CASE REPORT

A case report of recurrent pterygium in a paddy farmer following occupational risk exposure to solar radiation

Hanizah Mohd Yusoff, PhD[1], Norfaqihah Mohtar, MPH[1], Hanis Ahmad, MPH[1], Muhammad Zakwan Ilias, MD[2]

[1]Department of Public Health Medicine, Faculty of Medicine, Universiti Kebangsaan Malaysia, Malaysia, [2]Department of Ophthalmology, Hospital Tuanku Ampuan Najihah, Kuala Pilah, Negeri Sembilan, Malaysia

SUMMARY

Occupational-related pterygium, specifically among paddy farmers, was rarely discussed in the literature. However, given that they are outdoor workers exposed to direct solar ultraviolet, which is known to induce pathophysiological pterygium formation, the risk of pterygium development cannot be disregarded. To date, there is no standard assessment guideline for the ocular exposure hazards of Malaysian outdoor workers to prevent chronic eye diseases. We reported a case of recurrent left-eye pterygium due to chronic occupational ultraviolet radiation (UVR) exposure during paddy cultivation. This case report provides in-depth insight and valuable information regarding risk assessment and management for outdoor workers, particularly paddy farmers.

INTRODUCTION

Pterygium is a chronic eye disorder mainly induced by long-term exposure to solar ultraviolet (UV), particularly among outdoor workers.[1] Globally, extremely high UV-risk countries had the highest prevalence of pterygium, accounting for up to 52%, followed by very high UV risk (30.8%), high UV risk (9.4%), and moderate UV risk (up to 7.1%).[1] While solar UV radiation (UVR) has long been recognised as a major risk factor for pterygium, it remains under-researched in occupational fields, especially among paddy farmers. A similar issue was found in Malaysia. This case report focused on the case of a paddy farmer with recurrent left eye pterygium with a history of chronic exposure to solar UVR in rural West Peninsular Malaysia. This is a preliminary case report of occupation-related pterygium in this country. The findings reported here provide information on establishing ocular risk assessment.

CASE PRESENTATION

A 59-years-old Malay woman complained of painless left eye discomfort and gradual poor vision for 6 months. She denied eye redness, swelling, itching, irritation and floaters. The patient had initially noticed an elevated lesion of her left eye, which was presumably due to recurrent pterygium tissue growth approximately 2 years ago. In 2017, she was diagnosed with bilateral pterygium, where she underwent left eye excision and conjunctival autograft due to blocked vision. Further investigation determined that she and her husband were farming a 5-acre paddy field situated on one of the regions on the western coast of the peninsular Malaysia. Her job responsibilities focused on the paddy growth process, which included pre-planting, growth and post-production. Her regular schedule included 3 days of duty and 1 day off, with a total of 4 to 6 hours of labour per day that included 1 to 2 hours of rest. Depending on the sun rising and setting in this reported region, her shift began between 7.30 am and 8.00 am which was around sunrise (7.30 am) and ended between 11.30 am and 3 pm which was around 5 to 8 hours before sunset (7.30 pm). She often wore a wide-brimmed hat but not sunglasses while performing her farming tasks. Otherwise, she denied possible UVR exposure caused by either previous employment or outdoor hobby activities. She also denied any eye trauma such as exposure to rice husk dust or episodes of hypersensitivity when working. On further history, she stated that her husband had also complained for years of bilateral vision blurring. Nonetheless, he had not sought treatment as his symptoms were mild and tolerable.

Slit-lamp examination revealed a fleshy nasal triangular membrane 4.6 mm away from the limbus covering part of the corneal pupillary area of her left eye. Her right eye showed right pterygium at the nasal side 2 mm away from the limbus, which was not significantly increased as compared to 5 years ago. Her corrected vision with spectacles was 6/36 (left eye) and 6/9 (right eye). Fundoscopy for both eyes were normal.

The workplace hazard assessment was conducted using solar UVR hazard assessment tool for ocular exposures (2007) from the International Labour Organisation (ILO), the International Commission on Non-Ionising Radiation Protection (ICNIRP) and the World Health Organisation (WHO) (Table I). [2] The calculation of this value was performed using the formula provided:

Ocular exposure factor = $(f_1) \times (f_2) \times (f_3) \times (f_4) \times (f_5) \times (f_6)$.

