Case Study

Teledermatology—a Hitherto Underestimated Tool in Occupational Medicine—Indications and Limitations

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Skin diseases account for a major and growing part of reported occupational diseases. Occupational dermatology, however, is mostly not part of the education of an occupational physician. The treatment of an occupational dermatosis in its early stage can improve its prognosis, but with the progression of the disease the treatment becomes increasingly difficult. It would therefore be desirable for the occupational physician to be able to recognize the disease at an early stage. This poses a problem, since occupational physicians are seldom dermatologists and occupational dermatoses begin with minimal skin impairment and unspecific, often transitory, lesions that are very difficult to judge, especially for the inexperienced physician. Of occupational skin diseases, 90–95 per cent are either allergic or irritative contact eczema. Contact eczema are not life-threatening but nevertheless cause considerable treatment costs and sick leave and can even be responsible for the end of a professional career if not treated efficiently. The remaining 5–10 per cent of occupational skin diseases comprise potentially life-threatening or at least mutilating diseases like basal cell carcinoma, keratoacanthoma, squamous cell carcinoma or Bowen’s disease; pathognomonic lesions such as tar or arsenical keratoses; occupational fungal or bacterial infections; or rare diseases like porphyria cutanea tarda and vitiligo. In all cases the correct diagnosis is needed in order to provide adequate treatment as fast as possible and to develop preventive strategies. Telemedicine can offer effective diagnostic support, especially for the company physician, who is often inexperienced in the field of dermatology. Telemedicine has been defined as the practice of medicine at a distance, medical care without the patient and the doctor being in the same place. Naturally, this requires the transmission of anamnestic and diagnosical data. Telemedical tools applied to the field of dermatology, is known as teledermatology, a section of teledermatology where transmission of visual information becomes vitally important. All current telemedicine systems are basically either store and forward, or live videoconferencing systems. While videoconferencing systems require rather sophisticated technical equipment like video cameras, sound systems, high speed digital lines and synchronization of the schedules of doctor and patient, store and forward systems depend mainly on digital cameras and appropriate storage media which often already exist in companies. Focussing on occupational dermatology, the advantages and limitations of one possible application of a store and forward method are discussed on the basis of the following case report of phototoxic reactions in 6 railroad workers. Additionally, further fields of application in occupational medicine (e.g. expert’s assessment of occupational diseases, dermatologist’s report and therapy-surveillance) are recommended.

Case

The doctor in charge of our out-patient clinic was called by an occupational physician responsible for a group of six railroad-workers who developed acute inflammatory skin lesions after working during the daytime. Since the occupational physician was not a dermatologist, she was not sure how to proceed. The range of possible diagnoses that could be derived from the information given by telephone comprised a wide spectrum of diseases, ranging from airborne contact dermatitis over delayed type contact dermatitis and irritative dermatitis to UV-associated dermatoses, including photoallergic and photosensitizing contact dermatitis, polymorphic light eruption, UV—induced autoimmune diseases (e. g. lupus erythematosus) and sunburn.

We therefore recommended taking digital photographs of the workers’ skin lesions. The workers were also asked to fill in a questionnaire consisting of three parts. The first part comprised questions related to their working conditions, such as protective clothing, working hours and working procedures. The second part contained questions concerning skin colour, sensitivity to UV radiation, tanning history, body care, use of cosmetics and sunscreens. Furthermore, it contained questions concerning medical history regarding skin and other diseases and medication. In the third part the workers were asked to describe their current skin lesions by
answering multiple choice questions and drawing the extent and localisation of the lesions on a body and face pictogram.

The workers filled in the questionnaires voluntarily and gave their consent to the photographs and questionnaires being sent to us. Questionnaires and photographs were correlated by number code, but were otherwise anonymous to ensure data- and privacy protection. The anonymous photographs were sent to us via E-mail and were evaluated by three dermatologists. The questionnaires were sent by conventional mail and were evaluated separately. The findings were subsequently correlated.

Evaluation of the photographs
The photographs showed several rather diverselooking skin lesions. Some workers had diffuse, reddened swellings on the backs of their hands and forearms (Fig. 1), some had diffuse reddening without swelling.

Facial shots on the contrary showed a clear limitation of the affected skin to sun-exposed areas with very sharp circumscriptions (Fig. 2). Areas of the skin where protective glasses had been used were spared as were other sun-protected areas like crevices of wrinkles or nose shadows. The affected sun-exposed facial areas were reddened and looked slightly scaly and swelling did not occur (Fig. 2).

The dermatologists agreed, that judging by morphology alone, the skin alterations had to be associated with UV exposure. They also agreed, that because of the distinct circumscription of the facial skin lesions, a phototoxic reaction seemed to be more probable than a photoallergic one.

