JOHNSON'S

SURGERY OF THE CHEST

JOHN A. WALDHAUSEN
WILLIAM S. PIERCE

FIFTH EDITION

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Foreword

IT GIVES ME great pleasure to introduce the Fifth Edition of this text and to have it bear the title *Johnson's Surgery of the Chest*. I am particularly pleased that John A. Waldhausen, my former associate, and William S. Pierce, my former resident, have edited this beautiful new edition and have maintained the fine tradition that the book has always enjoyed. The book has been extensively updated but still fulfills its fundamental purpose as a practical guide to chest and cardiac surgery. I am sure that it will be of great value to residents and practicing surgeons.

JULIAN JOHNSON, M.D.
GLADWYNE, PENNSYLVANIA

Preface to the First Edition

THIS BOOK is primarily an atlas of thoracic surgical operations. Our objective, both in the text and in the illustrations, has been to present the step by step details of operative technic in as clear a manner as possible. Nearly all operations of established value are included. The operative methods portrayed are those which we have found to be reliable. We believe that these methods, except for variations in minor technical details, are representative of those utilized by leaders in thoracic surgery throughout the world.

In addition to describing and illustrating operative technic, we have discussed the physiologic mechanisms which must be thoroughly understood by those who undertake thoracic surgical procedures and have stressed the abnormalities in function produced by many lesions. The features of preoperative, operative and postoperative care which are so important in assuring a successful outcome of many major intrathoracic procedures have been considered in some detail. Diagnostic technics of special value in thoracic surgery have been described in Chapter 1, but it has not been possible to include a discussion of the differential diagnosis, etiology, life history or pathology of most lesions for which the operations are performed.

In the selection and presentation of the material in this volume, we have tried to provide all the information needed by those with a background in general surgery who wish to learn the technic of thoracic surgical procedures. It has also been our desire to present the material clearly and simply enough so that students of thoracic surgery at any level of training may understand how the various operations are performed.

A bibliography has been purposely omitted and eponyms have been used in the titles of only a few operations. Progress in thoracic surgery has resulted from the efforts of a great many individuals. We believe that there is little to be gained by recording our own impressions concerning priority, and that great injustice might result from inadvertently omitting mention of important contributors. We hope it is clearly understood that only a few of the concepts and methods presented originated with us.

We wish to thank Year Book Medical Publishers for their splendid cooperation.

JULIAN JOHNSON, M.D.
CHARLES K. KIRBY, M.D.

Preface to the Fifth Edition

JULIAN JOHNSON and the late Charles Kirby originally published their short manual *Surgery of the Chest* in 1952. It soon became a classic in that students and residents dealing with surgery of the chest carried it around as their bible and would brush up on procedures late at night, before going to the operating room the next morning well prepared for the intricacies of the case at hand. Most senior thoracic surgeons in this country and abroad still own, somewhere, a tattered copy: testimony to the book's intense and practical use.

It has been 15 years since the last edition appeared. In the interim much that is new in thoracic and cardiac surgery has occurred. This edition addresses these advances and changes without altering the basic concept of the book. It is still written for the student, resident, and thoracic surgeon as a basic guide in the operating room. It is still the view of only one group of surgeons working in one cardiothoracic surgical clinic. In general, only how they practice cardiothoracic surgery is described. Rarely is an alternative approach presented. All diagnostic studies have been omitted, as have most aspects of preoperative and postoperative care, since they are complex enough to form separate subjects. As in the original text, no references are included because they add little to the information needed prior to an operation. Thus, the book truly focuses on "how to."

The general thoracic portion (Part I) has been extensively revised. However, we have kept most of the original and superb illustrations by Edna Hill. The cardiac portion (Parts II, III, and IV) has been completely redone in both text and illustrations. Dan Beisel has contributed almost all of the new drawings. His work is in the detailed and magnificent tradition of the late Edna Hill's as well as in that of his teachers in the Department of Medical Illustrations of the Johns Hopkins University School of Medicine.

We thank the Culpepper Foundation for its generous support in underwriting a large portion of the cost of redoing the book and in making the volumes more accessible to students and residents. We also thank Daniel J. Doody of the Year Book Medical Publishers, Inc., for his assistance and sage advice. It has been a great pleasure working with him.

We thank Marian T. Waldhausen, who made helpful suggestions in changing and correcting the sometimes unintelligible text; she was most patient, especially, with the senior editor. Kathleen Corbin typed and retyped the text, and we are most grateful to her for the many hours she worked on the manuscript.

This book is dedicated, with esteem and respect, to Julian Johnson, a pioneer thoracic surgeon: "A surgeon and something more."*

JOHN A. WALDHAUSEN, M.D.
WILLIAM S. PIERCE, M.D.

