

*The Management of*

EMERGENCIES

IN THORACIC SURGERY

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THORACIC SURGERY**

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*To My Wife*  
HELEN

## Preface

Emergencies in thoracic surgery range widely from cardiac arrest to ruptured esophagus and from bilateral spontaneous pneumothorax to strangulated diaphragmatic hernia. Their common pathologic link is that they all create a state of emergency which must be promptly recognized and treated if satisfactory results are to be achieved.

Much of what has been written on thoracic emergencies still lies scattered widely throughout an extensive literature and has not yet been brought together in textbook form. Yet the knowledge of how to recognize the emergency, its dangerous points, and what to do is so important that the time has come for a monograph on the subject.

There are few groups of physicians who do not meet such emergencies at some time in their medical career, be they general practitioners faced with an endobronchial foreign body masquerading as acute asthma, residents or ambulance doctors faced with crush injuries of the chest or spontaneous rupture of the esophagus disguised as coronary thrombosis, obstetricians faced with hydramnios and babies that drool saliva because of a tracheoesophageal fistula, pediatricians faced with problems of acute laryngeal edema or tension pyothorax in babies, physicians faced with severe hematemesis from ruptured esophageal varices, residents watching spontaneous hemopneumothorax exsanguinate their patients, psychiatrists faced with problems of corrosive burns of the esophagus, or, finally, the anesthetist or surgeon faced with cardiac arrest.

The aim of this book is to present those thoracic lesions which are essentially *surgical* emergencies and to describe their pathologic nature, their clinical features, and their management. Those who are familiar with thoracic surgery know full well that many standard operations, such as thoracoplasty, lobectomy, pneumonectomy, and esophageal anastomosis, can also have postoperative complications which are themselves real emergencies. They, too, will be briefly described.

This book will help general practitioners, house staff, and consultants appreciate the emergencies of a new specialty from the surgeon's viewpoint. They usually see the patient before the surgeon is called and should be aware of what surgery can offer. Under present hospital practice, it is usually an hour or more before the patient is in the operating room. Therefore, the faster the state of emergency is recognized and the surgeon consulted, the sooner these and other delays will be shortened.

This book will introduce medical students to lesions which they will meet, often unexpectedly, throughout their professional lives and which they might otherwise find baffling.

I am happy to acknowledge initial encouragement in the writing of this book from Professor Howard C. Hopps, Department of Pathology, University of Texas, Galveston, who spent his sabbatical leave of 1955 at the University of Otago Medical School, New Zealand. Through him I was introduced to Mr. George A. McDermott, the Medical Editorial Director at Appleton-Century-Crofts, Inc., to whom I am deeply indebted for helpful suggestions and cooperation. I gratefully acknowledge the devoted and untiring services of my secretaries, Mrs. Q. Stuart and Mrs. N.



Hooper, and also the enthusiastic support of Miss Catherine Entwistle, Medical Artist. For photographs, I am indebted to Mr. Gerald Brooks, Photographic Unit, Otago Medical School, and also to Mrs. Daphne Lemon and Mr. Kenneth White. I thank Mr. Litherland, Department of Photography, Auckland Hospital, for other photographic work done during my term at Green Lane Hospital.

In the matter of references to published literature, Miss E. Murray of the Medical Library gave great assistance, as did Mr. H. D. Erlam, the chief librarian. Dr. Robert Christie read the manuscript with great care and Dr. Graham Campbell assisted me in reading the page proof. Their willing help is gratefully acknowledged.

Finally, I humbly thank my wife for all her patient encouragement, for her reading of drafts and manuscript, and for her cheerful shouldering of the greater share of caring for our young family during the time of writing.

JOHN BORRIE

## Foreword

The relative newness of thoracic surgery as a speciality is reflected in the comparative paucity of standard textbooks on the subject. The newly appointed resident or registrar may not wish to plough through a full-length book in order to learn about the imminent and more practical problems with which he will be faced. A formal textbook often has to devote so much space to a comprehensive presentation of all aspects of the subject that inevitably the practical everyday things tend to receive less attention. This seems to have guided Mr. Borrie in his presentation of the subject of the management of emergencies in thoracic surgery. Although true emergencies are dealt with, the book covers more than these; it includes all the everyday manipulations and procedures which form the basis of so much of the routine of thoracic surgery.

