

# Asthma in Workers: An Overview

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**Abstract** Asthma is a respiratory disease commonly found in general medical practice and in various fields of study. Furthermore, asthma may be found in every age range. Twenty five percent of adult-onset asthma is occupational asthma. Allergens that cause occupational asthma are commonly found in work place such as animal proteins, plant proteins, metal transition, chemical substances, etc. The guideline on medical practice of the American College of Chest Physicians 2008 divides occupational asthma into two categories: sensitizer-induced occupational asthma and irritant-induced occupational asthma. Pathogenesis of disease are based on Immunologically mediated with participation of specific IgE, Immunologically mediated without evidence of participation of IgE and Non-immunologic. The diagnosis of occupational asthma in terms of symptoms and signs does not differ from the diagnosis of general asthma. The difference is that the diagnosis of occupational asthma must be reassured that the exposure to allergens involves a contact to irritating substance within workplace. Cure by medicine for occupational asthma is not different from that for general asthma. The best treatment would be to avoid allergens in the workplace. The preventive measures may be erected.

**Keywords:** *asthma, workers, occupational*

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## 1. Introduction

Asthma is a respiratory disease commonly found in general medical practice and in various fields of study, including general medicine, paediatrics, family medicine, and emergency medicine. Furthermore, asthma may be found in every age range. Twenty five percent of adult-onset asthma is occupational asthma [1]. The said occupational asthma is also occupational lung disease that is most often found in the developed countries [2].

Asthma is the result of an immune response to various substances that cause allergic reactions (allergen) which usually irritates the lower respiratory tract. The disease conditions of occupational asthma do not differ from those of common form of asthma. That is, obstruction of respiratory tract, high sensitivity of epithelial cells of respiratory tracts, and inflammation of the tissue in the respiratory tract [3]. The difference is that allergens that cause occupational asthma are commonly found in work place. If such allergens can be identified, it will help improve the diagnosis and treatment of occupational asthma.

## 2. Types of Occupational Asthma

The guideline on medical practice of the American College of Chest Physicians (ACCP) 2008 [4] divides occupational asthma (OA) into two categories: sensitizer-induced

occupational asthma and irritant-induced occupational asthma. The causes are as follows:

**1. Sensitizer-induced occupational asthma** is caused by physical contact with allergens in the workplace. The contact may occur in two ways:

- 1.1. High-molecular weight sensitizers: a contact to high molecular weight allergens such as protein from animals which occurs in cattle farming, honey bee farming or seafood preparation process, high-molecular weights allergens from plants such as dyes, latex, starch, or high-molecular weight allergens from fungi such as mushroom spore contacted by mushroom farmers or a scientist in a laboratory.
- 1.2. Low-molecular weight sensitizers: a contact to low-molecular weight allergens which are mostly chemicals or initial substance used in industrial manufacturing of other chemical substance such as organic solvents or organic compounds of metals.

**2. Irritant-induced occupational asthma** is caused by physical contact with substance irritant to the respiratory system at a high level within a short period of time which can directly damage the tissue within the respiratory tract of the patient. Examples of triggering events are swimming pool lifeguard inhaling chlorine gas at a high-level or a scientist in a laboratory inhaling intense vaporizing acidic or basic substance. A person may come into contact with the irritating substance by accident or being exposed to it in an unavoidable natural disaster incident. Naturally, human being will not tolerate

contacting with intense irritants for a long period of time. From a study of patients who suffer irritant-induced occupational asthma caused by inhaling intense dust smog from the World Trade Center tragedy in the United States, it is found that many fire fighters and people situated within a close proximity of the World Trade Center suffered asthma-like symptoms. The condition of irritation-induced occupational asthma shows for every patient who comes into contact with irritating substance at a high level. This is different from sensitizer-induced occupational asthma which occurs to only certain people who are allergic to the contacted substance [5].

