Library of General Practice

Respiratory Disorders

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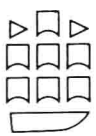

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Respiratory Disorders

Library of General Practice Vol. 8

The **Library of General Practice** is a series of books for GPs about medical problems as they prresent in the community. The editorial board is chaired by John Fry, OBE, MD, FRCS, FRCGP — himself a GP and also an experienced author and researcher and a member of the Council of the Royal College of General Practitioners.

Each volume deals with an important aspect of general practice, written by a GP well-known for his work in the field, often in association with a leading specialist in the field.

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Note

Our knowledge in clinical medicine and related biological sciences is constantly changing. As new information obtained from clinical experience and research becomes available, changes in treatment and in the use of drugs become necessary. The author and the publisher of this volume have, as far as it is possible to do so, taken care to make certain that the doses of drugs and schedules of treatment are accurate and compatible with the standards generally accepted at the time of publication. The readers are advised, however, to consult carefully the instruction and information material included in the package insert of each drug or therapeutic agent that they plan to administer in order to make certain that there have been no changes in the recommended dose of the drug or in the indications or contraindications for its administration. This precaution is especially important when using new or infrequently used drugs.

Preface

The respiratory tract is the body system most exposed to the external environment. With every breath is inhaled not only air but also irritants, pollutants, micro organisms and potential allergens. It is not surprising therefore that diseases of the respiratory tract are the most prevalent of any body system. In general practice they make up about one-third of all the work.

In spite of their prevalence, disorders of the respiratory tract pose considerable problems for practitioners. For the new entrants into practice, trainees and principals in their early years, they make up an unfamiliar ragbag of poorly definable conditions, difficult to diagnose with accuracy and with few specific investigations to assist the practitioner.

For established practitioners, 10 or more years out of medical school, the problems are not of familiarity, or rather unfamiliarity, but of keeping up to date with basic scientific advances and their applications. Developments in respiratory physiology, pathology, microbiology and immunology have had major effects on our understanding of asthma, otitis media, throat infections, pneumonias and most chronic lung diseases such as bronchitis and neoplasms. These basic scientific advances have been associated with dramatic progress in pharmacology creation and introduction of new drugs. The scope of the practitioner's pharmacopoeia for managing respiratory disorders is unrecognisable to that of 10 years ago.

The changing scene demands a periodic stand-back reassessment of an understanding of these common diseases and of the application of advances to their management in general practice.

It was with these objectives of review, assessment and application that the two general practitioner authors and a hospital consultant specialising in general medicine and respiratory disease collaborated

in this book. It has been a complementary collaboration with the joint experiences of general practice and hospital work being brought together.

The emphasis has been on putting together recent advances and applying objective facts to general practice situations. We have endeavoured to make a complex and confusing subject easier and more understandable.

1984

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Michael Whitfield

Contents

1

Applied anatomy and physiology of the respiratory tract

The function of the respiratory tract is to enable clean, humidified air to reach the alveoli where gas exchange occurs. Its structure is summarised in Table 1.1.

ANATOMY

The respiratory tract passes through nose, pharynx and tracheobronchial tree to the alveoli. It is traditionally and rather arbitrarily divided into the *upper respiratory tract* (from the nose to the larynx), the *middle respiratory tract* (larynx and trachea) and *lower respiratory tract* (the bronchial and alveolar system).

Upper respiratory tract

Nose

The major purpose of the nose is to conduct and prepare inspired air for safe reception into the lungs. It also contains the olfactory organ. The approximate volume of the nasal cavity (excluding the sinuses) is 7–8 ml on each side. The anterior third of the nasal cavity is lined by squamous or transitional epithelium; the remainder of the tract down to the oropharynx being lined by ciliated epithelium.

Various *paranasal sinuses* open from the nasal cavity. The function of these sinuses is not known; several suggestions have been made which include:

(1) humidification and warming of inspired air
(2) lightening the skull
(3) altering the resonance of the voice.

