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Bilateral Ultraviolet Keratitis following Exposure to Mercury Vapour Lamp and Unshielded Metal Halide Lamp in a Primary School in South Tamilnadu

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Abstract: ***Background: We investigated an outbreak of Ultraviolet (UV) Keratitis in attendees at a school event in a rural primary school in Ervadi, Tamilnadu, South India, the first of its kind to be reported in India. Objective: To confirm the diagnosis, describe the cluster by time, place and person and identify reasons for its occurrence Design and setting: A retrospective cohort study of persons presenting with UV Keratitis following exposure to mercury vapor and metal halide lamps at the event. Participants: 154 persons potentially exposed during the event Main outcome measure: UV keratitis of onset within 12 hours of exposure. We defined UV Keratitis as the occurrence of any of the following symptoms in an event attendee since the start of the event: redness, photophobia, tearing, foreign body sensation or swelling of eyelids Results: Out of the 154, we identified 111(72%) persons who met our case definition of UV keratitis. The age specific attack rate was 70% in the below 5 age group, 72% in 5- 13 age and 77.9% in adults. The median incubation period was 6 hours. Of the 154, 134 were seated in the first ten rows at the event. Among persons seated in the high risk area the attack rate was 80 %. Two lamps, one mercury vapor and one unshielded metal halide used 8 Ft above the dais were responsible for the UV Keratitis. Conclusion: The UV Keratitis was caused by exposure to the mercury vapor lamps and the unshielded metal halide lamp. Proximity of the participants to the lamps increased the severity of UV K. Avoiding indoor use of mercury vapor lamps, avoiding use of unshielded metal halide lamps, and enforcement of high fixture of these UV Radiation sources are recommended to prevent further occurrence of similar outbreaks.***

Keywords: Ultraviolet Keratitis, Photokeratitis, Mercury vapor lamp, unshielded metal halide lamp exposure

1. Background and Introduction

On March 17, 2018, local press reported about 100 persons affected with blurred vision following attendance at a school event on March 16 at Ervadi village, Tirunelveli district, Tamil Nadu State in South India. On March 18, 2018, a team from Tirunelveli medical college led by an Assistant professor of Ophthalmology in collaboration with a team from Tamil Nadu Directorate of Public Health and Preventive Medicine led by Field Epidemiology Training Program (FETP) trainee investigated the episode to confirm the diagnosis, describe the cluster by time, place and person and identify reasons for its occurrence.

2. Material and methods

Participants: There were 180 attendees at the event of whom we could interview 154. We studied the retrospective cohort of 154 persons with potential exposure to the UV lamps. We excluded 4 of them as they had preexisting eye disease.

Immediate action: 60 students, 5 teachers and 46 onlookers complained of redness, FB Sensation, and photophobia from the time of exposure to mercury vapor and metal halide lamps at the school event . Circum corneal congestion and superficial punctate keratitis (*Figure 1*) were seen on ocular examination. We reassured them and treated them with lubricant eye drops for 3 days.

Additional intervention: We, a team of ophthalmologists and FETP trainee and interns went to the PHC, Ervadi to study the causes for the UV Keratitis.

3. Results

Investigation into the cause of the UV Keratitis:

Time: The school day celebration (event) lasted 2 hours from 2.30 to 4.30 PM on march 16, 2018. The weather was hot.

Place: The event was held in a hall measuring 836 sq ft(38x 22 ft). 3 small windows (1.5x 1.5 ft) on one side and a large railing on the other side were the available ventilation. The dais was in level with the floor and measured 12x 5 ft). Two lamps used for stage lighting. One of the lamps was a 400 W mercury vapor lamp with phosphor coated casing.(*Figure 2a*). The other was an unshielded metal halide lamp(*Fig. 2b*). Both the lamps were temporarily installed at a ht of 8 ft from the floor (*Figure 3a*).

Person: There were 180 attendees at the function. We could interview 154 out of the 180.

134 were seated in the first 10 rows in front of the dais (*Figure 3b*). Performers and two of the teachers were on stage. Others stood along the sides of the hall. There were 10 children below 5 years of age who were siblings of the students at the primary school. 81 were students in the age group of 5 to 13 years. 24 were between 14 and

30 years and 35 were above 30 years.

The overall attack rate was 74% (110 of 154). *The age-specific attack rate* was 80% (28 of 35) among those above 30 years 75% (18 of 24) among those between 14 and 30 years, 72% (58 of 81) among children aged 5-13 years and 70% (7 of 10) among children below 5 years.(Table 1). The attack rate was the same in male and female (74% each). nor by type of attendee [70% (60/86) among students, 100% (all 5) among teachers and 78% (46/59) among onlookers. Attack rate among the attendees seated in the first ten rows (approximately 20 ft. from dais) was 80% (107 of 134) which was significantly higher than the attack rate among those seated in the back rows which was 25% (4 of 12). (RR=3.1; 95% CI=1.3-7.4) (Figure 3b). We found severe keratitis and lid edema in 4 of the attendees. 2 of them were children who performed longer on stage and one was a teacher who stood under the lamp for a longer period. The other organizer stood with the children who were performing.