Today thoracic surgery is becoming less of a closed speciality; the general surgeon has expanded through the diaphragm into the chest and the whole field of chest injuries may also involve him. He and his team must be familiar with the basic anatomical and physiological factors involved in chest wounds or chest operations and their clinical application. Correct preoperative and postoperative management is essential to success and to lower morbidity and mortality. This management is clearly and simply presented by Mr. Borrie with a wealth of illustration that makes for absolute clarity and simplicity. Those dealing with thoracic cases, whether senior or junior, will find a description of all the various manipulations and manoeuvres they may be called upon to use. Especially valuable is the account of such features as sputum retention and its prevention and treatment; of pleural drainage and the varieties and perils of pneumothorax. In no other book that I know is this practical side of thoracic surgical work presented so comprehensively and so lucidly.

The preoperative and postoperative care of chest patients involves others in addition to surgeons. The nursing staff, the physiotherapists, and other ancillaries will have no difficulty in profiting from this book, so clearly is it written.

In such a wide subject there are bound to be some variations of opinion and of teaching, and one inevitably finds features with which one is not wholly in agreement. This is not to say that alternative views are not correct; they may in fact be more correct and more acceptable. In every instance Mr. Borrie explains his recommendations by giving the factors which guide him.

I wish him every success in this book which should find a wide field of readers, both senior and junior, specialist and nonspecialist, who will profit and learn from it and will acquire confidence and knowledge of great value to their practical surgical chest work.

RUSSELL BROCK



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# General Thoracic Surgical Procedures

## 1

### BASIC PRINCIPLES OF THORACIC SURGERY

**Introduction.** An understanding of the principles of thoracic surgical anatomy and physiology is as fundamental as a knowledge of pathology in recognizing and appreciating all the problems of the management of thoracic operations.

Historically, the generation of surgeons who followed Lister's (1) emancipation of surgery in 1867 was not slow to appreciate the surgical possibilities of thoracic disease, but their operations, based on pathology and general surgical technic alone, almost invariably failed, because of insufficient regard for those equally important principles of thoracic physiology. Postoperative sputum retention, atelectasis, pneumothorax, and pleural infection were all rocks on which their ventures foundered.

Although anesthesia, blood replacement, and antibiotic therapy have all contributed to the rapid progress of the past 20 years, with careful surgical technic, blood loss can often be minimized and the need for antibiotic prophylaxis against infection much reduced or even made unnecessary. Success today is achieved, even more than by perfection of technic, by the frequent and painstaking assessment of chest function for at least two weeks following operation and the prompt correction of any errors that become manifest.

An essential prerequisite for treating thoracic emergencies is that the potential of thoracic surgery be recognized by all persons handling such problems, and that the emergency be promptly diagnosed and referred for surgical opinion.

Success is equally dependent on the teamwork of keen residents and house staff, a department of radiology prepared to take high quality chest x-ray films at all times, both night and day, and a competent operating-theater staff. Also needed is a team of nurses and physiotherapists who understand the aims of the surgeon, and who, by striving for the return of full function to the lungs, give the patient further confidence and encourage his convalescence.

**Fundamental Principles.** The fundamental fact to remember in the surgical phase of treating chest lesions is that the lungs, in fulfilling their role of transferring oxygen from the air to the blood stream for tissue oxidation, require:

- (a) A clear airway from the mouth via the bronchial tree to the alveoli of the lung;
- (b) Positive pressure inflation of the lungs during operation;
- (c) Full re-expansion of the lung by removal of air and fluid from the pleural cavity after operation;
- (d) A soundly reconstituted chest wall;
- (e) Normal blood volume.

As Johnson and Kirby (2) stress, "The thoracic surgeon must be trained to think constantly in terms of function." To understand these points better and to know how, when, and why to correct them when disordered require an understanding of the mechanics of the bronchi and pleura, which will now be discussed.

