OCCUPATIONAL SKIN DISEASES

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Occupational dermatology is the facet of dermatology that deals with skin diseases the cause or aggravation of which is related to some exposure in the workplace. By its nature, occupational dermatology is also related to occupational and preventive medicine. The ideal role of a medical practitioner involved in occupational dermatology is to diagnose and treat patients and to determine the cause of the occupational skin disease and make recommendations for its prevention. Making the diagnosis and offering treatment, determining cause, and recommending preventive measures can all be difficult undertakings.

Many references on occupational skin disorders are available.[1,31,52] In addition, the National Institute for Occupational Safety and Health offers an occupational dermatoses photo library and program for physicians on its Internet Web site *http://www.cdc.gov/niosh/ocderm.html.*

Occupational dermatology covers a wide variety of skin diseases. The causes of occupational skin disorders can be grouped into the following general categories:

1. physical insults (friction, pressure, trauma, vibration, heat, cold, variations in humidity, ultraviolet/visible/infrared radiation, ionizing radiation, and electric current)
2. biologic causes (plants, arthropods, bacteria, rickettsiae, viruses, fungi, and parasites)

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3. chemical insults (water, inorganic acids, alkalis, salts of heavy metals, aliphatic acids, aldehydes, alcohols, esters, hydrocarbons, solvents, metallo-organic compounds, lipids, aromatic and polycyclic compounds, resin monomers, and proteins)

Because epidemiologic data show that contact dermatitis accounts for 90% to 95% of all occupational skin diseases,[15,26,40,55] this entity is emphasized here. Other occupational skin diseases that are discussed include contact urticaria, skin infections, and skin cancers.

OCCUPATIONAL CONTACT DERMATITIS

Occupational contact dermatitis is an inflammatory skin condition caused by skin contact with an exogenous agent or agents found in a workplace setting. It is widely accepted that of all cases of contact dermatitis, 80% are caused by a nonimmunologic reaction to chemical irritants (irritant contact dermatitis) and 20% to allergic reactions (allergic contact dermatitis).[17,27] Irritant contact dermatitis is a cutaneous inflammation resulting from a direct cytotoxic effect of a chemical or physical agent, whereas allergic contact dermatitis is a type IV, delayed or cell-mediated immune reaction. Any chemical, in sufficient concentrations and under the right conditions, can cause irritation. Only certain chemicals are allergens, and only a proportion, usually small, of people are susceptible to them. Complete reviews of irritant and allergic contact dermatitis are available in other sources.[1,52,72,75]

In contact dermatitis, the skin initially turns red and can develop small, oozing vesicles and papules. After several days, crusts and scales form. Stinging, burning, and itching may accompany the rash. With no further contact with the causative agent, the rash usually disappears in 1 to 3 weeks. With chronic exposure, deep fissures, scaling, and hyperpigmentation can occur. Exposed areas of the skin, such as hands and forearms, which have the greatest contact with irritants or allergens, are most commonly affected. Epidemiologic data show that occupational contact dermatitis has a particular anatomic distribution, with the hands and the face being the most common sites.[90] Approximately 80% of occupational contact dermatitis cases have hand involvement[23,67] and 10% have involvement of the face.[67] If the chemical gets on clothing, it can produce rashes at areas of greatest contact, such as thighs, upper back, armpits, and feet. Dusts can produce rashes at areas where the dust accumulates and is held in contact with the skin, such as under the collar and belt line, at the tops of socks or shoes, and in flexural areas (e.g., front of the elbow, back of the knee). Mists can produce a dermatitis on the face and anterior neck. Irritants and allergens can be transferred to remote areas of the body (such as the trunk or genitalia) by unwashed hands or from areas of accumulation (such as under rings or in between fingers).

It is often impossible to clinically distinguish irritant contact from allergic contact dermatitis because both can have a similar appearance and both can be clinically evident as an acute, subacute, or chronic condition.

Public Health Importance

Measures of the public health importance of a disease include the absolute number of cases, incidence, prevalence, economic impact of the disease, and the prognosis and preventability of the disease.[48,49]

Specific national occupational disease and illness data are available from the US Bureau of Labor Statistics (BLS). The BLS conducts annual surveys of approximately 250,000 employers, selected to represent all private industries in the United States.[12] All occupational skin diseases or disorders, including contact dermatitis, are tabulated in this survey. Bureau of Labor Statistics data show that occupational skin diseases accounted for a consistent 30% to 45% of all cases of occupational illnesses from the 1970s through the mid 1980s and now represent 10% to 15% of all occupational illness.[12] The decline in this proportion may be partially related to an increase seen in disorders associated with repeated trauma.