In the present case, as Malaysia is situated at an approximate latitude of 30ºN and experiences an average annual temperature of 25.4°C, which is comparable to the temperature observed during the summer season, the Geographical Latitude factor (Factor f_1) was assigned a score of 9. The score of 1.5 for Factor f_2 (cloud cover) determined that the workplace environment had partial clouds, sometimes covering the sun. The assigned score for the duration of exposure (Factor f_3) was 0.3, given that this

This article was accepted: 05 March 2024
Corresponding Author: Norfaqihah Mohtar
Email: faqihahmohtar@gmail.com

Table I: Hazard assessment factors for ocular exposure

Season	**Geographical latitude (Factor f_1)**		
	>50°N or S	**>30° - >50°N or S**	**<30°N or S**
Spring/summer	4	7	9
Autumn/winter	0.3	1.5	5
Cloud cover		**Factor f_2**	
Clear sky		1	
Partial cloud sometimes covering sun		1.5	
Overcast sky		0.8	
Duration of exposure		**Factor f_3**	
All day		1	
An hour or two around midday		0.35 – 0.5	
Four to five hours around midday			
Early morning or late afternoon		0.2	
Ground reflectance		**Factor f_4**	
Fresh snow		1.0	
Dry sand, sea surf, concrete		0.1	
All other surfaces, including open water		0.02	
Eyewear		**Factor f_5**	
None		1	
Sunglasses without hat		0.5	
Clear spectacles without brimmed hat		0.2	
Sunglasses or spectacles with brimmed hat		0.02	
Shade		**Factor f_6**	
No shade e.g., open fields, tundra, beach, ocean		1	
Horizon blocked by hills, housing, scattered trees		0.3	
Horizon and lower sky blocked by tall buildings/terrain		0.02	

patient had worked for approximately one and a half hours at midday. The ground reflectance (Factor f_4) score was 0.02, which represented 'all other surfaces'. The patient's score for the eyewear factor (Factor f_5) was 1 due to the patient's usage of sunglasses while working was infrequent. The shade factor (Factor f_6) assigned score was 1, representing open fields. Thus, by considering these risk factors, the ocular exposure factor value in this case is:

Ocular exposure factor = 9(f_1) x 1.5(f_2) x 0.3(f_3) x 0.02(f_4) x 1(f_5) x 1(f_6) = 0.081 (low)

Although her UV exposure risk was low (0.081), this value should be interpreted with caution, as the score was calculated based on perceived information from the patient's history and clinical findings. Considering her strong occupation-related clinical history and suggestive clinical findings, at the same time, other non-occupational causes for pterygium, which were infection symptoms, hobby, trauma and hypersensitivity, had been ruled out, the treating ophthalmologist diagnosed the patient with recurrent left eye pterygium secondary to chronic occupational solar UVR exposure. Successful excision of the left eye pterygium with conjunctival autograft under local anaesthesia was performed in June 2022. Nevertheless, further details about workplace management were not available in the patient's medical reports or from deep interviews with both the patients and the treating doctor.

DISCUSSION

To date, many epidemiological studies have reported the association between outdoor work and pterygium.[2–5] Several studies conducted in Asia reported significant findings between occupational pterygium prevalence and solar UVR exposure.[4-5] Studies conducted in Singapore suggested that occupational pterygium prevalence was 10.1 to 12.3%. [4-5] Unsurprisingly, a study in Thailand reported that more than 50% of respondents diagnosed with pterygium were farmers,[3] while Ang et al. reported that severe pterygium was detected only among outdoor workers.[4] These findings are predictable, as most Asian countries, including Malaysia, have extremely high ultraviolet index risk (UVI ≥ 11). Although recent local epidemiology data on pterygium among outdoor workers are not available, we strongly believe that the country faces a similar issue.

Our patient was notably involved in a high-risk occupation that exposed her to solar UVR, with cumulative solar UVR exposure, for approximately 25 years. Compared to other individuals who do not perform outdoor work, she was 20 times more likely to develop pterygium.[6] Consequently, the significant cumulative UVR exposure caused eye damage, which increased the likelihood of limbal stem cell and fibroblast proliferation and subsequently triggered the pterygium formation. Furthermore, UVR also induces proinflammatory cytokines, growth factors and matrix metalloproteinases, which promote the progression of pterygium.[6] The above path mechanism might possibly apply to both the patient's primary and recurrent pterygium growth.

Table II: Ultraviolet radiation exposure limits and relative spectral effectiveness

