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Occupational Skin Allergies: Testing and Treatment (The Case of Occupational Allergic Contact Dermatitis)

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Abstract Occupational contact dermatitis, including occupational allergic contact dermatitis, is one of the most common occupational diseases. Making a timely and accurate diagnosis is important to improving the outcome. Taking a work history and patch testing are essential elements in the diagnostic process. Management, based on an accurate diagnosis, must include both medical treatment to address the disease and workplace modifications as appropriate to reduce exposure the causative agents.

Keywords Occupational skin disease · Occupational contact dermatitis · Occupational allergic contact dermatitis · Occupational history · Patch testing · Health services · Return to work · Tertiary prevention · Treatment · Multi-disciplinary teams · Diagnosis

Introduction

Occupational allergic contact dermatitis (OACD) is one of the two main types of occupational contact dermatitis, the other being occupational irritant contact dermatitis (OICD). A worker may experience both OACD and OICD. Occupational contact dermatitis is the most common occupational disease in many countries [1]. Much work has been done on understanding the impact of occupational skin disease. The impacts include the disease itself and its symptoms of itching and pain, but also functional outcomes which lead to impacts on quality of life including work and social functioning and the resulting costs [2–6].

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A challenge with occupational skin disease, as with many other occupational diseases such as asthma, is that they are not recognized nor reported as being work-related. This means they are under-estimated in administrative statistics that often drive prevention strategies. Therefore, it is important to raise awareness of occupational skin diseases, not only with workers, employers, and compensation authorities but also with health care providers. Of particular relevance to health care providers is that, if the occupational cause is not identified, the management will likely be sub-optimal as the workplace factors will not be addressed. Thus, both the accurate diagnosis and appropriate management are of critical importance if good outcomes are to be achieved.

Because of the problems of under-recognition and under-reporting, it is challenging to find good prevalence and incidence data that usually come from regulatory agencies such as insurance schemes or government reporting [7]. There are some workplace-based studies that provide useful information. Recent studies of health care workers who have exposure to both workplace irritants and allergens found 1-year prevalence rates of 21 and 22 % [8••, 9]. Similar results have been found in hairdressers [10••]. While these provide a sense of the magnitude of the problem of occupational skin disease, they do not differentiate between OACD and OICD.

Patch test databases are available and provide information about important occupational contact allergens. These databases can provide both snapshots in time as well as trends in particular allergen positivity over time [11••, 12••, 13••]. For example, there can be both decreases in sensitivity due to preventive strategies (chromium in cement) and increases in sensitivity due to new exposures, often of known allergens in new uses such as methylisothiazoline in paints and epoxy in building trade workers [11••, 12••, 13••].

The major contact dermatitis groups such as the European Environmental and Contact Dermatitis Research Group, The German Contact Dermatitis Research Group, the Danish

Contact Dermatitis Group, and the North American Contact Dermatitis Research Group publish their results regularly. One limitation of these data is that they are based on different screening series of allergens (different allergens, different numbers of allergens, different concentrations) that relate to both work and non-work exposures. In addition, the findings will not reflect occupational allergens not included on the various screening series that may be of relevance given the particular type of industry in the area. A recent publication using Canadian data from the North American Contact Dermatitis Group found the 10 most commonly identified occupational allergens were epoxy resin, thiuram mix, carba mix, nickel sulfate, cobalt chloride, potassium dichromate, glyceryl thioglycolate, p-phenylenediamine, formaldehyde, and gluataraldehyde [14].

There have been several recent reviews and guidelines published related to occupational skin disease [15, 16, 17••, 18]. These contain useful evidence-based findings relevant to many aspects of occupational skin disease including diagnosis and management.

Diagnosis

The diagnosis of OACD is the first important step in management. The timeliness of definitive diagnosis affects the outcome of the disease. Several studies have demonstrated that the longer the time between onset of symptoms and diagnosis the poorer the outcome [19, 20]. While there is little information about the length of time between onset of symptoms and diagnosis, several studies have documented average times between approximately 2 to over 5 years [19–21].

The importance of an accurate diagnosis is critical in the case of OACD. If the correct diagnosis is not made and the causative agents not identified, management may be suboptimal with the result of ongoing problems for the worker. The first step in the diagnosis is the history including the occupational history. The occupational history needs to include details about the worker's job, their exposures at work, their use of personal protective equipment, work and skin care practices, the relationship of the symptoms to work, and whether other workers are also affected [15, 16, 17••].

The physical examination of the affected skin is important. Various patterns of dermatitis have been described that are representative of particular types of hand dermatitis; however, it is important to note that such features are unreliable in the differentiation of OACD and OICD. A recent study from the Danish Contact Dermatitis Group has demonstrated that one cannot rely on clinical pattern for the diagnosis [22]. Using the Danish Contact Dermatitis Group classification system based upon etiology and clinical pattern, the authors sought to determine whether an etiological diagnosis as determined by patch testing to appearance could be predicted. The authors reported that, while there were some associations observed, there was substantial overlap. The importance of their results is that, though there were relationships between etiological diagnosis and pattern of dermatitis, these findings were not of the magnitude that would allow accurate diagnosis without appropriate exposure history and patch testing. In summary, the occupational history is the first important step in making the diagnosis. While the clinical findings may be helpful, patch testing is critical to making the accurate diagnosis of OACD.

