

**Dr. Surender K. Sharma**, Additional Professor, Department of Medicine, All India Institute of Medical Sciences (AIIMS), New Delhi, obtained his MBBS and MD degrees from PGIMER, Chandigarh. He worked as Research Fellow in the Department of Pulmonary Immunology and Molecular Biology at the Massachusetts General Hospital (Harvard Medical School), Boston, USA (January-December 1993). He has authored more than 125 publications in reputed national and international journals. He also won a prize in 'Envirotech Contest' (1994) for the best published material on environment and pollution caused by stone dust. Dr. Sharma is the recipient of *National Merit Scholarship* (1967-73); *Sorof-Jyoti Award* (1987, 1989); and First of the four *Shakuntala Amir Chand Prizes* (1991) of the Indian Council of Medical Research.

**UNDERSTANDING  
ASTHMA**

# **UNDERSTANDING ASTHMA**

**Dr. S. K. Sharma, MD**



**VIGYAN PRASAR**

**Published by**

**VIGYAN PRASAR**

Technology Bhawan

New Mehrauli Road, New Delhi - 110 016

Phones : 6866675, 6967520, 6965978/ 80/ 85

## **UNDERSTANDING ASTHMA**

**(A publication under Vigyan Prasar Health Series)**

### **Author**

Dr. S.K. Sharma

### **Series Editors**

Dr. Narender K. Sehgal

Dr. (Mrs.) Divya Srivastava

Dr Subodh Mahanti

### **Production and Layout**

Ganesh A Hegde

Ranjana Arora

### **Illustrations**

Dr. S.K. Sharma

### **Cover Design**

Shabnam/Amitabh

### **Keywords:**

1. Asthma - Bronchial Diseases
2. Chest Diseases
3. Pollution - Allergens
4. Chest Diseases - Treatment

**ISBN 81-7480-012-3**

**© 1996 Vigyan Prasar**

All rights reserved. No part of this book may be reproduced or utilized in any form, or by any means, electronic or mechanical including photocopying, recording, or by any information storage and retrieval system without permission from publishers.

Responsibility for the information provided in this publication rests with the author.

Printed at The Offsetters, New Delhi-110 003

# CONTENTS

|                                                                                                                                                                                                                                                                                                                                                                                       |           |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| <b>Foreword : Narender K. Sehgal .....</b>                                                                                                                                                                                                                                                                                                                                            | <b>9</b>  |
| <b>Introduction .....</b>                                                                                                                                                                                                                                                                                                                                                             | <b>11</b> |
| <b>What is Asthma? .....</b>                                                                                                                                                                                                                                                                                                                                                          | <b>13</b> |
| Historical background -- Definition of asthma -- Magnitude of the problem -- Mortality from asthma -- Is incidence of asthma increasing? -- Is asthma a familial illness? Genetic tendencies in asthma -- Gene and environment interaction -- The natural course of asthma -- Problem of recurrence -- The outlook of asthma in adults -- Type of asthma -- Asthma and other illness. |           |
| <b>The Lung .....</b>                                                                                                                                                                                                                                                                                                                                                                 | <b>23</b> |
| The normal lung -- The airways -- The bronchial glands -- Smooth muscle -- Inspiration and expiration -- Pathogenesis of asthma -- Bronchial reactivity -- Lungs and airways in asthma -- Inflammation -- Inflammatory cells -- Bronchospasm -- Mucus production.                                                                                                                     |           |
| <b>Triggers of Asthma .....</b>                                                                                                                                                                                                                                                                                                                                                       | <b>33</b> |
| Exercise -- Pollen and spores -- House dust mites -- Pets -- Occupational asthma -- Food allergy -- Drug induced asthma -- Emotional and psychological factors -- Infection -- Air pollution -- Gastro-oesophageal reflux.                                                                                                                                                            |           |
| <b>Symptoms, Diagnosis and Monitoring of Asthma .....</b>                                                                                                                                                                                                                                                                                                                             | <b>43</b> |
| Cough -- wheezing -- Detailed medical history -- Spirometry/ pulmonary function tests -- Treatment of bronchial asthma -- Environmental changes -- Irritants -- Drug treatment -- Alternative treatments -- Special situations                                                                                                                                                        |           |
| <b>Summary points .....</b>                                                                                                                                                                                                                                                                                                                                                           | <b>69</b> |
| <b>Index .....</b>                                                                                                                                                                                                                                                                                                                                                                    | <b>71</b> |

## FOREWORD

This is one of a set of publications brought out by Vigyan Prasar in connection with the celebrations of the National Science Day (NSD) in 1995 for which the focal theme was "Science for health". The idea originally was to quickly come out with several small books or booklets on familiar health topics of everyday interest to the common people, written by well-known practicing doctors specialising in those areas. But since things did not happen 'quickly' enough to meet the NSD deadline, a decision was taken to reorient this effort and the concept of a "Vigyan Prasar Health Series" was born.

This volume titled *Understanding Asthma* by Dr. S K Sharma, Additional Professor, Department of Medicine, All India Institute of Medical Services (AIIMS), New Delhi deals with an ailment whose occurrency is reportedly on the rise. Because of mounting vehicular and other emissions and a variety of chemical operations around us all over the country, more and more people, especially children, are falling prey to Asthma and other respiratory diseases.

In the accompanying pages, the author has attempted very ably to describe the ailment, its various forms, factors thought responsible for causing and/or aggravating it and various ways of coping with it in real life, alongside different approaches to its treatment and management.

One hopes that readers, in particular those, who have seen or known someone close to them suffer from this ailment would be able to benefit through a better understanding of the underlying causes and an appreciation of the basic philosophy behind its medical care and control.

Suggestions not only in respect of this and other volumes in the series, but also on additional topics for inclusion, would be most welcome.

New Delhi

**Narender K. Sehgal**  
Director  
Vigyan Prasar

## INTRODUCTION

Asthma is a common malady that affects both children and adults. Although asthma begins in childhood, it can start at any age. It is a chronic disease with episodic nature. Acute exacerbations (episodes or flares) in asthma are interspersed with symptom-free periods of variable duration. Long periods of remission are not uncommon in this disease. Typically, acute exacerbations tend to be episodic (short lived) and are followed by complete recovery. However, at times there is a phase in which the patient experiences mild degree of airways obstruction almost daily. Sometimes bouts of severe airways obstruction may punctuate this phase of mild obstruction and last for days or weeks.

Symptoms of bronchial asthma are not fixed but keep on changing. An asthmatic is in a best position to evaluate these changes, sometimes with the help of measurements at home and with the advice of his/her physician. Therefore, the best way to cope with the day-to-day problems of asthma calls for the involvement of asthmatics in the management of their own disease and parents in the management of their children's disease.

It must be emphasised here that various therapeutic or preventive measures can be undertaken to reduce many of the problems associated with asthma but in a majority of the patients there is no cure. A few asthmatics may suffer from one specific allergy which can be avoided, others have their problems brought on by various triggers or precipitating factors. In these patients it may be possible to get rid of asthma by removing the trigger but these cases are in a minority. A significant proportion of patients have more than one trigger for their asthma such as pollen or dust which are

---

\* Terms asthma and bronchial asthma are used interchangeably.

not readily avoidable, or they may have no obvious triggers at all. It is for this group of asthma patients that the appropriate treatment will be necessary to suppress the disease process. The present day drug treatment for asthma is generally very effective and has almost negligible side effects. An asthmatic must know the common problems of asthma and should try to deal with them effectively with drugs or by other means.

Asthma in children can lead to absentism from school resulting in impaired educational and career prospects. Although asthma has a low mortality, its morbidity is staggering with awesome socioeconomic consequences. Because of persistent symptoms in adults, asthma may result in considerable degree of disability and impose limitations on both social life and occupation. With the institution of presently available appropriate drug treatment, however, all patients should be able to lead normal lives.

\* \* \*

# WHAT IS ASTHMA ?

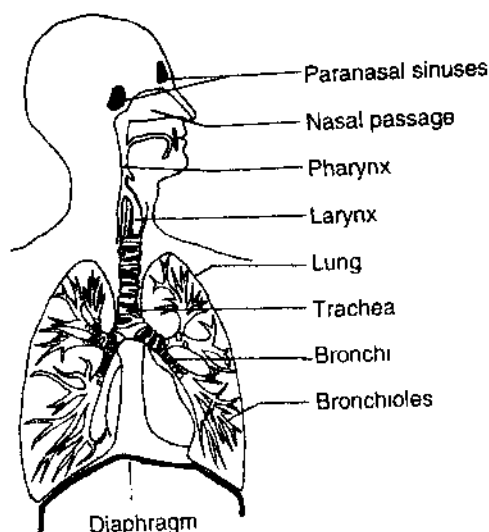
## Historical background

Asthma has been recognised for over 2000 years. Hippocrates, the great Greek physician, who lived from 460 to 360 B.C. on the island of Kos, used the term 'asthma' for any shortness of breath. Asthma is a Greek word which means "breathless" or "to breathe with open mouth". Originally, asthma was used to describe shortness of breath of any cause, as exemplified by its use in the description of the mode of death of metal miners ('from the disease the Greeks call asthma') by Agricola in 1556. Subsequently, the word asthma was used to describe episodic breathlessness due to bronchial disease. In 1698, Sir John Floyer in his book, *A Treatise of the Asthma*, used the term in its general sense but confined himself to the discussion of the episodic type from which he himself suffered. Henry Hyde Salter in 1869, who himself was a patient of bronchial asthma, in his famous book, titled *Asthma : Its Pathophysiology and Treatment*, specifically used "asthma" to describe "episodic" type of breathlessness.

## Definition of asthma

The above mentioned "illness" of Floyer and Salter is so characteristic that even a "non-medical" person may be able to make a diagnosis of asthma easily. Given that the above statement is true, the debate about the definition of asthma may surprise the layman. But such debate continues and is likely to remain unresolved. This is because of the fact that asthma results from the interaction of genetic and many environmental influences on the tone and reactivity of the airways. The response varies in different individuals from time to time. As more and more research is carried out over

the years, our understanding of the pathogenesis of asthma is changing. Previously, asthma was viewed as a complex of symptoms and signs; subsequently, in terms of distinctive physiological and pathological features. Presently, asthma is considered to be a disease affecting the airways of lungs (Fig. 1). Patients with asthma have airways which have a



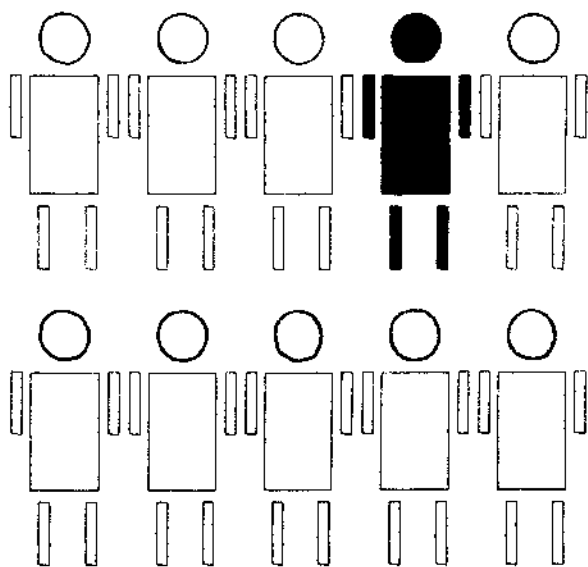
**Fig. 1. The normal lungs and airways**

tendency to narrow (also known as bronchoconstriction). The characteristic feature of asthma is reversibility of airflow obstruction over short periods of time. Usually either bronchoconstriction in response to specific stimuli or bronchodilatation in response to treatment. This tendency of airways to narrow in response to diverse environmental stimuli is also known as "airway hyperreactivity or bronchial hyperreactivity (BHR)". This BHR is supposed to be a very important feature of bronchial asthma and results from

bronchial inflammation. In the older age-group, difficulties may be encountered in differentiating asthma from chronic bronchitis and emphysema, diseases associated with tobacco smoking. Asthma differs from chronic bronchitis and emphysema in that its course is not relentlessly progressive. Bronchoconstriction in adult asthmatics is often persistent and difficult to reverse with treatment, and behaves like bronchoconstriction observed in chronic bronchitis and emphysema. In chronic bronchitis, the mucus glands enlarge and secrete excessive mucus which is coughed up most days as sputum. In emphysema, the walls of the alveoli (the tiny air sacs in the lungs) breakdown .