Wavelength[a] (nm)	Exposure limit (J.m^{-2})	Exposure limit (mJ.cm^{-2})	Relative spectral effectiveness S_λ
180	2500	250	0.012
190	1600	160	0.019
200	1000	100	0.030
205	590	59	0.051
210	400	40	0.075
215	320	32	0.095
220	250	25	0.120
225	200	20	0.150
230	160	16	0.190
235	130	13	0.240
240	100	10	0.300
245	83	8.3	0.360
250	70	7.0	0.430
254[b]	60	6.0	0.500
255	58	5.8	0.520
260	46	4.6	0.650
265	37	3.7	0.810
270	30	3.0	1.000
275	31	3.1	0.960
280[b]	34	3.4	0.880
285	39	3.9	0.770
290	47	4.7	0.640
295	56	5.6	0.540
297[b]	65	6.5	0.460
300	100	10	0.300
303[b]	250	25	0.120
305	500	50	0.060
308	1200	120	0.026
310	2000	200	0.015
313[b]	5000	500	0.006
315	1.0×10^4	1.0×10^3	0.003
316	1.3×10^4	1.3×10^3	0.0024
317	1.5×10^4	1.5×10^3	0.0020
318	1.9×10^4	1.9×10^3	0.0016
319	2.5×10^4	2.5×10^3	0.0012
320	2.9×10^4	2.9×10^3	0.0010
322	4.5×10^4	4.5×10^3	0.00067
323	5.6×10^4	5.6×10^3	0.00054
325	6.0×10^4	6.0×10^3	0.00050
328	6.8×10^4	6.8×10^3	0.00044
330	7.3×10^4	7.3×10^3	0.00041
333	8.1×10^4	8.1×10^3	0.00037
335	8.8×10^4	8.8×10^3	0.00034
340	1.1×10^5	1.1×10^4	0.00028
345	1.3×10^5	1.3×10^4	0.00024
350	1.5×10^5	1.5×10^4	0.00020
355	1.9×10^5	1.9×10^4	0.00016
360	2.3×10^5	2.3×10^4	0.00013
365[b]	2.7×10^5	2.7×10^4	0.00011
370	3.2×10^5	3.2×10^4	0.000093
375	3.9×10^5	3.9×10^4	0.000077
380	4.7×10^5	4.7×10^4	0.000064
385	5.7×10^5	5.7×10^4	0.000053
390	6.8×10^5	6.8×10^4	0.000044
395	8.3×10^5	8.3×10^4	0.000036
400	1.0×10^5	1.0×10^5	0.000030

[a]Wavelength chosen are representative; other values should be interpolated at intermediate wavelengths.
[b]Emission lines of a mercury discharge spectrum.

Our patient's likelihood of recurrent pterygium was possibly aggravated by her previous surgical history, although the detail was not clear. Several factors such as preoperative pterygium features (size, vascularity index, active growth of the pterygium), surgical factors (insufficient conjunctival graft size and inadequate peripheral dissection), postoperative graft retraction due to inadequate fixation, caruncle abnormality and genetic factors are also the factors of recurrent pterygium.[7-8] Furthermore, postoperative lesion is also a possibility, with greater extension of fibrovascular growth than its primary presentation depending on the preoperative condition and operative approach.[7] Therefore, we postulated that one of the above factors could be the underlying reason for the progressive unilateral pterygium growth in her left eye.

Despite her significant clinical history and suggestive clinical manifestations mentioned previously, the ICNIRP, ILO and WHO assessment tool[2] deemed that our patient had low UV risk. The tool has been recognised as the main reference for ocular hazard assessment in occupational fields to date. However, in certain instances, the UV risk assessment results might not be reliable, particularly for countries with tropical climates, as the tool was designed for temperate countries. As one of the elements used to determine UV risk assessment, the ground reflectance value must be carefully tailored to the employment environment. Due to the lack of a standard reflectance value, it was difficult to ascertain the value of the paddy field earth surface in the case. Therefore, we firmly believed that the discrepancy between the patient's risk assessment score and clinical history and manifestations was due to the limitations of the tool.

In Malaysia, ocular hazard assessment with an established assessment tool and the use of personal protective equipment (sunglasses or wide-brimmed hat) are uncommon practices, especially among paddy farmers, due to certain circumstances. For example, based on the ICNIRP guideline, the actinic UV (UV-B and UV-C) spectral region value is 180 to 135 nm on unprotected eyes within an 8-hour period (Table II).[2] Hence, the maximum safe UVR exposure in the tropics throughout the summer and under clear skies would be reached in approximately 6 minutes at solar noon.[2,9] However, determining an adequate UVR dose in a natural outdoor context is difficult for a number of reasons. For example, the brow ridge, the upper lid, squinting reactions and behavioural responses to sunshine limit the amount of UVR that reaches the eyes.[2,9] The amount of UVR exposure to the eyes might be significant when the sky is overcast because the eyelids are open widely.[9] Contrastingly, the retina is protected from direct sunlight when the person squints under clear skies, particularly when the sun angle > 10°. The fact that eyes are naturally drawn downward and forward during work presents another issue. Consequently, radiant energy from ground reflectance, rather than direct UVR exposure, dominates ocular exposure.[2,9] Given these considerations, it is likely impractical to adhere to the aforementioned exposure limit. Another option is to use the WHO Global Solar UVI, which is a simple tool for protecting against and preventing the dangers associated with solar UVR overexposure. Nevertheless, the tool does not provide useful information regarding a person's actual UV exposure. Instead, it is aimed at assessing the dangers of sun exposure for recreational purposes and to raise public awareness about the importance of taking precautions against UVR.

