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ORIGINAL ARTICLE

Solar Eclipse Retinopathy; an Underemphasized Public Eye Health Concern?

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ABSTRACT

Aim: To evaluate the impact of public eye health campaigns on people's attitudes during the solar eclipse.

Methods: Retrospective chart review of patients with solar eclipse retinopathy. Hazard awareness, source of information, and types of self-proclaimed safety measures were analyzed. It was a multicenter study conducted at Ophthalmology departments of different hospitals of Faisalabad, Gilgit, Sialkot and Dera Ismail Khan for one month from July 2020 to August 2020.

Results: Data of a total of 31 patients were analyzed. Twenty-two (71%) patients had hazard awareness either from the internet or mainstream media, while 9 (29%) had no understanding of eclipse viewing hazards. Eleven patients had some idea about appropriate eclipse viewing glasses while none used them. Thirteen (42%) patients didn't use any protective measures, while the rest either used radiographic films or sunglasses (SG). Knowledge, availability and affordability were significant barriers towards using standard safety wear. There was no difference among patients who viewed the eclipse with the naked eye or with sunglasses and radiographic films in terms of initial and final visual outcomes.

Conclusions: Most patients are aware of potential visual hazards from viewing solar eclipse; however, they are not well educated about appropriate ocular safety wear for viewing a solar eclipse.

Keywords: Solar eclipse, Retinopathy, Health concern

INTRODUCTION

Solar retinopathy is a well-described entity that describes retinal damage caused by solar rays affecting eyes after sungazing, solar eclipse viewing, sunbaths, and other activities that may cause direct macular exposure to sunlight.[1] Other types of photo retinal damage include welders maculopathy, operating microscope, and endoilluminator induced retinal injuries. All of these retinal phototoxicity occur when the retina's natural defensive and repair mechanism is swept over by intense light-induced rapid intraretinal photochemical reactions.[2]

Solar eclipse retinopathy is the most common form of solar retinal damage caused by direct sun viewing during an eclipse without appropriate ocular protection.[1] The primary mechanism involved in solar retinopathy is photochemical damage or thermally enhanced photochemical damage.[2, 3] Both photochemical and photothermal damage are initiated when photons of light are absorbed by retinal chromophores including melanin, hemoglobin, xanthophyll and other absorbers such as lipofuscin, rhodopsin, melanopsin ,cone-pigments, cytochrome c oxidase and porphyrins. Some of these molecules have absorption peaks at specific wavelengths, while others have a linear inverse relationship with wavelength (i.e., absorption spectra increase when wavelength decreases). Ultraviolet spectrum has a crucial role in triggering photochemical toxicity to the retinal tissue through several mechanisms, including oxygen-derived toxicity and free-radical damage.[2-6]

Outer retina, specifically retinal pigment epithelium(RPE) and photoreceptors, are more prone to photochemical damage. The absorbed photons of incident solar radiations excite electrons to higher energy states and extra energy is dissipated when electrons return to the ground state. It subsequently initiates a cascade of free radical formation (e.g., superoxide and hydrogen peroxide radicals), peroxidation of cellular lipids and proteins, disruption of lysosomes and thus tissue damage.[2, 7, 8, 4, 5, 3] The absorption spectrum of lipofuscin, which is found in RPE, increases steadily with decreasing wavelength and specifically causes RPE damage when exposed to UV light.[2, 9, 3]

Although asymmetrical solar retinopathy is almost always bilateral with a tendency for relatively more severe involvement of the dominant eye. Patients who suffer acute solar/ solar eclipse burns present with chromatopsia, metamorphopsia, blurred vision, photophobia and central/ paracentral scotomas. However, a significant number of patients may remain asymptomatic and retinal changes may be found incidentally during a routine ophthalmic exam. In most cases, visual acuity is mildly reduced (usually 20/40 to 20/60) but it may range from 20/20 to finger counting.[2, 10, 11]

Initially, the fundus may appear normal or has macular edema that gradually subsides, followed by a yellow-white foveal lesion surrounded by mottled dark pigmentation within a few days. The lesion gradually evolves over several weeks to months into a round, oval red foveal reflex. In almost all cases visual acuity improves gradually improves over time.[12, 13, 11, 14]

The visual acuity tends to improve over the course of disease with restoration of anatomy in most cases leaving behind variable degree of outer retinal changes that range from mild ellipsoid zone (EZ) and interdigitation zone (IZ) disruption to an outer retinal defect. The outer retinal defect is always associated with relatively poorer end visual function. Nonetheless, in most cases visual function improves to near normal; some experience small, permanent, central or paracentral scotomas.[9, 12, 15, 11, 14] Some authors have described visual and anatomical restoration with systemic corticosteroids.[16, 17] Interestingly, some cases developed central serous chorioretinopathy after treatment with corticosteroids.[18-20] Nonetheless, retinal structure and function tends to improve over time without treatment; and the evidence of benefit from corticosteroids is limited; administration of these agents may not be warranted.