Patch Testing

The critical importance of patch testing in the diagnostic process is emphasized in several review and guideline documents [15, 16, 17••, 18]. Further, it is preferable for workers to be assessed in a specialized clinic with expertise in contact dermatitis [16, 17••, 23].

Patch testing, developed by Jadassohn over 100 years ago, is central to the diagnosis of allergic contact dermatitis. There is a standardized methodology for patch testing [24]. A useful reference book for patch testing is *Patch testing and prick testing* by Lachapelle and Maibach [25••]. There remains challenges with the standardization of patch testing such as the subjective nature of the reading and that the interpretation may be influenced by the reader's knowledge and expertise [26]. Patch test results include not only the severity of the patch test reaction but also the relevance, i.e. whether exposure to the allergen is the cause of the dermatitis. Though relevance is theoretically determined using defined criteria, it is likely in practice that such rigor is not applied.

Most commonly, standard screening panels are used for patch testing. There are a number of different screening panels with differing numbers of allergens. The rate of positive patch test reactions will vary depending upon age, gender, location of dermatitis, atopic status, and occupational exposures. The European Surveillance System on Contact Allergy is a helpful resource in interpreting differences in positive patch test results and interaction with these variables [27]. Often patch test groups report their results based on positive results, but do not include the relevance of the results.

Generally speaking, the more allergens that are tested, the more likely one is to make a diagnosis of allergic contact dermatitis. The use of a screening tray with a smaller number of allergens may be useful for screening patients with possible allergic contact dermatitis, but, if an occupational cause is suspected, more extensive and focused patch testing is indicated.

In addition to screening series of allergens, there are a number of commercially available specialized series of allergens. Many of these specialized series are important in the investigation of OACD. Specialized series may be targeted by particular jobs or chemicals. Examples of specialized series

focused on particular industries or jobs include bakery, dental, hairdressing, and examples of specialized series focused on particular chemicals include acrylates, epoxy, isocyanates, metals, oils and coolants, plastics and glues, and rubber.

The advantage of using focused panels continues to be demonstrated. The German Contact Dermatitis Research Group demonstrated the added value of a focused tray for metalworking fluids and also the need to continue to adjust the allergens included as industrial processes and the chemicals in use change [28, 29]. Holness and Nethercott demonstrated the added value of a plastics and glues series wherein 5 % would have been missed if the specialized tray was not used [30]. They also investigated the use of a specialized rubber series and found an additional 11 % with positive rubber reactions not detected with the screening tray [31]. They demonstrated that for glove-related problems, the allergies were generally identified with the screening tray; however, for OACD related to industrial rubber production, additional cases of OACD were identified. Wang et al. reviewed their experience with testing with the screening series and hairdresser series and found that 6.4 % would not have been detected without the hairdressing series [32]. While in general these studies identify a relatively small number of additional cases, the identification of the specific allergens may be important for workplace management in these cases.

Even though specialized series are available, they do not cover all types of industry or chemicals and, even when there are specialized series, there is still a limited number of allergens tested. As a result of these limitations, testing with workplace materials is recommended and is commonly done in Europe, but not in North America. Custom testing should be done by those with expertise in contact dermatitis, as there is increased risk of severe reactions and sensitization.

There is limited information in the literature regarding the use of custom testing. Aalto-Korte and colleagues described their experience with isocyanate patch testing [33]. They found that a polymeric MDI test substance made in-house was superior to the commercial MDI allergen. Geier et al. examined patch testing with metalworking fluids from the patient's workplace and found positive responses in 16 % of those tested [34]. Houle and colleagues examined the use of testing with workplace epoxy materials. For 25 % of those assessed with custom testing, as well as testing with a standard screening series and an epoxy series, the diagnosis of allergic contact dermatitis would have been missed if the custom testing had not been performed [35]. The Australian experience with patch testing with the patient's own products demonstrated an overall added value of testing with the patient's own products of 5 % [36].

Treatment

The treatment of OACD involves two components, medical management and management related to the workplace. There have been several recent reviews that have reviewed the evidence related to management of OCD. Usually, the review focuses on OCD generally, though there may be some specifics related to OACD. An early systematic review related to treatment and prevention of contact dermatitis was performed by Saary et al. for the Ontario Workplace Safety and Insurance Board [37]. Several reviews followed from the United Kingdom, including evidence-based guidelines for the diagnosis, management, and prevention of OCD [15, 16, 17••, 18].

Medical Treatment

The medical management of OACD has been discussed in several of the reviews noted above [16, 18, 37]. The recommendations are relatively general including the use of topical corticosteroids, emollients, and soap substitutes. In addition, a German Guideline in the management of hand eczema provides more detailed advice regarding medical treatment [38].

