and Gutt ceftazidime 5% | No light perception | Phthisis bulbi |

BCVA: best-corrected visual acuity

## Declarations

### Ethics approval and informed consent
Not required.

### Consent for publication
The patient provided informed consent for the publication of the clinical data and images contained in this case report.

### Competing interests
None.

### Funding
None.

### Acknowledgements
None.

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Malaysian Journal of Ophthalmology

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*Case report*
*https://doi.org/10.35119/myjo.v3i2.212*

# Orbital apex syndrome with frontal abscess secondary to sinusitis due to *Candida guilliermondii*

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## Abstract

*Candida guilliermondii* is an opportunistic pathogen that rarely causes invasive candidiasis even in immunocompromised humans. We report a case presentation of invasive *C. guilliermondii* rhinosinusitis causing an orbital and intracranial extension (frontal lobe abscess). An aggressive multidisciplinary team management is a key approach in invasive fungal sinusitis and avoided mortality in this case. When orbital apex syndrome secondary to sinusitis is encountered in an immunocompromised patient, the treating physician should consider fungal infection as a causative agent.

*Keywords: Candida guilliermondii,* fungal rhinosinusitis, orbital apex syndrome

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# Abstrak

Candida guilliermondii adalah patogen oportunistik yang jarang menyebabkan penyakit kandidiasis invasif meskipun kepada manusia yang mengalami gangguan imun. Kami melaporkan kes kandidiasis invasif oleh C. guilliermondii rhinosinusitis yang menyebabkan penyebaran lanjutan ke orbit dan intrakranial. Penglibatan pelbagai disiplin medikal yang agresif adalah pendekatan utama dalam mengatasi masalah ini dan mengelakkan kematian. Apabila sinusitis yang menyebabkan sindrom orbital apeks ini dijumpai pada pesakit yang mempunyai gangguan sistem imun, doktor yang merawat perlu mempertimbangkan fungus ini sebagai salah satu punca jangkitan.


*Kata kunci: Candida guilliermondii*, fungus rinosinusitis, sindrom orbital apeks

## Introduction

Fungal infection is one of the reported aetiologies of orbital apex syndrome, mainly as a sequela of rhinosinusitis.[1] Fungal rhinosinusitis can be further classified into invasive and non-invasive. Immunocompromised patients, such as those with diabetes mellitus, cancer, leukaemia or acquired immune deficiency syndrome, are more commonly susceptible to this condition.[2,3]

## Case presentation

A 54-year-old Malay female who had poorly controlled diabetes mellitus presented with progressive blurring of vision in the left eye for 3 weeks. It was associated with drooping of the left eyelid and proptosis, headache, facial numbness, and anosmia (Fig. 1).

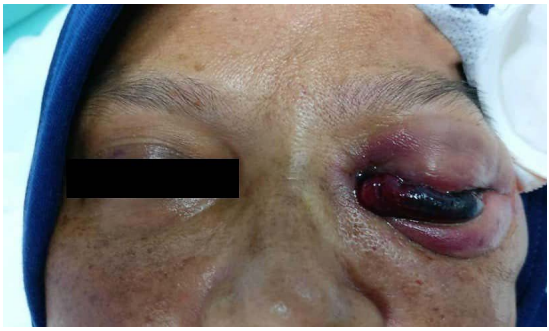

*Fig. 1.* Left eye swelling with proptosis, complete ptosis, and ophthalmoplegia.

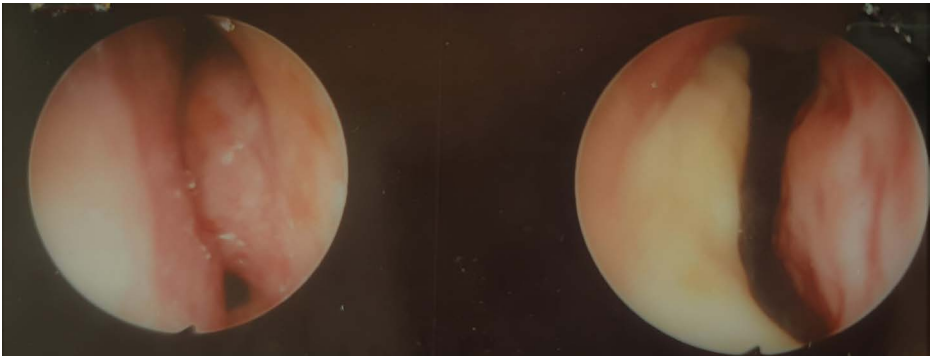

*Fig. 2.* (*Left*) Left oedematous and enlarged inferior turbinate. (*Right*) Thick crust and slough adhering to the septum.