Evaluation of the questionnaires
The workers were all male Caucasians, aged 21 to 55 yr, with skin-types III (1 person) and IV (5 persons) according to Fitzpatrick. None of the workers reported allergies or incompatibilities; and no former episode of skin impairment in any of the workers’ previous history was revealed. The use of special skin care products and potentially photosensitizing medication was denied by all of them, as were photosensitizing therapy and systemic diseases likely to cause skin symptoms. Two of the workers reported having used sunscreen: one of them developed facial skin impairment, whereas the other did not. All workers reported having worn protective gloves. One worker wore protective glasses. All except for one worker reported having worn long-sleeved working clothes and four workers wore a cap or a helmet. When we correlated these statements to the markings in the body pictograms, it showed that skin impairment occurred mostly in areas that were not or only partly covered with protective clothing. Apart from itching and burning sensations in the affected skin-areas, none of the workers suffered from extracutaneous symptoms such as neuropathy, dizziness or diarrhoea. The skin lesions appeared within hours and resolved completely within a few days (restitutio ad integrum). They have not reoccurred ever since. A summary of the evaluation is given in Table 1.

The skin affections occurred when the workers had been doing their usual work routine, which is laying wooden sleepers on railway bridges. In order to lay them properly, the railroad sleepers are always bored and ground, resulting in an exposure to bore dust and swarf.

Fig. 1. Diffuse erythematous swelling on the back of the right hand.

Fig. 2. Generalized erythema in the facial area with sunburn-like scaling on the forehead and on the back of the nose. No edema and wrinkles are spared.
The sleepers had previously been impregnated with creosote to prevent them from rotting and had been stored for several weeks. Therefore, the sleepers that were laid were dry and the workers had no direct contact with the liquid creosote, only with creosote—saturated dust. Since railroad traffic at nighttime is lower than during daytime, the workers usually worked at night. Exceptionally, however, this time they were working by day. By evaluation of the photographs the spectrum of feasible diagnoses was narrowed down to either phototoxic or photoallergic contact dermatitis. The evaluation of the questionnaires gave further evidence that the most probable explanation for the skin impairment was an UV-induced inflammatory skin reaction, since the only changed parameter in the workplace setting were the working hours (from night to daytime). The only irritating and possible phototoxic work related substance present was the creosote used for impregnating the sleepers. Although the sleepers were dry and no liquid creosote was present, the workers were nevertheless exposed to creosote-containing bore dust. The affection of the backs of hands and forearms in spite of long-sleeved working gear and gloves can be explained by contamination of the working gear and a lack of decontamination measures when the working gear was pulled off, e. g. during breaks. It could therefore be concluded that the workers suffered from UV-induced inflammatory skin reaction caused by creosote-containing bore dust and swarf. The step by step diagnostic procedure is summarized in Table 2.

In the present case, therapy was synonymous with preventive strategies, meaning exposure reduction and improvement of protective measures. Exposure reduction could be achieved by replacing creosote with a less hazardous substance (like copper naphthenate), or using sleepers made of different materials such as concrete or composite, thereby shunning the necessity of impregnation altogether. Another possible approach would be avoidance of dust exposure and improvement of personal protective gear. The latter seems to be the easiest to achieve because it consists mainly of the use of UV-proof full-body work clothing providing physical UV protection and preventing skin contact with creosote-containing dust. The most important measure concerning the dust exposure, however, is raising the awareness of the workers and thereby improving the proper use of protective gear and the implementation of decontamination measures such as thorough washing of the hands, arms and face whenever possible. However, the most effective way to prevent further episodes of inflammatory skin reactions seems to be the maintenance of a strict night working routine, thereby avoiding exposure to UV radiation. In the present case, the skin impairment occurred only once and if preventive measures are being taken, a second episode can be avoided.

**Discussion**

The use of computer appliances and means of telecommunication in the diagnostic and therapeutic procedures of medicine, now commonly called telemedicine, is a well-established concept. The earliest references date as far back as 1950\(^5\) and telemedicine

