CASE REPORT

Clustered outbreak of skin and eye complaints among catering staff

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Abstract

In August 2002, kitchen staff at a hotel in Central Scotland experienced skin and eye problems believed to be related to their working environment. Of a total of 20 staff, eight cooks reported problems with a painful red skin affecting the face, eyelids, side and front of neck as well as burning, gritty eyes. Five of the affected individuals were clinically assessed in April 2003. The overall clinical impression was of conjunctivitis and sunburn-like erythema. Examination of the data sheets of all cleaning agents and sprays used within the kitchen pointed against an environmental phototoxin. The kitchen area was inspected and two electric fly killers positioned on the ceiling and sidewalls were found to be incorrectly fitted with UVC tubes. The output of these tubes was spectroradiometrically assessed. The recommended unprotected skin and eye exposure limit was reached in 14 s at a distance of 30 cm from the tubes. An exposure of about 60 s would be sufficient to induce minimal erythema in someone of skin type I/II. These results demonstrate the importance of exposure to ultraviolet radiation as a possible cause of facial erythema and conjunctivitis, no matter how unlikely this may seem. It is recommended that there should be increased awareness of the need to fit the correct type of lamps to electric fly killers and other devices that incorporate UV lamps.

Key words

Catering; electric fly killers; erythema; occupational; photokeratitis; sunburn; UVC.

Introduction

Work-related ocular damage is not uncommon [1]. One survey of patients attending an eye casualty unit in Scotland found that 21.7% of the cases were work-related [2]. Common eye injuries are due to chemical burns or foreign objects in the eye [3]. Two cases in the literature report eye problems due to incorrectly used UV sources in the workplace: a UVB source in one case [4] and a UVC source in another case [5]. UVC irradiation from welding equipment has caused or exacerbated skin conditions in three reported cases [6–8].

Occupational exposure to irritants can also cause skin disease. Gawkrodger et al. [9] reported the common occurrence of hand dermatitis in cleaners and kitchen workers in hospitals. Lammintausta et al. [10] found that 1% of hospital workers had hand dermatitis. This figure included, most commonly, cleaners, kitchen workers and nurses.

‘Wet’ occupations can increase the risk factor for developing hand eczema [11] and many cleaning products contain irritants and contact allergens [12,13]. Domestic and occupational products commonly contain fragrances, many of which are known to provoke contact allergy dermatitis [14]. Rarely, foodstuffs can cause allergic contact dermatitis [15–17] but as in the cases of irritant or contact dermatitis due to cleaning products, it is the hands that are most commonly affected.

A red face can have various explanations. Flushing is a common cause for a transiently red face [18]. Estimated figures suggest that as much as 10% of the general population suffer from rosacea that causes a characteristically reddened face and can increase the frequency of flushing. Patients with rosacea have also reported affected eyes, including dryness and chronic conjunctivitis [19]. The reddened face of seborrhoeic dermatitis may also involve secondary conjunctivitis, but the estimated occurrence of this dermatosis in the general population is only 1–3% [20]. Atopic dermatitis can be another cause of a red face, thought to affect 20% of the population, and the hands are commonly involved [21]. The face is also a common site for contact or photocontact dermatitis to manifest itself. Allergens may be airborne or in direct contact with patients’ skin. Airborne allergens can also cause conjunctivitis [22].
In August 2002, kitchen staff at a hotel in central Scotland experienced skin and eye problems that they believed to be related to their working environment. Symptoms included reddened, peeling skin on the face and hands and burning ‘gritty’ eyes. This prompted the company’s occupational health department to instigate an investigation into the cause of this outbreak. Occupational health contacted the Dermatology department at the local hospital and requested that the workplace be examined. Following the inspection, a request was made to further examine the kitchen in order to make radiometric measurements. The results of the investigation are presented in the current paper.

**Patients and methods**

**Clinical cases**

Out of 20 permanent kitchen staff, eight were reportedly affected. In April 2003, four of these were clinically evaluated at their workplace (patients 1–4). At the time of examination, all presented with erythema and some peeling on their faces. The skin on photoexposed sites was clearly pigmented. There was minimal involvement of the arms, hands and ears. Patients 1–3 also had conjunctivitis at the time of examination.

