



## Ocular tuberculosis in Hospital Universiti Sains Malaysia – A case series

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### ABSTRACT

**Introduction:** Ocular tuberculosis (TB) encompasses a broad spectrum of clinical manifestations affecting different structures of the eye. It is caused by *Mycobacterium tuberculosis*, a great ancient organism that induces various types of diseases and unfavorable outcomes if unrecognized and not well treated.

**Purpose:** To report the clinical profile of 34 ocular TB cases observed during 6 years period in Hospital Universiti Sains Malaysia (HUSM).

**Method:** A retrospective review of medical records from 34 patients diagnosed with ocular TB in HUSM from January 2011 until December 2016.

**Results:** The mean age was  $43 \pm 14.6$  years old. Both male and female affected in about 1:1 ratio. The majority of subjects were local Malays (91.2%). Risk factors included previous contact with pulmonary TB patients (38.2%), and patients with underlying diabetes mellitus (26.5%). Most patients showed normal chest radiography (79.4%). However they had positive Mantoux test (94.1%) and raised erythrocyte sedimentation rate (ESR) value (58.8%). Uveitis was the most common ocular manifestation of ocular TB (70.6%) while the rare ocular manifestations included optic perineuritis and optic neuritis, orbital apex syndrome, orbital cellulitis, sclerokeratitis, corneal ulcer and conjunctival abscess. All patients responded well to anti-TB treatment, but visual outcome was variable.

**Conclusions:** This review shows the diverse entity of ocular TB spectrum in an endemic area. Good clinical response to anti-tuberculous therapy supported the presumed diagnosis of ocular TB in majority of the cases.

### 1. Introduction

Tuberculosis (TB) is a well-known disease existed since ancient times. It causes significantly high rates of morbidity and mortality worldwide due to its infectivity and the hypersensitivity incited in an infected host. The World Health Organization (WHO) estimated 9.6 million incident cases of TB globally in 2014 [1]. Men were infected in 56% of the cases, 33% in women and the remaining 10% occur among children population [1].

The burden of TB disease in a country is reflected in terms of incidence of newly detected and relapse cases, the prevalence and the significant morbidity leading to death of TB patients [1]. A new list of high burden countries (HBC) was announced by WHO in 2015 [1]. Malaysia is surrounded by HBC, mainly Indonesia, Thailand, Myanmar and Vietnam. A substantial influx of foreign-born workers from these countries has led to continuously rising number of new TB cases in Malaysia [2,3]. According to an unpublished statistic TB incidence in Malaysia in 2014, the highest number of reported cases was from Selangor (65%) and Kelantan (25%). Selangor is a state with high

population density, a mixture of locals and foreign workers whereby Kelantan has large numbers of immigrants from Thailand and Myanmar.

TB generally affects the lung, but also affects other organ. Ocular TB is one of the extra-pulmonary manifestations of TB. Spectrum of ocular TB is diverse, affecting any part of the adnexa, different layers and structures of the globe, orbital contents, optic nerve to the orbital apex posteriorly [4]. The most common manifestations are granulomatous uveitis. It results from secondary haematogenous dissemination of bacteria via extensive uveal and choroidal vasculature [5]. Rarely, ocular TB may be primary as a result from direct inoculation and entry of the *Mycobacterium* into ocular surface [5]. A delayed hypersensitivity reaction to the *Mycobacterium* protein also account for the pathogenesis of the disease [5]. The aim of this case series is to review the clinical and laboratory profiles, and ocular manifestation of ocular TB patients in an endemic area, specifically in Hospital Universiti Sains Malaysia (HUSM). The work has been reported in line with the PROCESS criteria [6].

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## 2. Materials and methods

This is a retrospective single-centre case series of ocular TB in HUSM from January 2011 until December 2016. HUSM is a tertiary referral centre and a teaching hospital in Kelantan, at the east coast region of Peninsular Malaysia. It has a total number of 774 beds with 72% bed occupancy rate and caters about 33,000 outpatients monthly.