Bureau of Labor Statistics data for occupational skin diseases for 1993 to 1997 are shown in Figure 1. In 1997, BLS data estimated 57,900 cases of occupational skin diseases or disorders in the US workforce.[12] Because of BLS survey limitations, however, it has been estimated that the number of actual occupational skin diseases may be on the order of 10 to 50 times

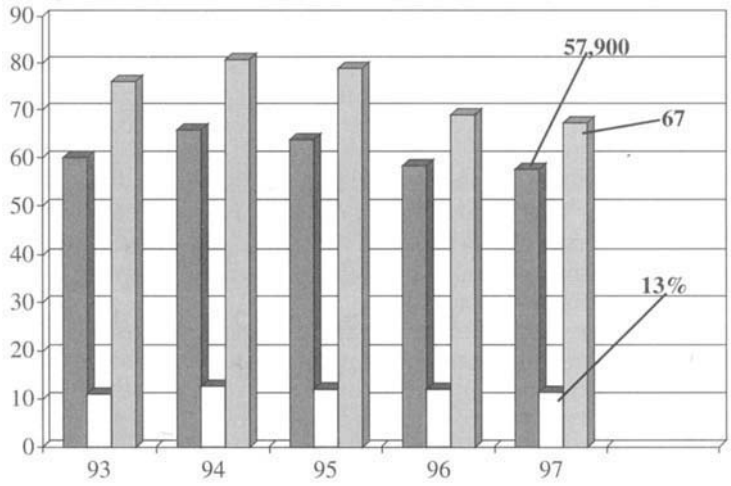

Figure 1. Occupational skin diseases, 1993–1997. Solid bars = number (000s); open bars = percentage of total illnesses; shaded bars = incidence (per 100,000). (*Data from* US Bureau of Labor. Occupational Injuries and Illnesses in the United States. Washington DC, US Bureau of Labor Statistics 1999.)

higher than reported by the BLS.[53,62] This would potentially raise the number of occupational skin disease cases to between 0.5 million and 2.9 million per year. Bureau of Labor Statistics data showed an annual incidence of 67 cases per 100,000 workers in 1997.[12]

In 1988, the National Health Interview Survey (NHIS) included an Occupational Health Supplement. The survey consisted of personal interviews with members of randomly selected households. For 30,074 people participating in the NHIS, the period prevalence for occupational contact dermatitis occurring in the preceding year was 1.7%. Projecting these results to the US working population resulted in an estimate of 1.87 million people with occupational contact dermatitis and a 1-year period prevalence of 1700 per 100,000 workers.[7] It is important to stress that the numbers and rates in the BLS and NHIS surveys are not directly comparable because they rely on different information sources with different ascertainment methods and different case definitions.

The economic impact of a disease can be measured by the direct costs of medical care and workers' compensation or disability payments, and the indirect costs associated with lost work days and loss of productivity. An analysis of 1984 US occupational skin disease data estimated annual medical costs of more than $4.7 million ($67 per case) and workers' compensation claim awards of over $6.3 million ($1590 per case).[53] In several studies, a consistent 20% to 25% of the workers with occupational skin diseases lost time from work, staying out an average of 9 to 11 days per lost work day case.[12,15,40,92] Based upon these numbers, the estimated annual indirect cost of lost productivity attributable to occupational skin diseases in 1984 was $11 million ($700 per case).[53] In 1984, the estimated annual direct and indirect costs exceeded $22 million. Considering that the actual annual incidence figures may be 10 to 50 times greater than reported in the BLS data, however, the total annual cost of occupational skin diseases may range from $222 million to $1 billion.[53] These estimates do not include costs of occupational retraining or costs attributable to the effects on the quality of life.

A review of 1993 BLS data showed that of 60,200 cases of occupational skin diseases, 12,613 (21%) resulted in days away from work.[13] The mean time away from work was 3 days, but 17.4% of lost work day cases had more than 11 days away from work.[13] Of those with days away from work, 70% had a diagnosis of dermatitis.

Although there may be discrepancies among countries regarding health care, compensation, and labor policies, international data provide some interesting information. If time off from work is used as a potential measure of severity, then conflicting information comes from existing studies. In one study of hand dermatitis in Dutch workers, 2% to 10% of the cases took sick leave for hand dermatitis and 15% to 30% sought medical attention.[82] This led to a conclusion that "although the relatively high prevalence of hand dermatitis ... emphasizes the need for preventive measures, the proportion requiring medical attention and sick leave suggests that the symptoms were relatively mild in the majority of cases."[82] A study of 1496 Swedish patients with contact dermatitis found that 42%

had taken sick leave because of the condition.[26] A follow-up study of 235 Canadian workers with occupational skin diseases showed that 35% had been away from work for greater than 1 month, 14% between 1 week and 1 month, 17% less than 1 week, and 33% did not lose work days because of the skin condition.[35]

Studies investigating the prognosis of occupational contact dermatitis are limited. Of patients with occupational contact dermatitis followed over a 3 to 10 year period, only 25% had complete healing of dermatitis; approximately 75% had chronic eczema or recurrences of dermatitis.[14,26,29] Of 555 patients completing a follow-up questionnaire 2 to 3 years after diagnosis, only 26% of the women with irritant contact dermatitis had complete healing (22% had continual symptoms, 52% had recurring symptoms) and only 31% of the men had complete healing (29% had continual symptoms, 40% had recurring symptoms).[26] A telephone survey of 235 occupational skin disease patients, conducted a mean of 4 years after diagnosis, showed that 40% had continuing dermatitis, although, of this group, 76% reported an improvement in their skin condition.[35] Other studies are contradictory as to whether allergic or irritant contact dermatitis has a better prognosis.[26,32,35] Outcomes may or may not be influenced by leaving the dermatitis-provoking job.[26,29,35] These studies show that primary prevention of occupational contact dermatitis is all the more important.[20,32]