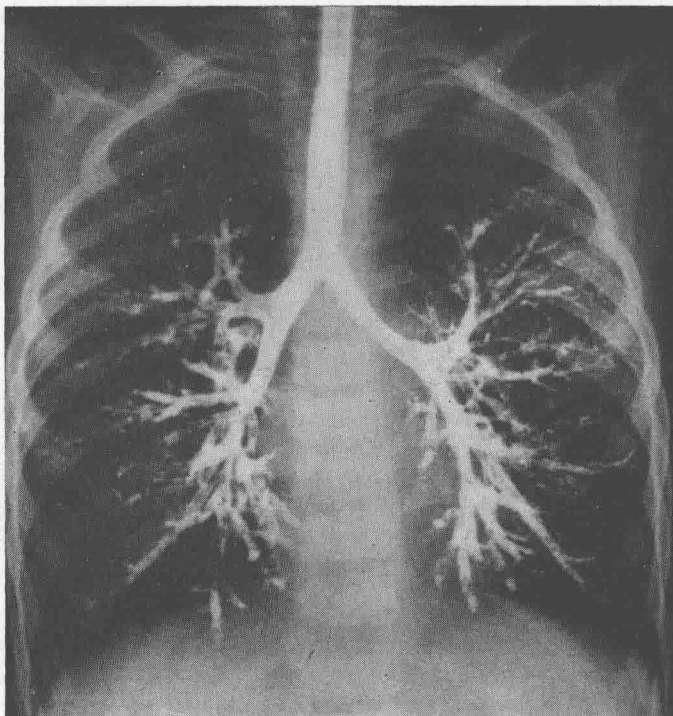


Fig. 1A. Bronchogram showing normal outline of the bronchial tree.

(The regional anatomy and surgical approach to the thoracic cavity are ably described by Sweet (3) and will not be considered here.)

### SURGICAL ANATOMY OF THE AIRWAY

The practitioner need hardly be reminded that the respiratory mechanism includes not only the airway—comprising the nose, pharynx, larynx, trachea, and lungs with their bronchi, bronchioles and terminal alveoli—but also the diaphragm and the thoracic and abdominal walls. It must also be borne in mind that, from the viewpoint of the thoracic surgeon, the two parts of the airway commanding the greatest respect are the vocal cords and the bronchi.

**The Vocal Cords.** Situated in the larynx, the vocal cords, under certain conditions, may obstruct the airway either totally or in part when:

- (a) The left cord is paralyzed from direct neoplastic invasion of the left recurrent laryngeal nerve or from external pressure from an intrathoracic neoplasm or aneurysm;
- (b) A foreign body such as bone or eggshell becomes wedged between the cords;
- (c) Edema of the glottis not only forms an effective obstruction to normal respiration but also prevents expulsion of intrapulmonary secretions.

**The Bronchi.** The need for accurate diagnosis and treatment of pulmonary disease in terms of the bronchial tree led to widespread study and a clearer description of the segmental anatomy of the lung, culminating in 1946 in the publication of Brock's *The Anatomy of the Bronchial Tree* (4). In 1949, at the International Con-