### **Magnitude of the problem**

Asthma is one of the commonest causes of chronic ill health (Fig. 2). In adults the exact prevalence of asthma is



**Fig. 2. Asthma affects one in ten persons**

difficult to estimate because of problems encountered with the precise definition of asthma as has been mentioned previously. The current prevalence of asthma in adults in UK, based on the demonstration of reversibility of airflow obstruction of at least 15 per cent, has been estimated at around 5 per cent. Similar figures have been reported in adults aged between 40 and 64 years from other European countries. Prevalence of asthma in children is 10-12 per cent. In most western countries, asthma ranks amongst the commonest diseases in children. Boys are affected more commonly than girls. The ratio is around 2:1 at the age of 7 but it begins to even out above this age since boys are more likely to loose their asthma as they get older.

### **Mortality from asthma**

In recent years, our understanding of pathogenesis of bronchial asthma has increased considerably. We also have better modalities of drug treatment for the management of bronchial asthma. Despite all these advances, mortality from bronchial asthma continues to rise instead of declining. In the past, there have been several temporary increases in the death rates from asthma: in the UK in the 1960s and in New Zealand in the early 1980s. There has been no satisfactory explanation to account for this increased mortality. Overreliance on bronchodilator treatment at home instead of seeking immediate emergency room treatment and under-use of corticosteroids treatment could be a possible explanation. Exact mortality figures for bronchial asthma are not available from India. Asthma deaths in England and Wales are nearly 2,000 per year. Major cause of mortality in asthma is failure to appreciate severity of asthma and to treat it adequately. This fact is illustrated by a study carried out by the British Thoracic Association's evaluation of 90 asthma deaths. Findings of the study reveal that in a majority of the cases failure to recognise the severity of an episode of asthma and its undertreatment were the principal determining factors.

Patients at risk include those with previous severe attacks, particularly if the onset was sudden; those with a large diurnal variation in peak expiratory flow rates (PEFR) and those recently discharged from the hospital.

### **Is incidence of asthma increasing?**

Asthma is a common disease throughout the world and there is evidence to suggest that its incidence is on the rise in most countries. There is, however, a lot of geographical variation and in some communities there is very little asthma indeed. In Gambia and among the Eskimos, asthma is uncommon. Studies in villagers in the highlands of New Guinea 20 years ago showed very little asthma but later studies have shown that even in this primitive rural community asthma is on the increase. This increase in incidence of asthma could be related to air-pollution associated with increasing urbanization and industrialization (Fig. 3).



**Fig. 3. Air pollution--a hazard of urbanization.**

## **Is asthma a familial illness ?**

Asthma has a strong tendency to run in families and this is illustrated by the following example. In 1946 the population of the island of Tristan da Cunha in the Atlantic Ocean was studied, and nearly one-half of the inhabitants were found to have asthma. This was traced back to three asthmatic women who were among the original 15 settlers on the island and it shows the strong genetic element in the inheritance of asthma. However, there is no simple genetic explanation for inheritance of asthma.

## **Genetic tendencies in asthma**

It is possible that there are two separate tendencies being inherited; a tendency to form antibodies (*vide infra*) against common substances such as pollen or house dust, and a tendency for the airways to narrow easily. Asthma occurs when these two tendencies are combined and the environment provides the right stimulus. The body produces these substances called antibodies [immunoglobulins (Ig)] when it encounters a new substance. These are generally protective and help in resisting infections but in some circumstances, such as asthma, the antibodies themselves may produce harmful reactions. The tendency to form antibodies (IgE type) is known as atopy and occurs in about one in three people. The presence of these antibodies can be shown by skin tests. Two conditions run in the same families as asthma; hay fever, childhood eczema, and atopy is related to them.

## **Gene and environment interaction**

Genes are certainly not the only determinants of asthma; the environment is also important. This has been seen with the changing rates of asthma among the Tokelau islanders who moved to mainland New Zealand and among those who have

moved from the Indian subcontinent to the UK. Xhosa children in rural Transkei in southern Africa rarely have asthma but the rate of asthma increases 30 times if they move to live in urban Cape Town. The importance of other factors is also indicated by studies of twins. In an identical pair of twins when one is asthmatic the other, commonly but not invariably, also has this condition. The chances of asthma occurring in a child whose parents are asthmatic are 20 times higher than a child whose parents are not asthmatic. Furthermore, if one of the parents has asthma, the chances of the child having asthma is around 25 per cent (one in four) which increase to 40 per cent (two in five) if both parents have asthma.

### The natural course of asthma

Most parents are anxious to know whether their child will grow out of asthma. Growing out of asthma is illustrated in Fig. 4.

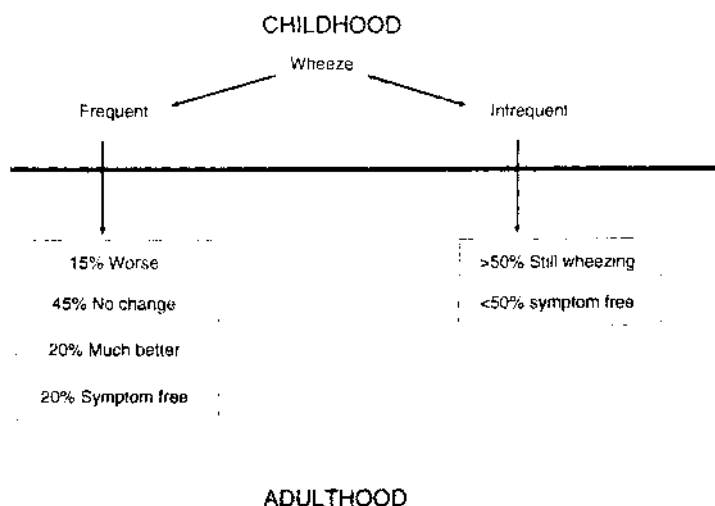


Fig. 4. Course of asthma from childhood to adult

## Problem of recurrence

Unfortunately, even if asthma goes away as children grow up there is no guarantee that it will stay away permanently. An Australian study shows that one third of the children who had lost their asthma had problems again by the time they got into their 20s. It seems that the tendency to develop asthma is still in the background waiting to be given the right opportunity to show itself again. This has important implications for such children. They should avoid circumstances which are likely to provoke problems. They should not smoke and certainly should avoid exposure to smoke as far as possible. This implies keeping dust down, and avoiding feather bedding and furry pets even when the asthma seems to have settled.

## The outlook of asthma in adults

Adult patients are less likely to improve spontaneously. A variable pattern of asthma is seen in adults. Sometimes behaviour of bronchoconstriction is similar to that seen in childhood with a great deal of variability and good response to treatment. In other people it is more persistent; drug treatment has an effect but does not always reverse the bronchoconstriction and needs to be used on a regular basis.

## Types of asthma

There are two broad categories of asthma and the two follow rather different patterns. These are extrinsic and intrinsic types.

**Extrinsic asthma:** Extrinsic type of asthma begins in childhood and is often related to hay fever and eczema in the child or other family members (Fig. 5). In this form of asthma there are usually obvious precipitating factors which bring on attacks (Fig. 5), this can usually be confirmed by skin tests.

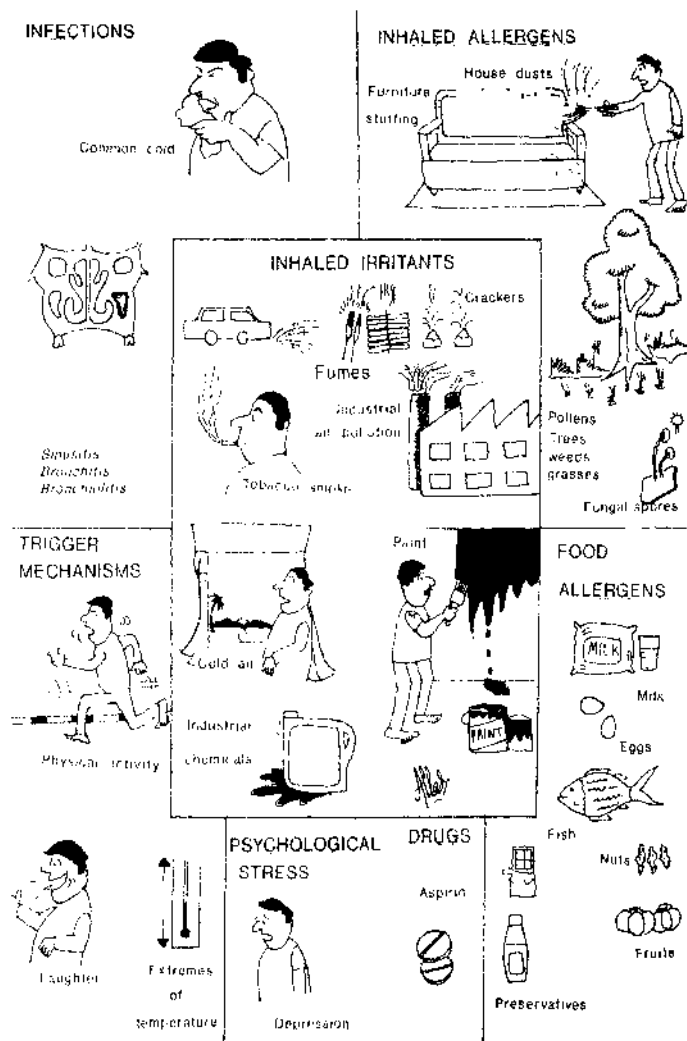


Fig. 5. Factors precipitating bronchial asthma

Infections such as common cold, emotion, and exercise often bring on attacks. Because of all these external influences this form is often called extrinsic asthma. In general there is a lot of variability in the amount of airway narrowing. However, response to treatment in this type of asthma is extremely good.

***Intrinsic asthma*** : This is the type that usually starts in adult life. The asthmatic episodes are often brought on by upper respiratory tract infections, and bronchitis (Fig. 5), but other triggers are not usually so evident and skin tests are negative. The bronchoconstriction tends to be less easily reversible with treatment and these patients often have persistent and chronic symptoms.

The aforementioned types are just broad groups and many patients may fall somewhere in between these two groups.

## **Asthma and other illnesses**

People often suffer from hay fever as well as asthma, particularly the extrinsic type. More than half of extrinsic asthmatics but only one in every 15 intrinsic asthmatics have hay fever. The other condition linked to atopy, childhood eczema, is found in about a third of asthmatics.

***Overweight*** : Obesity increases the work that the lungs have to do and should be avoided. Asthmatics with obesity should be advised to reduce weight. It is wise to keep ourselves as fit as possible to ease the work of the lungs.

# THE LUNG

## The normal lung

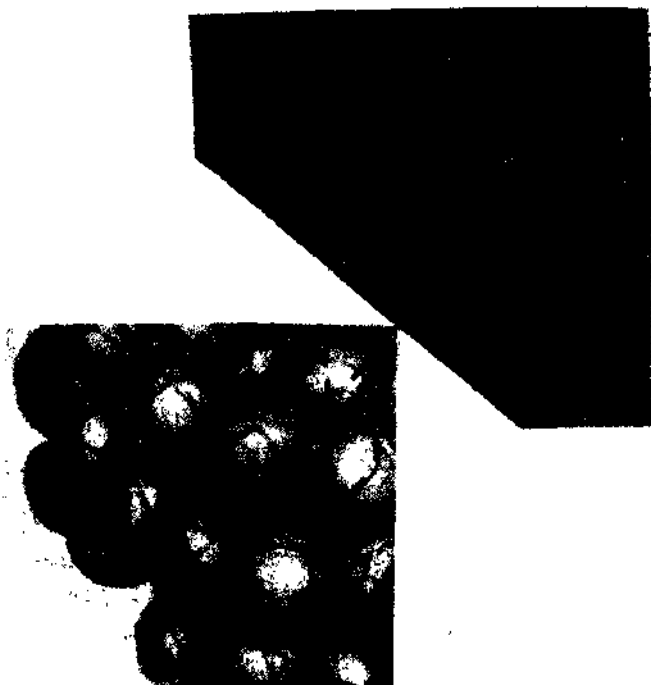
In order to understand what goes wrong in the lungs in patients with asthma, we first need to understand a little about the normal structure and function of the lungs.