We reviewed the list of notified TB cases under respiratory-TB clinic follow-up during this 6 years period and patients diagnosed with ocular TB were included in the review. Demographic data of patient's age, gender and race was collected. We reviewed their medical records and documented all clinical data in a confidential manner.

All patients underwent both ophthalmic and medical evaluation. Ophthalmic evaluation included best-corrected visual acuity (BCVA), Goldman applanation tonometry, gonioscopy and slit-lamp examination for anterior segment and fundus. Anterior segment imaging, fundus photography, B-scan ultrasonography, optical coherence tomography (OCT) of the macula and computed tomography (CT) scan of the brain was done in selected cases.

Patients presented with uveitis were investigated to exclude autoimmune diseases and other common infectious aetiology including sarcoidosis, toxoplasmosis and syphilis. They underwent a series of routine laboratory blood tests [peripheral blood count, calcium, sodium, potassium, chloride, liver enzymes, urea and creatinine, erythrocyte sedimentation rate (ESR), C-reactive protein, glucose, serum angiotensin-converting enzyme, rheumatoid factor, antinuclear antibody, anti-double-stranded deoxyribonucleic-acid (anti-dsDNA), complements (C3/C4) and toxoplasma serology] followed with sputum smear for detection of acid-fast bacilli (AFB), chest X-ray and Mantoux test. They were screened for human immunodeficiency virus (HIV) and syphilis. Cerebrospinal fluid analysis was done in a patient who had choroidal lesion and multiple cerebral abscess. Eye swab was taken in all patients who had eye discharge at presentation, and sent for culture and sensitivity test. Sample of pus and friable tissue from conjunctival abscess was also sent for culture. In patients with corneal ulcer, corneal scrapping specimen was sent for polymerase chain reaction (PCR) to detect presence of mycobacterial DNA. Tissue biopsy from conjunctival lesion was sent for histopathological examination (HPE) and TB PCR analysis. Biopsy of intraocular tissue or fluid was not done.

The diagnosis of presumed ocular TB made based on the ophthalmic findings and laboratory results. Once diagnosed by ophthalmologist, patients were referred to respiratory physician for further physical assessment. Any concurrent pulmonary or other extra-pulmonary TB manifestations were evaluated. Patients were then started on anti-TB therapy. Physician continued to follow up these patients for general body response and side effect of anti-TB drugs during intensive phase until completion of treatment. Ophthalmologist monitored the progress of the symptoms and managed the ocular complications accordingly. For all patients in this case series, treatment was started with broad spectrum topical antibiotic on the first visit to ophthalmology clinic. Corticosteroid therapy was administered after commencement of anti-TB therapy.

The collected data were then analyzed. Data with numerical variables were described as the mean and standard deviation, while categorical data were expressed by frequency (n) and percentage (%). Ethical approval is not required by our institution for reporting individual cases or case series. The consent to write and publish this retrospective observational case series was obtained from the Director of HUSM on behalf of all patients. This review of case series was conducted in accordance to Declaration of Helsinki for human research, registered under Research Registry (Researchregistry2768). The patient's personal identification and clinical data were kept confidential, and data were reported as collective information.

**Table 1**  
Demographic data of patients with ocular tuberculosis.

Variables	Frequency (n)	Percentage (%)
<b>Age (year)</b>		
Mean $\pm$ SD	43 $\pm$ 14.6	
Range	9–82	
<b>Age group</b>		
< 15	1	2.9
15–24	2	5.9
25–44	15	44.1
45–64	13	38.2
$\geq$ 65	3	2.9
<b>Gender</b>		
Male	19	55.9
Female	15	44.1
<b>Race</b>		
Malay	31	91.2
Chinese	2	5.9
Others * foreigner	1	2.9
<b>Comorbidities</b>		
Pulmonary TB		
● Treated	3	8.8
● On treatment	2	5.9
● Newly diagnosed	1	2.9
Diabetes mellitus	9	26.5
HIV	1	2.9
<b>TB contact</b>		
Yes	13	38.2
No	21	61.8

TB: tuberculosis, HIV: human immunodeficiency virus.

