



Occupational Dermatitis

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Abstract

Purpose of Review The purpose of this review is to provide an update on occupational contact dermatitis including gaps in knowledge and practice. Occupational contact dermatitis is the most common occupational skin disease.

Recent Findings New sources of exposure for known allergens and new allergens are continually being reported. Through clinical databases and surveillance systems, effects of prevention efforts or introduction of new allergens or new uses of known allergens can be monitored. Though the diagnostic process is clear, there are delays in workers seeking care. As early detection and intervention improves outcomes, screening should be implemented. Gaps in primary prevention in the workplace are identified and should be addressed to reduce the burden of disease.

Summary Surveillance systems support the prevention mandate. Understanding limitations of our knowledge and identifying gaps in practice can lead to initiatives to address research and practice needs and improve prevention of occupational dermatoses.

Keywords Occupational contact dermatitis · Irritant contact dermatitis · Allergic contact dermatitis · Patch testing · Outcomes · Prevention

Introduction

Occupational skin diseases are one of the most common occupational diseases. The most common reported is contact dermatitis and this will be the focus of this review. Contact dermatitis is defined as an “inflammatory skin condition induced by exposure to an external irritant or allergen” [1]. There are two types of contact dermatitis: irritant and allergic. Irritant contact dermatitis (ICD) is the more common and is caused by the irritant having a direct toxic effect on the skin [2]. The irritants cause disruption of the skin’s barrier function [2]. Allergic contact dermatitis (ACD) is caused by exposure to sensitizing agents that result in a delayed type IV immune response and is diagnosed with patch testing [2]. Occupational

contact dermatitis (OCD) results when the exposure is found in the workplace. A key component of the definition is the work-relatedness of the contact dermatitis. In the case of occupational disease, there may be both a clinical definition of OCD that physicians use in practice but there may also be other legal definitions related to the work-relatedness component that are specific to various workers’ compensation laws or insurance programs .

Epidemiology

There are a variety of sources of information about OCD and its causative agents. These include case reports and series, clinic-based studies, surveillance schemes, registries, administrative data, and workplace studies. Much of the literature focuses on ACD that is diagnosed with patch testing.

Case reports and case series are valuable as sentinel events. They often identify new sources of exposure to known allergens or new allergens. Examples of known allergens being used in new settings include methylisothiazolinone (MI) and epoxy. Epoxy resin is a well-known contact allergen. In 2012, Fillenham and colleagues reported a case series of construction workers using epoxy to reline pipes [3, 4]. OCD related to epoxy resins has also recently been described in 3D printing

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[5]. There has been a dramatic increase in ACD caused by exposure to MI. As the incidence began to increase, it was identified that MI was being used in paints, resulting in occupational exposure to MI and the resulting development of OCD [6, 7]. An example of a new allergen described in case reports is sodium cocoamphopropionate, a surfactant used in disinfectant soaps [8, 9]. Occupational ACD to cocoamphopropionate was described in several countries in workers of fast food restaurants where frequent hand washing with the soap occurred [8, 9].

While case reports and case series identify new applications of known allergens and new allergens, they do not provide information about how common the problem is. Studies based on clinic populations are another way of identifying common causative agents through patch testing. While individual clinics may report their experience, pooling patch test data across clinics increases the number of cases and the power to explore associations. Examples of pooled data include groups in North America and Europe. The reporting of patch test results for these large populations provides valuable information on the common occupational allergens. The North American Contact Dermatitis Group (NACDG) regularly publishes its overall results that may include some information on OCD [10, 11]. The NACDG found 8.9% and 10.2% of those tested had occupationally related skin disease in 2013–2014 and 2015–2016 respectively [10, 11]. There are a number of pooled European patch test databases including the European Surveillance System on Contact Allergies (ESSCA) [12]. The ESSCA found 10.3% of the subjects had occupationally related disease in non-specialized clinics whereas 44.6% had an occupationally related disease if they were seen in clinics specializing in occupational dermatology [12]. There are also national databases as well such as the German Information Network of Departments of Dermatology (IVDK) [13]. In addition to overall results, there is information published periodically with a focus on OCD [14]. This type of analysis provides information about the most common jobs affected and most common work-related contact allergens. For example, a review of ESSCA data from 2002 to 2010 revealed that the most common jobs affected were hairdressers, nurses, precision workers in metal and related materials, tool-makers, and related trades [14]. The allergens which had at least double the risk of OCD included thiurams, epoxy resin, and antimicrobials including methylchloroisothiazolinone/MI, methyldibromo glutaronitrile, and formaldehyde [14]. These databases can also be used to examine the common allergens associated with specific sectors and jobs. The NACDG examined healthcare workers and highlighted the common allergens including rubber (thiuram and carba), sterilizing solutions containing glutaraldehyde, and soap components [15]. The IVDK examined nurses and again found rubber components to be a common allergen in addition to preservatives [16]. The IVDK also examined dental technicians and found a variety of acrylates and methacrylates