The most important function of the lungs is gas exchange; that is taking in oxygen from the air into the blood stream and getting rid of the waste gas carbon dioxide. In order to do this, air has to be brought very close to the blood and this happens in tiny air sacs called *alveoli* (Fig. 6). These are like tiny bubbles with thin blood vessels running in their walls. These alveoli are the end of an extensive branching structure which starts with trachea, the main airway into the lung (Fig. 1).

The alveoli are each about a quarter of a millimetre (mm) in diameter and there are about 300 million of them in the lungs (Fig. 6). The total surface area of the alveoli available for gas exchange is about the size of a tennis court. Blood from the veins (from all over the body) drains into the right side of the heart and is then pumped through the lungs by way of the tiny vessels in the walls of the alveoli. There it picks up oxygen (oxygenation of blood) and gets rid of carbon dioxide before returning to the left side of the heart. Oxygenated blood from the left side of the heart is pumped out to all the tissues in the body through the arteries.

## The airways

Various objects including liquids and food particles can enter



**Fig. 6. Air sacs (alveoli)**

the lungs via trachea. This entrance to the trachea can be closed by the epiglottis which hangs over it and by the vocal cords which can come together across the trachea like two shutters. The trachea is about two centimetres (cm) in diameter and is 10 cm long. It divides into the left and right main bronchi which supply the two lungs. The large airways such as the trachea have a stiff wall, which contains cartilage, the same substance as that supports our nose and ears. These are present in the form of a ring. These cartilaginous rings are present only anteriorly and are absent posteriorly (Fig. 1). This makes these large airways less likely to narrow in asthma. In children, of course, all the airways are smaller. The trachea is only 0.5 cm wide in an infant and attains a size of 1 cm by the age of seven years. The bronchi branch several times to form the tiny airways or bronchioles which supply the alveoli.

All the airways are lined by an *epithelium*, which is like a thin skin, and on the top of this skin are tiny hairs called *cilia* which are constantly in motion wafting up the lung secretions from the outer portions of the lungs to the large airways. Some cells in the epithelium, called goblet cells, are active in making some of these secretions. Underneath the epithelial layer there is a loose mass of tissue called connective tissue in which there are two important structures, the bronchial glands and the smooth muscle.

### The bronchial glands

These have little tubes opening on to the inner surface of the airway. Through these, they pour secretions of mucus into the airway where again it is wafted up the larger airways and then coughed up as abnormally sticky sputum. This adds to the narrowing of the airways and may become important in patients with asthma. These thick and tenacious mucus plugs blocking most of the airways constitute the most remarkable feature in the lungs of patients who die of asthma (Fig. 6a).

### Smooth muscle

The bronchi have smooth muscles wrapped around like stripes on a candy cane. The state of tension of these muscles



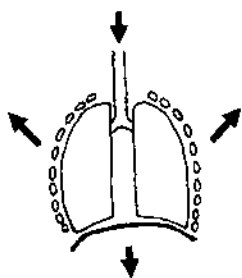
Fig. 6a. Thick and tenacious sputum seen in bronchial asthma.

is an important factor in determining the diameter of the bronchus; contraction of bronchial muscles narrows the bronchus, while relaxation widens it.

## Inspiration and expiration

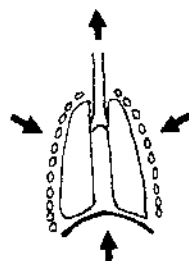
Breathing-in is also known as inspiration (inhalation) and breathing-out is called expiration (exhalation) (Fig. 7). Air comes in and out of the lungs through the pumping action of muscles. Even if we do not do any thing, about 500 litres of air is breathed in and out every hour. During inspiration, the *diaphragm*, (an inspiratory muscle), and the *rib cage* enlarge the chest, and air flows into the lungs through the trachea and all its branches. Expiration is usually a passive process, that is, the muscles just relax and the lungs shrink in size like a deflating balloon. However, the lungs do not get rid of all the air; in adults a litre or so remains in the lungs, no matter how hard we try to breathe out. Under normal circumstances, little work is required for the breathing process. However, there are two things that make this work much harder and difficult:

Inspiration (Breathing in)



Movement of the ribs and diaphragm leads to expansion of the lungs

Expiration (Breathing out)



Movement of the ribs and diaphragm leads to contraction of the lungs

Fig. 7. Movement of ribs and diaphragm

(i) stiffness of the lungs, which makes them difficult to expand and (ii) narrowing of the airways, which means that more work is required to pull the air through them and air may have to be pushed out actively. Breathing through a narrow airway is hard work and this is exactly what a person is required to do during an attack of asthma.

## **Pathogenesis of asthma**

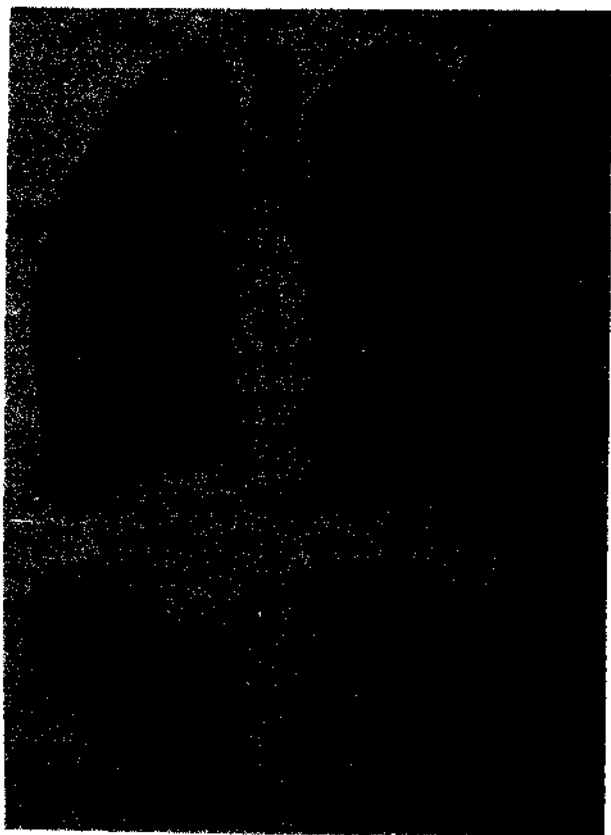
Many factors produce narrowing of the airways in asthma, and even in between attacks (when there are no symptoms and measurements such as the peak expiratory flow rates are normal), the airways are not normal.

## **Bronchial reactivity**

Increased bronchial reactivity in asthma is related to airway inflammation in which many cells participate. These include mast cells, eosinophils, lymphocytes, macrophages, neutrophils and platelets etc. Previously, it was believed that mast cells are the crucial cells in the pathogenesis of bronchial asthma. However, it has been shown recently that other cells also participate in the pathogenesis. These cells release various mediators which are responsible for symptoms of bronchial asthma. One such mediator histamine, released from mast cells results in immediate symptoms (acute bronchospasm or wheezing) of bronchial asthma. Mediators released from other cells result in bronchial hyper-responsiveness as a result of which asthmatic airways exhibit an exaggerated response to non-specific stimuli such as dust and smoke. Specific responses to agents such as pollen may lead to increased non-specific reactivity for days or even weeks. Upper respiratory tract viral infections may lead to similar changes and may increase reactivity in non-asthmatic subjects.

## **Lungs and airways in asthma**

When the air passages narrow, as in asthma, the lung seems to try to keep the airway lumen as wide as possible by keeping more air in the lungs, this is called overinflation or hyperinflation of the lungs (Fig. 8). It means that there is less room to take more air in with each breath, and breathing-in becomes difficult while breathing-out is limited by the narrow airways. Asthmatics, during an acute attack of asthma, usually find it most comfortable to sit up so that their main muscle of respiration (the diaphragm) works best and they may even use extra muscles in the neck to help their breathing.



**Fig. 8.** Increased lung volume is seen during an attack of asthma.

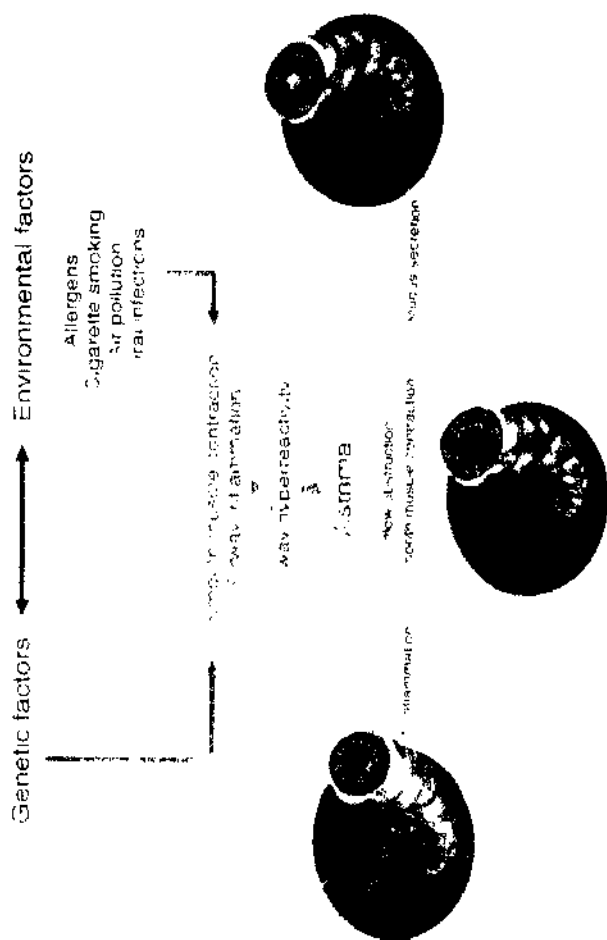


Fig. 9. Changes in Airways of Asthmatics

Typical changes which involve the airways in asthmatics include: inflammation, bronchospasm and mucus production (Fig. 9).

## Inflammation

Research workers have paid much attention to contraction of the smooth muscle (bronchoconstriction) in asthma. In fact, it was considered to be the crucial feature of bronchial asthma and all treatment modalities in the past were directed at reversing this bronchoconstriction. Currently, infiltration of airway wall by various inflammatory cells is considered to be the key abnormality in the pathogenesis of bronchial asthma. Bronchoconstriction is certainly important; but so is the swelling of airway wall by various inflammatory cells (Fig. 10). This swelling is a sign of inflammation and is

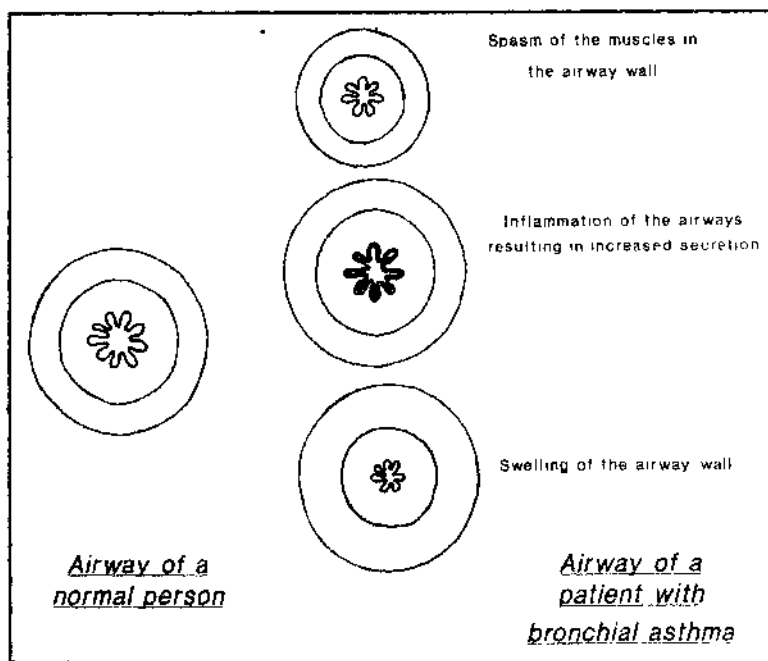


Fig. 10. Cross Section of Airways

equivalent to swelling which develops when the skin is burned or grazed. It is composed of fluid and of cells which release various substances that attract other cells; this causes more swelling and leads to contraction of the muscle. Research work has revealed that this inflammation persists to some degree in the walls of airways of asthmatics even when they are free of any problems and even when the disease has not given any trouble for 6 to 12 months. These cells lie quietly in the airway wall waiting for the right stimulus to activate them again and spark off the changes which lead to an attack of asthma. Corticosteroid medications are used to reduce this inflammation. Inhaled steroids or cromolyn used routinely may prevent it.