Over the years, there have been changes in the epidemiology of occupational skin diseases, of which, as noted, the overwhelming majority of cases are contact dermatitis. A decrease in the absolute number of cases and incidence in the BLS survey from the 1970s and into the 1990s may be attributable to several factors: changes in industry and industrial practices, increased awareness and preventive measures, and possible underreporting, underrecognition, and misclassification.[85] Still, the data do point out that occupational contact dermatitis remains a relatively common disease with a noteworthy public health impact. These factors, along with the potential chronicity of the disorder, its effect on an individual's vocational and avocational activities, and the fact that it is preventable make occupational contact dermatitis a disease of public health importance.

Population at Risk and Causative Agents

Information on general contact dermatitis risk factors is helpful to delineate risk factors and susceptibilities for occupational contact dermatitis. Overall, the major risk factor for any contact dermatitis is exposure to an irritant or sensitizer. In terms of irritant contact dermatitis, there are age-associated changes in the skin that can alter the skin's response to irritants. The epidemiology as it relates to age is not well characterized, however. Racial characteristics may play a role, with black skin possibly being more resistant to irritant reactions than white skin.[4] In some studies, skin irritation of the upper extremity is more often found in women than

men.[47,59] Genetic factors also play a role in the development of irritant contact dermatitis, as shown in studies with monozygotic twins.[36] Finally, other skin diseases, such as atopic dermatitis, may predispose an individual to develop irritant contact dermatitis.[26,76–78] Environmental factors such as heat, cold, humidity extremes, and wet work may have similar effects.[80]

Many factors play a role in allergic contact dermatitis, including factors related to the individual, the allergen, and the environment. As in irritant contact dermatitis, the individual factors include age, gender, and genetic predisposition. Pre-existing irritant dermatitis results in a breakdown of the epidermal barrier and allows for sensitization to develop more readily.[24] Unlike the situation with irritant contact dermatitis, however, individuals with atopic dermatitis are not more likely to develop allergic contact dermatitis.[76,78]

A myriad of occupations have unique exposures resulting in occupational contact dermatitis. Many of these are well described in the literature.[2,52] Total numbers and incidence rates of occupational dermatologic conditions by major industry division from the BLS Survey for 1996 are listed in Table 1.[12] The greatest numbers of cases of occupational skin diseases are seen in manufacturing, but the highest incidence is seen in agriculture/forestry/fishing.

In addition, high incidence rates have been noted in industries involved with the following goods and services: landscaping and horticulture, poultry dressing and processing, fresh and frozen packaged fish, beet sugar, surface active agents and penetrants, adhesives and sealants, and abrasive products.[55,58] In a patch test clinic study of more than 9700 patients in Belgium, the most commonly affected occupational groups included mechanics, housekeepers, metal workers, cleaners, health care workers, office workers, cement workers, hairdressers and beauticians, bakers, and cooks.[23] In the NHIS, the occupational groups with the highest prevalence of self-reported occupational contact dermatitis included physicians, dentists, nurses, pharmacists, dieticians (5.6%); public transport at-

Table 1. NUMBERS AND INCIDENCE OF OCCUPATIONAL SKIN DISEASES BY MAJOR INDUSTRY, BUREAU OF LABOR STATISTICS 1996

Industry	Number of Cases	Incidence per 100,000
Agriculture/forestry/fishing	2170	168
Manufacturing	25,877	141
Services	19,912	82
Transport/utilities	2125	36
Construction	1616	33
Wholesale/retail	5573	25
Mining	96	16
Finance/insurance/realty	731	12
Total	58,100	69

Data from Bureau of Labor Statistics (BLS): Occupational Injuries and Illnesses in the United States 1996. Washington, DC, US Department of Labor, BLS, Bulletin 2512, April 1999.

tendants, cosmetologists, other personal service occupations (4.9%); health care therapists, technologists, technicians, assistants (3.5%); and mechanics and repairers of vehicles, engines, heavy equipment, and machinery (3.5%).[7] Of all accepted workers' compensation claims for occupational contact dermatitis in Oregon, the common occupations were laborers (14.2%), food service (13.8%), machine operators (13.1%), agriculture (9.0%), health professionals (8.2%), janitors and maids (6.4%), followed by production crafts, mechanics, construction, and hairdressers or cosmetologists.[70]