On examination of the left eye, visual acuity was light perception with positive reverse afferent pupillary defect. Further examination revealed restricted gaze movement in all directions, complete ptosis, and marked proptosis. The anterior segment showed an injected conjunctiva with raised intraocular pressure. Fundoscopy showed pale disc with quiescent lasered proliferative diabetic retinopathy. On examination of the right eye, visual acuity was 6/18 while the anterior segment was unremarkable. Fundoscopy examination showed moderate non-proliferative diabetic retinopathy.

The otorhinolaryngology team was referred to evaluate the involvement of the paranasal sinuses. Endoscopic examination revealed purulent lesions in both nasal cavities extending to the nasopharynx region (Fig. 2). A biopsy was taken from the lesions. Computed tomography scans of the brain, orbit, and paranasal sinuses showed extensive sinusitis involving the orbital apex region (Fig. 3) and extending into the intracranial space, causing left frontal abscess (Fig. 4). The histopathology result revealed fungal infection of *C. guilliermondii*. The patient underwent functional endoscopic sinus surgery and drainage of the frontal lobe abscess was performed by the neurosurgical team.

Intravenous amphotericin B 1 mg/kg/day was initiated. However, renal function was impaired, leading to drug-induced nephropathy. Intravenous medication was then switched to liposomal amphotericin B 3 mg/kg/day followed by oral voriconazole 200 mg BD for 6 weeks. The patient's condition improved and a second computed tomography scan showed a reduction in lesion size.

However, the left eye progressed to neovascular glaucoma as a result of ischemia caused by the compressive effect of proptosis. During post-treatment follow-up, the vision progressed to no light perception and was treated conservatively with a single intraocular pressure-lowering agent.

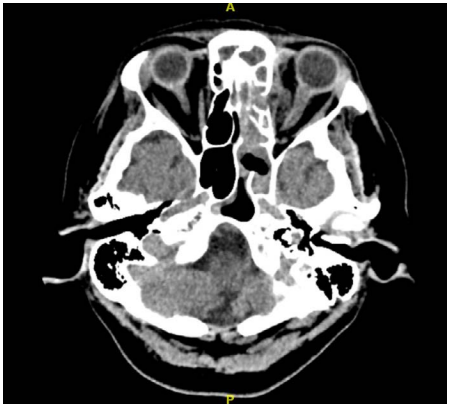


*Fig. 3.* Computed tomography of the orbit and paranasal sinuses showing mixed density lesion in left nasal cavity and ethmoid sinus, with extension to lateral extraconal space of left orbit. Left optic nerve was displaced and appear thickened.

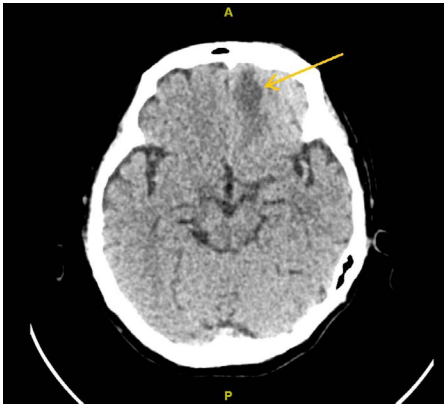


*Fig. 4.* Superior extension into the left frontal lobe area and ill-defined hypodensity posterior to left frontal abscess.

## Discussion

Our case report exhibits a rare case of extensive rhinosinusitis caused by *C. guilliermondii* infection. It caused an invasive fungal sinusitis, extending intraorbitally causing orbital apex syndrome and intracranially causing left frontal lobe abscess.

*C. guilliermondii* is considered an uncommon yeast compared to *Candida albicans.* Reported cases of *C. guilliermondii* ocular infection caused chorioretinitis[4] and fungal interstitial keratitis in post-Descemet's membrane endothelial keratoplasty.[5] However, a case of *C. guilliermondii* causing an invasive rhinosinusitis with orbital and intracranial extension has never been reported in the literature before.

