

Guideline for the Diagnosis of Occupational Asthma – the Role of the Occupational Physician

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Abstract

Occupational asthma - defined by the presence of reversible airflow obstruction and/or bronchial hyperreactivity - is caused by agents existing in the work environment. It is the most common occupational respiratory disease in industrialized countries, and it is estimated that 5 to 20% of new asthma cases are attributable to occupational exposure. It can be immunological, depending on the type of agent the worker is exposed to, exposure factors (dose/concentration, exposure time, route of exposure), and individual susceptibility factors (atopy, bronchial hyperactivity, or smoking).

This protocol proposes several sequential steps to the diagnosis of occupational asthma: suspicion of occupational asthma; confirmation of bronchial asthma; confirmation of occupational asthma; confirmation of occupational agents' sensitization and confirmation of occupational agents' causal role.

The authors aim to prompt occupational asthma diagnosis by the Occupational Physician. Based on that, adaptations may be proposed in the workstation, modification, or even deciding the worker's unfitness for work. All these steps are essential for a better prognosis of occupational asthma and minimize important legal and socio-economic implications.

Keywords: Diagnosis of asthma; Occupational medicine; Occupational exposure; Occupational disease; Occupational asthma; Asthma

Introduction

Occupational Asthma (OA), defined by the presence of a reversible airflow obstruction and/or bronchial hyperreactivity, is caused by agents present in the work environment. It is the most common occupational respiratory disease in most industrialized countries and it is estimated that the proportion of new cases of asthma attributable to occupational exposure ranges from 5 to 20% [1].

The cause may or may not be immunological, depending on the type of agent to which the worker is exposed, exposure factors (dose/concentration, exposure time, route of entry into the organism, etc.), and susceptibility factors of the individual himself (previous history of atopy, bronchial hyperreactivity or smoking). Thus, we speak of immunological AO when there is a latency period (from the beginning of exposure until the onset of symptoms) and it is possible to document an immune mechanism, mediated, or not, by IgE antibodies. On the other hand, non-immunological AO is usually caused by irritating substances, in which case there is no latency period. As for the

substances that cause asthma, these are divided into substances of High Molecular Weight (APM) and substances of Low Molecular Weight (BPM) [2]. As an example [3]:

(a) High molecular weight agents: cereals, enzymes, latex, food additives, spices, and animal allergens, among others;

(b) Low molecular weight agents: isocyanates, metals, different types of anhydrides, amines, anilines, acrylates, formaldehyde, and glutaraldehyde, among others.

Materials and Methods

This protocol proposes that the diagnosis made by the Occupational Physician takes place in several stages. To this end, the authors constructed a medical protocol to produce the diagnosis.

Results

Occupational asthma diagnostic steps [8]: suspected occupational asthma; confirmation of bronchial asthma; confirmation

of occupational asthma; confirmation of awareness of occupational agents and confirmation of the causal role of occupational agents.

Suspected Occupational Asthma

The suspicion that a worker has occupational asthma is stronger the more criteria are met. With regard to asthma, the following symptoms are the most prevalent: wheezing, dyspnoea, nocturnal cough, chest tightness. These symptoms do not have to co-exist. In most cases, the condition is sudden, with no previous history of atopy. The doubt as to whether or not it is occupational arises when the clinical picture improves with leave from work, that is, when there is attenuation of symptoms on

weekends, days off and/or vacations. Such improvement is not seen in all workers diagnosed with AO. The probability of a work-related cause increases when other exposed workers have similar symptoms. Physical examination is usually normal, although the presence of wheezing on expiration is the most frequently perceived alteration; however, it is not specific to asthma and may be present in other pathologies [6].

Bronchial Asthma Confirmation

When faced with a worker with suspected bronchial asthma, the first step is to confirm and quantify the severity and reversibility of airway obstruction through respiratory function tests (PFR) (Table 1):

Table 1: Lung function tests – at work and away from work.