## 3. Results

There were 885 notified TB cases registered under respiratory-TB clinic HUSM during 6 years period, from January 2011 until December 2016 and 34 of them was diagnosed as ocular TB. This is approximately 3.84% from the total number of registered TB cases in HUSM.

The demographic data of the patients at time of diagnosis is illustrated in Table 1. The mean age was 43  $\pm$  14.6 years old (range 9–82). The highest percentage of ocular TB were among age group 25–44 years old (44.1%) and 45–64 years old (38.2%). Both group were equally affected in ocular TB. The ratio between male and female was about 1:1 with slightly higher percentage from male group (55.9%). Majority of the patients were local Malays (91.2%) and only 1 foreigner affected. Thirteen patients (38.2%) had history of contact with pulmonary TB (PTB), 3 had concurrent PTB, and another 3 patients were successfully treated for PTB in the past. We also noted 9 patients (26.5%) who had underlying diabetes mellitus and 1 patient with underlying HIV infection. Association with PTB and underlying comorbidities may be regarded as the risk factor for development of ocular tuberculosis.

TB in general is a great masquerader. The disease had tendency for unilateral manifestations as seen in 58.9% cases. Most cases (n = 27, 79.4%) had insidious onset and 13 of them had suffered the symptoms for more than 1 month. General ocular symptoms were reported by our patients such as redness, discomfort, photophobia and tearing. The most common ocular symptoms at presentation were blurred vision (76.4%) and eye redness (67.6%). Diplopia, proptosis, ophthalmoplegia, scotoma and metamorphopsia were the less common ocular presentation. Out of 29 cases reported of having first episode of the symptoms, only 7 patients presented within one week from the onset. Recurrent symptoms were observed in 5 cases (3 cases of conjunctivitis, 1 case of blepharitis and 1 case of orbital cellulitis) that had presented early, but was under-diagnosed and treated for other causes.

For majority of patients, the diagnosis of ocular TB was

presumptive, based on suggestive clinical features, positive Mantoux test (induration greater than or equal to 10 mm after 48–72 h) and high ESR (HUSM laboratory reference range: male 4–20 mm/h, female 10–28 mm/h, a cut-off  $\geq 25$  mm/h in both sexes was considered high for this case series). At the time of diagnosis, 79.4% of these patients showed normal chest radiography, but 58.8% had raised in ESR with mean value of  $35 \pm 33$  mm/h. There was one patient previously treated for PTB, who had fibrotic changes over one side of the lung, and noted to have active consolidation area on the contralateral lung. Meanwhile, chest X-ray of the HIV-infected patient showed miliary TB changes.

Positive Mantoux test (mean  $22 \pm 8.62$  mm) was seen in 94.1% of the cases. A confirmed diagnosis of ocular TB established when *Mycobacterium tuberculosis* (MTB) demonstrable. Out of 34 patients, one had sputum-smear positive for AFB and another one patient had sputum-smear positive for nontuberculous mycobacteria. Two patients had atypical presentation, one case of corneal ulcer and the other one was conjunctival abscess. Both of them did not respond to topical antibiotic and antifungal treatment, therefore further investigations were carried out. A repeated corneal scraping specimen was sent for PCR and revealed positive for MTB. The organism was also found in the smear of inflamed friable conjunctiva of the conjunctival abscess. In another patient with conjunctival lesion, HPE from the tissue biopsy showed non-caseating granuloma and TB PCR was negative, but patient clinically improved with anti-TB therapy. Details of the clinical and laboratory profiles of the patients are shown in Table 2.