Extensive lists of irritants and allergens are available in reference books.[1,72] The most frequent causes of irritant contact dermatitis include soaps and detergents, fiberglass and other particulate dusts, food products, cleaning agents, solvents, plastics and resins, petroleum products and lubricants, metals, and machine oils and coolants.[55,57] Causes of allergic contact dermatitis include metallic salts, organic dyes, plants, plastic resins, rubber additives, and germicides.[57]

In 5046 patch-tested patients, the most common allergens were nickel, thimerosal, neomycin, formaldehyde, paraphenylenediamine, quaternium-15, thiuram mix, balsam of Peru, cinnamic alcohol, ethylenediamine, cinnamic aldehyde, carba mix, mercapto mix, and potassium dichromate.[67] In patients with occupational contact dermatitis, the common allergens included mercapto mix, mercaptobenzothiazole, rosin, thiuram, paraphenylenediamine, and epoxy resin.[67] In a Belgian study of more than 2000 patients with occupational contact dermatitis, the most frequent allergens were nickel, chromate, paraphenylenediamine dihydrochloride, cobalt, epoxy resin, thiuram derivatives, and black rubber mix.[23]

Diagnosis and Treatment

The work-relatedness of skin diseases may be difficult to prove. The accuracy of the diagnosis is related to the skill level, experience, and knowledge of the medical professional who makes the diagnosis and confirms the relationship with a workplace exposure. Guidelines are available for assessing the work-relatedness of dermatitis,[56] but even with guidelines, the diagnosis may be difficult. The diagnosis is based on the medical and occupational histories and physical findings. The importance of the patient's history of exposures and disease onset is clear. In irritant contact dermatitis, there are no additional confirmatory tests. Patch tests or provocation tests are discouraged because of a high false-positive rate. In many instances, allergic contact dermatitis can be confirmed by skin patch tests using specific standardized allergens or, in some circumstances, by provocation tests with nonirritating dilutions of industrial contactants.[72] Patch testing is less than the ideal gold standard; its sensitivity and specificity are about 70%, with a 50% relevance (predictive value positive) for positive tests (i.e., in half the cases, the chemical inducing a patch test response can be established as the cause of the patient's present or past skin condition).[66] Skin patch tests should only be conducted by health care pro-

fessionals trained in conducting and interpreting the tests. Skin patch tests should never be conducted with unknown substances.

The following questions can be used as criteria for determining work-relatedness:[56] (1) Is the clinical appearance consistent with contact dermatitis? (2) Are there workplace exposures to potential cutaneous irritants or allergens? (3) Is the anatomic distribution of dermatitis consistent with cutaneous exposure in relation to the job task? (4) Is the temporal relationship between exposure and onset consistent with contact dermatitis? (5) Are nonoccupational exposures excluded as probable causes? (6) Does dermatitis improve away from the exposure to the suspected irritant or allergen? (7) Do patch tests or provocation tests identify a probable causal agent?

Avoiding causative irritants and allergens is the first step in any treatment regimen. Dermatitis is treated according to its clinical stage. Acute dermatitis treatment options can include a short course of systemic steroids, topical steroids, and soothing compresses or baths. Antihistamine therapy or use of sedatives may be helpful to decrease pruritus. If secondary infection is present, topical or systemic antibiotics are indicated. Subacute dermatitis and chronic dermatitis are usually treated with topical steroid therapy and lubrication of the skin. Potential dangers of long-term use of topical steroids (especially the high-potency steroids) include systemic effects and skin atrophy. In addition, contact dermatitis can occur from the fragrance additives, vehicles, or the steroids themselves.

Prevention

Strategies in the prevention of occupational contact dermatitis include identifying allergens and irritants, substituting chemicals that are less irritating or allergenic, establishing engineering controls to reduce exposure, using personal protective equipment such as gloves and special clothing, emphasizing personal and occupational hygiene, and establishing educational programs to increase awareness in the workplace.[55,57,63] Chemical changes in industrial materials have proved to be beneficial. The addition of ferrous sulfate to cement to reduce the hexavalent chromium content was effective in reducing occupational allergic contact dermatitis in Europe, for example. The prevalence of chromate allergy in cement workers had fallen from 11% to 3% over a 6-year period during which this intervention occurred.[5] The introduction of personal protective equipment must be considered carefully because it may actually create problems by occluding allergens or irritants or by directly irritating the skin. Similarly, the excessive pursuit of personal hygiene in the workplace may actually lead to misuse of soaps and detergents and resulting irritant contact dermatitis.[54] The effectiveness of gloves depends on the specific exposures and the types of gloves used. Among solderers in the electronics industry, glove use decreased the period prevalence of work-related skin rashes from 15.4% to 3.4%.[41] The effectiveness of barrier creams is controversial,[69] and, at times, workers using barrier creams may have a higher

prevalence of occupational contact dermatitis than those who do not use the creams.[89] Other interventions, which included providing advice on personal protective equipment and educating the workforce about skin care and exposures, were beneficial for construction workers.[37]

OCCUPATIONAL CONTACT URTICARIA

Urticaria is defined as the transient appearance of elevated, erythematous pruritic wheals or serpiginous exanthem, usually surrounded by an area of erythema. Areas of macular erythema or erythematous papules may also be present. These skin lesions appear and peak in minutes to hours after the causative exposure, and individual lesions usually disappear within 24 hours. Urticarial lesions usually involve the trunk and extremities, although they can involve any epidermal or mucosal surface. Large wheal formation, in which the edema extends from the dermis into the subcutaneous tissue, is referred to as *angioedema*. This condition is more commonly seen in the more distensible tissues, such as the eyelids, lips, ear lobes, external genitalia, and mucous membranes.