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* Julian Johnson: A Surgeon and Something More; Presidential Address to the American Association for Thoracic Surgery. *J. Thorac. Cardiovasc. Surg.* 46:141–149, 1963.

Contents

Part I

Thoracic Surgery

CHAPTER 1

The Physiology and Management of Chest Injuries

SURGICAL PHYSIOLOGY OF THE THORAX

AN UNDERSTANDING of the basic mechanics of respiration and of cardiorespiratory physiology is essential for success in thoracic surgery and the management of chest injuries. Abnormal function cannot be accurately interpreted unless normal physiologic processes are understood.

Normally, intrapleural pressure is slightly below atmospheric pressure. It is the presence of this negative pressure within the thorax that maintains the lungs in their constantly expanded state. When the thoracic cage enlarges on inspiration, as a result of the action of the respiratory muscles, and the diaphragms pull downward, the subatmospheric pressure is further decreased. The elastic lungs follow the chest wall outward, and air is sucked in through the tracheobronchial tree. On expiration, when the respiratory muscles and diaphragms relax, the thoracic cage returns toward a resting position, and air is expelled from the lungs. The normal intrapleural pressure varies from about −9 to −12 cm of water on inspiration and from about −3 to −6 cm of water on expiration.

Figs 1–1, A and B.—The mechanics of normal respiration are illustrated diagrammatically.

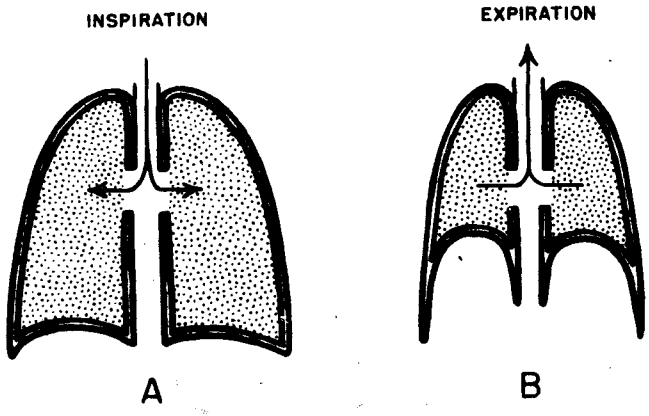
OPEN PNEUMOTHORAX

When there is a large opening in the chest wall, such as a thoracotomy incision or a shell fragment wound, an open pneumothorax exists. This is commonly called a "sucking wound" of the chest because of the harsh, sucking noise which is frequently heard on inspiration, when the wound edges are not widely separated.

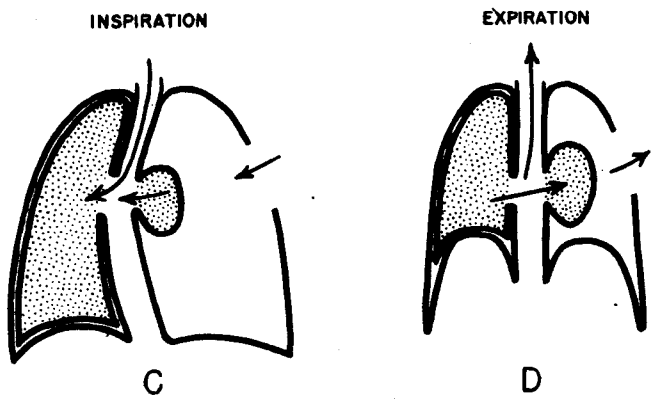
C and D.—The abnormalities in open pneumothorax are shown. Air from the outside rushes into the pleural cavity, since it is at a lower pressure. The lung, which in its noninflated state is smaller than the chest cavity, now collapses. On inspiration, more air enters the pleural cavity through the chest wall opening than through the smaller glottic aperture. The intrapleural air competes for space with the effective ventilatory air within the lungs. As the intact chest wall on the opposite side expands on inspiration, the mediastinum is pulled over by the increased negative pressure, and the contralateral lung cannot expand completely. On expiration, more air passes out through the opening in the chest wall than through the glottis, and the mediastinum swings back to the midline or beyond it. This to-and-fro motion of the mediastinum is called mediastinal flutter. The mediastinum moves paradoxically with respect to the intact chest wall; as a result, there is a useless interchange of poorly oxygenated air between the two lungs. There are also pathologic alterations in circulatory dynamics in open pneumothorax. The efficiency of the pumping action of the thorax in returning venous blood to the right heart is impaired. The great vessels, particularly the venae cavae, may be kinked by mediastinal flutter.

These abnormalities must be corrected in treating open wounds of the thorax and must be counteracted during intrathoracic operations. An open chest wound should be converted to a closed pneumothorax as soon as possible. During intrathoracic operations, the effects of open pneumothorax are counteracted by intermittently raising the intrapulmonary pressure above that of the atmosphere. This maintains expansion of the lungs and provides a pressure differential which produces adequate ventilation.