Patients 1 and 4 described the skin sensation as being very like sunburn. All except patient 3 complained of stinging, burning or ‘gritty’ eyes. The staff reported that their skin became red and sore in the evening following a shift at work. Peeling developed 1 day later. Symptoms always subsided within a day or two if they were not at work. The members of staff had all begun to suffer from October 2002 onwards.

Patient 5 presented with no symptoms. He had suffered only one episode of skin and eye trouble the morning after he had painted the kitchen during one night in November 2003. All lights were on in the kitchen and he had painted the ceiling using a long armed roller. Three hours after finishing the painting, he reported painful, swollen and weeping eyes, reddened and peeling skin. The symptoms cleared over a 5-day period off work. He has not had any recurrence of the symptoms since.

The patients’ symptoms are summarized in Table 1. The skin type (Table 2) of the individual did not seem to affect the severity of their symptoms. There was no history of atopy, drug ingestion, family involvement or excessive consumption [23] of psoralens (e.g. celery or parsnips) in any of the patients examined. None had a past history of contact allergy or were taking photoactive medication.

### Table 1. Summary of presenting patients’ symptoms

<table>
<thead>
<tr>
<th>Patient</th>
<th>Age</th>
<th>Sex</th>
<th>Skin type</th>
<th>Shift worked</th>
<th>Marked tanning or erythema</th>
<th>Sore eyes</th>
<th>Precautions taken</th>
<th>Medical care sought</th>
<th>Days of work lost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>29</td>
<td>M</td>
<td>3</td>
<td>8–9 h</td>
<td>✓</td>
<td></td>
<td>Ski goggles</td>
<td>GP</td>
<td>None</td>
</tr>
<tr>
<td>2</td>
<td>19</td>
<td>M</td>
<td>2</td>
<td>8 h</td>
<td>✓</td>
<td></td>
<td>None</td>
<td>GP</td>
<td>None</td>
</tr>
<tr>
<td>3</td>
<td>34</td>
<td>M</td>
<td>4</td>
<td>8 h shift split by 2.5 h</td>
<td>✓</td>
<td></td>
<td>None</td>
<td>GP</td>
<td>None</td>
</tr>
<tr>
<td>4</td>
<td>34</td>
<td>F</td>
<td>1</td>
<td>8 h shifts</td>
<td>✓</td>
<td></td>
<td>Ski goggles</td>
<td>Attended casualty on one occasion</td>
<td>None</td>
</tr>
<tr>
<td>5</td>
<td>44</td>
<td>M</td>
<td>3</td>
<td>7.5 h painting the kitchen ceiling on one occasion</td>
<td>✓</td>
<td></td>
<td>None</td>
<td>Optician</td>
<td>5</td>
</tr>
</tbody>
</table>

### Table 2. Fitzpatrick skin types [39]

<table>
<thead>
<tr>
<th>Skin type</th>
<th>Colour</th>
<th>Reaction to sun</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type I</td>
<td>Very fair, blond or red hair, freckles, blue eyes</td>
<td>Always burns, never tans</td>
</tr>
<tr>
<td>Type II</td>
<td>Fair skin, blond or red hair, freckles, blue or green eyes</td>
<td>Burns easily, tans with difficulty</td>
</tr>
<tr>
<td>Type III</td>
<td>Fair to medium skin tone</td>
<td>Burns moderately, tans gradually</td>
</tr>
<tr>
<td>Type IV</td>
<td>Medium skin tone</td>
<td>Rarely burns, always tans well</td>
</tr>
<tr>
<td>Type V</td>
<td>Olive or dark skin tone</td>
<td>Very rarely burns, tans very easily</td>
</tr>
<tr>
<td>Type VI</td>
<td>Deeply pigmented</td>
<td>Never burns</td>
</tr>
</tbody>
</table>

Clinical impression

The overall clinical impression was conjunctivitis and sunburn-like erythema. It would be extremely unlikely that 24% of a workforce would have independently and simultaneously developed a dermatosis such as rosacea or seborrhoeic dermatitis. Eczema would not account for the ocular involvement. Given the prevalence of occupational skin disorders in kitchen staff, an irritant in the kitchen environment was suspected.