Urticarial lesions can be classified in one or more of the following categories, based upon characteristic features:

1. duration or chronicity—acute or chronic
2. clinical distribution of the lesions or the extradermal manifestations—localized, generalized, or systemic associated with rhinitis, conjunctivitis, asthma, or anaphylaxis
3. etiology—idiopathic or cause-specific
4. routes of exposure—direct contact, inhalation, or ingestion
5. mechanisms—nonimmunologic, immunologic, or idiopathic

Acute urticaria ranges from a single episode to recurrences over a period of less than 6 weeks. Common causes of acute urticaria include insect bites or stings and food or drug allergies. Chronic urticaria occurs daily (or almost daily) over a period longer than 6 weeks. Food, drugs, and infections can also be causes of chronic urticaria. In the chronic form, however, the exact causative agents may never be identified. In the majority of cases of urticaria, the cause is unknown.

Occupational urticaria is urticaria that is presumed or proven to be caused by exposure to one or more substances or physical agents in the workplace. Occupational urticaria may be acute or chronic, localized or generalized, or associated with systemic manifestations, such as asthma. In occupational settings, direct contact with substances, and possibly inhalation, may be the most common routes of exposure inducing urticaria. The pathologic mechanisms may be nonimmunologic, immunologic, or of uncertain cause. Contact urticaria is defined as urticaria that occurs after direct skin contact with a substance. Extensive lists of causative agents are available in several sources, and new agents are continually being described.[33,43–45,51,73,86] Urticarias that result from nonchemical exposures are commonly classified as physical urticarias. Up to 17% of chronic

urticarias may be attributable to physical causes.[18] These include mechanical urticarias (caused by trauma, pressure, friction, and vibration) and urticaria resulting from local exposure to physical agents (such as cold, heat, and solar radiation) and water.[10,16]

Public Health Importance

Data specific for occupational urticaria are limited. In 1993, BLS estimated 60,200 cases of occupational skin diseases or disorders in the US workforce.[12] Further information is available on the estimated 12,613 cases that involved days away from work. Of this subgroup, an estimated 142 (1.1%) had urticaria or hives; their median time away from work was 5 days. These 142 workers included 81 from the services industry, 39 from manufacturing, 9 from transportation and public utilities, and 13 not classified.

Population At Risk and Causative Agents

In general, risk factors for contact urticaria include a history of atopy, a compromise to the barrier function of intact skin (such as eczema, abrasions, ulcers), and, in some cases, occupation.[81] Based upon reviews of epidemiologic studies, exposures, and patterns seen in case reports, several occupations may be at higher risk for the development of contact urticaria. These include: (1) food handlers, cooks, caterers, and bakers; (2) general health care workers,[19] dental professionals,[38] and pharmaceutical industry workers[79]; (3) animal handlers, such as laboratory workers and veterinarians; and (4) gardeners, florists, woodworkers, and agricultural workers.

For food handlers, cooks, caterers, and bakers the following foods have been reported to produce contact urticaria: apples, bean, beer, caraway seed, carrot, egg, endive, fish, garlic, kiwi fruit, lettuce, meat (beef, chicken, lamb, liver, pork, and turkey), milk, peach, potato, rice, shellfish, spices, and strawberries.[73,86] Bakers can develop contact urticaria and other systemic symptoms after exposure to cereal flours, buckwheat flour, and additive flour enzymes such as α-amylase.[60,73,88]

In health care, dental, and pharmaceutical environments, handling or producing a variety of medications or chemical disinfectants can put workers at risk. Exposures that can cause contact urticaria include aminothiazole, bacitracin, benzocaine gel, cephalosporins, chloramine (a sterilizer, disinfectant, and chemical reagent), chloramphenical, chlorhexidine (an antiseptic), chlorocresol (a disinfectant), ethylene oxide, gentamicin, neomycin, nitrogen mustard, penicillin, pentamidine isethionate, phenothiazines, rifamycin, and streptomycin.[8,73,86] Furthermore, natural rubber latex has been found to be an important cause of contact urticaria in health care professionals.[25,68,87] Natural rubber latex gloves are the most common source of exposure.