Tests	Results
Average daily diurnal PEF variability (twice daily PEF over one week)	Daily variability > 10%
Expiratory airflow limitation	FEV ₁ /FVC < 0,75
Positive bronchodilator (BD) responsiveness (reversibility) test (10-15 min. after BD: 200-400 µg salbutamol or equivalent)	Increase in FEV ₁ > 12% and > 200 mL

1st: Calculate the daily variability of the maximum expiratory flow measured in L/s (Peak Expiratory Flow, PEF) from two daily measurements during one to two weeks. If there is a daily variability greater than 10%, it is considered that there is a limitation of the expiratory flow;

2nd: When FEV1 (Forced Expiratory Volume at first second) is reduced (< 80%), it is necessary to confirm whether FEV1/FVC (FEV1/Forced Vital Capacity) is reduced compared to the lower limit of normal (it is usually > 0.75-0.80);

3rd: Confirm the variability of pulmonary function by carrying out a reversibility test (10-15 minutes after bronchodilation (BD) with 200 to 400 µg of salbutamol or equivalent), which

is positive if an increase in FEV1 of more than 12% and more than 200mL compared to baseline (pre-BD readings).

When spirometry is negative, a nonspecific bronchoprovocation test with methacholine or histamine is performed. It is important that it is carried out during the working day, since, in some cases, it can return to normal after a period without exposure.

If the later test is negative, the diagnosis of asthma is excluded, as bronchial hyperreactivity is not confirmed.

Confirmation of Occupational Asthma

One of the most important aspects of any diagnosis is the detailed collection of the occupational history (Table 2).

Table 2: Work history and exposures.

Professional Categorys/Occupations and duration		
Exposures	Vapors, gases, dusts, aerosol, fumes and others	
Personal protective equipment (PPE)	Gloves, safety glasses and shoes, earplugs or muffs, hard hats, respirators, or coveralls, vests and full body suits.	
Environmental control measures	Ventilation (natural and mechanical), filtration, ultraviolet germicidal irradiation, and other methods of air cleaning	
Personal history	Atopy, Personal history of food allergy or atopic dermatitis Other allergies, Chronic obstructive pulmonary disease (COPD) Gastroesophageal reflux, Other exposures: biomass, tobacco Smoke and sports/hobbies/interests	
Family history of atopy, allergic sensitization, allergy or asthma		
Symptoms	wheeze, shortness of breath (dyspnea), chest tightness and cough	
Improvement	at night, in the early morning, weekends, vacation, sports, other	
Frequency of daytime and night-time asthma symptoms		
Intensity of crises	mild, moderate, severe	
Other workers with symptoms	yes	No

It is essential to know the professional category and functions carried out throughout life, with the respective duration, as well as to consult the safety data of the products. It is imperative to identify direct and indirect exposures to potential causal

agents of OA, with or without collective and individual Protection Equipment (PPE). In addition, recognize respiratory symptoms (nature, latency period, temporal relationship with exposure to work, especially in the initial period after the

onset of symptoms) and the presence of other potentially occupational pathologies (rhinoconjunctivitis, urticaria, contact dermatitis).

However, the diagnosis cannot be based on occupational history alone. There must be, on the one hand, objective evidence of exposure to known sensitizers (or airway irritants) and, on the other hand, demonstration of an association between exposure and airflow limitation at work (serial PEF measurements). PEF serial measurements must be carried out during two work periods separated by a period without work activity (periods of one week, each) taking measurements every 4 hours (3 forced expirations in each measurement with variation between them of less than 10%, considering the best value). Subsequently, the patterns of variation in periods of work activity are compared with periods of eviction from work. Significant changes in non-specific reactivity, both on and off the job, can be seen but are less sensitive and less specific than PEF screening.

Confirmation of Awareness to Occupational Agents

Once the diagnosis has been established, it is necessary to confirm the awareness of the occupational agent and demonstrate its connection to the worker's clinic. It should be noted that exposure can also sensitize other people in the workplace. Skin tests are performed (intradermal: more sensitive but less specific, with a higher probability of adverse effects; Prick-test: less sensitive but more specific and economical) or by means of serum determination of specific IgE to confirm sensitization/allergy to a certain allergen.

