

INTRODUCTION

The strong association between asthma and allergy has been known for a long time. Exposure to an allergen is an important risk factor for the development of atopic sensitization to that specific allergen; this then keeps the disease active by precipitating asthma attacks or by promoting the persistence of symptoms. This allergic reaction in the airways leads to an increase in the inflammatory reaction, airway hyperresponsiveness and lung eosinophils. Such sensitization may occur with small amounts of airborne allergen, which can cause major changes in the lungs of sensitized people. A major unresolved question is whether exposure to allergens is the primary cause of the development of new asthma or if this exposure merely triggers asthma attacks or leads to persistence of symptoms in subjects who already have asthma. Some studies have suggested that sensitization amongst genetically susceptible persons to certain indoor allergens such as house dust mites, animal dander and cockroach is a risk for developing asthma in children. The importance of such sensitivity as a cause of asthma declines with advancing age. Other studies have shown a negative association of exposure to some allergens with current expression of asthma.

For any asthma patient, it is important to identify and reduce exposure to relevant allergens and irritants in the environment. These include a) Inhalant allergens, b) Occupational exposures, and c) Irritants. Asthma symptoms, peak expiratory flow rates and bronchial hyperresponsiveness improve when patients avoid environmental allergens to which they are sensitive. It is to be remembered that food allergens are NOT a common precipitant of asthma symptoms.

INHALANT ALLERGENS

Exposure of an asthma patient to inhalant allergens to which the patient is sensitive increases airway inflammation and symptoms. The patient must therefore be evaluated for the degree of exposure to the allergen, the sensitivity to the allergens to which the patient is exposed, (which may require skin testing or in vitro testing), and the clinical significance of positive allergy tests in the context of the medical history.

Indoor allergens include house dust mites, animal allergens, cockroach allergens, and fungi. With increasing urban development, the number of indoor allergens has actually increased.

The house dust mite allergens

The house dust mite is the most common indoor allergen associated with asthma worldwide. Domestic mite allergens are present in various parts of the mite bodies, secretions and excreta. The principal mite species are the *D. pteronyssinus* and *B. tropicalis*. Mites are photophobic, absorb humidity from the atmosphere, and live on organic matters. Mites feed on human and animal scales colonized by yeasts, microfungi and bacteria. They are found in the greatest numbers in bedding and carpets. They can be found on floors and also tend to bury themselves deep in mattresses and soft furnishings. Conditions for growth are a temperature between 22°-26°C and a relative humidity greater than 55%.

Effective avoidance measures are:

- Physical barriers around bedding:
The most important measures are to cover pillows, mattresses and bolsters in an allergen impermeable cover, and to wash all sheets, pillow cases and blankets weekly using hot water at a temperature $\geq 65^{\circ}\text{C}$.
- Reducing areas that can harbour them in the house; carpets should be removed from the bedrooms. The patient should avoid sleeping or lying in upholstered furniture. Children's beds should have no or minimum stuffed toys and they should be washed weekly with hot water.
- Controlling humidity. The aim is to keep indoor humidity to less than 50% to reduce mite growth. In a tropical climate, air-conditioning is useful as it also allows windows and doors to stay closed thus preventing the entry of outdoor allergens.

The use of chemicals to kill mites or denature allergens has only marginal effects and is not recommended.

Vacuuming removes mite allergen from carpets but is inefficient in removing live mites. Vacuuming carpets once or twice a week is useful to reduce the accumulation of house dust. However, it is probably best that someone else who does not get symptoms attends to the vacuuming and empties the bags. There is a rise in aeroallergen during and after vacuuming. Wet vacuum cleaners are efficient at removing surface allergen but the effect is lost within weeks, and the residual water contributes to the increased proliferation of mites.

Evaporative coolers and humidifiers are not recommended because they potentially cause more harm by increasing humidity and encouraging the growth of both moulds and house mites.

Indoor air-purifiers are of several types including those that use mechanical filters (eg HEPA filters), electrostatic precipitating devices (ionisers) and hybrid filters. They aim

to reduce the concentration of indoor pollutants or allergens. However, they cannot substitute for good cleaning and hygiene practice, and most studies on air filters or ionisers have failed to demonstrate an effect on asthma symptoms or pulmonary function. It may be difficult to determine why air filtration is not more successful. The most likely explanation is that much aero-allergen exposure is from local sources close to the individual (head on pillow, cushion). Therefore, air filtration operating at some distance does not have sufficient impact on exposure.

Animal allergens

All warm-blooded animals release allergens in secretions, excretions, and dander. Cat allergens are potent airway sensitizing agents. Even when cats are removed from the house, allergens may persist for months. The quantity of cat allergen that accumulates in carpets, sofas and mattresses represents a major reservoir that is difficult to remove with routine cleaning. Other animals like dogs or hamsters are also potentially allergenic.

