

Clinical Update on Occupational Asthma

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Abstract

Occupational asthma is the most common occupational respiratory disease in many developed countries as well as in Singapore. About 4% to 9% of adult asthmatics may have occupational asthma. The condition is still under-diagnosed and under-reported. Asking an adult asthma patient whether his or her symptoms improve when away from work and worsen during periods at work is important in detecting potential cases of occupational asthma. Serial peak expiratory flow rate (PEFR) monitoring during periods at work and away from work is useful for providing objective documentation of work-relatedness. Specific challenge testing is carried out to confirm a specific causative agent where a new agent is suspected, where there are multiple agents involved and it is important to establish the exact agent, and when it is not possible to carry out serial PEFR monitoring. Early diagnosis and removal from further exposure to the causative agent in the workplace will benefit the patient with occupational asthma. Preventive measures are important to protect other workers at risk.

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Key words: Prevention, Serial peak expiratory flow rate, Work-related asthma

Introduction

Occupational asthma is the most common occupational respiratory disease in the United Kingdom¹ and also in Singapore.² Recent estimates of the proportion of adult asthmatics where the cause could be occupational range from 4% to 9%.³⁻⁵ It is an important disease that our doctors would encounter. For these cases to be properly managed, the work factors which caused or contributed to the asthma should be identified and measures taken to avoid further exposure.

Definition

There is no universally accepted definition of occupational asthma. The definition has gradually broadened over time. It used to be narrowly defined as “asthma induced by sensitisation to an agent inhaled at work”.⁶ It was later defined as “a disease characterised by variable airflow limitation and/or airway hyper-responsiveness due to causes and conditions attributable to a particular occupational environment and not to stimuli encountered outside the workplace”.⁷ This definition recognises that there are many cases of asthma caused by exposures at work which are not due to immunological mechanisms or where the mechanisms are unknown. This definition includes cases of asthma due to irritants at the workplace but excludes those with pre-existing asthma aggravated by occupational

exposures. Recently, there was a proposal for “prevention by definition” which proposed a definition which includes all the above three categories of asthma on the basis that all workers with asthma, whether caused or aggravated by the working environment, would require investigation and workplace intervention measures for their proper management.⁸ While researchers prefer a more exclusive definition, practitioners may prefer a more inclusive definition for the purpose of prevention. The term “work-related asthma” has been used for cases of pre-existing asthma which are aggravated by the working environment.

In Singapore, occupational asthma is a legally notifiable industrial disease under the Factories Act and a compensable occupational disease under the Workmen’s Compensation Act. The Occupational Health Department, Ministry of Manpower defines occupational asthma as “asthma caused or aggravated by the working environment” (provided that the aggravation is significant and can be demonstrated objectively).

Incidence

Finland is one of the few countries with a very reliable and relatively complete notification system for occupational asthma. For the period 1989 to 1995, the average annual incidence rate was 17.4 cases per 100,000 employees.⁹ It was the highest when compared with Sweden, the United

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Kingdom, the United States and Quebec. Among these countries, Massachusetts, USA had the lowest incidence rate of 0.3 case per 100,000 employees.¹⁰ Based on the three cases of reported and confirmed occupational asthma in Singapore in 2000,¹¹ the incidence rate was 0.14 case per 100,000 employees. It is difficult to draw conclusions from such comparisons, given the different reporting and surveillance systems in each country. It is likely to be under-reported locally.

Several cross-sectional studies have been carried out among workers exposed to isocyanates,¹² soldering fumes,¹³ polyvinyl chloride resin dust¹⁴ and wood dust¹⁵ in Singapore but no definite cases of occupational asthma were detected. This could be due to the “healthy worker effect” as affected individuals would likely have left employment of their own accord.

Causative Agents

More than 250 agents capable of causing occupational asthma have been reported.¹⁶ Substances that cause occupational asthma are classified either as high molecular weight allergens or low molecular weight compounds. Some examples of high molecular weight agents include laboratory animal allergens, flour, detergent enzymes and fish and seafood protein. Examples of low molecular weight agents include acid anhydrides, metals, isocyanates, western red cedar, amines, colophony and antibiotics. A useful website of agents causing occupational asthma is: <http://asmanet.com>. While such lists are useful, it should be kept in mind that occupational asthma can be caused by agents not found in such lists. At least four new agents have been reported from Singapore.¹⁷⁻²⁰ There is also the possibility of asthma being caused by an interaction of agents. Sometimes it is simply not possible to identify the exact causative agent.

