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Health Effects Associated with Occupational Immune Disorders

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Review Article

Occupational immune disorders are one of the most common illnesses affecting workers. An estimated 11 million American workers in all industries have become substances that can cause allergic diseases such as asthma, allergic contact dermatitis (ACD), urticaria, allergic rhinitis, eczema, and folliculitis. It may have been exposed [1]. Importantly, occupational exposure accounts for approximately 9-25% of all adult asthma cases [2, 3], and ACD accounts for 20% of all work-related skin disorders [4]. These illnesses affect a person's health and ability at work and can result in significant financial loss [4]. These illnesses affect human health and productivity in the workplace and can result in significant financial loss [5, 6]. Similar findings have been reported in Europe and other developed countries where occupational allergens are recognized as a health risk [7]. Occupational asthma and ACD have been reported to show an increased incidence of health care workers [8]. Cosmetologists and cosmetologists [9, 10]; people working in the manufacturing and automotive industries [11]; people working with and metals compared to people in other professions [12]. More than 250 occupational asthma pathogens have been reported, with approximately 400 allergens available for human patch testing, demonstrating the wide range of potential allergens found in the workplace. The severity of an allergic condition can be influenced by several factors, including the route of exposure, the source of exposure, the environment, and genetics. Allergic diseases are characterized by an incubation period between exposure (sensitization) and symptoms (induction) and may include immunoglobulin E (IgE) and non-IgE mediated reactions. As first classified by Gelland Coombs in 1963, there are four basic hypersensitivity reactions associated with hypersensitivity or allergic reactions [13]. Different responses were characterized based on the primary effector molecules and immune cells involved in each response. Type I and Type IV (called IgE and non-IgE mediators, respectively) are the most common hypersensitivity reactions in the workplace. Although these classification schemes have been further subdivided in recent years, there is growing awareness of the importance of the role of the innate immune system in allergies.

Immunoglobulin E-Mediated

IgE-mediated allergic reactions are mediated by IgE antibodies and mast cells and are sometimes referred to as immediate (type I) hypersensitivity. This includes the initiation of T helper 2 cytokines such as interleukin (IL) -4 and IL-13, which triggers IgE production by B cells. When IgE is produced and secreted, it binds to mast cells and basophils. When activated, these cells degranulate and release soluble allergic mediators such as histamine and leukotrienes. They act on smooth muscle, sensory nerves, mucous glands, arteries, and eosinophils [14]. Common clinical outcomes of IgE-mediated responses are increased vascular permeability, smooth muscle cell contraction, and vasodilation. IgE-mediated reactions appear within minutes to hours after exposure. Depending on the location and frequency of allergen exposure, these reactions occur in one or more organs and can lead to diseases such as asthma, allergic rhinitis, urticaria, and anaphylaxis.

Non-Immunoglobulin E-Mediated

Non-IgE-mediated or delayed-type hypersensitivity reactions (Type IV) are T-cell-mediated and are characterized by excessive inflammation. The most characteristic feature of non-IgE-mediated hypersensitivity response is the observed delay between the allergen challenge and the immune response. After sensitization, subsequent exposure activates and recruits inflammatory cytokines (granulocyte macrophage colony stimulator, interferon-γ IL-3, IL-12 and tumor necrosis factor-β), macrophages and other immune cells. .. Due to the time it takes for these cytokines to attract and activate macrophages at the site of exposure, the effector phase usually develops 24 hours after exposure and generally peaks 48-72 hours after exposure [14]. ACD is an example of a hypersensitivity reaction that is not mediated by IgE.