68% (75 of 110) persons developed symptoms within 12 hours of exposure to the source of UV Radiation. The median incubation period was 6 hours. (*Figure 4*).

The lamps used were identified as Philips 400W White ED37 mercury vapor Bulb and an unshielded metal halide bulb. (*Figure 2a, 2b*).

4. Discussion

Ultraviolet or Phototoxic keratitis is a well recognized condition characterized by damage to the ocular surface by UV Radiation from a natural or artificial source. UV Keratitis is known to occur in Public gatherings [1], school gymnasia [2] and stage performances where lighting is improper. Cornea transmits most of the visible spectrum. Corneal epithelium absorbs 100% of UV- C, most of UV –B and 10-20 % of UV –A[3, 4, 5].

Ocular pain, Foreign body sensation, redness and photophobia typically occur 10 – 12 hours after exposure to UV Radiation. Circum corneal congestion and superficial punctate keratitis are seen on ocular examination. Diffuse flourescein staining is observed. A photochemical injury resulting in inhibition of mitosis causes loosening of epithelium[6].

Natural exposure to UV R occurs typically at high altitudes and manifests as snow blindness. Artificial sources of UV R are welder's arc, photographic flood lights, halogen desk lamps and electric sparks. Artificial sources of UV are much closer to the subjects than the sun, so there is very little atmosphere acting to filter out the shorter-wavelength, more harmful ultraviolet radiation (particularly ultraviolet-C). Mercury vapor lamps and metal halide lamps emit more UV Radiation than other sources of light. They also emit heat. The dose of UV R, duration of exposure and the distance between the subject and the source are the factors responsible for the severity of UV K. A high ambient temperature also increases the harmful effects of UV Radiation [7].

5. Conclusion

The UV Keratitis was caused by exposure to

mercury vapor lamp and unshielded metal halide lamp. Proximity of the participants to the lamps increased the severity of UV K. Avoiding indoor use of mercury vapor lamps, avoiding use of unshielded metal halide lamps, and enforcement of high fixture of these UV

Radiation sources would help prevent occurrence of similar outbreaks.

What this study adds:

This incident is one of its kind in that UV Keratitis occurred in more than a hundred children in a rural school setting. Effort to create awareness among school authorities and local electrical personnel would be helpful to prevent further occurrence.

Table 1: Attack rate (%) of phototoxic keratitis among attendees of school event by age, gender and types of attendees, Eruvadi village, Tamil Nadu, South India, March 2018

Characteristics		# Cases	# attendees	Attack rate (%)
Age group (in years)	<5	07	10	70
	5-13	58	81	72
	14-30	18	24	75
	31+	28	35	80
Gender	Male	43	58	74
	Female	68	92	74
Type of attendee	Students	60	86	70
	Teachers	05	05	100
	Onlookers	46	59	78
Total		111	150	74

Figure 1: Superficial Punctate Keratitis :Flourescein stain

Figure 2 (a): Mercury vapor lamp

Figure 2 (b): Unshielded Metal Halide lamp

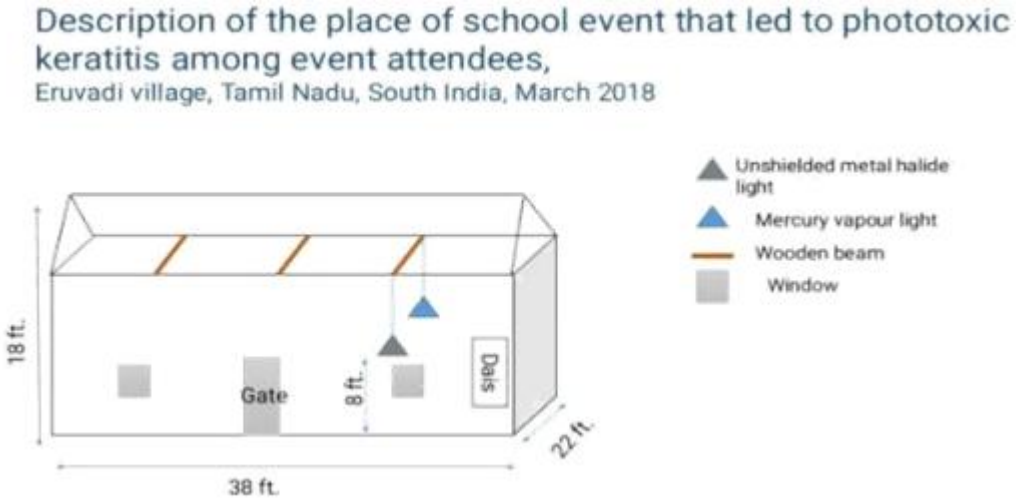

Figure 3 (a)