Invasive fungal sinusitis is a potentially fatal disease. The prognosis in this condition is usually poor because the orbital apex is located adjacent to the middle cranial fossa via the optic nerve canal and the superior orbital fissure. As such, a multidisciplinary approach is key to successful management.

Aggressive medical and surgical treatment is therefore necessary to reduce the mortality rate.[2,6] Amphotericin B is a standard antifungal treatment for invasive fungal sinusitis due to its wide spectrum and high effectiveness; however, this medication occasionally impairs renal function.[6] Therefore, a substitute of liposomal amphotericin B can be used in this condition.[7]

In our case, despite the success in treating the invasive *C. guilliermondii* infection and preventing a mortal outcome for our patient, the left eye progressed to neovascular glaucoma due to retinal ischemia secondary to the compressive effect

of proptosis. Neovascular glaucoma is a devastating secondary glaucoma requiring early diagnosis, followed by immediate and aggressive treatment.

## Conclusion

*C. guilliermondii* is an opportunistic pathogen and rarely causes invasive fungal sinusitis. When extensive orbital involvement in a rhinosinusitis case is encountered, the treating ophthalmologist should consider fungal infection as a causative agent.

## Declarations

**Ethics approval and informed consent**
Not required.

**Consent for publication**
Consent was obtained from the patient for the publication of images and other clinical information reported in the journal.

**Competing interests**
None.

**Funding**
None.

**Acknowledgements**
The authors wish to thank the staff directly or indirectly involved in this study.

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Malaysian Journal of Ophthalmology

© Malaysian Journal of Ophthalmology 2021; 2:139-141
*Eye-quiz*
*https://doi.org/10.35119/myjo.v3i1.153*

# Conjunctival intraepithelial microcyst

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## Clinical context

A 17-year-old teenage girl with open-angle glaucoma as a complication of penetrating keratoplasty had undergone an uneventful primary augmented trabeculectomy surgery. One year postsurgery, her intraocular pressure (IOP) was stable in the low teens with a shallow diffuse bleb.

**Question 1**
Describe the findings in Figure 1a and 1b.

**Question 2**
What is the implication of the presence of the findings in Figure 1a and 1b in trabeculectomy surgery?

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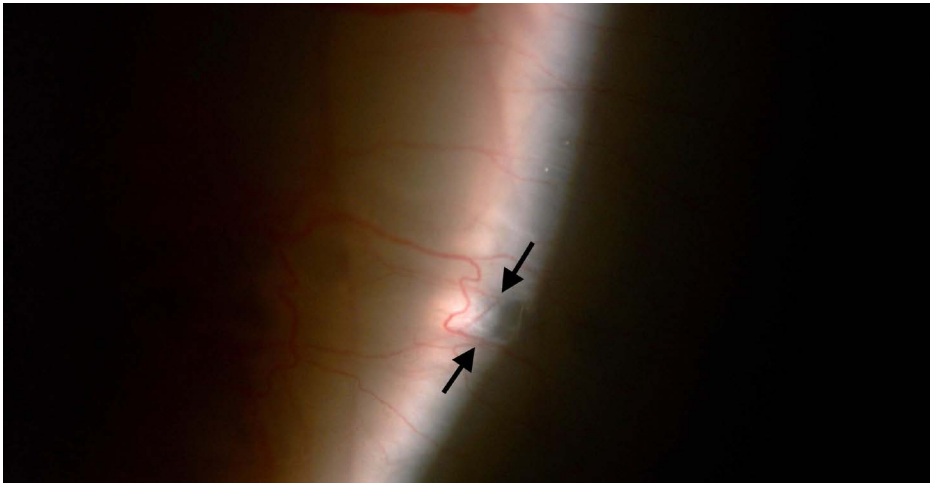