Allergens Related to Occupational Diseases

Occupational allergens contain a variety of substances. This includes both proteins and chemicals, high and low molecular weight (HMW / LMW) compounds, natural and synthetic products, as shown in Table 1. Some of the most common allergens are wheat and enzymes (bakers). Latex, antibacterial, biocide (healthcare professional); isocyanate and anhydride (manufacturing); nickel and cobalt (metal worker); and persulfate (beauty salon). Occupational allergens are usually classified as either HMW> 5kDa or LMW <5kDa, and their size is thought to play an important role in their allergenism and mechanism of action. The protein allergen is usually HMW, but the chemical allergen is LMW. Although HMW agents act as complete antigens and are immunogenic in nature, LMW chemicals must first react with self or heterologous proteins to form a hapten complex before acting as a functional allergen there is IgE responses are most commonly seen after the HMW antigen challenge, but also after the LMW challenge. Metal ions such as nickel, cobalt and chromium are one of the most common triggers for ACD [15]. However, little is known about the immune response to metals [16].

Low Molecular Weight Occupational Allergens

LMW chemical allergens are diverse in structure, reactivity, and applications. However, there are some common attributes related to immunogenicity. This includes the potential for haptenization (protein reactivity), the ability to access the epithelium, and the potential for irritation. Thousands of chemicals have been identified as the causative agents of skin sensitization leading to ACD, but far fewer chemical

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allergens have been identified as the causative agents of asthma (<100) 29. Most LMW sensitizers have no established mechanism for immune response and can often trigger IgE and non-IgE-mediated reactions [17]. Toluene diisocyanate (TDI), one of the most common occupational chemical allergens, is a highly reactive chemical used in the automotive industry and in the manufacture of polyurethane foams, paints, elastomers and coatings. TDI is a potent allergen and exposure can cause a variety of illnesses such as asthma, rhinitis and ACD [18,19].

The incidence of asthma associated with occupational TDI exposure was estimated to be less than 5.5% for the entire workforce [20]. Based on the most available epidemiological data, persulfates have been reported as another common occupational allergen and can cause ACD, urticaria, rhinitis and asthma. Persulfates (ammonium, potassium, and sodium) are inorganic salts that are used as oxidizers for hair bleach and hair dye in concentrations below 60%. 31TDI and persulfates are generally classified as IgE-mediated sensitizers, but one answer via non-IgE. However, although animal studies support IgE-mediated mechanisms, patients with TDI asthma often do not have measurable TDI-specific IgE. Similar results have been reported for persulfates [21]. The complete immunological mechanism of sensitization to these chemicals and other LMW sensitizers is not fully understood.

Many LMW chemical allergens are used in the medical setting. These include biocides (formaldehyde, glutaraldehyde, orthophthalaldehyde) and surface disinfectants (quaternary ammonia compounds) commonly used to sterilize medical devices that are sensitive to normal heat or steam sterilization processes included. Aldehydes and quaternary ammonia compounds have been identified as part of the most common non-IgE-mediated allergens. In addition, medical gloves containing certain rubber accelerators (Thiuram-Mix and Carba-Mix) and antibacterial hand sanitizers and soaps (chloroxylenol and cocamido-diethanolamine) have also been identified as common sources of allergens. It has been. The above examples represent some of the most common occupational LMW allergens. However, there are many other occupationally relevant LMW allergens.

High Molecular Weight Allergens

Since most HMW allergen-induced allergies are IgE-mediated, allergies are identified using the detection and quantification of specific IgEs that recognize the causative protein. This can be demonstrated by a positive prick test or immunoassay. There are several challenges in diagnosing and identifying HMW allergies. The HMW allergens found in some compounds, such as wheat and latex, have better properties than other compounds. Most recombinant proteins are available for testing, but multiple proteins can be the cause, individuals may have different sensitivities to different proteins, and in identifying suspicious drugs. It can pose a challenge [22]. In addition, LMW chemicals can be part of the raw allergen (introduced through processing or manufacturing) and can also trigger non-IgE-mediated reactions. It is estimated that 6-17% of healthcare professionals suffer from latex allergies, and rubber gloves are the most common cause. Latex allergies can manifest as urticaria, rhinitis, conjunctivitis, asthma, anaphylaxis, and ACD. Latex from the Hevea brasiliensis (rubber) tree contains a variety of cellular proteins, lipids and amino acids. The allergens responsible for latex have not been fully characterized, but a list of 15 allergens (Hev b 1 to Hev b 15) has been established, with Hev b 5, Hev b 6.01, and Hev b 6.02 has been identified as the most common professional latex allergen [23]. Chemicals such as thiuram, stabilizers, and antioxidants (thiocarbamate, diphenylamine, dihydroquinolin, phenylenediamine) that may be added to latex during rubber production are known to induce ACD.