### 3. Pathogenesis

Pathogenesis of disease are based on 3 causes [6] as follows:

1. Immunologically mediated with participation of specific IgE, like that for general asthma, is a stimulation of the immune system through classic IgE antibody-mediated mechanism [7]. Such mechanism is largely found in high-molecular weight sensitizers, but can also be found in certain low-molecular weight sensitizers [8]. The underlying allergens act as a complete antigen that stimulates the response mechanism of antibody. Symptoms commonly found in this group of patients are allergic rhinitis and allergic conjunctivitis.
2. Immunologically mediated without evidence of

participation of IgE is a stimulation of antibody which is not done through IgE. The pathogenesis mechanism remains unclear but some studies explain that the disease may be caused by certain change in the chemical structure of the underlying allergen [9,10]. For example, metal transition elements in chemical substances may receive or exchange electron with the electron of the tissue, causing malfunction at the cellular level in the tissue, or the function group of an organic compound may trigger certain chemical reaction in the tissue leading to a stimulation of antibody-related mechanism. However, certain studies specify that such stimulation may be done through a cellular mediated pathway [11,12]. Such a mechanism is largely found in the group or low-molecular weight sensitizers.

3. Non-immunologic, irritant mediated is caused by a quick contact to intense substance that irritates respiratory system. The irritating substance could be in the form of vapor, gas, dust, smog, radiating mass or smoke which may directly damage the tissue of respiratory tract, leading to inflammation that requires wound treatment and a possible scar later on [13]. The symptoms of this group of patient are asthma-like. The sensitivity of respiratory tract may persist for months or years, depending on the severity of damage done to the tissue of respiratory tract. This group of symptoms may collectively be called "reactive airways dysfunction syndrome (RADS)".

Table 1. Type of allergens correlating to occupations [5]

| Allergens                                      | Correlated occupation                                         |
|------------------------------------------------|---------------------------------------------------------------|
| <b>High-molecular weight sensitizers</b>       |                                                               |
| <b>Animal and insect derived</b>               |                                                               |
| Birds protein (feather, serum)                 | Bird breeding                                                 |
| Crustaceans: carb, pawn                        | Seafood industry, fisheries                                   |
| Eggs (chicken)                                 | Food processing industry, cattle farming                      |
| Insects                                        | Honey bee or silkworm farming, rice plantation, silk industry |
| Mammalian proteins                             | Laboratory operation, veterinary medicine, pet shop           |
| Pharmaceutical enzymes                         | Pharmaceutical industry                                       |
| Sea squirt (oyster parasite)                   | Fisheries                                                     |
| <b>Bacterial and fungal derived</b>            |                                                               |
| <i>Bacillus subtilis</i> -derived enzymes      | Cleansing agent or detergent manufacture                      |
| <i>Penicilliumcaseii</i>                       | Cheese production                                             |
| Thermophilic molds                             | Mushroom farming                                              |
| <b>Plant derived</b>                           |                                                               |
| Latex, natural rubber                          | Rubber plantation, rubber industry, public health operation   |
| Plant enzymes (papain, bromelain)              | Food industry, pharmaceutical industry                        |
| Vegetable gums (arabic, guar)                  | Printing industry, food industry                              |
| Wheat flour                                    | Bakery                                                        |
| <b>Low-molecular weight sensitizers</b>        |                                                               |
| Persulfates (in hair bleaching solution)       | Hairdressing                                                  |
| Chromium                                       | Mining, cement-related work                                   |
| Cobalt                                         | Metal work, diamond cutting                                   |
| Nickel sulfate                                 | Smelting                                                      |
| Platinum                                       | Alloys industry                                               |
| Acid anhydrides                                | Plastic industry, dye industry, pesticide industry            |
| Acrylates, methacrylate (artificial nail glue) | Organic solvent manufacture, printing industry                |
| Ethylenediamine                                | Lacquer manufacture, furniture production                     |
| Paraphenyldiamine (in hair dye)                | Hairdressing                                                  |
| Polyisocyanates (toluene diisocyanate)         | Glue industry, spray-painting, wet painting                   |
| Pharmaceuticals (antibiotic)                   | Pharmaceutical industry, public health operation              |