All the paranasal sinuses are lined with ciliated epithelium that is

Table 1.1 Summary of structure of the respiratory tract

	Cartilage	Muscle	Mucous gland	Epithelium	Situation
Trachea and main bronchi	U-shaped	Transverse bands across horns of cartilage	Between cartilages anteriorly, in fibromuscular layer posteriorly	Pseudostratified 4-6 layers Goblet cells Ciliated cells	Outside the lung
Bronchopulmonary segmental bronchi	Plates	Spiral bands in both directions	Maximal external to muscle	Pseudostratified 3–4 layers Goblet cells Ciliated cells	In peribronchial space
Intrasegmental bronchi	Small plates	Spiral bands arranged more steeply	Fewer external to muscle	Pseudostratified 2–3 layers Goblet cells Few Clara cells Ciliated cells	In peribronchial space
Bronchioles	Absent	Proportionately thickest	Absent	Cuboidal 1 cell thick Fewer goblet cells More Clara cells Ciliated cells	Attached to surrounding lung

continuous with that in the nasal cavity.

Infections affecting the sinuses cause swelling of the lining mucosa and symptoms often result from this and blockage of the drainage channels. The frontal and maxillary sinuses are clinically of greatest importance. Their main development takes place after puberty.

Frontal sinuses. These are of variable size and are situated in the frontal bones. Each drains into the anterior middle meatus. They are small at birth but are fairly well developed by 7–8 years.

Maxillary sinuses. These are the largest of the paranasal sinuses. The roof of the sinus is the orbital floor and its floor is closely related to the three molar teeth. The sinus opens into the ethmoidal infundibulum just inferior to the middle turbinate.

Ethmoidal sinuses are numerous thin walled cavities situated between the upper parts of the nasal cavities and the medial walls of the orbits. The anterior and middle groups of ethmoidal sinuses open into the middle meatus. The posterior ethmoidal sinuses open into the superior meatus.

Sphenoidal sinuses are placed behind the upper part of the nasal cavity and immediately below the pituitary.

Pharynx

The pharynx is the part of the respiratory and digestive system placed behind the nasal cavities, the mouth and above the larynx. The pharynx is funnel-shaped (broadest at its upper end) and in adults is about 14 cm in length, extending from the base of the skull to the level of the sixth cervical vertebra and the lower border of the cricoid cartilage.

The *nasal part of the pharynx* lies above the level of the soft palate. The lateral wall on each side presents the pharyngeal opening of the pharyngotympanic tube.

A collection of lymphoid tissue, best developed in children, lies in the mucous membrane of the upper part of the nasopharynx — *the nasopharyngeal tonsil or adenoids*. It just becomes visible to the naked eye during the later months of foetal life and usually increases in size up to the age of 6 or 7 years, after which it usually begins to atrophy. The enlargement of the adenoids is related to immunological responses of the body and appears to be a non-specific response to infections. This enlargement can extend forward and effectively blocks the opening of the pharyngotympanic tube with resultant recurrent ear infections and deafness (Fig. 1.1).

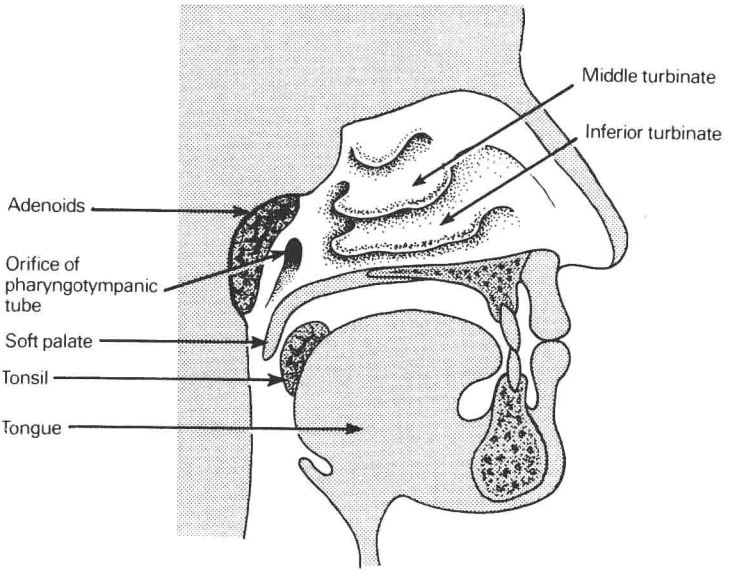

Fig. 1.1 The lateral wall of the nasopharynx

The pharyngotympanic (Eustachian) tube connects the nasopharynx to the middle ear. In adults it is about 36 mm long. The diameter of the tube is greatest at the pharyngeal end and least at the junction of the cartilaginous (nasal) portion and the bony (tympanic) length.