flour is another very common occupational HMW allergen, and epidemiological reports indicate that asthma, rhinitis, and ACD are the major health effects of exposure. Wheat flour is a complex organic dust that contains grains processed by milling. Wheat flour dust usually plays an important role in improving the dough, including various enzymes (α-amylase, cellulose, hemicellulose, and malt enzyme), additives (baker's yeast, egg flour, milk flour, sugar), fragrances, spices, etc. contains various ingredients that play whereas chemical components (preservatives, antioxidants, bleach). Wheat is the main flour used in the bakery industry and has been shown to contain at least 40 allergens, accounting for about 10-15% of the dry weight of grains. Bakery asthma is one of the most common forms of occupational asthma, and most studies have found that wheat and rye flour proteins account for 60-70% of bakeries with work-related respiratory problems. It indicates that it is an allergen [24]. The enzymes α-amylase (added to improve bakery properties), thioredoxin, simple lipid transfer proteins, and serine proteinase inhibitors are one of the major factors associated with bakery asthma, according to studies. , The highest frequency was found to be the more specific IgE measurements. The chemical constituents of flour, such as the α-amylase inhibitors Tria28 and Tria01 / 29/41 preservatives and bleaches, can cause ACD in bakeries.

Exposure to laboratory animals has been shown to lead to occupational allergies and is commonly observed among technicians working in the pharmaceutical industry, university laboratories, livestock farms, zookeepers, doctors and scientists. I am. Rodents, such as mice and rats, commonly used in animal studies, are the most common contributor to occupational allergies to laboratory animals. The dramatic increase in mouse use in experimental models has led to an increase in mouse sensitization among laboratory animal technicians and researchers. It is estimated that 5% to 8% of this population is affected, and some estimates in the United States suggest an increase of less than 23% over two years. Urine is the main source of allergen protein in both mice and rats, but allergens are also found in dandruff, hair, saliva, and serum [25]. Like most mammals, the main inhaled allergen in mice and rats is lipocalin (Musm1 and Ratn1 respectively). These allergens share 64% homology between amino acid structures. Protein from mouse urine showed IgE cross-reactivity with protein from rat urine and Equ c 1 (a major allergen in horses).

Conclusion

Occupational allergies have significant social and economic implications for workers, their families, employers and government agencies. Sensitive workers should avoid exposure to allergens at work and outside to maximize their chances of improving or eliminating allergic symptoms. This can be achieved by changing duties and responsibilities, implementing engineering controls, or providing workers with appropriate personal protective equipment. In most cases, sensitive workers will need to move to a completely different location or change jobs or occupations to avoid further exposure to the triggering allergen. However, many approaches have been developed to control exposure to allergens in the workplace by integrating risk assessment and risk management strategies 58–61. In this context, it is imperative to establish an effective risk management strategy designed to prevent the induction of inexperienced sensitizers. It inhibits the induction of allergic reactions in sensitized individuals. Such a strategy should include both primary and secondary prophylaxis. Another important tool that helps characterize and control workplace exposure to occupational hazards is Occupational Exposure Limits (OEL).

Despite its widespread use around the world, few OELs are set up for sensitization prevention. The quantitative risk assessment approach used to derive OEL was developed primarily for non-immune effects such as: B. Invasion portal effect, non-cancer systematic effect or cancer. The application of these approaches to developing OEL for allergens has been hampered by data limitations and a lack of understanding of the biological processes that control immune-mediated effects. Exposure routes, exposure intensities, and duration / frequency of exposure have also been identified as factors complicating this process. Studies addressing these challenges and a better understanding of allergic disorders have a direct impact on hazard identification and provide information on appropriate risk assessment and management decisions promotes intervention and prevention of occupational allergies.

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