## 4. Diagnosis

The diagnosis of asthma is based on history taking, physical examination, and laboratory results such as peak expiratory flow rate, and spirometry. The diagnosis of occupational asthma in terms of symptoms and signs does not differ from the diagnosis of general asthma. The difference is that the diagnosis of occupational asthma must be reassured that the exposure to allergens involves a contact to irritating substance within workplace. This requires additional detailed information on the patient's work history, the nature of the work in the past, and his or her asthma history (in case that the patient has asthma history and the symptom has been aggravated during work, the symptom is called work-exacerbated asthma, not occupational asthma), asthma history in the patient's family and of the colleagues. The history taking steps that could lead to a conclusion that a patient has occupational asthma is as follows:

1. Medical evidence specifies asthma symptoms;
2. Differential diagnosis shows identical illness;
3. There is history or evidence showing patient's exposure to allergens at work and outside work;
4. The onset takes place after an exposure and there is a clear period of pathogenesis;
5. Symptoms shown during certain periods has a correlation with the exposure to allergens in the area in question;
6. Symptoms during certain periods has improved as the patient is not exposed to the environment in the area in question;
7. Multiple persons suffer the same symptom from an exposure to the same substance, or there is an epidemiologic investigation report stating as such;
8. There is consistency with a prior study or report examining a person or animal;
9. The diagnosis backed by medical treatment can prove the cause of asthma.

Mere history taking is not sufficient to diagnose asthma. A further step may require a workplace survey by an occupational physician to collect additional information for the assessment of surrounding environment at work in order to identify allergens in question. The complete history taking and supporting information collected in accordance with the steps aforementioned will serve as evidence to conclude whether the found asthma is occupational one. The benefit of being able to identify allergens in the workplace will help improve the ongoing treatment.

## 5. Cure and Prevention

Cure by medicine for occupational asthma is not different from that for general asthma. The best treatment would be to avoid allergens in the workplace [14]. The preventive measures may be erected as follows:

1. **Primary prevention** dealing with the root cause – the underlying allergens by:
  - 1.1. adopting various engineering control tools including using machines to replace man power and

terminating or changing the use of substance that contains allergens;

- 1.2. adopting pathway control tools or the design of appropriate ventilation system, including the use of partition between irritating substance and workers or dividing work into shifts;
- 1.3. adopting personal protective equipment.

2. **Secondary prevention** involving early screening of persons at risk, such as spirometric screening of workers exposed to allergens before, during and after employment, and requiring a walk-through survey of factory or plant by an occupational physician as a supporting information for the screening of risk group in each department

3. **Tertiary prevention** in order to delay the progress of illness once the symptom has shown, and administer standard treatment. This might require switching the patient to a new department or assigning him or her new task. The physician will have to take into account compensation for the patient's lost opportunity in relation to his or her medical welfare.

## 6. Conclusion

Adult-onset asthma may be the result of an exposure to allergens in workplace. Detailed history taking regarding the patient's occupation will help physician diagnose occupational asthma with accuracy and provide effective treatment. In any event, prevention and non-exposure to irritants is the most important factor to avoid occupational asthma. For the treatment, sufficient information necessary for a diagnosis requires a walk-through survey of the factory or plant and occupational physicians play a crucial role in such a survey. Standard treatment must also be carried on. Another important issue regarding occupational asthma is that the patient is entitled to compensation prescribed by law. The responsible physician will have keep that in mind in order to safeguard the patient's right to compensation at best.

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## Statement of Competing Interests

The authors have declared that no competing interests exist.

## Acronyms and Abbreviations

- OA: Occupational asthma  
 ACCP: the American College of Chest Physicians  
 Ig: Immunoglobulin  
 RADS: reactive airways dysfunction syndrome.

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