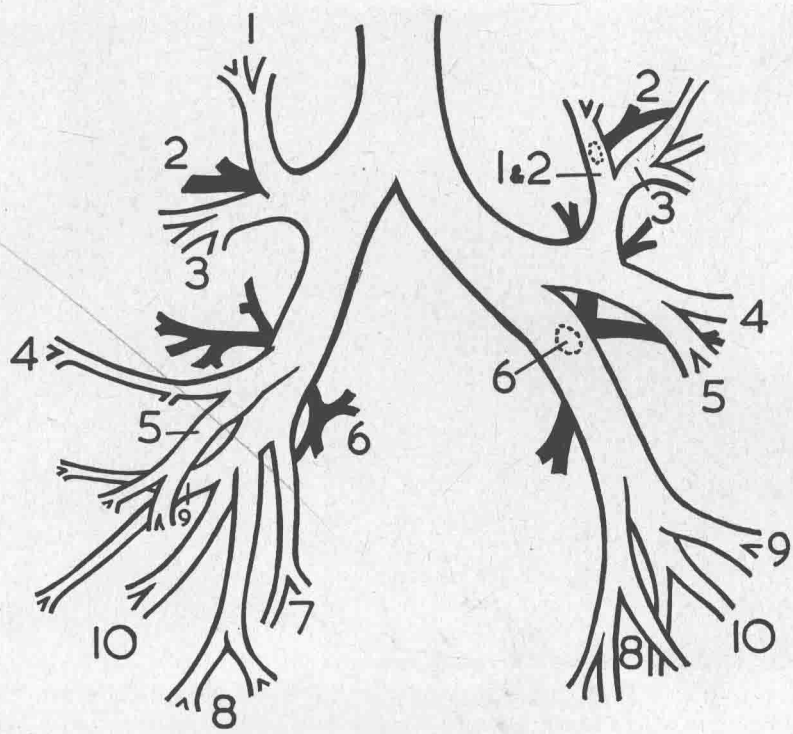


Fig. 1A. (cont). Diagram of major branches of bronchial tree.  
*Right lung, upper lobe:* 1. apical, 2. posterior, 3. anterior; *middle lobe:* 4. lateral, 5. medial; *lower lobe:* 6. apical, 7. medial (cardiac); 8. anterior basal, 9. lateral basal, 10. posterior basal.  
*Left lung; upper lobe:* 1. apical, 2. posterior, 3. anterior, 4. superior lingula, 5. inferior lingula; *lower lobe:* 6. apical, 8. anterior basal, 9. lateral basal, 10. posterior basal.

ference (5), agreement was reached on an acceptable nomenclature for the various bronchopulmonary segments (Fig. 1). More recently, the painstaking studies of Boyden (6) have further added to the detailed knowledge of the peripheral branches of the major bronchi. Much of the important new knowledge of the anatomy and surgical technics of the thorax was collected in 1954 by Birnbaum (7).

The description that follows is of the major bronchi and their immediate branches which are the accessible and significant parts of the airway in the management of thoracic operations.

**RIGHT MAIN BRONCHUS.** The right main bronchus follows the vertical direction of the trachea more closely than the left main bronchus does. The right main bronchus is shorter and wider than the left and is therefore the more common site for intrapulmonary foreign bodies.

The main and segmental divisions of the right main bronchus are as follows:

Right Upper Lobe Bronchus	Middle Lobe Bronchus	Right Lower Lobe Bronchi
Apical segment	Lateral segment	Apical segment
Anterior segment	Medial segment	Medial basal segment
Posterior segment		Anterior basal segment
		Lateral basal segment
		Posterior basal segment

The first branch of the right main bronchus is the *right upper lobe bronchus*. This arises 1.5 cm. from the trachea and lies above the main pulmonary artery. The



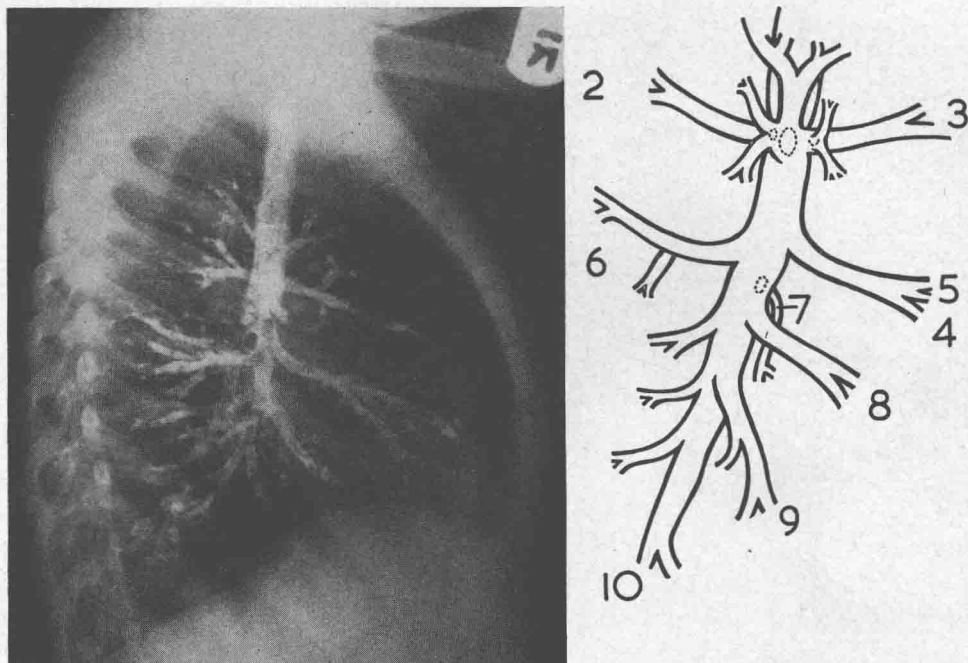


Fig. 1B. Lateral view of the right bronchial tree. Diagram clarifies the position of its main segmental branches, whose numbers are the same as those in the legend of Figure 1A.

right upper lobe bronchus passes upward and laterally from the main bronchus before dividing into *apical*, *anterior*, and *posterior* segmental bronchi.