Due to wider access to media and internet, public has been frequently updated about forthcoming solar and lunar eclipses through mainstream and social media in recent years. Consequently, the general public has become increasingly interested in observing and photographing the eclipses leading to an increase in the incidence of solar retinopathy. Despite mainstream and social media campaigns by eye care doctors and health authorities about the ocular hazards of eclipse viewing, the general public does not take these precautions. This report analyzes the barriers involved in using appropriate safety wear for solar eclipse viewing, including hazard awareness, knowledge about appropriate eclipse wear, and other related factors.

MATERIAL AND METHODS

In this study, we retrospectively reviewed the data of 31 patients with solar eclipse retinopathy from the past two solar eclipses in

Pakistan (26th December 2019 and 21st June 2020) visible in our region). Besides clinical data and the main drive for eclipse viewing, factors including awareness about solar eclipse hazards, protective eyewear, access and affordability are described. Visual acuity (VA) was converted from Snellen notation to decimal equivalent for analysis. Diagnosis of solar retinopathy had been established using clinical examination and optical coherence tomography (OCT). SPSS-24 was used to analyze data. Quantitative and normally distributed variables were expressed as mean +/-SD while counts (percentages) used to express proportions and numbers. Paired Sample t-test was used to compare baseline and final best corrected visual acuity(BCVA) while ANOVA was performed to compare VA across groups.VA across the groups was based on the type of protections used during eclipse viewing. A p value of <0.005 was considered significant.

RESULTS

Of 31 patients, 22 (71%) were male and 9 (29%) were female with a mean± SD age 21.4±5.7 years. The drive behind viewing an eclipse was curiosity in 18 (58.1%) and photography among 13 (41.9%). Nine (29%) patients were not aware of the hazards of eclipse viewing, whereas 9 (29%) received information from television/ media and 13 (41%) through social media and internet.

Table 1 shows the demographics, source of information, protections used and barriers involved in use of appropriate protective wear.

	None	Social Media	TV/ Media
N (%)	9	13	9
M/F	6/3	10/3	6/3
Protection Used None/SG/X-ray	9/0/0	4/3/6	0/6/3
Barriers			
Awareness	9	7	3
Affordability	0	0	3
Availability	0	6	3

Of 22 patients who had some hazard awareness, 10 (45.5%) did not know about appropriate protective filters, while 12 (54.5%) had some idea of such filters.

More people from the social media group (n=7, 70%) than the TV/media group (n=3, 30%) did not know appropriate protective filters.

Nonetheless, lack of clear knowledge about appropriate protective filters, availability and affordability were significant barriers towards the use of proper protective filters in 19 (61%), 9 (29%) and 3 (10%) patients, respectively.

Overall, 13 patients (42%) viewed the eclipse through the naked eye (or corrective wear), while X-ray films and sunglasses were used by each of 9 patients (29%).

None of the patients from the TV/media group, while 1/4th from social media groups (n=4, 30.8%) had viewed the eclipse through the naked eye. All patients from the no hazard awareness group (n=9, 100%) viewed the eclipse with the bare eye.

Half of the patients from the social media group (n=6, 46%) compared to 1/3rd from TV/media group (n=3, 33%) had used X-ray films to view the eclipse. In contrast, most patients in the TV/media group used sunglasses (n=6, 66.7%) compared to less in the social media group (n=3, 23%).

Overall baseline VA was 0.63±0.18 decimals and final VA was 0.80±0.18. There was a significant change in VA from baseline with mean difference of 0.18±0.14 decimals [t=10, P<0.001]

Impact Of Protection Type On Visual Function: The mean ±SD baseline VA in no protection, sunglasses and x-ray film groups was 0.64±0.2, 0.62±0.22 and 0.61±0.08 decimals respectively. There was no statistically significant difference in baseline VA between three groups [F (2,59=0.17, P= 0.84]

Final VA over a mean ±SD follow up period of 6.48±1.9 (range 3- 9) months was 0.81±0.19, 0.75±0.13 and 0.86±0.21 decimal in no protection, sunglasses and X-ray film group. There was not any significant statistical difference between the 3 groups in terms of final visual acuity [F (2,59) =1.88, P=0.16]. (**Figure 1)**