The spectrum of visual disturbances varied. We classified vision impairment into 2 main groups to reflect the severity of vision loss in the affected eye; BCVA equal or better than 6/60 (no vision impairment, mild and moderate vision loss) and BCVA worse than 6/60 (severe and profound vision loss). At presentation, we noticed 22 out of 48 eyes that affected by the disease already had severe visual impairment. The vision observed at 1-year (in patients completed treatment) and during last follow-up (in defaulted/deceased patients) showed BCVA equal or better than 6/60 in 30 eyes, whilst the remaining 18 had profound vision loss.

The ocular manifestations of ocular TB is shown in Table 3. Uveitis accounts for 70.6% of the cases (24 patients) involving 35 eyes. Rare manifestations of ocular TB included conjunctival abscess, subconjunctival granuloma, corneal ulcer, sclerokeratitis, rubeosis iridis, optic perineuritis, optic neuritis, orbital apex syndrome and orbital cellulitis. The 2 cases of rubeosis iridis presented with hyphema and raised intraocular pressure (IOP).

In this case series, panuveitis was the most common type of TB uveitis (51.4%), followed by anterior uveitis (25.7%). Granulomatous anterior uveitis with characteristic mutton-fat keratic precipitates (KPs) (Fig. 1) was observed in 9 cases out of 17 who had KPs. Posterior uveitis were mostly manifested as vitritis, choroiditis, retinitis and vasculitis. Choroidal tuberculoma and snowbanks were seen in 2 cases, each. The anatomical classification of TB uveitis is shown in Table 4.

All patients were co-managed with TB-physician. Anti-TB therapy was given in 6–12 months duration with 2 months of intensive phase. A standard treatment regime of ethambutol, isoniazide, rifampicin and pyrazinamide (EHRZ) prescribed to 30 patients, while another 4 patients received streptomycin, isoniazide, rifampicin and pyrazinamide (SHRZ). Revised treatment was done in a patient with active pulmonary lesion, following detection of *nontuberculous mycobacteria* in the sputum culture. For the side effects of anti-TB therapy, we observed 2 cases of transaminitis caused by ethambutol and they were managed closely by the physician. There was no reported case of toxic optic neuropathy or multiple drug resistant among ocular TB patients receiving ethambutol in this case series.

Patients also received concomitant topical corticosteroid and cycloplegic eye-drops to control inflammation in the eyes. Twenty-three patients (67.6%) were given oral steroid with initial dose of 1 mg/kg/day for 4 weeks duration, which was then gradually tapered. Majority

**Table 2**  
Clinical and laboratory profiles of ocular tuberculosis.

Clinical Profile	n (%)	Laboratory Profile	n (%)
<b>Presenting Symptoms</b>		<b>ESR value (mm/hour)</b>	
Blurred Vision	26 (76.4)	< 25	14 (41.2)
Redness	23 (67.6)	> 25	20 (58.8)
Eye Discomfort	19 (55.9)		
Eye pain	15 (44.1)	<b>Mantoux test (mm)</b>	
Photophobia	12 (35.3)	Negative (< 10)	2 (5.9)
Floaters	7 (20.6)	Positive	32 (94.1)
Tearing	5 (14.7)	● 11–20	22 (64.7)
Scotoma	3 (8.8)	● 21–40	10 (29.4)
Metamorphopsia	3 (8.8)	● > 40	1 (2.9)
Proptosis	2 (5.9)	● With blisters	1 (2.9)
Ptosis	2 (5.9)		
Diplopia	1 (2.9)	<b>Chest radiography</b>	
		Normal	27 (79.4)
<b>BCVA*</b>		Lung fibrosis (old PTB)	3 (8.8)
At presentation		Consolidation (active PTB)	3 (8.8)
● equal or better than 6/60	26 (54.2)	Miliary TB	1 (2.9)
● worse than 6/60	22 (45.8)		
At 1-year/ last follow-up		<b>Positive <i>Mycobacterium tuberculosis</i></b>	
● equal or better than 6/60	30 (62.5)	Corneal specimen (PCR)	1 (2.9)
● worse than 6/60	18 (37.5)	Conjunctival specimen (smear)	1 (2.9)
		Sputum (smear)	1 (2.9)
<b>Duration of symptoms</b>			
Less than 1 week	7 (20.6)		
Up to 1 month	14 (41.2)		
Between 1 to 6 months	11 (32.4)		
More than 6 months	2 (5.9)		
<b>Onset of disease</b>			
Acute	7 (20.6)		
Insidious	27 (79.4)		
<b>Course of disease</b>			
First episode	29 (85.3)		
Recurrent	5 (14.7)		
<b>Laterality</b>			
Bilateral	14 (41.2)		
Unilateral	20 (58.9)		