*Fig. 1a.*

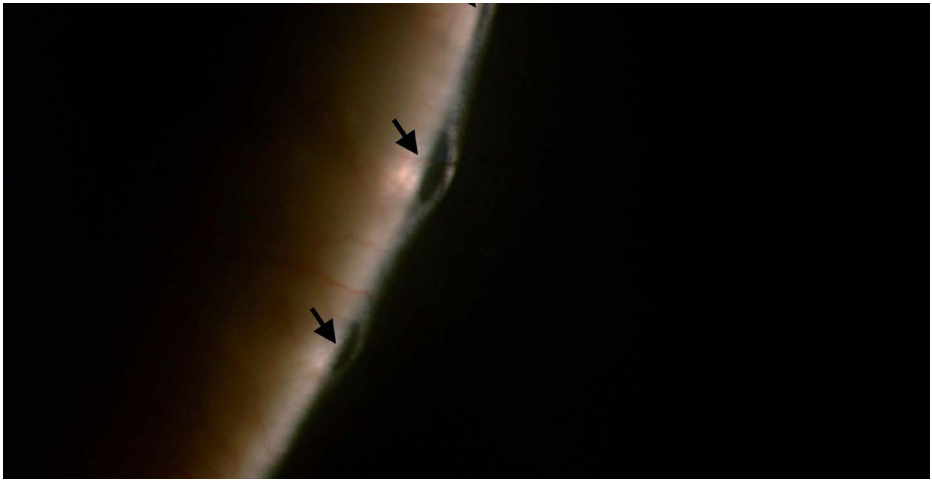

*Fig. 1b.*

**Answer 1**

Slit lamp examination revealed multiple conjunctival intraepithelial microcysts. As seen in Figure 1a, the parallelepiped illumination of the slit lamp shows a conjunctival intraepithelial microcyst. In Figure 1b, specular reflection technique of the microcysts shows the cross-section of tiny cystic vesicles present on the outer surface of the conjunctiva. The microcysts consist of various sizes of cystic cavities covered by a thin layer of conjunctiva with conjunctival vessels overlying it.

**Answer 2**

Conjunctival intraepithelial microcysts are associated with lower IOP and are an indicator of successful glaucoma surgery.[1-2] It is possible these microcysts act as mini-reservoirs for aqueous to leave the conjunctival vessels via the transconjunctival route.

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# In memoriam

## Dr. Zainal Mohamad (1959-2021) A cool pediatric ophthalmologist and skillful refractive surgeon

Dr. Zainal Mohamad

Dr. Zainal Mohamad passed away on February 7, 202, at the age of 61 due to complications of Covid-19. He was born on August 9, 1959 in Kajang, Selangor. He played the trombone and was a pragmatic debater during his schooling years in St. John Secondary School, Kuala Lumpur. He pursued his medical degree in Universiti Kebangsaan Malaysia (UKM), where he graduated in 1985. He fell in love with ophthalmology in his undergraduate days and pursued his specialty degree in ophthalmology in the same institution. He then became a medical lecturer and ophthalmologist in the Department of Ophthalmology, Faculty of Medicine, UKM in 1991. Seven years later he challenged himself again by pursuing a subspecialty training in pediatric ophthalmology in Nottingham, United Kingdom. He was one of the pioneering pediatric ophthalmologists in Malaysia.

He was a passionate teacher, always willing to help his students. An excellent motivator to many and always full of wisdom.

*His passion and commitment to do whatever it took to help his trainees was amazing. He was a great asset to Hospital Universiti Kebangsaan Malaysia and an excellent resource to his students. He worked hard and was always willing to put in the extra mile if the situation called for it. I am deeply grateful to have been his student and appreciate everything he did to help me complete the training program successfully.*

**Dr. Mohd Yusof Ismail**
**Ex-student of the MSurg (Ophthal) program**
**Yusof Eye Specialist**

Subsequently, he joined Tun Hussein Onn National Eye Hospital (THONEH) in 1999. His passion for teaching continued in this new role. He continued to motivate and encourage others, including optometrists, in THONEH. His easygoing personality made him popular among colleagues and staff. He was tasked to lead THONEH in 2015.

*Indeed, I can say that I have known Dr. Zainal Mohamad in more ways than one and can be proud to have been associated with this great man who was quiet, pleasant, unassuming, and always willing to take over any responsibilities when asked. I feel a vacuum at the workplace without Dr. Zainal Mohamad.*

**Dr. Pall Singh**
**Senior consultant ophthalmologist**
**Tun Hussein Onn National Eye Hospital**

He was ever willing to share his experience and advice with many young ophthalmologists, helping to shape their career in many ways.