The second branch of the right main bronchus is the *middle lobe bronchus*. This arises from the ventral aspect of the main bronchus 3 cm. below the upper lobe bronchus and divides into *medial* and *lateral* segmental bronchi.

The third and fourth branches of the right main bronchus are the *right lower lobe bronchi*. The third branch is directly posterolateral across the main bronchus and leads to the *apical* segment of the right lower lobe. The main bronchus then descends to its fourth or terminal branch which divides into the *medial basal*, *anterior basal*, *lateral basal*, and *posterior basal* segmental bronchi.

**LEFT MAIN BRONCHUS.** The left main bronchus has a longer and more oblique course than the right main bronchus. The main and segmental divisions of the left main bronchus are as follows:

Left Upper Lobe Bronchus	The Lingula	Left Lower Lobe Bronchus
Apical segment	Superior segment	Apical segment
Posterior segment	Inferior segment	Anterior basal segment
Anterior segment		Lateral basal segment
		Posterior basal segment

The first branch of the left main bronchus is the *left upper lobe bronchus*. This arises 2.5 to 3 cm. from the trachea and has the left main pulmonary artery winding around its lateral surface. The left upper lobe bronchus divides into three segmental branches: *apical*, *posterior*, and *anterior*. The lingula, which corresponds to the middle lobe branch of the right main bronchus, is fused to the anterior segment of the left upper lobe bronchus and is divided into *superior* and *inferior* segmental bronchi.



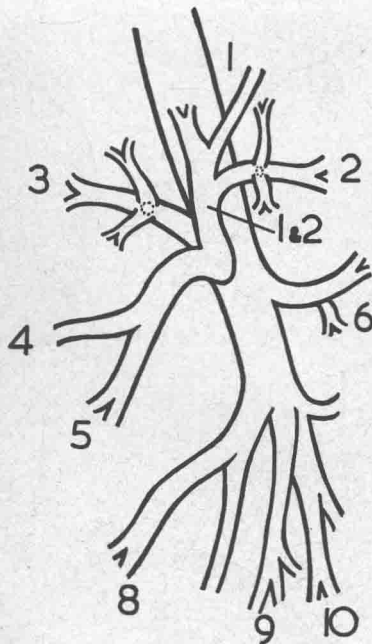
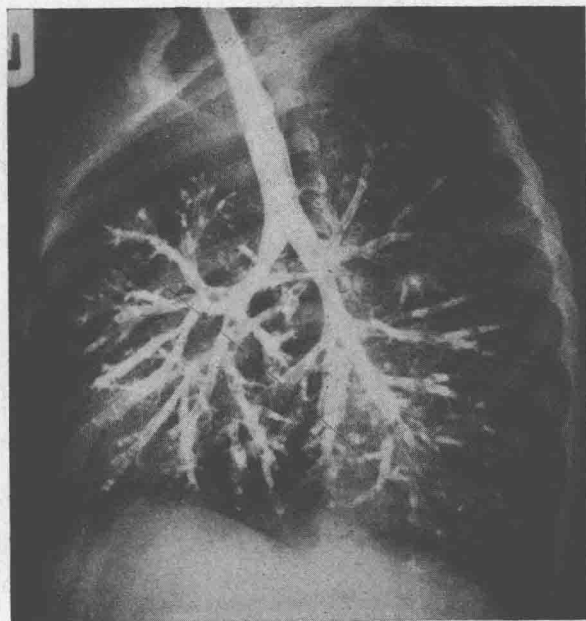


Fig. 1C. Left oblique view of the left bronchial tree. Diagram similarly clarifies the position of its main segmental branches, whose numbers are also the same as those in the legend of the preceding Figure 1A.

The second branch of the left main bronchus arises dorsally just below the left upper lobe bronchus and leads to the *apical* segment of the left lower lobe. The left lower lobe bronchus divides further into *anterior basal*, *lateral basal*, and *posterior basal* segmental bronchi. There is no separate left medial basal bronchus.

