

Dermatitis with an Unusual Explanation in a Welder

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Occupational diseases among welders include asthma, acute keratoconjunctivitis, and various skin disorders. A localized cutaneous erythema from UVC radiation is common and does not generally constitute any problem, as its cause is obvious to the welder, the symptoms are slight, and it is transient. In this report a welder with UVC-induced erythema on the cheeks is described. Initially, neither the worker, the physician at the factory, nor ourselves suspected a UVC erythema. Extensive investigations, including factory visits with measurements of UVA, UVB, and UVC irradiance during welding, revealed the cause of the dermatitis to be UVC, most likely reflected from a textile hood used to prevent exposure to dirt. Key words: protective equipment; reflection; ultraviolet radiation; UVC; welding.

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Welding generates ultraviolet (UV) radiation within a wide spectral range and also infrared radiation (1–3). The UV radiation is mainly within the UVC region (200–290 nm). This radiation can be harmful to human skin and eyes and therefore welders are usually well protected against UV radiation and the heat generated. Nevertheless, in welders the skin is sometimes unintentionally exposed to UV radiation in doses inducing UVC erythema. Such an erythema does not generally constitute any problem to the worker, since its cause is obvious, the symptoms are slight, and it soon disappears. However, in a recent report (4) on a recurrent dermatitis in a welder, the explanation was found to be unintentional UVC exposure; this became clear after visits to his place of work, where his way of working was studied.

In this paper we report on a recurrent work-related face dermatitis in a welder. The cause of the dermatitis was revealed only after repeated factory visits.

CASE REPORT

A 30-year-old man had worked as a welder for 10 years in a factory where buckets were manufactured. Various sections of the buckets were welded (MIG welding technique) together by a few hundred welders.

The welder had previously been healthy but had experienced transient erythema from the welding radiation several times. However, recently a rash, different from the ordinary transient welding erythema, had appeared on the lower parts of his cheeks, in the shape of a slightly itching redness after he had been working for a few hours. The redness disappeared during the subsequent night. The same course of events was repeated every working day. For this reason he consulted the physician at the health department of the plant. Also the physician considered the rash different from the ordinary welding erythema, so the welder was put on sick leave, and measures to give him other work assignments without exposure to welding heat were initiated. He was also referred to the Department of Occupational Dermatology with a suspected heat-related urticaria.

When first examined by an occupational dermatologist, he had been on sick leave for 12 weeks. On this occasion no skin lesions were found and he had no history of any skin rash during sick leave. To facilitate the diagnosis he returned to his ordinary job. The symptoms and the rash reappeared as soon as after a few hours of welding. At examination the same day a symmetric, slightly infiltrated erythema with a bluish tinge, without any papules and vesicles, was seen on the lower parts of the cheeks. The erythema was sharply delimited caudally but less sharply cranially. The size of the lesion on each cheek was approximately 5 × 7 cm.

Apparently the dermatitis was work-related. Two major possibilities were considered, (i) either a dermatosis provoked, but not caused, by work and in that case most likely a light-related dermatosis, or (ii) a dermatosis caused by work.

In order for us to explore the possibility of a light-related dermatosis, routine laboratory investigations were carried out and found normal. Antinuclear antibodies were missing. Histologic examination of diseased skin revealed only a discrete oedema of the upper part of dermis. No sunburn cells or any other epidermal changes were seen. Immunofluorescence investigation of diseased skin revealed an insignificant