### **Inflammatory cells**

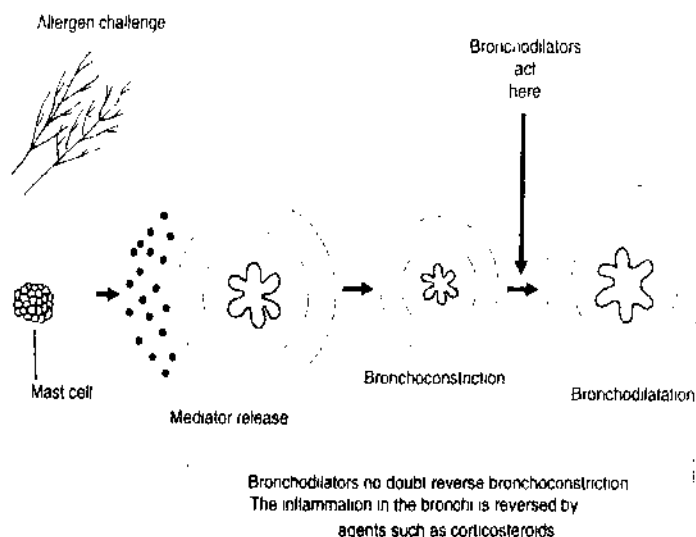
Many kinds of inflammatory cells in the wall of the airway are important in asthma. Those which have been best studied are the mast cells. These contain little packages containing preformed mediators which are released if these cells are triggered in the right way, for instance by a pollen grain in someone with the right allergy. These preformed mediators in little packages are highly active substances which cause the muscle to contract; produce swelling of the wall of the airway; and attract more and more inflammatory cells to the area, thereby increasing the inflammation and the response to further stimuli. Other cells include, eosinophils, lymphocytes, platelets, neutrophils etc.

### **Bronchospasm**

Another characteristic of asthma is increased sensitivity of the airways. This leads to bronchospasm, due to spasm of the smooth muscle around the airways. Bronchospasm causes further narrowing of the airways. Bronchodilator drugs are very effective in reversing this muscle spasm (Fig. 11).

## Mucus production

In some asthmatics, the mucus glands in the airways produce excessive, thick mucus which further narrows the airways. Corticosteroids decrease swelling, thereby lessening mucus production. Drinking adequate fluids and deep coughing can also help to remove the mucus. Expectorants (medications which increase sputum production), and mucolytics (medications which loosen the secretion) may also be beneficial.



**Fig. 11. Target of bronchodilators**

## TRIGGERS OF ASTHMA

### Exercise

Strenuous exercise produces narrowing of the airways in most asthmatics. Exercise-induced asthma (EIA) can be a problem in children, where it may interfere with games at school. The type of exercise influences the response; most patients find swimming in warm indoor pools the activity least likely to induce asthma. This observation is related to cooling and drying of the airways during hyperventilation and exercise. This exercise effect can be simulated by breathing cold and dry air. By contrast, breathing warm and humid air during exercise, as happens in indoor swimming pools, protects against the asthmatic response. The best protection against EIA is inhalation of a  $\beta_2$  stimulant or disodium cromoglycate prior to exercise. This form of treatment allows an asthmatic child to participate in games at school. It may be essential to explain the use of the drugs and the objectives of treatment to teachers. It is necessary for both parents and teachers to understand that, asthma in a child is quite compatible with a successful sporting career.

### Pollens and spores

Seasonal bronchial asthma is most commonly related to grass pollens. This variety of asthma is commonly associated with rhinitis and conjunctivitis. Pollens (Fig. 12) and mould spores (Fig. 13) are less common precipitating factors. It is rather impossible to completely avoid such pollens. A proportion of patients with asthma develop sensitivity to the spores of the fungus *Aspergillus fumigatus*. This condition is known as allergic broncho-pulmonary aspergillosis (ABPA).

## House dust mites

The house dust mite, *Dermatophagoides pteronyssinus* (Fig. 14), can precipitate bronchial asthma. The major allergen is found in the mites' faeces. These mites are widely distributed in bedding, carpets, soft toys and furniture and require damp and warm conditions for their thriving. Practically it is difficult to have environment almost free of house dust mites. However, regular cleaning of bedrooms and measures to avoid dust collection can significantly reduce the allergen load. Dust mite de-sensitisation may be useful in asthmatic children. This is discussed in more detail under immunotherapy.

## Pets

Among household pets, cats cause the greatest problem. Sources of allergens in the cat include dander, saliva and urine. Other domestic animals can also trigger asthma. Therefore, patients with asthma should avoid contact with household pets. In case these pets are already present in the house before a diagnosis of asthma is made, then these pets should be kept out of bedrooms. Patients should also be advised not to acquire new pets.

## Occupational asthma [Fig. 5]

The entity of occupational asthma has been increasingly appreciated over the last few years. It is defined as asthma which develops after a variable period of symptomless exposure to a sensitising agent at work. More than 200 precipitating agents have been implicated to cause occupational asthma. Table 1 provides causes of occupational asthma. Proteolytic enzymes and laboratory animals are likely to produce occupational asthma in individuals with



**Figs. 12. Pollens**

atopy, however, isocyanate asthma is not related to atopic status. Platinum salts are also known to produce occupational asthma. Asthmatic responses may exhibit variable timing. Response may occur soon after arriving at work, later in the day or gradually over many days.



**Fig. 13. Mould spores**



**Fig. 14. House dust mite**

**Table 1: Agents of occupational asthma**

|                          |                                                                                                                                                                                                                         |
|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Chemicals</b>         | <ul style="list-style-type: none"><li>• Isocyanates</li><li>• Hair sprays</li><li>• Aluminium</li><li>• Platinum salts</li><li>• Nickel</li><li>• Tungsten carbide</li><li>• Colophony</li><li>• Formaldehyde</li></ul> |
| <b>Enzymes</b>           | <ul style="list-style-type: none"><li>• <i>Bacillus subtilis</i></li><li>• Trypsin</li></ul>                                                                                                                            |
| <b>Animals</b>           | <ul style="list-style-type: none"><li>• Laboratory rodents</li><li>• Shellfish</li><li>• Larger mammals</li><li>• Locusts</li></ul>                                                                                     |
| <b>Vegetable sources</b> | <ul style="list-style-type: none"><li>• Wood dusts</li><li>• Grains</li><li>• Cotton, hemp and flax</li><li>• Gum acacia and tragacanth</li><li>• Coffee beans</li><li>• Tea leaves</li><li>• Cotton seeds</li></ul>    |

**Drugs**

- Penicillins
- Salbutamol
- Piperazine
- Pesticides and insecticides may also cause occupational asthma.

**Food allergy**

Food allergy is usually evident from a carefully recorded history of the disease. Food articles commonly implicated include milk, eggs, wheat and nuts (Figs. 15 and 16). Food allergy more commonly causes gastrointestinal upset and eczema rather than asthma. Intolerance to food does not always mean an allergic mechanism. Asthmatic responses may be related to pharmacologic mediators such as tyramine or histamine in the food. They may also be produced by food additives (tartrazines) or preservatives (sulphites) (Fig. 17).



Fig. 15. Food Articles

**Drug induced asthma**

Asthma can be induced by certain drugs and these include,

salicylates (aspirin) and beta blockers (propranolol).  $\beta$ -blockers can induce bronchoconstriction even when they are administered as eye drops. Although some cardio-selective  $\beta$ -blockers such as metoprolol and atenolol are available, it is better to avoid  $\beta$ -blockers in patients with bronchial asthma and alternative drugs can be used for treatment of *angina pectoris* and hypertension in them. Salicylates (aspirin) and other non-steroidal anti-inflammatory agents (such as ibuprofen also known as brufen) can also produce severe airway narrowing in adults with asthma and

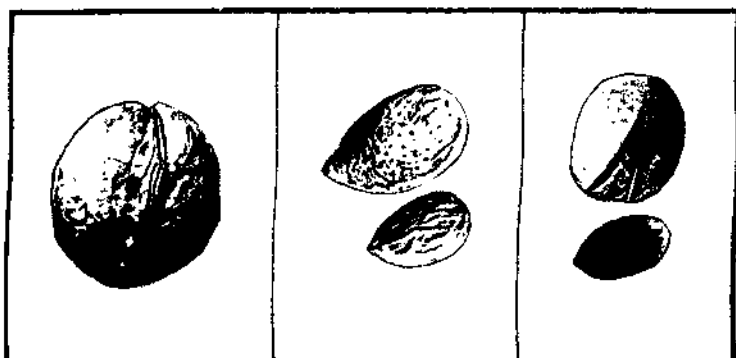


Fig. 16. Food Items



Fig. 17. Sulfites used for preserving food articles

this is related to changes in arachidonic acid metabolism. Salicylate sensitivity is known to occur in 15 per cent of adults with asthma and nasal polyps. Rarely drugs used to treat asthma can themselves produce bronchoconstriction. This paradoxical effect has been described with aminophylline, sodium cromoglycate, ipratropium bromide and propellants in metered dose inhalers. Hypotonic solutions have a potential to produce bronchoconstriction in asthmatics. Therefore, nebuliser solutions must always be made up with normal saline rather than water.

### **Emotional and psychological factors [Fig. 5]**

Emotional and psychological changes can affect asthma exactly in the same way as all other triggering factors. Airway changes can be induced by suggestion. The changes in airway size caused by emotional and psychological factors are generally small compared with the effects of allergens and other stimuli. Asthma associated with laughing and crying may be related to the response of the hyperreactive airways to deep inspiration or the inhalation of cold, dry air.

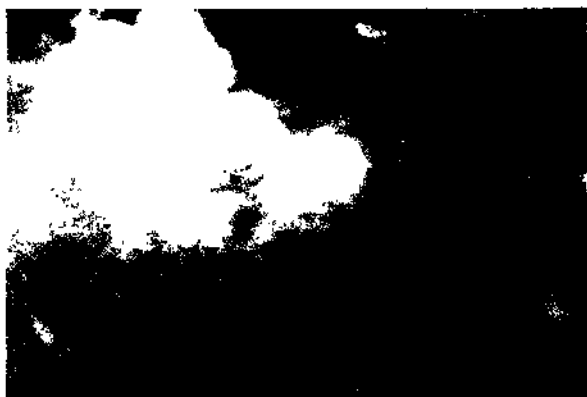
### **Infection**

Upper respiratory tract infections most often bring on an acute episode of asthma. Majority of these infections are caused by viruses. Viral infections particularly during infancy produce wheezing because of the smaller size of the airways of infants and these episodes may be followed by recurrent bouts of wheezing. But majority of these infants who have these wheezy attacks in the first year of life do not go on to develop asthma.

The viruses denude the epithelial lining of the airways, exposing the nerve endings and attracting inflammatory cells. All these changes produce bronchial hyperreactivity. Antibiotics are usually not effective for these viral infections.



**Fig. 18. Cigarette smoke**



**Fig. 19. Smoke**



**Fig. 20. Dust**

In addition to specific treatment of bronchial asthma, antibiotics must be used to treat bacterial infections especially when they complicate an episode of viral infection.

### **Air pollution [Figs. 18-20]**

Cigarette smoke is the commonest form of air pollution that asthmatics are likely to come across. It produces irritation of the sensitive airways of asthma patients. Asthmatics are advised to avoid cigarette smoking. Non-smoking asthmatics may also get exposed to cigarette smoke at home and at workplace. This form of smoking is known as "passive smoking". Lot of emphasis has been given to this form of smoking in the context of air pollution in recent years. Environmental pollutants, such as sulphur dioxide in industrial smoke can also cause problems for asthmatics. Therefore, young asthmatics at the time of recruitment in the job are particularly advised to avoid dusty, smoky and cold atmospheres.