The type of causative agents would vary according to the type of industry in each country. In the UK in 1998, based on 822 reported cases, the most common causative agents were enzymes (14%), isocyanates (13%), laboratory animals and insects (12%), colophony fluxes and solders (9%), flour (7%) and glutaraldehyde (5%).¹ Based on a total of 90 reported cases (1983 to 1999), the most common causative agents in Singapore were isocyanates (31%), colophony fluxes and solders (13%), welding fumes (9%) and wood dust (4%).²¹

A detailed occupational history and a knowledge of the common causative agents and their association with various occupations and industries are helpful in identifying possible causative agents. In many cases, the input of the employer or the chemical supplier is useful. It is useful to visit the workplace and study the various processes and the materials used. In many countries including Singapore, factory

occupiers are required to obtain the Material Safety Data Sheets (MSDS) of all the materials and chemicals they are using. Chemical suppliers are required to provide such MSDS.

Diagnosis

The detailed criteria for the diagnosis of occupational asthma may vary from country to country. Essentially, the diagnosis is made by demonstrating the presence of asthma, a relationship between the asthma symptoms and work, and exposure to a specific causative agent. There is an excellent review on the methods used in the diagnosis of occupational asthma by Chan-Yeung.²²

History and Physical Examination

The diagnosis of asthma can be made clinically based on a history of episodic breathlessness, wheeze, cough or chest tightness, usually in response to certain trigger factors. It may be confirmed by the demonstration of:

- 1) reversibility in the forced expiratory volume in the first second (FEV₁) following the use of inhaled bronchodilator, or
- 2) a diurnal variation of at least 20% on the serial peak expiratory flow rate (PEFR), or
- 3) a positive methacholine challenge test.

It should, however, be noted that a negative methacholine test in a case of confirmed occupational asthma due to toluene diisocyanate has been reported,²³ although this is likely to be the exception rather than the rule. Work-relatedness can be suspected based on the history demonstrating improvement when away from work and onset of symptoms during working periods.

The purpose of the history and physical examination is to obtain information on which the provisional diagnosis of asthma and the likelihood of work-relatedness will be based. The clinical history is more reliable in excluding than confirming occupational asthma. In a study of asthmatics, the negative predictive value of the clinical history was 83% while a history suggestive of occupational asthma had a positive predictive value of only 63%.²⁴ Nevertheless, the simple question of whether the symptoms improve when away from work and recur during periods at work is a useful screening tool. In some cases, the patient can even identify the specific causative agent.

Serial Peak Expiratory Flow Rate

It would be best to document this observation by doing serial PEFR monitoring during periods at work and away from work. Using specific challenge testing as the gold standard, PEFR monitoring has been found to be both sensitive (86%) and specific (89%).²⁵ While this can be time-consuming to the patient and the results of such

monitoring can be falsified, in most cases our patients have been reliable and we have found it to be a useful tool in documenting work-relatedness in our patients. There have been various schedules of monitoring ranging from every 2 hours to 4 times a day. We have used 3 hourly monitoring during the waking hours. Each time the best of 3 readings is taken. The worker is asked to record his or her peak flow readings in this manner for about 3 weeks with a continuous period of about 1 week away from work. Sometimes, we can get away without the need of arranging a 1-week away from work if the patient's asthma improves over the weekends. Plotting the maximum, minimum and mean PEF for each day on a graph gives a good visual picture of the pattern of work-relatedness, if any. Ideally, such monitoring should be done with the patient not taking any asthma controller medications (e.g., inhaled corticosteroids or long-acting bronchodilators) as this may mask the work-related pattern. However, if the patient requires medication, the monitoring can still be done by keeping the dose to a minimum and uniform for periods at work and away from work.

There are new peak expiratory flow (PEF) meters in the market which automatically record the PEF as well as FEV1 values and the time at which the manoeuvre was carried out.²⁶ These instruments may improve the quality and reliability of the PEF records. There are also computer-assisted interpretation software which attempt to distinguish between occupational and non-occupational causes of airflow obstruction.²⁷ However, they are relatively expensive and we have not used them locally.

Specific Bronchial Provocation Test

While the gold standard is a positive specific bronchial provocation test to the causative agent, there could be false negatives and positives, making interpretation difficult at times. In being cautious, test exposures are kept low and short. This could result in a false negative result. It is very difficult to reproduce the exact exposures in the workplace in terms of exposure time, concentration and nature of the agents. The possibility of interaction between different agents in causing the asthma is also difficult to exclude.