<table>
<thead>
<tr>
<th>n=6</th>
<th>Age</th>
<th>Skin type</th>
<th>Location of skin impairment</th>
<th>Symp.</th>
<th>UV protection</th>
<th>Gloves</th>
<th>Protective glasses</th>
<th>Hat</th>
<th>Long sleeves</th>
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<tr>
<td>1</td>
<td>46</td>
<td>IV</td>
<td>forehead, cheeks, chin, backs of both hands, forearms</td>
<td>–</td>
<td>–</td>
<td>+</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>2</td>
<td>21</td>
<td>IV</td>
<td>forehead, left forearm</td>
<td>–</td>
<td>–</td>
<td>+</td>
<td>+</td>
<td>–</td>
<td>+</td>
</tr>
<tr>
<td>3</td>
<td>21</td>
<td>IV</td>
<td>forehead, cheeks, back of right hand, neck</td>
<td>–</td>
<td>–</td>
<td>+</td>
<td>–</td>
<td>–</td>
<td>+</td>
</tr>
<tr>
<td>4</td>
<td>44</td>
<td>IV</td>
<td>forehead, cheeks, right wrist, neck</td>
<td>–</td>
<td>–</td>
<td>+</td>
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<td>–</td>
<td>+</td>
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<td>IV</td>
<td>forearms</td>
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<td>–</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>6</td>
<td>44</td>
<td>III</td>
<td>forehead, cheeks, chin, backs of both hands</td>
<td>–</td>
<td>+ (30)</td>
<td>+</td>
<td>–</td>
<td>+</td>
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</tr>
</tbody>
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\(\sigma\): male, -: answer in questionnaire=no, +: answer in questionnaire=yes, symp: extracutaneous symptoms such as neuropathy, dizziness or diarrhoea, SPF: sun protection factor
has developed ever since in tandem with the constant development of telecommunications and data-processing and their technical means⁶). The practical use of telemedical tools in dermatology is dependent on advances made in imaging techniques such as photography and videotaping in respect of colour, resolution and storage capacity; and the possibility of transferring image data files, electronically. Therefore, teledermatology did not develop until the 1990s⁴), but has been utilised in many fields of application since then. It can be applied to melanoma screenings⁷–¹⁰), in the surveillance of the long-term therapy of leg ulcers¹¹), or in medical attendance in rural or remote areas¹², ¹³). There is ample proof that telecare and teledermatology is practicable and well accepted by patients¹⁴–¹⁷). However, we could find few studies in the literature concerning the use of telemedical tools in occupational dermatology. This is surprising since dermatology and occupational dermatology are two completely different specialties. In spite of occupational dermatoses representing a major and growing part of all reported occupational diseases, occupational dermatology is not a major subject during the training of occupational physicians. A dermatologist’s knowledge is needed to identify and treat the disease, but only an occupational physician can supply the knowledge of working conditions, hazardous substances, possibilities of organisational and technical safety measures and personal protection gear that is necessary to make the treatment successful and in the long run to keep many specialized workers in employment. Better and faster communication between occupational physicians and dermatologists is needed and the use of E-mail for digital image files (store and forward technique) is one feasible method. In the present case, it was possible, with a certain amount of background information, to diagnose the skin lesions by using teledermatological tools alone, without a face-to-face consultation. However, this is not always the case. A dermatological diagnosis normally has to include, apart from textural (roughness, atrophy, scaling) and haptic aspects (softness, solidity), a three-dimensional component (such as different qualities of elevation and/or swelling as in wheals or papules, ulceration and indentation) of the lesion, which cannot, or can only be insufficiently conveyed via images. Furthermore, although using a digital camera does not require dermatological knowledge and can be done by an occupational health nurse, an occupational physician or even a working colleague, the definition of certain standards is necessary to improve the usability of this, in itself uncomplicated, procedure. The standards would have to contain specifications concerning the lighting and background, since light colour and brightness of the lighting and the colour and reflection of the background influence the appearance of skin lesions, as does the use of flashlights. The same applies to the exposure time and the level of resolution that can be achieved with a digital camera. In addition to that, the digital imaging itself brings with it a certain colour inconsistency that cannot be influenced and might in some cases complicate the dermatological diagnosis, if the colour of a skin lesion is of crucial importance. For instance, differences between livid and erythematous lesions might appear either diminished or exaggerated depending on the
capture medium, the personal computer on which the photographs are being analyzed, its monitor, or even the software that is used to view the images. In some cases, the characteristic distribution of skin lesions can be helpful to find the correct diagnosis, so it would be necessary to define, which areas of the body have to be photographed. Regardless of these drawbacks, there are several areas in occupational dermatology where using telemedical tools, especially those with store and forward technique, could definitively facilitate the everyday work routine of dermatologically inexperienced occupational physicians and their patients by allowing both of them access to dermatological expert knowledge in an uncomplicated, fast and cost-effective way. Especially in the case of transitory skin lesions, the use of digital images allows an almost real-time assessment of workers’ skin conditions. In the present case, this proved to be important because the lesions were uncharacteristic, temporary and did not recur.

If medical therapy should become necessary, the use of teledermatological tools would allow a thorough surveillance of workers’ skin conditions during therapy without them having to leave the workplace for a longer period of time. In cases where the patient is working in a remote area this could save both worker and employer lots of time and money. Therapy compliance could be improved, progress or failure of therapy could be monitored more closely and the therapy regime could be adjusted according to the situation. This could help preventing the development of a manifest and severe occupational disease and in the long run keep the employee in employment. Apart from this, in the field of occupational dermatology, as in occupational medicine in general, there are always legal aspects to be considered. In the case of a manifest occupational disease and the assessment procedures that follow after the report, the work of the medical expert could be facilitated by detailed visual information and would not have to rely on formerly given diagnoses alone, whereas the employee would have an objective means of proof, even if his skin condition had improved or been mitigated through therapy since the date of the assessment.

References