### **Gastro-oesophageal reflux**

Some of the patients with asthma experience increased bronchoconstriction when there is reflux of acid up into the oesophagus. This leak of acid up from the stomach is more likely to occur on lying down during the night time.

\* \* \*

# SYMPTOMS, DIAGNOSIS AND MONITORING OF ASTHMA

## SYMPTOMS

The main symptoms of asthma are: cough, wheezing. Shortness of breath, chest tightness, and mucus production, *none of these symptoms is characteristic of asthma.* Only cough and wheezing, the main symptoms are discussed below:

### Cough

Cough may be the only symptom of asthma, especially in children. *When a cough is the main symptom, asthma is particularly likely to go unrecognised.* In children, the cough is usually worst at night and with exercise, and this may result in disturbed nights for children and parents. Cough is rarely the only symptom in adults. In these patients it may be difficult to demonstrate narrowing of the airways. Their disease may not fit into the conventional diagnosis of "asthma" but they do have irritable airways and get better with conventional asthma treatment. This cough is akin to the irritating cough which "non-asthmatic" people sometimes get after a "viral infection" in the throat and upper airways and these individuals behave like "asthmatics" for a brief period. In "non-asthmatics" the airway narrowing is limited and the damage is repaired within 4-6 weeks. By contrast, airways of "asthmatics" have a tendency to narrow down in response to various stimuli and this persists rather indefinitely.

### Wheezing

Wheezing is a whistling sound caused by vibration of the walls

of an air passage like the reed in the mouthpiece of a toy trumpet. In asthma there is wide spread narrowing of many airways in the lungs. Although wheezing is the most characteristic symptom of bronchial asthma; it must be emphasised here that "all that wheezes is not asthma". Thirty per cent of adults say that they have wheezing occasionally and only about quarter of these are likely to have asthma. Wheezing can also come from narrowing of one of the large airways such as the trachea. Choking due to a foreign body can partly block a large airway and produce wheezing. In adults one of the main airways may be narrowed by a growth or some other condition which may occasionally be confused with asthma.

## DIAGNOSIS

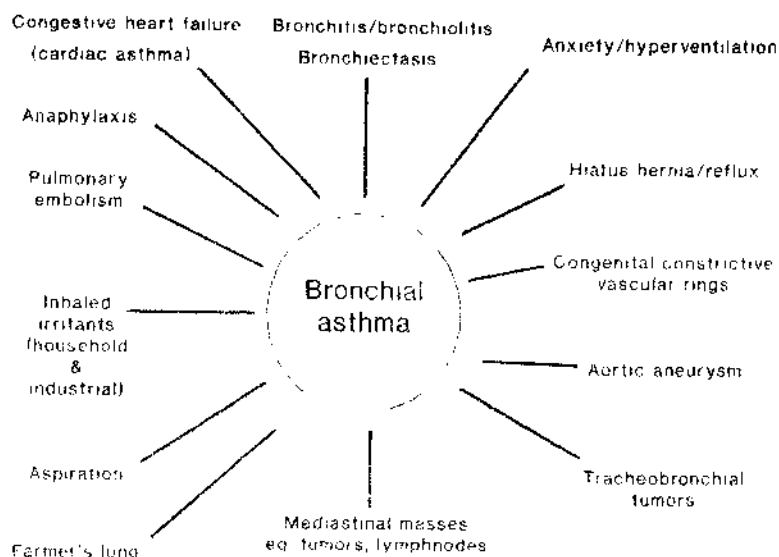
Sometimes symptoms of other medical problems may mimic asthma (Fig. 21). Examples are vocal cord abnormalities, other causes of airways obstruction and even heart disease. In most cases, diagnosis of asthma is based upon history, symptoms and response to treatment.

### Detailed medical history

This should include detailed information on symptoms, their pattern, triggers, home situation, medical and family history.

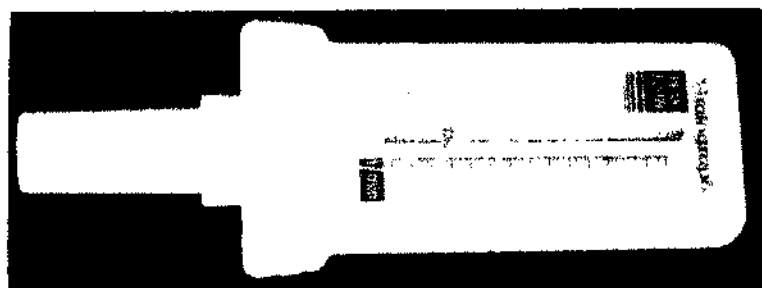
### Spirometry/pulmonary function tests

**Recording airflow obstruction :** Airflow obstruction can be measured with the help of minipeak flow meters (Fig. 22}. This instrument provides a cheap and reliable method of measuring air flow obstruction and allows the patients to objectively assess the control of their asthma and its response to treatment. Acute episodes of asthma are mostly preceded by a gradual deterioration in control (and this may not be



**Fig. 21. Conditions mimicking asthma**

apparent) which may be detected by peak flow meter recordings. Mini peak flow meter recordings for airflow obstruction in asthma are equivalent to urine tests in patients with diabetes mellitus. Table 2 provides peak expiratory flow rate values in normal Indian subjects.



**Fig. 22. Mini peak flow meter**

Table 2. Showing Peak Expiratory Flow Values in Normal Indian Subjects

## MALE

| Age<br>yrs | 15  | 20  | 25  | 30  | 35  | 40  | 45  | 50  | 55  | 60  | 65  | 70  |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 5'0"       | 464 | 475 | 482 | 485 | 484 | 479 | 470 | 457 | 440 | 419 | 394 | 365 |
| 152 cm     |     |     |     |     |     |     |     |     |     |     |     |     |
| 5'3"       | 483 | 494 | 501 | 504 | 503 | 498 | 489 | 476 | 459 | 438 | 413 | 384 |
| 160 cm     |     |     |     |     |     |     |     |     |     |     |     |     |
| 5'6"       | 503 | 514 | 521 | 524 | 523 | 518 | 509 | 496 | 479 | 458 | 433 | 404 |
| 168 cm     |     |     |     |     |     |     |     |     |     |     |     |     |
| 5'9"       | 519 | 530 | 537 | 540 | 539 | 534 | 525 | 512 | 495 | 474 | 449 | 420 |
| 175 cm     |     |     |     |     |     |     |     |     |     |     |     |     |
| 6'0"       | 539 | 550 | 557 | 560 | 559 | 554 | 545 | 532 | 515 | 494 | 469 | 440 |
| 183 cm     |     |     |     |     |     |     |     |     |     |     |     |     |
| 6'3"       | 558 | 569 | 576 | 579 | 578 | 573 | 564 | 551 | 534 | 513 | 488 | 459 |
| 191 cm     |     |     |     |     |     |     |     |     |     |     |     |     |

PEAK EXPIRATORY FLOW (PEF) VALUES IN LITRES/MINUTE PEF VALUES FOR MEN UP 110 l/  
MIN LESS THAN THE PREDICTED VALUES ARE STILL WITHIN NORMAL LIMITS  
(PEFR values based on the Regression Equation derived by Malik & Jindal - *Indian J Chest Dis  
& All Sci*, Vol 27, No 1, p 50-51, 1985)

## FEMALE

| Age<br>yrs | 15  | 20  | 25  | 30  | 35  | 40  | 45  | 50  | 55  | 60  | 65  | 70  |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 4'6"       | 353 | 354 | 352 | 349 | 343 | 336 | 326 | 315 | 301 | 286 | 268 | 249 |
| 137 cm     |     |     |     |     |     |     |     |     |     |     |     |     |
| 4'9"       | 370 | 371 | 369 | 366 | 360 | 353 | 343 | 332 | 318 | 303 | 285 | 266 |
| 145 cm     |     |     |     |     |     |     |     |     |     |     |     |     |
| 5'0"       | 385 | 385 | 384 | 380 | 375 | 367 | 358 | 346 | 333 | 317 | 300 | 280 |
| 152 cm     |     |     |     |     |     |     |     |     |     |     |     |     |
| 5'3"       | 402 | 402 | 401 | 397 | 392 | 384 | 385 | 363 | 350 | 334 | 317 | 297 |
| 160 cm     |     |     |     |     |     |     |     |     |     |     |     |     |
| 5'6"       | 418 | 419 | 417 | 414 | 408 | 401 | 391 | 380 | 366 | 351 | 333 | 314 |
| 168 cm     |     |     |     |     |     |     |     |     |     |     |     |     |
| 5'9"       | 433 | 434 | 432 | 429 | 423 | 416 | 406 | 395 | 381 | 366 | 348 | 329 |
| 175 cm     |     |     |     |     |     |     |     |     |     |     |     |     |

PEAK EXPIRATORY FLOW (PEF) VALUES IN LITRES/MINUTE PEF VALUES FOR WOMEN UP 102  
l/MIN LESS THAN THE PREDICTED VALUES ARE STILL WITHIN NORMAL LIMITS  
(PEFR values based on the Regression Equation derived by Malik & Jindal - *Indian J Chest Dis  
& All Sci*, Vol 27, No 1, p 50-51, 1985)

**Diurnal variation in peak flow rates :** Airway tone is not fixed even in normal individuals. These changes are reflected in PEFr measurements. In patients with bronchial asthma these changes get exaggerated. The lowest peak flow values occur in the morning and highest values are seen in the afternoon. Patients with asthma usually show a difference of least 15 per cent between mean morning and evening values [Figure 23]. Patients with asthma commonly complain of worsening of symptoms at night and most of the deaths from asthma occur in the early hours of morning.

**Response to bronchodilators :** Responsiveness to bronchodilators can be used to establish a diagnosis of asthma and should be assessed with a selective  $\beta_2$ -stimulant such as salbutamol or terbutaline. This is given as a supervised inhalation of two puffs from a metered dose inhaler (MDI) and can be given even to patients with coronary artery disease. An increase of 15 per cent in peak flow rate is generally considered to be significant. These strict measurement criteria may not be valid in patients with asthma who have severe degree of airflow obstruction even though they demonstrate a limited degree of reversibility.

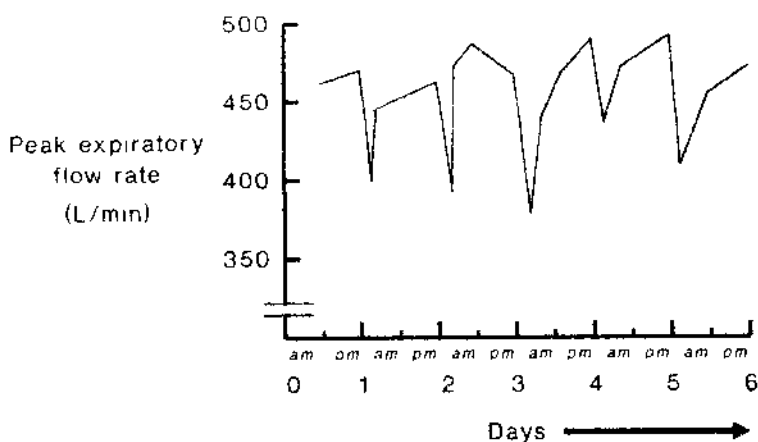


Fig. 23. Peak flow meter readings showing diurnal variation in bronchial asthma

**Methacholine/bistamine challenge test** : Bronchial hyperreactivity can be demonstrated by inhalation tests with histamine or methacholine. These tests produce a range of responses usually defined in terms of the dose of the challenging agent necessary to produce a drop in  $FEV_1$  (a spirometry parameter; pulmonary functions are tested using a spirometer) of at least 20 per cent [Figures 24-25]. Almost all patients with asthma demonstrate an abnormally increased responsiveness, a basic feature of bronchial asthma.

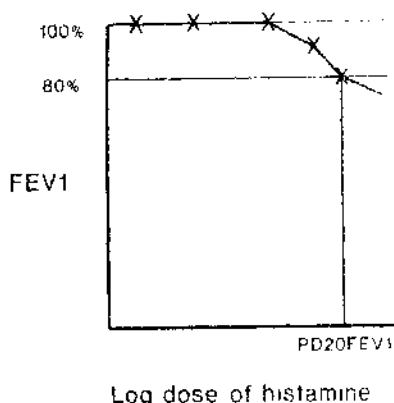


Fig. 24. Challenge test in a patient with asthma. Normal persons will not show a positive response

**Exercise testing** : Exercise testing is a safe and simple procedure and is useful when the diagnosis of asthma is in doubt [Figure 26]. About 90 per cent of asthmatic children will show a positive exercise response. Details of exercise testing are beyond the purview of this book.

