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Allergies in the workplace

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The health and economic burden linked to occupational allergies caused by agents in the workplace is increasing progressively. In view of the rapid changes in work processes as a consequence of globalisation and the changing environment and lifestyles in developing countries, the prevalence of allergic diseases is likely to increase further.[1] New trends in occupational allergies, the diversity and complexity of causative agents/inducers, and the majority of agents remaining unknown, hinder efforts to reduce the incidence of occupational allergies. Although the type, intensity and route of allergen exposure are the major triggers of symptom development, inter-individual variation in susceptibility plays a significant role. Atopy, psychological stress and genetic variability (e.g. gene mutations encoding the epidermal protein filaggrin increase the risk for contact dermatitis) have been associated with various occupational allergic diseases.[2-5] Most of these variants act in combination with other genes and environmental factors to modify disease progression and severity.[6]

Different immunological mechanisms are mediated by high molecular weight (HMW) and low molecular weight (LMW) occupational allergens.[7] HMW allergens (typically proteins) induce type I hypersensitivity responses inducing IgE antibodies, which lead to a continuum of symptoms.[8] LMW allergens acting as haptens form complexes with proteins that are recognised by the immune system, leading to the ensuing allergic response.[9] Workplace allergens can affect various organ systems, leading to different clinical syndromes including allergic respiratory conditions (conjunctivitis, rhinitis, asthma, angio-oedema, hypersensitivity pneumonitis and anaphylaxis) and cutaneous reactions (allergic contact dermatitis, irritant contact dermatitis, protein contact dermatitis and contact urticaria).[10,11] Work-related asthma (WRA) can be broadly defined as: (*i*) occupational asthma; and (*ii*) work-exacerbated asthma or pre-existing asthma worsened by workplace exposures.[12] Symptoms of patients with pre-existing rhinitis, conjunctivitis or chronic urticaria may also be aggravated by workplace agents.[12-15]

Epidemiology

The rates of occupational allergies differ by country, with higher rates postulated for developing countries.[1] Should the hygiene hypothesis be true, one can expect that developing countries may soon be facing an epidemic of allergic diseases.[1] Industries with a high risk for the development of occupational allergies include food, farming, construction, manufacturing, medical, pharmaceutical and mining industries.[16] Occupational dermatitis, occupational asthma and irritant-induced asthma are among the leading occupational diseases in 2007 reported to the Compensation Commissioner of South Africa (personal communication – Monge Lekalakala). A number of epidemiological studies from South Africa demonstrated a high prevalence of occupational allergies across the various industrial sectors.[12,17]

Occupational skin disease (OSD) is among the commonest diseases caused by work, with allergic contact dermatitis accounting for 90 - 95% of all OSDs.[18] Workers may also develop multiple contact allergies, i.e. contact allergy to three or more allergens, also referred to as multiple chemical sensitivity (MCS), possibly due to an increased susceptibility factor.[19] Individuals with MCS report experiencing disabling symptoms – from low-level exposures to chemicals generally tolerated by other persons.[20-21] Occupational dermatoses often affect individuals with atopic dermatitis and can prevent individuals from performing job-related tasks or preclude working altogether.[18]

Occupational asthma is one of the more frequently compensated occupational respiratory diseases. The incidence is low in South Africa (1.8/100 000). However, provincial differences exist, with a higher incidence (2.5/100 000) in the Western Cape, which is similar to that in the USA and other European countries.[12] The epidemiology of irritant-induced asthma and occupational rhinitis is less clear, although rhinitis is often associated with asthma and/or precedes its clinical manifestation.[10]

The epidemiology of occupational rhinitis or conjunctivitis is not well recognised in developing countries, as surveillance programmes for such conditions are practically non-existent. In addition, these conditions have a milder clinical outcome and as such are rarely reported by workers. Work-related sneezing, nasal discharge and obstruction often precede occupational asthma; therefore early diagnosis may prevent the development of asthma.[22]