Contact urticaria has been found to be caused by animal hair (rat and guinea pig exposure in laboratory workers), dander, insects (such as cockroaches and locusts), animal placenta, saliva, seminal fluid, and serum.[86] Slaughterhouse workers can develop contact urticaria upon exposure to animal blood.[28] Contact urticaria can be seen in veterinarians after exposure to cow's hairs and placenta, horse dander, and pig's bristles.[73]

Certain woods and plants can cause contact urticaria. These include the larch, limba, obeche (African maple), and teak woods,[30,86] and plants such as chrysanthemum, *Ficus benjamina* (weeping fig), lilies, *Limonium tataricum*, *Phoenix canariensis* (canary palm), *Spathiphyllum walisii* (spathe flower), tulips, and fungi (shiitake mushrooms).[6,11,39,42,71,83,84] High-risk occupations include agricultural workers, carpenters, florists, gardeners, and woodworkers. Caterpillar hair, insect stings, and moths can also cause contact urticaria in outdoor workers.[86] Agricultural workers may also be exposed to fertilizers and pesticides, some of which can cause contact urticaria.

A variety of industrial chemicals can cause contact urticaria, including acrylic monomers (plastics), aliphatic polyamines (epoxy resins), alkylphenol novolac resin, ammonia, castor bean (fertilizers), diethyltoluamide, formaldehyde (used in clothing, leather, fumigation, and resins), lindane (a parasiticide), paraphenylenediamine, phenylmercuric priopionate (an antibacterial fabric softener), plastic additives (such as butylhydroxytoluene and oleylamide), reactive dyes, sodium sulfide (used in photographs, dyes, and tanning), sulfur dioxide, vinyl pyrilidine, xylene, and other solvents.[73,86] Contact urticaria can occur with exposure to a variety of metal salts, including iridium, nickel, platinum, and rhodium.[9,86]

Diagnosis and Treatment

The diagnosis of occupational urticaria is based on the medical and exposure histories, physical findings, and in vitro or in vivo testing. Definitely proving work-relatedness may be difficult. Suggested criteria include[51]: (1) documentation of urticaria by physical examination; (2) exposure to an agent known or presumed to cause urticaria; (3) a temporally consistent relationship between exposure and onset of urticaria (usually 30–60 minutes); (4) associated medical symptoms and localization of urticaria consistent with the route of exposure; (5) resolution of the urticaria away from the exposure; (6) exclusion of nonoccupational causes; (7) medical testing results indicating allergy to a substance in the workplace; these tests include open or closed patch test, prick or scratch test, and evidence of specific IgE to suspect occupational antigens using radioallergosorbent test assays.

In cases of occupational urticaria in which a specific causal agent can be identified, the initial treatment is avoidance of the offending agent. First-generation antihistamines, which block H_1 receptors (e.g., diphenhydramine, hydroxyzine), should be employed initially, but they frequently cause sedation; this may present a safety issue for certain occu-

pations (e.g., heavy equipment operators). When sedation occurs or presents a safety concern, nonsedating second-generation antihistamines (cetirizine, astemizole, loratadine, fexofenadine) may be employed. When H_1 histamine blockers alone are not sufficient, they may be combined with H_2 blockers (e.g., cimetidine, ranitidine, famotidine) or doxepin, a tricyclic antidepressant with potent H_1 and H_2 blocking activity. Doxepin is extremely sedating and should be used cautiously, if at all, when safety concerns arise on the job. Oral corticosteroid therapy may be employed for severe cases of chronic urticaria, especially those associated with angioedema.

Prevention

Strategies in the prevention of occupational urticaria overlap those used in the prevention of contact dermatitis and include identifying allergens, substituting chemicals that are nonallergenic, establishing engineering controls to reduce exposure, using personal protective equipment such as gloves and special clothing, emphasizing personal and occupational hygiene, and establishing educational programs to increase awareness in the workplace.[55,57,63] Recommendations for preventing allergic reactions to natural rubber latex in the workplace have been published by the National Institute for Occupational Safety and Health.[64]

OCCUPATIONAL DERMATOLOGIC INFECTIOUS DISEASES

Occupational dermatologic infectious diseases are diseases that have a major manifestation on the skin surface and that result from exposure to an infectious agent found in a workplace setting. Many of the occupational dermatologic infectious diseases result in cutaneous signs and symptoms and in systemic effects. The exposure can occur through direct skin contact (epicutaneous), inoculation (percutaneous), or through the respiratory system (inhalational).

Public Health Importance

Epidemiologic data specifically related to occupational dermatologic infectious diseases are very limited. Other than limited descriptions in case presentations, case studies, and epidemic investigation reports, little is known about the epidemiology of most of these diseases in the United States. It is impossible to determine what proportion of the infectious diseases that are nationally reportable are caused by occupational exposures.

Population at Risk and Causative Agents

Occupational dermatologic infectious diseases can be grouped by causative agent into the following disease categories: (1) bacterial, (2) rick-

ettsial, (3) viral, (4) superficial fungal, (5) subcutaneous fungal, (6) systemic fungal, and (7) parasitic.[50] In general, risk of infection can be associated with individual worker susceptibility (e.g., immune status, trauma to the skin breaching its protective barrier), the distribution of the pathogen in the environment, and occupational exposure to the pathogen, considering its reservoir, mode of transmission, and conditions in which the pathogen thrives. Reservoirs and fomites of the pathogens include people (coworkers, clients, patients, or children), animals or animal products, soil or plant materials, ticks and other insects, water, and marine life. Conditions in which pathogens can thrive and increase worker susceptibility include wet work and hot and humid environments. The occupational dermatologic infectious diseases associated with these sources and conditions are listed subsequently. In addition, laboratory personnel working directly with pathogens are at risk of infection.