In the newborn child the pharyngotympanic tube is more horizontal in direction and its bony part is relatively shorter but much wider than in the adult. The fact that children are more susceptible to acute and chronic ear infections than adults is thought to be due to the shorter size and horizontal position of the pharyngotympanic tube, particularly if there is blockage of the nasal opening by hypertrophied adenoids.

The epithelium is ciliated and varies from simple columnar at the tympanic end to pseudostratified near the nasopharynx.

The oral part of the pharynx is from the soft palate to the upper border of the epiglottis. Its lateral wall consists of the palatopharyngeal arch and the tonsil (Fig. 1.2).

The *tonsils* vary in size and typically increase in size from 4–7 years, thereafter beginning to decrease.

The tonsils form part of a circular band of lymphoid tissue which guards the opening into the digestive and respiratory tubes. The anterior and lower part is formed by the lingual tonsil, the lateral

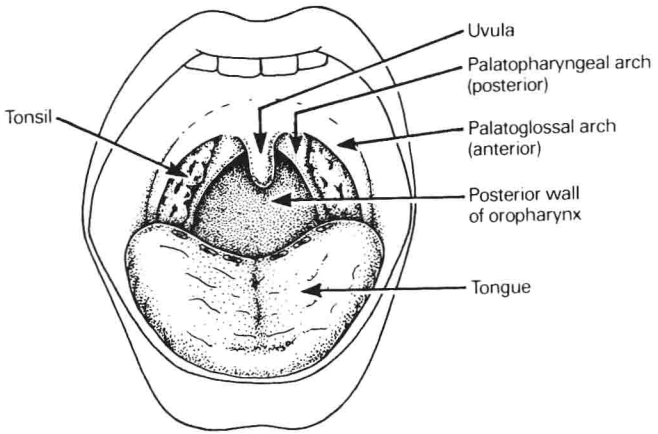

Fig. 1.2 The oropharynx

portions are formed by the tonsils and the posterior part by the adenoids.

The pits of the tonsils are lined with stratified squamous epithelium as is the whole of the oral pharynx. The appearance of the tonsils in health and disease has no direct relationship to pathological process or infecting organisms.

The *laryngeal part of the pharynx* includes on its anterior aspect the inlet of the larynx with a small recess, the piriform fossa, lying on each side of the laryngeal orifice. It is lined with stratified squamous epithelium.

Middle respiratory tract

The larynx extends from the root of the tongue to the trachea (Fig. 1.3).

The functions of the larynx are the protection of the lower airway during swallowing and breathing, and vocalisation.

The larynx consists of a framework of cartilages held together by ligaments and intrinsic and extrinsic muscles.

During respiration the vocal cords open and close, opening during inspiration and narrowing during expiration. These movements are very slight during quiet breathing, increasing as the depth of respiration increases.

The lumen of the larynx in infants is narrower and more funnel shaped than in adults and the infantile laryngeal cartilages are softer

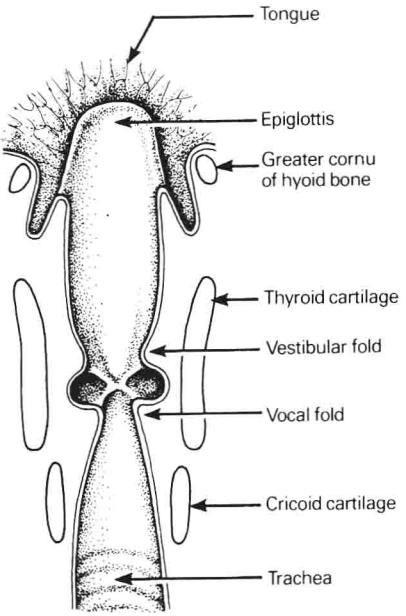

Fig. 1.3 Anterior part of the larynx as seen from behind

and collapse more easily, contributing to the greater vulnerability of the infant's larynx during attacks of acute laryngotracheobronchitis and epiglottitis.

The mucous membrane is stratified squamous epithelium down to the vocal cords and upper part of the vestibule of the larynx; ciliated epithelium lines the remainder of the larynx. There are numerous mucous glands in the larynx.

The branches of the vagus nerve provide sensory and motor innervation to the larynx. The inferior recurrent laryngeal nerve is important because of its different route on the right and left sides and the fact that it contains the motor supply to most of the intrinsic muscles of the larynx; it can be affected by bronchial neoplasms and is at risk during thyroid surgery.