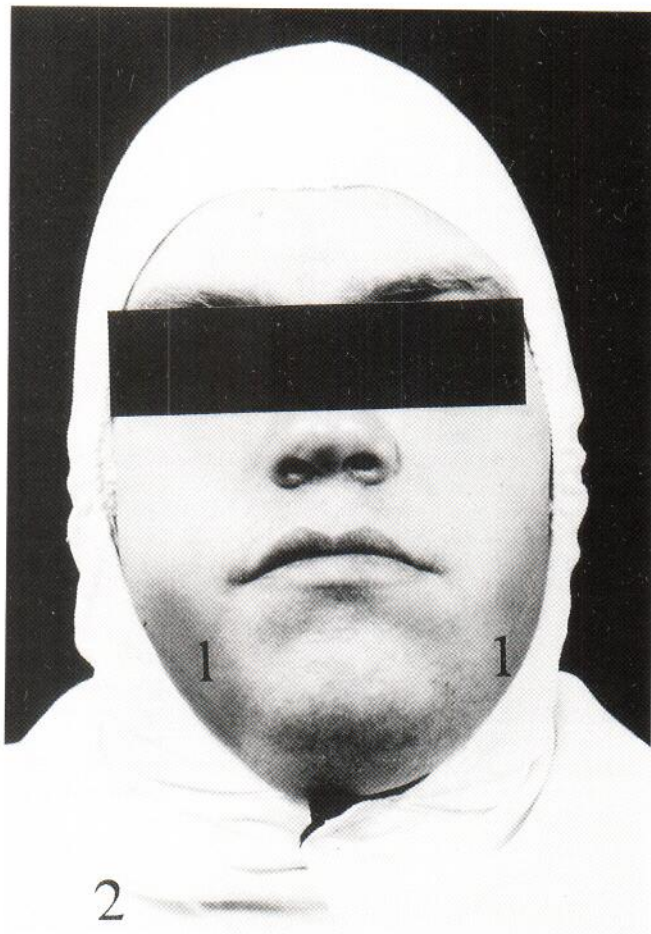


Fig. 1. The welder without the welding helmet but with the hood on. The erythematous lesions are marked (1) and thought to be caused by reflection mainly from the shoulder parts of the hood (2).

Table I. The significance of various combinations of work factors for the development of dermatitis

Work situation	Work factors					
	Welding operation	Helmet on	Hood on	Sunscreen applied	Black cloth on	Presence of dermatitis
1	Yes	Yes	Yes	No	No	Yes
2	No	No	Yes	No	No	No
3	Yes	Yes	No	No	No	No
4	Yes	Yes	Yes	Yes	No	No
5	Yes	Yes	Yes	No	Yes	No

perivascular immunocomplex deposition. Thus, no indications of a light-related dermatosis were found.

The other major possibility was a dermatosis caused by work. Protection equipment, welding fumes, UV radiation and heat were considered as possible causes. One week prior to the first onset of the dermatitis the patient had started to use a protective textile hood in addition to his welding helmet. This hood was intended to protect him from dirt and also meant that a much smaller part of his face was unprotected (Fig. 1). The hood was the only new factor added at work just prior to the onset of the dermatitis.

Patch testing was performed with our standard series, and materials from his work, including various parts of the hood, were tested as they were as well as ultrasonic bath extracts with acetone (5). No positive reactions were obtained.

Photopatch testing was carried out with a standard series (6) and also with the above-mentioned extracts from his work materials. Again the results were negative. A standardized routine irradiation test was performed with long-wave (UVA) and medium-wave (UVB) UV radiation, respectively. The minimal erythema doses (MED) were within normal range and the skin reactions to radiation were morphologically normal.

At this stage we designed some experiments, particularly with regard to the significance of the hood and UV radiation, to establish the requirements for the development of the dermatitis (Table I). The results of these experiments show that both the textile hood and UV radiation were required.

The textile hood was white, so we thought that it could be reflections from this hood that caused the dermatitis. In order for us to explore this hypothesis, either the right or the left part of the hood was covered with photographic black cloth. No dermatitis appeared on the black side after welding for several hours, a fact supporting the reflection hypothesis.

A significant part of the UV radiation generated by welding is UVC. We determined UVA, UVB, and UVC by a measuring cell (UVX radiometer and sensors UVX-25, UVX-31 and UVX-36, Ultra-Violet Products Inc., San Gabriel, California, USA) attached to the cheek (the part of the cheek that became diseased). The UVC irradiation was found to be approximately 15 times higher on the cheek adjacent to the white cloth as compared to the black side, while there were no differences for UVB and UVA irradiation, respectively (Table II). The dermatitis was therefore considered to be caused by welding radiation, most likely reflected by the white hood.

Table II. The average UVB, and UVC irradiance and doses on the cheek with the textile hood on (measured with the textile hood uncovered and covered with black cloth) during welding

The UV doses are based on active welding during 30% of the time of an 8-h work day. MED = minimal erythema dose according to the literature (15–16)

Work situation	Welding				MED	
	Irradiance in $\mu\text{W}/\text{cm}^2$		Dose in mJ/cm^2		mJ/cm^2	
	UVB	UVC	UVB	UVC	UVB	UVC
1. Textile hood on, no black cloth	0.60	13.9	5.2	120	10–100	~ 10
5. Textile hood covered with black cloth	0.58	0.9	5.0	7.8	10–100	~ 10

Now the welder wears his old cap at work and has no skin problem.