*I remember telling him my anxiety and fears around starting my private practice; he reassured me and continued to support me. I still can clearly remember on one of our outreach programs in Keningau, Sabah he taught me the skills of managing patient expectations, especially for refractive surgeons, which is something I still practice to this very day. What really surprised me was his humility, always smiling even when things were not going the way he expected, such as in complicated cases. No doubt I will miss him. May his soul be placed among Prophets, martyrs, and the pious. Aameen.*

**Dr. Muiz Mahyudin**
**Consultant ophthalmologist**
**Tun Hussein Onn National Eye Hospital**

He served at THONEH for more than two decades. He shall be missed not only by his colleagues but also by his patients. He left behind his beloved wife, Puan Wahidah binti Othman (a retired head nurse in Institute Jantung Negara), three children, and four grandchildren. His son is also a medical doctor.

*He was the best father to us and a loving husband to my mother. A man of few words but full of practical action. He expressed love by his responsible actions rather than words. His most treasured advice was to be someone who always did well unto others with good deeds regardless of what you do in life. I miss him more than before. May Allah forgive all his sins, make his grave spacious, and place his soul in the highest place.*

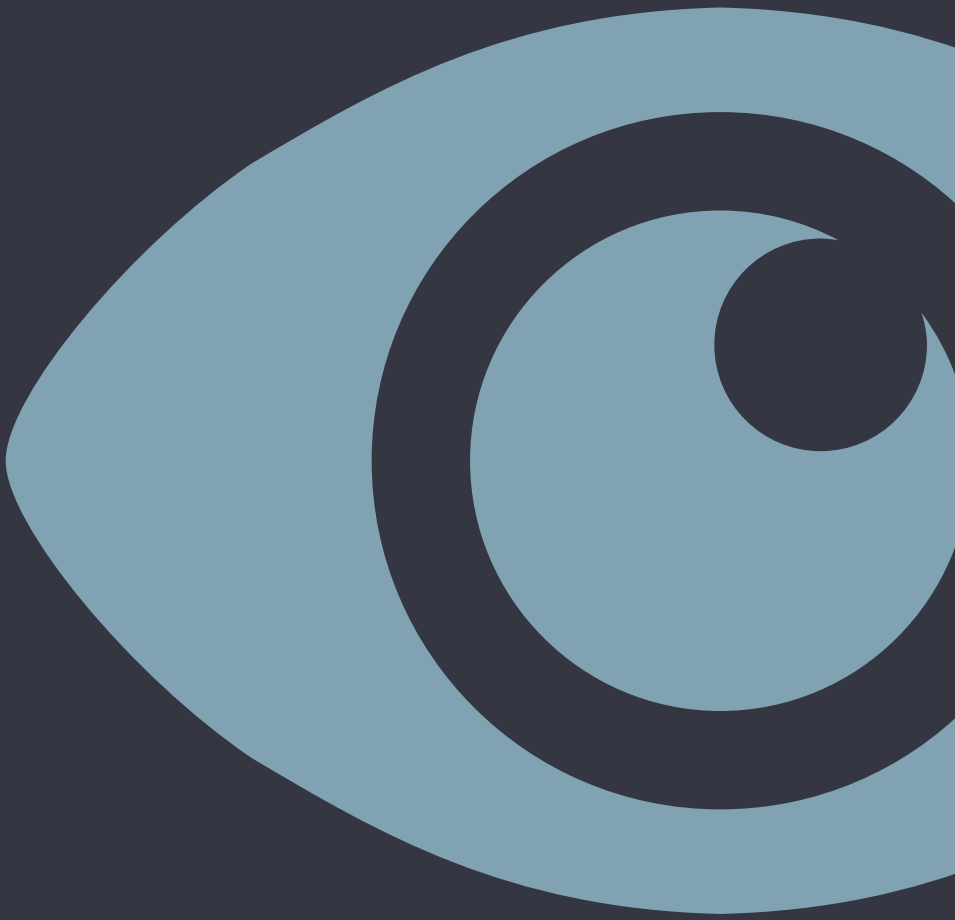
**Dr. Muhammad Aiman Zainal**
**Occupational health doctor**
**Pusat Darah Negara**

The Malaysian ophthalmology fraternity lost a great member. May his soul rest in peace. May Allah grant him Jannah. Aameen.

Dr. Zainal Mohamad, Dr. Muiz Mahyudin, and other young budding ophthalmologists.


Dr. Zainal at the wedding of a young trainee.

Dr. Zainal with his family.



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