**Skin tests** : These are also known as allergy tests and are performed by injecting appropriate allergen into the skin. Positive skin tests do not establish a diagnosis of asthma. They demonstrate only the tendency to produce IgE antibodies to

common allergens. While more than 20 per cent of the population have positive skin reaction, only a quarter of these develop asthma. Skin tests will be negative if anti-histaminic drugs (avil or piriton tablets) are being taken. Skin testing provides rapid, reliable and reproducible results. The simplicity, efficiency and relatively low cost of the technique make skin tests preferable to other approaches in defining an individual's specific allergies. However, the results of skin tests must be interpreted with caution. Only those that correlate with the patient's history can be considered meaningful. Practical utility of skin test in the routine management of bronchial asthma remains questionable and these tests should not be recommended routinely for the diagnosis of bronchial asthma.

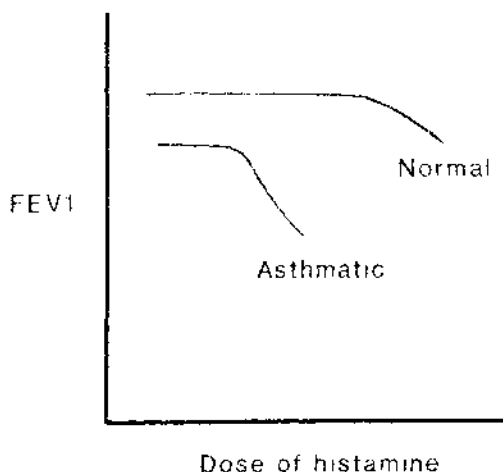


Fig. 25. Challenge test in a patient with asthma

**Complete blood counts :** Total and differential blood counts should be done. Peripheral blood examination reveals proportion of the eosinophils to be increased.

**Sputum examination** [Fig. 27] : Sputum examination may reveal presence of eosinophils. Besides, an evidence of bacterial and fungal infection may also be obtained.

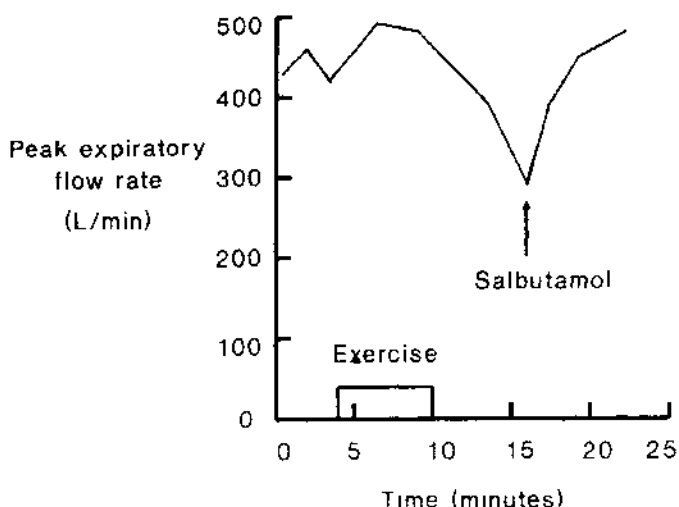


Fig. 26. Exercise testing. The characteristic asthmatic response is "a fall in peak expiratory flow rate of > 15 per cent several minutes after the end of exercise".

**Radiological examination Chest X-ray** [Fig. 28] : Chest X-ray does not prove the diagnosis of bronchial asthma.

**Sinus X-ray**: Sinus X-ray should be done because inflammation of the sinuses is a common trigger.

## Treatment of Bronchial Asthma

Since there is no cure for bronchial asthma, patients must be involved in the management of their asthma so that they are able to lead a normal life. With good control, patients can often change asthma from a major disrupting illness to a relatively minor annoyance. Table 3 provides summary points of intervention strategies in the management of bronchial asthma.

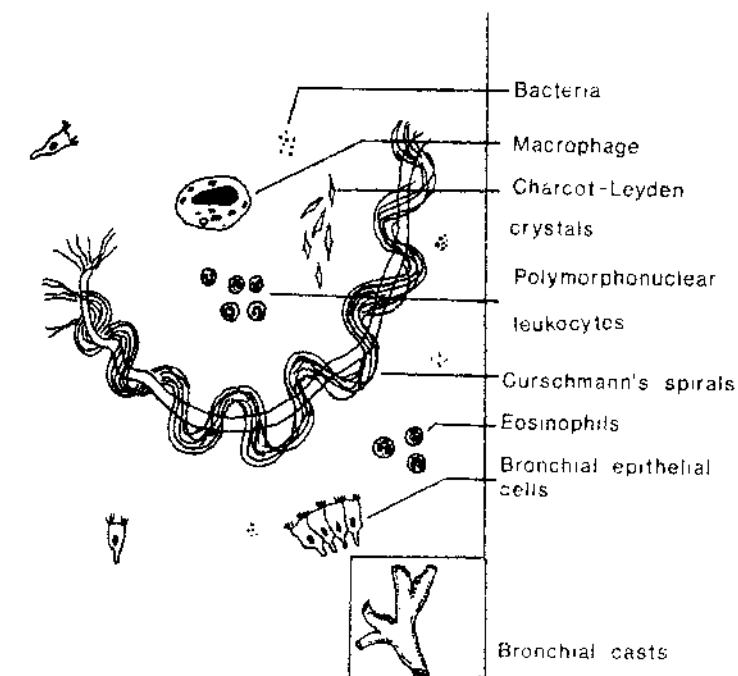


Fig. 27. Low power microscopic view of sputum in bronchial asthma

Treatment of asthma consists of two approaches :

- (1) Evaluation of the triggers and directing treatment towards their removal or control. In some asthmatics this may require making changes in the environment in which they live (Fig. 30).
- (2) Reducing inflammation and hyperreactivity of the airways through medication and other means.

### Environmental changes

**Allergens:** If evaluation reveals that patient's asthma is triggered by allergens, then appropriate measures can be taken at home or workplace to decrease exposure to these

TABLE 3. Intervention strategies in the management of bronchial asthma

| PATHOGENESIS                                                                                                                                                                                                                                                                                                       | MANAGEMENT                                                                                                                                                                          |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Genetic ↔ Environmental factors</p> <p>* Air pollution<br/>* Allergens<br/>* Cigarette smoking<br/>* Viral infectious agents</p> <p>↓</p> <p>Bronchial smooth muscle contraction</p> <p>Bronchial inflammation</p> <p>↓</p> <p>Airway hyperresponsiveness</p> <p>↓</p> <p>ASTHMA</p> <p>Airflow obstruction</p> | <p>← Nonpharmacologic therapy</p> <p>* Patient education<br/>* Environmental control<br/>* Immunotherapy</p> <p>← * Anti-inflammatory therapy</p> <p>← * Bronchodilator therapy</p> |

offending agents. If symptoms are triggered by animal dander or feather, removal of the substance is the best treatment. Some allergens, such as house dust mites or moulds, are difficult to remove completely. However, one can lessen exposure to these triggers. If patient is allergic to house dust mites and lives in a humid area; he should be advised to cover mattress in plastic encasings and wash his pillows, sheets and blankets in hot water every week. Mould can grow in damp areas of patient's home. Adequate ventilation of these areas and frequent cleaning using a weak chlorine bleach can decrease mould growth. Humidifiers should be used with caution because as their frequent use increases growth of



Fig. 28. Chest X-ray may help in detecting complications seen during acute asthma such as infection

mould and dust mites. It should be cleaned routinely as it can become a source for moulds. Use of dehumidifiers can be considered if basement is damp or patient lives in a humid climate. Air conditioning may decrease the number of airborne allergens by making it easier to keep windows closed in hot weather. Central air conditioning also has the benefit of lowering the humidity within the home. Air filtration systems, if carefully selected and properly maintained, can aid help some patients by decreasing exposure to their allergens.

**Irritants:** Many substances in the environment can irritate patient's sensitive airways. Cigarette smoke is one of the commonest irritants and is a strong trigger of asthma. Exposure to aerosol sprays, perfumes, strong cleaning products and other sources of strong odours should be avoided (Fig. 29).

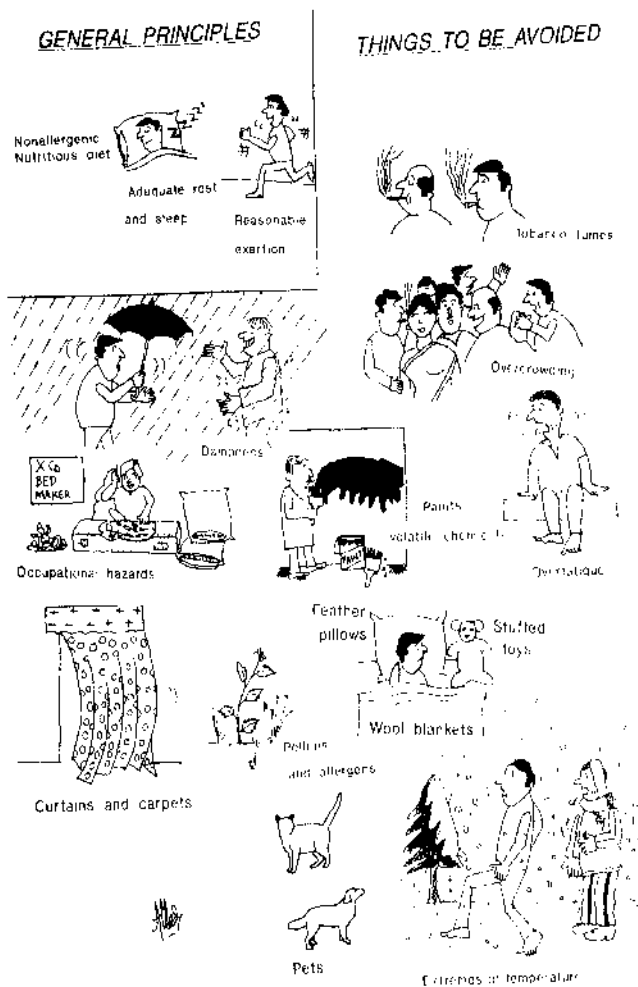


Fig. 29. Common Irritants to Airways

## MONITORING OF ASTHMA

### Drug treatment

There have been significant advances in asthma treatment over the past few years. Research has allowed physicians to have better understanding of the role of inflammation in the airways. As a result of this, there are new approaches to treatment of asthma.

Following are the objectives of medical treatment :

- i) Prevention of acute episodes of asthma;
- ii) normalisation of breathing tests and reduction of hyperreactivity of airways; iii) use of drug-treatment which is easy to administer, has less side effects and is affordable.

Depending on the frequency of symptoms, drug-treatment can be taken on an "as and when required basis", or "regularly" to prevent or lessen breathing difficulty. Some of the asthmatics benefit from prophylactic or preventive treatment which provides on-going protection even if the patient is not having any symptoms. However, majority of asthmatics will require a combination of medications.

Most of the drugs for asthma treatment are available for inhalation. With correct technique, medication is deposited directly into the airways and less is absorbed into the blood stream. This has the advantage of fewer side effects than tablets. *There is a common belief among Indian patients with asthma that inhalation therapy should only be taken when patient has advanced disease and tablets and injections do not work. However, this belief is not true. On the contrary, patients should use inhalers at the onset of illness.*

Many asthma medications are preventive and patient

should not skip any doses, no matter how well he feels ! Patient should understand that there is no single "best" drug regimen. Treatment programmes must be individualised according to needs, of each patient. Most of the medications used for asthma treatment fall into two major groups: i) Anti-inflammatory drugs; ii) Bronchodilators

**Corticosteroids ("steroids"):** Steroids are the most effective anti-inflammatory drugs for the treatment of asthma. They decrease and prevent inflammation in the airways thereby decreasing airway hyperreactivity. They are available as injections, tablets and inhalers. Steroid injections are administered during an acute attack of asthma. In this setting, it is better to overtreat rather than undertreat a patient with steroid injections. The most commonly prescribed injectable steroids are hydrocortisone hemisuccinate (Efcorlin) and dexamethasone (Decadron). The most commonly available oral steroids are: prednisolone (Wysolone); dexamethasone (Decadron) and beta-methasone (Celestone, Betnelan) Many asthmatics require periodic administration of short-term courses of oral steroids to reduce the severity of symptoms and prevent emergency (casualty) room visit or hospitalization. A short-term course given during an acute attack may last 3 to 10 days and does not require a gradually decreasing dosage schedule (also known as tapering-off).