as the most common allergens [17]. The NACDG has examined a number of other jobs including hairdressers/cosmetologists, food service workers, mechanics and repairers, print machine operators, and production workers while the IVDK has examined bricklayers and tile setters [18–22].

Another valuable use of these larger databases is for surveillance. Surveillance not only identifies current important known allergens and the exposures associated with OCD, but also provides information about emerging allergens and trends over time [13]. Such tracking has demonstrated the positive effects of prevention efforts such as the decrease in chromium sensitivity in Europe due to directives to reduce chromium in cement and leather [23–25]. This tracking has also identified the increased usage of particular allergens such as the epidemic of MI allergy that has occurred internationally [26–28]. While these database results are very useful to understand overall prevalence of sensitization to allergens, work-associated allergens and trends over time, there are limitations with the data. These include the lack of patch test centers in some areas that may have particular industries so some industries and occupations are under-represented. There are also possible referral biases where only the more severe cases are referred for patch testing. They also do not provide information about the prevalence or incidence of OCD. Finally, because they are focused on patch test results relevant to allergic contact dermatitis, they may not provide detailed information about irritant contact dermatitis, the more common form of OCD.

Other surveillance systems are based on physicians reporting cases to a surveillance scheme. An example of this is The Health and Occupation Reporting (THOR) network in the UK that includes a number of reporting schemes for different specialties. The two schemes relevant to occupational skin disease are EPIDERM receiving reports from dermatologists and the Occupational Physician Reporting Activity (OPRA) receiving reports for occupational physicians [29, 30]. These schemes have provided information about the incidence of occupational skin disease [29, 30]. EPIDERM has been useful in demonstrating trends over time including the decrease in chromium sensitivity and the increase in MI sensitivity [31, 32]. EPIDERM has also been able to identify trends in irritant exposures, most notably the increase in occupational ICD associated with the promotion of hand hygiene in health care [33].

Another source of information is national registries or administrative data like insurance or workers' compensation. There are several disease-specific registries in Germany and Switzerland [34]. These may provide a more realistic picture of the distribution of irritant and allergic contact dermatitis. There is also reporting from insurance and workers' compensation but these are subject to under-reporting and also some industries may not be covered.

Workplace-based studies provide useful epidemiological evidence for industries and jobs commonly affected by

OCD. In these cases, a population of workers is assessed and prevalence rates can be assessed. The limitations of such studies are that they are expensive to carry out so there is limited information, with particular industries being more commonly assessed. Also, they generally do not do patch testing so they lack definitive diagnoses. They provide information on hand dermatitis, but not necessarily the cause. Workplace studies have been conducted in a number of different workplaces with a large number being carried out in healthcare. Earlier workplace-based studies in healthcare found prevalence rates varying from 20 to 30% and a recent study found a rate of 31%, suggesting problems still exist in this sector [35, 36, 37]. These studies have demonstrated an association between hand dermatitis and wet work.

In summary, there are many sources of information related to the causes, prevalence, and incidence of OCD. A useful source for summary information is guidelines that have been produced based on systematic reviews. These summarize the results of many studies using an evidence-based approach [38]. Common irritants include wet work, alcohols, cutting oils and coolants, disinfectants, detergents, alkalis, solvents and friction while common allergens include the metals nickel, chromates and cobalt, epoxies, resins and acrylics and preservatives, cosmetics and fragrances, plants and, though not included in the review, rubber accelerators [38].