TB: tuberculosis, PTB: pulmonary TB, ESR: erythrocyte sedimentation rate, PCR: polymerase chain reaction, BCVA\* - best corrected visual acuity of 48 eyes affected from 34 patients.

patients were able to follow and complete the anti-TB therapy as directed; in 6 months (n = 8, 23.5%), 9 months (n = 11, 32.4%) and 12 months (n = 8, 23.5%). There were 4 cases of non-compliance who only completed their 1 month of intensive therapy and refused further treatment. Three of them continued topical corticosteroid eye-drop instillation and clinical recovery seen within first 6 months. Another one patient did not turn up for follow up and the final status was unknown. Out of 34 patients included in this case series, 3 died before completion of anti-TB, secondary to other causes not related to ocular TB and the treatment.

Based on documented BCVA at 1-year/last follow-up, profound vision loss was observed in 37.5% out of 44 eyes affected by the disease. The permanent visual impairment was due to complications. Complications of ocular TB in our case series, as illustrated in Table 5, included uveitic glaucoma, cystoid macular oedema (CMO), cataract, macular scar and retinal vein occlusion.

For management of the ocular complications, patients were counseled for medical and surgical treatment accordingly. In all 3 cases of CMO, they were treated with topical non-steroidal anti-inflammatory drugs (NSAIDs) eye-drop. Two patients had complete resolution while another one patient developed subsequent macular scarring and macular hole. Surgical intervention was carried out for managing cases

**Table 3**  
Ocular manifestations of ocular tuberculosis.

Ocular manifestations	Frequency (n)	Percentage (%)
Chronic blepharitis	3	8.8
Conjunctivitis	4	11.8
Conjunctival abscess	1	2.9
Subconjunctival granuloma	1	2.9
Corneal oedema	9	26.5
Keratitis (corneal ulcer)	1	2.9
Keratic Precipitates (KPs)	17	50.0
- Granulomatous	9	52.9
- Non-granulomatous	8	47.1
Sclerokeratitis	1	2.9
Iris nodules	4	11.8
- Koeppe nodules	2	50.0
- Busacca nodules	2	50.0
Synechia	16	47.1
- Posterior synechia	10	62.5
-Peripheral anterior synechia	3	18.8
- Seclasio pupillae	3	18.8
Uveitis	24	70.6
- Anterior chamber cells	22	91.7
- Flare/fibrin	6	25.0
- Vitritis	11	45.8
- Choroiditis	8	33.3
- Retinitis	6	17.6
- Vasculitis	6	17.6
- Choroidal tuberculoma	2	8.3
- Snowbanks	2	8.3
Rubeosis	2	5.9
Optic Neuropathy	9	26.5
- Optic Perineuritis	2	22.2
- Optic Neuritis	1	11.1
- Papillitis	6	66.7
Orbital apex syndrome	2	5.9
Orbital Cellulitis	1	2.9



**Fig. 1.** Left eye showed diffuse mutton-fat keratic precipitates on corneal endothelium with fibrin in anterior chamber.

with cataract as well as secondary glaucoma that was not optimized with medical treatment. Cataract surgery was generally difficult due to 360° posterior synechia and high IOP. Filtering surgery was performed

**Table 4**  
Anatomical classification of uveitis in ocular tuberculosis.

	Frequency of eyes involved (n)	Percentage (%)
Anterior uveitis	9	25.7
Intermediate Uveitis	2	5.7
Posterior Uveitis	6	17.1
Panuveitis	18	51.4

\*Uveitis observed in 24 patients which involved 35 eyes.