It is not necessary to require a specific bronchial provocation test to diagnose or confirm every case of occupational asthma. There are risks involved besides the time and expense that is required from the patient as well as the investigating doctor. Some indications for specific bronchial provocation testing include:

- 1) to document new (i.e., previously unreported) causative agents,
- 2) to distinguish between multiple known agents,
- 3) to provide objective evidence in a difficult case or where it is not possible to do a serial PEF monitoring

as in a patient who has already left employment.

Patients should be carefully selected for such a procedure, which should be carried out in specialist departments with the necessary precautions taken.

Management

It has been advocated that all workers confirmed to have occupational asthma be permanently transferred to a job with totally no exposure to the causative agent. This is particularly important in the case of the patient with severe asthma and who is sensitised to the particular agent. There have, in fact, been reports of death from occupational asthma in the workplace although this is rare.²⁸ One of the favourable prognostic factors suggested was how early the patient was transferred following diagnosis.⁶

Pharmacological treatment is similar as for any case of asthma. The first-line medication for asthma treatment is a daily-inhaled corticosteroid at a dose adequate for control of symptoms, with inhaled short-acting beta-2-agonist as necessary for symptom relief. If asthma control is still not achieved at moderate to high doses of inhaled corticosteroids (e.g., >800 mcg of beclomethasone or budesonide), a long-acting inhaled beta-2-agonist or oral (slow release) theophylline may be added.

As with any chronic illness, the key to successful treatment outcome is the patient's participation in partnership with the doctor in the management of his or her illness. The patient must be educated regarding the nature of the illness, the role of the medications (controllers vs. relievers), and the importance of compliance to the medications. The patient must be taught the correct inhaler technique, and the most appropriate delivery device should be chosen for them. The patient should be encouraged to identify and avoid factors which may trigger or exacerbate the asthma e.g., smoking cessation, house dust mite control measures. Any concomitant allergic rhinitis or sinusitis should also be adequately treated.

A significant proportion of patients with occupational asthma continue to have persistent symptoms even after job transfer. It is, however, important to consider on-going exposure to the causative agent in patients who continue to have persistent asthma attacks despite a job transfer and optimal medications. The patient may have been transferred from direct exposure to the causative agent, but may still be working in the same room or same workplace and is still indirectly exposed to the agent. The patient may be employed in another job and still be exposed to the same agent. The patient may also be exposed to non-specific irritants which may aggravate his or her hyper-reactive airways.

There have been studies showing that patients with occupational asthma who were transferred did better in terms of their asthma but had significant loss of income.^{29,30}

The objective, therefore, is to manage the asthma without exposing the worker to unacceptable risk and causing unacceptable financial hardship. Very few countries have a generous compensation system which would adequately compensate a worker for the loss of earnings for the rest of his or her life. In a large company, it may be possible to medically board out a worker with occupational asthma who is not able to be relocated. In this case, the worker may benefit financially depending on the number of years of service.

There have been several case reports showing that the use of respirators allowed workers with occupational asthma exposed to laboratory animal allergens, aluminium pot room fumes, flour, cow dander and grains to continue with their jobs successfully.³¹⁻³⁴ However, this may be possible only in selected patients depending on the agent, the exposure circumstances, type of respirator and the particular worker's condition.

A change of job environment with complete cessation of exposure to the relevant asthma-inducing agent is to be favoured and offers the best chance of full recovery, but may not be practical if the worker is to avoid permanent unemployment. The alternative of continued work for the same employer in a new capacity with diminished exposure, possibly with medication and the use of respirators, may offer an acceptable compromise.³⁵

What is very important is a proper dialogue with the patient and, where indicated, with the employer, so that all parties understand the condition and cooperate to find the best possible solution that will ultimately benefit both the worker and the employer.

Compensation

Persons with occupational asthma may incur considerable financial expenses from long medical leave, loss of job opportunities and possible long-term medical expenses which they may continue to incur even after leaving the employment where they developed their asthma. They may have difficulty securing a job with a comparable salary particularly if they are in the older age group.

At one stage, cases of occupational asthma were assessed for disability using the same criteria as for pneumoconiosis which was based on the lung function after optimal treatment and bronchodilatation.³⁶ This was deemed to be unfair to workers with occupational asthma who had normal lung function but continued to suffer from frequent asthmatic attacks and requiring long-term medication.³⁷ The American Thoracic Society has recommended that for the assessment of asthma, other factors should also be considered such as the degree of airway hyper-responsiveness and the type and amount of medication required to control symptoms.³⁸

In Singapore, a case of occupational asthma is assessed using the FEV1 but if this is normal, then an award of between 5% and 20% disability can be given depending on the minimum medication requirements.³⁹ Such assessments should be made only after the patient is stabilised and there has been an adequate period since transfer from exposure to the causative agent.