DISCUSSION

Occupational diseases among welders include asthma (7), acute keratoconjunctivitis (2, 8) and various skin disorders (8). Within the group of skin diseases, chronic discoid lupus erythematosus (9, 10) and allergic contact dermatitis due to chromate (11–13) are found. However, the most frequent skin disorders are localized cutaneous erythema and small cutaneous scars from burns and lacerations (3, 8, 14). The UV radiation is at least responsible for the acute keratoconjunctivitis, cutaneous erythema, and sometimes also for the burns (8).

Generally, UVC erythema in welders does not constitute a problem, as its cause is obvious to the worker, the symptoms are slight, and it is only transient. However, occasionally a more severe photodermatitis may arise, and initially it is not obvious that UV radiation is the single cause of the dermatitis (4). Sometimes, site visits are required to reveal the cause, as in the recently reported case of a photodermatitis in a welder, where UV radiation on unprotected skin was found to be responsible for the dermatitis (4).

The present case was also found to suffer from a UVC dermatitis, but initially such a dermatitis was not suspected by the welder, the physician at the factory, or ourselves. The reason for our not suspecting an ordinary UVC erythema was partly the initial macroscopic features, with slightly infiltrated lesions, but mainly the fact that no change in the work procedure had taken place. The addition of a textile hood to prevent exposure to dirt was a further protective equipment which should diminish the UVC irradiation on the skin. After we had excluded the possibility of a UV-provoked light-sensitive dermatosis by histological examinations and blood analyses, interest focused on a skin

disease caused by the work. Visits to the plant showed that the welder's cheeks were bare but protected from direct UV radiation by the helmet in front of the face. When he was also wearing the textile hood, a small part of the cheeks was unprotected, but it was in fact these parts which became diseased at welding. When irradiation tests, patch and photopatch tests were negative, some experiments were designed to find out which factors were required to get a dermatitis (Table I).

Welding as well as the helmet and the hood seemed to be required (situation 1, Table I). The hood alone was insufficient to elicit a dermatitis (situation 2) as was the welding with only the helmet (situation 3). The welding procedure generates both UV radiation, fumes, and toxic gases but the significance of the UV radiation was demonstrated by the use of a sunscreen (situation 4). Theoretically, it can be argued that the sunscreen acted as a barrier cream and thus prevented the noxious substances in the fume or a toxic gas to penetrate into the skin. However, covering the white textile hood with the black cloth finally proved the UV radiation and the white textile hood to be responsible for the dermatitis. Since phototoxic and photoallergic contact dermatitis was excluded by photopatch testing, a UVC-induced dermatitis emerged as a possibility. Furthermore, the quick appearance and the disappearance within 24 h without giving any pigmentation fitted well with a UVC erythema (15). The results of the measurements of UV irradiation on the cheeks while welding with and without the white textile hood and with the white cloth covered by black cloth strongly supported the interpretation that the skin dermatitis was caused by UV radiation from the welding reflected by the white textile hood (Table II). According to our measurements only UVC radiation increased on the cheeks when welding took place with the textile hood, while UVB and UVA radiation remained essentially unchanged. Even if the radiometer used was not adjusted to the spectral distribution of UV radiation from the welding equipment, the measured values can be used for comparisons between the various work situations with and without the textile hood and the black cloth, and for the crude estimates of UV doses obtained on the cheeks. The UVC dose obtained after welding for 8 h (active welding was estimated to be carried out during 30% of the work time) without the white textile hood, or with the white textile hood covered by black cloth, was below what is required to elicit a UVC erythema (16). On the contrary, the MED for UVC erythema was obtained after welding for only a

few hours when the welder had the white textile hood on, in good agreement with the clinical situation. Other welders also wore textile hoods but they were not so big and had less prominent cheeks, which meant that their cheeks were completely covered by the hood.

The extensive investigations in this case resulted in the establishing and subsequent elimination of the etiologic agent, which meant that the patient could continue to work as a welder. Furthermore, this paper shows an unexpected adverse effect of a protective equipment and the possible significance of reflection of UV radiation for the development of photodermatitis.

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