Lower respiratory tract

The tracheobronchial tree

The five *lobar bronchi* (three on the right and two on the left)

subdivide into 19 named bronchopulmonary segment branches (Fig. 1.4). These are units of bronchial and blood supply that can usually be clearly distinguished and can be separated and removed surgically without dividing major vessels or bronchi beyond those supplying the segment itself.

The remaining portion of the conducting airways consists of dividing bronchi, the most peripheral being the terminal bronchioles. There are about 25,000 of these and they are the most peripheral structures not to bear an alveolus. The bronchial tree does not branch in a simple dichotomous fashion; it is possible to get to the alveolar surface of the lung in as few as eight or as many as 23 branches depending on whether one takes a long or short pathway. The tracheobronchial tree also narrows at different rates depending on the branch path followed.

Much respiratory disease results from constriction of the bronchioles and often this results from contraction of smooth muscle in the bronchial walls. The mechanisms for this appear to be that following antigen/antibody interaction a series of mediators are released from mast cells to stimulate smooth muscle contraction. Interference with the mediators at different types of receptors (β_2 adrenergic, adrenergic, cholinergic and histaminergic) is the basis of the various types of asthma therapy.

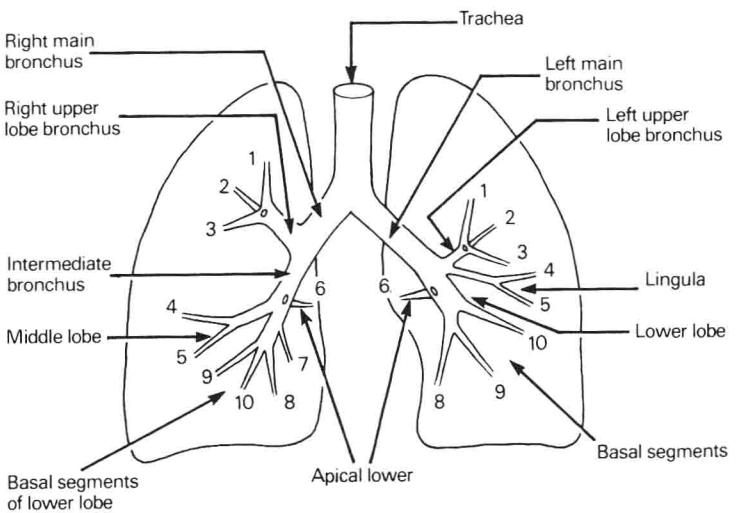

Fig. 1.4 Trachea and segmental bronchi

Cellular constituents of the conducting airways

Respiratory epithelium is traditionally described as consisting of pseudostratified ciliated cells interspersed with occasional goblet cells. This type of epithelium is found from the trachea to the bronchioles, with only a gradual reduction in cell height and pseudostratification signifying a more peripheral location. In the small bronchioles, however, goblet cells are scanty and ciliated cells are outnumbered by clara cells.

Ciliated cells. There are about 200 cilia per cell. They beat in an aqueous lining layer; there is mucus on the surface of this film.

Clara cells. These smooth surfaced cells are most numerous in the peripheral airways, where they tower over the more cuboidal ciliated cells which they equal or exceed in number. Considerable controversy attends this type of cell, particularly in relation to the nature of its secretory product and the means of secretion.

Goblet cells. These discharge mucus into the lumen of the airways.

Bronchial glands. These far exceed the surface epithelium in cell mass and must be considered the major source of bronchial secretions. The ratio of ciliated to goblet cells is approximately 5:1.

Sputum

The secretions of the various glands and cells lining the tracheobronchial tree together with the results of inflammatory reactions constitute sputum. The healthy person does not produce sputum, but postnasal discharge from the nasopharynx can sometimes be confused with sputum especially in children.

Sputum has many macroscopic variations: it may be very viscid or like water; it may be colourless or contain purulent material.

All sputum contains mucus together with water and various proteins. Other possible constituents are listed below.

Microorganisms. These may be pathogens or merely normal respiratory bacteria. There is often no way to distinguish pathogens from non-pathogenic bacteria so bacterial culture has its limitations. Occasionally fungi, such as *Candida* and *Aspergillus*, are found in the sputum.

Cellular constituents. There may be phagocytes and other cells and where bronchial carcinoma is present malignant cells are often found. Eosinophil cell counts may be helpful in distinguishing asthma from other causes of airways obstruction, such as chronic bronchitis.