Diagnosis

The diagnosis of OCD is based on the history, physical examination, and patch testing. The first step is taking a detailed history of symptoms and exposure and the relationship between the two. There are a number of guidelines that emphasize the importance of the history including a detailed exposure history [38–44]. The 2010 British Occupational Health Research Foundation guidelines for OCD were summarized by Adisesh et al. [39] The UK standard of care is to conduct a full clinical and occupational history for any individual of working age presenting with a skin rash, including their job title and what it entails, the materials with which they work, the location of the rash, and any temporal relationship with work [39]. Johnston et al. provide some detail about the components of the history including products used and how they are handled and the use of personal protective equipment [40]. It is also important to obtain information about skin care practices [45]. An important source of information about the agents used in the workplace are safety data sheets (previously referred to as material safety data sheets) [40, 45]. While there are some limitations with the content of safety data sheets, they may provide detailed information about the components of various products used in the workplace [45].

There is information in the literature about how commonly an occupational history is taken in the context of OCD. There

is variation in the reporting of occupational history taking, depending on whether the information is coming from the patient or physician. Two separate studies in the same clinic investigated patient and physician's experiences with management of OCD [46, 47]. Patients reported that the majority of family physicians asked about their job (67%) but most did not ask for material safety data sheets (3%) [46]. Similarly, patients reported that 53% of dermatologists asked the patient about their job and only 3% asked for material safety data sheets [46]. From the physicians' perspective, 91% of dermatologists report always taking an exposure history, compared with 57% of family physicians [47]. Common barriers preventing dermatologists and family physicians from taking workplace histories were found to be time constraints, lack of knowledge, lack of adequate reimbursement, and complicated/excessive forms to fill in [47].

The physical examination should include documentation of the location and morphology of the dermatitis [41]. However, for the hands and face, the pattern and morphology is unreliable in differentiating atopic dermatitis from contact dermatitis [39].

Once the history and physical examination are complete, patch testing is usually undertaken. Even if the diagnosis seems to be ICD, it is important to patch test workers to ensure there is not a component of ACD as well. It is suggested that patch testing be done when a contact allergy is suspected, the dermatitis has not improved in 3 months, or there are implications for employment [39]. There are a variety of guidelines for patch testing [48, 49]. Based on the exposure history, decisions about the appropriate allergens for testing can be made. In addition to the screening tray, additional trays of allergens should be applied to ensure that common workplace agents are included in the patch testing. There are a number of trays for specific industries, jobs, or exposures. Common trays that could be used in the context of OCD include hairdressers, acrylates, epoxy, rubber, isocyanate, oils and coolants/metal-working fluids, acrylates, and dental. In addition to testing with commercially available allergens, many centers that focus on OCD also perform custom testing with various workplace agents. Custom testing requires expertise in patch testing and OCD and should only be carried out in centers with experience and facilities. Lachapelle and Maibach provide useful guidelines for custom testing [49].

As patch testing is the key diagnostic test for contact dermatitis, it is important to ascertain where patients can obtain patch testing services. Generally, dermatologists and allergists provide patch testing services. Several early studies surveyed dermatologists and allergists about their patch test practices. One study that surveyed American dermatologists found that 83% of dermatologists patch test, but 83% of those perform less than 5 patch tests per month [50]. For the dermatologists that did not do patch testing, reasons given for not testing included the patient history is adequate for diagnosis (43%), patch testing is too time consuming (41%), has insufficient reimbursement

(26%), and patch testing is inconvenient for practice scheduling (12%). At the same time, a survey of allergists on patch testing practices in the USA found that 53% patch test, but 89% of these patch less than 6 patients a month [51]. A recent study surveyed members of the American Contact Dermatitis Society regarding barriers to patch testing [52]. They found the most common barriers were inadequate insurance reimbursement and lack of departmental support. The new development has been the use of administrative databases to examine patch test usage and its characteristics. One study looked at Medicare billings in 2012 in the USA and found substantial variation in patch test useage [53]. A study from Ontario, Canada, where there is universal health insurance and two billing codes for patch testing, one for occupational and one for non-occupational, examined patch testing, over a 20-year period from 1992 to 2014 [54]. It found that there was variation by region. Over time, there was an increase in non-occupational patch testing while the rate for occupational patch testing was fairly stable. For non-work-related patch testing, 72% was done by dermatologists and 17% by other medical specialties including allergy and occupational medicine. For occupational patch testing, only 46% was conducted by dermatologists with 46% done by the other medical specialties.