Confirmation of the Causal Role of Occupational Agents

The specific bronchial provocation test with the suspected agent, Gold-standard in the diagnosis of asthma, involves a series of variables and allows simulating the symptoms developed in the work environment. They must be carried out in specialized centers, and currently there are none in Portugal with cameras that control the concentration of exposure to the allergen. As an alternative to the Gold-standard method, it is sufficient if one can obtain (a) objective confirmation of asthma and bronchoconstriction related to the work environment, (b) prove exposure to a well-known agent and (c) prove sensitization to this agent (positive skin test or specific IgE).

Notification of Professional Disease

After diagnosis, measures must be instituted to reduce or eliminate exposure, as well as effective treatment of the disease (similar to non-occupational asthma) [1,7]. Notification of occupational disease is a legal imposition, in most developed countries, and must be done by the physician who makes the diagnosis.

Discussion

The diagnosis always depends on two assumptions: confirmation of the diagnosis of asthma and association of symptoms with occupational exposure [4]. Suspicion arises when the worker mentions respiratory symptoms that improve on non-working days (weekends, days off, or holidays). So, it is essential to collect a detailed occupational history, allowing the doctor to assess the probability of occupational asthma.

According to the British Occupational Health Research Foundation (BOHRF), there are activities considered high risk,

which should lead the Occupational Physician to a high index of suspicion: use of sprays on painting, processing chemical products, baking, stomatology, food processing, welding, grinding, metallurgy, carpentry, manufacture of rubber and plastic components, laboratory work with animals, textile industry, agriculture, hairdressers/manicures. In any case, non-inclusion in the BOHRF list does not exclude the diagnosis of AO [5].

Conclusion

Occupational asthma is a pulmonary disease that must be considered as a differential diagnosis in any case of asthma in adults with a working activity, together with asthma aggravated by work, occupational rhinoconjunctivitis, allergic rhinitis, chronic obstructive pulmonary disease, bronchiectasis, hypersensitivity pneumonitis, among others. A timely suspicion of the possible relationship between the clinic and exposure at the workplace to a certain agent allows for an early diagnosis and better control of the disease, with therapeutic optimization in an acute and long-term situation. The Occupational Doctor's alert for this issue allows investment in collective protection strategies and individual protection equipment, as well as the assessment of the need to change the job or reintegrate the worker into the world of work.

Author Contributions

Maria José Costa de Almeida: 1th author, guarantor, selection of the theme, research and references review, writing
Sara Alves de Matos: form review, co-authorship
Moreira Freire Duarte, Mariana Moreira de Sá, Ana Sofia Duarte, Noémia Loio Marques: co-authorship
Leonor Cunha: scientific review; final approval

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References

1. Baur X, Sigsgaard T, Aasen TB, et al. Guidelines for the management of work-related asthma. [Erratum appears in *Eur Respir J*, 2012; 39(6): 1553]. *European Respiratory Journal*, 2012; 39: 529-545.
2. Salvadó MG, Celma GR. *Protocolos de actuación, diagnóstico y tratamiento del asma como enfermedad ocupacional*. Madrid, 2008.
3. Baur X, Bakehe P. Allergens causing occupational asthma: an evidence-based evaluation of the literature. *Int Arch Occup Environ Health*, 2014; 87(4): 339-363.
4. Aasen, Tor B, et al. "Diagnostic approach in cases with suspected work-related asthma." *Journal of occupational medicine and toxicology (London, England)*, 2013; 8(1): 17. doi:10.1186/1745-6673-8-17.
5. Nicholson PJ, et al. "Evidence based guidelines for the prevention, identification, and management of occupational asthma." *Occupational and environmental medicine*, 2005; 62(5): 290-299. doi:10.1136/oem.2004.016287.
6. Global Initiative for Asthma. *Global Strategy for Asthma Management and Prevention*, Disponible em, 2022.
7. Henneberger PK, Patel JR, de Groene GJ, et al. *Workplace interventions for treatment of occupational asthma*. *Cochrane Database Syst Rev*, 2019; 10: CD006308.
8. Eulalio Colomer Vilela E, Ruiz Frutos C, Marqués Marqués F. NTP 327: Asma ocupacional: criterios diagnósticos actuales. *Ministerio de trabajo y asuntos sociales de España*. Instituto nacional de seguridad e higiene en el trabajo, 1999.