We firmly believe that prolonged UVR exposure and aggravation by surgical history were the main reasons for the pterygium recurrence in the present case despite the low solar UVR assessment score. Pterygium is also considered as an occupation-related disease because our patient was mostly exposed to solar UVR at her workplace, excluding other non-occupational risks such as family history, trauma, hypersensitivity and outdoor activity. To prevent negligence among outdoor workers, Malaysia requires a standardised national hazard assessment tool for workplace solar UV ocular exposure. A walkthrough survey is crucial to identify spatial and temporal factors to develop an effective risk assessment tool. A detailed work task is required via photographs or videos to observe details concerning the workplace, the exposed people, the existing engineering, administrative procedures and protective outfit practice.[2] Despite the recent growing interest in epidemiology studies on UV exposure in occupational medicine, analytical studies specifically involving paddy farmers remain limited in Southeast Asia. Although the role of UVR exposure in occupational pterygium has not been consistently reported, some evidence from previous studies strongly recommended that paddy farmers wear sunglasses and wide-brimmed hats to protect themselves from solar UVR hazards. Furthermore, appropriate solar UV protection was followed by a statistically significant decrease in pterygium recurrence.[10]

CONCLUSION

Our patient is an example of a recurrent pterygium case secondary to chronic occupational solar ultraviolet radiation (UVR) during paddy farming. To derive our conclusion, we considered certain occupational factors that increase the risk of recurrent pterygium, namely outdoor work in a high-solar UVR risk region and non-compliance with the use of self-protective equipment such as sunglasses. We also did not identify any other related causal factors such as history of trauma, hypersensitivity or possible UVR exposure outside the patient's occupational activities or hobbies. To date, Malaysia does not have a national standardised hazard assessment and management guideline for occupational ocular exposure. Although it has long been associated with occupational eye disease, occupational ocular exposure has received less attention from local medical professionals and other relevant parties. Hopefully, the new information in our case report will benefit the development of a standard hazard assessment for ocular solar UVR exposure among paddy farmers in Malaysia.

ACKNOWLEDGEMENT

The authors express their appreciation of the Hospital Tuanku Ampuan Najihah Department of Ophthalmology staff and the patient for their commitment and support of this study.

CONFLICT OF INTEREST

The authors declare no conflict of interest. Informed consent on patient participation in this investigation and publication of any data included in this article has obtained.

REFERENCES

1. Modenese A, Gobba F. Occupational exposure to solar radiation at different latitudes and pterygium: A systematic review of the last 10 years of scientific literature. Int J Environ Res Public Health 2018; 15(1): 7-10.
2. International Commission on Non Ionizing Radiation Protection (ICNIRP), International Labour Organization (ILO), World Health Organization (WHO). Protecting Workers from Ultraviolet Radiation. In: Vecchia P, Hietanen M, Stuck BE, van Deventer E, Niu S, Editors. International Commission on Non-Ionizing Radiation Protection; 2007: 31-68.
3. Artornsombudh P, Sanpavat A, Tinnungwattana U, Tongkhomsai V, Sansopha L, Tulvatana W. Prevalence and clinicopathologic findings of conjunctival epithelial neoplasia in pterygia. Ophthalmol 2013; 120: 1337-40.
4. Ang M, Li X, Wong W, Zheng Y, Chua D, Rahman A, et al. Prevalence of and racial differences in pterygium: A multiethnic population study in Asians. Ophthalmology 2012; 119: 1509-15.
5. Cajucom-Uy H, Tong L, Wong TY, Tay WT, Saw SM. The prevalence of and risk factors for pterygium in an urban Malay population: the Singapore Malay Eye Study (SiMES). Br J Ophthalmol 2010; 94(8): 977-81.
6. Coroneo MT, Di Girolamo N, Wakefield D. The pathogenesis of pterygia. Curr Opin Ophthalmol 1999; 10: 282-8.
7. Fernandes M, Sangwan VS, Bansal AK, Gangopadhyay N, Sridhar MS, Garg P, et al. Outcome of pterygium surgery: analysis over 14 years. Eye 2005; 19(11): 1182-90.
8. Penfold H. Case of pterygium crassum in both eyes, treated successfully by ligature and subsequent iridectomy. Br Med J 1876; 2(829): 651-2.
9. Sliney DH. Epidemiological studies of sunlight and cataract: The critical factor of ultraviolet exposure geometry. Ophthalmic Epidemiol 1994; 1(2): 107-19.
10. Murugia L, Chong KL, Lim LT, Alias R. Recurrent pterygium in Bintulu, Sarawak (Malaysian Borneo): determining its risk factors. Malaysian J Ophthalmol 2021; 3(1): 9-20.