**Table 5**  
Ocular Complications of ocular tuberculosis.

	Frequency (n)	Percentage (%)
Glaucoma	10	29.4
Cystoid macular oedema	3	8.8
Cataract	3	8.8
Macular scar	1	2.9
Retinal vein occlusion	1	2.9

in conjunction with maximum medical therapy to control the high IOP in 50% of patients with secondary glaucoma. Severe inflammations noted post-operatively for both surgeries. They required prolonged both topical eye-drop and oral corticosteroid therapy, but the visual outcome remain unchanged.

#### 4. Discussion

TB is a notifiable disease in Malaysia. All diagnosed cases of pulmonary and extra-pulmonary TB must be notified by the attending physician. It is important to know the latest trend of the disease to increase awareness among general populations and medical personnel in preventing and limiting the mycobacterial transmission. To our knowledge, there is limited data regarding ocular TB in Malaysia. This case series shows various manifestations of ocular TB and is beneficial to all general practitioners, public health and medical personnel, as well as for the community living in endemic TB area.

Ocular TB is often unilateral and asymmetric [4] as seen in 58.9% of our case series. This finding matched to an observation done in a tertiary centre in Philippine, in which all 7 cases of ocular TB in active pulmonary TB patients had unilateral manifestation [7]. Extensive literature reviews reported ocular TB in the form of uveitis frequently has insidious onset, persistent and runs a chronic course. Patient might experience the symptoms for weeks to months before the disease become apparent and visually disturbed. However in patients with tuberculous optic neuropathy, the onset of disease is acute and visual impairment occurs early.

It is difficult to detect and diagnose ocular TB in early phase, unlike the other form of extra-pulmonary TB. This partly because low index of suspicion among general physicians in treating patient with ocular symptoms at primary centre. As mentioned in Table 2, the commonest presenting symptoms were blurred vision associated with eye redness, discomfort, and pain which is always mistaken for dry eyes and conjunctivitis. A complaint of subtle blurred vision is always neglected, thus referral to ophthalmologists often delayed.

No consensus has been made so far for the investigations of ocular TB as well as for the definitive treatment course and duration [8,9]. It is difficult to obtain microbiologic evidence through procedures such as vitreous aspiration, aqueous paracentesis, or retinal biopsy especially in an inflamed eye. They are not routinely done by ophthalmologists worldwide in view of low sample volume obtained, and the inflammation may worsen after such procedures. According to available data in literature, intraocular fluid study does not increase the yield and probability to demonstrate the organism. Special investigations like PCR and Gold TB-quantiferon tests provide more sensitive and specific

results [10] but expensive. They also require longer processing time before the actual result ready. This is the reason why such valuable investigations have not yet gained popularity in endemic –TB countries.

For vast majority of ocular TB, the diagnoses are presumptive. Ophthalmologists realized that presumptive diagnoses are inadequate. However any further delay in starting anti-TB drugs when it is most likely TB aetiology, can compromise the vision permanently. Our centre employs the same diagnostic criteria used internationally to establish probable diagnosis of ocular TB. Positive history of TB contact, positive chest x-ray findings, positive Mantoux test in the suspicion range, a significant high ESR and granulomatous ocular signs on slit lamp examination are the diagnostic criteria of ocular TB, especially TB-uveitis [9,11]. Mantoux test is not specific yet it is the most feasible, relatively inexpensive test and still considered as mandatory investigations for TB. Furthermore, the diagnosis of ocular TB is not solely on positive mantoux test, but clinical features of granulomatous infections and laboratory results counts. It is also not mandatory for all ocular TB patients to have active pulmonary and systemic disease. The absence of clinically evident active pulmonary TB lesion does not exclude the possibility of ocular TB. In a study among 103 extra-pulmonary TB patients, Herath and Lewis reported 27 of them had normal CXR with two smear positive sputum cultures [12]. It is evidenced by 79.4% of cases (27 patients) having normal chest radiography in our case series.