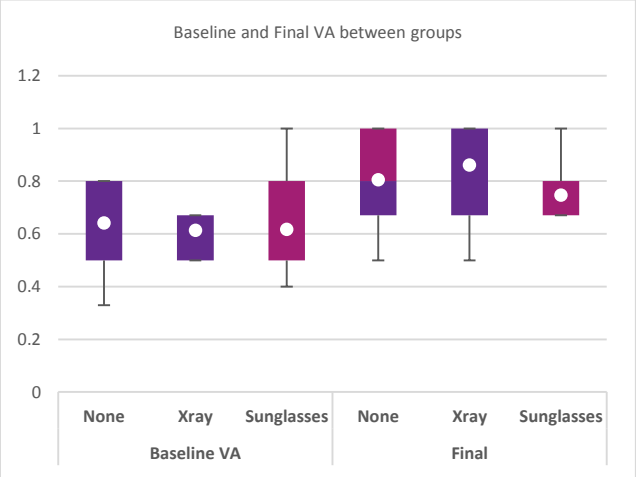

Figure 1: Shows baseline and Final VA across 3 groups

DISCUSSION

Solar eclipse retinopathy is one of the most common forms of retinal phototoxicity.[1, 2] Other related disease entities that partake a common etiopathogenesis include retinal damage from sungazing, laser pointer maculopathy, welder maculopathy, high altitude climber retinopathy and operating microscope induced retinal injury.[2]

Since most individuals won't seek medical attention unless symptomatic; it is challenging to determine accurate incidence of the disease in developed countries. Lack of awareness, eye care facilities and financial barriers are additional factors that hinder the correct estimation of the epidemiology of solar damage in developing and undeveloped countries. Most of the available data on the incidence of solar retinal hazards is from Europe and America. An extensive literature search about the incidence of solar maculopathy did not return any data from south Asian countries except Nepal and Pakistan.[21-23] However, these studies are clinical studies describing clinical signs and patterns and no information about the prevalence or incidence could be obtained.

Despite active social media and mainstream media campaigns by doctors and health authorities, public have a tendency to watch solar eclipse either because of curiosity and amusement or for photography. Most of the general population has awareness about hazards of watching solar eclipse to their ocular health but majority do not have a clear idea about the appropriate filters. It is worth stating that people, in general, from developing and underdeveloped countries have availability and/or financial constraints when it comes to buying eclipse viewing glasses. They look for other alternatives like sunglasses, polarizing filters and Do It Yourself (DIY) methods to make solar eclipse viewers. Use of X-ray films to watch an eclipse has been a common practice in our population. In the current study, initial visual insult and final visual outcomes were similar among all the patients who watched the eclipse without any kind of self-proclaimed protective filters suggesting that such measures do not provide any safety at all. Alternatively, people using such inappropriate filters may apt watching eclipse for extended periods because of a misconceived safety, leading to tissue damage comparable to that with naked eye. Nonetheless, none of these patients could provide a close estimation of an eclipse viewing time beyond statement "a few seconds". It is desirable to discourage viewing eclipse directly using methods other than standard eclipse viewing glasses.

Our data suggests that eclipse hazard and safety campaigns on social and mainstream media do not convey the message

effectively and do not effectively emphasizing lasting damage to visual function and retinal tissue. Further, educating public about appropriate and recommended filters and discouraging use of DIY measures, sunglasses and polarizing glasses are almost always ignored. International standards Organization (ISO), American Astronomical Society and American National Standards Institute (ANSI) have defined safety standards for direct sun viewing.[24-26] (Table 2)

Table 2: ISO safety standards for direct sun and solar eclipse viewing filters.

I.	No more than 0.00032 percent of the sun's light may be transmitted through the filters.
II.	The filters must be free of any defects, such as scratches, bubbles and dents.
II.	Handheld viewers must be large enough to cover both eyes.
V.	Labels on the viewers (or packaging) must include the name of the manufacturer, instructions for safe use and warnings of the dangers of improper use.

These standards should be emphasized as part of all public campaigns for better eye safety of public and reduce the incidence of solar retinopathy. In the current report, 70% of patients had received information either from social media or mainstream media but they did not realize the actual impact of viewing eclipse without use of filters meeting safety standards. It is evident that people have a frequent access to media and a great source of information for general public. Effective social and mainstream media campaigns about ocular hazards of solar eclipse and emphasis on following safety standards may reduce the visual burden and loss of vision in a significant number of people.

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