Once the history, physical examination, and patch testing have been completed, a final diagnosis can be determined. Mathias published a set of criteria for the diagnosis of OCD to aid physicians in making the diagnosis of work-related disease [55]. Ingber and colleagues assessed the Mathias criteria and found them to be useful in the assessment of OCD [56].

Management

The management of OCD involves traditional medical management but in addition attention to workplace factors is also needed. Medical management should be guided by guidelines for contact dermatitis or hand dermatitis generally. In general, topical treatments are used, at least initially. These include the regular use of emollients and medications, most commonly corticosteroids but also calcineurin inhibitors may be used. [45] If the dermatitis is severe and not responding to topical medications, phototherapy, or systemic therapies such as corticosteroids, retinoids and immunosuppressives may be considered [1, 42, 43, 45].

Equally important is attention to workplace factors. Based on the diagnosis and severity of reaction, various workplace modifications will be necessary. In some cases, the worker may not be able to return to their workplace. Key considerations in workplace management include the elimination or reduction in exposure to causative agents, the use of appropriate protective equipment, and skin care management. Depending on workplace requirements, other considerations may have to be accommodated such as the need for hand hygiene in health care

workers. A useful tool for summarizing and conveying the workplace recommendations is the “workplace prescription [57]. It guides the provider through the various common workplace modifications and provides a written record of recommendations that can be shared with the worker, employer, and others involved in the worker’s care [57]. Returning individuals with irritant contact dermatitis may be aided by recommendations for graduated return to work [58].

Health Care Utilization

As the assessment and diagnosis are critical to provide appropriate workplace management, information on health service utilization by workers with OCD is helpful to understand possible gaps in care. Studies have demonstrated a significant time between onset of symptoms and seeing a physician. Keegel et al. in Australia found that the mean duration of OCD symptoms before presentation to the physician was 120 weeks [59]. Holness et al. in a study of contact dermatitis clinic patients found a mean delay of 25 months in patients with OCD [48]. In a more recent study, Nurmohamed found 20% had waited over 1 year to see a physician [50]. Hald et al. found the mean duration between onset and seeing a primary care physician of 1.4 years and 2.1 years for seeing a dermatologist [60]. Rusca et al. found an average delay of 8.6 months [61]. Longer patient delay and longer exposure to the causative agent have both been shown to correlate with poorer prognosis [48, 60, 62, 63].

There is information about reasons for the delay in seeking care. Rusca et al. found both patient and disease factors influence the decision to seek medical care [61]. Patient factors included fear and anxiety with regard to losing their job or being made redundant were the most common reasons for delay, expressed by 62% of study respondents. A patient’s attitude towards consulting the health care system is important: 83% first attempted their own methods before seeking help. Patients with symptomatic skin changes, such as pain and burning, and multiple affected areas have less delay. Nurmohamed et al. investigated both reasons for waiting to seek care and then reasons for seeking care [64]. The most common reasons for not seeking care were thinking the symptoms would get better (75%), that they were not serious enough (44%), or that they were not limiting their ability to work (29%). The reasons for seeking care included not getting better or getting worse (51%), symptoms were bothersome (24%), and difficulty to do work or activities (8%). Bathe et al. found that most patients were unable to interpret dry skin as a feature of dermatologic disease [65].

Early Detection/Screening

Delay in seeking care may result in extended exposure to the disease-causing agent. As noted above, there is evidence in the

literature that the earlier a diagnosis is made, the better the outcome. As early identification and management improves outcomes, screening to detect early disease would be desirable. There is limited information in the literature with regard to screening workers in high-risk industries for hand dermatitis. While Emmett recommended screening many years ago, there has been little published in this area and guidelines generally suggest that screening might be useful but there is not enough evidence [66]. While Nordic Skin Questionnaire has a short version, it is four pages and may be too long for a screening program [67]. Recently, the Hand Dermatitis Screening Tool has been developed and tested in health care workers [37•]. This may serve as a useful screening tool and can also be self-administered.