Interestingly, kitchen staff working split shifts (10 am–2 pm and 5 pm–10 pm) reported no symptoms or lesser effects than their colleagues working 8-h stretches. This
implied that the threshold dose for the irritant was only exceeded after 4 h.

The involvement of the face, hands and eyes might have suggested an airborne irritant rather than one that required physical contact. Nevertheless, cleaning products were suspected, because irritants can be transferred from hands to face and eyes in affected individuals. However, examination of the data sheets of all cleaning agents and sprays used within the kitchen pointed against an environmental phototoxin.

Hotel management had provided the staff with ski goggles to wear in order to protect their eyes. Only patients 1 and 4 chose to wear the goggles. They found that their skin involvement continued, although the eyes and area photoprotected by the goggles was no longer affected. This evidence, along with the marked cut off of erythema on photoprotected skin suggested that there might be a UV source in the kitchen. Thus, the decision was made to examine the light sources in the kitchen for hazardous levels of UV.

**Kitchen evaluation**

The hotel had several kitchens, but the affected individuals all worked in one area. This area was inspected and hazard measurements were made using an International Light S\(\lambda\) weighted radiometer. This detector is a filtered photodiode and gives a weighted irradiance (W/m\(^2\)) value indicating the hazard associated with the measured source. Spectral irradiance measurements were also taken from several light sources in the kitchen using a single grating, diode array Sola Scope 2000 meter with calibration traceable to the National Physical Laboratory (NPL, Teddington, UK) [24].

**Results**

The on site survey using the Sola Scope 2000 meter revealed that incandescent lamps positioned on the food counter (to keep food hot) were found to emit some UV, but the S\(\lambda\) meter readings confirmed that this was not enough to be hazardous to health. Similarly, overhead fluorescent lights were found to emit minimal UV. There were also electric fly killers placed around the kitchen. Two of these units (Rentokil) contained clear fluorescent tubes with no phosphor coating in evidence. The Sola Scope 2000 meter proved to have too little sensitivity at low wavelengths to detect any hazardous UV, but the S\(\lambda\) radiometer readings at 20 cm from the unit suggested that there was a hazardous level of UV emitted from these tubes (1 W/m\(^2\)).

There was a label on the units that stated that the tubes had been cleaned and replaced in July 2002. This date corresponds closely to the start of the skin and eye complaints. The tubes themselves were labelled ‘UVC’ and ‘Dangerous for skin and eyes’ on the outside of the glass envelope. UVC-induced erythema and photokeratitis account for all the symptoms reported by the hotel staff [25]. Patient 5 suffered the worst episode of photokeratitis because he was looking upwards in the direction of the UVC sources while he was painting the kitchen ceiling.

One of the tubes was removed from one of the fly killers and taken to the United Kingdom Accreditation Service (who provide independent proficiency inspection and certification for calibration and testing laboratories) accredited photo laboratory at Ninewells Hospital, Dundee for accurate measurement of the spectral irradiance from the source. Measurements were made at a distance of 30 cm using a Bentham DM150 double grating spectroradiometer. This instrument has a cooled photomultiplier tube (\(-20^\circ\text{C} \pm 1^\circ\)) and its calibration is traceable to NPL. The tubes were found to emit strongly in the UVC region (100–280 nm) (Figure 1). Total irradiance from the tubes (200–600 nm) was found to be 4.6 W/m\(^2\). Guidance on maximum occupational exposure levels to unprotected skin and eyes has been published by the International Radiation Protection...
Association [26] and is used by the Health & Safety Executive in the UK. Application of these guidelines to the spectral output from the lamp indicates that the recommended exposure limit would be exceeded only after 14 s. This calculation involves the use of the so-called S\(\lambda\) weighting function that gave an effective irradiance of 2.2 W/m\(^2\). The occupational exposure limit is an S\(\lambda\) weighted effective dose of 30 J/m\(^2\). Since 1 W = 1 J/s, the time to reach the exposure limit is found by dividing the exposure limit by the effective irradiance from the lamp. The same weighting function can be used to calculate the time to the threshold dose for photokeratitis. This threshold is between 50 and 100 J/m\(^2\) effective dose [27]. This dose would have been reached in 23–46 s.