Diagnosis

Diagnosis of occupational allergies includes objectively demonstrating the relationship between allergic reactions and workplace agents, which has direct implications on intervention and prevention strategies.[10] Understanding the immunological mechanisms and the immunochemical properties of agents (e.g. adjuvants such as endotoxin, chitin) is important because of the prognostic and socioeconomic implications.[1,23,24] Commercially available allergens including recombinant allergens are used for testing. However, not all workplace agents are commercially available. Certain workplace agents can be prepared in specialised testing centres, which is advantageous as workers are tested with substances that they are actually exposed to. The disadvantages are that interfering substances may be present, affecting the test, and the concentration of the desired agent may be low compared with other substances. Furthermore, cross-reacting carbohydrate determinants (CCDs) may influence the interpretation

Table 1. Diagnostic tests for the investigation of occupational allergies[8,26]

Diagnostic test	Description of test
Skin-prick test	Sensitive, easy to perform, cost-effective and results are available within 20 minutes. However, patients must stop antihistamine medication for 72 hours prior to testing and anaphylactic shock may occur in rare circumstances[27]
Immunoassays	Enzyme immune assays (EIA) or radio-allergosorbent test (RAST) measures specific IgE or IgG in serum. These assays are mostly automated; there is no need to withdraw antihistamine medication and no risk of anaphylactic reactions. IgG is a sign of exposure in food allergies; however, only a few allergens have been evaluated and cut-off values determined[28]
Cell activation test	Basophil activation test (BAT) mimics *in vitro* contact of allergen and circulating basophils. If IgE antibodies expressed on the basophils are specific to the allergen, activation occurs and inflammatory mediators (histamine, tryptase and leukotrienes) are released. Some tests measure cell membrane markers of activation (CD63 and CD203 GP53).[28] The cellular antigen stimulation test (CAST) and flow cytometric allergen stimulation test (FAST) are similar to BAT in that they also involve activation of cells and measurement of inflammatory mediators released
Agar-gel precipitation	IgG levels measured to test for alveolitis to bird allergens[28]
Molecular techniques: Microarray	Hundreds of allergens can be screened using only minute quantities of a patient's serum.[29] However, microarray chips include a limited number of occupational allergens
Immunoblotting	Proteins from the extracts are separated according to size by gel electrophoresis and transferred to a membrane by blotting. IgE or IgG antibodies from a sensitised patient will bind appropriate allergens in the membrane[30,31]
Nasal challenge test	Performed to identify the causative agent in patients with suspected rhinitis[22]
Lung function test	Breathing test that measures the quantity and speed of exhaled air
Exhaled nitric oxide	Employed in diagnosing asthma, monitoring response to therapy, evaluating current symptom control, and predicting exacerbations of asthma[32]
Patch test	Suspected allergens placed on patient's back induce a type IV hypersensitivity reaction via specific T lymphocytes which is read after 72 hours to determine allergic reaction[8]

of the results.[25] Diagnostic methods vary, depending on the clinical manifestation (Table 1).

Management

Management is directed at minimising exposure in the workplace through risk assessments, by administering appropriate medicine regimens, and by educating workers about their condition and avoidance measures.[1] Assessing the risk of allergen exposure encompasses a multifaceted approach using several risk assessment techniques (medical and occupational history questionnaires, hazard identification through observations and measurements, job exposure matrix), focusing on controlling allergen exposure.[33,34] Prompt intervention may lead to reversibility of symptoms. However, this may be challenging as the condition may be intermittent, transient, and often absent at the time of clinical assessment.[10] Assessing the aggravation of symptoms from occupational sensitisation is important because patients with exacerbated conditions can usually continue to work with minor adjustments to their medication or environment. Sensitised workers must be removed from the offending exposure until interventions have been made to accommodate them, or they should be relocated to an unexposed area.[30] Onset of symptoms may be rapid or slow, occurring years after repeated exposure in the work environment. Once sensitised, reactions may be triggered by minute quantities of allergen,[35] and continuing exposure could be life threatening.[10]

Conclusion

Early identification of suspected allergens in the workplace can lead to reversibility of symptoms and avoidance of chronic occupational allergies, which can result in permanent disability and loss of work. Understanding the various occupational allergy phenotypes, the inter-individual variability and the relation to exposure provides new insights into disease management and may lead to the development of novel preventive and therapeutic strategies.

References available at www.cmej.org.za