The following actions are recommended to control animal antigens:

If the patient is sensitive, the animals and products made of feathers should be removed from the home environment. If removal is really not acceptable, keeping the pet outdoor is effective. If this is still not acceptable, the pet should be kept out of the bedroom, with the bedroom door closed all the time, all upholstered furniture and carpets removed from the home and the pet isolated from the patient as far as possible. Weekly washing of the pet may decrease the amount of dander and dried saliva.

Cockroach allergens

Most cockroaches live in tropical climates. Cockroaches produce allergens that have been shown to trigger asthma in sensitive individuals. It is important to keep the home environment clean by removing garbage and food waste promptly from the home, removing cockroach debris quickly and exterminating them by using multiple baited traps or poisons.

Outdoor allergens

The most common outdoor allergens that may lead to asthma in susceptible people are pollens (tree, grass and weed) and seasonal fungal spores.

OCCUPATIONAL EXPOSURES

Early recognition and control of exposures is essential, because the likelihood of complete resolution of symptoms decreases with time; there may be progressive deterioration and permanent disability if exposure continues. Occupational asthma is defined as asthma induced by a specific agent in the workplace. It is the most common occupational lung disease in developed countries and may

cause up to 5-15% of adult onset asthma. It should be suspected in all new cases of adult onset asthma. It is suggested by a correlation between asthma symptoms and work, with improvement when away from work. Enquiry about temporal nature of symptoms, weekends and long leave is necessary. The patient may fail to recognize the work relationship because the symptoms sometimes only occur several hours after exposure, such as in the late reaction. More than 200 types of occupational chemicals, organic and inorganic, natural and synthetic antigens have been described. These include TDI in the plastics industry, flour amongst bakers, disinfectants and latex amongst nurses, steel fumes or chromium in welders. In addition to evaluating the potential for workplace related symptoms, the pattern of symptoms in relation to work exposure with particular attention to relief during days off and holidays, documentation of work-relatedness of airflow limitation is necessary; this requires serial charting of PEFR at work and also off during a period off work as needed. Challenge testing for the specific suspected agent can be used to confirm the relationship. The ideal treatment is the permanent removal of the patient from further exposure to the causal agent.

IRRITANTS

A variety of irritants can trigger asthma. Irritants may be found indoors or outdoors.

Environmental tobacco smoke

Environmental tobacco smoke is the most important environmental indoor irritant and a major precipitant of asthma symptoms. There is an increased frequency and severity of exacerbations of asthma. A person with asthma should not smoke, smoking should not be allowed in the person's home and he should avoid second-hand smoke as far as possible. Exposure to maternal smoke has been shown to be a risk factor for the development of asthma in infancy and childhood; the effects of environmental tobacco smoke may also occur in utero.

Air pollution

Outdoor air pollution has been linked to acute exacerbations of asthma. Currently the air pollutants of most concern are inhalable particulates of $1 = 1 \mu\text{m}$, ground level ozone, acid aerosol, sulphur dioxide and nitrogen dioxide. Ambient concentrations of respiratory particulates have been associated with increased emergency room, physician visits and hospitalizations for asthma. It is therefore advisable for asthmatics to remain indoors when the PSI levels rise above 100.

Others

Other indoor respiratory irritants include fumes from unvented gas or other types of indoor combustion, oil, kerosene stoves, sprays, and perfumes.

Learning Points:

- In practice, the physician must look at every asthmatic patient for the possibility of any allergy to a major indoor or outdoor allergen, any occupational cause for his asthma, and any identifiable irritant, which contributes to the worsening of his condition.
- Increasing medication for asthma control is not a substitute for avoidance of exposure to allergens and irritants.
- Appropriate measures to decrease exposure must be taken, including controlling potential sources and minimizing reservoirs of allergen. Simple measures described to control exposure to domestic house mites, animal dander, or cockroach debris, and reduction of carpets and upholstered furniture can go a long way to reduce the severity of asthma symptoms.

- The precise role of immunotherapy in asthma is controversial. Currently available asthma medications and avoidance strategies usually provide good control of asthma. Specific immunotherapy directed at a particular allergen, which cannot be avoided, and which is clearly the culprit, when pharmacological approaches have not been successful may be considered; this form of treatment is not standard in Singapore and should ideally only be undertaken by an allergist or immunologist.

REFERENCES

1. Li JT. Allergy testing. Am Fam Physician 2002 Aug 15;66(4):621-4
 2. German JA, Harper MB. Environmental control of allergic diseases. Am Fam Physician 2002 Aug 1;66(3):421-6.
 3. Youakim S. Work-related asthma. Am Fam Physician 2001 Dec 1;64(11):1839-48.
-