Outcomes

There are a variety of different types of outcomes to consider for workers with OCD. Disease outcome has been assessed and while many workers improve if management is instituted, there are still groups who continue to have dermatitis [38]. A recent study from Denmark found that only 19% reported complete healing at follow-up [68].

There is limited information on how OCD impacts function. Holness et al. studied function in workers with OCD and found moderate to severe finger joint restrictions in 30% of those assessed and 31% had a greater than 10% decrease in productivity [69].

OCD has been shown to have significant impact on work. This includes lost time from work, change of job, and loss of job. The systemic review concluded that up to 50% of workers lose time from work due to their dermatitis [38]. At times, this may be for extended periods. For example, in a group with OCD followed for at least 2 years, 35% had lost more than 1 month of work [70]. Loss of job or change of employment is also common in workers with OCD [38]. For example, in a study performed at the time of definitive diagnosis, 9% were not working because of their skin disease, 19% had a different job, and 48% experienced high work instability [69]. Diepgen, in an analysis of cost, noted that 63% of workers had lost time from work and that the average was 76 days in the past year [71]. A recent study from Denmark found over 50% of those with occupational hand eczema were no longer in the same profession: 33% had changed profession and 19% were not employed [72•].

OCD also affects quality of life. While there are many quality of life tools, the most commonly used in the case of OCD is the Dermatology Life Quality Index. There are many studies that have examined quality of life and in summary it is thought that up to half of workers with OCD have adverse impact on their quality of life [38]. In addition, some studies have examined mental health impact and found 20% had a positive anxiety score and 14% a positive depression score [73].

The economic impact has also been assessed. Diepgen et al. estimated the cost of illness for those with OCD in Germany, both direct and indirect costs [71]. Annual costs were calculated as 8799 Euros per patient. Estimated societal costs associated with OCD range from \$4984 for those with partial disability (sick leave up to 3 months) to \$115,029 for those with total permanent disability in their current profession [74]. These costs, compounded by a high prevalence rate, lead to the potential for significant economic loss by the compensation and healthcare systems, employers as well as the ill workers.

Prevention

Given the frequency of OCD and the impact on not only workers, but also employers, insurers and the health care system, prevention is key. An excellent resource covering the various aspects of prevention is by Sithamparadanadaraj [75]. There have been several systematic reviews of prevention for occupational contact dermatitis including that of the British Occupational Hygiene Research Foundation, summarized by Nicholson et al. and a Cochrane review for the prevention of irritant contact dermatitis that has been recently updated [40, 76••]. The general principles of prevention include elimination or substitution of the hazardous agent, engineering controls, personal protective equipment, education, and hand care. While prevention strategies are well known and often required under occupational health and safety legislation, there is evidence that they are not always in place. Recent studies have demonstrated that less than half of workers being assessed for possible occupational contact dermatitis (having exposures in the workplace) do not report workplace training specific to skin exposure prevention [77, 78].

Summary

Contact dermatitis remains the most common occupational skin disease and has significant disease, function, work, quality of life, and economic consequences. Wet work continues to be the major source of irritant exposure. New uses of known allergens and emerging allergens continue to be recognized. There are a variety of sources of information on the common jobs and causative agents, all with limitations but taken together provide a good picture of the common jobs and causative agents. The clinical history is critical, in particular a complete occupational history, and patch testing are important but studies show delays in seeking health care and also variation in patch test availability. Medical management is for the improvement of dermatitis, but workplace interventions are critical to successful outcomes. As early identification and management results in better outcomes, screening should be considered and the new Hand Dermatitis Screening Tool (<http://creod.on.ca/occupational-skin-disease/skin-health-toolbox/>) has been developed for this purpose.

While the prevention strategies for OCD are known, there is continued demonstration that they are not necessarily implemented in the workplace. In summary, although much is known about OCD, there continue to be gaps in practice related to primary, secondary, and tertiary prevention that need attention in order to reduce the burden of OCD.

Compliance with Ethics Guidelines

Conflict of Interest The author declares no conflicts of interest relevant to this manuscript.

Human and Animal Rights and Informed Consent Research involving human subjects, human material, or human data, has been performed in accordance with the Declaration of Helsinki and has been approved by an appropriate ethics committee.

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