Patients may experience side effects such as increased appetite, fluid retention, stomach upset and moodiness. These side effects are temporary and mild and disappear after stopping the medication.

Steroid tablets alone should not be used indefinitely for a long time to treat symptoms of asthma as this use can be associated with significant side effects.

Everyone does not experience these side effects. Long-term oral steroids should be continued only when absolutely

necessary. The lowest possible dosage should be used and it should be taken in the morning with food as it can irritate the stomach lining.

**Cromolyn:** Cromolyn is a prophylactic drug. It acts by stabilising mast cells that release inflammatory chemicals upon exposure to certain triggers and helps to lessen symptoms triggered by cold air, exercise and allergens. When used routinely, it can help prevent inflammation. Being a preventive, it must be taken on a regular basis for it to be effective. It is slow to start working and may require 4-8 weeks before improvement can be appreciated. It is important for the patient to understand that cromolyn does not work quickly, like a bronchodilator. Cromolyn has a very low incidence of side effects. Throat irritation and cough can occur, especially with the spinhaler form.

Cromolyn is available in inhaled forms [in metered dose inhaler, (fintal, cromal and ifiral)] It is also available as a nasal spray and eye drops for hay fever.

**Bronchodilator:** A bronchodilator is a drug which increases the diameter of the airways over a short period, thus decreasing the resistance to the passage of air during inspiration and expiration. It acts partly by relaxing the bronchial smooth muscle. They are given to reverse airway narrowing which has already occurred or to prevent the effect of some types of asthma trigger. There are three main groups of bronchodilators available:

(1) **Beta adrenergic drugs:** These drugs act in the same way as the body's natural hormone, adrenaline. Alterations in their chemical structure results in their more selective action on bronchi rather than the more general stimulating actions of adrenaline. This group of drugs is the most widely used bronchodilators in clinical practice.

**(2) Anticholinergics:** This group of drugs act by blocking the signals to constrict the airways that come from the main nerve supply to the lung running in the vagus nerve. Ipratropium bromide (ipravent) is available as inhaler.

**(3) Xanthine derivatives:** This group of drugs have similar properties to caffeine, the active ingredient in coffee and are available as tablets or injections.

**Inhalation Therapy:** The value of inhalation as a route of drug administration has been recognised for thousands of years by ancient civilisations in India, China and the Middle East, as well as by Hippocrates and Galen.

The Ayurvedic system of medicine advocated the use of *Datura ferox* root smoked in a pipe for a variety of disorders including dyspnoea. In the 19th century, *Atropa belladonna* given by smoking became the standard remedy for asthma relief. "Asthma cigarettes" made from *Datura* leaves are still available from herbalists. Several present day pharmaceuticals have been derived from ancient remedies. Bronchodilator aerosols have been in use since 1935. In the past adrenergic bronchodilators have been given by hand-held squeeze-bulb nebulisers. This cumbersome device has yielded place to modern day spray and powder aerosols. Pressurised aerosols were introduced in 1956 and constituted a breakthrough in inhalation treatment at that time. Even today the pressurised aerosol remains the most widely used inhalation device in asthma, because of its mechanical reliability, accuracy of dose measurement, portability and ready availability of a dose when required. In recent times inhalation therapy of asthma has been developed to a high level of sophistication. Advantages of inhalation therapy include:

- \* Greater antiasthmatic effect
- \* Quick response

- \* Self administration on demand
- \* Short term prophylaxis
- \* Lack of side effects.

The key to inhalation therapy is the aerosol particle. An aerosol is a suspension of fine liquid or solid particles in air. Two examples from everyday life are deodorant sprays and insecticide sprays. For inhalation therapy an aerosol of the drug may be generated in 3 ways viz;

1. Pressurized aerosol systems (metered dose inhalers or MDIs) (Figs. 30 and 31)
2. Dry powder systems (Fig. 32)
3. Nebulisers
  - a. Jet nebulisers (Fig. 33)
  - b. Ultrasonic nebulisers (Fig. 34)

Metered dose inhalers can be used with spacers [Fig. 35] which help in better deposition of the drug in lungs [Fig. 36]. Steroid inhalers should be preferred over oral steroids. In fact, they may be used as first line of treatment in bronchial asthma. For symptomatic relief short acting  $\beta_2$ -stimulant inhalers (asthalin, terbutaline, "Glaxo" salbutamol inhalers) can be used. Long acting inhalers (Serobid or Salmeter) are best suited for the treatment of nocturnal asthma [Fig. 5].

## Alternative Treatments

**Immunotherapy (Allergy Injections):** It consists of a series of injections with solutions containing patient's allergens. The goal is to reduce patient's sensitivity, thereby lessening his symptoms. Immunotherapy usually begins with injections of a weak solution given once or twice a week, with gradually

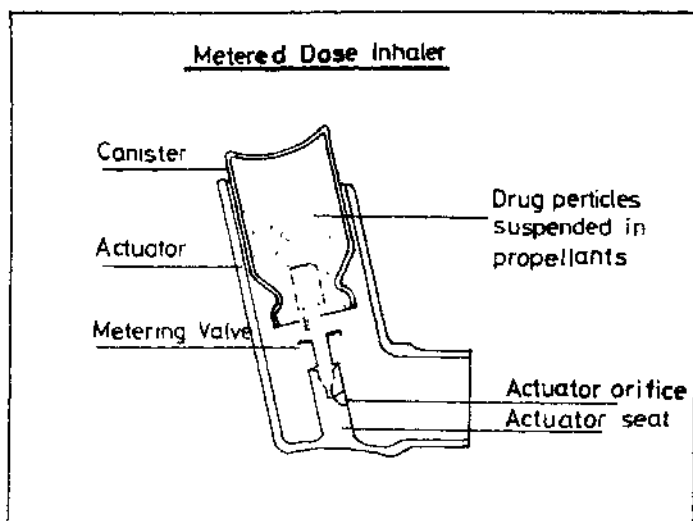


Fig. 30. Metered dose inhaler (MDI)

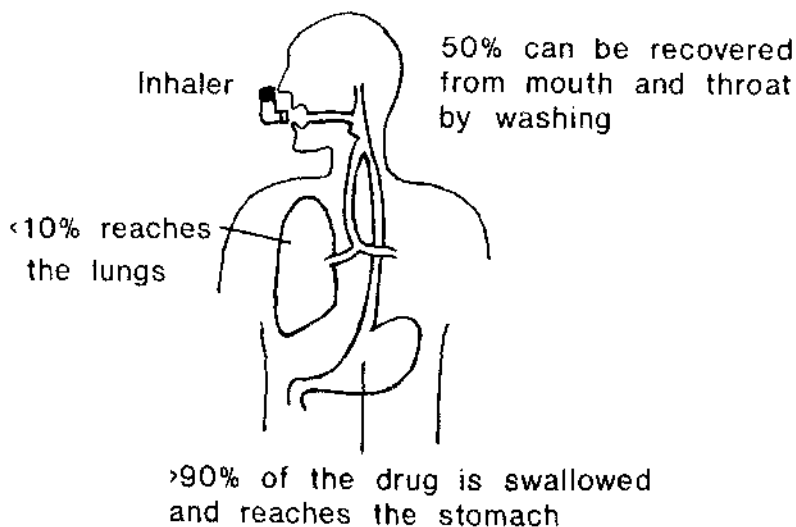


Fig. 31. Amount of drug deposited in the lung when a metered dose inhaler is used

increasing concentration. When the highest dosage is reached, the injections are usually given once a month. A period of six months to one year may be required before improvement is experienced. A normal course of treatment for injections is 3-5 years. Every patient may not respond well to this treatment. If a patient does not improve after two years of injections then treatment should be stopped.

### Dry powder Inhaler

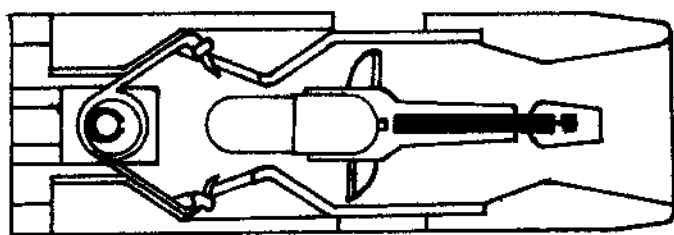


Fig. 32. Dry powder inhaler

### Jet Nebuliser

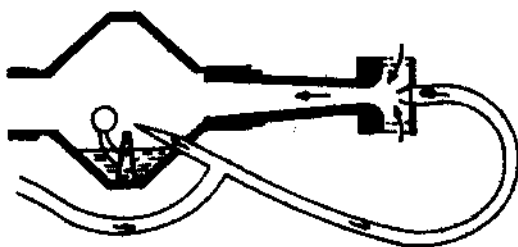


Fig. 33. Jet Nebulizer

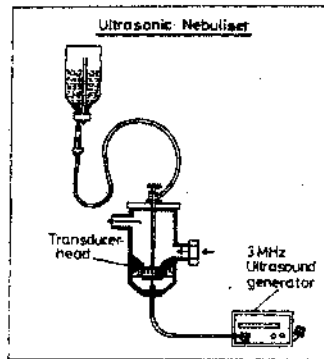


Fig. 34. Ultrasonic nebuliser



Fig. 35. Metered dose inhaler attached to spacer

### Sinus care

Sinus care is an important part of an overall treatment programme for many asthmatics. Treatment of infection and decrease of postnasal drip can reduce cough and throat irritation thereby, decreasing asthma symptoms. Treatment should include:

- A. **Administration of antibiotics** : Bacterial infection is indicated by an increased amount of thick, yellowish,

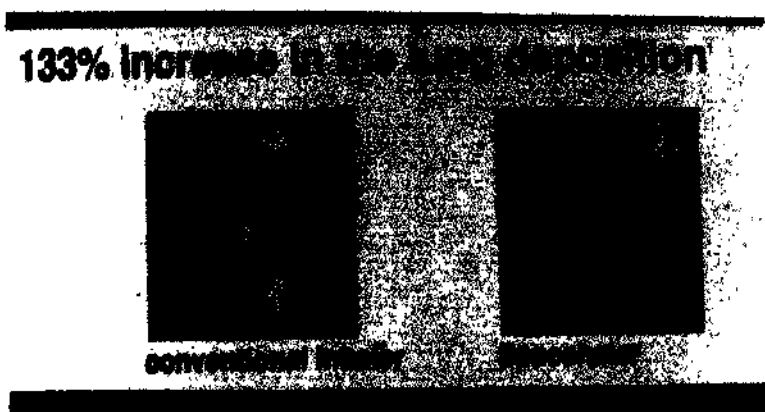
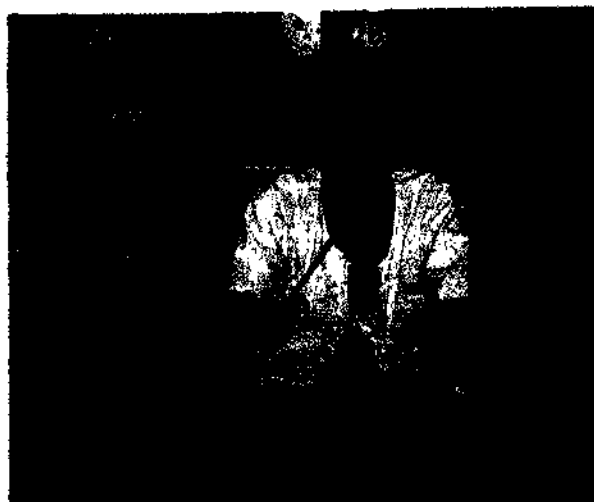


Fig. 36. Spacer device helps in better deposition of the drug in the lung

green or brown colored mucus. A long course of antibiotics (2 or 3 weeks) is usually required.