**Bronchoscopic Appearances.** The bronchoscopic appearances of the trachea and bronchi follow the descriptions just given and are easily recognized (Fig. 2). Once the bronchoscope is past the vocal cords, the rings of the trachea are seen arching in front with the unsupported muscular part lying behind. The tracheal bifurcation or carina is normally sharp. In the presence of disease, however, the carina may be widened because of enlargement of lymph nodes lying directly beneath it.

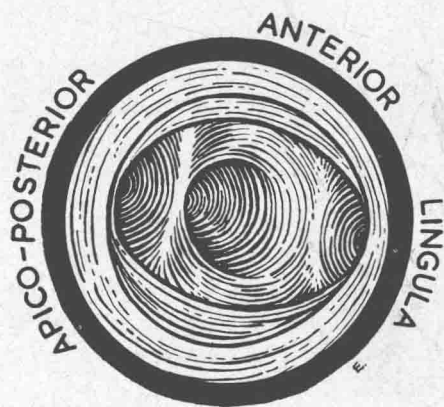
**RIGHT MAIN BRONCHUS.** The first branch, on its lateral side, is the right upper lobe bronchus, whose three secondary bronchial orifices are clearly visible with a right angle telescope. Beyond this, and ventrally at 12 o'clock, lies the opening of the middle lobe in which are the orifices of its two major branches.

Dorsally, opposite the middle lobe at 5 o'clock, is the opening of the apical segment of the lower lobe. At the end of the main bronchus three basal bronchial orifices (anterior, lateral, and posterior) are recognized, while just proximal to this point, and in the medial wall, is the opening of the medial basal bronchus.

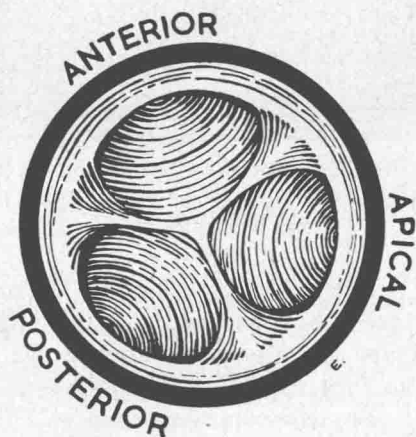
**LEFT MAIN BRONCHUS.** With the patient's head turned to the right and raised forward, the bronchoscope will readily pass to the left and beneath the aortic arch. The upper lobe orifice arises on the left side, some 4 cm. from the main carina. Normally, the origin of the lingula is obvious, adjacent to the upper lobe carina. A right angle telescope, however, is required to see the origin of the remaining three secondary bronchi. The pattern of the left lower lobe corresponds to that of the right lower lobe, except that the apical bronchus is subjacent to the upper lobe orifice and that there is no medial basal bronchial orifice.



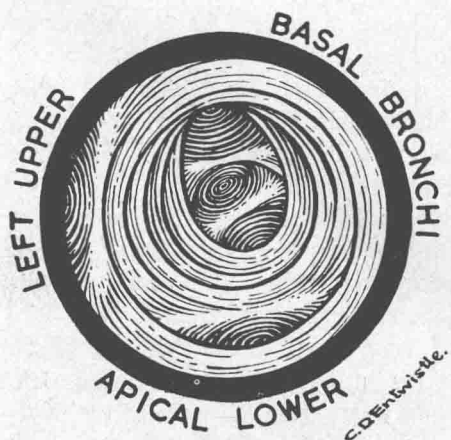
CARINA



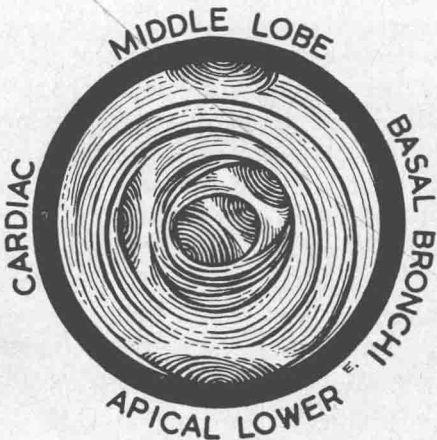
LEFT UPPER BRONCHI



RIGHT UPPER BRONCHI



LEFT LOWER BRONCHI



RIGHT LOWER BRONCHI

Fig. 2. Bronchoscopic appearance of carina and main bronchi.