Prevention

Primary prevention would be the ideal, with the elimination of workplace exposures to known asthma causing agents. Companies can be encouraged to substitute such agents or to totally enclose the process. However, this is not always practicable or cost effective, given the apparently low incidence of occupational asthma. Reduction of exposures to these agents through the use of local exhaust ventilation systems, dilution ventilation and dust suppression may help to reduce the risk. The effective use of respiratory protection may also help reduce worker exposure.

There is also a place for secondary prevention i.e., early detection of cases of occupational asthma because of the more favourable prognosis of early detection and removal. Health education of employers and workers to increase the awareness of the condition may result in earlier self-reporting. Periodic screening of workers at risk using spirometry, skin prick or specific antibody testing has been proposed, but the cost effectiveness of such a procedure has to be considered. The use of a simple questionnaire at pre-employment and at periodic intervals may be a useful and relatively inexpensive screening test.

There have been some reports that smoking and atopy may be risk factors in the case of exposures to certain agents.⁴⁰ However, there is still insufficient justification for excluding such otherwise healthy individuals from working with certain agents⁴¹ although there may be some grounds for excluding a known asthmatic from exposure to agents which may potentially exacerbate the asthma.

Conclusion

Occupational asthma is not an uncommon condition. It is important to consider the possibility of work-related asthma in any adult patient with asthma. In patients where the history is suggestive, investigations should be properly conducted to confirm or exclude the diagnosis of occupational asthma, as the subsequent management of the case may have implications on the patient's livelihood. There are also medicolegal considerations. Early diagnosis and prompt removal from further exposure to the causative agent in the workplace will benefit the patient with occupational asthma.

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QUESTIONS

1. Occupational asthma is
 - a) notifiable under the Factories Act
 - b) compensable under the Workmen's Compensation Act
 - c) the most common occupational lung disease in Singapore
 - d) caused only by allergy to specific sensitisers
2. The following are known causative agents for occupational asthma
 - a) flour
 - b) panadol
 - c) colophony
 - d) isocyanate compounds
3. Patients with occupational asthma
 - a) recover completely after a job transfer
 - b) may present with delayed asthmatic reactions following exposure
 - c) may have associated rhinitis
 - d) are atopic
4. A specific inhalational challenge test is carried out to
 - a) document a new cause of occupational asthma
 - b) evaluate the patient's response to a permanent job transfer
 - c) distinguish between multiple known agents
 - d) assess disability for Workmen's compensation purposes
5. A diagnosis of occupational asthma can be made based on
 - a) a serial PEFr showing a work-related pattern
 - b) a positive specific inhalational challenge test
 - c) a positive methacholine challenge test
 - d) a positive skin prick test to common environmental allergens

ANSWER SHEET

Continuing Professional Development:
Clinical Update on Occupational Asthma

Question 1

- | | | | |
|---------|-----------------------|-------|-----------------------|
| a) True | ☐ | False | ☐ |
| b) True | ☐ | False | ☐ |
| c) True | ☐ | False | ☐ |
| d) True | ☐ | False | ☐ |

Question 2

- | | | | |
|---------|-----------------------|-------|-----------------------|
| a) True | ☐ | False | ☐ |
| b) True | ☐ | False | ☐ |
| c) True | ☐ | False | ☐ |
| d) True | ☐ | False | ☐ |

Question 3

- | | | | |
|---------|-----------------------|-------|-----------------------|
| a) True | ☐ | False | ☐ |
| b) True | ☐ | False | ☐ |
| c) True | ☐ | False | ☐ |
| d) True | ☐ | False | ☐ |

Question 4

- | | | | |
|---------|-----------------------|-------|-----------------------|
| a) True | ☐ | False | ☐ |
| b) True | ☐ | False | ☐ |
| c) True | ☐ | False | ☐ |
| d) True | ☐ | False | ☐ |

Question 5

- | | | | |
|---------|-----------------------|-------|-----------------------|
| a) True | ☐ | False | ☐ |
| b) True | ☐ | False | ☐ |
| c) True | ☐ | False | ☐ |
| d) True | ☐ | False | ☐ |

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