- B. **Nasal wash** : When done routinely, this can help lessen postnasal drip and wash out bacteria.
- C. **Steroid nasal spray** : This helps to decrease irritation and inflammation in the nasal and sinus passages so that mucus production decreases. Beclomethasone (beclate) is available as a nasal spray.
- D. **Cromolyn nasal spray or drops** : This can help prevent allergic reactions in the nasal passages and lessens irritation and inflammation. Cromolyn nasal spray is also available as fimal nasal spray or ifiral nasal drops.

**Diet:** No special kind of diet has been shown to be beneficial for asthma. They should take normal diet. Patient should avoid specific foods that are known to trigger symptoms. Refrigerated items and stored food should be avoided.



**Fig. 37.** The anxious look of a patient with acute asthma

**Yoga:** Yoga exercises have been found useful in patients with asthma. They may be used as adjunct to other treatments.

### **Counselling**

Living with a chronic illness such as asthma requires making some adjustments in the patient's life style. Patient may experience feelings of anger, stress, fear and depression. Patients should consult a psychologist or a psychiatrist to cope with these feelings.

### **Special Situations**

**Acute Asthma:** Presentation of acute episodes is variable. Early indication of deterioration is provided if the patient has to use his normal bronchodilators more often than usual. All asthmatics should be aware about various measures to be taken when there is worsening. This worsening in the control can be detected by regular monitoring of peak expiratory flow rate (PEFR). In the event of decline in PEFR measurement

appropriate changes in the treatment can be made before patient develops severe episode of acute asthma. In more severe asthma eating, talking and drinking may become difficult. Hospital admission may be considered if patient has difficulty in moving from a chair. The most common symptom is breathlessness and there is more often difficulty in inspiration than in expiration. Some of the patients may have few symptoms with moderately severe asthma and fail to appreciate the changes in the degree of their airflow obstruction. These patients are at particular risk during acute attacks.

**Hospitalization:** An acute episode of asthma is very frightening (Fig. 37). Patient must be reassured to relieve his anxiety. Most of the problems of acute asthma arise from a failure to appreciate the severity of an attack. Continued observation is mandatory because immediate improvement after treatment may be followed by the return of severe asthma.

It is not possible to lay down strict criteria for admission to hospital [Fig. 38]. Problems occur in acute asthma when the patient or physician fails to appreciate the severity of an attack. During a severe attack it is better to do overtreatment than undertreatment.

**Examination:** Patient may be confused or cyanosed. Cyanosis means bluish discoloration of tongue and extremities and indicates low oxygen tension in the blood. Pulse rate is high. An evidence of circulatory embarrassment, low blood pressure may be present. Patient may have high temperature which usually suggests bacterial infection. Patient may complain of cough with yellowish expectoration. Examination of the chest reveals a fast breathing rate and wheezing. In very severe asthma, wheezing may not be audible because of severe bronchoconstriction as air flow is too little. Therefore,



**Fig. 38. Hospitalization for acute asthma**

a quiet chest in acute asthma is a worrying feature. Sputum during acute severe asthma is thick, tenacious and does not come out easily. Patient may be dehydrated and this adds to the stickiness of the sputum. In severe attacks the peak expiratory flow rate may be unrecordable, however, it should be monitored throughout the attack as it is a useful guide to the efficacy of treatment. There are two indications for chest X-ray during acute severe asthma. It helps to detect infection and pneumothora. Pneumothora is accumulation of air in the pleural space (pleural space is a potential space and contains only a few ml of fluid which helps in gliding movements of the lungs during respiration). Peripheral venous blood examination may reveal an increase in total white cell count with preferential increase in the neutrophils. All this is an evidence of infection. Arterial blood examination will reveal low oxygen tension with low carbon dioxide tension during an acute attack. Normal or high carbon dioxide tension in the blood may indicate a requirement for assisted ventilation using a mechanical ventilator [Fig. 39].

***Treatment of acute asthma:*** Patients with acute asthma should be treated in the hospital. Salbutamol (Salsol, Asthalin) or terbutaline ( Bricanyl) should be administered with a nebuliser. These drugs are available for nebulisation.

Corticosteroid injection should be administered. Antibiotics should be administered if there is a suspicion of superadded bacterial infection. Oxygen should be administered to correct low oxygen tension in the blood. Adequate hydration must be maintained since dehydration significantly contributes to the stickiness of the sputum. Cough expectorants and mucolytic agents should be administered. Steam inhalation may help loosen thick secretions. Sedation in the form of tablets or injections (calmpose, ativan, morphine) is strictly prohibited. Patients



**Fig. 39. Mechanical ventilator**

usually show response in a desired fashion and as soon as patient improves he should be prescribed oral treatment. Patient can start using MDIs. Sometimes patient may not respond to treatment. Complications such as pneumothorax should be ruled out in this setting. Assisted ventilation (Fig. 39) may be required if patient fails to respond and shows signs of fatigue.

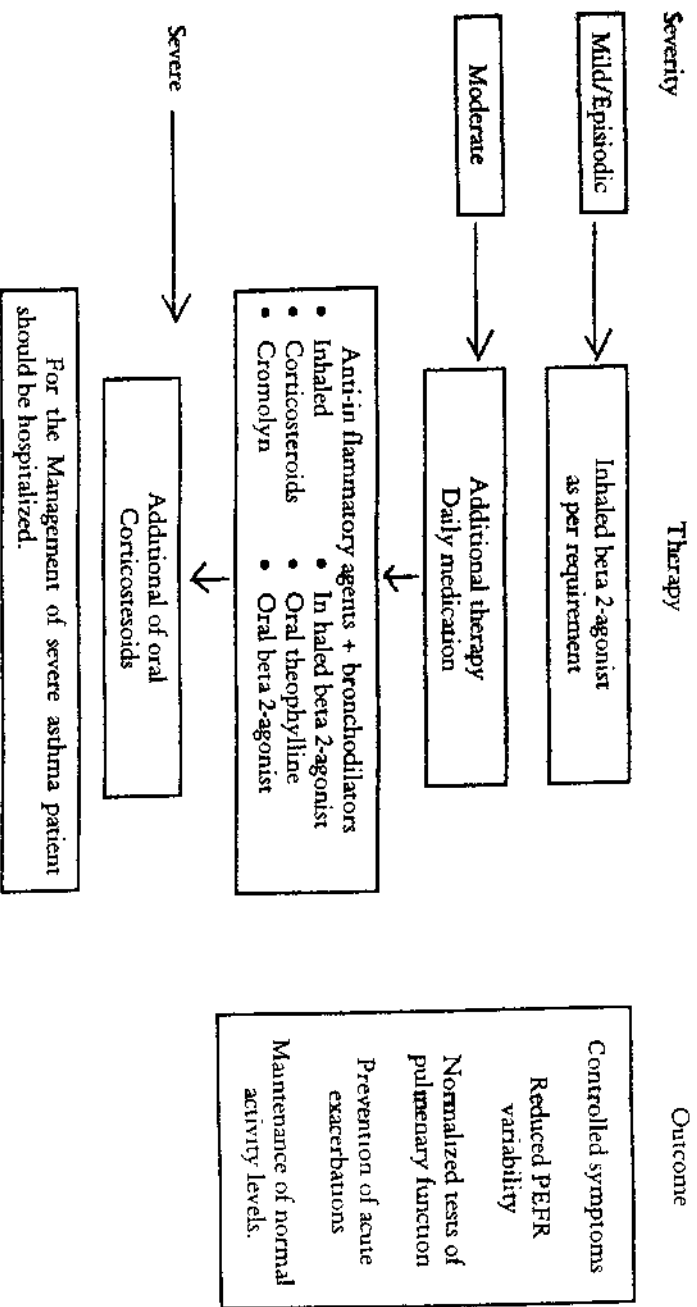
**Nocturnal Asthma:** Many asthmatics experience worsening of symptoms at night time. Drug-treatment should be adjusted to reverse bronchoconstriction at night time. Long-acting theophylline, (Deriphyllin Retard, Theo PA, TR phyllin and Theolong), salbutamol (ventorlin controlled release, asthalin SA) and terbutaline (Bricanyl Durules) preparations are available. These medications can be taken at bed time to provide protection during the early morning hours. Long-acting beta-2 stimulant inhaler salmeterol (Serobid, salmeter) is also available.

**Pregnancy:** Pregnancy and the menstrual cycle can also cause changes in asthma. The effect of pregnancy on asthma is variable. Thirty per cent of the female patients with asthma are better; 20 per cent deteriorate and the remaining 50 per cent remain unchanged. Fortunately, there are no specific problems with asthma treatment during pregnancy. During pregnancy inhalation therapy, with both bronchodilators and anti-inflammatory drugs (sodium cromoglycate and corticosteroids) are better tolerated, particularly from side-effects point of view.

## SUMMARY POINTS ABOUT ASTHMA

- Asthma is an underdiagnosed condition. Exact figures about its prevalence in Indian population are not available. However, worldwide surveys indicate that approximately 5 per cent adults and 10-12 per cent of children suffer from asthma.
- Exact mortality figures in Indian patients with asthma are not available.
- Failure to appreciate severity of asthma quite early, overreliance on home-treatment and underuse of corticosteroids, all these contribute to mortality.
- Patients with asthma present with shortness of breath, cough and wheezing. *At times, especially in children, cough is the sole presentation.* The cough may be troublesome at night.
- Mini peak expiratory flow meter should be used to demonstrate diurnal variation in peak expiratory flow rates (PEFR) and fall in PEFR following exercise. Airways reversibility can also be demonstrated using PEF meter.
- Monitor PEFR continuously as falling rates may be indication of an impending episode of severe asthma.
- Recognition and avoidance of trigger factors may help to prevent attacks of asthma.
- Asthmatics can lead normal life provided they use appropriate treatment.
- Inhalation therapy is the best mode of treatment. Patients should know correct inhaler technique and should choose the appropriate inhaler device.
- High dose corticosteroids should be used early in patients with severe asthma.
- Patients with worsening of symptoms should consult their treating physicians and if required these patients should be hospitalized.

Summary of Management of Asthma



## INDEX

- Adrenaline, 57
- Aerosols, 58
- Agricola, 13
- Airpollution, 42
- Airways, 14, 23, 40
- Allergens, 51
- Alveoli, 15, 23
- Angina pectoris, 39
- Antibiotics, 62
- Anticholinergics, 58
- Antihistaminic drugs, 49
- Aspergillus fumigatus, 33
- Asthma
  - bronchial, 60
  - drug induced, 38
  - extrinsic, 20
  - intrinsic, 21
  - natural course, 19
  - nocturnal, 68
  - recurrence, 20
  - exercise induced, 33
  - occupational, 33
  - agents, 37
- Asthalin, 68
- Asthma monitoring, 55
- Asthma diagnosis, 44
- Asthma Pathogenesis, 27
- Atlantic Ocean, 18
- Ativan, 67
- Atopy, 18, 35
- Atropa belladonna, 58
  - $\beta$  blockers, 39
  - $\beta$ 2 stimulants
    - salbutamol, 47
    - terbutaline, 47
- Beta adrenergic drugs, 57
- British Thoracic Association, 16
- Bronchial constriction, 14, 20, 30, 40, 68
- Bronchodilator, 47, 57
- Bronchial glands, 25
- Bronchial hyperactivity, 14, 40
- Bronchitis, 15, 22
- Broncho pulmonary
  - aspergillosis, 33
- Bronchospasm, 27, 28, 31
- Calmpose, 67
- Cape town, 19
- Cells
  - mast Cells, 27, 31
  - lymphocytes, 27, 31
  - eosinophils, 31, 49
  - neutrophils, 31
- Childhood eczema, 18
- Cilia, 24
- Conjunctivitis, 33
- Corticosteroid, 32, 56, 68
  - medication, 31
- Cromoglycate
  - disodium, 33
  - sodium, 40, 68
- Cromolyn, 31, 57
- Cromolyn nasal spray, 63
- Cyanosis, 65
- Datura ferox*, 58
- Dermatophagoides
  - pteronyssinus, 34
- Diaphragm, 28
- Emphysema, 15
- Epiglottis, 23
- Epithelium, 24
- Eskimos, 17
- Expiration, 26
- Exhalation, 26
- Food allergy, 38
- Galen, 58