Erythemal weighting [28] of the UVC tube spectra revealed that the erythemal effective irradiance was 4.5 W/m\(^2\). This weighting function takes account of the relative effectiveness of different wavelengths to induce erythema. Midday Southern European summer sun, by contrast, has an erythemally effective irradiance of 0.27 W/m\(^2\) [29]. The UVC tube would thus deliver one standard erythema dose (100 J/m\(^2\)) [30] in 22 s. For comparison, it would take >200 s to receive a similar dose at a distance of 30 cm from a narrow band UVB (TL01) unit consisting of eight tubes, such as one might find in a phototherapy unit for treatment of psoriasis.

The spectra obtained from the light sources in the kitchen are shown in Figure 1. The relative intensity of the UVC tube is clear to see. This figure also shows the spectrum of the correct type of tube to fit in electric fly killers.

Given the results obtained, it was recommended that the UVC tubes were removed. This was done and the employees’ problems resolved very soon afterwards.

Discussion

Although cases of occupational UVC irradiation are rare [6–8], episodes of accidental exposure have been reported before. In 1991, Forsyth et al. reported a similar incident where workers in a meat processing factory had been exposed to UVC radiation from similar Rentokil electric fly killers [5]. Electric fly killers are an effective method of trapping insects. Standard fly catching tubes use UVA radiation from fluorescent tubes to attract insects onto an electrified mesh where they are killed and their bodies drop into a collecting tray [31]. This kind of trap removes the need for chemical deterrents or killers and thus also removes the possibility of cross-contamination of foodstuffs. Therefore, they are ideal for (and widely used in) kitchens.

The irradiance levels reported in the current investigation represent a ‘worst case’ scenario. Catering work involves moving about the workplace and generally looking down at food that is being prepared. An accurate measurement of the actual dose that the staff received could only have been achieved by attaching dosimeters to the staff uniform. Nevertheless, occupational exposure limits were obviously exceeded during a working day as the limits are set so as to avoid symptoms of exposure. These devices were mounted overhead and therefore the heads, faces and necks of the staff were receiving the majority of the radiation. This explains why there was minimal involvement of the arms and hands. Hats are also worn in the kitchen, which explains why the ears were unaffected in most of the individuals.

The UVC tubes were fitted in July 2002 and the authors did not inspect the premises and identify the problem until late April 2003. Therefore, staff had been exposed to this radiation for about 9 months before the tubes were identified. The effects of long-term UVC exposure in humans are not known. UVC radiation is known to be mutagenic [32,33] and causes erythema in much the same manner as excessive UVB irradiation does [34]. While UVC photons are more energetic and therefore more damaging than longer wavelength UVB and UVA photons, they do not penetrate tissue as deeply so that undesirable effects are confined to the outer tissue layers [35]. For example, in the eye, UVC radiation is absorbed by the cornea and is not, therefore, transmitted to the retina [36].

This incident highlights the confusion that can occur resulting in incorrect tubes being fitted to electric flytraps. This type of tube is designed for air, water or surface sterilisation [37,38] and should not be used in fly killers. We suggest that the UVC tubes are labelled more clearly and that manufacturers obtain more details as to the intended application before supplying tubes of this type. We would also welcome a decision by manufacturers to make UVC tube fittings differently from other fluorescent tubes so that it would become impossible for end-users to fit this type of tube in error. Potential users and health professionals should also be educated as to the potential adverse effects of this type of UV tube so that these symptoms would not go undiagnosed.

References