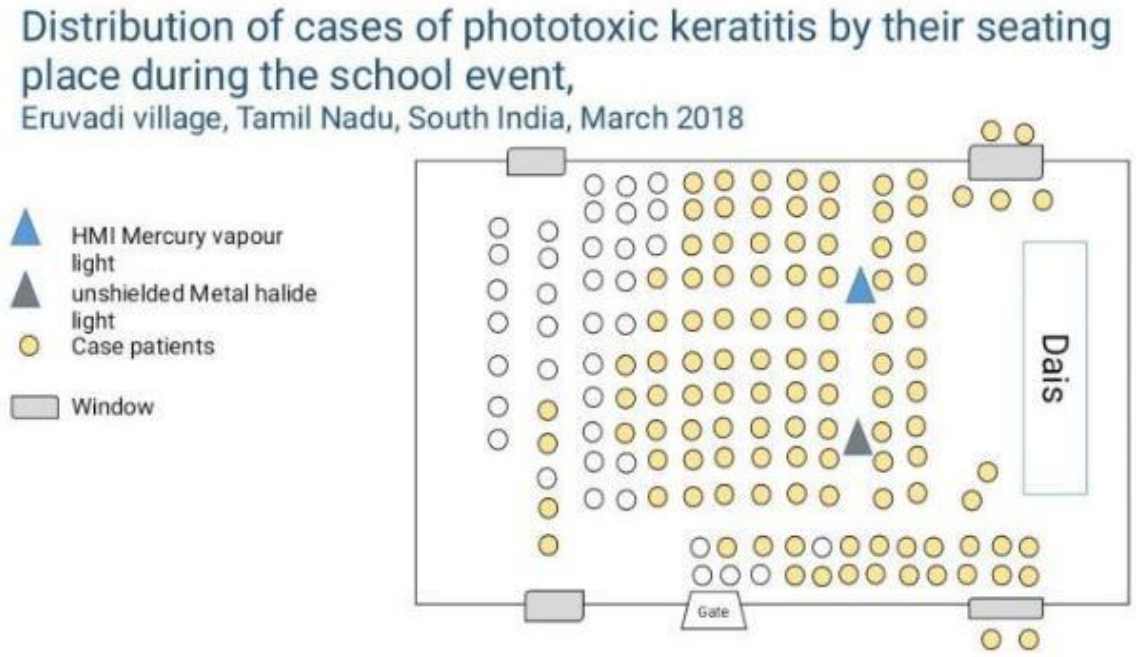

Figure 3 (b)

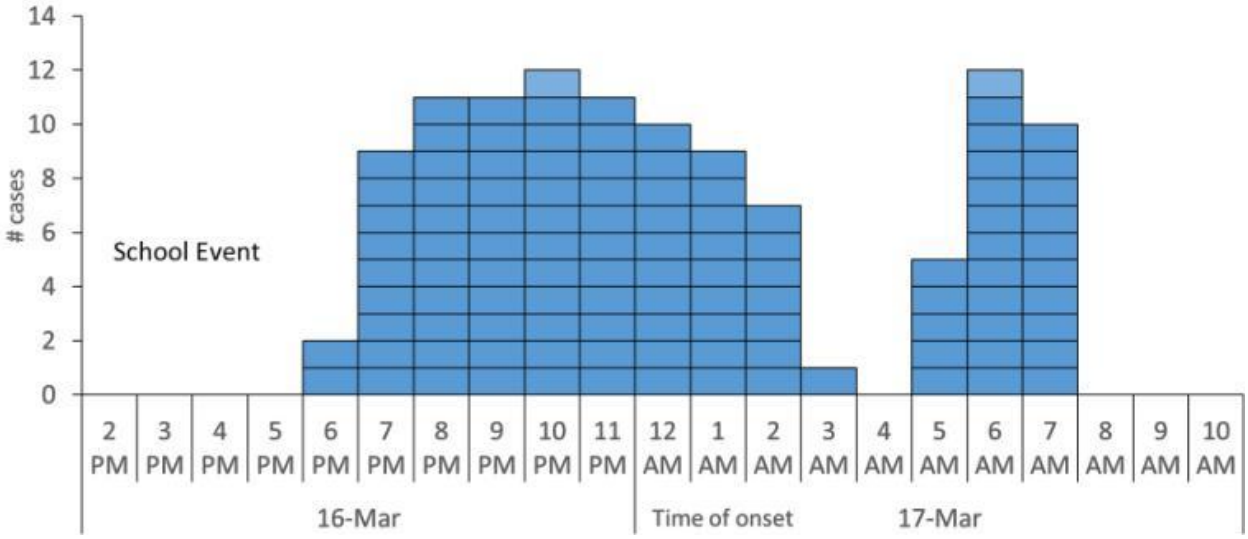

Figure 4

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