NORMAL RESPIRATION



OPEN PNEUMOTHORAX

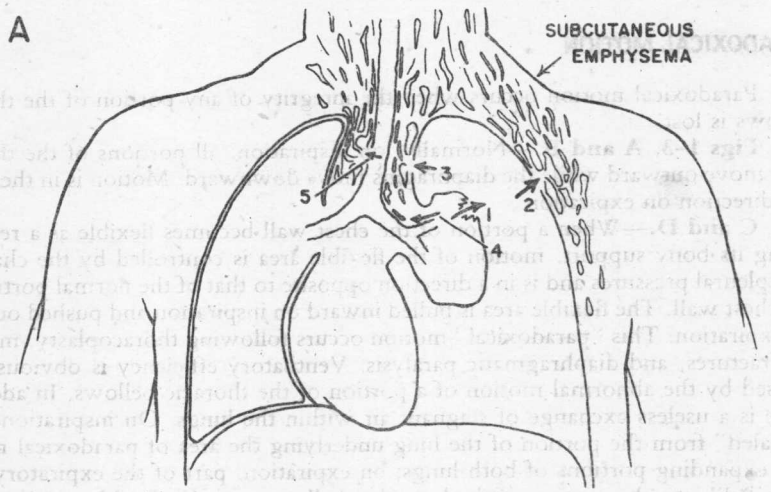


TENSION PNEUMOTHORAX

Injury or spontaneous rupture of the pulmonary parenchyma may cause an air leak with a valvelike mechanism. Air enters the pleural cavity as bronchi dilate on inspiration but cannot leave the pleural cavity as bronchi contract on expiration. The intrapleural pressure rises steadily; ill effects result from positive pressure within the closed hemithorax. Positive pressure is further increased when more air is forced into the pleural cavity during coughing. The ipsilateral lung is compressed, the mediastinum is pushed to the opposite side, and the contralateral lung is finally compressed. When the positive pressure rises to about 15–20 cm of water, venous return to the heart is markedly impeded.

Fig 1–2, A.—The effects of tension pneumothorax are illustrated diagrammatically. The distribution of air which may result is shown by the arrows. *Arrow 1* is the leak from the wound of the lung into the pleural cavity. *Arrows 2 and 3* represent the passage of air into the tissues of the chest wall and mediastinum through openings in the parietal and mediastinal pleurae. *Arrow 4* indicates air that has dissected proximally in the peribronchial tissues and entered the mediastinum without first entering the pleural cavity. *Arrow 5* represents leakage of air into the mediastinum through a wound of the trachea. Coughing and straining force large amounts of air into the mediastinum when there is a tracheal wound. A tracheostomy may relieve the problem by preventing the development of high intratracheal pressure. The patient may gently massage his eyelids laterally, displacing the air so that he can see. However, the air may return until the pressure forcing the air into the tissue planes is relieved.

B.—Large amounts of air may be forced into the tissue planes by tension pneumothorax. The tremendous inflation of facial tissues, shown here, resulted from a wound of the trachea. In this instance, air dissected down the arms to the fingers and down through the abdominal wall and retroperitoneal tissues to the groin.


A
SUBCUTANEOUS
EMPHYSEMA
1
2
3
4
5


B

PARADOXICAL MOTION

Paradoxical motion occurs when the integrity of any portion of the thoracic bellows is lost.

Figs 1–3, A and B.—Normally, on inspiration, all portions of the thoracic cage move outward while the diaphragms move downward. Motion is in the opposite direction on expiration.

C and D.—When a portion of the chest wall becomes flexible as a result of losing its bony support, motion of the flexible area is controlled by the changing intrapleural pressures and is in a direction opposite to that of the normal portions of the chest wall. The flexible area is pulled inward on inspiration and pushed outward on expiration. This "paradoxical" motion occurs following thoracoplasty, multiple rib fractures, and diaphragmatic paralysis. Ventilatory efficiency is obviously decreased by the abnormal motion of a portion of the thoracic bellows. In addition, there is a useless exchange of stagnant air within the lungs. On inspiration, air is "inhaled" from the portion of the lung underlying the area of paradoxical motion into expanding portions of both lungs; on expiration, part of the expiratory air is "exhaled" into the portion of the lung that balloons out the flexible portion of the chest wall. On inspiration the mediastinum is pulled toward the opposite side, and on expiration it swings back to the midline or beyond it. If the area of paradoxical motion is large and there is a wide swing of the mediastinum, circulatory dynamics may be seriously altered. The venous pressure rises, filling of the right side of the heart is inadequate, and the arterial pressure eventually falls. Paradoxical motion may be increased by atelectasis.