Most of the literature available worldwide mentioned the commonest form of uveitis in ocular TB is posterior uveitis with predominant lesions on choroid [4,6,13]. In an observation among 158 patients diagnosed with presumed intraocular TB in India, 42% had posterior uveitis followed with anterior uveitis in 36% of cases [13]. However, the clinical presentation in our patients was predominantly panuveitis (51.4%) and choroidal tuberculoma was only seen in 2 cases [14,15].

We observed 9 cases of tuberculous optic neuropathy which included optic perineuritis [16], papillitis and optic neuritis. The spectrum is wide and requires careful clinical evaluation with CT-brain assesment. A comprehensive study among neuro-ophthalmologist and inflammatory eye disease specialists involving data from 9 countries revealed the wide spectrum of tuberculous optic neuropathy as papillitis, neuroretinitis, optic nerve tubercle, compressive optic neuropathy, retrobulbar neuritis, optic neuritis and anterior ischemic optic neuropathy [17].

WHO reported the risk of developing TB in HIV infected person is between 26 and 31 times greater than those without HIV infection [1]. There were 8 immunocompetent patients with ocular TB reported from our institution in between 1994 and 2004 [18]. In this current review, we noted one case of miliary TB in an HIV-infected patient presented with bilateral optic neuritis [19]. She received concomitant treatment of highly active anti-retroviral therapy (HAART) and completed anti-TB but no improvement in vision [19].

In general, ocular TB can be regarded as a blinding condition. Posterior segment involvement is almost always associated with higher risk of vision threatening condition. We observed variable visual outcome in this case series. The causes of poor vision and permanent visual loss were posterior segment and optic nerve involvement at time of diagnosis, association with orbital apex syndrome and secondary complications of the ocular-TB.

## 5. Limitations

This case series has several limitations. Patients did not undergo the same laboratory tests and the treatment was not standardized. Confirmatory tests were only done in selected cases and we are not able to minimize bias at this stage. Treatment duration with anti-TB varied in regards to patient's response, drug toxicity and different doctors review.

## 6. Conclusions

In this retrospective case series, we provided detailed demographic data, various ocular symptoms at time of presentation, a broad spectrum of clinical manifestations and the complications of ocular TB. We hope that this could help for careful evaluation of patients with ocular symptoms, early referral to the experts, promptly diagnose and proper management to improve prognosis of the disease.

Despite medical advances, TB will continue to cause a major problem to the global health system. It is important to have a high index of suspicion in any ocular symptoms amongst population of endemic TB country. Any delay in the diagnosis of ocular TB especially tuberculous uveitis and optic neuropathy may result in permanent blindness.

## Ethical approval

Ethical approval is not required by our institution for reporting individual cases or case series.

## Author contribution

Shahidatul-Adha Mohamad – study design, data collection, data analysis and writing paper.

Zunaina Embong – study design, data analysis, writing paper.

Liza Sharmini AT, Wan Hazabbah WH, Shatriah I, Mohtar I, Azhany Y, Adil H – data analysis and discussion.

## Conflicts of interest

No conflicting relationship exists for any author, and we have no financial interest in this manuscript.

## Research registry

UIN: Researchregistry2768.

## Guarantor

Shahidatul-Adha Mohamad.

Zunaina Embong.

## Consent

The consent to write and publish this retrospective case series was obtained from the Director of HUSM on behalf of all patients. This case series however does not contain any personal information that could lead to the identification of the patient.

## Disclosures

All authors have no conflict of interest.

All authors attest that they meet the current ICMJE criteria for "Authorship".

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