Occupational dermatologic infectious diseases associated with exposures to patients or children include:

Tuberculosis (cutaneous)
Herpetic whitlow
Warts
Measles
Rubella
Chickenpox
Herpes zoster (shingles)
Hand-foot-mouth disease
Erythema infectiosum (fifth disease)
Dermatophytes (anthropophilic)
Scabies

Occupational dermatologic infectious diseases associated with exposures to animal and animal products include:

Anthrax
Brucellosis
Cat scratch disease
Erysipeloid
Tuberculosis (cutaneous)
Tularemia
Orf
Milker's nodules
Cowpox
Warts
Dermatophytes (zoophilic)

Occupational dermatologic infectious diseases associated with exposures to soil and plants include:

Anthrax
Dermatophytes (geophilic)
Chromomycosis
Mycetoma
Sporotrichosis

Blastomycosis
Paracoccidioidomycosis
Cutaneous larva migrans

Occupational dermatologic infectious diseases associated with exposures to ticks and insects include:

Lyme disease
Tularemia
Spotted fevers
Typhus
Ehrlichiosis
Rocky Mountain spotted fever
Leishmaniases

Occupational dermatologic infectious diseases associated with water, marine, fish, and shellfish exposures include:

Erysipeloid
Mycobacterium marinum granuloma
Tularemia
Vibrio vulnificus infection
Aeromonas hydrophila infection
Vibrio parahaemolyticus infection
Pseudomonas aeriginosa infection
Warts
Cercarial dermatitis

Occupational dermatologic infectious diseases associated with exposures to wet work and hot and moist environments include:

Candidiasis
Dermatophytoses
Tinea versicolor

Diagnosis and Treatment

In many cases it is difficult to prove the occupation-relatedness of the disease process. The questions to be answered by the clinician include the following: (1) Is the patient's condition a dermatologic infectious disease? (2) Is the organism found in the patient's workplace environment? (3) Was there an opportunity for the worker to become infected in the workplace? (4) What other exposures (e.g., recreational activities) must be considered?[22] Diagnosis and treatment are disease-specific and are beyond the scope of this article.

Prevention

The clinician should view each patient with a potential occupational dermatologic infectious disease from a broader public health perspective.

The worker with an occupational dermatologic infectious disease should be viewed as a sentinel health event.[46,65,74] This recognition and resulting action by the clinician, in consultation with public health authorities, could lead to potential disease prevention in other workers. This can only occur with proper diagnosis of the worker, a high level of suspicion on the part of the clinician in suspecting workplace exposures, ultimate confirmation of the association to the workplace exposures that caused the disease, and, finally, steps taken to modify those exposures.[74] If successful, this approach would lead to the prevention of relapses and of new cases of occupational dermatologic infectious diseases.

OCCUPATIONAL SKIN CANCERS

As early as 1894, Unna in Germany drew attention to the association between chronic sun exposure and skin cancers in outdoor workers (farmers and sailors). Skin cancers include melanoma, basal cell carcinoma, and squamous cell carcinoma. Studies have shown an association between excessive sun exposure and premature skin aging, pre-skin cancers (actinic keratoses), and skin cancer.[21] Nonionizing ultraviolet radiation (UVR) from the sun is the primary cause of skin cancer in general and is also the primary cause of occupational skin cancer. In addition, a variety of chemical exposures may play a causative role in occupational skin cancers.

Public Health Importance

Accurate data on the general prevalence of skin cancers related to occupational exposures are not available. Melanoma is the least prevalent of the three skin cancers but has the greatest risk of fatality, accounting for 85% of skin cancer deaths. The American Cancer Society estimates that more than 47,000 Americans will be diagnosed with melanoma in the year 2000, with 7700 deaths.[3] Melanoma is likely to be related to excessive sun exposure, although the relationship is complex; it seems to be associated with severe sunburns during childhood. Basal cell carcinoma and squamous cell carcinoma are more clearly related to sun exposure, probably as a result of cumulative, chronic exposure. Basal cell and squamous cell skin cancers are by far the most common cancers in the United States with up to 1 million Americans affected and more than 2000 deaths each year.

Population at Risk and Causative Agents

Implicated causes of skin cancers include nonionizing radiation (sunlight exposure and other sources of UVR), ionizing radiation, and thermal and chemical stimuli. Of concern is that outdoor workers may receive up to six to eight times the dose of UVR compared with indoor workers[34] and rates for some skin cancers among outdoor workers have been as-

sociated with cumulative UVR exposure.[91] According to Bureau of the Census statistics, in 1991, more than 8% of the workforce (more than 9 million workers) were listed in the following potential outdoor occupations: construction, farm, forestry, fishing, gardeners, grounds keepers, mail carriers, amusement or recreation attendants, surveying, and mapping. There are likely many more workers occupationally exposed to UVR in sunlight. In addition, workers exposed to chemical agents, such as polycyclic aromatic hydrocarbons, arsenic, alkylating agents, and nitrosamines may be at increased risk.[1] Other risk factors for skin cancers include Northern European or Celtic family origins and fair skin types.