Although there are many studies of various topical and oral treatments for hand dermatitis and OCD, most are not randomized controlled trials and do not meet the quality requirements of the systematic review process, and hence there is little good evidence for most treatments. There is fair to good quality evidence for the use of potent or moderately potent topical corticosteroids in the case of AOCD [37]. There is also fair to good quality evidence for the use of lipid rich moisturizers for the treatment of ICD, and most guidelines recommend moisturizers for OCD [15, 38].

Individuals with mild dermatitis should be treated promptly and effectively, before the disease becomes chronic. As noted above, there is good evidence for the use of corticosteroids. Considerations with respect to the potency of the corticosteroid and the vehicle will depend on the nature of the dermatitis. For acute disease, it is important to use a sufficiently potent corticosteroid and then change to a less potent agent as the disease improves [38]. Topical calcineurin inhibitors are often used. For more severe dermatitis, high potency topical corticosteroids and possibly UV therapy or retinoids may be added. For severe disease, systemic immunotherapy may be considered. Treatment guidelines from professional organizations can be used for more specific advice.

It is important to understand that restoration of the skin barrier may take weeks to months and care must be taken even though the workers' skin may appear to be normal [38].

Multi-Disciplinary Care

Several groups have introduced multi-disciplinary interventions for workers with OCD. The most developed and evaluated model is in Germany. They have developed strategies for both secondary and tertiary prevention. The tertiary program is in place at five sites in Germany and focuses on rehabilitation for those workers with severe disease [39]. The interdisciplinary

integrated care model involves both inpatient and outpatient components. Weisshaar et al. reported the results of 1,788 patients with severe OCD who had follow-up over 12 months following discharge from the program [40••]. The two most common industries represented in the patient group were healthcare (29 %) and the metal industry (27 %). The severity of disease decreased significantly, as did the use of topical corticosteroids and days absent from work, while the quality of life scores improved. Of note, 87 % remained in work in the workforce.

A group in the Netherlands has also developed a model based on a multidisciplinary care team including a evaluation by a dermatologist, education by a specialist nurse, and involvement of an occupational physician for work issues [41, 42]. A facilitator was good internal communication including knowledge exchange related to diagnosis and treatment from the different disciplinary perspectives is important. A similar multidisciplinary integrated care model is in place in Toronto, Canada, and has identified program components associated with return to work and demonstrated improved return to work outcomes [43]. The program components include intensive worker education, case conferences, formal communication with the workplace, and active follow-up of the worker including monitoring their skin condition. Avoidance of exposure was the key intervention and a return to work trial or graduated return to work were often utilized.

Workplace Management

In addition to medical treatment, management of exposures at the workplace is critical to successful outcomes. Avoidance of the allergens is one of the key steps in workplace management [15]. It is important to note that, even with avoidance of exposure, some individuals with OCD may have persistent disease. This is particularly notable in workers with OACD caused by chromates. The use of protective equipment, most commonly gloves, has been demonstrated to be of value for some workers [15]. Glove use can be irritating to the skin, and the use of cotton liners is often recommended to help mitigate this problem [17••]. Also important is ensuring that the correct type of glove is used that provides appropriate protection from the exposures, and that storage, donning, and doffing of the gloves is done appropriately. Additional practices that have been found to be useful include the use of fabric softeners when washing work clothing, use of disposable towels instead of dirty rags, and removal of contaminated clothing [15]. Education and counseling are also used when returning a worker with OACD to work. Advice about exposures in work practices and personal protective equipment and job change are recommended strategies, though studies report varying success rates [15]. It is important to remember that workers with OACD may also have OICD, so attention must be given not only to avoidance and protection from exposures to the causative allergens but also to protection from the irritant exposures. In addition to workplace modifications to reduce exposures, workers may have psychosocial issues involved with return to work that need to be identified and discussed. These concerns may include personal safety at the workplace and co-workers' about contagious issues [44].

Conclusions

OACD is an important cause of occupational skin diseases. To attain the best outcomes, it is important that a timely, correct diagnosis be made. Patch testing is a necessary component of diagnosis. Use of screening and specialized occupationally focused allergen series is the mainstay of diagnosis for OACD. In expert hands, custom testing of workplace materials may identify OACD that was not identified using commercially available allergens. In addition to the medical treatment, the use of multi-disciplinary teams may improve outcomes. Workplace changes to reduce exposures are important for successful return to work, and accurate diagnosis is critical in developing the appropriate workplace modifications to reduce or eliminate the allergen exposures and also to address irritant exposures if the two problems co-exist.

Compliance with Ethics Guidelines

Conflict of Interest D. Linn Holness has received honoraria for reviewing student scholarships from Worksafe BC, and has received grant support from the Ontario Ministry of Labour, Social Science Humanities Research Council, Workplace Safety and Insurance Board.

Human and Animal Rights and Informed Consent This article does not contain any studies with animal subjects performed by the author. With regard to the author's research cited in this paper, all procedures were followed in accordance with the ethical standards of the responsible committee on human experimentation and with the Helsinki Declaration of 1975, as revised in 2000 and 2008.

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