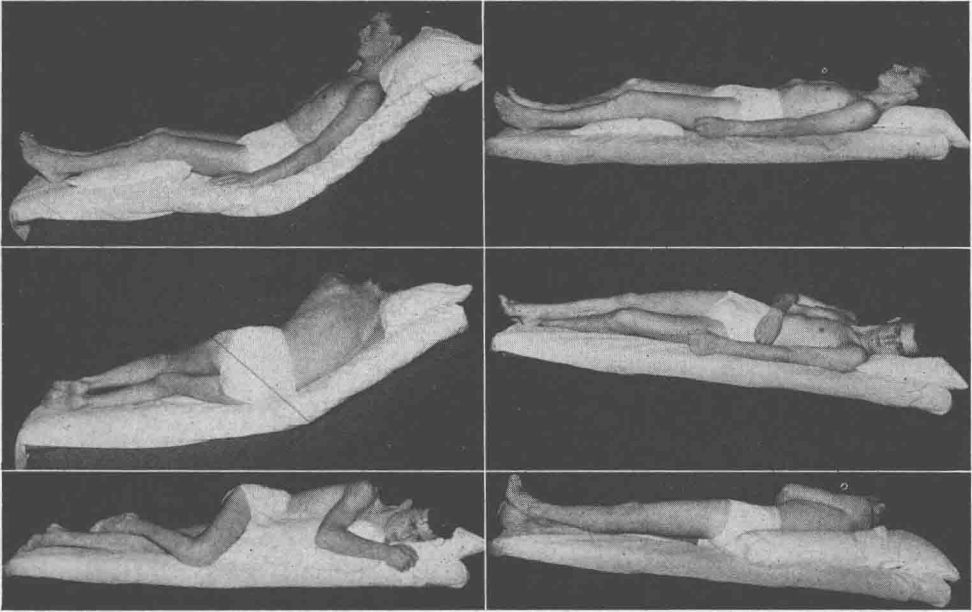


Fig. 3A. Upper lobes. Positions for postural drainage.

- |                                  |                                 |
|----------------------------------|---------------------------------|
| Top: Apical segment              | Top: Anterior segment           |
| Middle: Posterior segment, left  | Middle: Middle lobe, right lung |
| Bottom: Posterior segment, right | Bottom: Lingula, left lung      |

**Postural Drainage.** This is determined by the anatomy of the bronchial tree and aims at providing dependent drainage for the affected bronchus. Postural drainage is of particular value in the medical and surgical treatment of bronchiectasis and lung abscess, and as a means of clearing the lung of secretions before and after bronchography.

The patient assists expulsion of secretions by deep breathing and coughing under the supervision of a physiotherapist, who may further dislodge secretions by percussion or pummeling.

The required positions are illustrated in Figure 3.

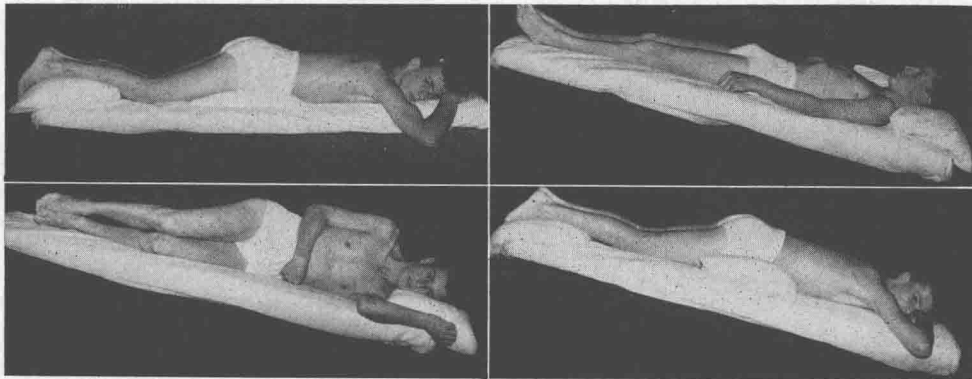


Fig. 3B. Lower lobes. Positions for postural drainage.

- |                                     |                                 |
|-------------------------------------|---------------------------------|
| Top: Apical segment                 | Top: Anterior basal segment     |
| Bottom: Right lateral basal segment | Bottom: Posterior basal segment |