Diagnosis and Treatment

Diagnosis is based upon the history, physical findings, and pathology results. Treatment of specific skin cancers, which is beyond the scope of this article, depends on the specific type of skin cancer, size, depth, and location of the lesion, and evidence of metastases.

Prevention

The strategies of prevention include preventing excessive UVR exposure by limiting exposure to sunlight, introducing changes in work practices to limit sun exposure during peak UVR hours (10 a.m. to 4 p.m.), wearing UVR-protective clothing and wide-brimmed hats, using broad-spectrum (blocking both UVA and UVB) sunscreens of at least solar protection factor (SPF) 15, and wearing UV-blocking sunglasses. Limiting skin exposure to chemicals known to play a role in skin cancers is also important.

In many areas, the National Weather Service, in cooperation with the Centers for Disease Control and Prevention and the Environmental Protection Agency, issues daily predictions for UVR exposure. The daily UV Index, reported on a scale from 1 to 15 (15 being high), is part of selected local weather broadcasts and can be used to warn outdoor workers of potential high-exposure days when prevention strategies should be emphasized.

OTHER OCCUPATIONAL SKIN DISEASES

Many other skin diseases may be related to occupational exposures (Table 2).[1,31,52] Other skin diseases may not be caused by occupational exposures but may be exacerbated by such exposures. Examples include lesions of psoriasis produced at sites of skin friction or injury, heat exacerbating rosacea, and wet work initiating dyshidrotic eczema.

Table 2. OTHER OCCUPATIONAL SKIN DISEASES AND EXAMPLES OF ASSOCIATED EXPOSURES

Condition	Associated Exposures
Hyperkeratoses/calluses/fissuring/blistering	mechanical trauma
Burns	heat, electricity, radiation, acids, alkalis
Frostbite/immersion foot, chilblain	cold, moist environments
Folliculitis/furuncles and acneform dermatoses	oils, greases
Chloracne	chlorinated hydrocarbons
Photodermatitis (phototoxic and photoallergic)	plants, coal tar, creosote, fragrances
Depigmentation/leukoderma	phenols, hydroquinones
Hyperpigmentation/occupational melanosis	coal tar, pitch
Skin discolorations	silver, gold
Occupational Raynaud's disease/vibration white finger	tools causing hand/arm vibration
Miliaria rubra/prickly heat	hot, humid work environments
Asteatoric eczema/winter eczema	cool, dry work environments
Granulomatous dermatoses	beryllium, zirconium
Ulcerative lesions	chromium, chemical burns
Connective tissue disorders such as sleroderma	silica, vinyl chloride
Nail disorders	mechanical trauma, contact dermatitis, infections
Alopecia	chlorbutadine, dimethylamine

CONCLUSION

Occupational skin diseases include allergic contact dermatitis, irritant contact dermatitis, contact urticaria, a variety of infectious diseases, and skin cancers. Thorough investigations of workers with occupational skin diseases can be difficult. Workers should be encouraged to report all potential work-related skin problems to their employers and physicians. Because the work-relatedness of skin diseases may be difficult to prove, each person with possible work-related skin problems needs to be fully evaluated by a physician, preferably one familiar with occupational dermatologic conditions. A complete evaluation would include a full medical and occupational history and a review of exposures, medical examination, diagnostic tests (such as skin patch tests to detect causes of allergic contact dermatitis), and complete follow-up to note the progress of the affected worker. Individuals with occupational skin diseases should be protected from exposures to presumed causes or exacerbators of the disease. In some cases of allergic contact dermatitis or contact urticaria, workers may have to be reassigned to areas where exposure is minimized or nonexistent.

Three factors point out the importance of occupational skin diseases to public health: (1) Occupational skin diseases are common. 2) They often have a poor prognosis. 3) They result in a noteworthy economic impact for society and for an individual because they affect vocational and avocational activities. They are also diseases amenable to public health inter-

ventions. The goal of the US Public Health Service for the year 2010, as established in its Healthy People 2010: National Health Promotion and Disease Prevention Objectives, is to reduce national occupational skin disorders or diseases to an incidence of no more than 46 per 100,000 full-time workers.[61] Both irritant and allergic contact dermatitis are considered priority research areas as outlined in the National Occupational Research Agenda introduced in 1996 by the National Institute for Occupational Safety and Health. Increased knowledge and awareness of occupational skin diseases by primary care physicians will assist in achieving the national public health goals.

ACKNOWLEDGMENTS

The author wishes to acknowledge Mitchell Singal, MD, MPH and Patricia Cusumano, MD for their review of the manuscript.

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